Edited by Piotr Maszczyk • Mariusz Próchniak • Małgorzata Znoykowicz-Wierzbicka

Governance, Environment and Democracy at the Crossroads: The EU Economy and Society in the 21st Century



SGH Publishing House

Governance, Environment and Democracy at the Crossroads: The EU Economy and Society in the 21st Century

Edited by Piotr Maszczyk • Mariusz Próchniak • Małgorzata Znoykowicz-Wierzbicka

Governance, Environment and Democracy at the Crossroads: The EU Economy and Society in the 21st Century

SGH Publishing House

WARSAW 2026

European Funds for Social Development
Republic of Poland
Co-funded by the European Union
NAWA POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE

Reviewers
Professor Bartosz Jóźwik (Reviewer of the entire monograph)
Professor Bartosz Witkowski (Reviewer of 13 chapters in accordance with the terms of the NAWA project)
Dr Jakub Borowski (Reviewer of 2 chapters in accordance with the terms of the NAWA project)

Editor
IURIDICO Legal & Financial Translations

© Copyright by Piotr Maszczyk, Mariusz Próchniak, Małgorzata Znoykowicz-Wierzbicka & SGH Warsaw School of Economics, Warsaw 2026
All rights reserved. Any copying, reprinting or distribution of a part or the whole of this publication without the prior permission of the publisher is forbidden.

This work is licensed under a Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
https://creativecommons.org/licenses/by/4.0/

First Edition

ISBN 978-83-8030-808-4

SGH Publishing House
al. Niepodległości 162, 02-554 Warsaw, Poland
www.wydawnictwo.sgh.waw.pl
e-mail: wydawnictwo@sgh.waw.pl

Cover design and production
Magdalena Limbach

DTP
DM Quadro

Print and binding
QUICK-DRUK s.c.
e-mail: quick@druk.pdi.pl

Order 79/VIII/26

TABLE OF CONTENTS

Piotr Maszczyk, Mariusz Próchniak, Małgorzata Znoykowicz-Wierzbicka
Preface 7

Jakub Borowski
1. Coronation Theory and European Monetary Integration: Does the Theory Still Hold? 11

Honorata Nyga-Łukaszewska, Tomasz M. Napiórkowski
2. Institutional Quality, Energy Demand Security, and International Competitiveness: A Comparative Analysis of Developed and Developing/Emerging Natural Gas Exporters 33

Mikołaj Pindelski, Anna Piętka, Arnstein Aassve, Artur Bogucki, Catalin Vrabie, Florina Pinzaru, Marie-Pierre F. Granger, Lily Xuehui Gao, Maciej Moroz, Natalia Menéndez González, Richard Wahlund, Tarana Jafarova
3. From Gatekeeper to Gateway: Institutional Challenges in Adopting Social Mobility-Centric AI Algorithms in EU Higher Education 55

Kamil Harla, Marta Ekner
4. Managing Investments in Dual-Use Technologies as a Driver of the Economic Development and Defence Capabilities 75

Tarık Iliman, Michał Aliński
5. Does Population Ageing Drive Health Expenditure? Evidence from Poland and Türkiye: A Comparative ARDL Analysis 97

Norbert Duczkowski, Lubomir Słowik
6. Cultural Determinants of the Pace of AI Adoption: Evidence from European Countries 123

Pier Luigi Parcu

7. From Factories to Platforms: European Institutions and the Challenge of Digital Inequality 157

Ryszard Rapacki, Piotr Maszczyk, Mariusz Próchniak

8. Patchwork Capitalism and the Paradox of Economic Performance: Fast Growth, Structural Imbalances, and Institutional Short-Sightedness 191

Dariusz Mongiało

9. The Janus-Faced Interest Representation: Role of Lobbying in European Union Governance 227

Maksym Bondar, Iryna Degtyarova, Małgorzata Molęda-Zdziech

10. Democracy and the Rule of Law in Times of War: Ukraine's Lessons in Resilience for Europe 251

Małgorzata Molęda-Zdziech, Kinga Torbicka

11. The War in Ukraine as an Anomie of Values. A Case Study of Poland and France in the European Context 279

Beny Saputra

12. Credit as a Conservation Policy in EU Green Finance 301

Florina Pînzaru, Alexandra Zbuchea

13. AI Literacy, Technological Anxiety, and Career Adaptability among Generation Z: An Empirical Framework for Career Resilience in AI-Driven Environments 329

Rebeca Cojocaru, Alexandra Zbuchea, Bogdan Hrib

14. Substance Use Prevention and Democratic Governance: Perceptions from Generation Z in Romania 353

Krzysztof Siegieda, Mateusz Zawisza

15. Memory Arms Race in Q-Learning: How Memory Asymmetry Shapes Algorithmic Collusion in Sequential Pricing 381

Piotr Maszczyk[1]
Mariusz Próchniak[2]
Małgorzata Znoykowicz-Wierzbicka[3]

Preface

The present volume is the outcome of the 1st CIVICA at SGH Conference, entitled *The EU Economy and Society in the 21st Century – Governance, Environment and Democracy at the Crossroads*, held at SGH Warsaw School of Economics (Warsaw, Poland) on 16–17 April 2026. The conference was organised by the Department of Economics II within the Collegium of World Economy at SGH Warsaw School of Economics within the framework of the project *Advancing Academic Excellence: CIVICA Collaboration for Research, Didactics, Dual Degrees, AI Training, and Scientific Internships (CIVICA+)*, financed by the Polish National Agency for Academic Exchange (NAWA) under the *Support for European Universities*[4] programme.

Since 1 October 2022, SGH Warsaw School of Economics has been a member of the CIVICA – the European University for Social Sciences alliance. In addition to SGH, the alliance comprises Bocconi University, Central European University, European University Institute, Hertie School, IE University, National University of Political Studies and Public Administration (SNSPA), Sciences Po, Stockholm School of Economics, and The London School of Economics and Political Science. The CIVICA+ project aims to further strengthen the internationalisation of SGH through the implementation of activities synergic and complementary to the cooperation undertaken within the framework of the CIVICA alliance of European universities.

The general and specific objectives of the CIVICA+ project are aligned with the objectives of the NAWA programme – developing the internationalisation of higher education and science institutions by supporting activities synergistic and

1 SGH Warsaw School of Economics (Poland), email: pmaszcz@sgh.waw.pl.
2 SGH Warsaw School of Economics (Poland), email: mproch@sgh.waw.pl.
3 SGH Warsaw School of Economics (Poland), email: mznoyk@sgh.waw.pl.
4 The amount of funding for the project from the European Union under the European Funds for Social Development (FERS) NAWA programme – Support for European Universities is PLN 1,562,499.68 (grant agreement no. PI/WUE/2024/1/00027/U/00001).

complementary to international academic partnerships within the framework of European University Alliances. The implementation of each project objective is based on close cooperation with CIVICA universities, and each specific objective complements the activities already carried out within the individual CIVICA work packages.

The conference held in April 2026 at SGH Warsaw School of Economics brought together scholars representing universities affiliated with CIVICA – The European University of Social Sciences, creating an important platform for academic dialogue on the most pressing economic, social, institutional, technological, and political challenges currently facing Europe. The chapters collected in this monograph reflect the interdisciplinary nature of these debates and illustrate the growing importance of international academic cooperation in understanding the complex transformations reshaping the European economy and society in the twenty-first century.

The idea behind this volume emerged from the conviction that contemporary Europe is experiencing a period of profound and multidimensional transition. The European Union and its member states are simultaneously confronted with geopolitical instability, accelerating technological change, growing social fragmentation, mounting environmental pressure, and increasing tension surrounding democracy, governance, and institutional legitimacy. The war in Ukraine, the rapid expansion of artificial intelligence, challenges related to the green transition, rising concerns about economic security and resilience, as well as transformations affecting labour markets, education systems, and social values together create a new and exceptionally demanding environment for European policymaking and institutional adaptation.

Importantly, these developments should not be viewed as isolated phenomena, but rather constitute interrelated dimensions of a broader structural transformation affecting the institutional, economic and social foundations of the European project. This perspective constitutes one of the central intellectual premises of the present monograph. Although the individual chapters address diverse research questions and employ different analytical approaches, they are united by a shared interest in the evolving relationship between institutions, governance mechanisms, technological progress, and socio-economic development in contemporary Europe.

At the same time, the growing complexity and interdependence of these challenges increasingly highlight the limitations of narrowly disciplinary and sector-specific analytical approaches. Understanding the contemporary transformations of the European economy and society requires a broader integration of perspectives derived from economics, political economy, institutional analysis, public policy, management studies, and social sciences. In this context, the present volume seeks not only to analyse selected dimensions of Europe's ongoing transformation, but

also contribute to a more comprehensive understanding of the mechanisms shaping institutional adaptation, governance capacity, technological change, and socio-economic resilience in the European Union.

A significant strength of this volume lies precisely in the diversity of perspectives represented by its contributors. The monograph more broadly combines approaches derived from economics, political economy, institutional analysis, management studies, public policy, European studies, and social sciences. Some chapters focus on macroeconomic and institutional challenges, including the evolution of European capitalism, institutional resilience, and governance structures, while others analyse the implications of artificial intelligence and digitalisation for labour markets, education, inequality, competition policy, and social mobility. Additional contributions address the problems of sustainable finance, the green transformation, lobbying and decision-making processes within the European Union, as well as the evolution of social values and democratic legitimacy in European societies.

Taken together, these analyses portray Europe as a space characterised not only by a diversity of institutional arrangements and development trajectories, but also by a growing interdependence between economic, technological, political, and social processes. In this sense, the volume highlights the need to move beyond narrowly sectoral or disciplinary perspectives in order to better understand the mechanisms shaping the future of the European Union and its member states.

The monograph also reflects the broader mission of the CIVICA alliance, which aims to strengthen academic cooperation among leading European universities and foster interdisciplinary research addressing key societal challenges. In a period of growing uncertainty and fragmentation, such cooperation is of particular importance, as many contemporary challenges transcend national borders and require coordinated intellectual and policy responses. Academic dialogue conducted within international and interdisciplinary networks therefore becomes not only scientifically valuable, but also socially and institutionally necessary.

One of the most valuable aspects of the conference was the opportunity to exchange experiences and research findings among scholars representing different academic traditions, methodological approaches, and institutional environments. The diversity of viewpoints presented during the discussions significantly contributed to the intellectual richness of this volume and helped create a platform for further scientific collaboration within the CIVICA framework and beyond.

We would like to express our sincere gratitude to all the authors who contributed their research to this monograph, as well as to the reviewers whose insightful comments and recommendations helped improve the quality of the published

material. We are also deeply thankful to all conference participants for their inspiring presentations, stimulating discussions, and openness to interdisciplinary dialogue.

Finally, we would like to acknowledge the support provided by SGH Warsaw School of Economics, the CIVICA alliance, and the Polish National Agency for Academic Exchange (NAWA), without which the organisation of the conference and the preparation of this volume would not have been possible.

We trust that the analyses presented in this monograph will contribute to ongoing academic and policy debates concerning the future of Europe and encourage further reflection on the institutional, technological, and societal transformations shaping the European economy and society in the decades to come.

The Editors
Piotr Maszczyk
Mariusz Próchniak
Małgorzata Znoykowicz-Wierzbicka

1

Jakub Borowski[1]

Coronation Theory and European Monetary Integration: Does the Theory Still Hold?

Abstract

This paper evaluates the coronation theory, which posits that the adoption of a common currency should follow substantial real convergence. A large income gap relative to the monetary union is associated with weaker synchronisation of inflation cycles, a greater risk of misaligned common monetary policy, and increased vulnerability to housing price bubbles and consumer credit booms following accession. These findings imply that countries at an early stage of convergence may benefit from delaying entry into a monetary union until income gaps narrow and the costs associated with the loss of monetary autonomy are substantially reduced.

Once the income gap narrows to moderate levels, further convergence yields only little additional improvement in the synchronisation of inflation cycles, and the benefits of postponing entry into a monetary union become marginal. However, macroprudential tools can effectively mitigate housing and consumer credit risks, reducing the practical importance of waiting for full convergence. Consequently, the coronation theory remains a useful guide for lower-income candidate countries, but provides limited justification for continued delay in adopting a common currency in countries that have advanced substantially in real convergence.

The conclusion on the limited use of the coronation theory for catching-up economies with a high degree of real convergence is especially relevant for Czechia, Hungary and Poland. Since joining the European Union in 2004, they have significantly narrowed the income gap relative to the euro area, so for these economies, additional

[1] SGH Warsaw School of Economics (Poland), e-mail: jborow@sgh.waw.pl.

convergence is unlikely to materially lower the costs of abandoning independent monetary policy. In these countries, future policy debate should therefore place greater weight on the dynamic long-run benefits of euro adoption.

1. Introduction

The loss of the ability to conduct an autonomous monetary policy constitutes a long-term cost of monetary integration, understood as the process of adopting a common currency and the implementation of a unified monetary policy across member states of a currency area. Following the adoption of a common currency, domestic interest rate policy and exchange rate adjustment can no longer be used as instruments to mitigate the effects of significant demand shocks that are asymmetric with respect to the monetary union and affect the acceding economy. Such shocks contribute to increased fluctuations in consumption around its long-run trend. Assuming households are risk-averse, heightened consumption volatility leads to a decline in household welfare [Lucas, 1987]. This effect may be further amplified by the adverse impact of output volatility on long-term economic growth, for instance through hysteresis effects in the labour market [Galí, Gertler, López-Salido, 2007].

The assessment of the costs associated with the loss of an autonomous monetary policy following the adoption of a common currency constitutes a central strand of the theory of optimal currency areas [Mundell, 1961]. This literature focuses on the risks arising from a potential misalignment between the common monetary policy and the cyclical conditions of an economy aspiring to join a currency area, while abstracting from the long-term benefits of adopting a common currency and its welfare implications [Grubel, 1970]. Within this framework, the following are typically evaluated:

- The effectiveness of labour market adjustment mechanisms. Adjustments operating through this channel – such as cross-border labour mobility or a decline in real wages – are constrained by numerous barriers to migration (including linguistic, cultural and social differences, as well as heterogeneous labour market regulations across countries) and nominal wage rigidities. As a result, such adjustments typically do not ensure a rapid return to macroeconomic equilibrium following a negative demand shock [Dellas, Tavlas, 2009; De Grauwe, 2020; Friedman, 1953].
- The effectiveness of exchange rate flexibility as an adjustment mechanism in restoring macroeconomic equilibrium following a negative demand shock [Canzoneri, Vallés, Viñals, 1996]. This strand of the literature advances the hypothesis

that a flexible exchange rate may itself constitute a source of asymmetric shocks arising from deviations of the real effective exchange rate from its medium-term equilibrium level [De Grauwe, Schnabl, 2005]. The less effective the exchange rate adjustment mechanism, the lower the cost of relinquishing monetary policy autonomy associated with joining a common currency area.

- The susceptibility of an economy to asymmetric shocks, typically assessed by measuring the degree of business cycle synchronisation between the monetary union and the acceding country, with both the degree and persistence of synchronisation being of critical importance [De Grauwe, 2020]. Strong and sustained synchronisation of business cycles between the monetary union and the aspiring economy indicates that, upon entry, the risk of a misalignment between the common monetary policy and the cyclical position of the acceding economy is low [Gros, Thygesen, 1998; Kenen, 1995]. Consequently, the greater the convergence of business cycles across the two economies, the lower the cost of relinquishing national monetary policy in the country joining the common currency area.
- The effectiveness of fiscal policy as an instrument for stimulating domestic demand and mitigating the impact of asymmetric shocks [Ishiyama, 1975]. Fiscal stimulus, implemented either through a federal (union-wide) or national budget, may arise from the use of automatic stabilisers, such as cyclical increases in public expenditure and reductions in tax revenues. It may also result from discretionary fiscal easing (tax cuts or increases in public spending), which is particularly warranted under conditions of pronounced and persistent economic slowdown, low interest rates, and the associated heightened risk of deflation [Auerbach, 2002; Fatás, Mihov, 2001; Feldstein, 2002]. The greater the effectiveness of federal or national countercyclical fiscal policy, the lower the cost of relinquishing monetary policy autonomy following accession to a monetary union.
- The risks associated with a substantial decline in interest rates following the adoption of a common currency [Walters, 1986]. These risks stem from differences in the natural rate of interest across economies within the monetary union and those aspiring to join it. A decline in the interest rate below its natural level, induced by accession to a currency union, may give rise to a credit boom [Brzoza-Brzezina, 2005], the formation of asset price bubbles in real and stock estate markets [Agnello, Schuknecht, 2011], the buildup of macroeconomic imbalances, and an increased risk of an unsustainable credit expansion followed by a sharp slowdown in economic activity. Following the adoption of a common currency, such risks cannot be counteracted through adjustments in national monetary policy. Accordingly, the greater the risks associated with interest rates dropping

below their equilibrium level after joining a monetary union, the higher the cost of relinquishing the ability to conduct an independent monetary policy.

The costs associated with the loss of the ability to conduct domestic monetary policy following accession to a monetary union may be analysed within a dynamic framework. If this cost evolves over time, it is necessary to determine the direction of this change. In particular, if the costs of relinquishing monetary policy autonomy decline over time, identifying the pace of this decline becomes crucial for determining the optimal timing of entry into a currency union.

The reasoning that, in converging economies, the costs associated with abandoning national monetary policy may decline over time underpins the concept referred to as the *coronation theory*. According to this view, only countries that have achieved a high level of competitiveness, implying a low susceptibility to asymmetric shocks, should be admitted to a monetary union [Cohen, 2012]. Within this framework, a sufficiently high level of competitiveness is reflected in a high degree of real convergence, understood either as a drop in income disparities between the monetary union and the aspiring country (i.e. a narrowing of the income gap) or as a high degree of structural similarity between these economies [Bini-Smaghi, Padoa-Schioppa, Papadia,1995; Pelle, Végh, 2019].

The purpose of this analysis is to assess whether, in light of empirical evidence, the coronation theory is relevant for the pace of monetary integration in Europe. Put differently, are countries with low GDP per capita and a floating exchange rate regime more vulnerable to the inadequacy of a common monetary policy for their macroeconomic conditions than economies with a narrower income gap in relation to the monetary union? Should catching-up economies operating under flexible exchange rate regimes – such as Czechia, Poland and Hungary – postpone entry into the euro area until the income gap in relation to the euro has narrowed substantially? Addressing these questions draws on the empirical findings discussed below concerning the determinants of the long-run costs associated with relinquishing monetary policy autonomy.

The remainder of the paper is structured as follows. The first section examines the impact of real convergence on the synchronisation of inflation cycles. The second section analyses the effect of the income gap on the risk of housing price bubbles. The third section investigates the relationship between real convergence and the risk of credit booms in the consumer lending segment. The paper concludes with a summary of findings and policy implications.

2. Real convergence and synchronisation of inflation cycles

The theoretical literature typically identifies two principal mechanisms through which real convergence affects business cycle synchronisation. The first is grounded in the new trade theory, according to which changes in factor endowments lead to a convergence in capital-labour ratios across trading economies. This results in an increased share of intra-industry trade [Helpman, 1981, 1987; Loertscher, Wolter, 1980] and, consequently, greater synchronisation of business cycles [Fidrmuc, 2004]. From the perspective of neoclassical growth theory, it follows that a reduction in the income gap between two economies driven by a diminishing disparity in capital intensity should be accompanied by stronger business cycle synchronisation and a corresponding decline in the costs associated with relinquishing monetary policy autonomy.

The second mechanism operates through changes in the structure of the economy that accompany real convergence. When significant differences are present in the composition of value added across two economies, the likelihood of asymmetric shocks is high. This is consistent with empirical evidence indicating that a greater similarity in economic structures enhances business cycle synchronisation [Fidrmuc, Ikeda, Iwatsubo, 2012; Karadimitropoulou, 2018]. Structural transformation may arise from shifts in consumption demand associated with rising income levels, which tend to induce a monotonic increase in employment in services, a transitional rise in industrial employment at early stages of development, and a monotonic decline in agricultural employment [Foellmi, Zweimüller, 2008]. Accordingly, a narrowing of the income gap between two economies contributes to greater similarity in their production structures, reduces their susceptibility to asymmetric shocks, and lowers the costs associated with relinquishing national monetary policy.

Borowski, Fidrmuc and Jaworski [2025] analyse the effects of the income gap on the synchronisation of inflation cycles, employing a fixed-effects panel model for a sample of 24 European Union countries over the period 2001–2022. In their estimation, the standard errors were adjusted for cross-sectional dependence following the procedure proposed by Driscoll and Kraay [1998]. This research objective offers a different perspective than earlier studies, which focused on the determinants of business cycle synchronisation. Inflation cycles are related to business cycles through the impact of the output gap on inflation. Economic expansions tend to increase inflation, while slowdowns reduce it. At the same time, inflation dynamics are influenced by supply shocks, including changes in energy and food prices. The effects of

these shocks vary across countries and may lead to the desynchronisation of inflation cycles. The degree of inflation synchronisation is important for assessing the costs associated with relinquishing an autonomous monetary policy after joining a currency union. A common nominal interest rate combined with divergent inflation paths leads to differences in national real interest rates, which, in turn, may destabilise economic conditions, particularly when real interest rates are not aligned with the domestic business cycle. Such misalignment may generate boom-bust cycles or an excessive tightening of monetary conditions [Walters, 1990]. These effects may cause economies to deviate from equilibrium for an extended period. Persistent boom-bust cycles in countries sharing a common currency may also give rise to rotating recessions [Landmann, 2012]. These cannot be effectively addressed by a common monetary policy, resulting in an increase in the costs associated with relinquishing national monetary autonomy.

The model's dependent variable is a 36-month rolling correlation of seasonally adjusted cyclical components of consumer price growth in a given European Union country and in the euro area, which is aggregated to annual frequency by averaging. The key explanatory variable is the income gap, which serves as a proxy for real convergence and is defined as nominal GDP per capita in purchasing power parity terms relative to the European Union average. This construction allows for direct comparison of income levels across countries, and also permits identification of both catching-up economies and those exceeding the average GDP level in the European Union. To capture potential nonlinearities in the relationship between income and inflation cycle synchronisation, the model includes both the relative level of GDP per capita and its square. This specification enables a test of the hypothesis that, as the income gap narrows, the increase in synchronisation of inflation cycles occurs at a decreasing rate.

The estimation results of the five panel models constructed by the authors confirm that a reduction in the income gap increases the synchronisation of inflation cycles across European Union countries and the euro area. In each specification, the coefficient on GDP per capita relative to the European Union average is positive and statistically significant, which implies that a higher relative income level, and thus real convergence, strengthens the co-movement of inflation fluctuations. The economic interpretation of this result is as follows. A narrowing income gap is associated with greater similarity in economic structures and a higher intensity of intra-industry trade linkages, which, in turn, reduces the probability of asymmetric price shocks. As a result, inflation in countries catching up to the European Union average in terms of GDP per capita becomes increasingly aligned with inflation in

the euro area. Consequently, the adequacy of the common monetary policy increases and the costs associated with relinquishing national monetary policy decline.

In the models used by the authors, the coefficient on the squared term of GDP per capita relative to the European Union average is negative and statistically significant, which indicates that the effect of the income gap on inflation cycle synchronisation is nonlinear. The marginal effect of further reductions in the income gap declines as the relative level of GDP per capita increases. At the early stage of real convergence, even a small increase in GDP per capita relative to the European Union average leads to a relatively large rise in inflation cycle synchronisation, while at higher income levels, the additional gains from further convergence become progressively smaller. The estimated inflection points of the function are located well above the European Union average, ranging from 144.8 percent to 160.6 percent of the average GDP per capita, depending on the model.

It is important to note that once a relatively high level of GDP per capita is reached, further synchronisation increases become negligible. For example, an increase in GDP per capita from 80 percent to 90 percent of the European Union average raises the correlation coefficient by only 0.06 to 0.08, depending on the model, which implies that in countries where GDP per capita is close to the European Union average, further reductions in the income gap do not lead to a significant decline in the costs associated with the loss of monetary policy autonomy.

The empirical evidence discussed above therefore indicates that, in a country with a relatively low level of GDP per capita that belongs to – or aspires to join – a monetary union, the process of real convergence increases the synchronisation of inflation cycles and thus improves the alignment of the common monetary policy with domestic economic conditions. This implies that a narrowing income gap reduces the costs associated with the loss of monetary autonomy. This conclusion is consistent with the so-called coronation theory, which applies to catching-up economies and emphasises the need to achieve durable real convergence as a precondition for low exposure to asymmetric shocks before joining a monetary union. However, in countries that are already undergoing real convergence and where the income gap is not substantial, the gains from further reduction are diminishing and limited. This weakens the underlying argument of the coronation theory, since delaying accession to a common currency area does not generate a meaningful decline in the cost of losing monetary policy autonomy.

3. Real convergence and the risk of housing price bubbles

A central strand of the theory of optimum currency areas also examines the risks associated with a substantial decline in interest rates following the adoption of a common currency [Walters, 1986]. These risks arise from differences in the natural rate of interest between economies already part of a monetary union and economies aspiring to join it. The natural rate of interest is defined as the short-term real interest rate that equates aggregate demand with potential output, thereby ensuring a closed output gap and stable inflation consistent with the central bank's inflation target [Blinder, 1999; Wicksell, 1936]. A factor that raises the natural rate is the marginal productivity of capital, which is relatively high in catching-up economies, which are characterised by low capital stocks and low GDP per capita. As a result, the risk of an excessive decline in interest rates after joining a monetary union is relatively high in these countries. Such a decline may trigger a credit boom [Brzoza-Brzezina, 2005], generate speculative bubbles in asset markets, including the housing market [Agnello, Schuknecht, 2011], and lead to growing macroeconomic imbalances. These imbalances may further increase inflation and lower the real interest rate, thereby amplifying the risk of credit booms, bursting asset bubbles, balance-sheet losses in commercial banks, banking crises, and a sharp slowdown in economic activity. After joining a monetary union, such a downturn cannot be countered through an easing of national monetary policy.

The probability of a housing price bubble is also amplified by the Balassa-Samuelson effect [Balassa, 1964; Samuelson, 1964], which may increase inflation and reduce the real interest rate in catching-up economies after they join a common currency area [MacDonald, Wójcik, 2006]. An additional factor raising the risk of credit booms in catching-up countries is the permanent income effect leading to consumption smoothing. In this case, credit growth accelerates due to expected income rising after accession to a monetary union [Drummond, Kuijs, Murgasova, Schadler, van Elkan, 2005]. The introduction of a common currency eliminates exchange rate risk and supports higher bilateral trade, stronger inflows of foreign direct investment, and greater domestic investment expenditure [Baldwin, 2006; Baldwin, De Santis, 2008; Petroulas, 2007]. The increase in expected income induced by membership in a monetary union may, through the permanent income effect, reduce the propensity of households to save, raise consumption, intensify inflationary pressures, lower real interest rates, and further increase household demand for assets [Kindleberger, Aliber, 2005; Milani, 2017]. It should be emphasised that the magnitude of

this effect increases with the size of the income gap between a given country and the remaining members of the monetary union.

The search for a link between credit booms, the buildup of speculative bubbles in asset markets, and the loss of domestic monetary policy after accession to a common currency area has become an important research strand since the global financial crisis. Czerniak, Borowski, Boratyński and Rosati [2020] estimate random-effects panel logit models using a robust maximum likelihood procedure based on data covering the period 1995–2014 for the fifteen pre-enlargement member states of the European Union. In the housing market models, the dependent variable is binary, taking a value of 1 in periods in which a housing price bubble occurred in a given country and 0 otherwise. The authors apply three statistical methods of housing bubble identification used in the literature. This empirical strategy allows them to identify 13 episodes of speculative housing bubbles in 10 of the 15 countries included in the sample. Following the literature on the determinants of price bubbles [Agnello, Schuknecht, 2011; Gerdesmeier, Reimers, Roffia, 2011], the authors include six groups of explanatory variables. These variables capture monetary, macroeconomic, demographic, institutional, and cultural determinants of housing bubble risk, as well as factors reflecting the effect of accession to a monetary union on aggregate demand in economies that belong to, or aspire to join, a currency union. These factors include euro area membership and economic distance, measured as the relative difference between GDP per capita in purchasing power parity terms in a given country and the average GDP per capita in purchasing power parity terms in the three euro area countries with the highest GDP per capita.

The estimation results obtained by the authors for the housing market model are consistent with earlier studies on the determinants of price bubbles in this market. The results show that higher mortgage interest rates and a higher level of financial sector development, including banks, investment funds and insurance institutions, reduce the probability of a housing price bubble. By contrast, a wider output gap, a larger share of the population in the household formation stage, faster growth in the number of migrants residing in a given country, and improved household expectations regarding future financial conditions increase that probability.

A particularly important result for identifying the determinants of the costs associated with relinquishing monetary policy autonomy is the negative effect of mortgage interest rates on the probability of a housing price bubble. This effect is statistically significant both in the model for the fifteen European Union countries and in the model estimated for the reduced sample containing only euro area countries. This finding suggests that in countries where accession to a monetary union lowers

short-term and long-term interest rates through the elimination of the exchange rate risk premium and the reduction of liquidity and default risk premia [Borowski, 2011], the probability of a housing price bubble increases. As a consequence, the costs associated with relinquishing national monetary policy also rise.

From the perspective of the coronation theory, the effect of the income gap on the probability of a housing price bubble is of central importance. In the model estimated for euro area countries, the coefficient on the variable describing the GDP level gap becomes statistically significant, while the remaining determinants included in the model for the fifteen European Union countries retain their statistical significance. This result suggests that the larger the income gap between a country sharing the common currency and the countries with the highest GDP per capita within the monetary union, the higher the risk of a housing price bubble in the lower-income country. It also implies a higher cost of losing monetary policy autonomy in that country. This result may be interpreted as follows. In catching-up economies, the equilibrium real interest rate is often higher than the common interest rate in the currency union. At the same time, the prospect of relatively rapid economic growth attracts foreign capital to the housing market and increases anticipated house price appreciation. Together, these factors stimulate demand for residential property and exert upward pressure on housing prices.

Assessing the risk of speculative bubbles in housing markets after accession to a monetary union is particularly relevant for countries with flexible exchange rates and GDP per capita well below the level observed in other member states. In these economies, the natural rate of interest is higher than in advanced countries, which is reflected in relatively high exchange rate risk premia, as well as liquidity and default risk premia. As noted above, the low level of GDP per capita combined with lower interest rates creates conditions that support stronger demand for residential property. The decline in interest rates, together with the resulting demand impulse, therefore increases the risk of a housing price bubble. If this risk materialises, the cost of relinquishing national monetary policy rises.

Simulation results reported by Czerniak et al. [2020], based on estimates for euro area countries, indicate that under monetary union membership the existing income gap would increase the probability of a housing price bubble by 58 percentage points in Poland, 0 percentage points in the Czech Republic, and 98 percentage points in Hungary. When the joint effects of lower interest rates and the income gap under euro area membership are taken into account, the probability of a housing price bubble reaches 100 percent in all three countries. By contrast, under a scenario in which these countries remain outside the euro area, the corresponding probabili-

ties are 42 percent, 100 percent, and 2 percent, respectively. These results suggest that in catching-up economies, where interest rates are substantially higher than in the monetary union and the income gap relative to the union remains large, accession to a common currency area is associated with a sharp increase in the probability of a housing price bubble. Consequently, a narrowing of the income gap and a reduction in the interest rate differential between an aspiring country and the member states of the monetary union lower the costs associated with relinquishing national monetary policy.

The empirical findings on the effect of the income gap on the risk of a housing price bubble therefore strengthen the empirical case for the coronation theory. According to this view, accession to a monetary union should only take place when the degree of real convergence in the joining country is high. It should be emphasised, however, that the risk of excessive credit expansion can also be reduced through the use of macroprudential policy tools, which limit the availability of credit to the non-financial sector, in particular to households [Bielecki, Brzoza-Brzezina, Kolasa, Makarski, 2019]. The European Systemic Risk Board (ESRB) recommends a range of macroprudential tools, including countercyclical capital buffers (CCB), systemic risk buffers (SRB), and caps on Loan-to-Value (LTV), Loan-to-Debt (LTD), and Debt-to-Income (DTI) ratios [European Systemic Risk Board, 2018]. A cross-country review by the International Monetary Fund of the use of various macroprudential instruments, including LTV and DTI limits, shows that these tools are generally highly effective in reducing excessive credit growth and leverage [International Monetary Fund, 2011]. Crowe, Dell'Ariccia, Igan and Rabanal [2013] point to several advantages of macroprudential measures, as they can be tailored more precisely to address specific risks, such as excessive leverage, and can be adjusted to reflect differing conditions across locations and over time. They also contribute to strengthening the resilience of the banking system. Freixas, Laeven and Peydró [2015] argue that restraining excessive credit expansion by increasing capital buffers can reduce the accumulation of systemic risk in the banking sector, and recommend flexible capital requirements that rise during boom periods when borrowers and banks take on excessive risk. Analysing the Spanish banking sector prior to the 2010–2012 debt crisis, Rubio and Carrasco-Gallego [2016] demonstrate that a macroprudential tool in the form of a countercyclical Loan-to-Value ratio responding to credit booms substantially reduces credit expansions and improves welfare.

It should be emphasised that macroprudential policy tools fall within the domain of supervisory policy. The restrictiveness of such a policy may depend on the degree of independence of the financial supervisor, which in turn is influenced

by its institutional design, including whether it is located within the central bank or established as a separate authority. Even when supervisory institutions enjoy operational autonomy, they face political pressure aimed at expanding household access to credit [Persaud, 2009] and limiting the redistributive effects of a macroprudential policy [Borio, 2014]. These effects are consistent with empirical evidence demonstrating that the use of some macroprudential instruments is associated with higher income inequality [Frost, Van Stralen, 2018], which suggests that the availability of macroprudential tools to an independent supervisory authority does not eliminate the risk of credit booms, the emergence and collapse of speculative bubbles, or growing macroeconomic imbalances after the adoption of a common currency. These developments increase the cost of losing monetary autonomy while, at the same time, the availability of macroprudential instruments weakens the argument advanced by the coronation theory that monetary policy autonomy should be relinquished only after the process of real convergence has been completed.

4. Consumer lending and a permanent income channel

Studies that assess the risk of a credit boom following accession to a monetary union, and the related threats such as asset price bubbles, usually focus on the mortgage market. In the case of corporate lending, the risks to financial stability associated with faster credit growth after adoption of the common currency are relatively limited, due to the fact that such credit is mainly used to finance working capital and firms' investments in fixed assets, which raise potential GDP and economic growth. Consumer credit, in turn, usually accounts for only a small share of household debt. Moreover, for consumer goods and services, the problem of low price elasticity of supply, which is characteristic of the housing market, is considerably less pronounced [Caldera, Johansson, 2013; Crowe et al., 2013]. These arguments suggest that expansions in consumer credit have limited importance as a potentially destabilising factor for the financial system.

It should be noted, however, that rapid growth in consumer credit increases domestic demand and intensifies inflationary pressure, which, in turn, weakens the price competitiveness of domestic firms, resulting in the probability of a boom-bust cycle rising. Such a cycle involves strong economic expansion followed by a collapse in activity, and in the case of membership in a monetary union, it cannot be countered through tighter domestic monetary policy. In addition, a boom in consumer credit, supported by lower interest rates, creates risks to financial stability due to the

possibility of future interest rate normalisation affecting the quality of consumer loan portfolios. Expansion in consumer credit and the associated rise in inflationary pressure also lowers real interest rates. The decline in real rates generates a feedback mechanism, whereby higher consumer credit raises domestic demand and inflation, which then reduces real interest rates and leads to further growth in consumer lending.

The above reasoning leads to the conclusion that the costs associated with relinquishing monetary policy autonomy are higher when the risk of excessive credit growth consumer lending following accession to a monetary union is greater. Membership in a monetary union may contribute to excessive growth in consumer credit through several mechanisms. First, a decline in the nominal interest rate, driven by lower exchange rate risk premia and lower liquidity and default risk premia, reduces the real interest rate, improves household creditworthiness, and increases access to consumer credit [Brzoza-Brzezina, 2005]. Second, in catching-up economies, where real exchange rate appreciation occurs as a result of the Balassa-Samuelson effect, the decline in real interest rates may become more pronounced following the adoption of a common currency. Accession to a monetary union implies an irreversible fixing of the nominal exchange rate, resulting in real exchange rate appreciation taking place through higher inflation than in advanced economies [Balassa, 1964; Samuelson, 1964], which lowers the real interest rate and increases the availability of consumer credit [MacDonald, Wójcik, 2006]. Third, the introduction of a common currency reduces exchange rate risk, which supports stronger international trade and higher domestic and foreign investment [Baldwin, 2006; Baldwin, De Santis, 2008; Petroulas, 2007], leading the income expected by households to rise. According to the permanent income hypothesis, when a shock improves the expected income path, households facing liquidity constraints may seek to borrow against future income, resulting in an increase in the demand for consumer credit. Stronger demand pressure and higher inflation then raise the risk of a boom-bust cycle in economic activity. After accession to a monetary union, such fluctuations cannot be mitigated through domestic monetary policy.

The increase in lending in the consumer credit segment after accession to a monetary union, driven by the permanent income effect and the associated consumption smoothing, is of substantial importance from the perspective of the coronation theory. If accession to a monetary union raises the expected income level of households, then this increase should be larger if household income at the time of accession is lower. This, in turn, implies that the risk of a credit boom in the consumer lending segment, together with the risk of stronger inflationary pressure deepening the decline in real interest rates, is greater when income per capita at the time

of adoption of the common currency is lower. Although this conclusion supports the coronation theory, it requires empirical verification.

Borowski, Jaworski and Olipra [2019] examined the determinants of consumer credit relative to nominal GDP in 23 European Union countries over the period 1997–2014. Employing robust covariance matrix estimators following Driscoll and Kraay [1998], they estimated fixed-effects panel regressions in which the dependent variable was the ratio of consumer credit to GDP. In addition, to address potential endogeneity concerns, they estimated random-effects panel regressions, which do not require the assumption of strict exogeneity of the explanatory variables [Verbeek, 2004]. Among the explanatory variables, the authors included numerous determinants of the supply, or availability, of consumer credit and of demand for such credit identified in the theoretical and empirical literature. These variables included income per capita, as a measure affecting credit availability through household creditworthiness and credit demand through the permanent income channel; membership in a monetary union, which contributes to lower real interest rates and strengthens the permanent income effect; and concentration and development of the banking sector as factors shaping competition in banking and access to financial services. They also considered the institutional location of financial supervision within the regulatory architecture. Integration of supervision with an independent central bank supports supervisory independence from the government, as well as greater discretion in macroprudential regulation affecting household access to credit. Additional variables included the share of young people in the population, since younger individuals are more likely to seek consumer credit under the life-cycle hypothesis; social and cultural characteristics of society, as behavioural factors influencing households' propensity to consume; education, which affects creditworthiness; and income inequality, as a determinant of political pressure for redistribution and greater credit access for low-income households. The authors also included variables capturing the business cycle phase, such as interest rates, the unemployment rate, and activity in construction, which may also affect the demand for consumer credit.

The panel regression estimates obtained by the authors indicate that an increase in the ratio of GDP per capita at purchasing power parity in a given country to GDP per capita in the richest country in the sample in a given year raises the ratio of consumer credit to GDP. This result is inconsistent with the permanent income hypothesis, suggesting that the effect of stronger creditworthiness resulting from higher income dominates the permanent income effect. The coefficients on variables capturing the share of the population aged 35–44 in the total population, the share of employment in construction, and the share of individuals with secondary

or higher education in the population are statistically significant, and their signs are consistent with the expected direction of the effect on the ratio of consumer credit to GDP. The remaining coefficients indicate a positive and statistically significant effect of bank branch network density and banking sector concentration on consumer credit.

The models estimated by the authors are particularly relevant with regard to identifying the determinants of the costs associated with relinquishing the ability to conduct domestic monetary policy after adoption of the common currency. In these models, they replaced the cyclical variable capturing activity in construction with three-month real interbank interest rates. Their effect on consumer credit is negative and statistically significant. This finding indicates that accession to a monetary union, accompanied by a decline in the real interest rate, increases household creditworthiness and, consequently, accelerates lending in the consumer credit segment. As in the case of the risk of a housing price bubble, the initial level of the interest rate may therefore be viewed as a determinant of the costs associated with relinquishing monetary policy autonomy. The deeper the decline in the short-term interest rate after adoption of the common currency, the stronger the rise in consumer credit and the greater the risk of a credit boom in this segment. The process is reinforced by higher inflationary pressure and a secondary decline in the real interest rate. This conclusion supports the coronation theory, since countries entering a monetary union with relatively low GDP per capita can expect a substantial decline in the short-term interest rate below its equilibrium level.

In addition, the authors also estimated models in which one of the determinants of consumer credit is the share of mortgage credit in GDP, which has a positive and statistically significant effect on consumer credit. This implies that consumer credit is complementary to mortgage credit, since households use consumer loans to finance durable goods purchases after purchasing a house. Consequently, any expansion of mortgage lending after accession to a monetary union may increase the risk of excessively rapid growth in consumer credit. Put differently, an acceleration effect may arise, deepening the macroeconomic imbalance generated by a boom in the mortgage market.

The authors also estimated models that captured the effect of accession to the euro area through a binary variable equal to 1 in the years in which a given country was a member of the euro area and 0 in the years in which it remained outside the monetary union. This effect is positive and statistically significant in two models that include the variables discussed above: the relative level of GDP per capita, the share of individuals aged 35–44 in the population, the share of construction employment

in total employment, bank branch network density, and the degree of concentration in the banking sector. This result is crucial from the perspective of the coronation theory, as it suggests that accession to a monetary union stimulates consumer credit through the permanent income channel. This conclusion appears justified in light of the fact that cyclical factors, including declining interest rates associated with accession to the monetary union, were captured by the authors through activity in the construction sector.

It is worth emphasising that the effect of joining a monetary union on consumer credit through the permanent income channel may arise before adoption of the common currency, during participation in a fixed exchange rate system that is one of the formal conditions for accession to the euro area. If the accession path is highly credible, adoption of such an exchange rate regime may generate economic effects similar to those associated with full membership in the common currency area. In particular, entry into a fixed exchange rate system, combined with the implementation of an economic strategy aimed at the earliest possible adoption of the common currency, may raise the expected level of income, which, in turn, may induce consumption smoothing and increase the demand for consumer credit. For this reason, Borowski et al. [2019] estimated models in which the explanatory variable capturing membership in the euro area was replaced by a binary variable indicating participation either in the euro area or in the Exchange Rate Mechanism (ERM or ERM2). This variable may be interpreted as relinquishing or limiting monetary policy independence. In an alternative specification, the authors used two binary variables capturing euro area membership and participation in the ERM or ERM2.

The estimation results obtained by the authors indicate that the variable capturing membership in the euro area or participation in ERM/ERM2 is statistically significant and has a positive effect on consumer credit. These results indicate that the loss or restriction of monetary policy autonomy increases the ratio of consumer credit to GDP by 1.5–1.7 percentage points, which is, on average, 0.8 percentage points higher than in the case where only euro area membership is considered. In the model that separately includes participation in the euro area and in ERM/ERM2, both variables are statistically significant and exert a positive effect on consumer credit. According to the estimates, participation in the Exchange Rate Mechanism increases the ratio of consumer credit to GDP by 1.3–1.5 percentage points, whereas membership in the euro area raises this ratio by 2.0–2.2 percentage points, all else equal. The estimation results therefore suggest that the prospect of adopting the common currency has a positive effect on anticipated household income and on the volume of consumer credit, while joining the euro area strengthens this

effect. This implies that excessive credit growth in the consumer lending segment may emerge during participation in a fixed exchange rate system, when the ability to counter such expansion through tighter monetary policy is substantially constrained. The result also indicates that the positive effect on consumer credit through the permanent income channel arises not only from membership in a monetary union, but also from participation in a fixed exchange rate regime preceding the introduction of a common currency. Consequently, the risk associated with excessive growth in consumer credit before accession to a monetary union may be reduced by postponing accession until the income gap between the aspiring country and the monetary union becomes substantially narrower, thereby limiting the scale of the permanent income effect. This conclusion may be regarded as confirmation of the coronation theory.

The risk of excessive growth in consumer credit before the introduction of a common currency or after accession to a common currency area may be reduced through the macroprudential policy instruments discussed above. However, empirical evidence on the effectiveness of these instruments in restraining consumer credit is more limited than in the case of mortgage lending, which reflects the fact that consumer credit relative to GDP is usually much smaller than mortgage credit, resulting in its role as a potential source of macroeconomic and financial instability being more limited. Chadwick [2018] evaluates the effects of Turkey's macroprudential measures on consumer loan growth and loan growth volatility during the years 2005–2017 using a panel VAR model. The results suggest that Turkey's macroprudential policies were effective in reducing vulnerabilities in the consumer credit market. Kozlovtceva, Penikas, Petreneva and Ushakova [2022] use data on Russian banks from 2015 to 2019 to assess the effectiveness of macroprudential measures in restraining the rapid expansion of consumer lending. The results show that these measures helped reduce the overall risk of bank loan portfolios and encouraged banks to build stronger capital buffers. In the short term, typically within one or two quarters of the announcement of a measure, banks reduced both new lending volumes and the average growth rate of consumer loan portfolios. These findings cast doubt on the reasoning at the core of the coronation theory, namely that accession to a monetary union should be preceded by a reduction of the income gap in relation to the union to a negligible level in order to limit the permanent income effect and the associated risk of excessive consumer credit growth.

5. Conclusions

Empirical evidence indicates that in countries aspiring to join a monetary union, where GDP per capita is substantially lower than in member states of the common currency area, the costs associated with relinquishing monetary policy autonomy are higher than in countries where the income gap in relation to the monetary union is marginal. In EU countries with relatively low GDP per capita, inflation cycles are less synchronised with those of the common currency area than in economies where the income gap relative to the monetary union is small. As the gap narrows, the risk that the common monetary policy of the European Central Bank will be misaligned with the phase of the business cycle in the aspiring economy declines. Moreover, EU countries with a large income gap face a higher risk of housing price bubbles after accession to the euro area than economies where the process of real convergence is already well advanced. The evidence also suggests that in EU countries with low GDP per capita that remain outside the euro area, the risk of stronger credit growth in the consumer lending segment after accession to a monetary union is higher than in countries with a relatively small income gap. Such credit expansion may generate excessive growth in demand and inflation, thereby pushing the economy away from macroeconomic equilibrium.

The empirical findings suggest that countries aspiring to join the euro area and exhibiting a low degree of real convergence should consider postponing accession to the monetary union until the income gap relative to the union has narrowed substantially. This conclusion is broadly consistent with the coronation theory, according to which adoption of the common currency should occur after the completion of real convergence. It should be emphasised, however, that the effect of the income gap on inflation cycle synchronisation is nonlinear. The marginal benefit in the form of stronger synchronisation declines as the income gap narrows. Once the gap falls to around 20% of the EU average GDP per capita, further reductions in inflation cycle synchronisation are negligible. Moreover, the risk of housing price bubbles and the risk of excessive credit growth in the consumer lending segment can be contained through a broad range of macroprudential policy instruments, whose effectiveness has been confirmed by international experience. This implies that the usefulness of the coronation theory as a concept justifying remaining outside a monetary union for countries with substantially advanced real convergence is limited.

The conclusion that the coronation theory has limited practical relevance is particularly important for countries such as Czechia, Poland and Hungary, which operate under floating exchange rate regimes. Since joining the European Union in 2004,

these countries have achieved a substantial degree of real convergence with the euro area. At the same time, empirical evidence indicates that, given the current level of the income gap between these countries and the EU average, further real convergence would not generate a significant reduction in the costs associated with the loss of monetary policy autonomy. This implies that the debate on the long-term macroeconomic consequences of accession in these countries should place greater emphasis than before on a dynamic assessment of the benefits associated with adopting the common currency.

References

Agnello, L., Schuknecht, L. (2011). Booms and Busts in Housing Markets: Determinants and Implications, *Journal of Housing Economics*, 20(3), pp. 171–190.

Auerbach, A.J. (2002). Is There a Role for Discretionary Fiscal Policy?, *NBER Working Paper*, No. 9306.

Balassa, B. (1964). The Purchasing-Power Parity Doctrine: A Reappraisal, *Journal of Political Economy*, 72(6), pp. 584–596.

Baldwin, R. (2006). The Euro's Trade Effects, *ECB Working Paper*, No. 594, European Central Bank.

Baldwin, R., De Santis, R.A. (2008). The Impact of the Euro on Foreign Direct Investment and Cross-Border Mergers and Acquisitions. In: *Study on the Impact of the Euro on Trade and Foreign Direct Investment* (pp. 93–110), R. Baldwin, V. DiNino, L. Fontagné, R.A. De Santis, D. Taglioni (Eds.), European Economy – Economic Papers, No. 321, European Commission.

Bielecki, M., Brzoza-Brzezina, M., Kolasa, M., Makarski, K. (2019). Could the Boom-Bust in the Euro Zone Periphery Have Been Prevented?, *Journal of Common Market Studies*, 57(2), pp. 336–352.

Bini-Smaghi, L., Padoa-Schioppa, T., Papadia, F. (1994). The Transition to EMU in the Maastricht Treaty, *Essays in International Finance*, 194, Princeton University.

Blinder, A.S. (1999). *Central Banking in Theory and Practice*. Cambridge: MIT Press.

Borio, C. (2014). Macroprudential Frameworks: (Too) Great Expectations? In: *Macroprudentialism* (pp. 29–45), D. Schoenmaker (Ed.). London: CEPR Press.

Borowski, J. (2011). *Integracja monetarna. Wyzwania dla Polski*. Warszawa: Polskie Wydawnictwo Ekonomiczne.

Borowski, J., Fidrmuc, J., Jaworski, K. (2025). Convergence, Inequality and Inflation Synchronization: Evidence from the Eurozone, *Empirica*, 52(3), pp. 413–433.

Borowski, J., Jaworski, K., Olipra, J. (2019). Economic, Institutional, and Socio-Cultural Determinants of Consumer Credit in the Context of Monetary Integration, *International Finance*, 22(1), pp. 86–102.

Brzoza-Brzezina, M. (2005). Lending Booms in the New EU Member States: Will Euro Adoption Matter?, *ECB Working Paper*, No. 543, European Central Bank.

Caldera, A., Johansson, Å. (2013). The Price Responsiveness of Housing Supply in OECD Countries, *Journal of Housing Economics*, 22(3), pp. 231–249.

Canzoneri, M.B., Vallés, J., Viñals, J. (1996). Do Exchange Rates Move to Address International Macroeconomic Imbalances?, *CEPR Discussion Paper*, No. 1498, Centre for Economic Policy Research.

Chadwick, M.G. (2018). Effectiveness of Monetary and Macroprudential Shocks on Consumer Credit Growth and Volatility in Turkey, *Central Bank Review*, 18(2), pp. 69–83.

Cohen, B.J. (2012). The Future of the Euro: Let's Get Real, *Review of International Political Economy*, 19(4), pp. 689–700.

Crowe, C., Dell'Ariccia, G., Igan, D., Rabanal, P. (2013). How to Deal with Real Estate Booms: Lessons from Country Experiences, *Journal of Financial Stability*, 9(3), pp. 300–319.

Czerniak, A., Borowski, J., Boratyński, J., Rosati, D. (2020). Asset Price Bubbles in a Monetary Union: Mind the Convergence Gap, *International Review of Economics & Finance*, 67, pp. 288–302.

De Grauwe, P. (2020). *Economics of Monetary Union*. Oxford: Oxford University Press.

De Grauwe, P., Schnabl, G. (2005). Exchange Rate Regimes and Macroeconomic Stability in Central and Eastern Europe. In: *Euro Adoption in Central and Eastern Europe: Opportunities and Challenges* (pp. 41–57), S. Schadler (Ed.). Washington, D. C.: International Monetary Fund.

Dellas, H., Tavlas, G.S. (2009). An Optimum-Currency-Area Odyssey, *Journal of International Money and Finance*, 28(7), pp. 1117–1137.

Driscoll, J.C., Kraay, A.C. (1998). Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data, *The Review of Economics and Statistics*, 80(4), pp. 549–560.

Drummond, P., Kuijs, L., Murgasova, Z., Schadler, S., van Elkan, R. (2005). Adopting the Euro in Central Europe – Challenges of the Next Step in European Integration, *IMF Occasional Paper*, No. 234, International Monetary Fund.

European Systemic Risk Board (2018). *A Review of Macroprudential Policy in the EU in 2017*, https://www.esrb.europa.eu/pub/pdf/reports/review_macroprudential_policy/esrb.report180425_review_of_macroprudential_policy.en.pdf?4b6e5f604e78b7d772b788f2f81fc0c8 (accessed: 14.04.2026).

Fatás, A., Mihov, I. (2001). Government Size and Automatic Stabilizers: International and Intranational Evidence, *Journal of International Economics*, 55(1), pp. 3–28.

Feldstein, M. (2002). The Role for Discretionary Fiscal Policy in a Low Interest Rate Environment, *NBER Working Paper*, No. 9203.

Fidrmuc, J. (2004). The Endogeneity of the Optimum Currency Area Criteria, Intra-industry Trade, and EMU Enlargement, *Contemporary Economic Policy*, 22(1), pp. 1–12.

Fidrmuc, J., Ikeda, T., Iwatsubo, K. (2012). International Transmission of Business Cycles: Evidence from Dynamic Correlations, *Economics Letters*, 114(3), pp. 252–255.

Foellmi, R., Zweimüller, J. (2008). Structural Change, Engel's Consumption Cycles and Kaldor's Facts of Economic Growth, *Journal of Monetary Economics*, 55(7), pp. 1317–1328.

Freixas, X., Laeven, L., Peydró, J.L. (2015). *Systemic Risk, Crises, and Macroprudential Regulation*. Cambridge: MIT Press.

Friedman, M. (1953). The Case for Flexible Exchange Rates. In: *Essays in Positive Economics* (pp. 157–203), M. Friedman. Chicago: University of Chicago Press.

Frost, J., Van Stralen, R. (2018). Macroprudential Policy and Income Inequality, *Journal of International Money and Finance*, 85, pp. 278–290.

Galí, J., Gertler, M., López-Salido, J.D. (2007). Markups, Gaps, and the Welfare Costs of Business Fluctuations, *The Review of Economics and Statistics*, 89(1), pp. 44–59.

Gerdesmeier, D., Reimers, H.E., Roffia, B. (2011). Early Warning Indicators for Asset Price Booms, *Review of Economics & Finance*, 1, pp. 1–19.

Gros, D., Thygesen, N. (1998). *European Monetary Integration – from the European Monetary System to Economic and Monetary Union*. Harlow: Pearson Education Limited.

Grubel, H.G. (1970). The Theory of Optimum Currency Areas, *The Canadian Journal of Economics*, 3(2), pp. 318–324.

Helpman, E. (1981). International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlin-Heckscher-Ohlin Approach, Economies of Scale and Monopolistic Competition, *Journal of International Economics*, 11(3), pp. 305–340.

Helpman, E. (1987). Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries, *Journal of the Japanese and International Economies*, 1(1), pp. 62–81.

International Monetary Fund (2011). *Macroprudential Policy: An Organizing Framework*, https://www.imf.org/external/np/pp/eng/2011/031411a.pdf (accessed: 14.03.2026).

Ishiyama, Y. (1975). The Theory of Optimum Currency Areas: A survey, *International Monetary Fund Staff Papers*, 22(2), pp. 344–383.

Karadimitropoulou, A. (2018). Advanced Economies and Emerging Markets: Dissecting the Drivers of Business Cycle Synchronization, *Journal of Economic Dynamics and Control*, 93, pp. 115–130.

Kenen, P.B. (1995). *Economic and Monetary Union in Europe: Moving Beyond Maastricht*. Cambridge: Cambridge University Press.

Kindleberger, C.P., Aliber, R.Z. (2005). *Manias, Panics, and Crashes: A History of Financial Crises*. Hoboken: John Wiley & Sons.

Kozlovtceva, I., Penikas, H., Petreneva, E., Ushakova, Y. (2022). Macroprudential Policy Efficiency in Russia: Assessment for the Uncollateralized Consumer Loans, *Emerging Markets Review*, 52, 100910.

Landmann, O. (2012). Rotating Slumps in a Monetary Union, *Open Economies Review*, 23(2), pp. 303–317.

Loertscher, R., Wolter, F. (1980). Determinants of Intra-Industry Trade: Among Countries and Across Industries, *Review of World Economics (Weltwirtschaftliches Archiv)*, 116(2), pp. 280–293.

Lucas, R.E. (1987). *Models of Business Cycles*. Oxford: Basil Blackwell.

MacDonald, R., Wójcik, C. (2006). Catching-up, Inflation Differentials and Credit Booms in a Heterogeneous Monetary Union: Some Implications for EMU and New EU Member States, *CESifo Working Paper*, No. 1761, Center for Economic Studies and ifo Institute.

Milani, F. (2017). Learning About the Interdependence Between the Macroeconomy and the Stock Market, *International Review of Economics & Finance*, 49, pp. 223–242.

Mundell, R.A. (1961). A Theory of Optimum Currency Areas, *The American Economic Review*, 51(4), pp. 657–665.

Pelle, A., Végh, M.Z. (2019). How Has the Eurozone Changed Since Its Inception?, *Public Finance Quarterly*, 64(1), pp. 128–148.

Persaud, A. (2009). Macro-Prudential Regulation, *ECMI Commentary*, No. 25/4, European Capital Markets Institute.

Petroulas, P. (2007). The Effect of the Euro on Foreign Direct Investment, *European Economic Review*, 51(6), pp. 1468–1491.

Rubio, M., Carrasco-Gallego, J.A. (2016). Coordinating Macroprudential Policies Within the Euro Area: The Case of Spain, *Economic Modelling*, 59, pp. 570–582.

Verbeek, M. (2004). *A Guide to Modern Econometrics*. Hoboken: John Wiley & Sons.

Samuelson, P. (1964). Theoretical Notes on Trade Problems, *The Review of Economics and Statistics*, 46(2), pp. 145–154.

Walters, A. (1986). *Britain's Economic Renaissance: Margaret Thatcher's Reforms, 1979–1984*. New York: Oxford University Press.

Walters, A. (1990). *Sterling in Danger: The Economic Consequences of Pegged Exchange Rates*. London: Fontana.

Wicksell, K. (1936). *Interest and Prices: A Study of the Causes Regulating the Value of Money*. London: Macmillan.

2

Honorata Nyga-Łukaszewska[1]
Tomasz M. Napiórkowski[2]

Institutional Quality, Energy Demand Security, and International Competitiveness: A Comparative Analysis of Developed and Developing/ Emerging Natural Gas Exporters

Abstract

The aim of this article is to investigate the relationship between energy demand security and international competitiveness. To account for differences associated with the level of economic development, the analysis distinguishes between two groups of countries; developed economies and developing/emerging economies. This study extends the concept of energy demand security by incorporating a governance dimension, which is treated as a key factor shaping the relationship between energy demand security and international competitiveness across the analysed countries. The nations included in the empirical research, encompassing the years 1997–2019, include: Canada, the Netherlands, Norway and the USA as developed economies, and Indonesia, Malaysia, Qatar and Russia as developing/emerging economies. The study employs panel data econometric modelling grounded in classical trade theories relying on the Ricardian and Heckscher-Ohlin frameworks. The results confirm the influence of energy demand security and governance on international competitiveness in the group of developing/emerging economies, with no relationship identified in the group of developed nations.

1 SGH Warsaw School of Economics (Poland), e-mail: hlukas@sgh.waw.pl.
2 SGH Warsaw School of Economics (Poland), e-mail: tnapio@sgh.waw.pl.

1. Introduction

Energy security and international competitiveness are of vital importance for every economy, although the importance of each of these phenomena varies across countries. This is conditioned by several factors, including a country's position in the international division of labour, the types of exported and imported energy resources, and the level of economic development. Energy-importing countries are mainly interested in stable energy supplies at reasonable prices, as this can contribute positively to the international competitiveness of their sectors of export. At the same time, energy-exporting countries are primarily interested in securing stable budget inflow from energy exports, favouring a more price-inelastic demand for energy resources, as this strengthens their competitive position relative to energy-importing countries. The level of economic development also influences the perspective of countries on international competitiveness and energy security. When building their international competitiveness, developing/emerging economies tend to focus on factors of production such as physical capital and labour, which rarely provide a sustainable source of competitive advantage, being more commonly driven by innovation [Kiseľáková, Šofranková, Onuferová, Čabinová, 2019]. There are natural limits to such *low-cost* strategies as a source of international competitiveness. According to Porter [1990], "a nation's competitiveness depends on the capacity of its industry to innovate and upgrade," which requires a solid stock of human capital, technology, and investments in the R&D and technology sectors through human capital and knowledge accumulation [Aghion-Howitt, 1992; Romer, 1990]. Such investments are more characteristic of developed economies [Dutta, Lanvin, León, Wunsch-Vincent, 2021], which tend to have better factor and demand conditions, related and supporting industries, and more favourable firm strategy, structure and rivalry. Similar differences are visible in the area of energy security. Developed nations, which are generally energy importers, view energy security primarily from the perspective of "national concerns about uninterrupted energy supplies at a constant price and volume" [Koakutsu, Watanabe, 2012, p. 28], while developing/emerging economies, which import energy, treat energy security as a "holistic concept comprising issues of energy availability, access, affordability and efficiency" [Koakutsu, Watanabe, 2012, p. 27]. Nevertheless, the issue of energy security in energy-exporting countries depends on their level of economic development, while its influence on international competitiveness remains relatively unclear [Nyga-Łukaszewska, Napiórkowski, 2022].

This paper examines whether and how energy demand security affects the international competitiveness of developed and developing/emerging economies. It advances the hypothesis that the impact of energy demand security on international competitiveness is different in the case of developed and developing/emerging economies. In developing/emerging economies, institutional factors underpinning energy demand security are expected to exert a significant influence on international competitiveness, while this impact is expected to be negligible in developed economies.

This study draws on the differences between developed and developing/emerging economies commonly used in international economics (e.g. Carbaugh [2014]). Developed nations are typically characterised by relatively high levels of GDP per capita, longer life expectancy, and higher levels of adult literacy. However, it is worth noting that there is no coherent and universally accepted international policy standard for classifying nations as developed or developing, even among leading international institutions such as the World Bank and the International Monetary Fund.

This study contributes to the existing literature in four ways. First, it focuses on the concept of demand security, whereas most studies concentrate on supply security [Dike, 2013]. Second, it extends the analysis of demand security beyond studies that examine developing [Bollino, Galkin, 2021; Novikau, 2021] and developed economies [Nyga-Łukaszewska, Napiórkowski, 2022] by comparing both groups. Third, the study incorporates the institutional perspective of energy demand security, which until now was primarily covered by energy studies in the context of the resource curse (e.g. Mehlum et al. [2006]), economic growth (e.g. Sachs and Warner [1995]), and Dutch disease effects (e.g. Ramírez-Cendrero and Wirth [2016]). The relatively limited literature on the relationship between institutional quality and energy security (e.g. Canh et al. [2021]) describes the influence of energy security on institutional quality in emerging economies. Finally, this study additionally responds to the research gap identified by Van de Graaf et al. [2016] concerning the general under-theorisation of energy studies.

In this paper, the terms *energy demand security*, *energy security of exporters*, *security of energy-exporting countries* and *demand security* are used interchangeably. Similarly, the term *developed economy* is synonymous with that of an advanced, high-income or industrialised country, while the term *developing* also includes emerging economies. The paper is organised as follows. The theoretical framework is presented after the introduction, followed by a description of the empirical methodology and data. The paper concludes with a discussion section.

2. Theoretical rationale

We extend the framework developed by Nyga-Łukaszewska and Napiórkowski [2022] by comparing the relationship between energy demand security and international competitiveness between developed and developing/emerging economies. As Nyga-Łukaszewska and Napiórkowski [2022] provide a comprehensive discussion of the relationship between energy demand security and international competitiveness, the present study only focuses on one specific dimension of energy demand security – institutional quality – and examines its influence on the international competitiveness of developed and developing/emerging economies.

From a methodological standpoint, this study draws on the framework developed by Levchenko [2004], who incorporates institutional quality into Ricardian and Heckscher-Ohlin models to examine differences in trade patterns between the global North and South, with an institutional focus on relations between governments and private companies, measured by contract enforcement, property rights, and investor protection. This study therefore falls within the broader literature examining the nexus between international trade and institutional quality. Although this relationship is supposedly bidirectional, this study focuses exclusively on the influence of institutional quality on international trade. Following Levchenko [2004], we further restrict our analysis to a certain type of institutional quality, namely government or macro-level institutional quality, which shapes the energy policy in a respective country.

Using a gravity-model framework, Anderson and Marcoullier [2002] demonstrate a positive relationship between institutional quality and trade. Similarly, Ranjan and Lee [2003] argue that institutional quality matters more for bilateral trade, especially in sectors classified as institutionally intensive, such as small arms or general industrial machinery. Building on this logic, we assume that due to its political and economic importance, the energy sector in general can be classified as institutionally intensive. Following Ranjan and Lee [2003], Schuler [2003] provides further industry-level evidence on the relationship between institutional quality and trade by investigating net exports of post-Soviet bloc economies following the collapse of the central planning system. The study concludes that the decline of central planning decreased net exports more strongly in institutionally intensive sectors than in sectors less dependent on institutional quality. To some extent, we revisit that argument, as Russia – which leads the group of developing/emerging economies – shares a similar background. Another study influencing our research design is the work of Mehlum et al. [2006]. Even though it belongs to the resource-curse

literature and therefore lies beyond the scope of our investigation, it does highlight the differences between countries according to their institutional quality. Mehlum et al. [2006] demonstrate that the resource curse occurs only in countries with inferior institutional quality. Extending this idea, we propose that institutions might be the decisive factor behind the influence of energy demand security on international competitiveness.

Institutional quality is embedded in energy security through the notion of governance, which in recent years has become an inherent element of energy security studies, particularly evident in the case of studies on supply security (to a lesser extent on demand security). Hippel et al. [2011] approach the topic of energy governance and supply security by extending the well-established concept of *4a's* by adding governance in addition to availability, affordability, accessibility and acceptability, thereby creating a broader conceptual framework emphasising the interconnected nature of energy security determinants. Sovacool [2013] develops this approach further by operationalising the governance dimension of energy security through an index based on the mean score of six World Governance Indicators. This measure, alongside around 20 other energy security indicators, is used to evaluate the performance of 18 countries over the period 1990 to 2010. Sovacool's idea was subsequently adopted by Karatayev and Hall [2020] in the context of energy demand security, where governance was likewise incorporated as a key component of the analytical framework. The empirical analysis of energy demand security in six Caspian Sea countries led Karatayev and Hall [2020] to the conclusion that proactive governance should remain a strategic priority for resource-rich economies.

While the governance dimension has increasingly been incorporated into measures of energy security, the question of what exactly constitutes this governance component remains open. To address this issue, we refer to the United Nations' [2016] definition of national governance. Given that energy policy in resource-rich countries is typically the domain of the national government, it naturally corresponds with energy demand security. Hence, "national governance (...) is broadly defined as the exercise of economic, political and administrative authority to manage a country's affairs (...). Specific forms of governance practices vary widely across countries and are shaped by each country's political, social and economic contexts, but good governance in general comprises the rule of law, effective institutions, transparency and accountability in the management of public affairs (...). Good governance also requires effective political leadership that promotes strategic vision and broad consensus on policies and procedures that are needed to foster peace, stability and development" [United Nations, 2016]. According to Amin et al. [2017], weak governance,

particularly in underdeveloped countries, contributes to energy deficits associated with energy insecurity. Conversely, strong governance contributes to energy security, as they demonstrate on the example of Bangladesh. Energy governance "is a set of instruments and practices that make energy policies work" [Bunevičiūtė, 2015]. Strong energy governance extends beyond national governments, also encompassing supranational actors, such as the European Union, United Nations, and the G7, as well as subnational actors, including civil society organisations, private businesses, and municipalities [Bunevičiūtė, 2015].

Following Sovacool [2013], we treat governance as a component of the institutional quality of a respective country. We acknowledge Williamson's [1998] distinction between institutions and institutions of governance, where institutions include "rules of the game-the polity, laws of contract, and property rights," whereas institutions of governance encompass "play of the game-the use of markets, hybrids, firms, and bureaus." We also draw on the concept of economic institutions presented by Acemoglu [2001], which includes "property rights, along with the presence and perfection of markets." These institutions are assumed to be shaped by national societies, which Acemoglu [2001] describes as the endogenous character of economic institutions. Finally, following Lederman and Xu, [2007], we assume that institutions affect patterns of natural resource trade (in our study in the form of the RCA index) and (drawing on Mehlum's et al. [2006]) we investigate whether institutions are the decisive factor shaping the influence of energy demand security on international competitiveness, and whether this relationship differs between developed and developing/emerging economies.

3. Methods

3.1. Variables' description

Data for the composite variables used in this study were gathered for the period 1997–2019, representing the longest period for which data on selected variables and for all the selected countries (Canada, the Netherlands, Norway, the United States, Indonesia, Malaysia, Qatar, and Russia) were available. The choice of countries results from their leading position in natural gas exports in recent years. Data on exports and imports (% of GDP), GDP (constant 2015 USD) and labour force (size) were obtained from the World Bank [2022a]. Physical capital (at constant 2017 national prices, expressed in millions of 2017 USD), human capital (index; for details see: University

of Groningen [2019]), and labour force compensation as a share of GDP (at current national prices) were sourced from Penn World Table version 10.0 [University of Groningen, 2022; Feenstra, Inklaar, Timmer, 2015]. Minor differences in base years are noted, but (due to the lack of high inflation during this gap) this should not impact the results (i.e. statistics) of the study. Data on governance quality were obtained from the World Governance Indicators database (2021 update; [WGI, 2022]). Data on total natural resource rents (defined as the sum of oil rents, natural gas rents, coal rents hard and soft, mineral rents, and forest rent; calculated as the "difference between the price of a commodity and the average cost of producing it;" as a % of GDP) and fuel exports (i.e. commodities in SITC section 3: mineral fuels, lubricants and related materials; as a % of merchandise exports) were obtained from the World Bank [2022b, c]. Finally, data on the energy security risk index (ESRI) were obtained from Global Energy Institute [GEI, 2020].

For operationalisation purposes, we adopt the approach proposed by Amoroso, Chiquiar and Ramos-Francia [2011], who studied the relative international competitiveness (RCA) of Mexico. Variables used in their model are expressed in relative terms and are calculated as values for selected variables (X) for a given country (i) and time (t) compared to the values for that variable for a selected country that serves as a reference point (p, 1).

$$rX_{it} = \ln(X_{it}) - \ln(X_{pt}) \tag{1}$$

The choice of countries included in the analysis stems from their classification as developed or developing, as well as their leading position in natural gas exports in recent years. The classification of countries follows the definitions provided by the IMF [2021] and the World Bank [2022a]. Since the analysis distinguishes between developed and developing countries, we use separate reference points. Norway serves as the benchmark for the group of developed countries (Canada, Netherlands, Norway, and the United States) as it ranks highest in the group in terms of governance quality (average rank of 96.35). The situation of Russia is the opposite (average rank of 26.40), and hence it serves as the reference point for the developing economies (Indonesia, Malaysia, Qatar, and Russia).

Since there is no universally accepted definition of international competitiveness [Capobianco-Uriarte et al., 2019], this study follows the approach proposed by Nyga-Łukaszewska and Napiórkowski [2022]. These authors note that the literature adopts a relatively liberal approach to its measurement (see, for example, Lin et al. [2019] and Kang et al. [2021]). Accordingly, following studies such as Su, Hou, Yang,

Han and Liu [2020] and Shuai et al. [2022], they employ an index (2) proposed by Balassa [1965], as it fits Heckscher-Ohlin and Ricardian trade hypotheses particularly well [Algieri, Aquino, Succurro, 2018].

$$rRCA^*_{it} = \ln(RCA^*_{it}) - \ln(RCA^*_{pt}) \tag{2}$$

Turning to independent variables, the first variable captures the relative endowment of physical capital (K) per worker (L), adjusted for the extent of its use (3). Amoroso et al. [2011] express the latter factor as a ratio of physical capital to Gross Value Added, while (due to data availability) this study uses Gross Domestic Product in the denominator. This and similar substitutions do not change the overall approach presented by Amoroso et al. [2011]; therefore, we do not see them as limitations of the study.

$$rk_{it} = \left[\ln\left(\frac{K_{it}}{L_{it}}\right) - \ln\left(\frac{K_{pt}}{L_{pt}}\right)\right]\frac{K_{it}}{GDP_{it}} \tag{3}$$

Second, relative human capital endowment (H) is multiplied by a ratio of the share of labour compensation in GDP (l) in relation to its average for the panel ($\bar{l}, 4$). Originally, the multiplier was based on wages, but data limitations forced us to make this change. The inclusion of these two production factors is also in line with exogenous (e.g. Solow [1956]) and endogenous (e.g. Romer [1990] and Aghion and Howitt [1992]) economic growth theories, as well as the approach to international competitiveness adopted by Schwab [2019], Purwanto et al. [2017], and Zhan [2015].

$$rH_{it} = [\ln(H_{it}) - \ln(H_{pt})]\frac{l_{it}}{\bar{l}} \tag{4}$$

Third, the model accounts for differences in labour productivity (where, once again, we substitute GVA with GDP, 5).

$$rLP_{it} = \left[\ln\left(\frac{GDP_{it}}{L_{it}}\right) - \ln\left(\frac{GDP_{pt}}{L_{pt}}\right)\right]\frac{l_{it}}{\bar{l}} \tag{5}$$

Fourth, the governance quality variable is (as with Sovacool [2013]; 6) constructed as the average rank from six individual categories: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption (Table 1).

$$rGindex_{it} = [\ln(Gindex_{it}) - \ln(Gindex_{pt})] \tag{6}$$

Table 1. Governance quality elements

Category	Definition
Voice and Accountability	Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
Political Stability and Absence of Violence/ Terrorism	Measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.
Government Effectiveness	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
Regulatory Quality	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
Rule of Law	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
Control of Corruption	Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the *capture* of the state by elites and private interests.

Source: WGI [2022].

Finally, energy-related variables (where $E = TNRR, FE, ESRI$) are introduced into the model separately (7). This approach serves three purposes. First, it eliminates the possibility of measurement error. As noted earlier, energy demand security does not have a universally accepted definition, and consequently, there is no single measure fully capturing this concept. Second, the inclusion of various measurements of a single concept allows for robustness of the obtained results. Third, it helps avoid the issue of severe multicollinearity.

$$rE_{it} = [\ln(E_{it}) - \ln(E_{pt})] \tag{7}$$

Descriptive statistics of final variables for the developed (Table 1) and for developing (Table 2) panels are presented below.

Table 2. Descriptive statistics for developed economies

	rRCA	rk	rH	rLP	rGqindex	rTNRR	rFE	rESRI
i=Canada								
Mean	–0.28	0.00	0.03	–0.63	–0.03	–1.25	–1.17	0.11
Minimum	–0.451	0.000	0.017	–0.707	–0.054	–2.764	–1.773	–0.120
Maximum	0.001	0.000	0.052	–0.564	–0.009	–0.118	–0.809	0.197

cont. Table 2

	rRCA	rk	rH	rLP	rGqindex	rTNRR	rFE	rESRI
Skewness	0.628	−0.362	0.262	−0.056	−0.152	−0.850	−0.762	−1.488
Kurtosis	−0.289	0.039	−1.562	−1.788	−1.400	4.110	−0.725	1.490
Std. Deviation	0.119	0.000	0.012	0.053	0.014	0.487	0.296	0.088
i=the Netherlands								
Mean	−0.18	0.00	−0.08	−0.50	−0.01	−2.75	−1.93	0.33
Minimum	−0.35	0.00	−0.09	−0.55	−0.04	−3.96	−2.38	0.17
Maximum	0.085	0.000	−0.062	−0.473	0.038	−2.031	−1.545	0.546
Skewness	0.607	−0.271	0.291	−0.691	0.711	−0.831	−0.412	0.578
Kurtosis	−0.881	−0.771	−1.036	0.130	−0.451	1.256	−0.890	−1.547
Std. Deviation	0.145	0.000	0.009	0.020	0.023	0.437	0.264	0.142
i=the United States								
Mean	−0.57	0.00	0.05	−0.27	−0.12	−2.31	−2.56	0.14
Minimum	−0.91	0.00	0.02	−0.34	−0.19	−3.12	−3.54	−0.24
Maximum	−0.207	0.000	0.073	−0.178	−0.041	−1.175	−1.372	0.273
Skewness	0.119	−0.521	0.360	0.558	0.528	1.004	0.005	−1.679
Kurtosis	−1.348	−0.587	−1.421	−0.930	0.121	3.983	−1.638	2.213
Std. Deviation	0.224	0.000	0.017	0.046	0.034	0.365	0.748	0.140

Source: Authors' own elaboration based on the World Bank [2022a, 2022b], University of Groningen [2022], Feenstra et al. [2015], WGI [2022], GEI [2020].

Table 3. Descriptive statistics for developing/emerging economies

	rRCA	rk	rH	rLP	rGqindex	rTNRR	rFE	rESRI
i=Indonesia								
Mean	−0.24	0.00	−0.42	−1.01	0.23	−0.80	−0.79	−0.08
Minimum	−0.443	0.000	−0.478	−1.163	−0.235	−1.399	−1.003	−0.638
Maximum	−0.037	0.000	−0.373	−0.760	0.553	0.610	−0.597	0.153
Skewness	0.167	−0.286	−0.493	0.685	−0.577	1.780	−0.183	−1.026
Kurtosis	0.087	−1.130	0.238	1.195	−0.833	5.538	0.214	0.014
Std. Deviation	0.094	0.000	0.026	0.092	0.246	0.409	0.096	0.230
i=Malaysia								
Mean	−0.18	0.00	−0.13	0.19	0.84	−0.39	−1.46	0.13
Minimum	−0.43	0.00	−0.17	0.06	0.72	−0.78	−1.84	−0.60
Maximum	−0.030	0.000	−0.110	0.433	1.079	0.725	−1.147	0.467
Skewness	−0.853	−0.781	−0.332	1.043	1.184	2.295	−0.285	−0.924
Kurtosis	1.095	−0.113	−0.972	−0.019	0.720	6.453	−1.244	−0.499
Std. Deviation	0.092	0.000	0.016	0.111	0.094	0.322	0.233	0.321

	rRCA	rk	rH	rLP	rGqindex	rTNRR	rFE	rESRI
i=Qatar								
Mean	0.32	0.00	–0.14	1.77	0.92	0.76	0.44	0.35
Minimum	–0.09	0.00	–0.29	1.36	0.74	0.28	0.16	–0.20
Maximum	0.684	0.000	–0.023	2.282	1.140	1.799	0.793	0.662
Skewness	0.029	1.175	–0.443	0.491	0.082	1.767	0.277	–0.889
Kurtosis	–1.089	1.027	–1.017	–1.306	–0.610	4.628	–0.528	–0.407
Std. Deviation	0.236	0.000	0.083	0.308	0.109	0.322	0.171	0.264

Source: Authors' own elaboration based on the World Bank [2022a, 2022b], University of Groningen [2022], Feenstra et al. [2015], WGI [2022], GEI [2020].

3.2. Modelling procedure

Each of the two panels has a sample size of 96 ($n = 93$) observations per group, each with four cross-sections ($i = 4$) and 23 periods ($t = 23$); hence, $i < t$. Following the transformation of variables into relative forms, the sample size decreases to $n = 69$ as $i = 3$.

Following the Heckscher-Ohlin relative resource endowment hypothesis, the relative international competitiveness of the analysed economies ($rRCA^*$) is explained by relative endowment in relative physical capital per worker (rk) and relative human capital (rH), while the Ricardian productivity hypothesis is represented by relative labour productivity (rLP). This core setup follows the approach adopted by Amoroso et al. [2011], Nunn [2007] and Levchenko [2007]. We extend this framework (following Nyga-Łukaszewska and Napiórkowski [2022]) by including variables of special interest to this study, namely relative governance quality ($rGindex$) and relative energy security (rE).

The model parameters were estimated with Ordinary Least Squares with cross-section and period effects. The choice between Random (RE) and Fixed (FE) effects was based on the Hausman test with appropriate corrections where necessary [Raza, Shahzadi, Akram, 2014; Son, 2016]. It should be noted that, following the transformation of variables into relative terms, the analysis is based on a limited number of cross-sectional units. Although we use the RE model to analyse the data, we acknowledge that the small number of countries in the sample limits our ability to make broad statistical claims. Our goal is to highlight the specific patterns found in these three cases to help guide future research.

The model residuals were tested for cross-section dependence (given that $i < t$ with the Breusch-Pagan LM test of independence – De Hoyos and Sarafidis [2006]), heterogeneity of variance (the modified Wald test for groupwise heteroskedastic-

ity), autocorrelation (the Lagram-Multiplier test for serial correlation, also known as the Wooldridge test for autocorrelation in panel data), normal distribution (using Jarque-Bera and Shapiro–Wilk tests) and (to account for the possibility of a spurious regression – Wooldridge [2009]) the presence of a unit root, i.e. stationarity (using the Levin–Lin–Chu and Harris-Tzavalis tests). Whenever the null hypothesis of residuals not correlated across entities was rejected, the Panel-Corrected Standard Error estimator was used [Hoechle 2007]. Although the Generalised Least Squares estimator was also an option, given its overoptimistic standard errors [Beck, Katz, 1995], which lead to an increase in the probability of a Type I Error, we decided to omit this estimator. Robust standard errors were employed to account for potential autocorrelation and heteroskedasticity. It should be noted that while traditional post-estimation residual tests such as the ones presented above are designed for FE models, we address the potential for heteroskedasticity and distributional issues within our RE model by employing cluster-robust standard errors. The use of robust errors ensures that our results remain reliable even if the error variance is not constant, effectively addressing the same concerns as traditional residual tests [Wooldridge, 2010]. Finally, model fit was assessed using Prob > chi2 and R^2 statistics. The high values of R^2-between and low values of R^2-within suggest that the model more effectively explains the differences across units than over time within individual countries. The R^2-overall values are at satisfactory levels (0.5 for developed economies and 0.7 for developing economies).

As a first step, a basic model (M0) excluding energy security explanatory variables was estimated. This serves as a base to assess whether the inclusion of energy demand security as an explanatory concept, or the way it is measured, impacts the results regarding quality of governance. Hence, in M1, energy security is represented by TNRR; in M2, by FE; and in M3, by ESRI. The first research hypothesis is represented in the model by $\beta_{rGindex}$, and the second by β_{rTNRR} in M1, β_{rFE} in M2, and β_{rESRI} in M3.

4. Results

Starting with the developed economies, the residual test results (at a 5% level of statistical significance) are presented in Table 4.

M0 and M1 showed signs of autocorrelation, while M2 and M3 showed signs of cross-sectional dependence, heteroskedasticity in the case of M2, and autocorrelation. The residuals discussed did not follow normal distribution and were found to be stationary. Given the sample size of more than 30, and accounting for null hypoth-

esis bias [Field, 2013], the lack of normal distribution of residuals does not disqualify the results.

Table 4. Residuals test results for developed countries

Model:	M0	M1	M2	M3
Test name:	Result	Result	Result	Result
Hausman test (sigmamore): Prob > chi2	0.285	0.166	0.001	0.005
Breusch-Pagan LM test of independence: Pr	-	-	0.000	0.000
Modified Wald test for groupwise heteroskedasticity: Prob > chi2	-	-	0.002	0.312
Wooldridge test for autocorrelation in panel data: Prob > F	0.023	0.012	0.029	0.023
Jarque-Bera normality test: P-value	-	-	0.019	0.037
Shapiro–Wilk W test for normal data: P-value	-	-	0.000	0.000
Levin–Lin–Chu unit-root test: P-value	-	-	0.000	0.000
Harris-Tzavalis unit-root test: P-value	-	-	0.000	0.000

Source: Authors' own elaboration based on the World Bank [2022a, 2022b], University of Groningen [2022], Feenstra et al. [2015], WGI [2022], GEI [2020].

Table 5. Model results for developed countries

Model:	M0	M1	M2		M3	
Parameter:	$\hat{\beta}$	$\hat{\beta}$	$\hat{\beta}$ (ar1)	$\hat{\beta}$ (psar1)	$\hat{\beta}$ (ar1)	$\hat{\beta}$ (psar1)
β_{rk}	–273742.5	–272664.5	–202401.6	–187914.0	–142916.9	–152277.1
β_{rH}	–3.851***	–3.924**	–4.043**	–3.860**	–3.909***	–4.000***
β_{rLP}	0.107	0.155	–0.561	–0.564	–0.551	–0.521
$\beta_{rGindex}$	1.118	1.179	–1.245	–1.231	–0.858	–0.709
β_{rTNRR}	-	0.011	-	-	-	-
β_{rFE}	-	-	–0.026	–0.020	-	-
β_{rESRI}	-	-	-	-	–0.300	–0.330
β_0	–0.552**	–0.502	–0.918***	–0.889***	–0.730***	–0.715***
Statistics:						
Prob>chi2	-	-	0.000	0.000	0.000	0.000
R^2	-	-	0.244	0.2219	0.315	0.405
R^2 within	0.094	0.095	-	-	-	-
R^2 between	1.000	0.9997	-	-	-	-
R^2 overall	0.552	0.552	-	-	-	-

*** p-value<0.01, ** p-value<0.05.

Source: Authors' own elaboration based on the World Bank [2022a, 2022b], University of Groningen [2022], Feenstra et al. [2015], WGI [2022], GEI [2020].

The estimated coefficients are consistent across all model specifications (Table 5), with only the relative human capital coefficient found to be statistically significant. Neither the use of different estimators nor the inclusion of various measures of energy security leads to substantial changes in the estimated coefficients across models in a significant manner, providing evidence of the robustness of the results. Hence, as the coefficient on relative human capital in Norway increased – $H_{it} \uparrow$ – relative to country i – $[\ln(H_{it}) - \ln(H_{pt})]\frac{l_{it}}{\bar{l}} \downarrow$ – Norway's international competitiveness relative to country i (ceteris paribus) also increased – $[\ln(RCA^*_{it}) - \ln(RCA^*_{it})]\uparrow$.

The modelling results for developed economies demonstrate that relative energy security (regardless of the measure used) and relative governance quality are not statistically significant determinants of relative international competitiveness. From an empirical perspective, these results can be explained by the relatively small differences observed between Norway and other countries, particularly in the case of *rGindex* and *rESRI* ($\overline{rGindex} = -0.05$, $\overline{rTNRR} = -2.1$ and $\overline{rFE} = -1.89$, and $\overline{rESRI} = -0.19$). This is the anticipated result for developed economies, as they tend to exhibit a similar level of institutional quality. A comparable pattern can be observed in the case of energy for developed energy exporters.

Turning to developing/emerging economies, the residuals test results for the four models are presented in Table 6.

Table 6. Residual test results for developing/emerging economies

Model:	M0	M1	M2	M3
Test name:	Result	Result	Result	Result
Hausman test (sigmamore): Prob>chi2	0.000	0.001	0.486	0.959
Breusch-Pagan LM test of independence: Pr	0.003	0.003	-	-
Modified Wald test for groupwise heteroskedasticity: Prob>chi2	0.000	0.000	-	-
Wooldridge test for autocorrelation in panel data: Prob>F	0.007	0.006	0.007	0.006
Jarque-Bera normality test: P-value	0.007	0.007	-	-
Shapiro–Wilk W test for normal data: P-value	0.000	0.000	-	-
Levin–Lin–Chu unit-root test: P-value	0.001	0.001	-	-
Harris-Tzavalis unit-root test: P-value	0.000	0.000	-	-

Source: Authors' own elaboration based on the World Bank [2022a, 2022b], University of Groningen [2022], Feenstra et al. [2015], WGI [2022], GEI [2020].

The M0 and M1 residuals show signs of cross-section dependence, heteroskedasticity, autocorrelation, lack of normal distribution, and no indication of a unit root. M2 and M3 show evidence of autocorrelation.

Table 7. Model results for developed economies

Model:	M0		M1		M2	M3
Parameter:	$\hat{\beta}$ (ar1)	$\hat{\beta}$ (psar1)	$\hat{\beta}$ (ar1)	$\hat{\beta}$ (psar1)	$\hat{\beta}$	$\hat{\beta}$
β_{rk}	–17967.1*	–11964.6	–14199.8	–9254.3	–22264.2	–37148.9**
β_{rH}	0s.740*	0.556	0.608	0.460	1.012	0.447
β_{rLP}	0.320***	0.265***	0.284***	0.237***	0.175***	0.391***
$\beta_{rGIndex}$	–0.284**	–0.226*	–0.272**	–0.210*	0.041	–0.052
β_{rTNRR}	-	-	0.033	0.029	-	-
β_{rFE}	-	-	-	-	0.182***	-
β_{rESRI}	-	-	-	-	-	0.371***
β_0	0.118	0.094	0.116	0.092	0.105*	– 0.268***
Statistics:						
Prob>chi2	0.000	0.000	0.000	0.000	-	-
R^2	0.428	0.431	0.456	0.4699	-	-
R^2 within	-	-	-	-	0.065	0.135
R^2 between	-	-	-	-	0.998	0.989
R^2 overall	-	-	-	-	0.738	0.746

*** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1

Source: Authors' own elaboration based on the World Bank [2022a, 2022b], University of Groningen [2022], Feenstra et al. [2015], WGI [2022], GEI [2020].

The coefficients estimated for developing economies are less consistent in terms of their statistical significance across models (Table 7). The coefficient of relative physical capital per worker is statistically significant only in models M0 and M3, suggesting that its statistical significance depends on the autocorrelation correction and on the measure of energy security. A similar pattern is observed for relative human capital, whose coefficient is statistically significant only in model M0 at a 10 percent level of statistical significance. By contrast, relative labour productivity has a statistically significant and positive coefficient across all models. However, the value of these estimates depends on the measure of energy security. Overall, the results suggest that the increase in labour productivity in Russia – $\frac{GDP_{pt}}{L_{pt}}\uparrow$ – relative to country i – $\left[\ln\left(\frac{GDP_{it}}{L_{it}}\right)-\ln\left(\frac{GDP_{pt}}{L_{pt}}\right)\right]\frac{l_{it}}{\bar{l}}\downarrow$ – is associated with Russia's international competitiveness relative to country i decreasing – $\ln(RCA^{*}_{it})-\ln(RCA^{*}_{it})\downarrow$.

Governance quality is found to be a statistically significant determinant of international competitiveness when energy security is excluded from the model (M0) or when it is measured as TNRR (M1). In these cases, an increase (relative to country i) in Russia's governance quality – $Gindex_{pt} \uparrow \Rightarrow [\ln(Gindex_{it}) - \ln(Gindex_{pt})] \downarrow$ – transferred into an increase (relative to country i] in Russia's international competitiveness – $[\ln(RCA^*_{it}) - \ln(RCA^*_{it})] \uparrow$. By contrast, an increase in Russia's relative fuel exports (M2) and ESRI (M3) – $E_{pt} \uparrow \Rightarrow [\ln(E_{it}) - \ln(E_{pt})] \downarrow$ – exhibited a negative relationship with Russia's relative international competitiveness – $[\ln(RCA^*_{it}) - \ln(RCA^*_{it})] \downarrow$.

5. Discussion

The results support the hypothesis that governance influences the international competitiveness of developed and developing economies differently. While governance quality does not appear to be a significant determinant of international competitiveness in the developed-country sample, its role is more pronounced in developing and emerging economies. This is particularly evident when energy demand security is measured by total natural resource rents. However, when energy security of exporters is additionally captured by fuel exports and the energy security risk index, institutional quality no longer exerts a significant influence on the international competitiveness of developing/emerging economies. One possible explanation behind such results could be the fact that the countries in question export not only energy commodities but also other natural resources. A second potential explanation for the selective influence of the governance indicator across different models for developing/emerging economies, and of fuel exports and the energy security risk index in particular, could be the fact that these variables are strongly connected with fuel prices. Hence, price volatility may affect their contribution to international competitiveness. Increases in fuel exports and in the energy security risk index reduce the RCA of developing/emerging energy exporters. This argument is, to some extent, supported by Chen and Hsu [2013], who analysed how oil price fluctuations during the period 1984–2009 affected bilateral trade volumes across 1,995 country pairs covering 117 countries. Using a gravity model, the authors confirmed that oil price volatility reduces bilateral trade volumes regardless of a country's position in the international division of labour. This effect is additionally highlighted by the distance between trading partners. The greater the distance, the stronger the reduction in bilateral trade flows. Since the RCA index primarily reflects trade flows, and the majority of the developing/emerging gas exporters included in our research (Indo-

nesia, Malaysia, and Qatar) are located relatively far from major gas importers, the results of Chen and Hsu [2013] may provide a relevant explanation for our findings.

The lack of statistical significance of the governance variable, as well as of other energy demand security measures, in the group of developed countries might be attributed to the relatively limited importance of energy exports in total foreign merchandise sales within this group. This is a consequence of the diversified structure of these economies and their large size, as measured by GDP. The insignificance of the general energy demand security variables is consistent with the findings of Nyga-Łukaszewska and Napiórkowski [2022]. Additionally, the limited importance of energy demand security in the group of developed economies might be attributed to the fact that some countries in the sample, such as the Netherlands, have gradually decreased the production and exports of hydrocarbons over time, while others, such as Norway, have already begun implementing decarbonisation strategies aimed at reducing the consumption and production of fossil fuels (Norway). Consequently, the importance of the hydrocarbon sector and its exports may have gradually diminished in these countries, further weakening the relationship between energy demand security and international competitiveness.

However, the lack of significance of the governance variable for international competitiveness in this group of countries came as a surprise. We believed that although the influence of institutional quality on international competitiveness would differ between developed and developing/emerging economies, the variable would nevertheless remain statistically significant, in line with the findings of Mehlum et al. [2006]. We assumed that high-quality governance would promote international competitiveness, just as it promotes economic growth in developed nations [Zhuo, Musaad, Khan, Muhammad, 2021]. One possible explanation for this result may be, on the one hand, data aggregation issues and, on the other hand, the high degree of similarity among developed economies in terms of their governance indicators. Using the mean of six governance indicators in our study might have distorted the results of the developed countries sample. Therefore, disaggregating the index into individual governance dimensions, as in Zhuo et al. [2021], may constitute an interesting avenue for further research.

Like any study, this paper has several limitations. These relate to the methodological approach, the country samples, and data aggregation issues. Firstly, the empirical strategy relies on a (modified) RCA index, which in its nature is neither a perfect nor the only measure of international competitiveness. Although we employ an updated version of this indicator, one may still argue that international competitiveness can be captured using alternative indexes. Secondly, data availability

constraints and the desire to rely on the most reliable data sources resulted in the exclusion of several important natural gas exporters, such as Turkmenistan, Nigeria, and Algeria. Therefore, future research focusing on developing countries could include these economies in the analysis. Thirdly, as mentioned earlier, given the relative lack of significance of the governance variable for developed nations, we would suggest disaggregating the governance indicator into single measures. Apart from this, another possible research direction, related to both data aggregation issues and sample composition, would be to distinguish natural gas exporters according to their position within gas transportation systems (LNG vs pipelines). The different composition of countries participating in LNG and pipeline gas exports provides support for such an approach.

References

Aghion, P., Howitt, P. (1992). A Model of Growth Through Creative Destruction, *Econometrica*, 60(2), pp. 323–351. DOI: 10.2307/2951599.

Algieri, B., Aquino, A., Succurro, M. (2018). International Competitive Advantages in Tourism: An Eclectic View, *Tourism Management Perspectives*, 25, pp. 41–52. DOI: 10.1016/j.tmp.2017.11.003.

Amoroso, N., Chiquiar, D., Ramos-Francia, M. (2011). Technology and Endowments as Determinants of Comparative Advantage: Evidence from Mexico, *The North American Journal of Economics and Finance*, 22(2), pp. 164–196.

Amin, S.B., Ali, T.I., Marzana, U. (2017). The Dynamics of Good Governance in Promoting Energy Security: The Case of Bangladesh, *Acta Universitatis Danubius. Relationes Internationales*, 10(1), pp. 61–78.

Anderson, J.E., Marcouiller, D. (2002). Insecurity and the Pattern of Trade: An Empirical Investigation, *The Review of Economics and Statistics*, 84(2), pp. 342–352.

Balassa, B. (1965). Trade Liberalisation and "Revealed" Comparative Advantage, *The Manchester School*, 33(2), pp. 99–123. DOI: 10.1111/j.1467-9957.1965.tb00050.x

Beck, N., Katz, J.N. (1995). What To Do (And Not To Do) with Time-Series Cross-Section Data, *American Political Science Review*, 89(3), pp. 634–647. DOI: 10.2307/2082979.

Bollino, C.A., Galkin, P. (2021). Energy Security and Portfolio Diversification: Conventional and Novel Perspectives, *Energies*, 14(14), 4257. DOI: 10.3390/en14144257.

Bunevičiūtė, R. (2015). The Governance of Energy Security. A Sensible Energy Policy Requires a Regional and Global Perspective, *Per Concordiam: Journal of European Security and Defense Issues*, 6(2), pp. 10–11, https://www.marshallcenter.org/sites/default/files/files/2020-10/pC_V6N2_en_Bunevi%C4%8Di%C5%ABt%C4%97.pdf (accessed: 02.08.2022).

Canh, N.P., Thanh, S.D., Van, D.T.B., Binh, N.Q. (2021). Does Energy Security Affect Institutional Quality? Empirical Evidence from Emerging Economies. In: *Dynamics of Institutional Change*

in Emerging Market Economies: Theories, Concepts and Mechanisms (pp. 335–377), N. Faghih, A.H. Samadi (Eds). Cham: Springer International Publishing.

Capobianco-Uriarte, M.d.l.M., Casado-Belmonte, M.d.P., Marín-Carrillo, G.M., Terán-Yépez, E. (2019). A Bibliometric Analysis of International Competitiveness (1983–2017), *Sustainability*, 11(7), 1877. DOI: 10.3390/su11071877.

Carbaugh, R.J. (2014). *International Economics (14th ed.)*. Mason: Cengage Learning.

Chen, S.-S., Hsu, K.-W. (2013). Oil Price Volatility and Bilateral Trade, *The Energy Journal*, 34(1), pp. 207–230. DOI: 10.5547/01956574.34.1.9.

De Hoyos, R.E., Sarafidis, V. (2006). Testing for Cross-Sectional Dependence in Panel-Data Models, *The Stata Journal*, 6(4), pp. 482–496. DOI: 10.1177/1536867X0600600403.

Dike, J.C. (2013). Measuring the Security of Energy Exports Demand in OPEC Economies, *Energy Policy*, 60, pp. 594–600. DOI: 10.1016/j.enpol.2013.05.086.

Dutta, S., Lanvin, B., León, L.R., Wunsch-Vincent, S. (2021). *Global Innovation Index 2021: Tracking Innovation Through the COVID-19 Crisis*. Geneva: World Intellectual Property Organization.

Feenstra, R.C., Inklaar, R., Timmer, M.P. (2015). The Next Generation of the Penn World Table, *American Economic Review*, 105(10), pp. 3150–3182. DOI: 10.1257/aer.20130954.

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. Los Angeles, SAGE Publications.

GEI (2020). *Index of U.S. Energy Security Risk: Assessing America's Vulnerabilities in a Global Energy Market*, https://www.globalenergyinstitute.org/energy-security-risk-index (accessed: 25.05.2021).

Hippel, D. von Suzuki, T., Williams, J.H., Savage, T., Hayes, P. (2011). Energy Security and Sustainability in Northeast Asia, *Energy Policy*, 39(11), pp. 6719–6730. DOI: 10.1016/j.enpol.2009.07.001.

Hoechle, D. (2007). Robust Standard Errors for Panel Regressions with Cross-Sectional Dependence, *The Stata Journal*, 7(3), pp. 281–312.

IMF (2020). *World Economic and Financial Surveys. World Economic Outlook. Database – WEO Groups and Aggregates Information*, https://www.imf.org/external/pubs/ft/weo/2020/01/weodata/groups.htm (accessed: 13.12.2021).

Kang, H., Yang, Z., Zhang, Z. (2023). The Competitiveness of China's Seaweed Products in the International Market from 2002 to 2017, *Aquaculture and Fisheries*, 8(5), pp. 579–586. DOI: 10.1016/j.aaf.2021.10.003.

Karatayev, M., Hall, S. (2020). Establishing and Comparing Energy Security Trends in Resource-Rich Exporting Nations (Russia and the Caspian Sea Region), *Resources Policy*, 68, 101746. DOI: 10.1016/j.resourpol.2020.101746.

Kiseľáková, D., Šofranková, B., Onuferová, E., Čabinová, V. (2019). The Evaluation of Competitive Position of EU-28 Economies with Using Global Multi-Criteria Indices, *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 14(3), pp. 441–462. DOI: 10.24136/eq.2019.021.

Koakutsu, K., Watanabe, R. (2012). *Energy Security and Developmental Needs*, https://www.iges.or.jp/en/publication_documents/pub/policyreport/en/316/03_energysecurity.pdf (accessed: 05.08.2022).

Lederman, D., Xu, L.C. (2007). Comparative Advantage and Trade Intensity: Are Traditional Endowments Destiny? In: *Natural Resources: Neither Curse nor Destiny* (pp. 289–322), D. Lederman, W.F. Maloney (Eds.). Washington: The World Bank; Palo Alto: Stanford University Press.

Levchenko, A.A. (2004). Institutional Quality and International Trade, *IMF Working Papers*, No. WP/04/231. DOI: 10.5089/9781451875560.001.

Levchenko, A.A. (2007). Institutional Quality and International Trade, *The Review of Economic Studies*, 74(3), pp. 791–819. DOI: 10.1111/j.1467-937X.2007.00435.x.

Lin, W., Chen, J., Zheng, Y., Dai, Y. (2019). Effects of the EU Emission Trading Scheme on the International Competitiveness of Pulp-and-Paper Industry, *Forest Policy and Economics*, 109. DOI: 10.1016/j.forpol.2019.102021.

Mehlum, H., Moene, K., Torvik, R. (2006). Institutions and the Resource Curse, *The Economic Journal*, 116(508), pp. 1–20.

Novikau, A. (2021). What Does Energy Security Mean for Energy-Exporting Countries? A Closer Look at the Russian Energy Security Strategy, *Journal of Energy & Natural Resources Law*, 39(1), pp. 105–123. DOI: 10.1080/02646811.2020.1794108.

Nunn, N. (2007). Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade, *The Quarterly Journal of Economics*, 122(2), pp. 569–600. DOI: 10.1162/qjec.122.2.569.

Nyga-Łukaszewska, H., Napiórkowski, T.M. (2022). Does Energy Demand Security Affect International Competitiveness? Case of Selected Energy-Exporting OECD Countries, *Energies*, 15(6), 1991. DOI: 10.3390/en15061991.

Porter, M.E. (1990). *The Competitive Advantage of Nations*, https://hbr.org/1990/03/the-competitive-advantage-of-nations (accessed: 15.08.2022).

Purwanto, A.J., Heyndrickx, C., Kiel, J., Betancor, O., Socorro, M.P., Hernandez, A., Eugenio-Martin, J.L., Pawlowska, B., Borkowski, P., Fiedler, R. (2017). Impact of Transport Infrastructure on International Competitiveness of Europe, *Transportation Research Procedia*, 25, pp. 2877–2888.

Ramírez-Cendrero, J.M., Wirth, E. (2016). Is the Norwegian Model Exportable to Combat Dutch Disease?, *Resources Policy*, 48, pp. 85–96. DOI: 10.1016/j.resourpol.2016.02.010.

Ranjan, P., Lee, J.Y. (2003). Contract Enforcement and the Volume of International Trade in Different Types of Goods, *Working Paper*, UC Irvine.

Raza, S.H., Shahzadi, H., Akram, M. (2014). Exploring the Determinants of Financial Development (Using Panel Data on Developed and Developing Countries), *Journal of Finance and Economics*, 2(5), pp. 166–172. DOI: 10.12691/jfe-2-5-6.

Romer, P.M. (1990). Endogenous Technological Change, *Journal of Political Economy*, 98(5), pp. S71–S102. DOI: 10.1086/261725.

Sachs, J.D., Warner, A.M. (1995). Natural Resource Abundance and Economic Growth, *NBER Working Paper*, No. 5398.

Schuler, P. (2003). *Institutions and the Changing Composition of International Trade in the Post-Socialist Transition*, Ph.D. Dissertation, University of Maryland.

Schwab, K. (2019). *The Global Competitiveness Report 2019*. Geneva: World Economic Forum.

Shuai, J., Peng, X., Zhao, Y., Wang, Y., Xu, W., Cheng, J., Lu, Y., Wang, J. (2022). A Dynamic Evaluation on the International Competitiveness of China's Rare Earth Products: An Industrial Chain and Tech-Innovation Perspective, *Resources Policy*, 75, 102444. DOI: 10.1016/j.resourpol.2021.102444.

Solow, R. (1956). A Contribution to the Theory of Economic Growth, *The Quarterly Journal of Economics*, 70(1), pp. 65–94. DOI: 10.2307/1884513.

Son, H. (2016). Trust, Economic Growth and Importance of the Institution, *International Journal of Economic Sciences*, 5(4), pp. 32–50. DOI: 10.20472/ES.2016.5.4.003.

Sovacool, B.K. (2013). Assessing Energy Security Performance in the Asia Pacific, 1990–2010, *Renewable and Sustainable Energy Reviews*, 17, pp. 228–247. DOI: 10.1016/j.rser.2012.09.031.

Su, H., Hou, F., Yang, Y., Han, Z., Liu, C. (2020). An Assessment of the International Competitiveness of China's Forest Products Industry, *Forest Policy and Economics*, 119, 102256. DOI: 10.1016/j.forpol.2020.102256.

United Nations (2016). *Governance and Institutions,* https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/2015wess_ch6_en.pdf (accessed: 02.08.2022).

University of Groningen (2019). *Human capital in PWT 9.0*, https://www.rug.nl/ggdc/docs/human_capital_in_pwt_90.pdf (accessed: 20.03.2020).

University of Groningen (2022). *Penn World Table Version 10.0*, https://www.rug.nl/ggdc/productivity/pwt/?lang=en (accessed: 14.05.2022).

Van de Graaf, T., Sovacool, B.K., Ghosh, A., Kern, F., Klare, M.T. (2016). States, Markets, and Institutions: Integrating International Political Economy and Global Energy Politics. In: *The Palgrave Handbook of the International Political Economy of Energy* (pp. 3–44), T. Van de Graaf, B.K. Sovacool, A. Ghosh, F. Kern, M.T. Klare (Eds.). London: Palgrave Macmillan.

WGI (2021). *World Governance Indicators, 2021 Update*, https://info.worldbank.org/governance/wgi (accessed: 04.05.2022).

Williamson, O.E. (1998). The Institutions of Governance, *The American Economic Review,* 88(2), pp. 75–79.

Wooldridge, J.M. (2009). Introductory Econometrics. *A Modern Approach*. Mason: South-Western, Cengage Learning.

Wooldridge, J.M. (2010). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: MIT Press.

World Bank (2022a). *World Development Indicators*, https://databank.worldbank.org/source/world-development-indicators# (accessed: 19.05.2022).

World Bank (2022b). *Total Natural Resources Rents*, https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS (accessed: 19.05.2022).

World Bank (2022c). *Fuel Exports (% of Merchandise Exports)*, https://data.worldbank.org/indicator/TX.VAL.FUEL.ZS.UN (accessed: 19.05.2022).

Zhang, K.H. (2015). What Drives Export Competitiveness? The Role of FDI in Chinese Manufacturing, *Contemporary Economic Policy*, 33(3), pp. 499–512.

Zhuo, Z., Musaad O, A.S., Muhammad, B., Khan, S. (2021). Underlying the Relationship Between Governance and Economic Growth in Developed Countries, *Journal of the Knowledge Economy*, 12(3), pp. 1314–1330. DOI: 10.1007/s13132-020-00658-w.

3

Mikołaj Pindelski[1]
Anna Piętka[2]
Arnstein Aassve[3]
Artur Bogucki[4]
Catalin Vrabie[5]
Florina Pinzaru[6]
Marie-Pierre F. Granger[7]
Lily Xuehui Gao[8]
Maciej Moroz[9]
Natalia Menéndez González[10]
Richard Wahlund[11]
Tarana Jafarova[12]

From Gatekeeper to Gateway: Institutional Challenges in Adopting Social Mobility-Centric AI Algorithms in EU Higher Education

1 SGH Warsaw School of Economics (Poland), e-mail: mpinde@sgh.waw.pl.
2 SGH Warsaw School of Economics (Poland).
3 Bocconi University (Italy).
4 SGH Warsaw School of Economics (Poland).
5 National University of Political Studies and Public Administration – SNSPA (Romania).
6 National University of Political Studies and Public Administration – SNSPA (Romania).
7 Central European University (Austria).
8 Stockholm School of Economics (Sweden).
9 SGH Warsaw School of Economics (Poland).
10 European University Institute (Italy).
11 Stockholm School of Economics (Sweden).
12 SGH Warsaw School of Economics (Poland).

Abstract

Artificial intelligence increasingly shapes access to education, employment and social mobility across Europe, yet its social consequences remain uneven and insufficiently understood. The AI Pathways Lab (AIPL) explores the dual role of AI as both a potential source of inequality and a driver of inclusion. Bringing together perspectives from social sciences, data science, behavioural economics, law, and public policy, the project examines how algorithmic systems used in admissions, recruitment and career guidance influence individual life trajectories across diverse institutional and national contexts.

As AI enters higher education and labour markets, initial optimism about its potential to resolve social mobility imbalances has given way to more cautious assessments. Rather than serving as a neutral equaliser, AI may function as an automated gatekeeper that reinforces systemic biases. This paper explores that dual nature: AI's capacity to deepen exclusion versus its potential to become a serious driver of social mobility.

1. Introduction

The deployment of artificial intelligence in European higher education has accelerated considerably in recent years. Algorithmic systems now influence a wide range of consequential decisions, from student admissions and scholarship allocation to career guidance and recruitment screening. While early proponents positioned AI as a tool capable of eliminating human bias and democratising access to education, a growing expert consensus points to a more ambivalent reality. This is evident in concerns regarding algorithmic unfairness, as highlighted in numerous research papers.

This paper presents findings from the AI Pathways Lab (AIPL), a cross-institutional research consortium affiliated with the CIVICA university network. The consortium brings together scholars from the Warsaw School of Economics (SGH), Stockholm School of Economics, Bocconi University, Central European University, the National University of Political Studies and Public Administration (SNSPA), the European University Institute, and Azerbaijan State University of Languages.

By employing a Delphi-inspired qualitative methodology, this study investigates how algorithmic systems in EU higher education and labour markets shape cumulative social mobility pathways over time, identifying the conditions under which they reproduce digital and institutional inequalities and how they can be redesigned to expand opportunities across diverse European educational and regulatory contexts.

The paper also situates these findings within broader EU policy frameworks, including the EU Digital Compass 2030 and the EU AI Act, and proposes a framework for designing proactive, inclusive AI tools that redistribute opportunities across the EU context.

2. Theoretical background and conceptual framework

2.1. AI as a gatekeeper and gateway

The central conceptual tension explored in this paper is the dual nature of AI in higher education. On the one hand, AI has the capacity to function as an automated gatekeeper that reinforces systemic exclusion. On the other hand, it may serve as a gateway that expands access to opportunity [Sawale, 2026]. This framing moves beyond simple bias detection to examine the structural mechanisms through which algorithmic systems may produce and reproduce inequality. As a gatekeeper, AI applies filters and exclusion, prioritising candidates who match historically privileged profiles and disadvantaging those whose strengths fall outside dominant evaluation criteria. As a gateway, AI holds the potential to identify hidden talent, support alternative pathways, and actively redistribute opportunity toward underrepresented groups. The transition between these two roles is not merely a technical matter but one of institutional values, governance design, political will, and legal considerations [Gulyamov, Rustambekov, 2026]. This is particularly important in the context of the digital transformation of Higher Education Institutions (HEIs) [Agi, Feng Cheng EN's Lab, 2026].

2.2. Theoretical background

The current research draws on the Theory of Algorithmic Injustice as a guiding analytical framework. Rather than only focusing on identifiable bias in individual decisions, it examines how automated decision systems produce structurally unjust outcomes through the interaction of historically biased training data, proxy variables that encode socioeconomic disadvantage, and cumulative effects that compound across life stages. The framework provides a basis for proposing systemic rather than merely corrective interventions. The problem has been examined from a variety of perspectives, including philosophical [Milano, Prunkl, 2025], structural [Tanriverdi, Akinyemi, 2025], social [Miragoli, 2025], epistemic [Fricker, 2007], legal

[McInerney, 2025], and technological and managerial [Kordzadeh, Ghasemaghaei, 2022] perspectives. This becomes particularly important because algorithmic decision-making, especially in systems that redistribute opportunity or exclusion, may deepen [Jasso, 2023] structural injustice and inequality [McKeown, 2021], as well as systemic injustice, perceived as a related term [Haslanger, 2022]. This study emphasises how biased data, undefined variables, and repeated decisions compound over time, which relates to structural injustice rather than just a bias model. It represents the opinions of academics on the topic of potential developments of artificial intelligence and its use in Higher Education Institutions (HEIs), as well as expected results. This relates to theories of cumulative advantage and disadvantage [Allison, Krauze, Long, 1982], according to which relatively early exclusion from educational institutions can result in later inequalities in networks, knowledge, experience, and access to labour markets. It also relates to the Gatekeeping theory, which focuses on access to information, education, social circles and career opportunities [Miller, Koerin, 2002; Erzikova, 2018; Nahon, 2008]. The central idea of this paper is a metaphor of AI as an automated and autonomous or semi-autonomous gatekeeper that can either block or allow access to opportunities associated with the best available higher education.

3. Research methodology

The research employs a Delphi-inspired qualitative synthesis methodology to investigate a complex and evolving issue for which longitudinal evidence is still limited, and therefore expert opinions are especially valuable. The Delphi method is particularly well suited for problems characterised by uncertainty, of an interdisciplinary nature, and requiring integration of knowledge across institutional and disciplinary areas. The reason behind this is that it allows researchers to systematically gather, refine and synthesise expert views through structured iteration and controlled feedback [Skulmoski, Hartman, Krahn, 2007; Hsu, Sandford, 2007]. In contrast to descriptive methods or cross-sectional approaches, Delphi-based research is useful where the objective is not simply an opinion, but rather to develop a reasoned, consensual and structured understanding of emerging phenomena that cannot yet be fully captured through longitudinal data [Okoli et al., 2004; de Villiers, de Villiers, Kent, 2005]. In this study, the method is used to examine how AI systems may shape access to higher education and social mobility across diverse European contexts, with particular focus on cumulative disadvantage, digital capital, and

institutional governance. The Delphi-inspired design enables the aggregation of perspectives from scholars across different universities, while preserving analytical space for disagreement and consensus. The methodology functions as a structured interpretive tool for identifying patterns, tensions and future research priorities in an area of rapid technological and institutional change. By gathering and synthesising insights from experts across the CIVICA network of universities, this approach avoids the pitfalls of groupthink and enables structured reflection on the dual nature of AI as both a source of inequality and a potential factor supporting social mobility. Expert participants represent disciplinary backgrounds such as sociology, economics, data science, law, public policy, and education studies.

The expert synthesis was guided by six structured research questions:
Q1: How do early-stage algorithmic exclusions in university admissions compound over time to create lifelong barriers to social mobility?
Q2: What is the most promising corrective mechanism for AI to proactively expand opportunities for unprivileged groups rather than merely avoid harm?
Q3: How can the EU prevent AI from privileging those already possessing high digital capital, thereby creating a new tech-based class system?
Q4: What unique European socio-economic and institutional factors must be considered to ensure AI-driven mobility is equitable across the Union?
Q5: What would the biggest challenge be for institutional adoption of AI systems designed to prioritise social mobility as a primary metric?
Q6: Do AI systems bring more threats or opportunities for social mobility fairness in EU universities?

The responses were thematically synthesised, with MAXQDA software used to identify cross-cutting patterns across institutional, regulatory and individual levels of analysis.

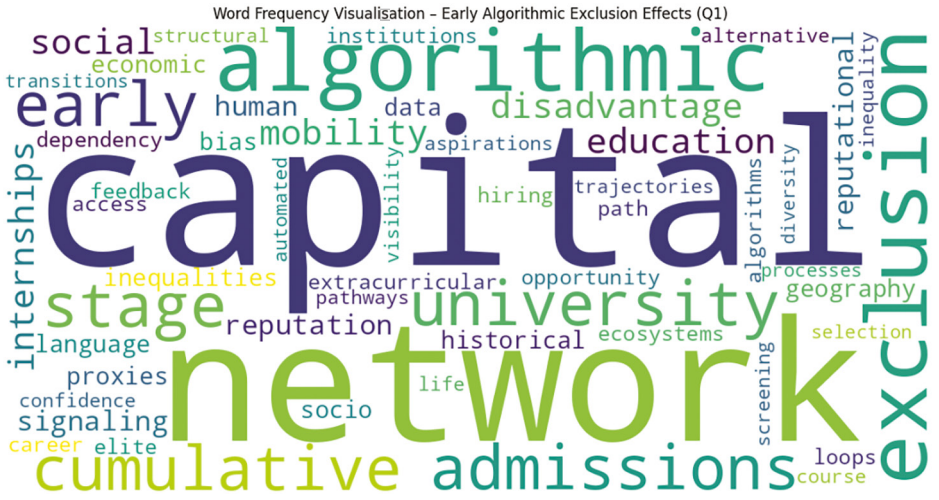
4. Results

4.1. Cumulative disadvantage through early algorithmic exclusion

Expert respondents broadly agree that algorithmic exclusion in university admissions creates cumulative, cascading disadvantages rather than isolated one-time effects. Admission to selective universities functions as a gateway to opportunity ecosystems, including high-quality education, professional networks, internships and international mobility. Early exclusion therefore limits access not only to education

but also to the broader institutional infrastructure that shapes long-term professional trajectories. The effect is particularly pronounced in countries characterised by high regional inequality, where access to major academic centres determines entry into national opportunity structures. Algorithmic admissions systems risk reproducing existing socio-economic inequalities, especially when trained on historical data reflecting past biases. Even formally neutral evaluation systems may indirectly disadvantage candidates through proxy variables such as educational background, geography, language style, or extracurricular participation.

Figure 1. Word cloud for responses to Q1



Source: Authors' own elaboration.

Figure 1, summarising the experts' responses to Q1, highlights the paper's main conceptual cluster, centred on the themes of *capital*, *network*, *exclusion*, and *admissions*. These remain the strongest terms, which suggests that the responses are centred on how AI affects access to opportunity through institutional filters. It also highlights cumulative and relational language, such as *cumulative*, *early*, *reputational*, and *network*, reinforcing the idea that exclusion is not a single event but a compounding process over time. A second important pattern is the presence of *algorithmic*, *university*, *admissions*, and *selection*, which demonstrates that the Figure is aligned with higher-education decision-making rather than AI in the general sense. The smaller yet visible terms such as *bias*, *proxies*, *mobility*, *opportunity*, and *inequalities* support the interpretation that experts raise the topic of structural inequality, rather than just technical fairness. The word cloud presents a gatekeeping

narrative, as AI-mediated admissions appear as mechanisms that can either open or restrict access to social mobility, with capital and network effects sitting at the centre of the argument.

Experts also identified feedback-loop dynamics whereby similar data patterns used in both admissions and hiring systems may generate reinforcing effects across multiple stages of algorithmic decision-making, producing layered and multiplying disadvantages over the life course. Algorithmic selection may additionally create a standardisation effect, privileging similar candidate profiles across institutions and sectors, thereby reducing alternative pathways for individuals whose strengths are not captured by dominant evaluation criteria. Finally, respondents noted psychological and motivational dimensions of early exclusion: rejection from selective institutions can affect confidence, aspirations, and willingness to pursue further educational opportunities, further reinforcing structural disadvantage beyond its material effects.

4.2. From bias correction to proactive opportunity expansion

Expert synthesis suggests that the most promising corrective approach is to shift the focus from passive bias reduction towards proactive opportunity expansion. The key mechanisms identified include incorporating the lived experiences, preferences and constraints of disadvantaged groups into training data, evaluation processes, and feedback loops; redesigning AI pipelines to create second-chance pathways, such as conditional admission routes or structured human review stages; placing greater emphasis on future potential rather than past achievement, since traditional performance indicators often reflect structural inequality rather than ability; implementing forms of algorithmic affirmative action, carefully adjusting evaluation criteria to compensate for structural disadvantages; deploying AI to direct institutional support resources, including scholarships, mentoring, tutoring, counselling and preparatory programmes, more effectively towards underrepresented applicants; and designing systems that provide actionable recourse mechanisms, offering candidates guidance on improving eligibility rather than only binary outcomes.

Figure 2 suggests that the respondents mainly associate opportunity-expanding AI with *support*, *human potential*, and *resources*. It also focuses on *expansion*, *potential*, *training*, *pathways* and *chances*, pointing to a proactive model of AI that helps disadvantaged groups rather than simply avoiding harm. A second pattern is the presence of words such as *review*, *feedback*, *mentoring*, *scholarships*, *counselling* and *structural*, which indicates that the preferred mechanisms are institutional and supportive

rather than purely technical, and that AI should be embedded within human oversight, targeted assistance, and fair-access pathways. AI is perceived as a tool for widening opportunity through adjustment, monitoring and inclusive resource allocation, rather than as a neutral selector.

Figure 2. Word cloud for responses to Q2



Source: Authors' own elaboration.

The experts emphasised that continuous testing, monitoring and adjustment of algorithms is necessary, and that human supervision and institutional oversight must remain central to AI-supported decision processes. Fairness should be understood not only as neutrality or bias avoidance, but also as the active widening of access to opportunity.

4.3. Digital capital and the risk of new stratification

There is broad expert agreement that AI risks reinforcing inequalities linked to digital capital, referring to the skills, access and familiarity with digital tools that increasingly determine effective participation in AI-mediated environments. Those already possessing high digital capital are better positioned to optimise their visibility within algorithmic systems, for example through digital self-presentation and strategic credential signalling.

Preventing a tech-based stratification system requires active institutional and governmental intervention. Recommended measures include redistributive public investment in digital infrastructure and education, expansion of digital literacy across all fields of study, lifelong learning initiatives targeting older workers and non-technical professions, and regulatory tools such as bias testing and mandatory evaluation of high-risk systems including admissions and hiring algorithms.

Figure 3. Word cloud for responses to Q3



Source: Authors' own elaboration.

Figure 3 demonstrates that *participation* and *inclusion* are the most prominent terms, suggesting that the discussion focuses on access and involvement in digital systems. Other visible words, such as *digital*, *adoption*, *capital*, *infrastructure*, *policy*, *access*, *skills*, and *bias*, indicate that the results emphasise structural conditions shaping who can benefit from technology. A pattern emerges around inequality--related mechanisms. Terms such as *education*, *training*, *intervention*, *redistribution*, *government*, and *universities* point to the importance of public action, capacity-building, and institutional support in reducing disparities. The presence of *bias*, *disparities*, *unemployed*, and *workers* suggests that the figure (Figure 3) reflects concerns about exclusion on labour market, and unequal access to the benefits of digital transformation. Overall, the visualisation presents digital inequality and opportunity gaps, demonstrating that inclusion depends on policy, infrastructure, skills, and targeted support, implying that reducing unfairness requires more than access to technology alone; it also requires investment, regulation, and the redistribution of resources.

Experts noted that achieving full equality of digital capability across EU member states is unrealistic as a short-term objective; targeted support and inclusive system design are therefore more practical than uniform implementation standards.

4.4. The European context: unique factors and regulatory opportunities

A recurring finding is that ensuring equitable AI-driven mobility across the EU requires governance frameworks sensitive to specifically European conditions. Key factors identified include:

- Strong cross-country heterogeneity in wealth, digital infrastructure, and education systems, particularly between Northern/Western and Southern/Eastern EU member states, which renders one-size-fits-all AI fairness approaches unsuitable.
- The EU's multilingual environment, which creates distinct risks of linguistic bias in AI systems predominantly trained on English-language or dominant-country datasets.
- The prevalence of small and medium-sized enterprises (SMEs) in European economies, which face structural disadvantages in AI adoption compared to large corporations.
- Europe's welfare-state traditions and strong public-sector role in education, which create institutional opportunities for accountable, socially-oriented AI governance.
- The EU regulatory framework, including GDPR, the AI Act, and anti-discrimination directives, which provides important safeguards while also constraining data availability for AI training.

Figure 4 highlights *diversity* and *Europe* as the dominant concepts, showing that the discussion is centred on how fair AI mobility depends on variation across European contexts. The largest supporting terms – *multilingual*, *welfare*, *systems*, *education* and *disparities* – suggest that the main issue is not just technology, but the institutional and social environment in which AI is adopted. The strongest theme is heterogeneity across Europe. Words such as regional, east, west, north and south demonstrate that geographical differences do matter, especially in infrastructure, regulation, and access to opportunity, which indicates that fairness in AI mobility cannot be treated as a single uniform policy problem; it must be adapted to different national and regional realities. A second major theme is the role of public governance. Terms such as *welfare*, *regulation*, *law*, *governance*, *legislation*, *accountability*, *GDPR*, and *public* point to the importance of legal and institutional frameworks in shaping equitable

AI use. The Figure suggests that fairness depends heavily on whether governments and institutions create rules that protect participation, inclusion and non-discrimination. A third theme relates to educational and labour-market inclusion.

Figure 4. Word cloud for responses to Q4



Source: Authors' own elaboration.

The experts noted that differences between EU countries often operate at the national and institutional level rather than primarily at the individual diversity level, in contrast to the U.S. context. Harmonising AI regulation across member states remains institutionally complex, with regulatory development consistently lagging behind technological change.

4.5. Institutional adoption as the primary barrier

The research consistently identifies institutional adoption as the central obstacle to realising mobility-oriented AI systems, rather than technical feasibility. The core barriers are institutional legitimacy, accountability concerns, and reputational risk management. Key challenges include tension between social mobility goals and traditional definitions of merit, efficiency and predictive performance in admissions and hiring. It is also important to recognise organisational resistance among staff and decision-makers, particularly in rule-based public-sector environments where deviations from established procedures carry risk.

Figure 5. Word cloud for responses to Q5



Source: Authors' own elaboration.

Figure 5 demonstrates that the strongest theme is institutional and social adoption rather than technical capability alone. The most frequently used words are *institutional*, *social*, *mobility*, *efficiency*, and *accountability,* which suggests that the main challenge is how organisations decide whether AI systems can be legitimised, governed and trusted. A major cluster centres on governance and legitimacy, with terms such as *governance*, *legitimacy*, *risk*, *oversight*, *standards*, *rule*, *law*, *GDPR*, and *fairness* demonstrating that institutional adoption depends heavily on legal compliance and public trust. This indicates that AI systems are not adopted merely because they are useful, but they are adopted when they appear responsible, lawful and defensible. Another clear theme is performance versus social purpose. Words such as *performance*, *efficiency*, *productivity*, *selection*, *predictive*, and *metrics* point to traditional institutional goals, while *social*, *mobility*, *inclusion*, and *fairness* reflect broader public-value objectives. The Figure highlights a tension between short-term measurable outputs and long-term social outcomes.

The experts also highlight the absence of governance structures that legitimise mobility-oriented selection objectives, making implementation difficult even if technically feasible. This is related to legal uncertainty regarding whether mobility-oriented algorithmic adjustments are permissible under EU anti-discrimination law and the AI Act. GDPR-related constraints on access to socioeconomic background data necessary for mobility-sensitive system design are also raised here, as well as

the misalignment between existing institutional performance metrics, which reward short-term outputs, and the long-term social impact orientation required for mobility-driven evaluation. This leads to the conclusion that cross-country differences within Europe mean that mobility-oriented AI systems would need locally adapted legitimacy frameworks rather than uniform implementation models.

4.6. Overall assessment: threats and opportunities

The expert respondents broadly view AI as presenting both opportunities and threats for social mobility fairness in EU universities, with many emphasising that the opportunities may outweigh the risks if governance is strong. On the opportunity side:

- AI can help identify talent beyond traditional credentials, potentially enhancing access for disadvantaged students.
- Properly designed systems may reduce some forms of human bias in admissions decisions.
- AI can support more transparent evaluation processes, especially when combined with human oversight.
- Personalised AI-supported learning may improve outcomes for underrepresented student groups.

On the risk side:

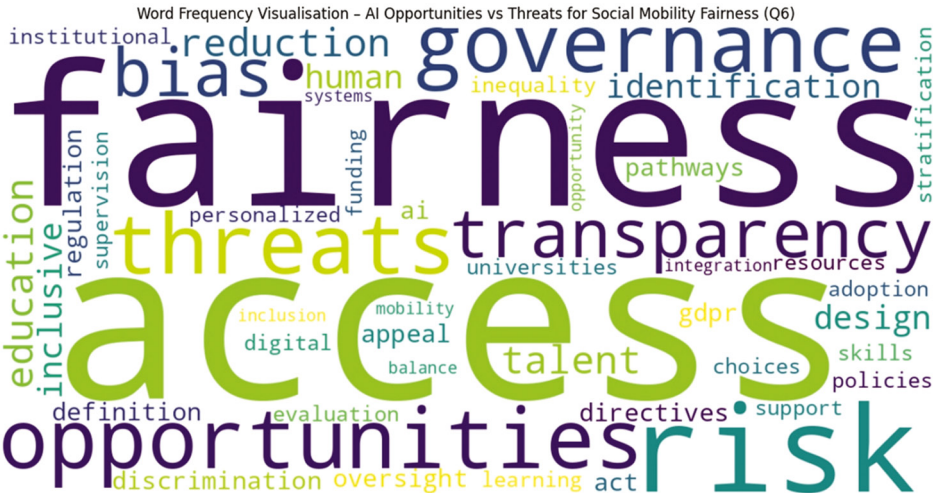
- Systems trained on historically biased data risk reproducing and amplifying existing inequalities.
- Unequal institutional resources across universities may produce uneven access to AI-supported systems.
- Without investment and training, AI adoption may increase inequalities between universities and student groups.
- AI may accelerate social mobility or reinforce digital stratification, depending entirely on implementation.

In Figure 6, positive terms such as *access*, *opportunities*, *talent* and *inclusion* are displayed together with negative terms such as *risk*, *bias*, *inequality* and *discrimination*. This points to the existence of a tension between AI as an enabler and AI as a reproducer of social disadvantage. The presence of *education*, *learning*, *skills* and *universities* points to education as a key pathway through which AI may either widen or reduce social mobility gaps.

Since this is a word cloud, the larger words relate to a higher frequency of responses, but the display does not show exact counts or statistical significance.

The presence of human-in-the-loop decision-making and appeal mechanisms is seen as essential for trust. The long-term impact depends primarily on institutional governance choices rather than the technology itself.

Figure 6. Word cloud for responses to Q6



Source: Authors' own elaboration.

5. Discussion

Across the expert synthesis, AI emerges not as a neutral selection tool but as a governance-dependent mechanism that can either reinforce cumulative inequality or expand social mobility in European higher education. The decisive factors are institutional adoption, regulatory context, and inclusive implementation, rather than the technology itself.

The findings reveal a paradox, as the same algorithmic systems with the greatest potential to identify underrepresented talent and expand opportunity are also those most likely, without deliberate intervention, to replicate and amplify existing structural inequalities. Resolving this paradox requires simultaneous attention to data governance, institutional incentive structures, regulatory design, and the active inclusion of marginalised communities in system development. The European context offers both unique opportunities and unique constraints, with the EU's regulatory infrastructure, particularly the AI Act's provisions on high-risk systems, creating a foundation for legally enforceable fairness standards. At the

same time, the heterogeneity of European societies, economies and educational traditions means that effective AI governance must operate through flexible, context-sensitive frameworks rather than uniform standards derived from non-European contexts.

The transition from gatekeeper to gateway logic ultimately requires more than merely technical adjustments; it demands fundamental shifts in how institutions define merit, design opportunity pathways, and allocate resources to inclusive digital infrastructure and regulation.

6. Conclusions and further research

6.1. Conclusions

This paper contributes to the emerging literature on algorithmic fairness and social mobility by providing a multi-institutional, European-focused analysis of how AI systems in higher education operate as mechanisms of inclusion or exclusion. Its principal finding is that early algorithmic exclusion in admissions can generate cumulative disadvantages over the life course through institutional, reputational, network, and psychological effects. In this sense, a single automated decision may function as an initial filter that shapes later access to better education, professional networks, internships, and employment opportunities. The analysis therefore demonstrates how algorithmic selection can become part of a broader process of stratification over time. A key implication of the Delphi-based research is that the reform requires more than passive bias reduction. Rather than merely preventing harm, institutions should pursue proactive opportunity expansion through evaluation, alternative admission pathways, structured human review, and stronger accountability mechanisms. Such an approach recognises that traditional merit indicators often reflect earlier inequalities and may fail to identify talent that falls outside conventional profiles. Human involvement remains essential here, not as a symbolic safeguard but as a means of contextual judgment, procedural fairness, and meaningful recourse.

The study also highlights that without targeted intervention, AI risks creating a new layer of digital capital-based inequality that limits access to education and employment. Individuals and institutions with greater digital literacy, access to resources, and familiarity with algorithmic environments should benefit from AI-driven systems. This can widen gaps not only between students, but also between

universities, regions and social groups, with digital capital becoming an additional axis of inequality rather than a neutral condition of participation.

The European regulatory framework offers important protections, particularly through data protection, anti-discrimination, and AI governance instruments. However, the findings suggest that these protections are not sufficient on their own, because AI adoption develops within highly unequal institutional and socioeconomic contexts across the EU. Differences in infrastructure, language, administrative capacity, HEIs and higher education systems point to the need for governance, where one-size-fits-all models are unlikely to work across such diverse settings.

The primary barrier to sustainable AI adoption is institutional rather than technical. Tensions around definitions of merit, legal uncertainty, accountability concerns, and limited resources often make organisations reluctant to adopt systems designed to prioritise social mobility. The evidence suggests that outcomes depend less on the technology itself than on sustainable governance, regulatory design, institutional incentives and inclusive implementation strategies. In other words, the same AI system can either reinforce inequality or widen opportunity depending on how it is designed, overseen and applied in institutional practice.

AI is therefore no longer perceived as neutral infrastructure. As this study shows, algorithmic systems increasingly function as gatekeeping mechanisms in European higher education, shaping who gains access to opportunity and who does not. Whether AI becomes a tool for widening participation or a mechanism for stabilising existing inequality will depend not on technological progress alone, but also on the governance choices, institutional commitments, and regulatory frameworks that European societies adopt in the years ahead.

6.2. Future research questions

Three main research questions emerge from this study:

1. How do AI-supported selection systems in education and employment shape long-term social mobility pathways across European societies? This addresses the shift from single-decision fairness to life-course mobility effects, which remains largely unexplored.
2. How can AI systems be redesigned to actively expand opportunity rather than reproduce inequalities linked to digital capital and institutional reputation? This moves the debate beyond bias detection toward proactive mobility-oriented algorithmic design.

3. Which European institutional, regulatory and educational differences most strongly influence whether AI becomes a mobility accelerator or a mechanism of digital stratification? This recognises that Europe cannot rely on U.S.-centred fairness models.

6.3. Future research goals

Building on the above questions, the AI Pathways Lab identifies the following empirical research priorities. The first is to develop and empirically test a life course model of algorithmic selection effects on social mobility in Europe. This would move the focus beyond single decision bias analysis towards understanding how sequential AI-supported decisions across admissions, learning pathways, internships, and hiring interact to produce cumulative advantage or disadvantage. The second priority is to operationalise social mobility fairness as a measurable analytical framework for evaluation of AI-supported admissions and hiring systems, including identifying indicators, proxy variables and evaluation metrics that allow researchers to assess whether algorithmic systems expand or restrict access to education, networks and career pathways across different social groups.

References

Agi, A., Feng Cheng EN's Lab (2026). *Institutional Transformation: Policy, Ethics, and Governance in AI-Led Universities*. DOI: 10.13140/RG.2.2.17699.52007.

Allison, P.D., Long, J.S., Krauze, T.K. (1982). Cumulative Advantage and Inequality in Science, American Sociological Review, (47)(5), pp. 615–625. DOI: 10.2307/2095162.

Buolamwini, J., Gebru, T. (2018). Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification, *Proceedings of Machine Learning Research*, 81, pp. 77–91.

Danks, D., London, A.J. (2017). Algorithmic Bias in Autonomous Systems, *Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI-17)*, pp. 4691–4697.

de Villiers, M.R., de Villiers, P.J., Kent, A.P. (2005). The Delphi Technique in Health Sciences Education Research, *Medical Teacher*, 27(7), pp. 639–643. DOI: 10.1080/13611260500069947.

Erzikova, E. (2018). Gatekeeping. In: *The International Encyclopedia of Strategic Communication*, R.L. Heath, W. Johansen (Eds.). Malden: John Wiley & Sons. DOI: 10.1002/9781119010722.iesc0080.

European Commission (2021). *2030 Digital Compass: The European Way for the Digital Decade* (COM/2021/118 final). Brussels: European Commission.

European Union (2024). Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 Laying Down Harmonised Rules on Artificial Intelligence and Amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act), *Official Journal of the European Union*.

Fricker, M. (2007). *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford: Oxford University Press.

Gulyamov, S.S., Rustambekov, I.R. (2026). Ethical Aspects of AI Regulation for Higher Education, *Legal Issues in the Digital Age*, 7(1), pp. 49–70. DOI: 10.17323/2713-2749.2026.1.49.70.

Haslanger, S. (2022). Systemic and Structural Injustice: Is There a Difference?, *Philosophy*, 98(1), pp. 1–27. DOI: 10.1017/S0031819122000353.

Hsu, C.-C., Sandford, B.A. (2007). The Delphi Technique: Making Sense of Consensus, *Practical Assessment, Research, and Evaluation*, 12(10), pp. 1–8. DOI: 10.7275/pdz9-th90.

Jasso, G. (2023). How Much Injustice is There in the World? Two New Justice Indexes, *American Sociological Review*, (64)(1), pp. 133–168. DOI: 10.1177/000312249906400110.

Kordzadeh, N., Ghasemaghaei, M. (2022). Algorithmic Bias: Review, Synthesis, and Future Research Directions, *European Journal of Information Systems*, 31(3), pp. 388–409.

Marjanovic, O., Cecez-Kecmanovic, D., Vidgen, R. (2022). Theorising Algorithmic Justice, *European Journal of Information Systems*, 31(3), pp. 269–287. DOI: 10.1080/0960085X.2021.1934130.

McInerney, T. (2025). The Algorithmic Construction of Epistemic Injustice. In: *Socio-Legal Studies on Epistemic Injustice and Spaces and Places. Palgrave Socio-Legal Studies* (pp. 123–154), M.L. Flear, C. Davies-Tyrie, D. Wincott (Eds.). Cham: Palgrave Macmillan. DOI: 10.1007/978-3-032-07581-9_5.

McKeown, M. (2021). Structural Injustice, *Philosophy Compass*, 16(7). DOI: 10.1111/phc3.12757.

Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., Galstyan, A. (2021). A Survey on Bias and Fairness in Machine Learning, *ACM Computing Surveys*, 54(6), pp. 1–35.

Milano, S., Prunkl, C. (2025). Algorithmic Profiling as a Source of Hermeneutical Injustice, *Philosophical Studies*, 182, pp. 185–203. DOI: 10.1007/s11098-023-02095-2.

Miller, J., Koerin, B.B. (2002). Gatekeeping in the Practicum, *The Clinical Supervisor*, 20(2), pp. 1–18, DOI: 10.1300/J001v20n02_01.

Miragoli, M. (2025). Conformism, Ignorance & Injustice: AI as a Tool of Epistemic Oppression, *Episteme*, 22(2), pp. 522–540. DOI: 10.1017/epi.2024.11.

Mittelstadt, B.D., Allo, P., Taddeo, M., Wachter, S., Floridi, L. (2016). The Ethics of Algorithms: Mapping the Debate, *Big Data & Society*, 3(2), pp. 1–21. DOI: 10.1177/2053951716679679.

Nahon, K. (2008). Toward a Theory of Network Gatekeeping: A Framework for Exploring Information Control, *Journal of the American Society for Information Science and Technology*, 59(9), pp. 1493–1512. DOI: 10.1002/asi.20857.

Okoli, C., Pawlowski, S.D. (2004). The Delphi Method as a Research Tool: an Example, Design Considerations and Applications, *Information & Management*, (42)(1), pp. 15–29. DOI: 10.1016/j.im.2003.11.002.

Sawale, P.S. (2026). Bias in AI Algorithms and Social Equity, *Scriptora International Journal of Research and Innovation*, 2, pp. 84–90. DOI: 10.65579/sijri.2026.v2si1.10.

Skulmoski, G.J., Hartman, F.T., Krahn, J. (2007). The Delphi Method for Graduate Research, *Journal of Information Technology Education*, 6, pp. 1–21. DOI: 10.28945/199.

Sweeney, L. (2013). Discrimination in Online Ad Delivery, *Communications of the ACM*, 56(5), pp. 44–54.

Tanriverdi, H., Akinyemi, J.-P.O. (2025). Algorithmic Social Injustices: Antecedents and Mitigations, *MIS Quarterly*, 49(4), pp. 1417–1448. DOI: 10.25300/MISQ/2025/18314.

Wendehorst, Ch. (2022). Bias in Algorithms – Artificial Intelligence and Discrimination. Luxembourg: Publications Office of the European Union.

4

Kamil Harla[1]
Marta Ekner[2]

Managing Investments in Dual-Use Technologies as a Driver of the Economic Development and Defence Capabilities

Abstract

This paper addresses the issue of the effectiveness of allocating innovation resources in the field of dual-use technologies across nine Central and Eastern European countries and three reference economies (Sweden, Finland and Turkey) between 2015 and 2025. The aim of the study is to identify and quantify the innovation potential of these technologies and assess the adequacy of existing institutional mechanisms for mobilising this potential in the context of building a regional security architecture. The study employs a three-tier empirical methodology: semantic analysis of patent applications from the EPO and USPTO databases using the IPC/CPC classification, analysis of macroeconomic fiscal indicators, and a comparative analysis of the institutional ecosystem supporting dual-use innovation at the alliance, EU and national levels. The results point to profound heterogeneity within the region, both in terms of patent activity and fiscal indicators. On this basis, the article refutes the dichotomy between full technological sovereignty and the acceptance of import dependency as analytically inadequate for the countries of the region, proposing instead the concept of selective technological autonomy realised through an ecosystem of cross-border competence hubs based on the principle of complementary specialisation. The article formulates recommendations addressed to innovation funding bodies, policy-makers, and the management boards of technology companies, derived directly from the empirical findings.

1 SGH Warsaw School of Economics (Poland), e-mail: kh125008@doktorant.sgh.waw.pl.
2 SGH Warsaw School of Economics (Poland), e-mail: me109496@doktorant.sgh.waw.pl.

1. The evolution of innovation theory in the defence sector

Contemporary innovation theory is undergoing a fundamental reorientation, moving away from a linear model of technological development towards dynamic, networked ecosystems in which the boundaries between the civilian and military sectors are becoming increasingly blurred. Traditionally, the dominant paradigm was the *spin-off* mechanism, whereby innovations generated in closed defence laboratories, funded by massive state budgets, trickled down into the civilian economy [Bromley, Maletta, 2025]. Examples such as GPS technology, internet protocols, and advanced jet engines formed the foundation of this theory, pointing to the military as the primary incubator of breakthrough solutions. However, in the face of the exponential pace of innovation in commercial sectors – particularly in the fields of artificial intelligence, software and microelectronics – this paradigm has been replaced by the spin-in mechanism [Acosta, Coronado, Ferrándiz, Marín, Moreno, 2020].

The spin-in mechanism refers to the process by which technological expertise and off-the-shelf commercial solutions (COTS) are integrated into defence systems, a shift stemming from the fact that global civilian R&D budgets far exceed spending on military innovation, making the commercial market the primary source of technological progress [Mazzucato, 2011]. The scientific literature indicates that the effectiveness of the spin-in mechanism is directly correlated with a company's military technological capability, i.e. its ability to adapt civilian knowledge to the specific requirements of the battlefield, such as resistance to interference, environmental durability or interoperability [Winterberg, 2025]. In Central and Eastern European countries, where the technology sector relies heavily on dynamic start-ups and SMEs, understanding this mechanism is key to building technological sovereignty.

The concept of the *entrepreneurial state* developed by Mariana Mazzucato can help to shed further light on the role of the public sector in the process of dual-use innovation. This concept posits that the role of public funding is not merely to correct market imperfections, but also to actively shape and create markets whilst taking on investment risks that are unattainable for the private sector [Freeman, McVea, 2001]. In the context of the CEE region, this concept takes on particular significance – programmes such as NATO DIANA or the European Defence Fund can be seen as fulfilling the role of an *entrepreneurial state* at the supranational level, de-risking innovations that the private sector might consider too uncertain.

An analysis of knowledge diffusion processes shows that although spin-offs generate a greater number of patent citations in quantitative terms, spin-ins offer greater strategic effectiveness [Mitchell, Agle, Wood, 1997]. This is because it allows

defence ministries to utilise the huge capital expenditure incurred by the private sector without having to bear the full technological risk in the early stages of development. Contemporary governments, including those of CEE countries, are increasingly promoting a *dual-use by design* approach, encouraging research institutes to design solutions that can serve both spheres from the outset [European Commission, 2025]. This approach minimises the costs of reconfiguring systems and accelerates their deployment, which, in an era of high-intensity conflicts such as the war in Ukraine, is of critical importance to national security.

Table 1. The evolution of innovation models in the dual-use technology sector

Innovation Model	Transfer Direction	Main Source of Funding	Key Characteristics	Example of Technology
Spin-off	Military to Civilian	Government budget (Defence	The transfer of military technologies to the civilian sector.	GPS, the Internet, Teflon
Spin-in	Civil to Military	Private equity (VC/PE)	Adaptation of commercial solutions for defence purposes.	AI, cloud computing
Dual-use by Design	Symbiotic	Hybrid (Public-Private)	Designing technology for both markets simultaneously.	Drones, cybersecurity, SMR
Two-Way Diffusion	Two-way	Network Systems	Constant exchange of knowledge between the civil and military sectors.	Advanced materials, 3D printing

Source: Bromley, Maletta [2025]; Acosta et al. [2020].

2. Shareholder theory, ESG and the Security Multiplier

In the traditional view of shareholder theory, the priority for boards of directors is to maximise value for owners by generating financial returns. For decades, the defence sector was viewed by a significant proportion of institutional investors as an area of high reputational risk, often excluded from portfolios due to restrictive ESG criteria [Chivvis, Joulwan, Gnehm, Hunter, Rand Corporation, 2008]. However, the drastic change in the geopolitical landscape after 2022 has forced a redefinition of these concepts. Currently, financial literature and strategic reports increasingly put forward the argument that national security is a public good, forming the foundation of economic stability and the ability to achieve any sustainable development goals [Balnord, 2025].

An alternative theory – stakeholder theory – was proposed by R.E. Freeman. It posits that a company should create value for all groups that influence its operations

or are affected by them – employees, customers, suppliers, local communities, as well as the state and society as a whole [Hill, Mancisidor, 2026]. Freeman's theory was expanded upon by Mitchell, Agle and Wood, who proposed a model for identifying and prioritising stakeholders based on three attributes: power, legitimacy and urgency. The more attributes a given stakeholder possesses, the higher their priority in the management process [NATO, 2025]. Applying this model to the dual-use technology ecosystem allows for the systematic classification of participants – from the state and the military (definitive stakeholders, possessing all three attributes) through industry and universities (dominant and dependent stakeholders) to VC investors, who, in the traditional sense, act as prospective stakeholders.

The shift in the geopolitical landscape after 2022 has necessitated a redefinition of the relationship between shareholder theory and stakeholder theory in the defence sector. As the European Commission points out in its White Paper for European Defence – Readiness 2030, Europe needs a "stronger and more resilient defence industrial base" and a "technological innovation ecosystem for the defence industry". In this context, the Commission identifies ESG barriers to access finance as an obstacle requiring removal, and also announces that it will clarify the relationship between the defence sector and the investment objectives of the sustainable finance framework as part of the SFDR review. Investments in defence are therefore no longer viewed solely as a "reputational risk"; rather, a substantial increase in defence spending could lead to a "quantum leap in European resilience," generating positive multiplier effects in terms of competitiveness, job creation and innovation across many sectors of the economy [Etzkowitz, Leydesdorff, 2000].

The *Security Multiplier* is becoming a key concept for quantifying the return on investment in defence and dual-use technologies. It is not defined solely as a simple fiscal (demand-side) multiplier, but as a synergistic effect resulting from the integration of military capabilities, infrastructure stability, and technological sovereignty [Audretsch, Belitski, 2023]. From a shareholder's perspective, investing in a company in the dual-use sector offers a unique risk-return profile: access to stable, long-term government contracts that serve as an anchor customer, thereby reducing the risks associated with the development of breakthrough technologies, whilst retaining the potential for exponential growth in the commercial market [Boschma, 2005].

The evolution of ESG criteria in the defence sector is moving towards *Materiality Assessment* – an assessment that takes into account supply chain resilience, the cybersecurity of critical infrastructure, and the ethical use of autonomy [Teece, Pisano, Shuen, 1990]. Investors such as venture capital funds in the CEE region (e.g. Expeditions and PFR Ventures) are beginning to treat dual-use technologies as a separate,

attractive asset class, which attracted record amounts of funding in Europe in 2024 [Boschma, Frenken, 2011]. Here, shareholder value is created through a *technology premium* – dual-use start-ups raise, on average, higher funding rounds than their purely commercial peers, as their products are tested under the most demanding operational conditions, which serves as the ultimate confirmation of quality [Acosta et al., 2020].

A contemporary financial analysis of the sector indicates that countries with strong regulatory oversight and a clear defence innovation strategy (such as NATO member states) offer a safer investment environment, minimising risks associated with human rights compliance and technological abuse [Bromley, Maletta, 2025]. Initiatives such as the NATO Innovation Fund (NIF) and the DIANA programme provide an institutional guarantee for private capital, confirming that, in the long term, innovation in the security sector is not only necessary but also economically viable [Dunne, Tian, 2013].

3. A comparative analysis of the region

The analysis to date has shown that the dual-use technology ecosystem in the CEE region operates within a complex network of stakeholders. However, in order to move from a qualitative analysis to a quantitative assessment of the region's innovation potential, it is essential to use standardised indicators of R&D expenditure, which allow for a comparison of the innovation intensity of individual countries, the identification of leaders and development gaps, and an assessment of the degree of private sector involvement in R&D funding, which, from an investor's perspective, is a key indicator of the ecosystem's maturity. The quantitative analysis encompasses nine Central and Eastern European countries (Poland, the Czech Republic, Hungary, Romania, Slovakia, Lithuania, Bulgaria, Estonia and Latvia) and additionally includes three reference economies: Sweden and Finland as mature Nordic innovation systems providing an upper benchmark for the region, and Turkey as a non-EU NATO member state with a rapidly expanding but structurally distinct R&D base. This broader comparative framework allows for a more robust assessment of the CEE countries' relative position on the innovation convergence path. The BERD and GERD indicators were used for the quantitative analysis. The GERD (Gross Domestic Expenditure on Research and Development) indicator covers total expenditure on research and development across four sectors: business, government, higher education and non-profit organisations. The BERD (Business Enterprise Expenditure

on R&D) indicator, in turn, measures expenditure by the business sector. The data used in this analysis are sourced from the Eurostat database and cover the period 2015–2024 for CEE countries.

The data used in Table 2 are sourced from Eurostat's statistics on expenditure on research and development. The BERD/GERD ratio is defined as the share of business sector expenditure in total national R&D expenditure in 2024. The GERD as a percentage of GDP was estimated indirectly on the basis of BERD as a percentage of GDP and the BERD/GERD ratio. The rate of change between 2015 and 2024 is expressed as the percentage change in the final value relative to the base value. Standard rounding conventions applicable to the presentation of comparative data have been applied. The data highlight fundamental differences in innovation potential both within the CEE region and in relation to the reference economies.

In terms of GERD intensity (expressed as a percentage of GDP), Sweden (3.56%) and Finland (3.23%) clearly lead the way, significantly exceeding the EU-27 benchmark. The other countries in the region, including the Czech Republic (1.82%) and Poland (1.41%), show intensity below the EU average, whilst Romania (0.45%) and Bulgaria (0.77%) remain well below the 1% threshold. As a non-EU reference economy, Turkey occupies an intermediate position (1.46%), comparable to the CEE leaders in terms of GERD intensity but far below the Nordic benchmark. A key measure of the maturity of the innovation ecosystem remains the ratio of BERD to GERD, indicating the private sector's share of total R&D expenditure. Among the CEE countries, the highest values are recorded by Hungary (0.756). Both Nordic reference economies also exhibit high ratios: Sweden (0.732) and Finland (0.679). This indicates that the business sector accounts for over two-thirds of total expenditure on research and development in these countries. Turkey (0.648) also recorded high values for this indicator, suggesting that despite differences in the overall scale of expenditure, these countries are characterised by a relatively strong position of the business sector within the national innovation system.

An analysis of Table 2 reveals a marked variation in the growth rate of expenditure over the years. Between 2015 and 2024, Poland recorded the highest increase in BERD in the region (+276%), representing an almost fourfold increase in business sector expenditure on R&D. Latvia (+262%) and Estonia (+239%) also show very high growth rates. This growth points to an ongoing process of innovation convergence and a gradual strengthening of the implementation potential of Central and Eastern European countries and their neighbouring regions. Turkey, included in the analysis as a reference economy, similarly exhibits rapid growth (+221%), which places it closer to the CEE convergence trajectory than to the Nordic benchmark.

The Nordic reference economies present a different profile. Sweden, despite a very high baseline level of R&D intensity, recorded the lowest growth in BERD (+43%), which indicates not so much a weakness in its innovation system as its high maturity and limited scope for further growth in relative terms. Finland also represents a model of a technologically mature economy, where the key objective is not rapid growth but the maintenance of a consistently high level of expenditure and a strong role for the business sector within the R&D structure. This contrast between CEE convergence dynamics and Nordic steady-state maturity is precisely what justifies the inclusion of the latter as reference points: they illustrate the innovation profile towards which CEE countries may be converging in the long term.

Table 2. Analysis of BERD and GERD indicators

Country	GERD %PKB	BERD %PKB	BERD/GERD	Δ GERD 2015–2024	Δ BERD 2015–2024
Poland	1.41	0.89	0.633	+177%	+276%
Czech Republic	1.82	1.18	0.647	+80%	+114%
Hungary	1.31	0.99	0.756	+78%	+84%
Romania	0.45	0.29	0.642	+108%	+203%
Slovakia	0.98	0.59	0.600	+38%	+196%
Lithuania	1.06	0.43	0.407	+112%	+215%
Bulgaria	0.77	0.50	0.651	+85%	+64%
Estonia	1.99	1.19	0.597	+161%	+239%
Latvia	0.93	0.34	0.365	+145%	+262%
Finland	3.23	2.19	0.679	+47%	+49%
Sweden	3.56	2.61	0.732	+36%	+43%
Turkey*	1.46	0.95	0.648	+144%	+221%
UE-27	2.24	1.49	0.665	+56%	+60%

* The absence of data for Turkey for 2024 in the Eurostat extracts used has been supplemented with TÜİK data, compiled in accordance with R&D statistical standards, and subsequently converted into euros using the ECB's average annual exchange rate. This adjustment has enabled Turkey to be included in the comparative analysis, whilst acknowledging the limited comparability of the source data.

Source: Authors' own elaboration based on Eurostat data.

4. Analysis of patent data

The empirical basis of the study is a collection of 4,426 patent applications obtained from the Espacenet database compiled by the European Patent Office for nine Central and Eastern European countries (Bulgaria, Czech Republic, Estonia,

Hungary, Latvia, Lithuania, Poland, Romania and Slovakia) and three additional countries included for comparative purposes (Finland, Sweden and Turkey). The dataset comprises applications classified into three main thematic areas corresponding to the technological categories defined within the study: Automation and Robotics, AI and Cybersecurity, and Advanced Materials and Manufacturing. The adopted time horizon (2020–2026) and selection criteria ensure the comparability of data across jurisdictions, eliminating duplicates resulting from parallel patent filings at multiple offices.

Table 3. Number of patent applications in the field of dual-use technology by country and technological subcategory (n = 4,426)

Country	Autonomation and robotics			AI and cybersecurity			Advanced materials and manufacturing			Total
	B64C39	B64U	G05D1	G06N	H04L63	G06F21	B33Y	B22F	C08L	
	Aircraft	Drones (UAVs)	Vehicle control	AI/ML	Cyberattack detection	Cybersecurity	3D print	Metallurgy	Composites	
Bulgaria	0	0	0	5	0	4	3	1	6	19
Czech Republic	27	4	11	6	0	20	71	15	65	219
Estonia	0	0	2	0	0	0	0	0	0	2
Lithuania	7	1	16	12	25	38	14	3	78	194
Poland	47	26	210	154	69	556	261	257	328	1908
Romania	1	0	1	0	0	3	3	4	3	15
Slovakia	0	2	0	2	0	2	5	0	8	19
Hungary	7	2	28	37	3	207	93	60	181	618
Latvia	0	0	0	1	0	0	2	0	0	3
Turkey	5	4	4	92	12	93	8	35	41	294
Sweden	4	5	84	72	0	129	35	42	78	449
Finland	43	14	72	130	4	233	48	51	91	686
Total	141	58	428	511	113	1285	543	468	879	4426

Source: Espacenet.

Each patent document was assigned to one of nine technological subcategories (Table 3), with the classification process carried out in two stages. In the first stage, alignment with the International Patent Classification (IPC/CPC) codes was used, with

each subcategory assigned a dedicated classification prefix: B64C39 and B64U for unmanned platforms, G05D1 for autonomous control systems, G06N for machine learning algorithms, H04L63 for network threat detection protocols, G06F21 for digital security mechanisms, B33Y for additive manufacturing technologies, B22F for powder metallurgy, and C08L for polymeric and composite materials. Subsequently, by analysing the application descriptions and the additional patent codes contained therein, the documents were grouped according to their application: civil, military, and dual-use. Only patents classified as dual-use were retained in the study.

The classification results were aggregated at the country and technology subcategory levels, forming a 12 × 9 matrix supplemented with row and column totals (Table 3). This structure allows for the simultaneous analysis of two dimensions: the geographical concentration of patent activity (with Poland dominating with 1,908 applications, accounting for 43.1% of the total) and the technological specialisation of individual countries. Poland exhibits a broad portfolio covering all subcategories, which corresponds to the national programme for the modernisation of the armed forces and the development of the automotive sector. Finland, the leading reference economy in patent terms (686 applications), is characterised by a clear overrepresentation in the AI/ML (130) and Security (233) subcategories relative to its size, which confirms the thesis regarding the complementarity of the technological advantages of the region's countries. At the opposite end of the spectrum, Estonia (2 applications) and Latvia (3 applications) show marginal dual-use patent activity for domestic companies and institutes in the categories examined, despite their recognised standing in the field of digital public administration. This discrepancy provides a significant signal for recommendations regarding the establishment of regional competence hubs.

5. Analysis of macroeconomic fiscal indicators

The patent analysis is complemented by an examination of the allocation of fiscal resources across two strategic categories of public and private expenditure: defence spending, and research and development (R&D) expenditure. The data cover the nine CEE countries and three reference economies (Sweden, Finland and Turkey) for the period 2015–2025, with figures for 2024–2025 shown as estimates derived from budget projections submitted by member states' governments to NATO and from Eurostat's forecasting models. The indicators are given as a percentage of gross domestic product (% of GDP), which ensures comparability between economies of significantly

different sizes – from Sweden, the largest reference economy (GDP ~$ 600 billion), to Latvia (~$ 45 billion), the smallest CEE economy in the sample.

Data on defence expenditure were obtained from three sources: official NATO reports (Defence Expenditure of NATO Countries 2014-2025), the SIPRI Military Expenditure Database (2025 edition) – which is particularly useful for Turkey and Sweden for the period prior to their accession to the Alliance – and European Parliament analyses of EU member states' defence budgets. Data on R&D expenditure are based on Eurostat statistics (GERD – Gross Expenditure on Research and Development), supplemented by World Bank data enabling the analysis of long-term trends and estimates from the WIPO Global Innovation Index 2025 for the current year.

The main analytical measure adopted in this study is the dual fiscal intensity index (DFI), developed specifically for this research, the methodological rationale for which is based on existing indices used in the literature on defence economics. In studies on military expenditure, an established practice is to express it as a percentage of GDP (military burden), which allows for comparisons between economies of different absolute sizes. An analysis of nearly 170 empirical studies consistently uses the indicator *military expenditure as a percentage of GDP* as the primary unit of comparative analysis, whilst noting that interpreting its value in isolation from the structure of other public expenditure is methodologically incomplete [Dunne, Tian, 2013]. The authors also applied this in their own study in a panel analysis of 106 countries, where the military burden is a key explanatory variable in economic growth models [Dunne, Tian, 2015]. The same logic justifies the use of the same unit for the denominator of the indicator: R&D expenditure expressed as a percentage of GDP.

In their critical analysis of growth models that include military expenditure, they demonstrate that the main channel through which defence spending affects the economy is its impact on investment: an increase in defence spending financed from the public budget crowds out productive private and public investment, including expenditure on research and development [Dunne, Smith, Willenbockel, 2005]. The authors highlight that models which ignore this substitution effect lead to erroneous conclusions regarding the neutrality or positive impact of military expenditure on growth. The ratio form of the indicator is a direct operationalisation of this logic: combining both expenditure streams into a single indicator allows for capturing the extent to which fiscal expansion on the defence side comes at the expense of the technological base, as measured by R&D expenditure. On this basis, the DFI is defined as:

$$DFI = \text{Defence expenditure (\% of GDP)} / \text{R\&D expenditure (\% of GDP)}$$

A value of one for the indicator signifies symmetry between the two expenditure streams. Values above one indicate that defence expenditure is overrepresented relative to the technological base, which, in light of findings regarding the negative impact of a high military burden on growth, points to a structural risk to long-term innovation [Dunne, Tian, 2015]. Values below one describe the opposite situation, potentially favouring the spin-in mechanism.

On this basis, three model strategic profiles of the examined countries have been identified. The military-dependent profile (DFI > 2.5) characterises countries in which dynamic growth in defence spending is not offset by a proportional increase in R&D expenditure – which, in accordance with the crowding-out mechanism, structurally limits the capacity for endogenous production of defence technologies [Dunne et al., 2005]. The innovation-balanced profile (DFI in the range 0.8–2.5) corresponds to a configuration in which defence capabilities are developed whilst maintaining significant R&D expenditure. Importantly, this profile is represented primarily by the two Nordic reference economies: Sweden and Finland, rather than by CEE countries, which underscores the structural nature of the gap between the two groups and reinforces the analytical rationale for their separate classification. Turkey, despite being a reference economy, exhibits a DFI trajectory closer to the upper CEE range, confirming its intermediate position. A civilian-dominated profile (DFI < 0.8) indicates the potential for converting civilian technologies for defence applications through the spin-in mechanism. The thresholds of the index (0.8 and 2.5) are heuristic in nature and were determined empirically based on the distribution of values in the sample of twelve countries studied, rather than derived from a theoretical model, which constitutes a limitation requiring verification on a broader sample in subsequent studies.

The data presented in Table 4 reveal significant fiscal heterogeneity among countries, which directly translates into varying potential for building technological resilience.

Poland is a case of extreme military dependence: defence spending rose from 2.1% of GDP in 2015 to an estimated 4.7% in 2025 – an unprecedented figure within the North Atlantic Alliance – whilst R&D expenditure remains at 1.4–1.5% of GDP, implying a WDIF of 3.1. This disparity signals a structural risk: the dynamic growth of the defence budget primarily finances the procurement of foreign equipment, without proportionally translating into an increase in domestic innovation potential. In the context of research into dual-use technologies, this constitutes an investment gap requiring systemic intervention.

Table 4. Macroeconomic Indicators for Defence and R&D Expenditure (Forecasts and Historical Data)

Defence and innovation expenditure in the CEE countries and reference economies (% of GDP, 2025-2025), * estimates												
Country	Indicator	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024*	2025*
Poland	Defence	2.1	2.0	1.9	2.0	2.0	2.2	2.2	2.4	3.9	4.1	4.7
	Innovations R&D	1.0	1.0	1.0	1.2	1.3	1.4	1.4	1.5	1.5	1.4	1.5
Estonia	Defence	2.0	2.1	2.0	2.0	2.1	2.3	2.2	2.1	2.7	3.4	3.7
	Innovations R&D	1.5	1.3	1.3	1.4	1.6	1.8	1.8	1.8	1.9	2.0	2.1
Lithuania	Defence	1.1	1.5	1.7	2.0	2.0	2.1	2.0	2.5	2.7	2.8	3.2
	Innovations R&D	1.0	0.9	0.9	0.9	1.0	1.1	1.1	1.0	1.0	1.0	1.1
Latvia	Defence	1.1	1.5	1.8	2.0	2.0	2.3	2.1	2.1	2.3	3.1	3.2
	Innovations R&D	0.6	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0
Czech Republic	Defence	1.0	1.0	1.0	1.1	1.2	1.3	1.3	1.3	1.5	2.0	2.1
	Innovations R&D	1.9	1.7	1.8	1.9	1.9	2.0	2.0	2.0	1.9	1.8	1.9
Slovakia	Defence	1.1	1.2	1.1	1.2	1.7	1.8	1.7	1.8	2.0	2.0	2.0
	Innovations R&D	1.2	0.8	0.9	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0
Hungary	Defence	0.9	1.0	1.0	1.1	1.2	1.6	1.6	1.8	2.1	2.1	2.1
	Innovations R&D	1.4	1.2	1.3	1.5	1.5	1.6	1.6	1.4	1.4	1.3	1.3
Romania	Defence	1.4	1.4	1.8	1.8	1.8	2.0	1.9	1.7	1.6	2.3	2.5
	Innovations R&D	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bulgaria	Defence	1.3	1.3	1.2	1.5	3.1	1.6	1.6	1.5	1.8	2.2	2.5
	Innovations R&D	1.0	0.8	0.7	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8
Finland	Defence	1.3	1.3	1.3	1.3	1.3	1.5	2.0	1.7	2.4	2.4	2.9
	Innovations R&D	2.9	2.7	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.2	3.3
Sweden	Defence	1.1	1.0	1.0	1.0	1.1	1.2	1.3	1.3	1.5	2.0	2.2
	Innovations R&D	3.3	3.3	3.4	3.4	3.4	3.5	3.4	3.4	3.6	3.6	3.6
Turkey	Defence	1.6	1.7	1.8	1.9	1.9	1.9	1.6	1.4	1.6	2.1	2.3
	Innovations R&D	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.3	1.4	1.5	1.5

Defence and innovation expenditure in the CEE countries and reference economies (% of GDP, 2025-2025), * estimates												
Country	Indicator	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024*	2025*
Average (all countries)	Defence	1.33	1.42	1.47	1.57	1.78	1.82	1.79	1.8	2.18	2.54	2.78
	Innovations R&D	1.43	1.29	1.33	1.4	1.44	1.53	1.53	1.54	1.58	1.58	1.63
Average (CEE countries)	Defence	1.33	1.44	1.5	1.63	1.9	1.91	1.84	1.91	2.29	2.67	2.89
	Innovations R&D	1.12	0.96	0.99	1.07	1.11	1.21	1.2	1.2	1.21	1.19	1.24
Average (Reference countries)	Defence	1.33	1.33	1.37	1.4	1.43	1.53	1.63	1.47	1.83	2.17	2.47
	Innovations R&D	2.37	2.3	2.37	2.4	2.43	2.5	2.5	2.57	2.7	2.77	2.8

* Estimates for 2024–2025.

Sources: NATO Defence Expenditure Report 2024/25; SIPRI Military Expenditure Database; Eurostat R&D Statistics (GERD); World Bank Open Data; WIPO Global Innovation Index 2025.

The two Nordic reference economies illustrate a fundamentally different fiscal configuration – Sweden and Finland – which follow an innovation-balanced model. Sweden maintains R&D expenditure at 3.4–3.6% of GDP, the highest in the region, whilst defence spending has risen moderately from 1.1% to 2.2% of GDP. Finland, having increased defence spending from 1.3% to 2.9% of GDP following its accession to NATO, is simultaneously systematically expanding its R&D base to 3.3% of GDP. Both countries are thus approaching the European benchmark for an integrated science and defence policy, in which civilian research investment serves as a natural reservoir of dual-use technologies. Their inclusion as reference economies is analytically motivated precisely by this profile: they represent the fiscal trajectory that CEE countries pursuing selective technological autonomy may seek to emulate, whilst illustrating the scale of the gap that currently separates most CEE states from a balanced defence-innovation equilibrium.

Bulgaria presents a particular analytical case, where an anomalous surge in defence spending to 3.1% of GDP in 2019 – unseen in any other year of the decade and not preceded by an increase in R&D expenditure – likely points to a one-off purchase of military equipment rather than a lasting change in the fiscal trajectory. Such data discontinuities pose a significant methodological challenge and justify the need to use data from various sources (NATO, SIPRI, Eurostat).

Estonia and Latvia present complementary patterns: Estonia maintains relatively high defence spending (3.7% of GDP in 2025, placing it second in the region) alongside moderate R&D expenditure (2.1% of GDP), whereas Latvia records low figures

for both indicators, placing it in the category of CEE countries lagging behind on both counts, despite its geographical and institutional proximity to the region's leader in digital transformation.

Three methodological caveats should be noted when interpreting the results. First, the % of GDP indicator does not take into account the absolute size of expenditure – a country with a low GDP and a high percentage may, in nominal terms, spend less than a country with a high GDP and a low percentage. Second, the GERD (gross expenditure on R&D) statistic covers both civil and defence research, which makes it impossible to directly isolate the dual-use component without access to sector-level disaggregated data. Third, the figures for 2024–2025 are estimates and may be revised following the publication of final budget reports.

Despite these limitations, the indicator-based analysis presented here provides a solid empirical basis for the recommendations set out in section 7: in particular, the proposal to make access to the investment pathway conditional upon applicants achieving a minimum threshold of synergy between defence expenditure and R&D expenditure, as measured by the WDIF indicator.

6. Institutional support for dual-use innovation in CEE

The analysis of patent data and fiscal indicators presented in sections 3 and 4 revealed a structural gap between rising defence expenditure and the relatively slow growth in R&D spending in most of the CEE countries studied – a gap that stands in stark contrast to the balanced fiscal profiles of the Nordic reference economies. Closing this gap is not possible through budgetary intervention alone – it requires the development of an institutional ecosystem that reduces the transaction costs of knowledge transfer between the civilian and defence sectors. Such an ecosystem is defined as a network of interdependent entities – government funding agencies, venture capital funds, testing centres and end-users – whose coordinated action generates synergistic effects unavailable to entities operating independently [Dunne, Smith, Willenbockel, 2005; Dunne, Tian, 2015]. In the context of dual-use technologies, the key challenge is the so-called *valley of death* – the stage between the laboratory prototype and operational deployment, during which the private capital market shows a systematic aversion to funding due to the long return horizon and the specific nature of the end-user.

This section analyses three levels of institutional support for dual-use innovation in the CEE region: the alliance level (NATO DIANA), the national level (e.g. PFR and

BGK in Poland; SmartCap in Estonia; NRB in the Czech Republic), and the EU level (the European Defence Fund and EIF mechanisms). The analysis focuses on four comparative dimensions: geographical scope, financial instrument, technological priority, and mechanisms for bridging the gap between the laboratory and implementation.

Established by NATO in 2022, the Defence Innovation Accelerator for the North Atlantic (DIANA) represents the Alliance's most advanced institutional response to date to the growing technological advantage of non-state actors in areas such as autonomy, artificial intelligence, and quantum technologies. DIANA's operational architecture is based on two complementary pillars. The first is a network of over 200 accredited test and evaluation centres located across member states, enabling the verification of technology readiness level (TRL) under conditions close to operational ones. The second pillar consists of a network of 23 regional accelerators, whose geographical distribution serves to purposefully integrate peripheral innovation ecosystems into the alliance network. From the perspective of the CEE region under analysis, the location of one of DIANA's leading hubs in Tallinn is of strategic importance. The choice was not accidental: despite the marginal patent activity noted in section 3, Estonia possesses one of the most mature ecosystems for digital public administration and cybersecurity on a European scale, making it a natural hub of expertise for digital dual-use technologies. The DIANA funding mechanism is based on non-dilutive funding instruments, which sets it apart from traditional venture capital funds and significantly lowers the barrier to entry for start-ups operating in sensitive technology sectors, where disclosing the ownership structure to external investors may give rise to restrictions under export regulations. A key distinguishing feature of the DIANA model is that it provides beneficiaries with direct access to end-users within the defence structures of the 32 NATO member states whilst the product is still at the development stage. This solution addresses the fundamental information asymmetry characteristic of the defence market: a manufacturer of civilian technology possesses engineering expertise but lacks access to operational knowledge of tactical requirements, whilst military structures possess this knowledge but lack mechanisms for effectively scanning the innovation market. DIANA therefore functions as an institutional intermediary that reduces the costs of this asymmetry.

Within the Polish institutional framework, the main operators of public capital directed towards technological innovation are the Polish Development Fund (PFR) and Bank Gospodarstwa Krajowego (BGK), which operate on the basis of different mandates and financial instruments but share similar strategic priorities. PFR Ventures, as the specialised investment arm of the PFR Group, supports dual-use innovation primarily through the PFR Deep Tech programme, which is aimed at companies

with high technological potential in the fields of artificial intelligence, cybersecurity, and space technology. BGK plays a complementary role to PFR, operating debt and guarantee instruments focused on financing infrastructure and strategic industrial sectors. From an analytical perspective, it is significant that BGK operates at the level of infrastructure and corporate projects, whilst PFR Ventures addresses the early stages of technology development – the two entities therefore cover different points, which in theory should eliminate gaps in the continuity of funding from basic research to implementation.

At EU level, the key instrument supporting dual-use innovation is the European Defence Fund (EDF), which operates on the basis of multinational consortia, prioritising projects involving entities from at least three Member States, thereby structurally favouring regional cooperation. This mechanism aligns with the proposal to establish cross-border competence hubs, as set out in the specific objectives of this study. The European Investment Fund (EIF), in turn, launched the DefenceEquity instrument, designed as an equity contribution to VC funds investing in dual-use start-ups. This instrument plays a role analogous to that of PFR Ventures at the national level, but it operates on a European scale and emphasises the internationalisation of investment portfolios, which is of particular importance for start-ups from smaller countries in the region, for whom the domestic market is too shallow to justify the high costs of commercialising defence technologies. An emerging trend at the regional level is the creation of cross-border dual-use competence clusters, combining the complementary strengths of individual countries. Notably, several cluster configurations identified by this study span the boundary between the CEE group and the reference economies, such as the digital hub linking Estonia's cybersecurity expertise with Finland's AI/ML capabilities, or the potential integration of Poland's manufacturing base with Swedish algorithmic competences. These cross-category linkages underscore the analytical value of including the reference economies in the study: they are not merely external benchmarks, but potential institutional partners whose complementary specialisations can accelerate the innovation convergence of CEE. This mechanism corresponds to the model of regional innovation specialisation [AppSentinels, 2025], in which economies of scale unattainable for individual participants are achieved through specialisation and the division of labour within the network.

An analysis of the institutions reveals systemic gaps, the elimination of which is a prerequisite for fully harnessing the innovative potential of dual-use technologies in the CEE region and for deepening cooperation with the reference economies. Among the CEE countries, none of the national funding instruments, with the exception of Estonia's SmartCap, explicitly includes a dual-use or defence criterion

as a condition for accessing funding. It is worth noting that the reference Nordic economies benefit from more mature institutional frameworks in this regard, which further widens the gap in the capacity to convert civilian innovation into defence applications, resulting in a situation where projects with high military potential may fail to secure support due to the lack of a formal assessment pathway, and publicly funded projects are not systematically reviewed for their transferability to defence applications. Allied (DIANA), EU (EDF, EIF) and national (PFR, BGK, NRB) instruments operate largely in parallel, without a mechanism for mutual recognition of project eligibility or shared databases of beneficiaries. A project funded by DIANA does not automatically benefit from BGK's preferential credit terms, even though it meets the strategic criteria justifying such preferences. The lack of a standardised dual-use innovation indicator at the regional level prevents a reliable assessment of the effectiveness of public fund allocation over the long term. The WDIF indicator proposed in section 4 represents a step towards filling this gap at the macroeconomic level; however, its operationalisation at the project level requires further methodological research.

7. Summary and recommendations

The aim of this article was to identify and quantify the innovation potential of dual-use technologies in CEE countries and assess the adequacy of existing institutional mechanisms for mobilising this potential. Three layers of empirical analysis – patent, fiscal and institutional – yielded convergent results, which together form a coherent picture of the structural conditions for dual-use innovation in the region.

An analysis of patent applications revealed a marked geographical imbalance in innovation activity: Poland accounts for 43.1% of the total, whilst Estonia and Latvia together account for just five applications in the categories examined. At the same time, an analysis of the structure of patent portfolios revealed clear technological specialisations – the reference Nordic economies (Finland and Sweden) dominate in the field of AI/ML and cybersecurity, Poland exhibits a broad but relatively shallow portfolio covering all pillars, while Turkey – the reference economy – concentrates its innovation activity in the algorithmic segment whilst showing a deficit in the area of advanced materials. Fiscal data compared with patent activity through the lens of the WDIF indicator revealed diverse strategic profiles: ranging from a military-dependent model among CEE countries (Poland, WDIF ≈ 3.1) through a balanced model characteristic of the Nordic reference economies (Finland and

Sweden) to a civilian-dominated model approaching the spin-in benchmark (the Czech Republic in the field of industrial R&D). An institutional analysis identified three systemic gaps – criteria-related, coordination-related, and evaluation-related – the simultaneous occurrence of which explains why rising defence expenditure does not automatically translate into an increase in endogenous technological potential.

The prevailing political discourse on technological security oscillates between two extremes: the vision of full technological sovereignty, which presupposes the ability to independently produce all critical defence technologies, and the pragmatic acceptance of import dependency as an acceptable cost within the framework of an allied division of labour. The findings of this study provide an empirical basis for challenging both extremes as analytically inadequate in relation to CEE countries. The thesis regarding the possibility of full technological sovereignty is refuted by patent and fiscal data. None of the countries studied – including Poland, which has the broadest patent portfolio and the highest defence expenditure – exhibits significant innovative activity across all nine identified technological subcategories simultaneously. Dual-use technology is characterised by high systemic complexity and deep embedding in global knowledge networks, which structurally precludes innovation self-sufficiency as a viable strategic option for medium-sized countries. Conversely, the argument that complete import dependency is acceptable is challenged by institutional analysis: a lack of domestic absorption capacity – measured, amongst others, by patent activity and the maturity of the VC ecosystem – prevents the effective adaptation of purchased technology to specific operating conditions and leads to dependence on the modernisation cycles of an external supplier over which the recipient has no control. An empirically justified alternative to both models is the concept of selective technological autonomy, understood not as an end in itself, but as the result of the rational allocation of limited R&D resources in areas where the country possesses existing comparative advantages or a strategically justified interest in building independent capabilities. This concept is rooted in the theory of dynamic capabilities [Barbieri, 2025] and remains consistent with the body of research on regional innovation specialisation: effective innovation does not stem from the comprehensiveness of coverage across the technology landscape but from the depth of specialisation in areas where there is a critical mass of accumulated knowledge.

The institutional analysis has highlighted the need to introduce a dual-use selectivity criterion into national funding instruments. It is recommended that a defence transferability coefficient be introduced into the regulations of the PFR Ventures and BGK programmes as an additional, non-mandatory scoring criterion in the evalua-

tion of applications. This criterion should operationalise the question of whether the technology being funded has an identifiable application pathway in defence systems or critical infrastructure, without requiring the applicant to undertake defence commercialisation as a prerequisite. This approach remains neutral with regard to the company's business objectives, whilst generating data that allows for the monitoring of the effectiveness of public innovation expenditure through the prism of security.

The creation of a regional map of technological specialisations as a basis for coordinating the innovation ecosystem would have a positive impact on the effectiveness of innovation development. The patent data presented in section 3 provide an empirical basis for constructing a regional map of the comparative innovation advantages of CEE countries. Such a map – developed and updated periodically by a specialised analytical unit, for example within the CEE structure or in cooperation with the EPO – would allow for the rationalisation of the allocation of EDF and DIANA funding by directing projects towards consortia combining complementary, rather than competing, specialisations. An example of applying this logic is the potential cooperation between the Polish manufacturing base in the field of autonomous systems and Finnish-Swedish algorithmic expertise in AI/ML – a combination that patent results justify, but which has not yet been institutionalised in any cooperation mechanism.

Establishing a mechanism for mutual recognition of eligibility between the alliance, EU and national levels. The coordination gap identified in section 5 has specific economic consequences: a project eligible for the DIANA programme de facto meets the strategic criteria required by BGK and the EIF, but does not automatically benefit from the preferential financing terms offered by these institutions. It is recommended, following the model of the mutual recognition system used in European product certification, that a protocol for the mutual recognition of the eligibility of dual-use projects be developed between selected financial instruments. Implementing this proposal requires bilateral or multilateral agreements between managing authorities, but does not require legislative changes at EU level, making it feasible in the medium term.

The development of an ecosystem of cross-border competence hubs based on the principle of complementarity. The findings of the study provide empirical justification for replacing the model of competition between national innovation ecosystems with a model of networks of specialised competence hubs, whose value stems from mutual complementarity rather than replication. Based on patent and institutional data, three natural axes of such a network can be identified: a digital hub (Estonia-Finland, expertise in cybersecurity and AI), a manufacturing and materials

hub (Poland-Czech Republic, expertise in metallurgy, additive manufacturing and unmanned systems) and an integration hub for the eastern flank (Poland-Romania-Lithuania, unmanned systems and automation). Each of these hubs already has a partial institutional framework in place – the role of public policy is to formalise this and link it to NATO and EU funding streams, rather than building from scratch.

Standardising the measurement of dual-use innovation effectiveness at regional level would address the evaluation gap that constitutes the most serious obstacle to evidence-based management of innovation policy in the security sector. The WDIF indicator proposed in this article is a diagnostic tool at the macroeconomic level – it must be supplemented with project-level measures to assess individual investments. We propose the creation of a regional dual-use maturity index (RIDD) based on a set of indicators covering: patent activity in IPC/CPC categories identified as dual-use, the structure of the investment portfolio of domestic VC funds according to the criterion of defence transferability, and the number of projects with DIANA certification or approved under the EDF. Such an index, published periodically for all CEE countries, with the reference economies included as upper-bound benchmarks, would create a mechanism for transparent benchmarking and allow for the empirical verification of the effectiveness of policy interventions in subsequent research cycles.

8. Limitations of the study and directions for further research

The results presented are subject to methodological limitations discussed in previous sections, which should be taken into account when interpreting the recommendations made. The classification of patents based on IPC codes and semantic analysis of the description field does not eliminate the risk of misclassification in the case of highly interdisciplinary technologies, particularly at the intersection of AI and materials engineering. The GERD indicator, as a measure of R&D expenditure, aggregates expenditure with very different application profiles, reducing its diagnostic precision in the context of dual-use technologies. Finally, the scope of patent analysis does not allow conclusions to be drawn about the actual commercialisation of the inventions filed or their actual degree of adoption by defence organisations.

Areas for further research cover at least three fields. First, disaggregating GERD data at sectoral level would allow for a more precise separation of the civilian and defence components within R&D expenditure, which would significantly improve the accuracy of the WDIF indicator. Second, a network analysis of patent citations –

which goes beyond the scope of this article – would enable the identification of actual knowledge flows between the civilian and defence sectors at the level of companies and research institutes, thereby empirically verifying the hypothesis that such flows are insufficiently dense in the region. Thirdly, a survey of managers at technology companies using the analysed funding instruments would allow for an assessment of subjective barriers to accessing the dual-use ecosystem, supplementing quantitative data with a supply-side perspective.

In summary, the findings of this study indicate that the strategic objective of innovation policy in CEE countries should be neither full technological sovereignty – which is unattainable and economically inefficient – nor the passive acceptance of import dependency, but rather a conscious and empirically grounded pursuit of selective autonomy in areas where a critical mass of accumulated knowledge makes the development of endogenous innovation capabilities both feasible and strategically profitable. A prerequisite for the implementation of this strategy is the replacement of fragmented national instruments with an integrated regional ecosystem, in which specialisation and complementarity replace replication as the organising principle of science-industry collaboration.

References

Acosta, M., Coronado, D., Ferrándiz, E., Marín, M.R., Moreno, P.J. (2020). Civil–Military Patents and Technological Knowledge Flows Into the Leading Defense Firms, *Armed Forces & Society*, 46(3), pp. 454–474. DOI: 10.1177/0095327X18823823.

AppSentinels. (2025). *Introduction: Why NIST Matters More Than Ever for API Security*, https://appsentinels.ai/blog/nist-api-security/ (accessed: 03.09.2026).

Audretsch, B.D., Belitski, M. (2023). The Limits to Open Innovation and its Impact on Innovation Performance, *Technovation*, 119, 102519. DOI: 10.1016/j.technovation.2022.102519.

Balnord (2025). *How to Build a Critical Industry in Europe? Launch of Second Edition "Dual-Use Founder's Handbook: From Foundation to Scale"*, https://www.balnord.vc/article/how-to-build-a-critical-industry-in-europe-launch-of-second-edition-dual-use-founders-handbook-from-foundation-to-scale (accessed: 03.09.2026).

Barbieri, M. (2025). Patent Analysis and Trends Related to 2D Nanomaterials for Active Food Packaging, *Engineering Proceedings*, 87(1). DOI: 10.3390/engproc2025087009.

Boschma, R. (2005). Proximity and Innovation: A Critical Assessment, *Regional Studies*, 39(1), pp. 61–74. DOI: 10.1080/0034340052000320887.

Boschma, R., Frenken, K. (2011). The Emerging Empirics of Evolutionary Economic Geography, *Papers in Evolutionary Economic Geography (PEEG)*, https://ideas.repec.org//p/egu/wpaper/1101.html (accessed: 03.09.2026).

Bromley, M., Maletta, G. (2025). The Militarization of Technology: Preventing Diversion and Misuse Through Export Controls, *SIPRI Research Policy Paper, November 2025*. DOI: 10.55163/VDOD7802.

Chivvis, C.S., Joulwan, G.A., Gnehm, E., Hunter, R.E., Rand Corporation. (2008). *Integrating Instruments of Power and Influence: Lessons Learned and Best Practices*, Rand Corporation, https://www.rand.org/content/dam/rand/pubs/conf_proceedings/2008/RAND_CF251.pdf.

Dunne, J.P., Smith, R.P., Willenbockel, D. (2005). Models of Military Expenditure and Growth: A Critical Review, *Defence and Peace Economics*, 16(6), pp. 449–461. DOI: 10.1080/10242690500167791.

Dunne, J.P., Tian, N. (2013). Military Expenditure and Economic Growth: A Survey, *The Economics of Peace and Security Journal*, 8(1). DOI: 10.15355/epsj.8.1.5.

Dunne, J.P., Tian, N. (2015). Military Expenditure, Economic Growth and Heterogeneity, *Defence and Peace Economics*, 26(1), pp. 15–31. DOI: 10.1080/10242694.2013.848575.

Etzkowitz, H., Leydesdorff, L. (2000). The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University – Industry – Government Relations, *Research Policy*, 29(2), pp. 109–123. DOI: 10.1016/S0048-7333(99)00055-4.

European Commission (2025). *White Paper for European Defence – Readiness 2030*. Brussels, https://commission.europa.eu/document/download/e6d5db69-e0ab-4bec-9dc0-3867b4373019_en?filename=White%20paper%20for%20European%20defence%20-%20Readiness%202030.pdf (accessed: 03.09.2026).

Freeman, R.E.E., McVea, J. (2001). A Stakeholder Approach to Strategic Management, *SSRN Electronic Journal*. DOI: 10.2139/ssrn.263511.

Hill, J., Mancisidor, L. (2026). A Responsible Investing Lens for AI, Defense and Energy Transition, Adams Street Partners, https://www.adamsstreetpartners.com/insights/responsible-investing-lens-for-ai-defense-energy-transition/ (accessed: 03.09.2026).

Mazzucato, M. (2011). The Entrepreneurial State, *Soundings*, 49(49), pp. 131–142. DOI: 10.3898/136266211798411183.

Mitchell, R.K., Agle, B.R., Wood, D.J. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts, *The Academy of Management Review*, 22(4), pp. 853–886. DOI: 10.2307/259247.

NATO. (2025). *Defence Innovation Accelerator for the North Atlantic (DIANA)*, https://www.nato.int/en/about-us/organization/nato-structure/defence-innovation-accelerator-for-the-north-atlantic-diana (accessed: 03.09.2026).

Teece, D.J., Pisano, G., Shuen, A. (1990). Firm Capabilities, Resources and the Concept of Strategy, E*conomic Analysis and Policy Working Paper EAP*, 38. Oakland: University of California.

Winterberg, S. (2025). *Implementing ESG in Dual-Use Technology*, https://www.ventureesg.com/wp-content/uploads/2025/03/VentureESG_ESG-for-Dual-Use-Technology-04.pdf (accessed: 03.09.2026).

5

Tarık Iliman[1]
Michał Aliński[2]

Does Population Ageing Drive Health Expenditure? Evidence from Poland and Türkiye: A Comparative ARDL Analysis

Abstract

This paper investigates the impact of demographic ageing on both real per capita public health expenditure (HEX) and real per capita out-of-pocket health expenditure (OUT) in Poland and Türkiye over the period 2000–2023. It also examines the effect of economic factors, namely real per capita gross domestic product (GDP) and the inflation rate (INF), on both HEX and OUT. To this end, the Autoregressive Distributed Lag (ARDL) approach is used to estimate both short-run and long-run relationships between demographic ageing and both types of health expenditure. Four ARDL models were constructed, enabling a comparative assessment of two structurally different economies at different stages of demographic transition and macroeconomic development.

The results of the four estimated models provide evidence of a long-run equilibrium relationship, indicating that HEX, OUT, and their determinants are cointegrated in both Poland and Türkiye. Furthermore, the long-run coefficients reveal that demographic ageing has divergent effects across the two countries. Population ageing has a statistically significant negative effect on OUT in Poland – indicating the protective role of the Polish public system – and on HEX in Türkiye, while its effect on OUT in Türkiye remains statistically insignificant. In Poland, GDP has a strong positive effect on both HEX and OUT. These findings support the classification of healthcare

1 SGH Warsaw School of Economics (Poland) and Aydın Adnan Menderes University (Türkiye), e-mail: tilima@sgh.waw.pl.

2 SGH Warsaw School of Economics (Poland), e-mail: malins@sgh.waw.pl.

as a luxury good. In contrast, Türkiye exhibits a negative income elasticity of HEX, which points to structural constraints in health financing.
Regarding short-run dynamics, the error correction mechanism is found to be statistically significant in three of the four models, confirming that deviations from long-run equilibrium are corrected over time. In the short run, GDP has a statistically significant positive effect on OUT in Türkiye, while exerting a significantly negative effect on HEX. The old-age dependency ratio (ODR) has a statistically significant negative effect on OUT in Poland in the short run and a similarly negative effect on HEX in Türkiye. The inflation rate emerges as a particularly powerful short-run determinant in Türkiye, exerting a statistically significant negative effect on both HEX and OUT. This finding reflects the detrimental impact of price instability on healthcare expenditure, both public and out-of-pocket.
Overall, the findings demonstrate that the effects of demographic ageing and economic factors on HEX and OUT differ between Poland and Türkiye, as evidenced by the divergent long-run and short-run results obtained for these countries.

1. Introduction

One of the fundamental goals of every individual is to maintain good health and benefit from its protective functions. In fact, health is not only a priority for individuals but also for society as a whole. As Traczyk [2025] emphasises, a well-functioning healthcare system contributes significantly to maintaining and improving population health. Given the importance of health, healthcare expenditure is a matter of concern for both individuals and governments. In this sense, health expenditure has shown a persistent upward trend in both developed and developing countries worldwide over recent decades [World Bank, 2025]. The factors underlying this increase in health expenditure are diverse and may include demographic, economic, political, environmental, technological, and social determinants, among others. In particular, pressure on healthcare systems has shown a growing trend in countries with a rising old-age dependency ratio (ODR), defined as the ratio of older dependents (aged 65 and over) to the working-age population (aged 15–64). This situation directly affects both public and private healthcare expenditure [De Meijer, Wouterse, Polder, Koopmanschap, 2013]. These dynamics underline the need to better understand the key drivers of health expenditure growth.

Poland and Türkiye exhibit distinctly different patterns of health expenditure, demographic change, and macroeconomic development over the period 2000–2023, which makes their comparison analytically valuable. According to World Bank data, real per capita health expenditure (HEX) in Poland averaged USD 1,005.5 over the

sample period, rising from USD 506.2 USD in 2000 to USD 1,624.4 in 2023. This reflects a steady upward trajectory associated with both economic growth and expanding public healthcare coverage. In Türkiye, HEX averaged a considerably lower USD 592.3, ranging from USD 160.9 USD to USD 1,282.2. This indicates greater volatility in real public health expenditure compared with Poland.

Out-of-pocket health expenditure (OUT) refers to healthcare spending paid directly by households [World Bank, 2025]. A similar pattern can be observed for OUT. Poland averaged USD 166.6 over the sample period, while Türkiye averaged only USD 79.7, less than half of that of Poland. However, OUT in Türkiye exhibited far greater variability, ranging from a minimum of USD 12.5 to a maximum of USD 267.8, reflecting the destabilising effect of high inflation on OUT.

In terms of demographic ageing, according to World Bank data, ODR in Poland increased from 17.9% in 2000 to nearly 30% in 2023, averaging 21.7%. This demonstrates a trajectory that reflects an advanced stage of demographic transition. In contrast, Türkiye maintained a considerably younger population structure, with an ODR averaging just 11.2% and rising modestly from 9.1% in 2000 to 14.7% in 2023. However, this relatively young demographic profile should not be mistaken for demographic stability: birth rates in Türkiye have been declining steadily, while the pace of population ageing is accelerating. As a result, Türkiye is losing its demographic youth advantage faster than the aggregate ODR figures alone might suggest.

On the economic side, according to World Bank data, Poland's real GDP per capita averaged USD 11,652 over the sample period, compared with USD 9,784 for Türkiye. Both countries followed an upward trend, although Poland experienced considerably greater stability. The inflation environments, however, could hardly have been more different. Poland averaged just 3.6% annually, whereas Türkiye averaged 20.2%, peaking at 72.3% in 2022. This reflects one of the most volatile macroeconomic environments among upper-middle-income economies during the sample period.

This combination of divergent health expenditure levels, demographic trajectories, income levels, and inflation environments makes Poland and Türkiye an unusually informative comparative pair for studying health expenditure dynamics, particularly with respect to the role of population ageing alongside economic factors. Against this background, the primary aim of this paper is to analyse the effect of ODR on both HEX and OUT in Poland and Türkiye, as well as assess the effects of economic factors – namely GDP and INF – on both expenditure categories. To achieve these objectives, we employ the Autoregressive Distributed Lag (ARDL) bounds-testing approach over the period 2000–2023. This research contributes to the existing literature in four ways: (i) by providing a comparative ARDL analysis of two structurally

different countries within a unified methodological framework; (ii) by simultaneously examining both HEX and OUT as separate dependent variables; (iii) by jointly analysing ODR, GDP, and INF as determinants within the same model; and (iv) by covering the period 2000–2023, which includes recent episodes of demographic pressure and macroeconomic instability in both Poland and Türkiye.

The remainder of this study is organised as follows. Section 2 reviews the relevant literature. Section 3 presents the data and methodology. Section 4 reports the empirical results. Section 5 discusses the findings and provides policy implications.

2. Literature review

The determinants of health expenditure have been widely examined in the literature for several decades. Although numerous factors may affect health spending, including technological development, political structures, environmental conditions, and social dynamics, this paper focuses on the effect of ODR on health expenditure. As a secondary aim, it also examines the role of selected economic factors.

The relationship between population ageing and health expenditure has attracted considerable attention in the literature. As the share of the elderly population increases, the demand for health services rises due to the higher prevalence of age-related and chronic diseases, while the number of active contributors to health insurance systems declines [Van Eenoo et al., 2016; Golinowska, Tabor, 2014]. De Meijer et al. [2013] find that population ageing moderately increases acute-care expenditure while significantly increasing long-term care expenditure, and emphasise that the fiscal impact of ageing depends critically on how healthcare systems are structured. Kallestrup-Lamb et al. [2024] confirm that ageing populations may create significant upward pressure on health expenditure over the long term. However, the relationship is not straightforward. Zweifel et al. [1999] argue that proximity to death, rather than age per se, is the primary driver of health expenditure, an argument known as the *red herring* hypothesis, which was confirmed by Werblow et al. [2007] across seven categories of healthcare services. Breyer and Lorenz [2021], reviewing two decades of red herring research, conclude that the empirical evidence remains contradictory and inconclusive.

Income has been identified as one of the most important determinants of health expenditure since the seminal work of Newhouse [1977], with Grossman's [1972] health capital model providing the theoretical foundation. A central debate concerns whether healthcare should be classified as a luxury or a necessity – that is, whether

income elasticity exceeds or falls below unity [Di Matteo, 2003]. Some studies support the classification of healthcare as a luxury good [Clemente, Lázaro-Alquézar, Montañés, 2019; Kiymaz, Akbulut, Demir, 2006], while others conclude that it should be perceived as a necessity [Baltagi, Moscone, 2010; Murthy, Okunade, 2016; Blomqvist, Carter, 1997]. Beyond income, GDP is widely recognised as the main macroeconomic factor associated with health expenditure [Akca, Sonmez, Yilmaz, 2017]. Inflation has also been identified as a significant determinant, particularly in economies where price instability erodes the real value of healthcare budgets [Issever, Sennaroglu, Donmez, 2024; Cheng, Witvorapong, 2021; İlgün, Konca, Sönmez, 2023].

Taken together, the literature suggests that both demographic and economic factors play important but context-dependent roles in shaping health expenditure dynamics. The impact of ageing varies across countries depending on the maturity and coverage of public healthcare systems, while the effect of income depends on the level of economic development and the structure of health financing.

3. Data and methodology

3.1. Data and variables

The variables used are presented in Table 1. The analysis is based on time-series data constructed separately for Poland and Türkiye, covering the period 2000–2023 and consisting of annual observations.

Table 1. Data description, variables and source

Variable	Definition	Unit/Transformation	Source	Type
HEX	Real Per Capita Public Health Expenditure	Log, CPI-adjusted (2010=100)	World Bank	Dependent
OUT	Real Per Capita Health Expenditure – health spending paid directly by households	Log, CPI-adjusted (2010=100)	World Bank	Dependent
GDP	Real Per Capita GDP	Log, Constant Prices	World Bank	Independent
ODR	Old-age dependency ratio (population aged 65/population aged 15–64)	Log, %	World Bank	Independent
INF	Inflation rate	Level, %	World Bank	Independent

Source: World Bank [2025].

HEX and OUT are used as dependent variables, while ODR, GDP and INF are included as independent variables. The selection of these variables is consistent with the existing literature. For example, HEX has been widely used as a dependent variable in studies such as Murthy and Okunade [2016], Hansen and King [1996], and Hirai and Okamoto [2025]. Similarly, OUT has been employed as a dependent variable by Hirai and Okamoto [2025] and Bhat and Jain [2004]. GDP is commonly used as a control variable reflecting economic capacity [Newhouse, 1977; Murthy, Okunade, 2016; Chang, T., Chang, Y.C., Wang, 2022; Çakmak, 2025], while ODR is frequently included as a proxy for demographic ageing [Bakara, Celik,Baloglu, 2014; Çakmak, 2025; Murthy, Okunade, 2016]. Inflation is also considered an important macroeconomic control variable [Issever et al., 2024; Cheng, Witvorapong, 2021]. Accordingly, these variables are employed in the empirical analysis. HEX, OUT, GDP and ODR are transformed into logarithmic form to improve comparability and reduce heteroskedasticity. INF, however, is retained in its level form because it may take negative values, rendering logarithmic transformation inappropriate.

3.2. Descriptive statistics

Table 2 presents the descriptive statistics for Poland and Türkiye.

Table 2. Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max	Obs
Poland					
HEX (USD)	1,005.5	343.7	506.2	1,624.4	24
OUT (USD)	166.6	34.4	97.4	232.2	24
GDP (USD)	11,652	3,146	7,402	17,410	24
ODR (%)	21.7	3.9	17.9	29.9	24
INF (%)	3.6	3.7	−0.9	14.4	24
Türkiye					
HEX (USD)	592.3	226.9	160.9	1,282.2	24
OUT (USD)	79.7	56.4	12.5	267.8	24
GDP (USD)	9,784	2,676	5,907	14,933	24
ODR (%)	11.2	1.5	9.1	14.7	24
INF (%)	20.2	19.7	6.3	72.3	24

Source: Authors' own calculations based on World Bank [2025].

- Regarding HEX, the average in Poland is USD 1,005, while the average in Türkiye is USD 592, clearly showing that HEX in Poland is nearly twice that of Türkiye.
- With regard to OUT, the average in Poland is USD 166.6, more than twice that of Türkiye's USD 79.7. OUT in Türkiye ranges from a minimum of USD 12.5 to a maximum of USD 267.8.
- The average GDP in Poland is USD 11,652, while Türkiye's GDP is USD 9,784.
- Türkiye experienced a high and volatile average INF of 20.2% during the sample period – approximately six times higher than Poland's average of 3.6%. Moreover, INF in Türkiye reached a peak of 72.3% within the sample period.
- In terms of ODR, Poland's average of 21.7% is approximately twice that of Türkiye's 11.2%.

These structural differences make the comparative analysis of health expenditure dynamics between the two countries both more meaningful and more valuable.

3.3. Correlation matrix

Table 3 shows the correlation matrix of variables used.

Table 3. Correlation matrix

	LNHEX	LNOUT	LNGDP	LNODR	INF
Poland					
LNHEX	1.000				
LNOUT	0.635	1			
LNGDP	0.992**	0.602**	1		
LNODR	0.908**	0.315	0.932**	1	
INF	0.173	−0.220	0.231	0.355	1
Türkiye					
LNHEX	1				
LNOUT	0.924**	1			
LNGDP	−0.824**	−0.857**	1		
LNODR	−0.922**	−0.921**	0.943**	1	
INF	−0.286	−0.250	−0.028	0.142	1

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Authors' own calculations based on World Bank [2025].

A high correlation is observed between LNHEX and LNGDP in Poland ($r = 0.992$), which is consistent with the strong income-health nexus documented by Murthy

and Okunade [2016] and Cakmak [2025]. Regarding Türkiye, LNODR and LNGDP have a high positive correlation (r = 0.943), while both also exhibit high negative correlations with LNHEX and LNOUT. This may reflect the adverse effect of exchange rate depreciation and inflation on real health expenditure throughout the sample period.

In this study, the observed high correlations among the variables do not necessarily pose a methodological concern within the ARDL framework. Rather than indicating problematic multicollinearity, these correlations reflect shared long-run dynamics among cointegrated time-series models. Under cointegration, the ARDL estimator is super-consistent, meaning that coefficient estimates converge at a rate of T rather than the standard $T^{1/2}$, which enhances the robustness of the estimates against high inter-variable correlations [Pesaran, Shin, 1999]. Murthy and Okunade [2016], Chaabouni and Abednnadher [2014], and Cakmak [2025] similarly include highly correlated variables in the same ARDL model without exclusion, obtaining reliable estimates.

3.4. Econometric framework

The variables are integrated of mixed orders, namely I(0) and I(1). This makes the ARDL bounds-testing approach developed by Pesaran, Shin, and Smith [2001] particularly suitable as the primary estimation framework.

First, the mixed integration order of the variables – with some series stationary at level I(0) and others requiring first differencing I(1) – renders conventional cointegration techniques, such as the Engle-Granger [1987] two-step procedure and the Johansen-Juselius [1990] maximum likelihood approach, inapplicable. Both methods require all variables to be integrated of the same order, typically I(1). By contrast, the ARDL bounds-testing approach remains valid irrespective of whether the regressors are I(0), I(1), or mutually cointegrated, as long as none of the variables are integrated of order I(2). Since none of the variables in this analysis are, the ARDL framework is fully applicable.

Second, the ARDL approach is particularly well suited to small sample sizes. Pesaran and Shin [1999] demonstrate that the ARDL estimator produces consistent and efficient estimates even with limited observations. This robustness to small samples constitutes an important methodological advantage over alternative multivariate cointegration techniques.

Third, unlike two-step procedures, the ARDL approach simultaneously estimates both short-run dynamics and long-run equilibrium within a single equation frame-

work, thereby eliminating error accumulation across estimation stages [Giles, 2014; Pesaran, Shin, 1999]. As a result, it provides a more efficient and consistent estimation framework.

Fourth, the ARDL estimator provides important protection against potential endogeneity concerns. Under cointegration, long-run coefficient estimates converge at a rate of T rather than the standard $T^{1/2}$. Pesaran and Shin [1999] show that this super-consistency property renders the estimates robust to weakly endogenous regressors. Furthermore, the dynamic lag structure of the ARDL model separates contemporaneous and lagged effects, thereby substantially reducing the risk of simultaneity bias. This is particularly relevant in the present study, where a potential two-way relationship between health expenditure and the old-age dependency ratio cannot be theoretically ruled out. Consequently, the super-consistency property of the ARDL estimator ensures that long-run estimates remain consistent even in the presence of such weak endogeneity [Inder, 1993; Pesaran, Shin, 1999].

Finally, the ARDL approach has become a widely used methodology in health expenditure time-series research, as expressed by Murthy and Okunade [2016], Hirai and Okamoto [2025], and Cakmak [2025]. Accordingly, its application in this study is both methodologically appropriate and empirically justified. A related methodological consideration concerns whether the HEX and OUT equations should be estimated jointly. The ARDL bounds-testing approach is a single-equation time-series estimator, and the separate estimation of equations for each dependent variable represents established practice in the health expenditure literature [Cakmak, 2025; Hirai, Okamoto, 2025; Murthy, Okunade, 2016]. Accordingly, the separate estimation strategy adopted in this study follows standard methodological convention. Table 4 summarises the key reasons for selecting the ARDL methodology.

Table 4. Rationale behind the selection of the ARDL methodology

Reason	Justification
Accommodates mixed integration orders I(0) and I(1)	Conventional methods, such as Engle-Granger [1987] and Johansen-Juselius [1990], require all variables to be I(1). ARDL remains valid regardless of whether the regressors are I(0), I(1), or mutually cointegrated.
Performs reliably with small sample sizes	ARDL produces consistent and efficient estimates even with limited observations, making it superior to alternative multivariate cointegration techniques [Pesaran, Shin, 1999].
Estimates short-run and long-run dynamics simultaneously	Unlike two-step procedures, ARDL estimates both short-run dynamics and long-run equilibrium within a single equation framework, eliminating error accumulation across estimation stages [Giles, 2014].

cont. Table 4

Reason	Justification
Robust to weak endogeneity	Under cointegration, the ARDL estimator is super-consistent and remains consistent in the presence of weakly endogenous regressors, reducing the simultaneity bias through its dynamic lag structure [Inder, 1993; Pesaran, Shin, 1999].
Widely used in health expenditure time-series literature	ARDL has become the standard methodology in health expenditure research, ensuring direct comparability with existing studies [Cakmak, 2025; Hirai, Okamoto, 2025; Murthy, Okunade, 2016].

Source: Authors' own elaboration.

3.5. Model specification

The ARDL (p, q1, q2, q3) specification is as follows: Δ denotes the first difference, a_0 is the constant term, a_1 is the error-correction coefficient, a_2, a_3 and a_4 represent the long-run coefficients, $\Sigma\beta_I$, $\Sigma\gamma_I$ **and** $\Sigma\delta_I$ represent the short-run coefficients, ε_t denotes the error term, and the lag lengths p, q1, q2, q3 are selected using the Akaike Information Criterion (AIC). The AIC is preferred over the BIC given the small sample size of 24 observations, as the BIC's stronger penalty for additional parameters may lead to underfitting in short time series.

Equation 1 – Real Per capita Public Health Expenditure Model (HEX)

$$\Delta LNHEX_t = a_0 + a_1 LNHEX_{t-1} + a_2 LNGDP_{t-1} + a_3 LNODR_{t-1} + a_4 INF_{t-1} + \Sigma\beta_I\ \Delta GDP_{t-1} + \Sigma\gamma_I\ \Delta LNODR_{t-1} + \Sigma\delta_I INF_{t-1} + \varepsilon_t \quad (1)$$

Equation 2 – Real Per capita Out-of-Pocket Health Expenditure Model (OUT)

$$\Delta LNOUT_t = a_0 + a_1 LNOUT_{t-1} + a_2 LNGDP_{t-1} + a_3 LNODR_{t-1} + a_4 INF_{t-1} + \Sigma\beta_I\ \Delta GDP_{t-1} + \Sigma\gamma_I\ \Delta LNODR_{t-1} + \Sigma\delta_I INF_{t-1} + \epsilon_t \quad (2)$$

Table 5 summarises the estimated ARDL models. M3 employs a maximum lag order of 3 due to the presence of serial correlation detected at maximum lag order 2 (Breusch–Godfrey test: p = 0.003). Increasing the maximum lag order to 3 resolves the serial correlation issue (p = 0.062), which is consistent with the standard procedure recommended by Kripfganz and Schneider [2023]. All other models use a maxi-

mum lag order of 2. For M1, M2 and M4, the lag combinations considered range from ARDL (1,0,0,0) to ARDL (2,2,2,2). For M3, combinations range from ARDL (1,0,0,0) to ARDL (3,3,3,3).

Table 5. Summary of the estimated ARDL models

Model	Country	Dependent Variable	Lag Order
M1	Poland	LNHEX	2
M2	Poland	LNOUT	2
M3	Türkiye	LNHEX	3*
M4	Türkiye	LNOUT	2

Note: * M3 uses a maximum lag order of 3 to address serial correlation. All other models use a maximum lag order of 2.
Source: Authors' own calculations.

4. Empirical results

4.1. Unit root tests

Before the ARDL analyses are implemented, the stationarity properties of all series are examined to ensure that no variable is integrated of order two I (2), which would invalidate the ARDL bounds-testing procedure [Pesaran et al., 2001]. To this end, we employ three complementary unit root tests. The Augmented Dickey-Fuller (ADF) test [Dickey, Fuller, 1979] augments the regression with lagged difference terms to eliminate serial correlation, with the null hypothesis of a unit root. The Phillips-Perron (PP) test [Phillips, Perron, 1988] addresses serial correlation and heteroscedasticity non-parametrically. The KPSS test [Kwiatkowski, Phillips, Schmidt, Shin, 1992] differs from the others in that its null hypothesis is stationarity rather than a unit root. Each test is conducted using the urca package in R, with a trend and intercept specification.

Table 6. Unit root test results

Variable	ADF Level	ADF Diff.	PP Diff.	KPSS Diff.	Decision
Poland					
LNHEX	0.247	0.090*	0.042**	0.100*	I(1)
LNOUT	0.561	0.383	0.010**	0.051	I(1)
LNGDP	0.673	0.376	0.040**	0.100*	I(1)

cont. Table 6

Variable	ADF Level	ADF Diff.	PP Diff.	KPSS Diff.	Decision
LNODR	0.922	0.538	0.790	0.021	I(0)
INF	0.968	0.203	0.010**	0.085	I(1)
Türkiye					
LNHEX	0.990	0.322	0.350	0.10	I(1)
LNOUT	0.504	0.020**	0.100*	0.10	I(1)
LNGDP	0.035**	-	-	-	I(0)
LNODR	0.525	0.696	0.795	0.10	I(0)
INF	0.685	0.071*	0.010**	0.069	I(1)

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. ADF and PP: H_0 = unit root; KPSS: H_0 = stationarity. I(0) = stationary at level; I(1) = stationary at first difference. LNODR in both countries is classified as I(0) based on the trend-and-intercept specification of the ADF test using the urca package in R and for all variables, the integration order is determined based on the joint evidence from the ADF, PP and KPSS tests. Where standard tests yield conflicting results, the urca trend-and-intercept specification [Pfaff, 2008] is used as the determining criterion.

Source: Authors' own calculations.

The variables exhibit a mixed integration structure; most series are I(1), while LNODR in both countries is classified as I(0) based on the urca trend model specification [Pfaff, 2008]. Specifically, Poland's LNODR yields a tau3 statistic of –4.021, exceeding the 5% critical value of –3.60, and Türkiye's LNODR yields tau3 = –5.185, exceeding the 1% critical value of –4.38. Moreover, LNGDP in Türkiye is found to be stationary at level. This mixed I(0)/I(1) structure confirms that no I(2) variable is present and the ARDL prerequisite is fully applicable.

4.2. ARDL bounds test for cointegration

The existence of long-run equilibrium relationships among the variables is examined using the bounds F-test developed by Pesaran, Shin and Smith [2001]. The test compares the computed F-statistic against two sets of critical values: a lower bound, which assumes that all variables are I(0), and an upper bound, which assumes that all variables are I(1). If the F-statistic exceeds the upper-bound critical value, the null of no cointegration is rejected regardless of the actual integration orders of the variables. The bounds test is conducted under Case 3 (unrestricted intercept, no trend) with k = 3 long-run forcing variables, and finite-sample adjusted critical values are obtained from Kripfganz and Schneider [2023].

Table 7 summarises ARDL bounds test results. These results reveal a notable and theoretically significant finding: cointegration is confirmed in all four models in both Poland and Türkiye, and with regard to both LNHEX and LNOUT. This is a stronger result than many comparable studies – for instance, Hirai and Okamoto [2025] find

cointegration only in their single-country Japanese model, while Chang et al. [2022] find no cointegration in their Chinese analysis. The confirmation of cointegration across all models validates the use of long-run multiplier estimation and the error-correction framework for all four specifications.

Table 7. ARDL bounds-test results

Model	F-Statistic	P-value	k	Decision
Poland				
M1; LNHEX = f(LNGDP, LNODR, INF)	4.571	0.039**	3	Cointegration EXIST (% 5)**
M2; LNOUT = f(LNGDP, LNODR, INF)	9.190	0.000***	3	Cointegration EXIST (% 1)***
Türkiye				
M3; LNHEX = f(LNGDP, LNODR, INF)	9.131	0.001***	3	Cointegration EXIST (% 1)***
M4; LNOUT = f(LNGDP, LNODR, INF)	5.315	0.014**	3	Cointegration EXIST (% 5)**

Source: Authors' own calculations.

The strength of cointegration varies across the models. M3 and M2 exhibit the strongest long-run relationships ($F = 9.131$ and $F = 9.190$, respectively, both $p < 0.001$), while M1 shows the weakest but still statistically significant cointegration at the 5% level ($F = 4.571$, $p = 0.039$). This relatively lower F-Statistic in M1 may reflect greater institutional stability in Poland's public healthcare financing, although further investigation is needed to confirm this interpretation. These results confirm that the healthcare financing systems of Poland and Türkiye are governed by stable long-run structural relationships.

The bounds-test results provide strong empirical evidence of long-run equilibrium relationships between health expenditure and its determinants in both Poland and Türkiye. The universal confirmation of cointegration across all four models – spanning two countries, two different health expenditure components, and two contrasting macroeconomic environments – represents a particularly robust finding. It implies that despite the structural differences between Poland's mature, EU-integrated healthcare system and Türkiye's rapidly evolving, inflation-prone health financing environment, both systems are characterised by stable long-run relationships with income, demographic ageing, and inflation. This finding is consistent with the theoretical predictions of Grossman's [1972] health capital model and the broader health economics literature, which posits that health expenditure is systematically determined by long-run economic and demographic fundamentals rather than being driven solely by short-term policy decisions or random shocks.

4.3. Long-run coefficients

We compute long-run coefficients from the ARDL models for all four specifications. Since cointegration is confirmed in all the models, long-run inference is statistically valid across all specifications. Table 8 illustrates the long-run coefficients.

Table 8. Long-run coefficients

Variable	M1 Pol.LNHEX	M2 Pol. LNOUT	M3 Tur. LNHEX	M4 Tur.LNOUT
LNGDP	1.410*** (0.104)	2.421*** (0.095)	–0.710** (0.256)	–4.263 (3.699)
LNODR	0.061 (0.204)	–2.908*** (0.248)	–1.543** (0.645)	4.423 (8.216)
INF	–0.010** (0.005)	–0.009 (0.005)	–0.031 (0.008)	–0.055 (0.040)
Cointegration	F = 4.571**	F = 9.190***	F = 17.663***	F = 5.315**
GDP Elasticity	1.410 – Luxury	2.421 – Luxury	–0.710 – Negative	Insignificant

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' own calculations.

In M1, the income elasticity of public health expenditure is estimated at 1.410 ($p < 0.001$). Since this value exceeds unity, healthcare may be classified as a luxury good in Poland, suggesting that a 1% increase in GDP may be associated with a 1.410% increase in real per capita public health expenditure. This finding is broadly consistent with Cakmak [2025], who reports an income elasticity of 1.049 for G-7 countries using a Panel ARDL approach. The INF coefficient is also statistically significant (–0.010, $p = 0.039$). Since real per capita public health expenditure is expressed in logarithmic form while the inflation rate is used in level form, this is a semi-elasticity estimate: a one-percentage-point increase in the inflation rate may be associated with an approximately 1.0% decline in LNHEX in the long run. The LNODR coefficient is statistically insignificant in M1, suggesting that demographic ageing may not exert a direct long-run effect on public health expenditure in Poland.

In M2, the income elasticity of out-of-pocket expenditure is estimated at 2.421 ($p < 0.001$), indicating that a 1% increase in GDP may be associated with a 2.421% increase in LNOUT. The higher income elasticity of per-capita real out-of-pocket health expenditure to real per capita public health expenditure may suggest that rising income drives demand for supplementary private healthcare services that are not fully covered by the public system, although further investigation would be needed to confirm this interpretation. The LNODR coefficient is –2.908 ($p < 0.001$), rep-

resenting the central finding of this study. Since both real per capita out-of-pocket health expenditure and the old-dependency ratio are in logarithmic form, this is an elasticity estimate: a 1% proportional increase in LNODR may be associated with a 2.908% reduction in LNOUT.

In M3, all long-run coefficients are statistically significant. The LNGDP coefficient is –0.710 (p = 0.020), suggesting that a 1% increase in LNGDP may be associated with a 0.710% decrease in real per capita public health expenditure in the long run. This negative income elasticity may reflect the structural transformation of Türkiye's health financing system, where rapid economic growth has been accompanied by increasing reliance on real per capita out-of- pocket health expenditure rather than real per capita public health expenditure. The LNODR coefficient is –1.543 (p = 0.038), indicating that a 1% proportional increase in LNODR may be associated with a 1.543% decrease in real per capita public health expenditure. The INF coefficient is –0.031 (p = 0.003); since real per capita public health expenditure is in logarithmic form, and INF is used in level form, this is a semi-elasticity estimate: a one-percentage-point increase in the inflation rate may be associated with an approximately 3.1% reduction in real per capita public health expenditure in the long run.

In M4, all long-run coefficients are statistically insignificant. The LNGDP coefficient is –4.263 (p = 0.252), the LNODR coefficient is 4.423 (p=0.592), and the INF coefficient is –0.055 (p = 0.177). As with M3, cointegration is confirmed (F = 5.315, p = 0.014), indicating that a long-run equilibrium relationship exists among the variables. The insignificance of individual coefficients may reflect the dominant role of macroeconomic instability – represented by average inflation of 20.2% and a peak of 72.3% – in preventing stable long-run identification.

The long-run coefficient estimates point to a fundamental structural divergence between Poland and Türkiye. In Poland, the income elasticity exceeding unity supports the classification of healthcare as a luxury good, while the large negative LNODR elasticity in M2 may provide evidence that the public health system effectively protects the ageing population from rising private health costs. In Türkiye, M3 reveals that all long-run coefficients are statistically significant, with income, demographic ageing, and inflation all exerting negative effects on real per capita public health expenditure. This pattern may reflect the structural pressure on Türkiye's public health financing, where rapid economic growth, a relatively young but ageing population, and persistent inflation may have jointly constrained the expansion of real per capita public health spending. In contrast, M4 yields no statistically significant long-run coefficients, suggesting that Türkiye's OUT dynamics may be governed primarily through short-run adjustment channels rather than stable long-run level effects.

4.4. Short-run dynamics and error correction

Short-run dynamics and the error-correction mechanism (ECM) are examined through the error-correction representation of the ARDL model. The ECM coefficient measures the speed at which the system returns to its long-run equilibrium following a shock, and a negative and statistically significant value confirms the validity of the cointegrating relationship [Pesaran et al., 2001]. Since the ARDL package in R reports the ECM coefficient with a positive sign, the adjustment speed is interpreted using the formula (1 – coefficient), which is mathematically equivalent to the conventional negative ECM representation [Kripfganz, Schneider, 2023]. Table 9 presents the short-run coefficients and error-correction results for all four models.

Table 9. Short-run coefficients and error-correction results

Variable	M1 Pol. LNHEX	M2 Pol. LNOUT	M3 Tur. LNHEX	M4 Tur. LNOUT
ECM	–0.714*** (0.174)	–2.839*** (0.608)	–0.560** (0.143)	–0.156 (0.114)
LNGDP	0.346 (0.331)	3.187** (0.942)	–0.398* (0.133)	2.678** (0.862)
LNODR	–1.820 (0.893)	–42.572** (10.421)	–4.687* (1713)	0.690 (0.951)
INF	–0.07* (0.003)	–0.018 (0.014)	–0.009*** (0.001)	–0.009*** (0.002)
R^2	0.994	0.952	0.997	0.973

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' own calculations.

In M1, the ECM coefficient is –0.714 ($p < 0.001$), which indicates that approximately 71.4% of any deviation from the long-run equilibrium is corrected within one year. Such a relatively rapid speed of adjustment may suggest that Poland's real per capita public health expenditure responds actively to disequilibria. The INF coefficient is statistically significant at –0.007 ($p = 0.045$), which confirms that inflation has an immediate negative effect on real per capita public health expenditure in Poland despite Poland's relatively low-inflation environment. The short-run LNGDP and LNODR coefficients are statistically insignificant, suggesting that neither income nor demographic ageing has any impact on real per capita public health expenditure in the short run.

In M2, the ECM coefficient is –2.839 ($p < 0.001$), which indicates that there is an exceptionally rapid speed of adjustment of 283.9% per period. While this value

exceeds unity in absolute terms, it may reflect overshooting dynamics in Poland's real per capita out-of-pocket health expenditure, where short-run responses temporarily overshoot the long-run equilibrium before converging. The short-run LNGDP coefficient is 3.187 ($p = 0.007$), which confirms that income increases have an immediate and strong positive effect on real per capita out-of-pocket health expenditure. The coefficient of LNODR is –42.572 ($p = 0.002$), indicating the large and immediate negative effect of demographic ageing on real per capita out-of-pocket health expenditure in the short run.

In M3, the ECM coefficient is –0.560 ($p = 0.003$), indicating that approximately 56.0% of any deviation from the long-run equilibrium is corrected within one year. The coefficient of LNGDP is –0.398 ($p = 0.014$), which reveals that LNGDP has a significant negative effect on real per capita public health expenditure. The coefficient of LNODR is –4.687 ($p = 0.021$), indicating a significant negative effect of demographic ageing on real per capita public health expenditure in the short run. The coefficient of INF is –0.009 ($p = 0.001$), which reveals that inflation has a strong and immediate negative effect on real per capita public health expenditure in Türkiye.

In M4, the coefficient of ECM is –0.156 ($p = 0.187$), which is statistically insignificant, indicating that real per capita out-of-pocket health expenditure in Türkiye does not exhibit a stable long-run adjustment mechanism. The coefficient of LNGDP is 2.678 ($p = 0.006$), which indicates that LNGDP is statistically significant and has a positive effect on real per capita out-of-pocket health expenditure in the short run. The coefficient of INF is –0.009 ($p < 0.001$), confirming that INF is statistically significant and has a negative short-run effect on real per capita out-of-pocket health expenditure.

Important dynamics are revealed in the short-run results across Poland and Türkiye. The coefficients of ECM in Poland are statistically significant in both M1 and M2, which confirms the existence of valid long-run adjustment mechanisms. In Türkiye, M3 exhibits a significant ECM while M4 does not, suggesting that public health expenditure adjusts toward long-run equilibrium while real per capita out-of-pocket health expenditure may be driven primarily by short-run factors. Inflation is consistently statistically significant across three of the four models, which underlines the role of inflation as a key driver of health expenditure dynamics across Poland and Türkiye. The high R-squared values across all models (ranging from 0.952 to 0.997) confirm that the estimated specifications capture the vast majority of variation in health expenditure.

4.5. Diagnostic tests and structural stability

The reliability and validity of all four ARDL models are assessed through a comprehensive battery of diagnostic tests covering serial correlation, heteroscedasticity, normality of residuals, and parameter stability. The Breusch–Godfrey (BG) Lagrange Multiplier test [Breusch, 1978; Godfrey, 1978] is used to examine the null hypothesis of no serial correlation. The Breusch–Pagan (BP) test [Breusch, Pagan, 1979] is employed to assess homoscedasticity. The Jarque–Bera (JB) test [Jarque, Bera, 1980] is used to evaluate the normality of residuals. Finally, the CUSUM (Cumulative Sum of Recursive Residuals) test developed by Brown, Durbin and Evans [1975] is applied to examine the temporal stability of the estimated parameters. Table 10 presents the results of these diagnostic tests.

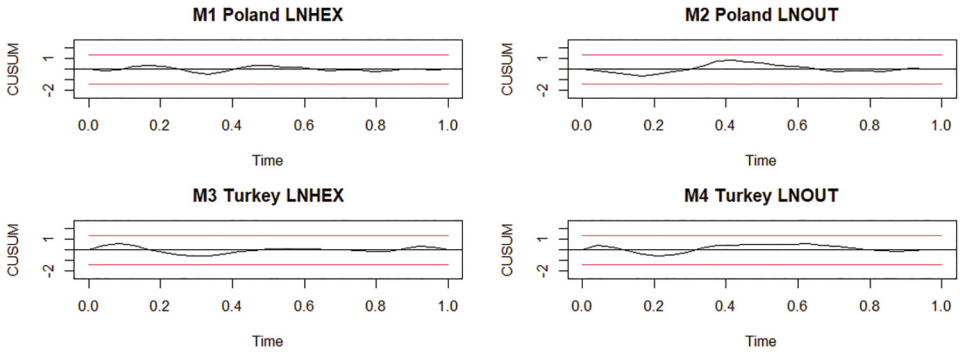
Table 10. Diagnostic and structural stability tests

Test	M1 Pol. LNHEX	M2 Pol. LNOUT	M3 Tur. LNHEX	M4 Tur. LNOUT
Breusch–Godfrey	p=0.285 ✓	p=0.500 ✓	p=0.062 ✓	p=0.955 ✓
Breusch–Pagan	p=0.338 ✓	p=0.697 ✓	p=0.736 ✓	p=0.141 ✓
Jarque–Bera	p=0.893 ✓	p=0.901 ✓	p=0.341 ✓	p=0.873 ✓
CUSUM	p=0.959 ✓	p=0.559 ✓	p=0.893 ✓	p=0.888 ✓

Note: ✓ indicates p > 0.05. BG test for M3 conducted at order=3.

Source: Authors' own calculations.

Figure 1. CUSUM stability test plots for all four models



Note: Straight lines represent 5% significance boundaries. The cumulative sum statistics remain within the boundaries for all models, confirming parameter stability.

Source: Authors' own calculations.

The diagnostic test results are satisfactory across all four models. The BG test confirms that there is an absence of serial correlation in all models, the BP test confirms that there is homoscedasticity across all specifications, the JB test confirms that residuals are normally distributed in all models, validating finite-sample inference, and the CUSUM test results indicate that all four models exhibit parameter stability throughout the 2000–2023 sample period, with the cumulative sum statistics remaining well within the 5% significance boundaries. These results confirm that the estimated long-run and short-run relationships are stable structural features of the health expenditure systems in both countries. Figure 1 presents the CUSUM plots for all four models, where the straight lines represent 5% significance boundaries and the cumulative sum statistics remain within these boundaries throughout the sample period, confirming parameter stability.

5. Discussion and conclusion

5.1. Comparative analysis

As shown in Table 11, Poland and Türkiye exhibit cointegrated health expenditure systems, but the mechanisms through which demographic ageing, income and inflation translate into spending differ considerably between the two countries. The following subsections discuss these differences in detail.

Table 11. Comparative summary of the empirical findings

Criterion	Poland	Türkiye
Average HEX (USD)	1.005,5	592.3
Average OUT (USD)	166.6	79.7
Average ODR (%)	21.7 – Mature demographic	11.2 – Young demographic
Average GDP (USD)	11,652	9,784
Average INF (%)	3.6 – Low and stable	20.2 – High and volatile
LNHEX Cointegration	F=4.571**	F=17.663***
LNOUT Cointegration	F=9.190***	F=5.315**
GDP Elasticity (LNHEX)	1.410*** – Luxury good	–0.710** – Negative
GDP Elasticity (LNOUT)	2.421*** – Luxury good	Insignificant
ODR Effect (LNHEX)	Insignificant	–1.543** – Negative
ODR Effect (LNOUT)	–2.908*** – Protective	Insignificant
INF Effect (LNHEX)	–0.010** – Negative	–0.031*** – Negative

cont. Table 11

Criterion	Poland	Türkiye
ECM (LNHEX)	−0.714*** – % 71.4	−0.560** – % 56
ECM (LNOUT)	−2.839*** – Overshooting	Insignificant
INF Short run	−0.007* (LNHEX)	−0.009*** (LNHEX and LNOUT)
All Diagnostic Tests	Passed ✓	Passed ✓
CUSUM Stability	Confirmed ✓	Confirmed ✓

Source: Authors' own calculations.

5.2. Key findings and policy implications

Cointegration is confirmed in all four models, indicating the existence of long-run equilibrium relationships between health expenditure components and their determinants in both Poland and Türkiye. This finding confirms the structural nature of health expenditure dynamics in the two countries and is stronger than in comparable studies, such as Chang et al. [2022], who find no cointegration for China, and Hirai and Okamoto [2025], who find cointegration only in a single-country Japanese model. Based on these findings, the following sub-headings discuss the key findings and policy implications with respect to demographic ageing and economic factors, respectively.

5.2.1. Demographic ageing

The primary goal of this analysis is to examine the impact of demographic ageing measured by the old-age dependency ratio on public and out-of-pocket health expenditure in both Poland and Türkiye. The empirical results reveal a context-dependent pattern, which requires careful interpretation within the broader literature.

Demographic ageing is statistically significant and has a substantial negative effect on Poland's real per capita out-of-pocket health expenditure in the long run. This significant negative elasticity may indicate that Poland's public health system effectively absorbs the financial burden of demographic ageing, shielding elderly citizens from rising private health costs. This is consistent with De Meijer et al. [2013], who similarly find that the fiscal impact of ageing depends largely on how health systems are structured to absorb age-related costs. In Türkiye, demographic ageing is statistically significant and has a negative effect on per capita real public health expenditure in the long run, although demographic ageing does not exert a statistically significant effect on per capita real out-of-pocket health expenditure. The insignificance of the effect of the old-age dependency ratio on public health

expenditure in the long run in Poland is consistent with the well-established *red herring* hypothesis first proposed by Zweifel, Felder and Meiers [1999] and confirmed by Werblow, Felder and Zweifel [2007], while Breyer and Lorenz [2021] conclude that the empirical evidence on ageing and health expenditure remains contradictory and inconclusive. Kallestrup-Lamb et al. [2024] confirm that ageing populations may create significant upward pressure on health expenditure in the long run. Comparing Poland and Türkiye, the direction of the old-age dependency ratio effect on per capita real out-of-pocket health expenditure diverges markedly – it is negative and significant in Poland but insignificant in Türkiye. This divergence may reflect the fundamental difference in health expenditure maturity between Poland and Türkiye.

From a policy perspective, although the old-age dependency ratio in Poland continued to rise from 17.9% in 2000 to nearly 30% in 2023, the long-run fiscal sustainability of its protective mechanism should be carefully monitored. For Türkiye, demographic ageing is still in its early stages, but the time left to act is limited. Türkiye should urgently implement proactive measures, including investments in geriatric care infrastructure, long-term care systems and preventive health services before demographic ageing reaches the level observed in Poland. Türkiye cannot afford to treat the current pattern of ageing effects as permanent, as its demographic transition is still underway and the full fiscal implications of demographic ageing are yet to materialise.

In Türkiye, the negative and statistically significant effect of the old-age dependency ratio on real per capita public health expenditure in the long run is a particularly noteworthy finding. Rather than reflecting a straightforward demand-driven increase in health spending, this result may indicate that Türkiye's public health financing system has not yet developed the institutional capacity to translate rising elderly dependency into commensurate increases in public health spending. As Kallestrup-Lamb et al. [2024] note, the full fiscal implications of demographic ageing tend to materialise over longer horizons, suggesting that Türkiye's current expenditure patterns may underestimate the scale of future fiscal pressure. The relationship between demographic ageing and health expenditure is therefore context-dependent, system-dependent, and time-horizon-dependent.

5.2.2. Economic factors

In Poland, the long-run income elasticity of public health expenditure significantly exceeds unity, classifying public healthcare as a luxury good, while the elasticity for out-of-pocket expenditure is even higher, confirming that private health

spending is more income-sensitive than public spending. Both findings are broadly consistent with Cakmak [2025]. The luxury good classification implies that as the economy grows, public health budgets face increasing demand pressure, and policymakers should ensure that the National Health Fund's financing mechanisms are adjusted accordingly.

In Türkiye, the income elasticity of public health expenditure is negative, suggesting that income growth may be associated with a reduction in real public health spending – a pattern that may reflect a crowding-out effect in Türkiye's health financing, where economic growth has been accompanied by increasing reliance on private spending rather than the expansion of public health coverage. This structural misalignment between economic growth and public health investment is a concerning finding. If economic growth consistently crowds out public health financing, vulnerable populations who cannot afford private healthcare may face increasing access barriers. Türkiye should therefore urgently address this gap by increasing the share of public revenue allocated to health, and ensuring that economic growth translates into expanded public healthcare coverage rather than accelerated privatisation, particularly to protect lower-income groups from rising out-of-pocket costs. This finding stands in contrast to the conventional expectation that economic growth expands fiscal space for public healthcare investments. One possible interpretation is that during Türkiye's rapid growth phase, the expansion of private healthcare provision outpaced public sector investments, effectively substituting rather than complementing public health expenditure. Another interpretation relates to exchange rate and inflation dynamics: periods of strong nominal GDP growth in Türkiye have frequently coincided with currency depreciation and high inflation, which erode the real value of public health budgets even when nominal expenditure rises.

Inflation emerges as a critical short-run determinant of health expenditure dynamics in both countries, with a particularly strong effect in Türkiye. Even in Poland's relatively low-inflation environment, inflation is found to erode the real value of public health budgets. The policy implication is clear: for Türkiye, achieving macroeconomic price stability is not merely a macroeconomic objective but a direct prerequisite for sustainable health financing. The 2021–2022 hyperinflationary episode may have inflicted severe damage on the real value of both public and private health spending. Future health financing strategies in Türkiye should incorporate inflation-adjustment mechanisms to prevent nominal budget increases from being systematically eroded in real terms, while in Poland, even modest inflationary episodes may undermine real health expenditure if nominal budget adjustments are delayed.

5.2.3. Error correction and adjustment dynamics

The error-correction results reveal important structural differences between the two countries. In Poland, both public and private health expenditure systems exhibit statistically significant error-correction mechanisms, confirming stable long-run adjustment dynamics. The exceptionally large ECM coefficient in M2 (−2.839) suggests overshooting dynamics. In this case, short-run deviations from equilibrium are rapidly corrected but temporarily overshoot the long-run level before converging. This pattern is consistent with the high income sensitivity of out-of-pocket expenditure documented in the long-run results. In Türkiye, M3 exhibits a significant ECM coefficient (−0.560), which indicates that public health expenditure adjusts towards long-run equilibrium at a speed of approximately 56% per year. In contrast, the ECM coefficient in M4 is statistically insignificant, which suggests that out-of-pocket expenditure in Türkiye does not follow a stable long-run adjustment path. M4 also lacks significant long-run coefficients. Together, these results suggest that Türkiye's out-of-pocket health expenditure is primarily driven by short-run factors such as inflation shocks and income volatility. This is an important policy finding. Household healthcare spending in Türkiye is highly vulnerable to macroeconomic instability.

6. Limitations and future research

This study has two principal limitations. First, only per capita real GDP and inflation are included as control variables alongside the old-age dependency ratio, as with only 24 annual observations, adding further independent variables would deteriorate the coefficient estimates. Second, the health system structure, governance quality, and institutional factors fall outside the scope of this analysis.

This study also has two future research amendments. First, future research could incorporate health system characteristics and institutional variables, as well as disaggregate health expenditure into subcategories such as hospital care and long-term care. Second, future research could also explore joint estimation approaches and apply instrumental variable methods to formally address potential endogeneity between health expenditure and demographic variables.

References

Akca, N., Sonmez, S., Yilmaz, A. (2017). Determinants of Health Expenditure in OECD Countries: A Decision Tree Model, *Pakistan Journal of Medical Sciences*, 33(6), pp. 1490–1494. DOI: 10.12669/pjms.336.13300.

Bakara, S., Celik, S., Baloglu, U. (2014). Dynamics of Health Expenditures in OECD Countries: Panel ARDL Approach, *Theoretical and Applied Economics*, 21(4), pp. 103–112.

Baltagi, B.H., Moscone, F. (2010). Health Care Expenditure and Income in the OECD Reconsidered: Evidence from Panel Data, *Economic Modelling*, 27(4), pp. 804–811. DOI: 10.1016/j.econmod.2009.12.001.

Bhat, R., Jain, N. (2004). Analysis of Public and Private Healthcare Expenditures, *Economic and Political Weekly*, 39(1), pp. 57–68.

Blomqvist, A.G., Carter, R.A.L. (1997). Is Health Care Really a Luxury?, *Journal of Health Economics*, 16(2), pp. 207–229.

Breusch, T.S. (1978). Testing for Autocorrelation in Dynamic Linear Models, *Australian Economic Papers*, 17(31), pp. 334–355.

Breusch, T.S., Pagan, A.R. (1979). A Simple Test for Heteroscedasticity and Random Coefficient Variation, *Econometrica*, 47(5), pp. 1287–1294.

Breyer, F., Lorenz, N. (2021). The 'Red Herring' after 20 Years: Ageing and Health Care Expenditures, *The European Journal of Health Economics*, 22(5), pp. 661–667.

Brown, R.L., Durbin, J., Evans, J.M. (1975). Techniques for Testing the Constancy of Regression Relationships Over Time, *Journal of the Royal Statistical Society*, Series B, 37(2), pp. 149–192.

Cakmak, C. (2025). The Relationship Between Income, Ageing Population, and Public Health Expenditures in G-7 Countries: A Panel ARDL Approach, *Business and Management Innovations Journal*, 13(4), pp. 1699–1715.

Chaabouni, S., Abednnadher, C. (2014). The Determinants of Health Expenditures in Tunisia: An ARDL Bounds Testing Approach, *International Journal of Information Systems in the Service Sector*, 6(4), pp. 60–72.

Chang, Y.C., Chang, T., Wang, M.C. (2022). Are Healthcare Expenditures Related to Economic Growth in China? Bootstrap ARDL Approach, *Frontiers in Public Health*, 9, 766091.

Cheng, C.H.J., Witvorapong, N. (2021). Health Care Policy Uncertainty, Real Health Expenditures and Health Care Inflation in the USA, *Empirical Economics*, 60(4), pp. 2083–2103.

Clemente, J., Lázaro-Alquézar, A., Montañés, A. (2019). US State Health Expenditure Convergence: A Revisited Analysis, *Economic Modelling*, 83, pp. 210–220. DOI: 10.1016/j.econmod.2019.02.011.

De Meijer, C., Wouterse, B., Polder, J., Koopmanschap, M. (2013). The Effect of Population Aging on Health Expenditure Growth: A Critical Review, *European Journal of Ageing*, 10, pp. 353–361.

Dickey, D.A., Fuller, W.A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association*, 74(366), pp. 427–431.

Di Matteo, L. (2003). The Income Elasticity of Health Care Spending: A Comparison of Parametric and Nonparametric Approaches, *European Journal of Health Economics*, 4(1), pp. 20–29. DOI: 10.1007/s10198-002-0141-6.

Engle, R.F., Granger, C.W.J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing, *Econometrica*, 55(2), pp. 251–276.

Giles, D. (2014). Some Questions about ARDL Models, *Econometrics Beat Blog*, https://davegiles.blogspot.com/2014/06/some-questions-about-ardl-models.html (accessed: 07.05.2026).

Godfrey, L.G. (1978). Testing against General Autoregressive and Moving Average Error Models when the Regressors Include Lagged Dependent Variables, *Econometrica*, 46(6), pp. 1293–1301.

Golinowska, S., Tabor, M. (2014). Sources of Health Care Financing, *Public Health and Management*, 12(3), pp. 205–217. DOI: 10.4467/20842627OZ.14.022.3440.

Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health, *Journal of Political Economy*, 80(2), pp. 223–255.

Hansen, P., King, A. (1996). The Determinants of Health Care Expenditure: A Cointegration Approach, *Journal of Health Economics*, 15(1), pp. 127–137.

Inder, B. (1993). Estimating Long-Run Relationships in Economics: A Comparison of Different Approaches, *Journal of Econometrics*, 57(1–3), pp. 53–68.

Issever, T., Sennaroglu, B., Donmez, C.C. (2024). Identifying Influential Variables on Health Expenditure of the OECD Countries, *Iranian Journal of Public Health*, 53(8), pp. 1847–1857.

İlgün, G., Konca, M., Sönmez, S. (2023). The Relationship between the Health Transformation Program and Health Expenditures: Evidence from an Autoregressive Distributed Lag Testing Approach, *Value in Health Regional Issues*, 38, pp. 101–108.

Hirai, T., Okamoto, H. (2025). Health Care Expenditure, Economic Growth, and Population Ageing in Japan: Empirical Evidence Using the Nonlinear ARDL Approach, *Applied Economics Letters*, 32(21), pp. 3059–3063.

Jarque, C.M., Bera, A.K. (1980). Efficient Tests for Normality, Homoscedasticity and Serial Independence of Regression Residuals, *Economics Letters*, 6(3), pp. 255–259.

Johansen, S., Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, 52(2), pp. 169–210.

Kallestrup-Lamb, M., Marin, A.O., Menon, S., Sogaard, J. (2024). Aging Populations and Expenditures on Health, *The Journal of the Economics of Ageing*, 29, 100518.

Kiymaz, H., Akbulut, Y., Demir, A. (2006). Tests of Stationarity and Cointegration of Health Care Expenditure and Gross Domestic Product: An Application to Türkiye, *European Journal of Health Economics*, 7(4), pp. 285–289. DOI: 10.1007/s10198-006-0375–9.

Kripfganz, S., Schneider, D.C. (2023). ardl: Estimating Autoregressive Distributed Lag and Equilibrium Correction Models, *The Stata Journal*, 23(4), pp. 983–1019.

Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y. (1992). Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root, *Journal of Econometrics*, 54(1–3), pp. 159–178.

Murthy, V.N.R., Okunade, A.A. (2016). Determinants of U.S. Health Expenditure: Evidence from Autoregressive Distributed Lag (ARDL) Approach to Cointegration, *Economic Modelling*, 59, pp. 67–73.

Newhouse, J.P. (1977). Medical-Care Expenditure: A Cross-National Survey, *The Journal of Human Resources*, 12(1), pp. 115–125.

Pesaran, M.H., Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. In: *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium* (pp. 371–413), S. Strøm (Ed.). Cambridge: Cambridge University Press.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships, *Journal of Applied Econometrics*, 16(3), pp. 289–326.

Pfaff, B. (2008). *Analysis of Integrated and Cointegrated Time Series with R* (2nd ed.). New York: Springer.

Phillips, P.C.B., Perron, P. (1988). Testing for a Unit Root in Time Series Regression, *Biometrika*, 75(2), pp. 335–346.

Traczyk, K. (2025). Determinants of Health Care Expenditure in Poland in the Years 2014–2023, *Olsztyn Economic Journal*, 20(2), pp. 157–168. DOI: 10.31648/oej.11747.

Van Eenoo, L., Declercq, A., Onder, G., Finne-Soveri, H., Garms-Homolová, V., Jónsson, P.V., Dix, O.H.M., Smit, J.H., van Hout, H.P.J., van der Roest, H.G. (2016). Substantial Between-Country Differences in Organising Community Care for the Elderly People in Europe – A Review, *European Journal of Public Health*, 26(2), pp. 213–219. DOI: 10.1093/eurpub/ckv152.

Werblow, A., Felder, S., Zweifel, P. (2007). Population Ageing and Health Care Expenditure: A School of 'Red herrings'?, *Health Economics*, 16(10), pp. 1109–1126.

World Bank (2025). *World Development Indicators*, https://databank.worldbank.org/source/world-development-indicators (accessed: 07.05.2026).

Zweifel, P., Felder, S., Meiers, M. (1999). Aging of Population and Health Care Expenditure: A Red Herring?, Health Economics, 8(6), pp. 485–496.

6

Norbert Duczkowski[1]
Lubomir Słowik[2]

Cultural Determinants of the Pace of AI Adoption: Evidence from European Countries

Abstract

The rapid evolution of Artificial Intelligence (AI) from simple algorithms to Large Language Models (LLMs) raises critical questions regarding its disparate adoption rates across nations. While the determinants of innovation diffusion in ICT (including IT) have been extensively researched, national culture remains a pivotal complex factor. This study investigates cultural dimensions as one of the key determinants of the speed of AI implementation using the Schwartz Theory of Basic Human Values framework (21 variables). Integrating data from Eurostat and the European Social Survey (ESS) for 13 countries, the research employs a two-stage computational approach developed in RStudio. The methodology transitions from Pearson correlation analysis to a Multilayer Perceptron (MLP) neural network model, utilising over 20,000 survey responses from the eleventh ESS round. The results confirm that integrating cultural factors significantly enhances the modelling of AI adoption rates ($R^2 = 0{,}7387$), where the key cultural variables identified by the neural network's relative importance ranking are: Importance of Freedom (IMPFREE), Importance of Success (IPSUCES), and Importance of Strong Government (IPSTRGV). The model reveals that while security and tradition remain relevant, the primary drivers of adoption are rooted in individual autonomy and achievement-oriented values. These findings offer practical strategic insights for the cross-border implementation and marketing of AI solutions, emphasising the need for culturally adaptive technological frameworks.

1 SGH Warsaw School of Economics (Poland), e-mail: nduczk@sgh.waw.pl.
2 Jagiellonian University (Poland), e-mail: lubomir.slowik@doctoral.uj.edu.pl.

1. Introduction

Artificial Intelligence (AI) constitutes one of the most dynamically evolving frontiers of contemporary science and technology, having transitioned from rudimentary algorithmic structures into sophisticated systems (agentic AI) capable of autonomous learning and complex content generation, exemplified by the proliferation of Large Language Models (LLMs). This rapid technological trajectory offers unprecedented transformative potential across diverse sectors, including cybersecurity, government and defence, finance and insurance, media and marketing, consumer services, robotics and IT hardware, entertainment and the arts, autonomous vehicles and healthcare [Duczkowski, Śliwiński, 2026; Duczkowski, 2026]. However, such promising prospects necessitate a critical examination of the disparate rates of AI integration across different nations, and identifying the underlying determinants of these adoption patterns is essential for informed strategic planning and optimising the global socio-economic benefits of AI.

In the field of innovation diffusion, particularly regarding Information and Communication Technologies (ICT), national culture has long been identified as a pivotal factor modulating societal attitudes and behaviours [Lee, Trimi, Kim, 2013]. Variations in value systems, social norms and collective beliefs between different countries substantially calibrate a nation's readiness to assimilate emerging technologies. The prevailing scientific literature offers several theoretical frameworks designed to quantify cultural dimensions, providing analytical lenses through which to examine their impact on socio-economic development [Lee et al., 2013; Tian, Deng, Zhang, Salmador, 2018; Leidner, Kayworth, 2006].

Prominent models frequently employed in innovation adoption research include Hofstede's Cultural Dimensions [Hofstede, 1983; 2001; 2013], the Trompenaars and Hampden-Turner model [Trompenaars, Hampden-Turner, 2000], and the Inglehart-Welzel framework [Lee et al., 2013]. These theories delineate various cultural orientations, such as individualism versus collectivism, power distance, and uncertainty avoidance, which shape how societies perceive and evaluate AI-driven solutions. Notably, however, Schwartz's Theory of Basic Human Values [Schwartz, 1992; 2006] has remained significantly underutilised in this specific research context, representing a research gap in the existing literature which the present study aims to address.

Recognising the influence of cultural substrates on the implementation of innovative solutions, this article investigates the correlation between AI adoption dynamics and national cultural factors, operationalised through the Theory of Basic Human Values. The primary objective is to empirically determine which specific cultural char-

acteristics are associated with the speed of AI adoption in companies. The findings of this research may provide actionable insights for policymakers, organisational leaders, and strategic marketers, facilitating the alignment of AI deployment strategies with the cultural specificities of diverse international markets.

The empirical analysis presented in this paper utilises secondary data for 13 countries synthesised from two complementary sources. AI adoption metrics were retrieved from the Eurostat database, while cultural factors were derived from the European Social Survey (ESS), a comprehensive study monitoring values and attitudes across Europe. Notably, the utilisation of ESS data in conjunction with AI adoption rates is rare in contemporary research, thereby reinforcing this study's contribution to bridging current research gaps.

The methodological framework of this paper employs a two-stage computational approach, transitioning from Pearson correlation analysis to a Multilayer Perceptron (MLP) neural network model. The dependent variable is defined as the relative change in AI adoption speed, while the independent, 21 cultural variables within the framework of the Schwartz Theory of Basic Human Values are constructed from a robust dataset of over 20,000 survey responses from the eleventh round of the European Social Survey (ESS). Rooted in the Schwartz Theory of Basic Human Values, this statistical analysis, conducted in RStudio, aims to identify complex dependencies between cultural dimensions and the speed of AI adoption across the analysed European nations.

2. The Theory of Basic Human Values as one of the basic cultural models

National culture is defined as a transgenerational set of shared values, norms and behavioural patterns that distinguish societies [Hofstede, 1983; 2011; 2013]. Geert Hofstede describes it as a collective programming of the mind that shapes how individuals think, feel and act within social and organisational contexts. It can also be understood as a constellation of interconnected elements forming specific cultural systems, subjectively experienced by group members through their values [Kozłowska, 1996]. It should also be pointed out that the definition of culture in the scientific literature depends largely on the specific theoretical model adopted.

Cultural programming begins in the family and evolves through education and social environments across three levels [Kostro, 2009]: universal (shared human nature), collective (group-specific identity) and individual (unique personal traits).

Table 1. Comparison of selected cultural models

LP	Model	Authors	Date of publication	Source paper	Main assumption	Key dimensions	Individual or group model	Similarities to Schwartz (individual)	Differences from Schwartz (individual)
1	Theory of basic human values (Schwartz)	Shalom H. Schwartz	1992	Universals in the Content and Structure of Values: Theoretical advances and empirical tests in 20 countries	Values as universal motivators of behaviour	10 values (e.g. self-direction, kindness, power)	Individual	– (reference point)	– (reference point)
2	Trompenaars andHampden-Turner's Cultural Model	Fons Trompenaars, Charles Hampden-Turner	1993	Riding the waves of culture: Understanding diversity in global business	Culture as a way of solving dilemmas	7 dimensions (e.g. individualism vs communitarianism)	Group	Individualism-communitarianism vs self-direction-kindness	Focus on cultural dilemmas, not individual values
3	Schwartz's Cultural Values Model	Shalom H. Schwartz	1994	Are There Universal Aspects in the Structure and Contents of Human Values?	A culture based on social values	7 dimensions (e.g. autonomy, hierarchy, harmony)	Group	Autonomy-self-direction, harmony-kindness	Analysis at the social, not individual level
4	Project GLOBE	Robert J. House and team	2004	Culture, Leadership, and Organisations: The GLOBE Study of 62 Societies *based on Review of Culture, Leadership and Organisations: The GLOBE Study of 62 Societies*	The Impact of Culture on Leadership and Organisations	9 dimensions (e.g. power distance, result orientation)	Group	Power-power distance, result-achievement orientation	Organisational and leadership context, not individual motivations

LP	Model	Authors	Date of publication	Source paper	Main assumption	Key dimensions	Individual or group model	Similarities to Schwartz (individual)	Differences from Schwartz (individual)
5	Hofstede Culture Model	Geert Hofstede	1983	National Cultures in Four Dimensions: A Research-based Theory of Cultural Differences among Nations	Culture as a set of values influencing social behaviour	6 dimensions (e.g. individualism vs collectivism, distance from power)	Group	Individualism-self-direction, distance from power	Focus on national culture, not individual values
6	The Big Five	Paul Costa, Robert McCrae	1992	Normal personality assessment in clinical practice: The NEO Personality Inventory	Personality traits	5 dimensions (e.g. extraversion, conscientiousness)	Individual	Agreeableness-kindness, openness-self-direction	Describes characteristics, not values
7	Maslow's hierarchy	Abraham Maslow	1943	A Theory of Human Motivation	Hierarchy of needs	5 levels (e.g. safety, self-realisation)	Individual	Safety-Security, Self-Realization-Achievement	Hierarchical approach vs parallel values
8	Rokeach Model	Milton Rokeach	1973	The Nature of Human Values, *based on Review of The Nature of Human Values*	Terminal and instrumental values	List of values (e.g. freedom, fairness)	Individual	Freedom-universalism, honesty-kindness	Lack of structure of relationships between values
9	Hexaco	Michael Ashton, Kibeom Lee	2001	A Theoretical Basis for the Major Dimensions of Personality	Expanded personality	6 dimensions (e.g. honesty, openness)	Individual	Honesty-kindness, openness-stimulation	Personality traits, not values

Source: Authors' own elaboration, based on the articles indicated in the table and References.

This division illustrates why cultural models can be systematically categorised into individual and group dimensions. Individual models analyse personal values, traits and motives as independent drivers of behaviour and life goals, regardless of the broader social context [Kostro, 2009]. Conversely, group-level models view values and norms as collective constructs that shape social interactions, power dynamics, and problem-solving processes within societies or organisations [Kostro, 2009]. This implies that individuals experience their national culture as a subjective lens through which they interpret and respond to objective reality [Kozłowska, 1996].

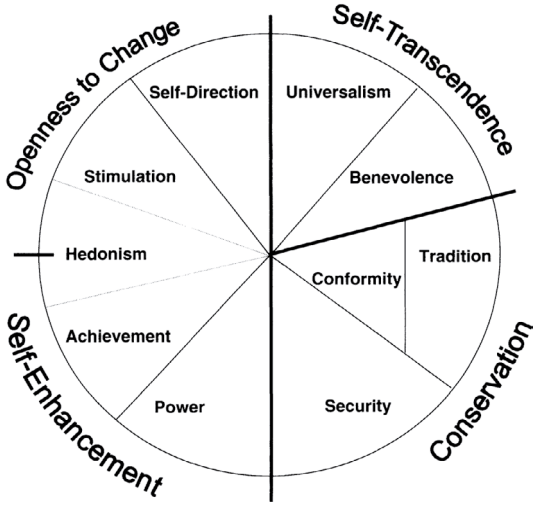
In both individual and group-level models, values hold a central role, serving as the engine of personal behaviour in the former, and the foundation of culture in the latter. Often shared within communities, values act as a bridge between the individual and the collective, representing universal human aspirations even when not explicitly stated. Despite varying terminology across the models, a significant conceptual overlap exists. For example, individualism in group models (Hofstede, Trompenaars) largely corresponds to self-direction in individual models such as Schwartz's. Both paradigms prioritise the impact of values on behaviours and attitudes, seeking to understand how they or their derivatives, such as norms and traits, guide human actions. While individual models focus on daily personal decisions and motivations, group models explain how collective preferences shape behaviour in social, national or organisational contexts. A detailed comparison of these selected models is provided in Table 1.

Given the central role of values in defining culture and the availability of highly reliable empirical data from the ESS survey, this paper employs the Theory of Basic Human Values [Schwartz, 1992; 2006; 2012a; 2012b] as its primary analytical framework. Although this theory is not as widely applied as Hofstede's cultural model [Hofstede, 1983; 2001; 2013], it offers an exceptionally effective and empirically grounded tool for identifying significant differences between countries. The selection of Schwartz's framework is also driven by its unique ability to capture granular psychological motivators, due to 21 variables that precede collective societal shifts [Schwartz, 1992; 2006]. In contrast to group-level models that often generalise cultural traits, Schwartz's individual approach allows for a direct correlation between individual value priorities, derived from extensive datasets such as the European Social Survey and the aggregate speed of AI adoption. Furthermore, the model's circular structure (Figure 1) provides a sophisticated lens to examine the inherent trade-offs between stability (conservation) and innovation (openness to change), making it uniquely suited for analysing the dynamic and disruptive nature of AI implementation across European nations. Consequently, in the comparative analy-

sis of the selected cultural models presented in Table 1, Schwartz's individual model is designated as the primary point of reference.

The Theory of Basic Human Values, proposed by Shalom H. Schwartz, is a conceptual framework designed to identify universal values that influence human behaviour across different cultural and social environments [Schwartz, 1992; 2006; 2012a; 2012b]. The model posits ten fundamental values (presented in Table 4: subscale column): self-direction, stimulation, hedonism, achievement, power, security, conformity, tradition, benevolence and universalism, organised in a quasi-circular structure that illustrates their interrelations and potential motivational conflicts. These values are characterised as preferred objectives that influence individuals' attitudes, choices and behaviours. Although their priority varies based on personal preferences, the model is categorised as an individual-level framework due to its focus on personal ideals.

Figure 1. Schematic representation of the Theory of Basic Human Values model



Source: Davidov et al. [2008].

Schwartz asserts that these universal values emerge from three fundamental categories of human needs [Schwartz, 1992; 2006]: biological requirements, social coordination, and existential needs. A defining feature of this theory is its distinctive circular arrangement, which maps the dynamic compatibility or conflict between specific values (Figure 1). Neighbouring values, such as benevolence and universalism, are inherently compatible and often coexist within an individual's motivational profile. Conversely, values situated on opposite sides of the circle, such as power

and benevolence, generate motivational discord, a pattern that has been empirically validated through cross-cultural research in more than 20 countries [Davidov, Schmidt, Schwartz, 2008].

To further elucidate these relationships, the model categorises values into four higher-order groups: Openness to Change (self-direction, stimulation), Conservation (security, conformity, tradition), Self-Enhancement (achievement, power) and Self-Transcendence (benevolence, universalism). This design emphasises that values constitute a cohesive, dynamic motivating system where their relative significance influences decisions in a predictable and quantifiable manner. For instance, a person prioritising stimulation may concurrently dismiss tradition, a dynamic visually represented by their contrasting locations within the circular framework. This structural complexity makes the Schwartz model particularly effective for examining value conflicts and their impact on human behaviour, as illustrated in Figure 1 [Davidov et al., 2008].

In conclusion, the Theory of Basic Human Values provides a robust and multidimensional framework for understanding the psychological foundations of societal behaviour [Schwartz, 1992; 2006; 2012a; 2012b]. By identifying universal motivators and their structural interrelations, this model transcends simple cultural descriptions, offering a quantifiable method to analyse how personal priorities, such as Openness to Change or Conservation, shape collective outcomes. Given that the adoption of disruptive technologies such as AI is inherently tied to a society's willingness to embrace novelty and manage risk, Schwartz's model serves as an ideal lens for this investigation. The following section will build upon this theoretical base, examining the specific empirical links between culture and the varying pace of AI implementation.

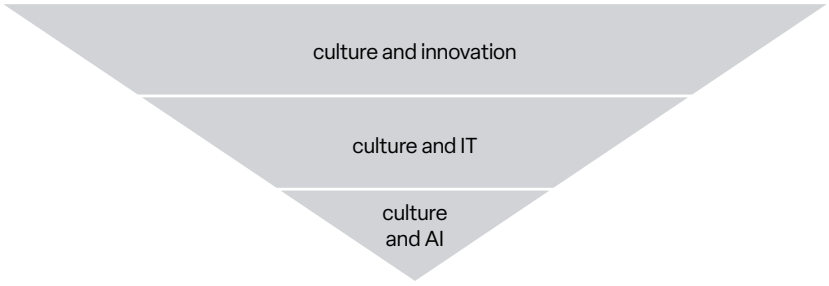
3. The influence of culture on innovation adoption and the pace of AI implementation

As already indicated, culture is fundamental to all aspects of human existence, influencing cognition, decision-making, communication and the evolution of social standards [Duczkowski, Słowik, Śliwiński, 2024]. Consequently, culture has emerged as a central theme in finance and management studies, where researchers and practitioners recognise that cultural variables are crucial to business operations, human resource management, and economic policy formulation. Kostro [2009] asserts that culture shapes corporate management styles, risk perceptions, and innovation strat-

egies, making it a vital factor in analysing economic and managerial phenomena. Incorporating cultural factors allows for a deeper understanding of the mechanisms regulating global economies and enhances the accuracy of behavioural forecasts regarding market participants.

Due to its significant relevance, culture has become the focus of intense academic inquiry into its influence on the conception and execution of broadly defined innovations, with researchers examining the impact of cultural variables on the adoption of ICT in various national and organisational contexts. There is a growing focus on the intersection of culture and artificial intelligence (AI), which is currently a fundamental component of modern IT solutions. Consequently, the following section presents a literature analysis conducted using a top-down methodology, moving from the general to the specific, to achieve a thorough understanding of studies concerning the rate of AI adoption, as illustrated in Figure 2.

Figure 2. Schematic overview of the literature review



Source: Authors' own elaboration.

The literature assessment indicates that national culture significantly influences a society's willingness to adopt innovation, affecting both the degree of trust in new technology and the acceptance of related dangers. Differences in cultural values can markedly expedite or impede the rate of innovation adoption among nations. Table 2 presents research findings analysing the correlation between national culture and the adoption of innovation.

Given that national culture profoundly impacts the acceptance of innovations, it can be inferred that it likewise affects the assimilation of ICT solutions, including systems based on Artificial Intelligence (AI). Cultural disparities influence individuals' attitudes towards new technologies, affecting their receptiveness to change and readiness to adopt them. In certain societies, cultural norms may promote the swift integration of digital tools, whilst in others, they may serve as impediments,

contingent upon dominant societal values. Ultimately, culture shapes user behaviour, suggesting that cultural factors significantly dictate the pace of AI and ICT adoption.

Table 2. Selected research papers analysing the relationship between national culture and innovation, with key conclusions

Research papers	Key conclusions
Allred and Swan [2004]; Bradley et al. [2013]; Desmarchelier, Fang [2016]; Efrat [2014]; Engelen et al. [2014]; Erez, Nouri [2010]; Espig et al. [2022]; Griffith, Rubera [2014]; Hsu et al. [2010]; Jones, Davis [2000]; Kaasa, Vadi [2010]; Lim, Park [2013]; Lin [2009]; Morris, Leung [2010]; Puia, Ofori-Dankwa [2013]; Rhyne et al. [2002]; Rossberger [2014]; Rujirawanich et al. [2011]; Shane [1992]; Shane [1993]; Shane [1995]; Singh [2006]; Steenkamp et al. [1999]; Taylor, Wilson [2012]; Tian et al. [2018]; van Everdingen, Waarts [2003]; Waarts, van Everdingen [2005]	1. Complex Cultural Impact: National culture, predominantly studied via Hofstede's model, serves as a multifaceted moderator of country-level innovation. 2. Power Distance Constraints: Low power distance facilitates the free flow of ideas, whereas high power distance inhibits innovation by restricting access to resources and opportunities. 3. Individualism vs Collectivism: Individualism typically encourages risk-taking and entrepreneurship, while collectivism may act as a barrier unless channelled through national sentiments. 4. Gender-Typed Environments: Innovation is driven by achievement-oriented masculine cultures, or, conversely, by trust-based and supportive feminine environments. 5. Temporal Orientation: Long-term orientation fosters sustained technological persistence while short-termism may occasionally catalyse radical, disruptive breakthroughs. 6. The Uncertainty Paradox: Rigid norms in high uncertainty avoidance cultures generally hamper innovation, though they can paradoxically trigger it as a strategic risk-mitigation tool. 7. Indulgence Research Gap: There remains a critical shortage of empirical data regarding the influence of the indulgence dimension on national innovative capacity. 8. Need for Granular Analysis: Persistent contradictions in current findings necessitate further investigation into how various cultural dimensions interact to shape technological progress.

Source: Authors' own elaboration based on Tian et al. [2018].

Accordingly, the interplay between culture and ICT, specifically IT, has been examined through various functional lenses, as categorised in Table 3. The existing literature can be broadly divided into three primary streams: ICT/IT Systems Development, Use and Outcomes; ICT/IT Adoption and Diffusion and ICT/IT Management and Strategy. To explore these dimensions, scholars have employed a wide range of methodologies, including experiments, surveys, case studies, and archival data analysis. This methodological diversity reinforces the conclusion that no single approach

dominates the field, allowing for a multifaceted understanding of how cultural factors influence different stages of the IT lifecycle.

Table 3. Selected research studies analysing the relationship between ICT/IT and national culture, categorised by thematic research areas

Research topic	Selected relevant research
ICT/IT Systems Development, Use and Outcomes	Dagwell, Weber, Kling [1983]; Hunter, Beck [2000]; Keil et al. [2000]; Kumar, Bjørn-Andersen, King [1990]; Lee et al. [2013]; Leidner, Kayworth [2006]; Peterson, Kim [2003]; Tan, Smith, Keil [2003]; Walsham [2002]; Choe [2004]; Downing, Gallaugher, Segars [2003]; Gamble, Gibson [1999]; Ishman, Pegels, Sanders [2001]; Johns, Smith, Strand [2003]; Leidner, Carlsson, Elam, Corrales [1999]; Quaddus, Tung [2002]; Rose, Evaristo, Straub [2003]; Tan, Wei, Watson, Walczuch [1998]; Watson, Ho, Raman [1994]; Yoo, Torrey [2002]; Festing et al. [2025]
ICT/IT Adoption and Diffusion	Chui, Kwok [2008]; De Vreede, Jones, Mgaya [1998]; Fischer, Mansell [2009]; Galliers, Madon, Rashid [1998]; Garfield, Watson [1998]; Griffith [1998]; Hasan, Ditsa [1999]; Hill, Loch, Straub, El-Sheshai [1998]; Lee et al. [2013]; Leidner, Kayworth [2006]; Madon [1992]; Straub [1994]; Straub, Keil, Brenner [1997]; Thatcher, Srite, Stepina, Liu [2003]; Marjanovic, Mester, Milic Marjanovic [2024]
ICT/IT Management and Strategy	Cougar [1986]; Husted [2000]; Kettinger, Lee, C.C., Lee, S. [1995]; Lee et al. [2013]; Leidner, Kayworth [2006]; Milberg, Burke, Smith, Kallman [1995]; Shore et al. [2001]

Source: Authors' own elaboration based on: Leidner, Kayworth [2006], Lee et al. [2013] and own analyses.

Table 3 substantiates that the correlation between culture and ICT/IT adoption has been extensively examined in academic research. However, these studies have typically adopted a broad perspective on ICT implementation rather than focusing specifically on Artificial Intelligence (AI). Furthermore, existing research has predominantly relied on Hofstede's cultural model, leaving alternative frameworks, such as the Theory of Basic Human Values, without considerable academic scrutiny in this domain. Significantly, these previous investigations have largely overlooked data from the European Social Survey (ESS), a highly reputable and robust data source that remains underutilised in the context of cultural drivers of AI adoption.

In line with the structural progression illustrated in Figure 2, the final stage of this literature review focuses on the direct relationship between culture and the speed of AI implementation. Numerous sources directly investigate the implementation of AI across diverse contexts, such as: Shahzadi, Jia, Chen, John [2024], Chew, Achananuparp [2022], Agarwal, Swami, Malhotra [2024], Jatobá, Ferreira, Fernandes, Teixeira [2023], Hamm, Klesel [2021], Khanfar, Kiani Mavi, Iranmanesh, Gengatharen [2025], Marocco, Barbieri, and Talamo [2024], Xiong, Sun, Wang [2024] or Tubadji, Denney, Webber [2021]. These studies examine the determinants affecting the

adoption of AI across many nations, companies and industries, including healthcare [Chew, Achananuparp, 2022], human resource management [Jatobá et al., 2023], and industry and financial services [Agarwal et al., 2024]. They recognise the advantages and obstacles related to AI integration, encompassing user views, ethical considerations, technological factors, organisational dynamics, and cultural aspects. Ultimately, these investigations validate diverse hypotheses regarding AI acceptability and establish a theoretical foundation for further empirical inquiry into how cultural nuances dictate the adoption curve in this rapidly evolving field.

The influence of culture, particularly national culture, on AI adoption is acknowledged as both substantial and complex [Khanfar et al., 2025; Hamm, Klesel, 2021; Tubadji et al., 2021]. National culture significantly influences the AI adoption process, affecting individual consumer preferences and corporate tactics regarding this technology [Tubadji et al., 2021]. Research consistently highlights that opinions towards AI adoption differ markedly between countries, indicating that technology preferences are profoundly rooted in cultural contexts rather than influenced solely by neophobia [Tubadji et al., 2021]. Furthermore, cultural relativity significantly influences customer perceptions and the adoption of AI-driven services, such as robo-advisory, within the financial industry [Tubadji et al., 2021].

The Culture-Based Development (CBD) concept posits that local norms and cultural values are essential factors influencing socio-economic decision-making, including the adoption of technical advancements like AI [Tubadji et al., 2021]. Empirical evidence demonstrates that the degree of social trust within a society substantially influences the propensity to utilise AI. Paradoxically, elevated overall trust may be associated with a diminished inclination to embrace AI in banking, as individuals may exhibit greater reliance on human interactions with advisors. Conversely, a heightened fear of deception is associated with an increased preference for AI, which is regarded as more objective and dependable [Tubadji et al., 2021]. Furthermore, receptiveness to novel concepts differs among cultures and directly influences the pace of AI adoption [Tubadji et al., 2021]. The hierarchical CBD model demonstrates that country-specific effects, indicative of cultural disparities, significantly contribute to the variety in the propensity to utilise robo-advisory services [Tubadji et al., 2021]. Analyses utilising World Values Survey data indicate that diverse cultural attitudes, such as receptiveness to innovation, trust in others, and apprehension of exploitation exert varying levels of effect on consumer willingness to adopt AI in banking [Tubadji et al., 2021].

In organisational contexts, while current research does not explicitly investigate the influence of national culture on AI adoption in HRM [Jatobá et al., 2023] or

in organisations broadly [Hamm, Klesel, 2021], it can be posited that culture affects organisational preparedness for AI adoption. This is particularly evident in promoting interdisciplinary collaboration and knowledge sharing, which are essential facilitators of successful AI implementation. National culture fundamentally influences the direction and rate of AI adoption across nations by impacting attitudes toward risk, uncertainty, innovation and social relations [Tubadji et al., 2021].

These findings indicate that cultural relativity is a significant factor influencing customers' propensity to embrace AI, especially within the financial services industry [Tubadji et al., 2021]. They also affirm the existence of a research gap, previously identified in the ICT/IT sector, regarding the influence of national culture on AI adoption. This literature assessment on the cultural factors of AI adoption distinctly identifies a research gap that the current study aims to remedy. This pertains to both the selection of data sources, such as the European Social Survey (ESS), and the explicit emphasis on the pace of AI deployment itself.

In summary, while the impact of culture on general technology is well-documented, its specific role in the rapid proliferation of AI remains an emerging field. This review reveals a critical need for nuanced empirical evidence that moves beyond broad ICT frameworks. By shifting the focus from Hofstede's dimensions to the Theory of Basic Human Values and utilising the robust European Social Survey (ESS) dataset, this research seeks to provide a granular understanding of how deeply embedded values accelerate or impede the digital transformation of European societies.

4. Research method and database

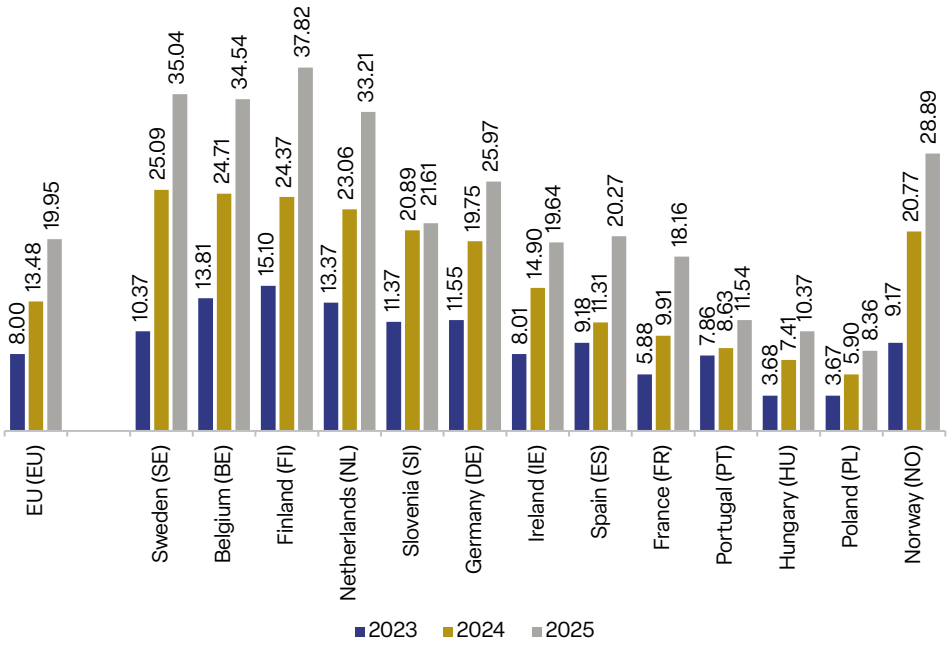
The research utilised secondary data sourced from Eurostat and the European Social Survey (ESS), widely recognised for their reliability and methodological rigour. The research sample consists of a selected group of European nations. Specifically, the study encompassed only those countries that participated in all rounds of the European Social Survey (ESS) to ensure longitudinal consistency [IFiS PAN, 2025d; ESS, 2025a – e]. These nations include: Belgium (BE), Finland (FI), France (FR), Germany (DE), Hungary (HU), Ireland (IE), the Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Slovenia (SI), Spain (ES) and Sweden (SE).

Data on firms employing AI technology in 2023–2025 were collected from the Eurostat database and presented in Figure 1. According to the Eurostat methodology, AI refers to systems that use technologies such as text mining, computer vision, speech recognition, natural language generation and speech synthesis, machine learning,

or deep learning [Eurostat, 2025b]. These technologies can be used to gather and/or use data to predict, recommend or decide, with varying levels of autonomy, the best action to achieve specific goals [Eurostat, 2025b]. AI systems can be software-based, such as image recognition software, virtual assistants, and speech and face recognition systems, or embedded in devices such as autonomous robots, self-driving vehicles or drones [Eurostat, 2025b].

The adoption of AI technologies across the analysed European nations, presented in Figure 3, shows a consistent upward trend between 2023 and 2025. While the EU average percentage of enterprises using AI increased from 8.00% to 19.95% over this period, significant disparities remain between individual countries. Leading the digital transformation are Finland (37.82%), Sweden (35.04%) and Belgium (34.54%), which exhibit the highest saturation of AI in their business sectors. In contrast, although countries like Poland (PL) and Hungary (HU) started from a lower baseline, they also demonstrate substantial growth, with Poland more than doubling its adoption rate from 3.67% in 2023 to 8.36% by 2025. This variance underscores the different speeds of technological assimilation within the European market.

Figure 3. Enterprises using AI technologies (% of enterprises) in 2023–2025



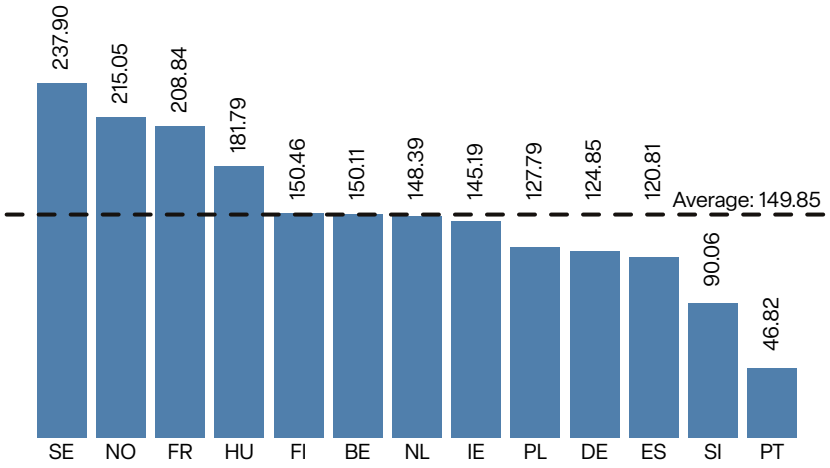
Source: Authors' own elaboration based on Eurostat [2025a, 2025b, 2025c].

For the purposes of this study, the pace of AI adoption in companies was calculated as a relative change (variable *AI_Relative_Change*), based on the formula (1) below:

$$AI_Relative_Change = \frac{\%\ of\ enterprises\ using\ AI\ in\ 2025 - \%\ of\ enterprises\ using\ AI\ in\ 2023}{\%\ of\ enterprises\ using\ AI\ w\ 2023} \quad (1)$$

The final values of the variable (*AI_Relative_Change*), calculated based on Formula 1 and utilised in this study, are presented in Figure 4.

Figure 4. Pace of AI adoption in 2023–2025 in % (variable: ***AI_Relative_Change***)



Source: Authors' own study based on Eurostat [2025a, 2025b, 2025c].

To evaluate cultural variations, this study utilises data from the European Social Survey (ESS), a major transnational academic initiative conducted across Europe since 2001 [ESS, 2025a; IFiS PAN, 2025a; IFiS PAN, 2025c]. The primary objective of the ESS is to monitor societal development by analysing longitudinal shifts in values, perspectives and behavioural trends [ESS, 2025a; ESS, 2025e; IFiS PAN, 2025a; IFiS PAN, 2025b].

The ESS questionnaire consists of a core module, covering socio-political, economic and psychological attributes, as well as rotational modules that address specific and evolving societal challenges [ESS, 2025a; IFiS PAN, 2025b]. This dual structure, combined with open-access availability, provides unique insights for scholars and policymakers to compare public sentiments across nations [ESS, 2025a]. To ensure data integrity, the ESS employs rigorous protocols, including probabilistic random sampling, multi-stage translation processes, and strict quality control [ESS, 2025a;

IFiS PAN, 2025e]. These methodological standards facilitate reliable international comparisons, making the ESS an indispensable resource for academic research [ESS, 2025a; IFiS PAN, 2025e].

This research specifically analyses responses regarding personal values, where participants assessed how closely they agreed with various statements [IFiS PAN, 2025e]. The variables and corresponding descriptions are detailed in Table 4. Responses were recorded on a six-point scale ranging from 1 ("Very much like me") to 6 ("Not like me at all"). Following standard procedures, missing or invalid data, including refusals (77), "don't know" responses (88), and no answers (99) were omitted from the final analysis to maintain dataset consistency [ESS, 2025d].

Table 4. Variables from the Theory of Basic Human Values model corresponding to the statements in the ESS survey

Lp.	Variable	Short description	Subscale
1	IPCRTIV	Important to have new ideas and be creative	Self-Direction
2	IMPRICH	Important to be rich, have money and expensive things	Power
3	IPEQOPT	Important that people are treated equally and have equal opportunities	Universalism
4	IPSHABT	Important to show abilities and be admired	Achievement
5	IMPSAFE	Important to live in secure and safe surroundings	Security
6	IMPDIFF	Important to try new and different things in life	Stimulation
7	IPFRULE	Important to do what is told and follow rules	Conformity
8	IPUDRST	Important to understand different people	Universalism
9	IPMODST	Important to be humble and modest, not draw attention	Tradition
10	IPGDTIM	Important to have a good time	Hedonism
11	IMPFREE	Important to make one's own decisions and be free	Self-Direction
12	IPHLPPL	Important to help people and care for others' well-being	Benevolence
13	IPSUCES	Important to be successful and that people recognise achievements	Achievement
14	IPSTRGV	Important that the government is strong and ensures safety	Security
15	IPADVNT	Important to seek adventures and have an exciting life	Stimulation
16	IPBHPRP	Important to behave properly	Conformity
17	IPRSPOT	Important to be respected by others	Power
18	IPLYLFR	Important to be loyal to friends and devote to people close	Benevolence
19	IMPENV	Important to care about nature and the environment	Universalism
20	IMPTRAD	Important to follow traditions and customs	Tradition
21	IMPFUN	Important to seek fun and things that give pleasure	Hedonism

Source: Authors' own elaboration based on ESS [2025a, 2025c, 2025d].

The survey values for each variable and country were averaged using the arithmetic mean. The results are presented in Table 5 and in Figure 5.

Table 5. Average response values of respondents in each country corresponding to specific values obtained in the eleventh round of the ESS survey

	Country	Portugal	Belgium	Germany	Spain	Finland	France	Hungary	Ireland	The Netherlands	Norway	Poland	Sweden	Slovenia
	Abbr.	PT	BE	DE	ES	FI	FR	HU	IE	NL	NO	PL	SE	SI
ESS survey variable (average value)	IMPDIFF	3.17	2.93	3.14	3.15	2.89	3.00	2.71	3.13	2.88	3.42	3.08	3.25	2.54
	IMPENV	2.29	2.03	2.08	2.05	1.92	2.27	2.11	2.11	2.15	2.43	2.08	2.21	1.77
	IMPFREE	2.10	2.03	1.86	1.91	2.11	2.45	2.34	2.13	1.89	2.31	2.12	2.29	1.85
	IMPFUN	2.92	2.45	3.10	2.89	2.55	2.94	2.42	2.99	2.41	3.03	3.69	2.70	2.68
	IMPRICH	4.23	4.21	4.44	4.47	4.54	4.74	3.46	4.22	4.32	4.46	3.92	4.54	4.20
	IMPSAFE	2.16	2.46	2.44	2.00	2.47	2.56	2.15	2.09	2.70	2.97	2.09	3.13	1.94
	IMPTRAD	2.77	2.75	3.04	2.91	3.29	3.37	2.58	2.63	3.03	3.18	2.36	3.44	2.48
	IPADVNT	3.93	3.73	4.13	4.06	3.86	4.07	3.65	3.63	3.71	3.74	3.97	3.83	3.64
	IPBHPRP	2.96	2.57	2.91	2.49	2.85	2.63	2.32	2.62	2.95	2.54	2.51	3.13	2.14
	IPCRTIV	2.54	2.52	2.45	2.36	2.60	2.56	2.60	2.54	2.41	2.54	2.88	2.43	2.27
	IPEQOPT	2.02	1.90	1.93	1.64	1.90	1.78	2.23	1.94	1.90	1.97	2.07	1.77	1.80
	IPFRULE	3.37	3.33	3.64	3.45	3.14	3.81	3.07	3.28	3.45	2.98	2.70	3.61	3.16
	IPGDTIM	2.60	2.62	2.41	2.89	2.86	2.25	2.66	3.35	2.88	3.22	3.68	2.92	2.49
	IPHLPPL	2.16	1.95	1.96	1.68	2.08	2.23	2.47	2.01	2.00	2.11	2.25	2.08	1.89
	IPLYLFR	2.00	1.74	1.59	1.74	1.78	1.87	2.08	2.05	1.89	1.81	2.01	1.81	2.02
	IPMODST	2.37	2.42	2.62	1.99	3.01	2.25	2.61	2.48	2.89	3.30	2.83	2.78	1.93
	IPRSPOT	2.98	3.34	3.41	3.70	3.97	3.75	2.81	3.03	3.48	3.54	2.97	3.63	2.63
	IPSHABT	2.94	3.19	3.73	3.64	3.86	3.68	2.65	3.15	3.22	3.84	3.29	3.76	2.58
	IPSTRGV	2.39	2.53	2.36	2.18	2.40	2.45	2.18	2.20	2.87	2.68	2.09	2.98	1.97
	IPSUCES	2.80	3.18	3.25	3.56	3.66	4.17	2.83	3.39	3.47	3.40	3.02	4.13	2.60
	IPUDRST	2.47	2.25	2.05	2.04	2.06	2.22	2.55	2.28	2.23	2.29	2.41	2.23	2.09

Source: Authors' own elaboration based on ESS [2025a, 2025c, 2025d].

Table 5 and Figure 5 reveal distinct cultural disparities across the analysed European nations. Scandinavian countries (FI, NO, SE) exhibit a specific profile, placing less emphasis on tradition and modesty while maintaining high levels of individualism. In contrast, Poland (PL) and Hungary (HU) demonstrate a stronger identification

with the pursuit of affluence compared to the European average. Values such as equal opportunity (IPEQOPT) and altruism (IPHLPPL) are highly esteemed across almost all nations (scoring below 2.00), indicating a robust European foundation of social solidarity. Analysing the factors with which respondents identify most strongly (the lowest numerical values):

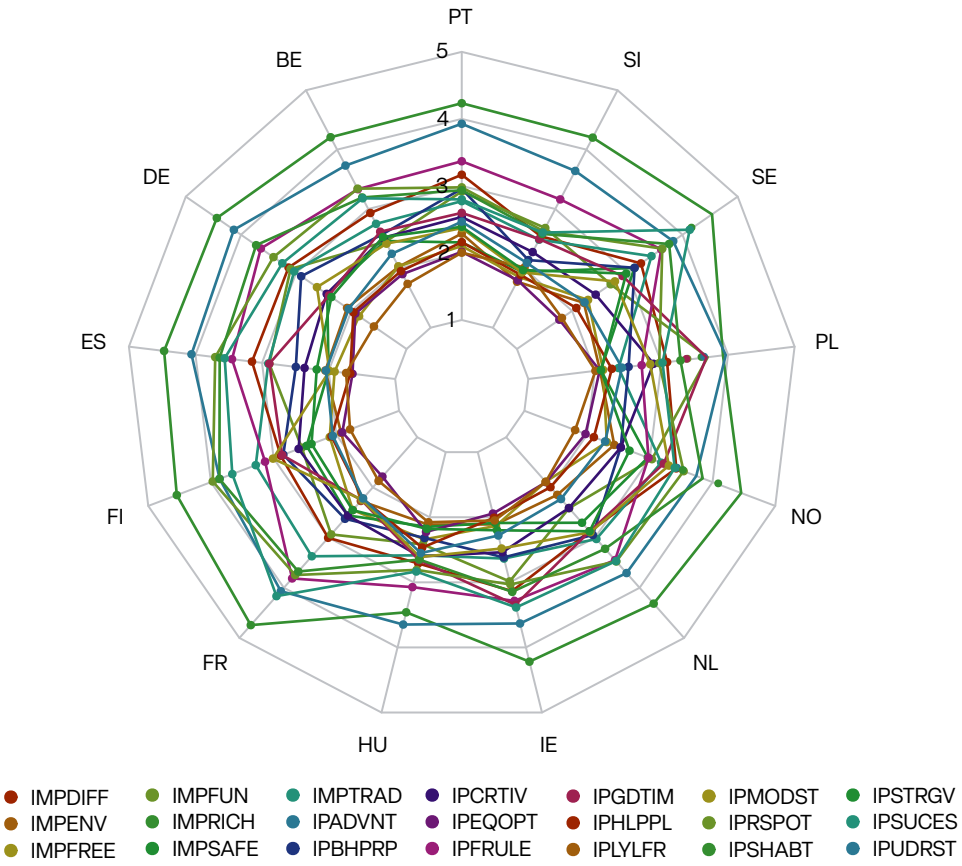
- Equal Opportunities (IPEQOPT): The highest importance to this factor is shown by respondents in Spain (1.64), Sweden (1.77) and France (1.78). Slovenia's score (1,80) also places it among the top nations promoting equal opportunities.
- Assisting Others (IPHLPPL): Altruistic attitudes are most strongly expressed in Spain (1.68), Slovenia (1.89) and Belgium (1.95). Germany, with a score of 1.96, also shows a very high level of identification with this value.
- Loyalty to Friends (IPLYLFR): This value is an absolute priority in Germany (1.59), representing the lowest score in the entire table. Very high levels of loyalty are also declared by respondents in Belgium (1.74) and Spain (1.74).
- The cultural values with the lowest degree of identification (scores above 3.5) include:
- Modesty and Tradition (IPSHABT): The highest scores were recorded in Finland (3.86), Norway (3.84) and Sweden (3.76). This suggests that traditionalism and conservative modesty have the least influence on life attitudes in these nations.
- Aspiration for Success and Admiration (IPSUCES): The least importance is attached to personal success in terms of prestige by respondents in France (4.17) and Sweden (4.13). For comparison, these aspirations are significantly stronger in Poland (3.02) and Slovenia (2.60).
- Affluence (IMPRICH): This variable generally sees the lowest identification across Europe. It is of least importance to the French (4.74) and of relatively greatest importance to the Hungarians (3.46) and Poles (3.92).

The analytical framework of this study is designed to identify and quantify the impact of cultural values on the speed of Artificial Intelligence (AI) adoption. To ensure high predictive accuracy and methodological rigor, a two-stage research process was implemented, combining classical statistical analysis with advanced machine learning techniques. All computational procedures, data preprocessing and model estimations were conducted using the RStudio.

The first stage of the research focuses on identifying the linear relationships between the all 21 cultural variables derived from the European Social Survey (ESS) and the relative growth of AI adoption (variable *AI_Relative_Change*). For this purpose, the Pearson Correlation Coefficient was calculated for each variable pair to determine the strength and direction of these associations. This exploratory phase serves

two primary functions: identifying whether specific cultural traits (variables) act as stimulants or inhibitors of technological progress, and evaluating the initial strength of influence before transitioning to neural network modelling. The results are visualised through a bar chart (Figure 6), where variables are ranked by the absolute strength of their influence. Cultural variables, characterised by a correlation coefficient exceeding or equal the |0.5| threshold, were subsequently selected as the primary input features for the construction and training of the Multi-Layer Perceptron (MLP) neural network model.

Figure 5. Average response values of respondents in each country corresponding to specific values obtained in the eleventh round of the ESS survey



Source: Authors' own elaboration based on ESS [2025a, 2025c, 2025d].

In the second stage, the study employs a Multilayer Perceptron (MLP), a class of feedforward Artificial Neural Networks (ANN). This approach was chosen for its

superior ability to capture dependencies and complex interactions between cultural dimensions (variables) that traditional econometric models might overlook. To ensure the stability of the neural network and prevent bias resulting from different scales of variables, Min-Max Normalisation was applied, transforming all data points into a uniform range of [0, 1]. The dataset was subsequently partitioned into a training set (70%), used to calibrate the network's weights and a testing set (30%), reserved for the final evaluation of the model's predictive capabilities.

The MLP model architecture consists of hidden layers (configured in a 4, 2 arrangement) using a logistic (sigmoid) activation function for hidden neurons and a linear (identity) function for the output layer. The training process utilised the Resilient Backpropagation (Rprop+) algorithm to ensure efficient convergence. To verify the reliability of the estimation, the model underwent comprehensive diagnostic testing (Table 6), including R-squared (R^2), Root Mean Square Error (RMSE) for goodness-of-fit, the Durbin-Watson (DW) test for residual autocorrelation, and the Shapiro-Wilk (SW) test to verify the normality of residuals.

The final phase of the methodology involves the synthesis of results through advanced visualisation and importance ranking. The study utilises a Relative Importance Ranking (Figure 8), based on the absolute weights of the neural network's input nodes. By calculating the mean absolute weights, the study provides a definitive ranking of which cultural variables serve as the most critical drivers of AI adoption speed in the analysed European nations. All empirical findings and statistical outputs are presented in Section 5: Results.

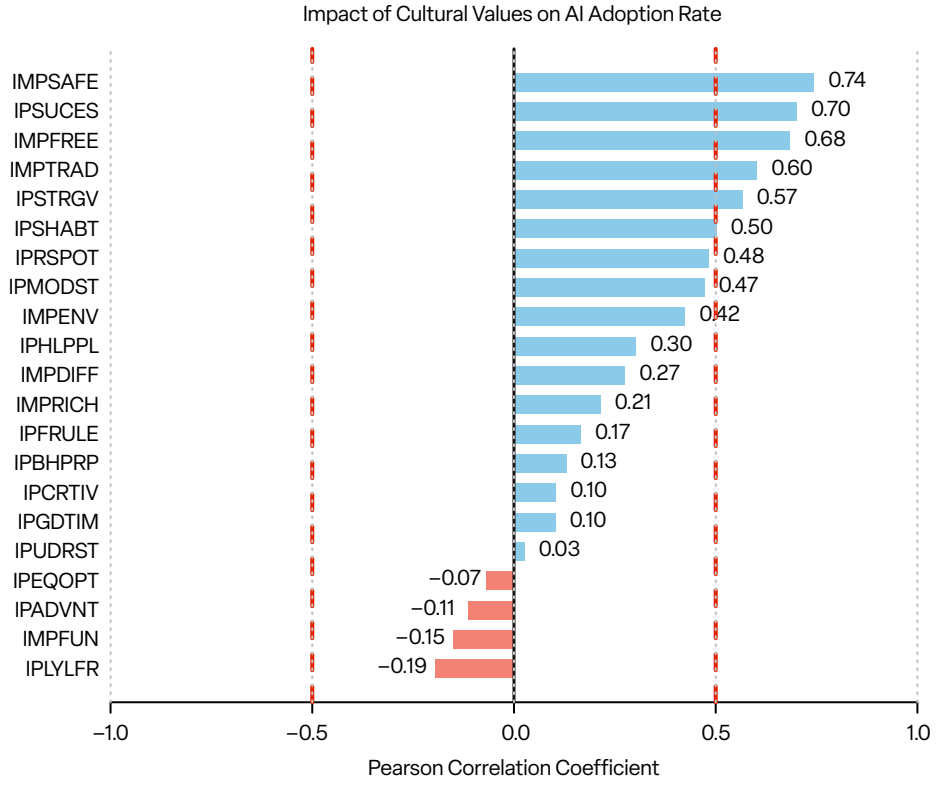
Despite maintaining methodological and statistical rigour, this study faces certain limitations, including the limited availability of comprehensive AI-specific data and the temporal misalignment between biennial ESS cycles and rapid AI shifts. Additionally, the scope was restricted to 13 countries to ensure data consistency between Eurostat and ESS datasets. Nevertheless, these constraints do not compromise the fundamental validity of the results, as the robust individual sample size and advanced non-linear modelling ensure the reliability of the identified cultural dependencies.

5. Results

The values of the correlation coefficients calculated between all the 21 cultural variables derived from the Theory of Basic Human Values, based on ESS data and the rate of AI adoption in firms (variable *AI_Relative_Change*), are presented in Figure 6.

Based on data presented in Figure 6, six cultural variables display a strong significant positive relationship with the speed of AI adoption, surpassing or equal to the correlation coefficient threshold of |0.5|. These variables are: IMPSAFE (r = 0.74): important to live in secure and safe surroundings; IPSUCES (r = 0.70): important to be successful and that people recognise achievements; IMPFREE (r = 0.68): important to make one's own decisions and be free; IMPTRAD (r = 0.60): important to follow traditions and customs; IPSTRGV (r = 0.57): important that the government is strong and ensures safety; IPSHABT (r = 0.50): important to show abilities and be admired. These six cultural variables were subsequently selected as the primary input features for the construction and training of the Multi-Layer Perceptron (MLP) neural network model.

Figure 6. Correlation coefficient values of cultural variables with the pace of AI solution adoption



Source: Authors' own elaboration.

In the second stage, the study employs a Multilayer Perceptron, a class of feedforward Artificial Neural Networks. The results are presented in Figure 7–8 and Table 6.

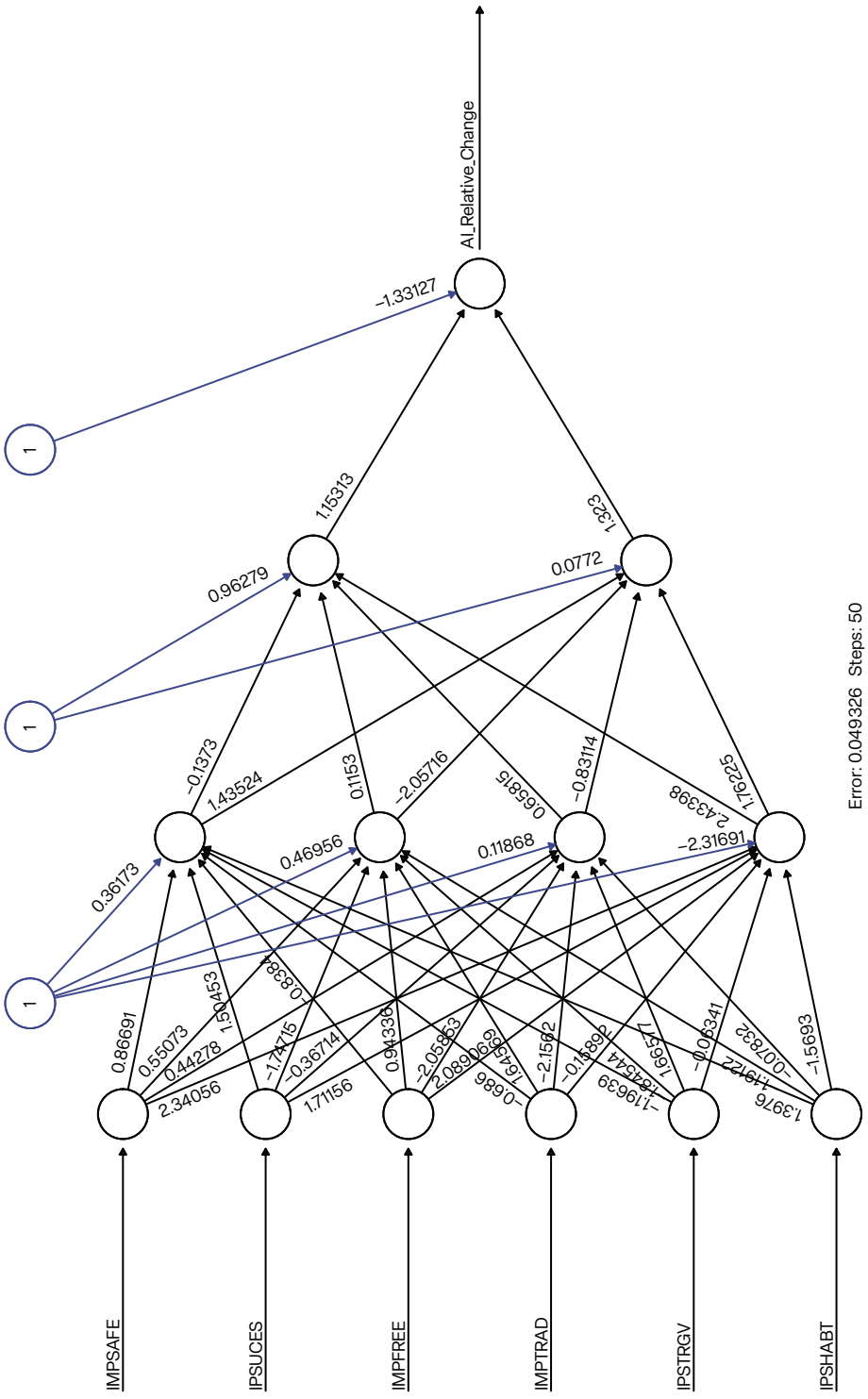


Figure 7. Architecture of the multilayer perceptron neural network model

Source: Authors' own elaboration.

Table 6. Model estimation results

Category	Parameter / Statistic	Value
Model Architecture	Network Type	multilayer perceptron (MLP)
	Configuration (hidden layers)	c (4, 2) (two hidden layers)
	Input Nodes (variables)	6 cultural variables: IMPSAFE, IPSUCES, IMPFREE, IMPTRAD, IPSTRGV, IPSHABT
	Output Node	1 (AI_Relative_Chang)
	Activation Function	Logistic (Sigmoid)
	Output Activation	Linear (Identity)
Training Process	Learning Algorithm	Resilient Backpropagation (Rprop+)
	Convergence Steps	50
	Error	0.049
Goodness-of-Fit	Coefficient of determination (R^2)	0.7387
	Root Mean Square Error (RMSE)	25.63
Diagnostic Tests	Durbin-Watson (autocorrelation)	DW=1.705 (pvalue=0.311)
	Shapiro-Wilk (normality)	SW=0.9167 (pvalue=0.229)

Source: Authors' own elaboration.

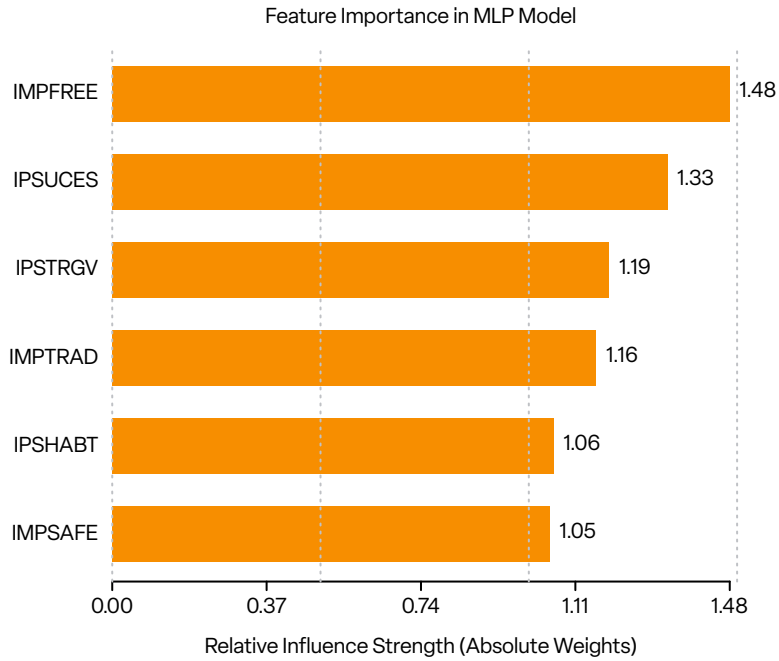
The estimation results for the MLP model, as presented in Table 6, demonstrate high predictive power and statistical robustness, characterised by $R^2 = 0.7387$. This value indicates that the six selected cultural variables explain approximately 74% of the variance in AI adoption speed, which represents a very strong fit for complex socio-cultural data. Diagnostic testing further confirms the model's reliability, as the Shapiro-Wilk test result (SW = 0.9167, pvalue = 0.229) shows no grounds to reject the null hypothesis regarding the normality of residuals. Furthermore, the Durbin-Watson statistic of 1.705 (pvalue = 0.311) indicates a lack of significant autocorrelation, proving that the observations are independent and the model is stable. The high efficiency of the Rprop+ algorithm is evidenced by the model reaching convergence in only 50 steps, with a minimal final error of 0.049, collectively proving that the MLP model is statistically sound and provides a highly credible basis for interpreting the influence of cultural values on technological progress.

The final phase of the research was a Relative Importance Ranking calculation, the results of which are presented in Figure 8.

The Relative Importance Ranking presented in Figure 8 provides a more nuanced view of the cultural drivers than the initial linear correlation analysis. While the pairwise correlations (Figure 4) identified IMPSAFE (r = 0.74) and IPSUCES (r = 0.70) as the leading individual indicators, the MLP model's absolute connection weights

shift the hierarchy of influence. In this MLP model, IMPFREE (Importance of Freedom) emerges as the most significant predictor with a relative influence strength of 1.48, followed by IPSUCES (1.33). Conversely, IMPSAFE, despite its high linear correlation, occupies the lowest rank in the neural network's internal weighting system with a value of 1.05, just below IPSHABT (1.06). Intermediate influence strengths were recorded for IPSTRGV (1.19) and IMPTRAD (1.16). This divergence between linear correlation coefficients and the neural network's absolute weights highlights that the importance of variables changes when they are analysed as an interacting system of predictors within the MLP architecture.

Figure 8. Relative Importance Ranking based on the absolute weights of the neural network's input nodes



Source: Authors' own elaboration.

6. Discussion

The objective of this research was to investigate the intricate relationship between cultural values and the speed of adoption of artificial intelligence (AI) across European nations. By shifting the analytical framework from a traditional linear correlation

to an MLP neural network model, this study achieved a relatively high explanatory power (R^2=0.7387). This significant result confirms that cultural determinants are not merely background noise but primary drivers of technological trajectories, explaining nearly 74% of the variance in AI implementation, which confirms earlier conclusions from the literature review [Tubadji et al., 2021].

The most compelling finding is the hierarchy of influence established by the model's internal weighting system, which offers a more sophisticated perspective than simple pairwise correlations. The dominance of IMPFREE (Importance of Freedom, 1.48) as the leading predictor suggests that AI adoption is most accelerated in high-autonomy cultures, in which the valuation of individual freedom likely translates into a higher tolerance for the disruptive nature of AI, where technology is perceived as a tool for personal empowerment and creative expansion rather than a threat to established norms.

This is closely complemented by the high ranking of IPSUCES (Importance of Success, 1.33). The prominence of achievement-oriented values indicates that nations which prioritise social recognition and demonstrated competence view AI as a critical strategic asset. In such contexts, the race for AI is driven by a cultural mandate to maintain competitive advantages and modern excellence.

Furthermore, the model highlights the role of institutional and behavioural stability through IPSTRGV (Strong Government, 1.19) and IPSHABT (Proper Behaviour/Habits, 1.06). The significant influence of these variables suggests that successful AI diffusion requires a structured foundation. While freedom drives innovation, the presence of a strong governmental framework and a cultural emphasis on disciplined social habits provides the necessary regulatory and ethical boundaries that allow for the systemic, large-scale integration of AI into public and private sectors. These observations align with the existing literature, which suggests that the successful adoption of AI is deeply rooted in social trust and the perceived objectivity of structured systems [Tubadji et al., 2021]. Interestingly, IMPTRAD (Importance of Tradition, 1.16) also holds a substantial position in the model. This counter-intuitive finding suggests that in the European context, respect for tradition does not necessarily impede progress. It may act as a stabilising force ensuring that technology is adopted in a way that remains congruent with long-standing societal structures, thereby preventing social fragmentation. This perspective is consistent with the empirical findings suggesting that AI adoption is not merely a matter of technical readiness, but is deeply embedded in the existing fabric of social trust and the perceived reliability of institutional frameworks [Tubadji et al., 2021].

Finally, the relatively lower weight assigned to IMPSAFE (Importance of Safety, 1.05) compared to its high linear correlation (r=0.74) provides a crucial insight into the non-linear nature of social change. While security is a strong individual correlate, the MLP model reveals that once other factors, such as freedom and success, are accounted for, safety becomes a baseline requirement rather than the primary engine of adoption, which implies that while people need to feel safe to accept AI, it is their desire for freedom and success that actually propels them to use it. This aligns with the CBD framework, where safety acts as a prerequisite, while the actual pace of adoption is dictated by deeper cultural drivers [Tubadji et al., 2021]. The lower model weight of IMPSAFE further suggests that once basic security thresholds are met, users increasingly prioritise AI for its perceived objectivity over human fallibility [Tubadji et al., 2021].

From a practical standpoint, these findings underscore the necessity of culturally responsive implementation models, where policymakers and technology providers must move beyond technical metrics and align their AI narratives with these core values. In societies where IMPFREE and IPSUCES dominate, AI should be marketed as an instrument for innovation and personal growth. Conversely, in regions where IPSTRGV and IMPSAFE are more prominent, the focus should shift toward institutional reliability, risk mitigation, and the enhancement of public order.

In conclusion, this paper demonstrates that the digital divide is, in many ways, a cultural divide. By utilising advanced neural network modelling, the study demonstrates that the successful adoption of AI is deeply rooted in the fundamental values of a society, requiring a delicate balance between individual autonomy, ambition, and institutional structure.

7. Conclusions

This study confirms that national cultural values are among the determinants of AI adoption. By successfully reaching its research objectives, this paper demonstrates that technological progress is deeply contingent on the culture, moving beyond purely economic or technical explanations. The empirical evidence suggests that while linear correlations initially highlight security as a major factor, the more sophisticated neural network analysis identifies individual freedom (IMPFREE) and the pursuit of success (IPSUCES) as the true primary drivers of the speed of adoption of AI. Furthermore, the research reveals that a combination of strong governance (IPSTRGV) and disciplined social habits (IPSHABT) provides the necessary stability

for systemic technological integration, suggesting that innovation is most effective when it is supported by a solid institutional and behavioural framework.

Methodologically, this research proves that machine learning architectures offer significantly higher analytical depth and predictive accuracy than traditional linear models when evaluating complex, multidimensional social data, which demonstrates the value of integrating advanced computational tools into the field of sociology and economics to better understand modern innovation cycles.

Future research should aim to validate these findings across broader geographical regions, also outside of Europe, and incorporate longitudinal data to track how cultural values evolve alongside rapid AI advancements. Additionally, the inclusion of variables such as digital infrastructure quality and levels of institutional trust could further enhance the model's precision. In summary, the successful adoption of AI requires strategic alignment with fundamental societal values, since the digital transformation of a nation is as much a cultural challenge as it is a technological one.

References

Agarwal, P., Swami, S., Malhotra, S.K. (2024). Artificial Intelligence Adoption in the Post COVID-19 New-Normal and Role of Smart Technologies in Transforming Business: A Review, *Journal of Science and Technology Policy Management*, 15(3), pp. 506–529. DOI: 10.1108/JSTPM-08-2021-0122.

Allred, B., Swan, K. (2004). Global Versus Multidomestic: Culture's Consequences on Innovation, *Management International Review*, 44/1, pp. 81–105, https://www.jstor.org/stable/40836012, (accessed: 21.03.2026).

Ashton, M.C., Lee, K. (2001). A Theoretical Basis for the Major Dimensions of Personality, *European Journal of Personality*, 15(5), pp. 327–353, http://differentialclub.wikidot.com/local--files/5fm/Ashton_6-factors_and_why.pdf (accessed: 21.03.2026).

Bradley, F., Gao, Y., Sousa, C. (2013). A Natural Science Approach to Investigate Cross-Cultural Managerial Creativity, *International Business Review*, 22/5, pp. 839–855, https://www.researchgate.net/profile/Yuhui-Gao/publication/271883538_A_natural_science_approach_to_investigate_cross-cultural_managerial_creativity/links/61b115cb4d7ff64f05367ce1/A-natural-science-approach-to-investigate-cross-cultural-managerial-creativity.pdf (accessed: 21.03.2026).

Chew, H.S.J., Achananuparp, P. (2022), Perceptions and Needs of Artificial Intelligence in Health Care to Increase Adoption: Scoping Review, *Journal of Medical Internet Research*, 24(1), e32939. DOI: 10.2196/32939.

Choe, J. (2004). The Consideration of Cultural Differences in the Design of Information Systems, *Information and Management*, 41(5), pp. 669–684. DOI: 10.1016/j.im.2003.08.003.

Chui, A.C.W., Kwok, C.C.Y. (2008). National Culture and Life Insurance Consumption, *Journal of International Business Studies*, 39(1), pp. 88–101. DOI: 10.1057/palgrave.jibs.8400316.

Costa, P.T., McCrae, R.R. (1992). Normal Personality Assessment in Clinical Practice: The NEO Personality Inventory, *Psychological Assessment*, 4(1), pp. 5–13. DOI: 10.1037/1040-3590.4.1.5.

Cougar, D. (1986). Effect of Cultural Differences on Motivation of Analysts and Programmers: Singapore vs. United States, *MIS Quarterly,* 10(2), pp. 189–196. DOI: 10.2307/249039.

Dagwell, R., Weber, R., Kling, R. (1983). Systems Designer's User Models: A Comparative Study and Methodological Critique, *Communications of the ACM,* 26(11), pp. 987–997, https://dl.acm.org/doi/pdf/10.1145/182.358465 (accessed: 21.03.2026).

Davidov, E., Schmidt, P., Schwartz, S.H. (2008) Bringing Values Back In: The Adequacy of the European Social Survey to Measure Values in 20 Countries, *Public Opinion Quarterly*, 72(3), pp. 420–445, https://www.jstor.org/stable/25167638 (accessed: 21.03.2026).

De Vreede, G.-J., Jones, N., Mgaya, R.J.S. (1998). Exploring the Application and Acceptance of Group Support Systems in Africa, *Journal of Management Information Systems,* 15(3), pp. 197–234. DOI: 10.1080/07421222.1998.11518218.

Desmarchelier, B., Fang, E. (2016). National Culture and Innovation Diffusion, *Technological Forecasting and Social Change*, 105, pp. 121–128. DOI: 10.1016/j.techfore.2016.01.018.

Downing, C.E., Gallaugher, J.M., Segars, A.H. (2003). Information Technology Choices in Dissimilar Cultures: Enhancing Empowerment, *Journal of Global Information Management,* 11(1), pp. 20–39. DOI: 10.4018/jgim.2003010102.

Duczkowski, N. (2026). Analiza empiryczna dynamiki incydentów AI [submitted for publication].

Duczkowski, N., Śliwiński, A. (2026), Negatywne skutki technologii AI jako nowy rodzaj ryzyka. In: *Dziedzictwo i przyszłość ekonomii, finansów i zarządzania,* J. Wielogórska-Leszczyńska, M. Matusewicz. Warszawa: Oficyna Wydawnicza SGH.

Duczkowski, N., Śliwiński, A., Słowik, L. (2024). Impact of Hofstede's Cultural Dimensions on Insurance Demand, *Wiadomości Statystyczne. The Polish Statistician*, 69(3), pp. 38–68. DOI: 10.59139/ws.2024.03.3.

Efrat, K. (2014). The Direct and Indirect Impact of Culture on Innovation, *Technovation*, 34(1), pp. 12–20. DOI: 10.1016/j.technovation.2013.08.003.

Engelen, A., Schmidt, S., Strenger, L., Brettel, M. (2014). Top Management's Transformational Leader Behaviors and Innovation Orientation: A Cross-Cultural Perspective in Eight Countries, *Journal of International Management*, 20(2), pp. 124–136. DOI: 10.1016/j.intman.2013.04.003.

Erez, M., Nouri, R. (2010). Creativity: The Influence of Cultural, Social, and Work Contexts, *Management and Organization Review*, 6(3), pp. 351–370. DOI: 10.1111/j.1740–8784.2010.00191.x.

Espig, A., Mazzini, I.T., Zimmermann, C., de Carvalho, L.C. (2022). National Culture and Innovation: A Multidimensional Analysis, *Innovation & Management Review*, 19(4), pp. 322–338. DOI: 10.1108/INMR-09-2020-0121.

ESS (2025a). About the European Social Survey European Research Infrastructure Consortium (ESS ERIC), https://www.europeansocialsurvey.org/about-ess (accessed: 21.03.2026).

ESS (2025b). ESS Data Portal, https://www.europeansocialsurvey.org/data-portal (accessed: 21.03.2026).

ESS (2025c). ESS Data Builder (Wizard), https://ess.sikt.no/en/?tab=builder (accessed: 21.03.2026).

ESS (2025d). ESS Variable List, https://www.europeansocialsurvey.org/sites/default/files/2023-06/ESSDE1-7e01_variable_list.pdf (accessed: 21.03.2026).

ESS (2025e). The Human Values Scale Findings from the European Social Survey, https://www.europeansocialsurvey.org/sites/default/files/2023-06/ESS_Findings_HVS.pdf (accessed: 21.03.2026).

Eurostat (2025a). Artificial Intelligence by Size Class of Enterprise, https://ec.europa.eu/eurostat/databrowser/view/isoc_eb_ai/default/table?lang=en&category=isoc.isoc_e.isoc_eb DOI: 10.2908/ISOC_EB_AIN2 (accessed: 21.03.2026).

Eurostat (2025b). Use of Artificial Intelligence in Enterprises, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Use_of_artificial_intelligence_in_enterprises (accessed: 21.03.2026).

Eurostat (2025c). Usage of AI Technologies Increasing in EU Enterprises, https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20250123–3 (accessed: 21.03.2026).

Festing, C., Proff, H. (2025). Assessing the Impact of National Culture on Digital Maturity, *Digital Business*, 5(2), p. 100121. DOI: 10.1016/j.digbus.2025.100121.

Fischer, R., Mansell, A. (2009). Commitment Across Cultures: A Meta-Analytical Approach, *Journal of International Business Studies*, 40(8), pp. 1339–1358, DOI: 10.1057/jibs.2009.14.

Galliers, R.D., Madon, S., Rashid, R. (1998). Information Systems and Culture: Applying 'Stages of Growth' Concepts to Development Administration, *Information Technology for Development,* 8(2), pp. 89–100. DOI: 10.1080/02681102.1998.9525296.

Gamble, P.R., Gibson, D.A. (1999). Executive Values and Decision Making: The Relationship of Culture and Information Flows, *Journal of Management Studies,* 36(2), pp. 217–240, https://onlinelibrary.wiley.com/doi/pdf/10.1111/1467-6486.00134?casa_token=9q5tT_8fK1MAAAAA%3A_QzzZ8Rb-u-5akR4cvLGljvglf2XLlEYqflscX9Ppvr YvJXrKlfjYML43mERb2S6nQeUcovSYaz-D5ihl0 g (accessed: 21.03.2026).

Garfield, M.J., Watson, R.T. (1998). Differences in National Information Infrastructure: The Reflection of National Cultures, *Journal of Strategic Information Systems,* 6(4), pp. 313–337. DOI: 10.1016/S0963-8687(98)00012-2.

Griffith, D., Rubera, G. (2014). A Cross-Cultural Investigation of New Product Strategies for Technological and Design Innovations, *Journal of International Marketing,* 22(1), pp. 5–20. DOI: 10.1509/jim.13.0082.

Griffith, T.L. (1998). Cross Cultural and Cognitive Issues in the Implementation of a New Technology: Focus on Group Support Systems in Bulgaria, *Interacting with Computers,* 9(4), pp. 431–447. DOI: 10.1016/S0953-5438(97)00033-7.

Hamm, P., Klesel, M. (2021). Success Factors for the Adoption of Artificial Intelligence in Organizations: A Literature Review, *27th Americas Conference on Information Systems, AMCIS 2021: Digital Innovation and Entrepreneurship,* Association for Information Systems, https://research.utwente.nl/files/303061943/Studie_AMCIS.pdf (accessed: 21.03.2026).

Hasan, H., Ditsa, G. (1999). The Impact of Culture on the Adoption of IT: An Interpretive Study, *Journal of Global Information Management*, 7(1), pp. 5–15. DOI: 10.4018/jgim.1999010101.

Hill, C.E., Loch, K.D., Straub, D., El-Sheshai, K. (1998). A Qualitative Assessment of Arab Culture and Information Technology Transfer, *Journal of Global Information Management*, 6(3), pp. 29–38. DOI: 10.4018/jgim.1998070103.

Hofstede, G. (1983). National Cultures in Four Dimensions: A Research-based Theory of Cultural Differences among Nations, *International Studies of Management & Organization*, 13(1–2), pp. 46–74. DOI: 10.1080/00208825.1983.11656358.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviours, Institutions and Organisations Across Nations* (2nd edition). Thousand Oaks, California: Sage Publications.

Hofstede, G. (2013). Replicating and Extending Cross-National Value Studies: Rewards and Pitfalls – An Example from Middle East Studies, *AIB Insights*, 13(2), pp. 5–7. DOI: 10.46697/001c.16952.

Hsu, Y., Hsu, L., Yeh, C. (2010). A Cross-Cultural Study on Consumers' Level of Acceptance Toward Marketing Innovativeness, *African Journal of Business Management*, 4(6), pp. 1215–1228, https://academicjournals.org/journal/AJBM/article-full-text-pdf/A83A13724701.pdf (accessed: 21.03.2026).

Hunter, M.G., Beck, J.E. (2000). Using Repertory Grids to Conduct Cross-Cultural Information Systems Research, *Information Systems Research*, 11(1), pp. 93–101. DOI: 10.1287/isre.11.1.93.11786.

Husted, B.W. (2000). The Impact of National Culture on Software Piracy, *Journal of Business Ethics,* 26(3), pp. 197–211. DOI: 10.1023/A:1006250203828.

IFiS PAN (2025a). *O Europejskim Sondażu Społecznym*, https://ess.ifispan.pl/o-ess/ (accessed: 21.03.2026).

IFiS PAN (2025b). *Tematyka Europejskiego Sondażu Społecznego*, https://ess.ifispan.pl/tematyka-europejskiego-sondazu-spolecznego/ (accessed: 21.03.2026).

IFiS PAN (2025c). *Historia ESS*, https://ess.ifispan.pl/historia-ess-2/ (accessed: 21.03.2026).

IFiS PAN (2025d). *Kraje uczestniczące w projekcie Europejski Sondaż Społeczny*, https://ess.ifispan.pl/kraje-uczestniczace-w-projekcie-europejski-sondaz-spoleczny/, (accessed: 21.03.2026).

IFiS PAN (2025e). *Metodologia Europejskiego Sondażu Społecznego*, https://ess.ifispan.pl/metodologia-europejskiego-sondazu-spolecznego/ (accessed: 21.03.2026).

Ishman, M.D., Pegels, C.C., Sanders, G.L. (2001). Managerial Information System Success Factors Within Cultural Context of North America and a Former Soviet Republic, *The Journal of Strategic Information Systems,* 10(4), pp. 291–312. DOI: 10.1016/S0963-8687(01)00055-5.

Jatobá, M.N., Ferreira, J.J., Fernandes, P.O., Teixeira, J.P. (2023). Intelligent Human Resources for the Adoption of Artificial Intelligence: A Systematic Literature Review, *Journal of Organizational Change Management,* 36(7), pp. 1099–1124. DOI: 10.1108/JOCM-03-2022-0075.

Johns, S.K., Smith, L.M., Strand, C.A. (2003). How Culture Affects the Use of Information Technology, *Accounting Forum,* 27(1), pp. 84–109. DOI: 10.1111/1467-6303.00097.

Jones, G., Davis, H. (2000). National Culture and Innovation: Implications for Locating Global R&D Operations, *Management International Review,* 40(1), pp. 11–39, https://www.jstor.org/stable/40835865 (accessed: 21.03.2026).

Kaasa, A., Vadi, M. (2010). How Does Culture Contribute to Innovation? Evidence from European Countries, *Economics of Innovation and New Technology,* 19(7), pp. 583–604. DOI: 10.1080/10438590902987222.

Keil, M., Tan, B.C.Y., Wei, K., Saarinen, T., Tuunainen, V., Wassenaar, A. (2000). A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects, *MIS Quarterly,* 24(2), pp. 295–325. DOI: 10.2307/3250940.

Kettinger, W.J., Lee, C.C., Lee, S. (1995). Global Measures of Information Service Quality: A Cross-National Study, *Decision Sciences,* 26(5), pp. 569–588. DOI: 10.1111/j.1540-5915.1995.tb01441.x.

Khanfar, A.A., Kiani Mavi, R., Iranmanesh, M., Gengatharen, D. (2025). Factors Influencing the Adoption of Artificial Intelligence Systems: A Systematic Literature Review, *Management Decision*, 63(10), pp. 3727–3755. DOI: 10.1108/MD-05-2023–0838.

Kostro, K. (2009). Zagadnienia kulturowe w ekonomii, *Gospodarka Narodowa. The Polish Journal of Economics*, 230(3), pp. 27–59. DOI: 10.33119/GN/101228.

Kozłowska, A. (1996). *Kultury narodowe u korzeni*. Warszawa: PWN, https://ozkultura.pl/wpisy/1815 (accessed: 21.03.2026).

Kumar, K., Bjørn-Andersen, N., King, R. (1990). A Cross-Cultural Comparison of IS Designer Values, *Communications of the ACM*, 33(5), pp. 528–538. DOI: 10.1145/78607.78613.

Lee, S.G., Trimi, S., Kim, C. (2013). The Impact of Cultural Differences on Technology Adoption, *Journal of World Business*, 48(1), pp. 20–29, https://www.academia.edu/download/47164436/WORBUS554.pdf (accessed: 21.03.2026).

Leidner, D.E., Carlsson, S., Elam, J., Corrales, M. (1999). Mexican and Swedish Managers' Perceptions of the Impact of EIS on Organizational Intelligence, Decision Making, and Structure, *Decision Sciences*, 30(3), pp. 633–661. DOI: 10.1111/j.1540-5915.1999.tb00901.x.

Leidner, D.E., Kayworth, T. (2006). A Review of Culture in Information Systems Research: Toward a Theory of Information Technology Culture Conflict, *MIS Quarterly*, pp. 357–399, https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=6b8fe767239a34e25e71e99bd8b8a64f8279d7f4 (accessed: 21.03.2026).

Lim, H., Park, J. (2013). The Effects of National Culture and Cosmopolitanism on Consumers' Adoption of Innovation: A Cross-Cultural Comparison, *Journal of International Consumer Marketing*, 25(1), pp. 16–28. DOI: 10.1080/08961530.2013.751793.

Lin, L. (2009). Effects of National Culture on Process Management and Technological Innovation, *Total Quality Management & Business Excellence*, 20(12), pp. 1287–1301. DOI: 10.1080/14783360903250621.

Madon, S. (1992). Computer-Based Information Systems for Development Planning: The Significance of Cultural Factors, *Journal of Strategic Information Systems,* 1(5), pp. 250–257. DOI: 10.1016/0963-8687(92)90014-N.

Marjanovic, U., Mester, G., Milic Marjanovic, B. (2024). Assessing the Success of Artificial Intelligence Tools: An Evaluation of ChatGPT Using the Information System Success Model, *Interdisciplinary Description of Complex Systems*, 22(3), pp. 266–275. DOI: 10.7906/indecs.22.3.3.

Marocco, S., Barbieri, B., Talamo, A. (2024). Exploring Facilitators and Barriers to Managers' Adoption of AI-Based Systems in Decision Making: A Systematic Review, *AI*, 5(4), pp. 2538–2567. DOI: 10.3390/ai5040123.

Maslow, A.H. (1943). A Theory of Human Motivation, *Psychological Review*, 50(4), pp. 370–396. DOI: 10.1037/h0054346.

McCrae, R.R., Costa Jr, P.T. (1991). The NEO Personality Inventory: Using the Five-Factor Model in Counselling, *Journal of Counseling & Development*, 69(4), pp. 367–372. DOI: 10.1002/j.1556-6676.1991.tb01524.x.

Milberg, S.J., Burke, S.J., Smith, J.H., Kallman, E.A. (1995). Rethinking Copyright Issues and Ethics on the Net: Values, Personal Information Privacy, and Regulatory Approaches, *Communications of the ACM*, 38(12), pp. 65–73, https://dl.acm.org/doi/pdf/10.1145/219663.219683 (accessed: 21.03.2026).

Morris, M., Leung, K. (2010). Creativity East and West: Perspectives and Parallels, *Management and Organization Review*, 6(3), pp. 313–327. DOI: 10.1111/j.1740-8784.2010.00193.x.

Peterson, D.K., Kim, C. (2003). Perceptions on IS Risks and Failure Types: A Comparison of Designers from the United States, Japan, and Korea, *Journal of Global Information Management*, 11(3), pp. 19–38. DOI: 10.4018/jgim.2003070102.

Peterson, M.F. (2004). Review of Culture, Leadership and Organizations: The GLOBE Study of 62 Societies, by R.J. House, M. Javidan, P.W. Dorfman, V. Gupta, & Paul J. Hanges, *Administrative Science Quarterly*, 49(4), pp. 641–647, http://www.jstor.org/stable/4131493 (accessed: 21.03.2026).

Puia, G., Ofori-Dankwa, J. (2013). The Effects of National Culture and Ethno-Linguistic Diversity on Innovativeness, *Baltic Journal of Management*, 8(3), pp. 349–371. DOI: 10.1108/BJOM-Jan-2012-0002.

Quaddus, M.A., Tung, L.L. (2002). Explaining Cultural Differences in Decision Conferencing, *Communications of the ACM,* 45(8), pp. 93–98, https://dl.acm.org/doi/fullHtml/10.1145/545151.545157 (accessed: 21.03.2026).

Rhyne, L., Teagarden, M., Van den Panhuyzen, W. (2002). Technology-Based Competitive Strategies: The Relationship of Cultural Dimensions to New Product Innovation, *The Journal of High Technology Management Research*, 13(2), pp. 249–277. DOI: 10.1016/S1047-8310(02)00047-0.

Rose, G.M., Evaristo, R., Straub, D. (2003). Culture and Consumer Responses to Web Download Time: A Four-Continent Study of Mono- and Polychronism, *IEEE Transactions on Engineering Management*, 50(1), pp. 31–43. DOI: 10.1109/TEM.2002.808262.

Rossberger, R. (2014). National Personality Profiles and Innovation: the Role of Cultural Practices, *Creativity and Innovation Management*, 23(3), pp. 331–348. DOI: 10.1111/caim.12075.

Rujirawanich, P., Addison, R., Smallman, C. (2011). The Effects of Cultural Factors on Innovation in a Thai SME, *Management Research Review*, 34(12), pp. 1264–1279. DOI: 10.1108/ 0140917 1111186397.

Schwartz, S.H. (1992). Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries, *Advances in Experimental Social Psychology,* 25, pp. 1–65, https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=dc49e27d0ed890cd3ed2e80ca0b0107207f12a64 (accessed: 21.03.2026).

Schwartz, S.H. (1994). Are There Universal Aspects in the Structure and Contents of Human Values?, *Journal of Social Issues*, 50(4), pp. 19–45, https://www.researchgate.net/profile/Shalom-Schwartz/publication/227762767_Are_There_Universal_Aspects_in_the_Structure_and_Contents_of_Human_Values/links/59dd3cb8aca272b698e14044/Are-There-Universal-Aspects-in-the-Structure-and-Contents-of-Human-Values.pdf?__cf_chl_tk=xLeDP_EbB9KbRumRe9zIeSnRdu_kP8ib8qqPVF38on4-1744048980-1.0.1.1-QGTPP8GxHeyjVYMb8MhMkNhasWzHW9z5LfCFIM9hx14 (accessed: 21.03.2026).

Schwartz, S.H. (2006). *Basic Human Values: An Overview*, https://uranos.ch/research/references/Schwartz_2006/Schwartzpaper.pdf (accessed: 21.03.2026).

Schwartz, S.H. (2012a). Toward Refining the Theory of Basic Human Values, *Methods, Theories, and Empirical Applications in the Social Sciences*, pp. 39–46. DOI: 10.1007/978-3-531-18898-0_6.

Schwartz, S.H. (2012b). An Overview of the Schwartz Theory of Basic Values, *Online Readings in Psychology and Culture*, 2(1). DOI: 10.9707/2307-0919.1116.

Shahzadi, G., Jia, F., Chen, L., John, A. (2024). AI Adoption in Supply Chain Management: A Systematic Literature Review, *Journal of Manufacturing Technology Management,* 35(6), pp. 1125–1150. DOI: 10.1108/JMTM-09-2023-0431.

Shane, S. (1992). Why do Some Societies Invent More Than Others?, *Journal of Business Venturing*, 7(1), pp. 29–46. DOI: 10.1016/0883-9026(92)90033-N.

Shane, S. (1993). Cultural Influences on National Rates of Innovation, *Journal of Business Venturing*, 8(1), pp. 59–73. DOI: 10.1016/0883-9026(93)90011-S.

Shane, S. (1995). Uncertainty Avoidance and the Preference for Innovation Championing Roles, *Journal of International Business Studies*, 26(1), pp. 47–68. DOI: 10.1057/palgrave.jibs.8490165.

Shore, B., Venkatachalam, A.R., Solorzano, E., Burn, J. M, Hassan, S.Z., Janczewski, L.J. (2001). Softlifting and Piracy: Behavior Across Cultures, *Technology in Society*, 23(4), pp. 563–581. DOI: 10.1016/S0160-791X(01)00037-9.

Singh, S. (2006). Cultural Differences in, and Influences on, Consumers' Propensity to Adopt Innovations, *International Marketing Review*, 23(2), pp. 173–191. DOI: 10.1108/02651330610660074.

Steenkamp, J., ter Hofstede, F., Wedel, M. (1999). A Cross-National Investigation into the Individual and National Cultural Antecedents of Consumer Innovativeness, *Journal of Marketing*, 63(2), pp. 55–69. DOI: 10.1177/002224299906300204.

Straub, D. (1994). The Effect of Culture on IT Diffusion: Email and Fax in Japan and the US, *Information Systems Research,* 5(1), pp. 23–47. DOI: 10.1287/isre.5.1.23.

Straub, D., Keil, M., Brenner, W. (1997). Testing the Technology Acceptance Model Across Cultures: A Three Country Study, *Information and Management,* 33(1), pp. 1–11. DOI: 10.1016/S0378-7206(97)00026-8.

Tan, B.C.Y., Smith, H.J., Keil, M. (2003). Reporting Bad News about Software Projects: Impact of Organizational Climate and Information Asymmetry in an Individualistic and Collectivist Culture, *IEEE Transactions on Engineering Management*, 50(1), pp. 65–77. DOI: 10.1109/TEM.2002.808292.

Tan, B.C.Y., Wei, K.K., Watson, R.T., Walczuch, R.M. (1998). Reducing Status Effects with Computer-Mediated Communication: Evidence from Two Distinct National Cultures, *Journal of Management Information Systems,* 15(1), pp. 119–141. DOI: 10.1080/07421222.1998.11518199.

Taylor, M., Wilson, S. (2012). Does Culture Still Matter? The Effects of Individualism on National Innovation Rates, *Journal of Business Venturing*, 27(2), pp. 234–247. DOI: 10.1016/j.jbusvent.2010.10.001.

Thatcher, J.B., Srite, M., Stepina, L.P., Liu, Y. (2003). Culture, Overload and Personal Innovativeness with Information Technology: Extending the Nomological Net, *Journal of Computer Information Systems*, 44(1), pp. 74–81. DOI: 10.1080/08874417.2003.11647554.

Tian, M., Deng, P., Zhang, Y., Salmador, M.P. (2018). How Does Culture Influence Innovation? A Systematic Literature Review, *Management Decision*, 56, pp. 1088–1107. DOI: 10.1108/MD-05-2017–0462.

Trompenaars, F., Hampden-Turner, C. (2000). *Riding the Waves of Culture: Understanding Diversity in Global Business*, https://ocan.yasar.edu.tr/wp-content/uploads/2013/09/Riding-the-waves_Part-1.pdf (accessed: 21.03.2026).

Tubadji, A., Denney, T., Webber, D.J. (2021). Cultural Relativity in Consumers' Rates of Adoption of Artificial Intelligence, *Economic Inquiry*, 59(3), pp. 1234–1251. DOI: 10.1111/ecin.12978.

van Everdingen, Y., Waarts, E. (2003). The Effect of National Culture on the Adoption of Innovations, *Marketing Letters*, 14(3), pp. 217–232. DOI: 10.1023/A:1027452919403.

Waarts, E., Van Everdingen, Y. (2005). The Influence of National Culture on the Adoption Status of Innovations: An Empirical Study of Firm Innovations Across Europe, *European Management Journal*, 23(6), pp. 601–610. DOI: 10.1016/j.emj.2005.10.007.

Walsham, G. (2002). Cross-Cultural Software Production and Use: A Structurational Analysis, *MIS Quarterly,* 26(4), pp. 359–380. DOI: 10.2307/4132313.

Watson, R.T., Ho, T.H., Raman, K.S. (1994). Culture: A Fourth Dimension of Group Support Systems, *Communications of the ACM*, 37(10), pp. 45–55, https://dl.acm.org/doi/pdf/10.1145/194313.194320 (accessed: 21.03.2026).

Williams, R.M. (1974). Review of The Nature of Human Values, by M. Rokeach, *Political Science Quarterly*, 89(2), pp. 399–401. DOI: 10.2307/2149267 (accessed: 21.03.2026).

Xiong, J., Sun, D., Wang, Y. (2024). Adoption of Artificial Intelligence Artifacts: A Literature Review, *Universal Access in the Information Society*, 23(2), pp. 703–715. DOI: 10.1007/s10209-023-00978-z.

Yoo, Y., Torrey, B., (2002). National Culture and Knowledge Management in a Global Learning Organization. In: *The Strategic Management of Intellectual Capital and Organizational Knowledge* (pp. 421–434), C.W. Choo, N. Bontis (Eds.). New York: Oxford University Press, https://www.researchgate.net/profile/Ben-Torrey/publication/266613852_National_Cultures_and_Knowledge_Management_in_a_Global_Learning_Organization_A_Case_Study/links/60ab4896a6fdcc6d626d3b05/National-Culture-and-Knowledge-Management-in-a-Global-Learning-Organization-A-Case-Study.pdf?__cf_chl_tk=HvJT7VU19lOoySytMENEmXraXAGXbuY76JUS0CvMxOI-1744054196-1.0.1.1-XOQFNeuxW5Gi5MlCLxx3pTQPuuwYqV2fCd2kLcSCRCg (accessed: 21.03.2026).

7

Pier Luigi Parcu[1]

From Factories to Platforms: European Institutions and the Challenge of Digital Inequality

Abstract

This paper argues that the digital transformation constitutes a second industrial revolution, generating a faster and more pronounced redistribution of income and power than the first. Long-run evidence for the United Kingdom and the United States indicates that since the 1980s, the labour share has declined more than twice as rapidly as during 1750–1850, while inequality has increased over 40% faster. The key discontinuity, however, is institutional: unlike the industrial era, the digital transformation has so far unfolded without the emergence of institutions capable of anchoring digital infrastructures in democratic principles. To account for this, the paper conceptualises digital infrastructures as digi-commons: systems characterised by non-rival use, increasing excludability, distributed value creation, and centralised control. Within this framework, economic and cultural inequalities are understood as structural outcomes of infrastructural organisation rather than isolated market failures. This perspective shifts the analytical focus from platform behaviour to the governance of infrastructures. Europe's response is analysed along three trajectories – regulatory, industrial and civic – which reflect distinct logics of governance but remain insufficiently aligned. Regulatory interventions lack adequate material capacity, industrial policy risks reproducing concentration without openness, and civic initiatives struggle to achieve scale. The paper argues that effective integration must therefore occur at the infrastructural level. Standardisation and interoperability emerge as key mechanisms linking these trajectories. Standards translate normative principles

[1] European University Institute (Italy), e-mail: pierluigi.parcu@eui.eu.

into operational rules, while interoperability promotes openness, contestability, and distributed participation across systems. Within this framework, industrial policy provides the material basis for digital capacity, while civic participation constitutes a condition of legitimacy within infrastructural governance. Digital sovereignty is thus redefined as an institutional process of aligning legality, capacity, and participation, embedding democratic principles into the architecture of digi-commons.

1. Introduction

The digital transformation is reshaping the organisation of economies and societies in ways that invite comparison with the first industrial revolution. Both periods represent profound shifts in the distribution of value, power and agency. Regarding inequalities, however, the analogy is revealing primarily because of its limits. Whereas the industrial revolution unfolded over more than a century and eventually triggered institutional responses capable of re-embedding markets – labour rights, public education, and welfare systems – the digital revolution has so far developed without adjustments of comparable scale or depth. Digital platforms have expanded globally, but democratic capacities have not kept pace. The argument is therefore not that digital capitalism is historically unique in principle, nor that an equivalent process of institutional re-embedding will never emerge. Rather, the current digital transition combines a much sharper distributive acceleration with an institutional response that remains comparatively weak, fragmented and asynchronous.

As Herbert Simon [1991] observed, even the industrial economy appeared less as a web of markets than as a landscape dominated by organised structures. If that intuition held in the age of the firm, it becomes even more compelling in the age of platforms, where coordination increasingly takes place within privately governed digital infrastructures.

This paper argues that the present transformation constitutes a second industrial revolution whose distinctive feature is a new form of expropriation. Mechanisation in the nineteenth century displaced artisanal skills and subordinated labour to machine-intensive production. Contemporary digital infrastructures extract value from labour, data, cognition and attention, shifting the economy's centre of gravity from production towards interaction, with platforms functioning as infrastructure-like intermediaries that govern income, access, visibility and participation. What is being reorganised, in other words, is not only the distribution of value, but the conditions under which agency is exercised. Long-run UK – US composite indicators illustrate this acceleration.

The decline in the labour share after 1980 has been more than twice as rapid as during 1750–1850, while the increase in inequality has been more than 40% steeper. These patterns strongly suggest that the distributive effects of digitalisation cannot be understood simply as extensions of historical trends. Rather, they reflect deeper transformations in organisational architectures – network effects, data accumulation, behavioural prediction – that concentrate market power and reproduce cultural asymmetries. Economic and cultural inequalities thus reinforce one another, creating feedback loops that undermine both market contestability and democratic deliberation. Digital infrastructures are not treated here as the sole source of contemporary inequality. Rather, they operate as the organisational medium through which broader forces – including financialisation, weakened labour bargaining, territorial divergence, and geopolitical dependence – are coordinated, amplified and stabilised.

As with earlier technological transformations, the full contours of this transition will become clear only in retrospect. Yet even under conditions of empirical uncertainty, its institutional direction is already visible: economic and cultural coordination are increasingly being reorganised around infrastructures whose scale and opacity exceed the effective reach of inherited democratic controls, thereby fostering new forms of inequality. The paper's central claim is that these inequalities are institutional in origin, arising from governance structures embedded in digital infrastructures rather than from isolated corporate misconduct or individual-level digital divides.

From a theoretical perspective, contemporary digital systems are best conceptualised as digi-commons: enabling infrastructures characterised by non-rival use alongside increasing excludability through proprietary standards, opaque algorithms, and the enclosure of data resources. While value creation is distributed across users, firms, public institutions and communities, value capture is increasingly centralised within a small set of global platforms. This conceptual shift – from platforms to infrastructures and from markets to governance – opens a new analytical space, highlighting that institutional responses must be directed not only towards regulating dominant firms but also towards redesigning the underlying architectures of connectivity, data flows, and interoperability.

In Europe, this institutional challenge has generated three partially overlapping but insufficient trajectories: a regulatory strategy focused on restraining platform power; an industrial strategy aimed at reducing geopolitical dependency and building technological capacity; and a civic strategy centred on open-source projects, public-interest technologies, and participatory infrastructures. These trajectories operate

on different timescales and rest on distinct logics of legitimacy and coordination, producing a governance field marked by temporal asynchrony, institutional fragmentation, and structural gaps between normative ambition and material capability.

The contribution of this paper is twofold. First, it offers a theoretical reframing of digital infrastructures as digi-commons, linking the literature on public goods, commons governance, and digital capitalism. Second, it outlines a governance framework that identifies standard-setting, interoperability, and participatory governance as mechanisms capable of integrating Europe's regulatory, industrial, and civic trajectories. Rather than proposing a single model, the aim is to identify the preconditions under which these trajectories can become functionally interdependent and capable of re-embedding digital platforms within democratic institutions.

The remainder of the paper proceeds as follows: Section 2 revisits the historical experience of the industrial revolution as a baseline for comparison; Section 3 analyses the economic dimensions of digital inequality; Section 4 examines its cultural and informational dimensions; Section 5 develops the conceptual foundations of digi-commons; Section 6 analyses Europe's three trajectories; Section 7 articulates a governance framework for their integration; and Section 8 concludes by outlining the implications for institutional design and digital sovereignty.

2. Industrial revolutions

The first industrial revolution offers the essential historical baseline for understanding the distributive and organisational dynamics of major technological transitions. Emerging in mid-eighteenth-century Britain and later diffusing across Europe and the United States, it reorganised production by introducing mechanisation, factory discipline, and capital-intensive processes.

These transformations produced unprecedented productivity gains but also radically altered the balance of power between labour and capital. Pre-existing production systems relied on artisanal skills, small workshops, and rural household economies, but the new industrial regime displaced these traditional forms by centralising production within factories. This shift was propelled by a cluster of technological innovations – mechanised spinning and weaving, the steam engine, and new iron production techniques – that transformed the organisation of production [Mokyr, 1990]. As documented by Hobsbawm [1962] and Thompson [1963, 1967], the factory system imposed a new temporal and organisational regime in which workers lost control over the rhythm and significance of their labour, which became subor-

dinated to machine-driven coordination. Mechanisation was therefore not merely a technological shift but a structural transfer of agency – an early form of functional expropriation. As Thompson [1967] further emphasised, the industrial labour process also introduced new forms of temporal discipline: clocks, bells and overseers reorganised the experience of time itself, replacing task-oriented rhythms with externally imposed schedules.

This restructuring of temporality constituted a distinctive feature of the early industrial regime and an important cultural dimension of the new forms of subordination. The distributive consequences of this transition are visible in long-run quantitative data. Annex Table 1 and Figures 1–3, based on the dataset reconstructed for this paper, document a clear and sustained decline in labour's share of national income between 1750 and 1850. In the United Kingdom, the labour share fell from roughly 75% in 1750 to around 68% in 1850; in the United States, it declined from around 77% to 70%. Over the same period, personal inequality increased sharply: the British Gini index increased from approximately 0.45 to 0.60 – an expansion of about one-third – while the United States exhibited a similar, though slightly less pronounced, pattern.

These trends reflected slow wage growth, the concentration of profits among factory owners, and the declining bargaining power of labour as production shifted to capital-intensive methods. Institutional and social processes reinforced this redistribution. The enclosure of common lands in Britain undermined rural subsistence and pushed displaced populations into precarious wage labour. Polanyi [1944] interpreted these developments as part of a broader institutional transformation in which land and labour were turned into *fictitious commodities*, reorganising society around market imperatives rather than social reciprocity. This constituted an early form of disembedding, whereby economic activity was detached from traditional social protections and subordinated to unmitigated competitive pressures. Urbanisation intensified social vulnerability. As Szreter [1997] demonstrates, industrial cities were characterised by overcrowding, poor sanitation, and high mortality, exposing how inequality manifested not only in income but also in health and life expectancy. Importantly, this inequality was not a temporary by-product of growth. Rather, it was structurally embedded within the emerging production system and institutional environment, which initially lacked mechanisms of social protection and labour representation.

At the same time, however, the concentration of workers in factories and cities created the basis for new forms of collective organisation: the industrial working class. Although initially the most exploited group, industrial workers gradually

became politically mobilised actors capable of demanding and precipitating institutional reform. Over time, the industrial revolution entered a prolonged phase of institutional adjustment. The process was uneven and politically contentious, but it mitigated the distributive pressures of industrial capitalism and stabilised mass democracies. From the late nineteenth century to the mid-twentieth century, collective bargaining systems, labour unions, public education, progressive taxation, and welfare institutions gradually re-embedded markets within social protection.

This evolution is reflected in the data. From the second half of the nineteenth century onwards, inequality began to stabilise and eventually declined. Britain's Gini coefficient fell from around 0.60 in 1850 to roughly 0.45 in 1900, and to about 0.37 by the mid-twentieth century, marking the high point of industrial egalitarianism. The United States followed a broadly similar, though less pronounced, trajectory. These long-run dynamics illustrate that the distributive tensions of early industrialisation were neither linear nor irreversible. Institutional reforms proved capable of reshaping the trajectory of inequality. To establish a coherent historical benchmark for comparison with the digital era, this paper constructs two composite UK – US indicators weighted by historical GDP shares: a Composite Labour Share and a Composite Gini Index (Table 2).

These indicators trace the distributive dynamics of the industrial age across two successive global economic centres, recognising the historical growth in the weight of the US economy. The weights assigned to the United Kingdom and the United States are derived from long-run historical GDP estimates from the Maddison Project, ensuring comparability across the two periods. The Composite Labour Share exhibits a persistent decline between 1750 and 1850, while the Composite Gini Index rises progressively. Together, they capture the dual nature of early industrial inequality: functional, reflected in a declining labour share, and personal, reflected in rising interpersonal inequality. Both series are coherent with the narrative presented in Annex Table 1 and with the broader historical literature on distributional dynamics [Lindert, Williamson, 1983; Allen, 2009].

The sense of this historical sequence was articulated, among others, by Polanyi [1944], who argued that technological disruption followed by institutional response was the defining feature of the first industrial revolution. Two analytical lessons emerge from this experience. First, major technological transformations generate structural inequalities: they reshape the functional distribution of income, alter the skill composition of labour, and redistribute organisational power. Second, these inequalities are not self-correcting. Institutional responses are contingent on political mobilisation, social organisation, and state capacity. The re-embedding that moder-

ated industrial inequalities did not arise automatically; rather, it was the outcome of prolonged contestation and institutional innovation.

Against this background, comparison with the digital revolution clarifies the magnitude of today's discontinuity. As Section 3 demonstrates, the decline in the share of labour and the rise in inequality in the digital era are both stronger and more rapid than during the period 1750–1850. More significantly, no broad institutional response has yet taken shape. The digital transition resembles the industrial revolution in its simultaneous capacity to unlock major societal advances while deepening distributive inequalities, but it differs in the absence of a systemic institutional adjustment. This asymmetry constitutes one of the central problems addressed in the remainder of the paper.

3. The digital revolution: economic inequalities

The digital revolution has transformed the organisation of economic activity in ways that fundamentally reshape the distribution of income and power. Unlike the first industrial revolution – where technological change acted primarily through mechanisation – digitalisation operates simultaneously across the functional, organisational, informational and geographic dimensions of inequality. Its effects are cumulative and stem from the architecture of digital markets rather than sector-specific transitions.

Long-run composite indicators for the United Kingdom and the United States illustrate the magnitude of this shift. Annex Table 2 and Figure 3 show that the Composite Labour Share has declined since 1980 at approximately –0.26% per year in log terms – more than double the –0.11% observed between 1750 and 1850. This post-1980 acceleration marks a structural break. The mechanisms driving it differ substantially from those of the industrial era. Economic activity is increasingly concentrated within digital *superstar firms* with extremely high mark-ups and disproportionate reliance on intangible assets and data-intensive production [Autor, Dorn, Katz, Patterson, Van Reenen, 2020; De Loecker, Eeckhout, 2017]. As economic weight shifts toward these ecosystems, aggregate labour shares decline through both productivity effects and compositional changes.

At the macroeconomic level, the rise of digital superstars also contributes to widening interpersonal inequality. High-income households disproportionately hold shares in the most profitable technology firms, while labour markets exhibit increasing polarisation between high-skill digital occupations and precarious low-skill

service roles. The result resembles certain distributive patterns of the first industrial revolution – an asymmetric reallocation of gains towards capital – but differs in its speed, scale, and global reach, reflecting the low marginal costs and instantaneous diffusion of digital technologies.

Personal inequality follows a similar trajectory. The Composite Gini Index, shown in Figure 4, has risen at around 0.38% per year after 1980 – more than 40% faster than during the period 1750–1850. This cannot be explained solely by conventional skill-biased technological change. Platforms dominate digital markets by internalising transactions, governing participation, and accumulating behavioural data. They do not merely match supply and demand; they organise the ecosystem in which modern economic activity takes place [Srnicek, 2017]. Furthermore, digital markets exhibit strong endogenous tipping dynamics [Parker, Van Alstyne, Choudary, 2016]. Unlike the cyclical leadership turnover characteristic of industrial capitalism, feedback loops linking data accumulation to improved performance foster persistent dominance. This represents a distinctive feature of digital capitalism, in which infrastructural control, data advantages, and network effects reinforce one another over time. The result is a structurally concentrated economy in which the primary mechanisms generating inequality are embedded within the design of digital infrastructures themselves.

Labour markets are being reshaped through both automation and the reorganisation of work. As Woodcock and Graham [2020] demonstrate, platform labour architectures systematically weaken workers' bargaining power by shifting risks onto individuals, fragmenting tasks, and centralising control through algorithmic management. Van Dijck, Poell, and de Waal [2018] argue that platform-mediated interactions individualise participation and fragment collective identities, thereby limiting solidarity and collective bargaining. These organisational asymmetries reduce workers' capacity to appropriate productivity gains and thus contribute directly to the decline of labour's share of income.

The gig economy both exemplifies and exacerbates these dynamics. Platforms such as Uber, Deliveroo and TaskRabbit intermediate between workers and consumers while exercising tight control over pricing, access, and evaluation. De Stefano [2016] describes this as the emergence of a *just-in-time workforce*: workers classified as independent contractors are in practice managed through opaque algorithmic systems that allocate work and determine income. Fragmented employment relationships and the erosion of collective bargaining rights leave these workers structurally vulnerable. Whereas the factory organisation concentrated workers physically, thereby facilitating unionisation, platform ecosystems disperse them, making collective

action considerably more difficult. These dependencies extend beyond low-skilled labour. Software developers, for example, often rely on proprietary app stores or cloud infrastructures controlled by a few dominant firms. Terms of access, fees, and visibility are unilaterally set, leaving smaller actors with limited bargaining power. Digitalisation thus erodes autonomy across the entire workforce, reinforcing the distributive dynamics captured by the post-1980 acceleration of the Gini index.

The geography of digital inequality further amplifies these dynamics. Investment and talent tend to cluster in a few metropolitan hubs – Silicon Valley, Shenzhen, Bangalore, Berlin – while peripheral regions struggle to attract digital infrastructure or high-value employment. Rodríguez-Pose [2018] characterises the resulting resentment as the *revenge of the places that don't matter*: communities excluded from digital opportunities express disengagement and political anger, as witnessed in the Brexit referendum. Within Europe, national institutions often lack the scale required to effectively address these imbalances. Although some member states have attempted to develop domestic digital sectors, Europe's fragmented digital landscape remains heavily dependent on imported technologies [Parcu, Carrozza, Innocenti, 2022]. Dependence on US and Chinese platforms for cloud computing, search and social media raises evident concerns about the European Union's digital sovereignty.

At the global level, longstanding asymmetries between advanced economies and the Global South are reinforced by digital inequalities. While mobile technology diffusion has expanded access to communication and basic financial tools, control over core infrastructures, standards and intellectual property remains concentrated in a small number of advanced economies. Couldry and Mejias [2019] describe this as *data colonialism*: a reconfiguration of global dependency through data extraction rather than material exploitation.

Financialisation further magnifies these distributive dynamics. The valuations of major technology platforms often reflect expectations of future dominance more than current profits, encouraging aggressive strategies of data extraction, rapid expansion, and market capture. Because equity ownership remains highly concentrated, the resulting wealth gains accrue to a narrow segment of the population, reinforcing interpersonal inequality. Unequal access to investment capital and venture financing further widens technological disparities.

Government responses have thus far remained limited. Competition policy has struggled to adapt to network effects, data-driven barriers to entry, and the growing importance of behavioural analytics [Ezrachi, Stucke, 2016]. Efforts to tax digital giants – such as the proposed EU digital services tax – have faced geopolitical resistance. Labour protections lag behind organisational realities: although some

jurisdictions have attempted to reclassify gig-economy workers as employees, platforms often find ways to circumvent such measures. The transnational reach of digital platforms complicates national regulation, while international coordination remains comparatively weak.

These limitations suggest that digital-era economic inequalities are structural rather than incidental. They originate in the architecture of digital markets and the institutional power of platforms, rather than in isolated instances of misconduct. What emerges is a renewed form of institutional disembedding, as economic coordination shifts to privately governed infrastructures that elude traditional oversight. The next section examines how these economic transformations translate into cultural and informational asymmetries – particularly in the distribution of visibility, attention and influence – in ways that further amplify inequality in the digital sphere.

4. The digital revolution: cultural inequalities

The structural mechanisms that generate economic concentration in digital markets also underpin the emergence of cultural and informational inequalities. Network effects, data advantages, and platform intermediation do not merely reshape production and value extraction, but determine patterns of visibility, influence and knowledge circulation. The same processes that produce *superstar firms* generate *superstar channels*, with attention becoming highly skewed and a small number of actors capturing most of the visibility while the majority remain marginal. In this sense, inequalities of wealth and market power translate into inequalities of attention and information. As Benkler, Faris and Roberts [2018] demonstrate, these asymmetries arise from the interaction between platform architectures and existing media and political structures. Digital infrastructures therefore amplify structural inequalities of visibility rather than originating them.

Early expectations that the internet would democratise communication should be reassessed in light of these dynamics. The initial decentralised architecture of the web was intended to lower the barriers to participation and enable citizens to bypass traditional gatekeepers [Shirky, 2008], but the trajectory of digital infrastructures has been characterised by consolidation and commodification. A small number of platforms now mediate the majority of online interactions and function as *superstar channels*. Hindman [2009] demonstrated that even in an ostensibly open environment, visibility and influence concentrate heavily. A long tail of websites exists, but users' attention is overwhelmingly focused on a few dominant

leaders. The shift from decentralised networks to integrated platform ecosystems has restructured the cultural landscape around commercial imperatives rather than participatory ideals.

This evolution entails a new mode of appropriation. Informational and cognitive activities, once private or unmonetised, become inputs in data-driven business models. Zuboff [2019] characterises this as *surveillance capitalism*: behavioural data are extracted, analysed and recombined to generate predictive and monetisable outputs. Algorithms curate information flows, converting attention into an optimisable and increasingly manipulable asset [Pasquale, 2015]. The opacity of these processes limits individuals' capacity to understand or contest how their data are being used. The asymmetry of information between platforms and users mirrors – and arguably intensifies – the asymmetries of power between factories and workers in the industrial revolution. Moreover, the digital revolution operating on a global scale and at unprecedented speed compresses the time available for institutional adaptation.

Algorithmic curation is central to cultural inequalities in the digital age. Platforms such as Facebook, YouTube, TikTok and X determine the prominence of content in personalised feeds. Optimised for engagement, these systems privilege sensational, emotionally charged, and polarising material [Allcott, Gentzkow, 2017]. Vosoughi, Roy, and Aral [2018] show that on Twitter (now X), false news spreads more rapidly than accurate information for precisely these reasons. More broadly, the contemporary disorder of digital information is not limited to false content alone. As Wardle and Derakhshan [2017] argue, digital ecosystems facilitate different forms of informational distortion – including misinformation, disinformation and malinformation – whose combined effect is to fragment the shared epistemic space and weaken the conditions for collective discussion. As a result, visibility is allocated through opaque rules that favour certain forms of content over others. Citizens increasingly inhabit divergent information environments, shaped by personalised feeds and echo chambers, which undermines the possibility of shared deliberation. When publics become more fragmented and polarised, the conditions for collective political action are weakened. The erosion of shared informational commons may be the most profound cultural consequence of the digital revolution. Cultural capital comprises not only education and skills but also recognition, legitimacy, and authority within cultural fields.

Cultural inequality therefore intersects with economic inequality in mutually reinforcing ways. Concentrated economic power enables platforms to shape the rules of visibility and monetisation, while cultural dominance attracts further revenue and data flows that further consolidate market power. The implications for

democracy are significant. Parcu [2020] highlights that the erosion of media pluralism reduces the diversity of perspectives available to citizens, making it harder for them to make informed choices. As dominant platforms displace traditional media, they become *irresponsible* gatekeepers that fail to provide equivalent safeguards for diversity and reliability. Helsper [2021] further emphasises that digital inequalities are socially structured, mirroring and amplifying existing divisions of class, race and gender.

These feedback loops render cultural and economic inequalities mutually reinforcing and resistant to incremental reforms. Measures such as reclassifying gig-economy workers or promoting fact-checking initiatives remain far below the scale of the systemic imbalances identified above. Important as they may be, these sporadic efforts on one or the other dimension of inequality are structurally inadequate to address the magnitude of the underlying problems. Without coordinated and structural interventions, the consolidation of economic and cultural power within dominant digital infrastructures will persist and deepen, threatening not only the cohesion of societies but the very resilience of democracy. Addressing these dynamics requires not only policy intervention, but a clearer conceptual understanding of the nature of the infrastructures through which they operate.

5. Digi-commons: conceptual foundations

The previous sections suggest that the central transformation associated with digitalisation lies not only in technological change, but also in the reorganisation of economic and social coordination around large-scale digital infrastructures. These infrastructures – platform ecosystems, data architectures, and algorithmic systems – mediate access to markets, information, and forms of participation, and thus operate as the primary sites where value is generated and distributed. The distributive patterns documented in Sections 3 and 4 – declining labour shares, rising inequality, and increasing concentration of visibility – are therefore more appropriately understood as outcomes of infrastructural organisation rather than as the result of isolated market interactions.

This observation raises a conceptual difficulty. Standard economic categories, and in particular the distinction between public and private goods, offer only a partial account of the nature of digital systems. In the classical formulation, public goods are characterised by non-rivalry and non-excludability [Samuelson, 1954], while subsequent contributions have explored the institutional conditions under which such

goods may be provided or regulated [Stiglitz, 1986]. Digital resources – data, software and information – appear to satisfy the non-rivalry condition, as they can be reproduced and shared at near-zero marginal cost. However, they are increasingly subject to forms of exclusion through technical design and legal arrangements, including proprietary standards, access restrictions, and control over data. As a result, digital infrastructures occupy an intermediate position – they are largely non-rival in use, yet increasingly excludable in practice, particularly through proprietary architectures and control over standards. A related category is that of club goods, or toll goods, which describes resources that are excludable but non-rival up to a point [Buchanan, 1965]. Digital infrastructures share some of these features. Yet the club-goods framework is insufficient here, because it focuses on access and congestion rather than on distributed value creation, network effects, and centralised control over interfaces, standards, and data flows. The concept of digi-commons is intended to capture this wider institutional configuration. The hybrid character of digital platforms limits the explanatory power of the public goods framework, suggesting that the key issue is not simply one of provision or allocation, but of institutional organisation. In this respect, the literature on commons governance provides a more relevant point of reference. Elinor Ostrom [1990] demonstrated that resources characterised by shared use can be governed through a variety of institutional arrangements that do not reduce to either market exchange or state provision. These arrangements define rules of access, participation, and monitoring that shape both the sustainability of the resource and the distribution of benefits. Similarly, Brett Frischmann's [2012] analysis of infrastructure as a shared input into economic and social activity emphasises that the value of infrastructures lies in enabling a wide range of downstream uses that cannot be fully anticipated or captured by their operators.

Digital infrastructures share important features with both traditions, yet they also depart from them in significant ways. Unlike traditional commons, they are not subject to depletion through overuse; rather, their value often increases with use. Network effects and data accumulation generate cumulative dynamics in which additional users enhance the performance and attractiveness of the system. At the same time, these mechanisms reinforce concentration, as increasing returns to scale and scope favour the emergence of dominant platforms. The result is not a tragedy of overuse but a process of cumulative centralisation.

This configuration produces a structural asymmetry between value creation and value appropriation. Value creation within digital infrastructures is inherently distributed: users generate data, contribute content, and participate in interactions that sustain the system. Firms design and maintain the technological architecture,

while public institutions and communities contribute to the broader informational and social environment in which these systems operate. By contrast, the capacity to appropriate and control value is concentrated in a relatively small number of actors that govern the infrastructure. These actors define conditions of access, establish interoperability standards, and determine the allocation of visibility and monetisation opportunities.

This institutional and power asymmetry clearly defines what is meant here by digi-commons. Digi-commons are enabling infrastructures characterised by four interrelated properties: non-rival use, increasing excludability, distributed value creation, and centralised governance. They differ from public goods in that access can be selectively restricted; they differ from private goods in that their value depends on widespread participation; and they differ from traditional commons in that governance is typically centralised rather than community-based. What defines them is not a particular ownership structure, but the combination of shared use and concentrated control. The concept does not apply to all digital platforms or all networked systems. Rather, it refers specifically to infrastructures whose value depends on broad participation, while control over interfaces, standards and data flows remains centralised.

Viewed from this perspective, the inequalities analysed in the previous sections appear as different manifestations of the same underlying institutional configuration. Economic inequality reflects the concentration of value capture within infrastructures that organise production and exchange. Cultural inequality reflects the concentration of visibility and influence within infrastructures that organise information and attention. Both are rooted in the rules governing access to and participation in digital systems. What links these dimensions is the governance of infrastructural bottlenecks. Control over interfaces, interoperability conditions, and the circulation of data enables the same institutional architecture to generate both economic extraction and asymmetries of visibility and influence.

The conceptual shift from goods to infrastructures has important analytical implications. It directs attention away from individual transactions and towards the institutional arrangements that structure them. In particular, it highlights how rules governing access, interoperability and data flows shape economic and social outcomes. These rules determine who can participate, under what conditions, and with what degree of autonomy. As such, they constitute a key mechanism through which power is exercised and inequalities are reproduced.

In recent years, the notion of *digital public goods* has emerged in both policy and academic debates as a response to some of these challenges. Initiatives associated with

international organisations and research institutions often emphasise the importance of open, accessible and reusable digital resources for development and inclusion. While framed as *digital public goods*, these systems extend beyond the provision of open and reusable resources and raise broader questions regarding the governance of the infrastructures within which such resources are embedded. Focusing on individual goods, however, risks overlooking the institutional conditions that shape access, control, and the distribution of value. Consequently, the digital public goods perspective captures only part of the governance problem.

The concept of digi-commons, by contrast, shifts the focus from the characteristics of individual resources to the institutional organisation of the systems that structure their use, providing a framework for analysing how shared resources can coexist with concentrated control, and how this combination shapes both economic and cultural outcomes. In doing so, it prepares the ground for examining the different institutional responses that have emerged in the European context, without presupposing their coherence or effectiveness.

6. Strategies for Europe's digital sovereignty

If digital infrastructures are understood as digi-commons, the central policy challenge extends beyond regulating market behaviour or fostering technological capacity. It concerns the governance of the institutional rules that structure access, interoperability and value distribution within these systems. From this perspective, digital sovereignty is not primarily a matter of control over firms or technologies, but of shaping the architectures through which economic and social coordination takes place.

Within this framework, Europe's response to the digital transformation has developed along three distinct trajectories: regulatory, industrial and civic. Each reflects a different conception of how digital infrastructures should be governed and a different entry point into the problem of digital inequality. However, these trajectories are not complementary components of a coherent strategy, but rather they represent structurally misaligned responses to different dimensions of the same underlying configuration.

The regulatory strategy focuses on constraining the behaviour of dominant platforms through legal obligations and rights-based frameworks. The industrial strategy seeks to build technological capacity and reduce external dependency by investing in infrastructures and innovation. The civic strategy emphasises

participation, openness and collective governance through bottom-up initiatives and commons-based models. Each trajectory captures an important aspect of digi-commons governance – conduct, capacity and participation – but none of them address the infrastructural level at which these dimensions are jointly determined.

As a result, Europe's approach remains fragmented. Regulatory interventions risk operating on systems whose underlying architectures they do not control. Industrial initiatives may build capacity without resolving how infrastructures are governed once established. Civic innovations demonstrate alternative forms of participation but struggle to scale and influence systemic outcomes. The problem, therefore, is not the absence of initiatives but their misalignment: a lack of integration across the institutional layers that shape digital infrastructures.

This misalignment reflects a deeper tension within the European project. The European Union possesses strong normative and regulatory capabilities, but limited centralised capacity for industrial coordination and an underdeveloped framework for integrating civic participation into infrastructural governance. In the context of digi-commons, where value creation is distributed but control remains concentrated, this fragmentation constrains Europe's ability to address the structural roots of digital inequality.

The following sections examine these three trajectories in turn, not as independent policy domains, but as partial and incomplete responses to a common institutional challenge.

6.1. The regulatory strategy

The regulatory trajectory represents the most visible and institutionally developed dimension of Europe's response to digital transformation. Rooted in the European Union's tradition of market regulation and rights protection, it seeks to constrain the power of dominant platforms through legal obligations and enforceable norms. From the General Data Protection Regulation [GDPR, 2016] to the Digital Markets Act (DMA) and the Digital Services Act [DSA, both 2022], the EU has progressively shifted from ex post competition enforcement towards ex ante regulatory intervention, targeting the systemic role of digital *gatekeepers*. In particular, the objectives of the DMA – restoring fairness and contestability in digital markets – are closely aligned with the structural features of digital concentration identified in previous sections.

Within the framework of digi-commons, however, the regulatory strategy operates primarily at the level of conduct rather than infrastructure. It defines how platforms should behave – through obligations relating to data use, interoperability,

transparency and access – but does not directly reshape the architectures through which digital coordination takes place. As a result, regulation can mitigate some of the effects of concentration without fundamentally altering the institutional configuration that generates them.

At the same time, the regulatory approach reflects Europe's broader normative ambition to embed democratic values – fairness, accountability and fundamental rights – into the governance of digital systems. The Artificial Intelligence Act [2024] extends this ambition to algorithmic infrastructures by introducing risk-based obligations to ensure transparency and human oversight. The Data Act and the Data Governance Act further expand the regulatory framework through measures promoting data portability, interoperability and the development of European data spaces. Taken together, these instruments articulate a distinctive model of digital sovereignty grounded in the rule of law.

This model is often interpreted through the lens of the Brussels Effect [Bradford, 2020]: the EU's capacity to project its regulatory standards globally through the size and attractiveness of its internal market. While this effect demonstrates Europe's normative influence, it also reveals a structural limitation. The global diffusion of European rules does not automatically translate into control over the infrastructures to which those rules apply. Regulation travels; infrastructures often do not.

The limits of a predominantly regulatory strategy become more evident when considered through the lens of the political economy of digi-commons. Legal norms can constrain behaviour, but they cannot by themselves generate the technological capabilities, investment capacity, or organisational ecosystems required to sustain infrastructural autonomy. As emphasised in the Draghi Report on European competitiveness [2024], regulation without corresponding industrial capacity risks producing a structural imbalance: a system in which Europe sets the rules, while others build and operate the infrastructures.

This tension is further reinforced by the geopolitical context. Transatlantic disputes over data governance, digital taxation, and platform regulation, combined with the strategic rivalry between the United States and China, reduce the effectiveness of regulatory projection as a standalone strategy. In this environment, Europe's reliance on normative power appears increasingly fragile. While it can shape behaviour within its jurisdiction, it struggles to secure a strategic position in the global digital economy.

In practice, the regulatory strategy rests upon a fundamental asymmetry. Europe governs platforms that it largely does not own and regulates infrastructures whose core technological layers are developed and controlled elsewhere. This creates a gap

between normative reach and material capacity. From the perspective of digi-commons, this gap is not incidental but structural: regulation addresses the symptoms of concentration, while the underlying architectures of coordination remain largely unchanged.

For these reasons, the regulatory strategy constitutes a necessary but insufficient component of digital sovereignty. It defines constraints and sets standards, but cannot by itself govern the infrastructural dynamics through which value is created and appropriated. Its effectiveness ultimately depends on its interaction with industrial capacity and civic forms of participation – dimensions that remain only partially integrated within the European response.

6.2. The industrial strategy

If the regulatory strategy defines Europe's capacity to set rules, the industrial strategy concerns its ability to build and sustain the infrastructures to which those rules apply. Within the digi-commons framework, this corresponds to the problem of capacity: the material and technological foundations required to support autonomous digital systems. Digital sovereignty depends not only on normative power, but also on the ability to develop, operate and scale the infrastructures through which economic and social coordination takes place.

The emergence of this industrial trajectory reflects a growing awareness of Europe's structural dependencies. The COVID-19 pandemic and the semiconductor shortages of 2021–22 exposed the extent to which critical components of digital infrastructures – including cloud computing, microprocessors, and large-scale data systems – remain dependent upon non-European suppliers. In response, the European Union has progressively re-legitimised industrial policy as a central instrument of digital sovereignty.

The European Chips Act [2022] exemplifies this shift, mobilising over €40 billion in public and private investment to strengthen Europe's semiconductor ecosystem and increase its share of global production. Similarly, Important Projects of Common European Interest (IPCEIs) in microelectronics, cloud computing, and artificial intelligence channel coordinated investment into strategic technological domains. Initiatives such as Gaia-X and the development of European Common Data Spaces aim to establish interoperable and trustworthy digital infrastructures under European governance [Reiberg, Niebel, Kraemer, 2022; European Commission, 2023]. Taken together, these efforts signal the return of industrial policy oriented towards resilience, technological capacity, and strategic autonomy.

Within the logic of digi-commons, however, the industrial strategy addresses only one dimension of the problem: the creation of infrastructures rather than their governance. Building European capacity does not, in itself, determine how these infrastructures will be organised, who will control access, or how value will be distributed. Without corresponding institutional design, industrial policy risks reproducing the very dynamics of concentration that characterise existing platform ecosystems, even when ownership shifts geographically or politically.

This limitation is reflected in the recurrent invocation of an *Airbus moment* for digital technologies. The analogy captures the need for scale, coordination and long-term investment, but it also obscures the structural differences between industrial and digital sectors. Unlike aerospace, digital infrastructures operate within open, global and rapidly evolving ecosystems characterised by network effects and data-driven feedback loops. In such contexts, scale can quickly translate into dominance, and public investment can unintentionally reinforce centralisation if it is not accompanied by appropriate governance mechanisms.

Moreover, the effectiveness of the industrial strategy is constrained by Europe's institutional architecture. The European Union lacks a centralised fiscal capacity capable of sustaining large-scale, long-term investment; capital markets remain fragmented; and coordination among Member States is frequently partial and uneven. European firms tend to remain smaller than their global competitors, while efforts to create *European champions* often generate tensions with competition policy. These structural constraints limit the speed and scale at which industrial initiatives can be deployed.

Geopolitical dynamics further complicate this trajectory. Growing protectionism in the United States and the intensification of U.S. – China technological rivalry place Europe in a position of strategic dependence and vulnerability. In this context, industrial policy becomes both necessary and fragile, seeking to reduce dependency while operating within a global system in which key technologies and supply chains remain controlled by external actors.

From the perspective of digi-commons, the central limitation of the industrial strategy lies in its separation from governance. It expands capacity without fully addressing how infrastructures should be organised, accessed, and regulated once established. As a result, it risks creating infrastructures without embedding the institutional conditions necessary to ensure openness, interoperability, and fair value distribution.

For this reason, industrial policy constitutes a necessary but incomplete component of digital sovereignty. It provides the material foundations of autonomy,

but cannot, on its own, resolve the institutional asymmetries that structure digital inequality. Its effectiveness ultimately depends on its alignment with regulatory frameworks and civic forms of participation – dimensions that remain only partially integrated within the European approach.

6.3. The civic strategy

If the industrial strategy represents Europe's attempt to build capacity, the civic trajectory reflects a different but complementary ambition: to democratise the governance of digital infrastructures through participation, openness, and collective agency. Within the digi-commons framework, this corresponds to the dimension of participation – the involvement of users, communities and public actors in shaping the rules and operation of digital systems.

This perspective begins from the recognition that digital infrastructures are not only governed from above but also co-produced through distributed forms of activity. Users generate data, create content, and sustain interactions; developers, researchers and public institutions contribute to the design and maintenance of digital environments. From this perspective, legitimacy cannot be derived solely from ownership or regulation, but must also emerge from participation in, and inclusion within, governance processes.

Across Europe, a heterogeneous ecosystem of initiatives reflects this logic. Open-source software communities, municipal digital platforms such as Decidim in Barcelona and Amsterdam, and other data governance experiments seek to reclaim digital infrastructures as shared resources governed according to public values. These initiatives do not merely challenge platform dominance; they experiment with alternative institutional arrangements in which participation becomes a constitutive element of governance.

Similarly, projects such as Policy Kit [Zhang, Grant, Bernstein, 2020] demonstrate how rules themselves can be encoded and adapted through collective deliberation, embedding governance procedures directly into digital systems. Research on algorithmic governance reinforces this perspective. Scholars such as Katzenbach and Ulbricht [2019] highlight how algorithms already function as instruments of governance, while Veale et al. [2018] and Brauneis and Goodman [2018] demonstrate that transparency, auditability and accountability can be incorporated into algorithmic systems, particularly within the public sector. Taken together, these developments suggest that digital infrastructures can be designed not only as economic systems, but also as institutional environments subject to democratic oversight.

In this context, Ostrom's [1990] theory of the commons provides a crucial analytical reference point. Her work demonstrated that shared resources can be sustainably governed through clearly defined rules, participatory decision-making, and effective monitoring. Transposed to the digital domain, these principles point towards architectures that enable conditional access, distributed decision-making, and adaptive rule-setting. In this sense, digital commons are not merely static repositories but institutional technologies that transform participation into governance.

Despite its conceptual relevance, the civic trajectory remains structurally fragile. Most initiatives operate at local or experimental scales, rely on limited funding, and lack the institutional continuity required to influence systemic outcomes. They demonstrate that participatory governance is feasible, but not easily scalable. Without stable connections to regulatory frameworks and industrial investment, civic innovation risks remaining peripheral – symbolically important, but structurally marginal.

From the perspective of digi-commons, the civic strategy addresses participation and legitimacy, although it does not operate at the infrastructural level at which digital coordination is organised. The civic strategy expands the space of institutional imagination, but lacks the capacity to shape the architectures through which value is generated and controlled. Consequently, it cannot counterbalance the concentration of control embedded in dominant platforms, and therefore remains necessary but insufficient.

7. Towards a democratic digital ecosystem

The analysis developed in the previous section demonstrates that Europe's response to the digital transformation is not limited by the absence of initiatives, but by their structural misalignment. Regulatory, industrial and civic trajectories address different dimensions of digital infrastructures – conduct, capacity and participation – but remain disconnected at the infrastructural level where these dimensions are jointly determined.

As a result, digital sovereignty cannot be achieved by strengthening any single trajectory in isolation. Regulation without capacity cannot reshape infrastructures; industrial policy without governance risks reproducing concentration; and civic participation without scale remains marginal. The central challenge is therefore one of integration: designing institutional mechanisms capable of linking these trajectories into a coherent framework for governing digi-commons. Such integration cannot

rely on simple convergence or centralisation. Instead, the objective is to establish functional interdependence across trajectories whose logics, actors and timescales are unlikely to align spontaneously.

In this context, standards emerge as a central mechanism of integration. They translate regulatory principles into operational requirements, guide industrial implementation, and create structured entry points for participation. In the European context, standard-setting has long functioned as more than a technical exercise: it has served as a mechanism for coordinating innovation across heterogeneous actors while avoiding the closure associated with siloed models [Parcu, Mazzoni, Innocenti, 2025]. Unlike legal norms or market structures, standards operate directly at the infrastructural level – they define how systems interconnect, how data flows, and how coordination is achieved. By doing so, they link the normative, technical and organisational dimensions of digital governance.

Standardisation should remain a technical process, but its governance must be opened to structured forms of participation. Rather than transforming it into a political arena, the objective is to make it a site of mediated participation, where public authorities, firms and organised civil society contribute to shaping the rules of digital infrastructures. In this sense, standardisation can function as a quasi-democratic mechanism – not by replacing representative institutions, but by embedding participation within the design of infrastructural rules. This potential and expansive role has become increasingly visible within the emerging European framework for artificial intelligence, where harmonised standards are expected to translate broad legal requirements into concrete technical specifications. In such settings, standards do not merely support regulation ex post; they contribute to defining the effective conditions of compliance ex ante. However, this shift also entails a significant delegation of regulatory authority to standard-setting bodies, raising concerns about democratic accountability and the capacity of technical processes to adequately reflect fundamental rights and public-interest considerations [Cantero Gamito, 2024]. As a result, the effective locus of digital governance increasingly shifts from formal legal provisions to the infrastructural processes through which they are operationalised, thereby functioning as delegated mechanisms of governance rather than neutral technical instruments.

Interoperability represents a second, equally important pillar of this framework. While standards define the rules of coordination, interoperability determines whether those rules can be effectively enacted across systems. It should therefore be understood not merely as a condition of connectivity, but as an institutional mechanism that structures access, participation, and control within digital ecosystems.

It shapes the extent to which infrastructures remain open, connected and contestable, or instead evolve into closed and self-reinforcing architectures.

In digital markets characterised by network effects and data accumulation, interoperability directly influences market dynamics and the distribution of power. By lowering switching costs, enabling multi-homing, and allowing data and functionalities to circulate across platforms, it counteracts the mechanisms that drive concentration. From the perspective of digi-commons, interoperability defines the practical conditions of participation, shaping who can access infrastructures, under what terms, and with what capacity to interact and innovate. Without effective interoperability, participation remains formally possible but substantively constrained, as users and smaller actors become locked into dominant systems.

Crucially, interoperability cannot be treated as a marginal technical feature. Its scope, depth and implementation are institutional choices with far-reaching distributive consequences. Weak or superficial interoperability may preserve the appearance of openness while leaving underlying control structures intact. By contrast, robust interoperability – supported by enforceable standards, monitoring mechanisms, and institutional coordination – can reshape digital ecosystems in ways that align more closely with democratic and competitive principles.

Standards and interoperability therefore operate jointly: the former define the rules, while the latter ensure that those rules are materially effective across systems. This approach shifts the focus from isolated policy instruments to infrastructural governance. Rather than attempting to correct market outcomes ex post, it seeks to shape the conditions under which coordination occurs. In practical terms, this implies embedding common standards, interoperability requirements, and auditing mechanisms within European digital infrastructures, including data spaces, cloud systems, and AI development environments.

One concrete pathway lies in the governance of European data spaces. At the regulatory level, EU legislation can mandate portability requirements, access conditions, and baseline interoperability obligations. At the industrial level, public funding and procurement can support the development of interoperable cloud and data infrastructures. At the civic level, structured participation by public-interest actors, researchers and user communities can be embedded in standard-setting, auditing and oversight procedures. In such a configuration, standards and interoperability operate not as abstract principles, but as institutional mechanisms linking legal norms, technical implementation, and mediated participation. Together, these elements act as binding constraints that align incentives across actors while preserving openness and adaptability.

A second dimension of integration concerns institutional learning. Rather than relying on a single comprehensive design, Europe can develop a portfolio of experimental initiatives that translate principles into practice. Pilot projects – such as public-service AI systems, federated civic platforms, or shared data infrastructures – should be understood not primarily as market interventions but as institutional experiments. Their significance lies in their capacity to generate transferable standards, practices and governance models that can be scaled across the European digital ecosystem.

At the same time, the legitimacy of this framework depends on the effective inclusion of civic actors. Participation is not an optional complement, but a condition for aligning infrastructures with democratic principles. Without mechanisms that enable users, communities and public-interest organisations to contribute to rule formation and oversight, the governance of digi-commons risks becoming technocratic or being captured by dominant actors. Structured participation within oversight and infrastructure-governance processes is therefore essential to ensure accountability and responsiveness. Europe's distinctive resource in this field is therefore not regulatory assertiveness alone, nor technological leadership in any narrow sense, but its capacity to organise legality, coordination and participation institutionally across multiple levels of governance. For such participation to be meaningful, civic actors require not only consultative access but also stable resources, institutional standing, and procedural rights within standard-setting, auditing and oversight processes.

Finally, the European strategy must be situated within a broader international context. Digital infrastructures are inherently transnational, and their governance cannot be confined to regional boundaries. Cooperation with like-minded partners, including countries in the Global South, is necessary to both prevent the emergence of new forms of dependency and promote open and interoperable standards at the global level. In this respect, Europe's role is less that of a hegemonic power than of a normative and institutional broker capable of shaping shared frameworks for digital governance.

Digital sovereignty should therefore be understood not as a final state, but as a continuous process of institutional alignment across legality, capacity and participation. The objective is not to eliminate the tensions between these dimensions, but to organise them productively through shared infrastructures and governance mechanisms. Only by embedding democratic principles into the architecture of digi-commons – through standards that structure coordination and interoperability that guarantees openness – can Europe address the structural roots of digital inequality and contribute to the emergence of a more open, contestable and accountable digital ecosystem.

8. Conclusion

Despite their immense contributions to human development, both industrial revolutions began by expropriating forms of human agency, concentrating wealth and power, and generating profound inequalities. The first subordinated craft, time and labour to the factory system; the second reorganises choice, data, visibility and participation through digital infrastructures. If labour law, public education, and welfare institutions were the major re-embedding mechanisms of industrial capitalism, their digital-era analogue would consist of institutions capable of governing access, interoperability, data flows, algorithmic accountability, and participatory oversight at the infrastructural level. Yet while the first revolution eventually triggered institutional responses capable of re-embedding markets within social and political constraints, the second has so far unfolded without a comparable process of institutional adjustment.

This paper has shown that the inequalities of the digital age are not merely distributive outcomes, but structural features of the way digital infrastructures are organised. Economic inequalities – manifested in declining labour shares, platform concentration, and territorial imbalances – are tightly interwoven with cultural inequalities rooted in asymmetries of visibility, attention and information. These dimensions reinforce one another through feedback loops embedded in platform architectures, undermining market contestability, media pluralism, and democratic resilience. Addressing these dynamics therefore requires moving beyond isolated interventions and focusing instead on the governance of the infrastructures that structure economic and social coordination.

Reframing digital systems as digi-commons provides a way of capturing this underlying configuration. Digital infrastructures combine non-rival use with increasing excludability, and distributed value creation with centralised control. The problem is therefore not simply one of regulating firms or correcting market failures, but of shaping the institutional arrangements that govern access, participation and value distribution within these systems.

Europe's response appears both advanced and incomplete. Regulatory, industrial and civic trajectories have developed in parallel, but their limited integration constrains their capacity to address digital inequality at the infrastructural level. Standards and interoperability emerge as key mechanisms for achieving this objective. Standards translate regulatory principles into operational rules and provide a shared framework for coordination across actors. Interoperability ensures that these rules are effectively enacted across systems, enabling openness, reducing

lock-in, and sustaining distributed participation. Together, they can provide the institutional and technical foundations of new democratic digi-commons, linking normative ambition, industrial implementation, and civic participation within a common architecture.

At the same time, this integration cannot be understood as a purely technical or regulatory exercise. The legitimacy of digital infrastructures depends on the extent to which participation is effectively embedded within their governance. Opening standardisation processes and infrastructural design to structured forms of participation allows digital systems to incorporate diverse perspectives while maintaining technical coherence. In this sense, democratic governance in the digital age operates not only through laws or markets, but also through the design of the infrastructures that organise coordination itself.

The European Union is relatively well positioned to advance such an approach. Its commitment to fundamental rights, economic fairness, and social inclusion provides a normative foundation; its experience in regulatory coordination and standard-setting offers institutional tools; and its tradition of collective action creates the potential for integration. Yet this potential remains contingent. Without deeper alignment between its regulatory, industrial and civic capacities, Europe risks projecting influence externally while remaining structurally dependent internally.

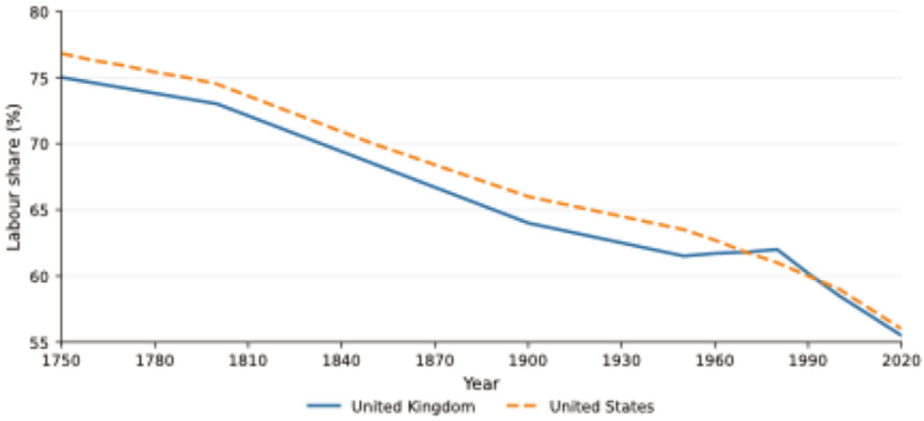
Moreover, the governance of digital infrastructures cannot be confined to regional boundaries. The dynamics of digital inequality are global, and persistent asymmetries between advanced economies and the Global South create the risk of new forms of dependency. A European strategy must therefore be embedded in broader forms of international cooperation aimed at promoting open, interoperable and accountable digital systems.

Digital sovereignty should therefore be understood not as a final state, but as a continuous process of institutional alignment across legality, capacity and participation. The objective is not to eliminate the tensions between these dimensions, but to organise them productively through shared infrastructures and governance mechanisms. This challenge becomes even more acute as AI systems increasingly mediate not only exchange and attention, but also the production, ordering and circulation of knowledge, opening a related agenda on epistemic inequality that extends beyond the scope of the present paper. The current argument is therefore diagnostic rather than definitive: it identifies a structural tendency before any durable institutional settlement has yet emerged.

Europe's task is therefore not to escape digital interdependence, but to govern it institutionally, so that the infrastructures on which collective life increasing-

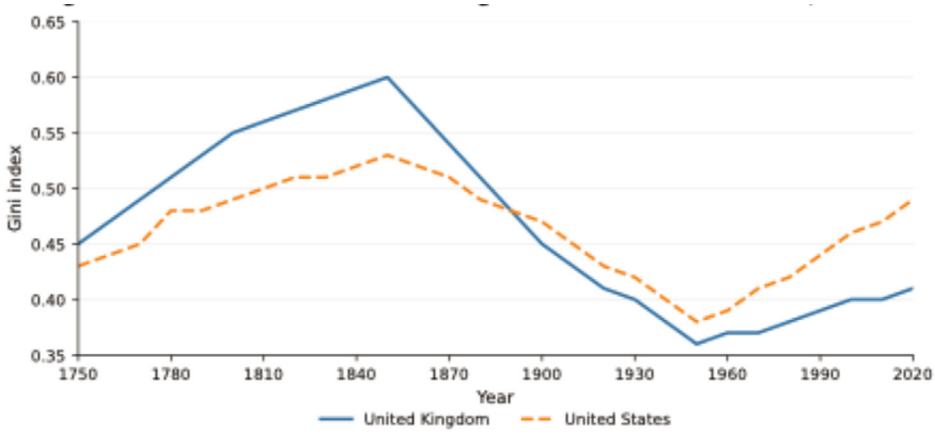
ly depends become supports for democratic coordination rather than engines of cumulative inequality.

Figure 1. Labour share in the United Kingdom and the United States, 1750–2020



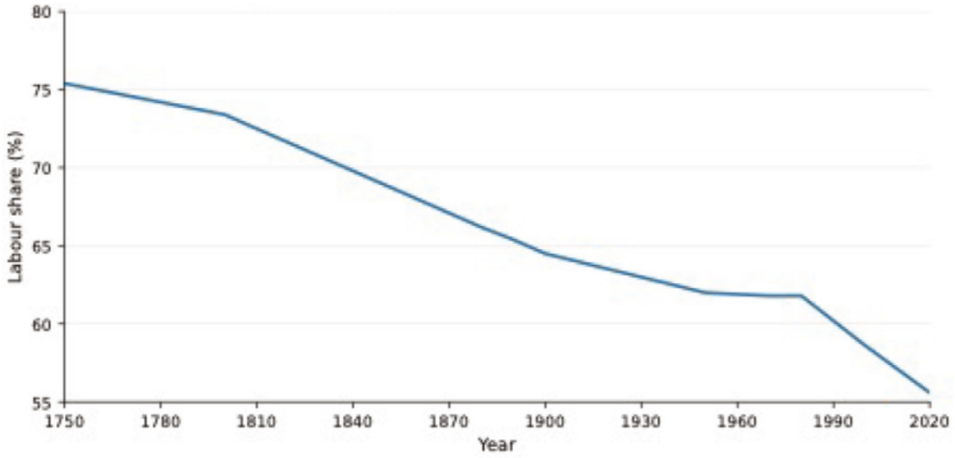
Source: Author's own elaboration based on the sources reported in Annex Tables 1 and 2.

Figure 2. Gini index in the United Kingdom and the United States, 1750–2020



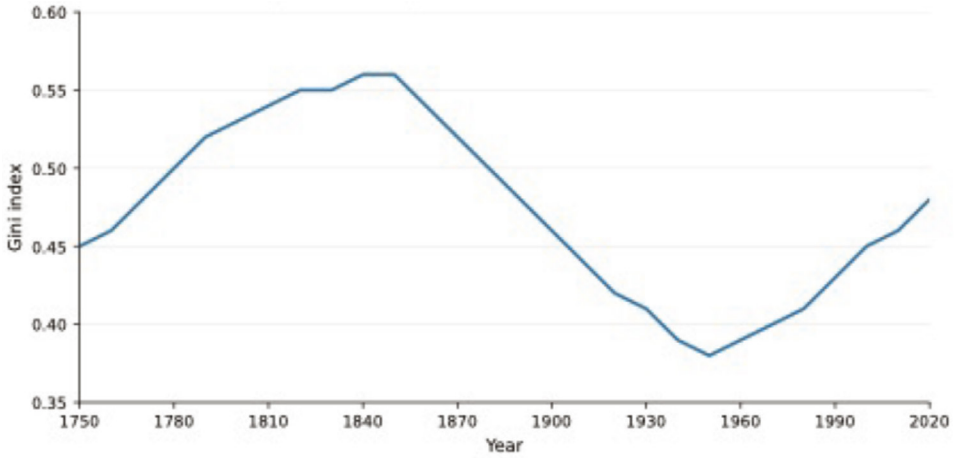
Source: Author's own elaboration based on the sources reported in Annex Tables 1 and 2.

Figure 3. Composite labour share, 1750–2020



Note: The composite indicator is weighted using historical GDP shares for the United Kingdom and the United States.
Source: Author's own elaboration based on the sources reported in Annex Tables 1 and 2.

Figure 4. Composite Gini index, 1750–2020



Note: The composite indicator is weighted using historical GDP shares for the United Kingdom and the United States.
Source: Author's own elaboration based on the sources reported in Annex Tables 1 and 2.

Annex 1. Construction of the composite labour-share and Gini indexes

To compare long-term inequality dynamics across the previous and the current industrial revolutions, the analysis employs two composite indicators: a Composite Gini index and a Composite Labour share index. Both series combine historical data for the United Kingdom and the United States – the two economies for which sufficiently long and internally consistent time series exist. Since neither country alone provides a representative picture of the evolving economic centre of gravity, the composite indexes weight the national series according to their relative shares of world GDP.

Formally, for each decade *t*:

$$X_t^{comp} = w_t^{UK} \cdot X_t^{UK} + w_t^{US} \cdot X_t^{US}$$

The weights are derived from the relative shares of world GDP accounted for by the United Kingdom and the United States, subsequently normalised to 1. The resulting series are therefore intended to capture the changing balance between the two economies rather than their combined share of world output in absolute terms. where:

- X_t^{comp} is the composite indicator (Gini or Labour Share);
- X_t^{UK} and $X_t^{US}$are the corresponding national values;
- w_t^{UK} and $w_t^{US}$are GDP-based weights such that
- $w_t^{UK} + w_t^{US} = 1$.

Weights are derived from the Maddison Project Database and interpolated into decade-level estimates to reflect the long-run shift of global economic leadership from the United Kingdom (dominant until the late 19th century) to the United States (dominant from the early 20th century onwards). This approach ensures that the composite indexes capture not only inequality dynamics but also the historical transition in economic primacy between the two economies. Labour-share and pre-tax Gini concepts are reconstructed from historical series that are not perfectly homogeneous across centuries. The composite indexes should therefore be interpreted as disciplined comparative proxies rather than as fully harmonised macro-historical measures. Where decade-level observations were unavailable, values were linearly interpolated from adjacent benchmark years. The slope comparisons reported in the paper are intended to capture the broad magnitude and direction of the historical contrast. While robust to the general pattern of the reconstructed series, they should not be interpreted as invariant to every possible specification choice.

The resulting series provide a synthetic and historically grounded proxy for the evolution of distributive patterns and labour-income relations across two centuries. While inevitably a simplification – limited by data availability and the Anglo-centric focus imposed by historical sources – the composite indicators enable a consistent comparison of inequality trends across the two technological eras and support the empirical findings reported in the paper.

Annex Table 1. Labour Share and Gini Index[2]

Years	Labour share UK	Labour share US	Gini index UK	Gini index US
1750	75.0	76.8	0.45	0.43
1760	74.6	76.3	0.47	0.44
1770	74.2	75.9	0.49	0.45
1780	73.8	75.4	0.51	0.48
1790	73.4	75.0	0.53	0.48
1800	73.0	74.5	0.55	0.49
1810	72.1	73.6	0.56	0.50
1820	71.2	72.7	0.57	0.51
1830	70.3	71.8	0.58	0.51
1840	69.4	70.9	0.59	0.52
1850	68.5	70.0	0.60	0.53
1860	67.6	69.2	0.57	0.52
1870	66.7	68.4	0.54	0.51
1880	65.8	67.6	0.51	0.49
1890	64.9	66.8	0.48	0.48
1900	64.0	66.0	0.45	0.47
1910	63.5	65.5	0.43	0.45
1920	63.0	65.0	0.41	0.43
1930	62.5	64.5	0.40	0.42
1940	62.0	64.0	0.38	0.40
1950	61.5	63.5	0.36	0.38
1960	61.7	62.7	0.37	0.39
1970	61.8	61.8	0.37	0.41

[2] The Gini Index is a standard measure of pre-tax income inequality ranging from 0 (perfect equality) to 1 (perfect inequality). It equals twice the area between the Lorenz curve and the 45° line. Values are unit-free but often reported as *Gini points* (e.g. 0.40 = 40). Changes in Gini points are absolute; percentage changes refer to proportional movements in the index. Changes of a few Gini points are typically interpreted as substantively large in the historical inequality literature.

Years	Labour share UK	Labour share US	Gini index UK	Gini index US
1980	62.0	61.0	0.38	0.42
1990	60.2	60.0	0.39	0.44
2000	58.5	59.0	0.40	0.46
2010	57.0	57.5	0.40	0.47
2020	55.5	56.0	0.41	0.49

Source: Historical data on the labour share and the Gini coefficients for the United Kingdom and the United States (1750–2020) were reconstructed and interpolated using the WID Project, the Maddison Project Database, and Lindert and Williamson [1983].

Annex Table 2. Composite Labour Share and Gini Index

Years	UK share	US share	Gini Composite	Labour Composite
1750	0.83	0.17	0.45	75.4
1760	0.80	0.20	0.46	75.0
1770	0.76	0.24	0.48	74.6
1780	0.73	0.27	0.50	74.2
1790	0.71	0.29	0.52	73.8
1800	0.71	0.29	0.53	73.4
1810	0.68	0.32	0.54	72.5
1820	0.65	0.35	0.55	71.6
1830	0.59	0.41	0.55	70.7
1840	0.52	0.48	0.56	69.8
1850	0.47	0.53	0.56	68.9
1860	0.42	0.58	0.54	68.0
1870	0.41	0.59	0.52	67.1
1880	0.39	0.61	0.50	66.2
1890	0.37	0.63	0.48	65.4
1900	0.36	0.64	0.46	64.5
1910	0.34	0.66	0.44	64.0
1920	0.29	0.71	0.42	63.5
1930	0.25	0.75	0.41	63.0
1940	0.25	0.75	0.39	62.5
1950	0.25	0.75	0.38	62.0
1960	0.20	0.80	0.39	61.9
1970	0.15	0.85	0.40	61.8
1980	0.13	0.87	0.41	61.8
1990	0.13	0.87	0.43	60.2

cont. Annex Table 2

Years	UK share	US share	Gini Composite	Labour Composite
2000	0.14	0.86	0.45	58.6
2010	0.12	0.88	0.46	57.1
2020	0.11	0.89	0.48	55.6

Source: Composite labour share and Gini indexes were constructed from UK and US historical series using GDP-based weights derived from the Maddison Project Database. Underlying national series were reconstructed from the WID Project, the Maddison Project Database, and Lindert and Williamson [1983].

References

Allcott, H., Gentzkow, M. (2017). Social media and fake news in the 2016 Election, *Journal of Economic Perspectives*, 31(2), pp. 211–236.

Allen, R.C. (2009). *The British Industrial Revolution in Global Perspective*. Cambridge: Cambridge University Press.

Autor, D., Dorn, D., Katz, L.F., Patterson, C., Van Reenen, J. (2020). The Fall of the Labor Share and the Rise of Superstar Firms, *Quarterly Journal of Economics*, 135(2), pp. 645–709.

Benkler, Y., Faris, R., Roberts, H. (2018). *Network Propaganda: Manipulation, Disinformation, and Radicalization in American Politics*. New York: Oxford University Press.

Bolt, J., van Zanden, J.L. (2020). *Maddison Project Database* (version 2020). Groningen Growth and Development Centre. Dataset.

Bradford, A. (2020). *The Brussels Effect: How the European Union Rules the World*. New York: Oxford University Press.

Buchanan, J.M. (1965). An Economic Theory of Clubs, *Economica*, 32(125), pp. 1–14.

Cantero Gamito, M. (2024). The Role of ETSI in the EU's Regulation and Governance of Artificial Intelligence, *Innovation: The European Journal of Social Science Research*, 37(5), pp. 1425–1440.

Couldry, N., Mejias, U.A. (2019). *The Costs of Connection: How Data is Colonizing Human Life and Appropriating it for Capitalism*. Redwood City, CA: Stanford University Press.

De Loecker, J., Eeckhout, J. (2017). The Rise of Market Power and the Macroeconomic Implications, *NBER Working Paper*, No. 23687.

De Stefano, V. (2016). The Rise of the "Just-In-Time Workforce": On-Demand Work, Crowd Work, and Labour Protection in the Gig-Economy, *Comparative Labor Law & Policy Journal*, 37(3), pp. 471–504.

Draghi, M. (2024). *The Future of European Competitiveness: A Competitiveness Strategy for Europe*. European Commission.

European Commission (2023). *European Data Spaces*. Luxembourg: Publications Office of the European Union.

Frischmann, B.M. (2012). *Infrastructure: The social value of shared resources*. Oxford/New York: Oxford University Press.

Helsper, E.J. (2021). *The Digital Disconnect: The Social Causes and Consequences of Digital Inequalities*. London: SAGE.

Hindman, M. (2009). *The Myth of Digital Democracy*. Princeton, NJ: Princeton University Press.

Hobsbawm, E.J. (1962). *The Age of Revolution: Europe 1789–1848*. London: Weidenfeld & Nicolson.

Karabarbounis, L., Neiman, B. (2014). The Global Decline of the Labor Share, *Quarterly Journal of Economics*, 129(1), pp. 61–103.

Lindert, P., Williamson, J. (1983). Reinterpreting Britain's Social Tables, 1688–1913, *Explorations in Economic History*, 20(1), pp. 94–109.

Mokyr, J. (1990). *The Lever of Riches: Technological Creativity and Economic Progress*. New York: Oxford University Press.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

Parcu, P.L. (2020). New Digital Threats to Media Pluralism in the Information Age, *Competition and Regulation in Network Industries*, 21(2), pp. 91–109.

Parcu, P.L., Innocenti, N., Carrozza, C. (2022). Ubiquitous Technologies and 5G Development: Who is Leading the Race?, *Telecommunications Policy*, 46(4), 102277.

Parcu, P.L., Mazzoni, L., Innocenti, N. (2025). Which Innovation Model Yields More for Society? Standard Setting Organizations Versus Silos. In: *Research Handbook on Competition and Technology* (pp. 87–105), P.L. Parcu, M.A. Rossi, M. Botta (Eds.). Cheltenham, UK: Edward Elgar Publishing.

Parker, G., Van Alstyne, M., Choudary, S. (2016). *Platform Revolution: How Networked Markets are Transforming the Economy*. New York: W.W. Norton & Company.

Pasquale, F. (2015). *The Black Box Society: The Secret algorithms that Control Money and Information*. Cambridge, MA: Harvard University Press.

Polanyi, K. (1944). *The Great Transformation: The Political and Economic Origins of Our Time*. New York: Farrar & Rinehart.

Reiberg, A., Niebel, C., Kraemer, P. (2022). What is a Data Space? Gaia-X Hub Germany, *White Paper*, 1(2022).

Rodríguez-Pose, A. (2018). The Revenge of the Places that Don't Matter (And What to Do About It), *Cambridge Journal of Regions, Economy and Society*, 11(1), pp. 189–209.

Samuelson, P.A. (1954). The Pure Theory of Public Expenditure, *The Review of Economics and Statistics*, 36(4), pp. 387–389.

Shirky, C. (2008). *Here Comes Everybody: The Power of Organizing Without Organizations*. New York: Penguin Press.

Simon, H.A. (1991). Organizations and Markets, *Journal of Economic Perspectives*, 5(2), pp. 25–44.

Srnicek, N. (2017). *Platform Capitalism*. Cambridge: Polity Press.

Stiglitz, J.E. (1986). *Economics of the Public Sector*. New York: W.W. Norton & Company.

Szreter, S. (1997). Economic Growth, Disruption, Deprivation, Disease, and Death: On the Importance of the Politics of Public Health for Development, *Population and Development Review*, 23(4), pp. 693–728.

Thompson, E.P. (1963). *The Making of the English Working Class*. London: Victor Gollancz.

Thompson, E.P. (1967). Time, Work-Discipline, and Industrial Capitalism, *Past & Present*, 38(1), pp. 56–97.

Van Dijck, J., Poell, T., de Waal, M. (2018). *The Platform Society: Public Values in a Connective World*. New York: Oxford University Press.

Vosoughi, S., Roy, D., Aral, S. (2018). The Spread of True and False News Online, *Science*, 359(6380), pp. 1146–1151.

Wardle, C., Derakhshan, H. (2017). *Information Disorder: Toward an Interdisciplinary Framework for Research and Policy Making*. Council of Europe report DGI (2017) 09.

Woodcock, J., Graham, M. (2020). *The gig economy: A critical introduction*. Cambridge: Polity Press.

Zhang, A., Hugh, G., Bernstein, M. (2020). PolicyKit: Building Governance in Online Communities, Proceedings of the 33 Annual Symposium, Association for Computing Machinery, pp. 365–378.

Zuboff, S. (2019). The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power. New York: PublicAffairs.

8

Ryszard Rapacki[1]
Piotr Maszczyk[2]
Mariusz Próchniak[3]

Patchwork Capitalism and the Paradox of Economic Performance: Fast Growth, Structural Imbalances, and Institutional Short-Sightedness

Abstract

This chapter examines the relationship between institutional design and economic performance in eleven former socialist countries, currently new EU members in Central and Eastern Europe (CEE11). To this end, it advances the concept of patchwork capitalism as a new, distinct model of contemporary capitalism being a product of path dependence, emerging from post-socialist systemic transformation. It conceptualises this model as a socio-economic order characterised by weak institutional fabric, general institutional ambiguity, poor complementarity, and the coexistence of divergent coordination mechanisms. These features result from the coexistence and interaction of institutional arrangements inherited from the proto-capitalist past, the socialist period, as well as those transplanted from various models of contemporary Western capitalism during the transition to a market economy and subsequent European integration.

The analysis identifies a paradox of economic performance in CEE11 countries: robust economic growth and rapid real convergence paralleled by pervasive macroeconomic imbalances and structural constraints on sustained long-term development. To explain

1 SGH Warsaw School of Economics (Poland), e-mail: rrapacki@sgh.waw.pl.
2 SGH Warsaw School of Economics (Poland), e-mail: pmaszcz@sgh.waw.pl.
3 SGH Warsaw School of Economics (Poland), e-mail: mproch@sgh.waw.pl.

this unusual pattern, the chapter introduces the concept of the *institutional short-sightedness syndrome* inherent to patchwork capitalism, as a key transmission mechanism between the institutional design and economic outcomes. It argues that low levels of trust, elevated perceived uncertainty, and increased risk-aversion shape incentives that affect economic behaviour and are conducive to shortened decision-making time horizons, thereby reinforcing the short-term orientation of economic agents. The chapter contributes to the comparative capitalism literature by highlighting the non-dichotomic and multifaceted nature of the institutions – economic performance nexus. It also demonstrates how trade-offs between growth and stability, flexibility and coordination, and external integration and internal coherence shape development trajectories in the CEE region.

1. Introduction

In recent decades, the relationship between institutions and economic performance has become a focal point in new institutional economics (NIE) and comparative political economy. A large body of literature spanning new institutional economics, comparative capitalism, and new economic sociology has consistently emphasised that institutional design plays a decisive role as a determinant of growth dynamics, macroeconomic stability, and the long-term development trajectories of countries and their clusters [Acemoglu, Robinson, 2012; Amable, 2003; Hall, Soskice, 2001; North, 1990]. At the same time, the predominant analytical frameworks have been largely geared towards advanced Western economies, leaving the institutional peculiarities of post-communist countries only partially conceptualised and insufficiently theorised.

This limitation becomes particularly evident in the case of Central and Eastern Europe (CEE11), where post-socialist transformation has produced institutional arrangements that do not fit neatly within any of the established models of capitalism identified in the European Union. While influential approaches such as the Varieties of Capitalism (VoC) framework [Hall, Soskice, 2001] and the Diversity of Capitalism (DoC) perspective [Amable, 2003] recognise the coexistence of multiple institutional equilibria, they offer limited analytical leverage in capturing the ambiguous, heterogeneous and historically-layered nature of post-communist institutional orders. Consequently, the economic performance of CEE11 economies is frequently interpreted either as a transitional phenomenon or as a delayed convergence towards Western institutional archetypes.

This chapter challenges such interpretations by advancing the concept of *patchwork capitalism* as a distinct and analytically autonomous model of capitalism. Rather

than representing a transitional stage to a fully-fledged institutional convergence *en route* from socialism to a target Western capitalist model, patchwork capitalism constitutes a specific socio-economic order characterised by a loosely integrated institutional architecture [Rapacki, Maszczyk, Próchniak, Lissowska, Sulejewicz, 2026; 2022; Gardawski, Rapacki, 2019; Gardawski, Rapacki, 2021]. It combines heterogenous building blocks inherited from different historical periods – including proto-capitalist and socialist legacies – with selectively adopted institutional arrangements transplanted from various models of contemporary Western capitalism, coupled with supranational regulatory frameworks associated with EU membership, and variegated external corporate governance practices incoming to the CEE region with foreign direct investment (FDI) and multinational corporations (MNCs). Crucially, these elements do not converge towards a single coherent and complementary institutional logic; instead, they form a heterogenous, monadic layout with a weak institutional fabric [Gardawski, 2022], shaping incentives, expectations and behaviours of economic and social actors in an ambiguous manner.

The central argument of this chapter is that patchwork capitalism gives rise to a paradox of economic performance. On the one hand, countries embodying this model have recorded strong economic growth and rapid real convergence towards more advanced EU economies, particularly in the post-accession period [Rapacki et al., 2026]. On the other hand, this growth record has been accompanied by persistent macroeconomic imbalances, including elevated inflation and recurring fiscal and external disequilibria, as well as structural weaknesses that undermine their long-term development potential. This coexistence of rapid growth and structural fragility challenges conventional dichotomies or a belief widely shared in new institutional economics that "strong" institutions are conducive to superior economic performance, whereas "weak" institutions entail poor developmental outcomes [Acemoglu, Robinson, 2012].

To explain this paradox, the chapter introduces and develops the concept of *institutional short-sightedness syndrome* as a key transmission mechanism linking institutional design with economic performance in patchwork capitalism. The syndrome reflects a systematic bias of policymakers, firms and households towards simple, quantitative short- and medium-term objectives at the expense of more complex, long-term qualitative development goals. It arises from a blend of weak institutional fabric, elevated levels of perceived uncertainty, low generalised trust, and shortened decision-making horizons [North, 1990; Williamson, 2000]. Within patchwork capitalism, these features translate into the incentive structures that foster risk-averse strategies, discourage long-term investment – particularly in

innovation – and contribute to the persistence of high inflationary expectations and macroeconomic imbalances.

By integrating conceptual and empirical insights, this chapter contributes to the field in three chief ways. First, it conceptualises the idea of patchwork capitalism as a new analytical category within the comparative capitalism framework, extending beyond *classic* typologies derived from the experience of Western Europe [Amable, 2003; Hall, Soskice, 2001]. Second, it offers an empirically grounded reinterpretation of the institutions – economic performance nexus, demonstrating that heterogeneous and weakly coordinated institutional arrangements can generate mixed and internally inconsistent outcomes. Third, it advances the notion of institutional short-sightedness as a novel explanatory concept that helps reconcile the coexistence of rapid economic growth and income-level convergence with constrained long-term development capacity.

The empirical perspective adopted in the chapter focuses on a group of eleven Central and Eastern European countries (CEE11) and situates their performance within a comparative framework encompassing four established models of capitalism in the European Union. It examines both growth dynamics and macroeconomic stability over the period 2004–2025, following EU accession. The findings suggest that the superior growth performance of the CEE11 economies in the EU has been driven largely by total factor productivity gains, triggered by institutional change, inflows of foreign direct investment, and access to EU funds [Rapacki et al., 2026]. At the same time, it reveals a structurally unbalanced growth pattern, characterised by persistently higher inflation and recurring macroeconomic disequilibria relative to Western European models.

The analytical logic developed in this chapter can be summarised as follows: patchwork capitalism, characterised by institutional fragmentation and poor complementarity, generates elevated uncertainty, low trust, and compressed time horizons of decision-making, which translate into a system of incentives that gives birth to institutional short-sightedness. This behavioural bias gives rise to a distinctive pattern of economic performance combining strong short- and medium-term economic growth dynamics with persistent macroeconomic imbalances and constrained long-term development potential.

The remainder of the chapter is structured as follows. Section 2 outlines the theoretical and conceptual framework, drawing on insights from new institutional economics, comparative capitalism, comparative political economy, and new economic sociology. Section 3 develops the concept of patchwork capitalism as an ideal type, detailing its historical formation, institutional design, and mode of operation.

Section 4 examines the economic performance of the model, focusing on growth dynamics, real convergence, and macroeconomic imbalances. Section 5 introduces the concept of *institutional short-sightedness syndrome* and elaborates its role as an explanatory key in the institutions – economic performance nexus. Section 6 discusses the sources of institutional comparative advantages and disadvantages inherent in patchwork capitalism. The final section concludes.

2. Theoretical and conceptual framework

This section develops the theoretical foundations underpinning the analysis of patchwork capitalism and its economic performance. The approach adopted in this chapter is explicitly multidisciplinary, combining insights from new institutional economics, comparative capitalism, comparative political economy, and new economic sociology. Such an integrative approach is necessary to capture both the structural properties of institutional arrangements and the behavioural mechanisms through which they influence economic performance. At the same time, it enables a move beyond standard analytical frameworks that, while highly influential, remain only partially adequate for explaining the institutional specificity of post-communist economies.

2.1. Comparative capitalism: analytical strengths and weaknesses

The starting premise for the present study is the synchronic perspective, or the diversity of institutional designs within contemporary capitalism. The comparative capitalism literature provides a versatile framework for conceptualising this diversity, most notably through the lens of the Varieties of Capitalism (VoC – Hall, Soskice, 2001) and the Diversity of Capitalism (DoC – Amable, 2003) approaches, which conceive capitalism as a system of interdependent institutional domains – such as labour markets, financial intermediation, corporate governance, welfare regimes, and innovation systems – whose characteristics are used as the key criteria for the subsequent typology aimed at discriminating between distinct models or varieties of capitalism.

A key insight of the comparative capitalism literature is the notion of institutional complementarity, whereby the effectiveness of a given institutional arrangement depends on its coherence with other institutions within the system. In coherent institutional architectures, complementarities reduce uncertainty, facilitate information flows, and encourage long-term cooperation among economic actors,

thereby enhancing efficiency. By contrast, incoherent institutional environments tend to weaken or disrupt institutional complementarities, generating inefficiencies and suboptimal outcomes.

While analytically powerful, this framework has important limitations when applied to post-communist economies. First, it implicitly assumes a relatively high degree of institutional coherence and complementarity, typically resulting from long-term evolutionary processes. Second, it is largely grounded in the experience of advanced Western economies, where institutional systems exhibit generally stable and internally consistent configurations. Third, it tends to interpret hybrid or mixed institutional arrangements as transitional phenomena, expected to converge over time towards an established model of Western capitalism.

These assumptions become problematic in the context of Central and Eastern Europe, where the institutional architecture that emerged from post-socialist transformation is neither fully coherent nor necessarily convergent to any single model of Western European capitalism. Instead, it reflects a complex interplay of historical legacies, externally imposed reforms, and endogenous adaptation processes. As a result, the analytical focus on complementarity and equilibrium tends to obscure the role of institutional heterogeneity, fragmentation and instability as defining features of the emerging post-communist capitalism in CEE11 countries.

2.2. Institutional ambiguity as an analytical problem

To address these limitations, this subchapter shifts attention from institutional complementarity to the problem of institutional incoherence. Rather than assuming that effective institutional systems must exhibit a high degree of internal consistency, it considers the possibility that some variations of capitalism may operate under conditions of persistent heterogeneity, weak coordination, and partial incompatibility among the constituent elements of their institutional architecture.

Institutional incoherence can be understood as a situation in which different components of an institutional architecture – originating from distinct historical periods or reflecting divergent coordination logics – coexist without forming a fully integrated and mutually reinforcing system. Such configurations may arise from rapid systemic change, path-dependent development patterns, and external influences that transplant culturally distant institutional arrangements without fully aligning them with the domestic institutional context.

In post-communist economies, institutional incoherence is not merely a transitional phenomenon but a structural characteristic. The coexistence of market-ori-

ented reforms, residual socialist institutions, and imported regulatory frameworks creates a complex and often contradictory institutional environment. In this context, economic actors operate under multiple and sometimes conflicting sets of rules, norms and expectations.

Importantly, institutional incoherence does not necessarily imply unambiguously poor economic performance. On the contrary, it may generate mixed outcomes, combining elements of dynamism and fragility. Certain institutional configurations may facilitate rapid growth by enabling flexibility, opportunistic adaptation, and selective openness to external resources and emerging opportunities. At the same time, the lack of coherence and stability may undermine long-term coordination, increase uncertainty, and constrain the capacity for sustained, innovation-driven development.

This perspective provides a conceptual premise for understanding why post-communist economies may exhibit performance patterns that deviate from standard expectations embedded in comparative capitalism frameworks. It also opens the way for theorising on new models of capitalism that are not necessarily based on institutional coherence, but rather on structured heterogeneity.

2.3. Institutions and economic performance: transmission mechanisms revisited

A central premise underlying the logic of this subchapter is that institutions influence economic performance through a set of transmission mechanisms that shape the behaviour of economic and social actors. In line with the new institutional economics tradition [North, 1990; Williamson, 2000], institutions define the rules of the game, thereby influencing incentives, transaction costs, and expectations. However, in systemic frameworks characterised by institutional incoherence, these mechanisms operate in a qualitatively different way.

First, the institutional design affects the level of perceived uncertainty. In coherent systems, stable and predictable institutional arrangements reduce uncertainty and facilitate long-term planning. In contrast, fragmented and weakly coordinated systems tend to raise uncertainty, as economic actors face ambiguity regarding the enforcement of rules and the stability of policy frameworks. This heightened uncertainty discourages long-term commitments and favours more flexible, short-term strategies.

Second, institutions influence attitudes toward risk. Elevated uncertainty, combined with low levels of generalised trust, typically leads to increased risk aversion.

Economic actors become less willing to engage in projects with uncertain returns, particularly those requiring substantial upfront investment and long gestation periods. As a result, economic activity tends to shift toward less risky ventures that offer more immediate and tangible profits.

Third, institutional environments determine the time horizon of decision-making. In stable and credible institutional settings, actors are more likely to adopt long-term perspectives, investing in capabilities that yield returns over extended periods, while institutional fragility, in turn, compresses time horizons, encouraging a focus on short- and medium-term outcomes. This shift has profound implications for capital accumulation, innovation and structural transformation.

Fourth, institutions influence investment patterns and innovation dynamics. By shaping access to finance, property rights protection, and regulatory stability, institutional arrangements affect both the volume and composition of investment. Innovation-intensive activities – characterised by high uncertainty and delayed returns – are particularly sensitive to institutional conditions. In incoherent systems, underinvestment in innovation may coexist with strong performance in areas driven by cost advantages or external inputs.

Finally, institutions play a pivotal role as determinants of macroeconomic stability and adjustment capability. They influence the credibility of fiscal and monetary policies, the effectiveness of regulatory frameworks, and the ability of the economy to effectively absorb external shocks. Weak institutional environments may lead to pervasive macroeconomic imbalances, including inflationary pressures and fiscal deficits, while also limiting the capacity for effective policy coordination and sustained macroeconomic stability.

Taken together, these mechanisms suggest that institutional incoherence may systematically bias some socio-economic orders towards growth patterns that are dynamic yet structurally unbalanced and unsustainable in the long run. They also provide an analytical foundation for linking specific features of the institutional design to observable economic outcomes.

2.4. Implications for the study of post-communist economies

The foregoing insights have important implications for the study of post-communist economies. Rather than treating their current institutional endowment as an incomplete version of Western capitalist models or as a transitory stage on the presumed path towards institutional convergence, it is more appropriate to conceptualise them as a distinct and analytically autonomous model of capitalism

whose defining characteristics include path-dependent and pervasive institutional heterogeneity, with a prominent role of the monadic-type layout in its design and operation.

This perspective shifts the analytical focus from institutional convergence towards established Western models of capitalism to divergent institutional development trajectories, shaped by the interactions between historical legacies, external influences, and endogenous institutional dynamics. It also highlights the need to account for the coexistence of seemingly contradictory outcomes, such as robust economic growth alongside pervasive macroeconomic imbalances and limited progress in raising innovative capability.

In this context, the standard dichotomy between *strong* and *weak* institutions becomes insufficient. Instead, the relationship between institutions and economic performance should be understood as contingent, multidimensional and potentially non-linear. Institutional arrangements that are suboptimal from the perspective of long-term economic development may nevertheless support strong short- and medium-term growth under specific conditions.

These insights point to the need to introduce a new analytical device capable of capturing the intricacies of the socio-economic order that came into being in Central and Eastern Europe following the collapse of socialism in 1989. This goal is pursued through the concept of *patchwork capitalism*, developed in the ensuing section, which provides a consistent framework for the study of heterogeneous orders featuring weak institutional fabric – particularly with regard to the very institution of the state – together with institutional incoherence, non-complementarity, and weak coordination. At the same time, it helps explain how some orders are capable of generating an ambiguous pattern of economic performance, combining robust growth and rapid real convergence in the short and medium term with constrained long-term development potential.

3. The ideal type of patchwork capitalism

This section develops the idea of *patchwork capitalism* as a distinct model of capitalism. Building on the theoretical discussion in the previous section, it conceptualises patchwork capitalism as an ideal type in the Weberian sense – that is, a stylised analytical construct designed to capture the most essential features of a particular socio-economic order and to facilitate comparative analysis [Weber, 2002]. The objective of this section is not to reproduce empirical reality in its entirety,

but rather to identify the key structural properties and underlying causal mechanisms that shape the institutional architecture of patchwork capitalism in Central and Eastern Europe.

3.1. Definition and ontological status

Patchwork capitalism can be defined as a socio-economic order characterised by a loosely integrated institutional architecture whose constituent elements originate from different historical periods (path dependence) and diverse models of contemporary capitalism [Rapacki et al., 2026; Gardawski, 2022; Gardawski, Rapacki, 2021; Rapacki, Gardawski, 2019]. These elements may be grouped into four categories: (i) institutional legacies from proto-capitalism; (ii) institutions inherited from socialism; (iii) market institutions transplanted from various models of Western capitalism during the post-socialist transformation; and (iv) supranational regulatory frameworks and transnational business practices (corporate governance patterns) associated with EU membership, large inflows of foreign direct investment (FDI), and the prominent role of multinational corporations (MNCs) in the CEE region.

A more in-depth understanding of the essence of patchwork capitalism requires delving into the intricacies of its institutional architecture. Viewed from the institutionalist perspective, the architecture involved can be broken down into three interrelated dimensions: (i) a system of formal and informal rules; (ii) the attitudes of economic and social actors toward these rules; and (iii) the mechanisms of enforcement [North, 2005].

What distinguishes patchwork capitalism from other models is not simply its institutional ambiguity or heterogeneity per se, but the specific mode of combining heterogeneous elements in its design without generating systemic coherence. In contrast to the assumption of institutional complementarity that underpins much of the comparative capitalism literature [Amable, 2003; Hall, Soskice, 2001], patchwork capitalism exhibits weak complementarity and pervasive mismatches and loopholes among its constituent elements.

This feature bears important ontological implications. Patchwork capitalism should not be conceived as a transitional or hybrid form of institutional setup located *between* established models of Western capitalism, nor as a intermediate stage on a presumed path leading towards any of them. Rather, it constitutes an distinct socio-economic order and an analytically autonomous category of research, defined by structured heterogeneity and the persistence of institutional fragmentation [Rapacki

et al., 2026; Gardawski, 2022; Gardawski, Rapacki, 2021; Rapacki, Gardawski, 2019]. In this sense, the concept challenges teleological interpretations of post-communist transformation that assume eventual convergence towards Western institutional archetypes as the only possible outcome.

Moreover, the concept of patchwork capitalism captures not only the structural properties of institutional arrangements in the CEE11 countries, but also a specific mode of institutional change. In this mode, new institutions are added and the existing ones modified in a piecemeal, incremental, and often ad hoc manner, rather than through coordinated and comprehensive systemic reforms. As a result, institutional adjustment tends to occur in response to immediate economic and political pressures rather than as part of a coherent long-term reform strategy, which limits the scope for coordinated systemic transformation and contributes to the persistence of mismatches and loopholes within the institutional architecture. Such a pattern is consistent with strands of NIE and CPE that emphasise layering, drift and conversion as key mechanisms of gradual institutional change.

3.2. Historical roots and contemporary formation: path dependence and discontinuity

The formation of patchwork capitalism is rooted in a historically distinctive development trajectory combining path dependence and profound institutional discontinuity. The experience of Central and Eastern Europe in the 20th century was shaped by two major systemic breakthroughs: the imposition of centrally planned economies after World War II and the subsequent transition to market capitalism after 1989. These *double U-turns* disrupted institutional continuity and generated a complex layering of institutional legacies.

From the perspective of historical institutionalism, such trajectories are characterised by the coexistence of inherited structures and newly introduced arrangements, which interact in non-linear and often unpredictable ways [North, 1990]. In the post-socialist context, formal institutions were frequently transplanted from advanced Western economies, often under conditions of strong external pressure, with the prominent role of international financial organisations, foreign investors, and the European Union.

However, the process of institutional transplantation was neither complete nor uniform. Formal rules were often only partially internalised, and their functioning remained mediated by informal social norms and behavioural practices inherited from the past, resulting in a persistent gap between formal institutional design

and actual institutional performance – a phenomenon widely documented in the literature on transition economies.

Crucially, this gap between formal institutional design and actual performance has been closely linked to the uneven development of enforcement mechanisms and the shallow social embeddedness of formal rules. In many cases, formally adopted institutions lacked the supporting enforcement capacity and axiological internalisation required to effectively function, which reinforced institutional ambiguity and incoherence.

At the same time, the accession of the CEE11 countries to the European Union introduced an additional layer of institutional heterogeneity, imposing regulatory frameworks and policy constraints that reinforced the patchwork character of their institutional architecture. While EU membership contributed to institutional upgrading in a number of key areas, it did not eliminate underlying inconsistencies and mismatches in other parts of the institutional architecture.

As a derivative of the foregoing processes, a new socio-economic order emerged in the CEE11 countries, previously labelled as *patchwork capitalism*. Its most salient features encompass the coexistence of heterogenous institutional arrangements inherited from different historical periods and/or transplanted from variegated external institutional and cultural contexts. While the former included the proto-capitalist and socialist legacies (path dependence), the latter comprised a mix of institutions imported after 1989 and selectively adapted from various contemporary models of Western capitalism, a body of supranational legal norms and regulatory frameworks inextricably linked to EU accession, and a medley of corporate governance patterns and business practices brought in with large inflows of FDI and the prominent role of multinational corporations in CEE11 countries. These peculiarities of patchwork formation give rise to a pervasive weakness of its institutional fabric and the loose, monadic layout of its institutional architecture, whereby its constituent parts and individual institutions are likened to an archipelago of isolated islands, displaying a low degree of overall institutional coherence and complementarity [Gardawski, 2022; Gardawski, Rapacki, 2021].

3.3. Institutional design: weak fabric, monadic layout, and coordination heterogeneity

The institutional design of patchwork capitalism reflects the overlapping effects of its historical roots and contemporary formation. Its core defining features include. *inter alia*. a monadic-type institutional layout in which key areas are largely incoher-

ent and weakly integrated, as they are governed by different and sometimes conflicting coordination mechanisms.

Unlike the *ideal-typical* varieties of capitalism singled out in the VoC framework – dominated by either market-based or non-market coordination mechanisms – patchwork capitalism exhibits a multiplicity of coordination logics, including market coordination, hierarchical state intervention, family-based coordination, and network-based arrangements. These mechanisms coexist devoid of a clear-cut hierarchy, which is conducive to coordination heterogeneity [Czerniak, 2022].

In the case of the CEE11 economies, this coordination heterogeneity is closely linked to the incoherence of their institutional architecture. Formal institutions – often transplanted from advanced Western systems – cohabit with largely incompatible informal norms inherited from earlier historical periods, resulting in the limited social embeddedness of the former. At the same time, enforcement mechanisms remain frequently weak and ineffective, reducing the credibility and predictability of formal institutional arrangements.

The heterogeneity of the institutional endowment inherent to patchwork capitalism is visible in several layers or dimensions. First, the layer of formal institutions suffers from multiple loopholes and mismatches, reflected not only in low levels of coherence between regulatory frameworks, policy objectives, and implementation practices, but also in their uneven enforcement across different domains of the economy. Second, there is a pervasive misalignment between formal and informal institutions, whereby informal norms and practices either compensate for or actively undermine formal rules, thus reinforcing institutional incoherence. Third, patchwork capitalism exhibits axiological heterogeneity, with divergent values and preferences adversely affecting individual and group attitudes toward cooperation, trust and innovation, which further complicates coordination and reduces the scope for a concerted long-term collective action.

Crucially, the prevalent coexistence pattern of divergent coordination mechanisms is not uniform across particular institutional areas in the ideal type of patchwork capitalism. Market-based coordination tends to dominate in product market and financial intermediation, while hierarchical coordination remains significant in labour relations and certain segments of the knowledge system. In other areas, such as housing or parts of social protection, network-based or family-based coordination mechanisms play a more prominent role [Czerniak, 2022].

An important implication of this pattern is the weak institutional complementarity inherent to the ideal type of patchwork capitalism. In other words, institutions operating in different domains of the institutional architecture do not consistently

reinforce one another –either within or between these domains – but instead often generate frictions and inefficiencies. This effect is strengthened by the very institutional design of patchwork capitalism as a loose collection of institutional monads or an archipelago of isolated islands with negligible spillover effects to the rest of the domestic economy [Gardawski, 2022]. At the same time, however, patchwork capitalism retains a degree of flexibility, allowing for pragmatic adaptation and selective openness to external influences, including foreign direct investment and integration into global value chains operated by MNCs.

As a result, patchwork capitalism should not be comprehended simply as a systemic hybrid, but as a monadic and weakly integrated institutional order, in which different coordination logics operate simultaneously, shaping incentives and behavioural patterns in a structurally inconsistent manner.

This combination of monadic institutional evolution and flexibility is central to understanding the ambiguous economic performance of patchwork capitalism, creating opportunities for rapid short-term adjustment and economic dynamism while simultaneously constraining long-term coordination and sustained development.

3.4. Mode of operation: between flexibility and development drift

The distinctive institutional design of patchwork capitalism gives rise to a particular mode of operation, best understood as a tension between adaptive flexibility and structural instability.

On the one hand, the coexistence of multiple institutional logics may enhance the capability of this model for effective short-term adaptation. The scarcity of institutional complementarities, in turn, allows economic actors to exploit opportunities arising from external shocks, technological change, and international integration. In particular, monadic institutional structures and heterogeneity of coordination mechanisms reduce coordination constraints, enabling relatively smooth adjustment to changing economic conditions. This flexibility can contribute to fairly strong economic performance, particularly during the catch-up phase of development.

On the other hand, the incoherence built into the institutional design of patchwork capitalism unleashes a tendency towards development drift, paralleled by rising problems with the capacity to sustain long-term economic growth. Policy-making in such an institutional setup tends to be reactive rather than strategic, and economic actors operate under conditions of elevated uncertainty. This

uncertainty is further compounded by poor enforcement and limited credibility of institutional arrangements, hindering the formation of stable expectations and long-term commitments.

This has important implications for patterns of economic activity. In particular, it encourages a structural bias towards investment projects with shorter pay-back periods, sectors characterised by lower technological complexity, and strategies based on cost advantages rather than innovation.

These structural biases are closely linked to the mechanisms of institutional short-sightedness inherent to the ideal type of patchwork capitalism, which systematically favour short- and medium-term optimisation over the long-term, innovation-driven development.

As a result, patchwork capitalism may generate high rates of economic growth in the short and medium term, while simultaneously facing constraints in terms of structural transformation and long-term competitiveness. In this sense, its mode of operation directly contributes to the emergence of the paradox of performance, whereby high growth dynamics coexist with persistent structural fragility.

3.5. Recap – patchwork capitalism in a broader comparative perspective

Positioning patchwork capitalism within the broader landscape of capitalist diversity requires moving beyond existing typologies. While the VoC and DoC frameworks provide useful benchmarks, they are not designed to capture the intricacies of institutional configurations characterised by pervasive heterogeneity and weak complementarity.

In this context, patchwork capitalism can be conceptualised as an intermediate yet distinct case that does not fit into the binary distinction between coordinated and liberal market economies defined in the VoC framework. Nor does it correspond to any of the models of capitalism identified within the DoC typology, as its defining feature lies not in a particular set of specific institutional arrangements as such, but in the specific mode of their interaction, which is unique to this particular model of post-communist capitalism.

Importantly, this mode of interaction is closely linked to the design and structural properties of the institutional architecture inherent to patchwork capitalism. These include, in particular, a weak institutional fabric, a monadic configuration of institutional building blocks with limited spillover effects on the rest of the economy, shallow social embeddedness of formal institutions, the coexistence of divergent

coordination mechanisms both within and across different institutional domains, and weak enforcement of formally binding rules.

This insight has broader implications for the study of comparative capitalism, suggesting that institutional diversity may be wider than conventionally assumed, and that institutional orders featuring weak complementarity may be more robust – and more economically competitive – than standard theories would suggest. It also challenges the common assumption in new institutional economics that institutional development is bound to lead to increasing coherence and convergence.

Along the same lines, it may be argued that such heterogenous institutional orders are likely to generate ambiguous and inconsistent patterns of economic performance. In particular, they may create structural conditions for fairly high growth dynamics, coupled with persistent macroeconomic imbalances and the constrained potential for long-term sustained development.

The conceptualisation of patchwork capitalism put forward in this section provides the basis for the empirical analysis that follows. In particular, it highlights the design features that are expected to shape its economic performance by impacting the expectations, incentives, risk attitudes, and decision-making horizons of economic actors.

4. Economic performance of patchwork capitalism

This section examines the economic performance of patchwork capitalism, focusing on two interrelated dimensions: economic growth and macroeconomic stability. Building on the conceptual framework developed in the previous sections, the analysis highlights the coexistence of strong growth dynamics and persistent macroeconomic imbalances as the most salient empirical manifestation of the paradox of performance inherent to this model.

The discussion is based on the experience of the CEE11 countries and examines their development trajectories in comparison with the established models of Western capitalism in the European Union.

4.1. Growth dynamics and real convergence

One of the most striking features of the economic performance of patchwork capitalism is its impressive growth record, particularly in the period following the accession of the CEE11 countries to the European Union. Despite a substantial

development gap at the outset of systemic transformation, they have achieved sustained and rapid economic growth, enabling significant real convergence towards the more advanced economies of the EU15. In comparative terms, the former have ranked among the strongest growth performers in the European Union throughout the post-accession period.

The early phase of system transformation (1990–2004) witnessed weak economic performance of the CEE11 countries, reflecting the high initial costs of systemic change, including the deep contraction of output (transformation recession), structural adjustment, and institution-building. However, the post-accession period marked a clear turning point. Between 2004 and 2025, the CEE11 economies recorded consistently higher average growth rates (3.0% per annum) than the EU15 (1.2%), with patchwork capitalism outperforming the remaining models of capitalism in the EU [Rapacki et al., 2026].

The main driver of accelerated economic growth in patchwork capitalism was total factor productivity (TFP). Compared to Western European models, TFP dynamics and its contribution to the overall GDP growth in the CEE11 economies was higher, a pattern that reflects a confluence of factors. First, large FDI inflows to the CEE region facilitated technology transfer, dissemination of organisational know-how, and the integration of these economies into global value chains. Second, access to the EU funds supported infrastructure development, institutional modernisation, and human capital accumulation. Third, institutional changes – particularly improvements in economic freedom and quality of governance – enhanced allocative efficiency and triggered productivity gains. In this sense, the growth model of patchwork capitalism has been strongly fueled by external drivers and productivity catch-up mechanisms rather than domestically generated innovation dynamics.

As a result, the CEE11 economies substantially narrowed their income gap relative to the EU15. While in 2004 their average GDP per capita (measured in purchasing power parity terms) amounted to around 44% of the EU15 level, by 2025 this ratio had risen to 77%, reaching historically unprecedented levels of real convergence [Rapacki et al., 2026; Eurostat, 2026] and making patchwork capitalism the most successful catch-up growth model in the European Union.

Nevertheless, the process of real convergence has been uneven across the CEE11 countries and remains structurally dependent on external drivers. Reliance on foreign capital, imported technologies, and access to the European markets implies that growth has not been fully rooted in domestically generated innovation and endogenous institutional strengths. This dependence reflects the underlying institutional

design and mode of operation of patchwork capitalism, which inhibit the development of endogenous growth capabilities. This feature becomes particularly relevant when assessing the long-term sustainability of the growth model pursued by the CEE11 economies to date.

4.2. Macroeconomic imbalances and structural fragility

The strong growth and real convergence achieved under patchwork capitalism have been accompanied by persistent macroeconomic imbalances, which constitute the second pillar of the paradox of its economic performance.

A central feature under this heading is the elevated and persistent inflation observed in the CEE11 economies compared to their Western European counterparts. From this perspective, inflation in patchwork capitalism has consistently ranked among the highest across all five models of capitalism identified in the EU. While part of this phenomenon can be explained by standard nominal convergence mechanisms – most notably the Balassa-Samuelson effect – the empirical evidence suggests that structural and institutional factors have also played an important role [Rapacki et al., 2026].

In addition to elevated inflation, patchwork capitalism has also suffered from recurring fiscal and external imbalances, including general government and current account deficits. These imbalances are not episodic but display a recurrent character, reflecting both the institutional determinants of the growth model pursued and the policy responses adopted in the face of internal and external shocks.

The response of the CEE11 countries to major adverse exogenous shocks – including the global financial crisis of 2008–2009 and the COVID-19 pandemic – provides further empirical evidence of the distinctive economic performance of patchwork capitalism. In both cases, the CEE11 economies demonstrated a certain degree of resilience to such shocks in terms of limiting losses in growth dynamics. However, this resilience was often achieved at the cost of heightened macroeconomic imbalances. Expansionary fiscal policies and accommodative monetary stances acted as major shock absorbers, but at the same time contributed to higher inflation and increased fiscal pressures. In this sense, macroeconomic adjustment under patchwork capitalism tends to rely on policies that protect growth in the short term while simultaneously amplifying structural imbalances.

This pattern suggests that macroeconomic stabilisation in patchwork capitalism is often subordinated to short-term growth objectives. Such a policy bias should be interpreted not as a contingent response to specific shocks, but as a systemic out-

come of the institutional design of patchwork capitalism, in which poor coordination, limited policy credibility, and *short-termism* in decision making-constrain the effectiveness of stabilisation policies.

4.3. Institutional explanation of the growth – disequilibrium nexus

The coexistence of strong growth and pervasive macroeconomic imbalances cannot be fully explained by standard macroeconomic variables alone. Rather, it reflects the underlying institutional design and operation of patchwork capitalism, together with the transmission mechanisms outlined in Section 2. From this perspective, the growth – disequilibrium nexus should be interpreted as an endogenous outcome of the key properties of the institutional architecture underpinning this model rather than a derivative of exogenous shocks or policy errors.

A central role in explaining this nexus should be ascribed to the weakness of the institutional fabric, which generates elevated levels of perceived uncertainty and risk aversion. In contrast to coherent institutional orders, where expectations are relatively well anchored, patchwork capitalism is characterised by a more volatile and less predictable institutional environment. This affects both private and public decision-making processes and is further compounded by weak enforcement and the limited credibility of formal institutions, which adversely affects the level of perceived uncertainty and hinders the formation of rational expectations.

One important consequence is the emergence of inflation expectations that are more adaptive and less firmly anchored than in more predictable institutional settings. Economic actors, anticipating institutional instability, adjust prices and wages in ways that reinforce inflationary pressure. This mechanism helps explain why inflation in patchwork capitalism tends to remain structurally higher than in Western European models, even after accounting for the effects of nominal convergence.

At the same time, low levels of generalised trust – a feature widely documented in post-communist societies – further compound these dynamics. Trust plays a crucial role in reducing transaction costs and facilitating long-term coordination. Its absence encourages more defensive and short-term oriented behaviour, promoting adaptive strategies and limiting the scope for forward-looking, stability-oriented decision-making, thereby reducing the effectiveness of both market and policy mechanisms aimed at maintaining stability.

Another important transmission channel stems from the heterogeneity of coordination mechanisms. The coexistence of multiple coordination logics – market-

based, hierarchical, family- and network-based, etc. – creates a complex institutional environment in which policy responsibilities are diffused and coordination is often incomplete. This reduces the credibility and consistency of macroeconomic policy, weakening its ability to meet expectations and ensure long-term stability. In particular, the absence of a clear hierarchy among coordination mechanisms makes it difficult to implement coherent and credible stabilisation policies and development strategies.

Taken together, these factors suggest that macroeconomic imbalances in patchwork capitalism should be understood not as temporary or cyclical deviations from a long-run trend, but as systemic outcomes of its institutional design. They reflect a persistent bias towards short-term adjustment and adaptive behaviour, which is structurally embedded in the very essence and most salient features of the institutional architecture of patchwork capitalism.

4.4. External anchors and internal constraints

An important dimension of the economic performance of patchwork capitalism concerns the interaction between external anchors and internal institutional constraints.

External anchors – such as EU membership, access to structural and cohesion funds, and integration into global value chains – have played a crucial role in enhancing economic growth and income-level convergence in the CEE11 countries. They have provided not only financial resources, but also institutional templates and policy frameworks that contributed to the modernisation of key sectors of their economies. In particular, these external anchors have functioned as partial substitutes for weak domestic institutional capabilities, supporting growth even in the absence of fully coherent institutional systems.

At the same time, heavy reliance on external drivers has not necessarily increased the coherence of the institutional architecture characteristic of patchwork capitalism. On the contrary, imported institutional arrangements or practices have often been incorporated selectively, functioning as institutional monads with limited spillover effects on the rest of the economy. As a result, imported institutions have tended to add new layers to the existing institutional configuration, reinforcing its patchwork character rather than reducing the scale of mismatches and inconsistencies embedded within it. This selective incorporation reflects the very nature of patchwork capitalism as an open-access order, in which the introduction of new institutions gives rise to negative synergies – such as the uncontrolled import of

entropy [Gardawski, Rapacki, 2021] – rather than their integration into a coherent system of rules, enforcement, and coordination.

This creates a situation in which economic performance is sustained in part by exogenous factors, while endogenous institutional capabilities remain relatively weak. External anchors may therefore spur economic growth while simultaneously inhibiting more balanced and coherent institutional development, thereby reinforcing the structural weaknesses of patchwork capitalism. Consequently, the long-term sustainability of this growth model becomes contingent upon the continued availability of external support and favourable international conditions.

4.5. Growth – stability trade-offs in patchwork capitalism

The empirical patterns witnessed in the CEE11 economies suggest that patchwork capitalism operates under a set of structural trade-offs that are key to understanding the paradox of its economic performance.

The first trade-off concerns economic growth and macroeconomic stability. The institutional design of patchwork capitalism appears to foster economic growth, particularly in the early phases of the catch-up process, but does so at the cost of persistent macroeconomic imbalances. Policy responses to shocks tend to prioritise growth and employment over price stability and fiscal discipline, reflecting both political incentives and institutional constraints. This trade-off is closely linked to the short-term bias of economic policymaking, which is shaped by uncertainty, weak coordination, and limited policy credibility.

The second trade-off concerns flexibility and coordination. The monadic structure of the institutional architecture allows for adaptive flexibility and rapid adjustment to changing conditions. However, this flexibility comes at the expense of coordinated long-term strategies, reducing the capability of patchwork capitalism to sustain innovation-driven growth and structural transformation. In particular, the coexistence of multiple coordination mechanisms without a clear hierarchy adversely affects the ability of this institutional order to implement coherent and forward-looking development strategies.

The third trade-off concerns external integration and internal coherence. Integration into the European and global economy has been a key growth driver, but it may also weaken incentives to redesign the institutional architecture in place with a view to making it more coherent and less volatile, thereby strengthening the patchwork essence of the socio-economic order involved. In this sense, external integration both supports economic performance and perpetuates the underlying monadic institutional design.

These trade-offs are embedded in the institutional logic of patchwork capitalism and help explain why the model can generate strong performance in certain domains while simultaneously exhibiting persistent weaknesses in others. Importantly, they should not be perceived as temporary or policy-induced distortions; rather, they define the structural boundaries of the model, with special regard to the feasible set of economic outcomes it generates.

5. Institutional short-sightedness syndrome

This section introduces and discusses the notion of the institutional short-sightedness syndrome as a key explanatory variable, which helps to explain the paradox of economic performance in patchwork capitalism. While the previous section demonstrated the coexistence of healthy growth with structural imbalances, the purpose of the current section is to identify the main institutional transmission channels that systematically generate this outcome. From this perspective, institutional short-sightedness provides a unifying analytical framework that links the institutional design of patchwork capitalism with its observed economic performance.

5.1. Conceptualisation

The institutional short-sightedness syndrome can be defined as a systematic bias of economic and social actors towards short- and medium-term simple quantitative objectives at the expense of more complex long-term, qualitative development goals, rooted in the structural properties of the institutional environment [Rapacki et al., 2026]. More specifically, it reflects a persistent compression of decision-making horizons arising from low institutional coherence, limited enforcement capacity, and the coexistence of divergent coordination mechanisms, combined with low levels of generalised trust and elevated perceived uncertainty inherent in the ideal type of patchwork capitalism.

This concept extends and integrates several strands of institutional and behavioural analysis. From the perspective of new institutional economics, it reflects the influence of institutional arrangements on incentives and expectations [North, 1990]. Within comparative political economy, it captures the interaction between institutional design and policy orientation [Hall, Soskice, 2001]. Finally, from a sociological perspective, it incorporates the role of trust, norms, and social capital in shaping economic behaviour [Williamson, 2000].

Importantly, institutional short-sightedness is not reducible to individual myopia or cognitive bias. Rather, it constitutes a systemic property of the institutional order, affecting policymakers, firms and households alike. It should be understood not as a deviation from optimal behaviour, but as an endogenous and structurally embedded response to a piecemeal, incoherent, and weakly coordinated institutional environment. Emerging endogenously from the very design and mode of operation of patchwork capitalism, it manifests itself in consistent patterns of decision-making across different domains of economic activity.

5.2. Core mechanisms: from institutional design to behavioural outcomes

The emergence of institutional short-sightedness can be traced to a set of interrelated mechanisms linking the institutional design of patchwork capitalism with its behavioural outcomes, i.e. induced rules of conduct, axiological norms, attitudes, and expectations of economic and social actors. Taken together, these mechanisms make up a transmission chain between institutional properties of this model and a short-term bias in economic behaviour.

Uncertainty and expectations

A primary driver of short-sightedness is the elevated level of perceived uncertainty that stems, above all, from the pronounced weakness of the institutional fabric and the high incidence of government failure characteristic of patchwork capitalism [Rapacki et al., 2026]. As emphasised in the NIE literature, uncertainty affects not only the level of economic activity but also its temporal structure [North, 1990]. In environments where rules are inconsistently enforced and policy frameworks lack credibility, economic agents face difficulties in forming stable expectations about the future. This uncertainty is closely linked to weak enforcement of binding formal institutions and the absence of a clear hierarchy of coordination mechanisms, both of which undermine the predictability of the institutional environment.

Such conditions encourage a shift from rational to adaptive expectations, in which decisions are based on short-term signals rather than long-term projections. In macroeconomic terms, this contributes to the persistence of elevated inflation expectations, while at the microeconomic level it discourages long-term investment and strategic planning.

Deficits of trust and social capital

The second mechanism underlying institutional short-sightedness in patchwork capitalism is the low level of generalised trust, which limits the scope for long-term coordination and collective action. As demonstrated in previous studies, low trust in the CEE11 countries is closely associated with a limited stock of social capital, particularly large deficits of bridging and linking capital [Rapacki et al., 2026; Gardawski, 2022; Gardawski, Rapacki, 2021].

The literature has consistently shown that trust reduces transaction costs and enables cooperation beyond immediate, self-enforcing arrangements. By contrast, economic actors in low-trust societies tend to rely on short-term, transactional relationships rather than long-term commitments [Fukuyama, 1995]. This encourages strategies that promise immediate and predictable returns, even at the cost of lower long-term efficiency. As a result, economic interactions become more defensive and less forward-looking, which further reinforces the short-term bias in decision-making. Moreover, the scarcity of bridging and linking social capital further constrains the ability to mobilise resources for complex, innovation-driven projects.

Risk aversion and investment structure

The conjunction of increased perceived uncertainty and low trust leads to elevated risk aversion, which plays a pivotal role in shaping the structure of incentives affecting economic activity. In such environments, actors systematically favour investments displaying lower risk and shorter payback periods.

This has several important implications. First, it creates a bias in the allocation of capital towards sectors exhibiting lower technological complexity and offering quicker returns. Second, it discourages investment in innovation, which typically involves high uncertainty and long gestation periods. Third, it reinforces the dependence on externally sourced technologies and organisational practices.

From a macroeconomic perspective, these dynamics give birth to a pattern of extensive growth that is quantitatively strong and easily replicable, but qualitatively constrained and associated with limited structural transformation.

Compressed time spans

Another mechanism fuelling the short-sightedness syndrome is the compression of decision-making horizons, which affects both private and public actors.

In stable and predictable institutional environments, long-term contracts and credible commitments support extended planning horizons. By contrast, the institutional fragility characteristics of patchwork capitalism encourage actors to focus on short-term outcomes.

For firms, this translates into business strategies oriented towards immediate profitability rather than long-term competitiveness. For policymakers, it results in policy choices that prioritise short-term stabilisation and electoral considerations over structural reforms. For households, it shapes savings and consumption behaviour, often favouring present consumption over long-term investment.

Taken together, these dynamics reinforce the short-term bias inherent in the ideal type of patchwork capitalism. In this sense, compressed timeframes represent the behavioural manifestation of its institutional short-sightedness, which ultimately defines the nexus between the institutional design features of this model and its observable economic performance.

5.3. Implications for macroeconomic equilibrium

The mechanisms described above have direct implications for macroeconomic equilibrium, particularly with regard to inflation, fiscal stance, and external balances. In this context, the institutional short-sightedness syndrome provides a coherent explanatory device of the prevalent pattern of macroeconomic equilibrium in the CEE11 countries discussed in Subchapter 4. Three dimensions of this pattern deserve particular attention.

First, institutional short-sightedness contributes to the persistence of inflationary pressures. Inflation expectations that are weakly anchored in stable and credible institutional and policy frameworks, combined with adaptive behaviour of firms and households, make it difficult to maintain price stability. Moreover, policy responses to shocks often prioritise short-term objectives, further fuelling inflationary dynamics. As a result, inflation in patchwork capitalism tends to remain structurally elevated, reflecting persistently high levels of uncertainty and correspondingly higher inflation expectations rather than purely cyclical factors.

Second, institutional short-sightedness also affects fiscal policy, creating a bias towards expansionary policy measures aimed at sustaining growth and mitigating the social costs of economic slowdowns and adjustment processes in the short term. While such policies may be effective in stabilising output, they often result in persistent fiscal imbalances and increased public debt. This reflects the limited capacity of policymakers to commit credibly to long-term fiscal discipline in

an environment characterised by pervasive uncertainty, weak coordination, and short decision-making horizons.

Third, institutional short-sightedness also influences external equilibrium, as growth strategies based on outward financing and import-intensive investment may generate current account deficits. Such reliance reflects both the opportunities created by integration into the European and global economy and the limitations of domestic institutional capacity. In particular, it may exacerbate the vulnerability of the CEE11 countries embodying the model of patchwork capitalism to exogenous shocks and adverse changes in geoeconomic and geopolitical conditions.

Taken together, these effects help explain the structurally unbalanced growth pattern characteristic of patchwork capitalism. In our view, this pattern should be understood as a systemic manifestation of the institutional short-sightedness inherent in this model rather than as a temporary anomaly or the outcome of specific policy choices.

5.4. Microeconomic and structural consequences

Beyond its short- and medium-term macroeconomic consequences, institutional short-sightedness has important implications for the structure of the economy and its capacity for long-term upgrading and qualitative transformation. In particular, it shapes the allocation of resources, the organisation of production, and the economy's ability to undergo structural upgrading.

At the firm level, shortened time horizons and increased risk aversion adversely affect both the propensity and the capacity for innovation and upgrading. Firms are less likely to invest in research and development, organisational change, and human capital accumulation, all of which are essential for moving up the global value chains. As a result, firm-level strategies tend to prioritise short-term efficiency and cost optimisation over capability building and long-term competitiveness.

At the industry and sectoral levels, the economy tends to specialise in activities that are compatible with short-term optimisation, such as assembly operations within global value chains or sectors that rely on cost advantages. While these activities may generate employment and growth, they offer limited opportunities for technological advancement and long-term productivity gains. This pattern of specialisation perpetuates a country's position in the international division of labour that is difficult to upgrade without significant changes in institutional and organisational capacities.

At the systemic level, institutional short-sightedness reduces the capacity of the ideal type of patchwork capitalism for learning and self-correction. Weak institution-

al memory and limited feedback mechanisms hinder the ability to adapt to changing conditions and address structural challenges, including those associated with technological change, demographic pressure, and environmental sustainability. In this sense, patchwork capitalism exhibits a limited capacity for endogenous transformation, thereby constraining its long-term development potential.

5.5. Institutional short-sightedness and the paradox of economic performance

The concept of institutional short-sightedness provides a framework for understanding the essence and intricacies of the paradox of economic performance intrinsic to the CEE11 countries discussed in this chapter. It explains how particular institutional arrangements that foster economic growth and real convergence in the short and medium term may simultaneously constrain long-term development potential. From this perspective, the paradox of economic performance should be understood as a systemic and logically consistent outcome of the institutional design and mode of operation of patchwork capitalism.

In particular, the bias towards short-term objectives inherent in this model facilitates the rapid mobilisation of resources, flexible adaptation to external conditions, and effective exploitation of opportunities associated with catch-up growth and European integration. At the same time, it constrains the development of key capabilities required for sustained, innovation-driven growth. This dual effect highlights the non-linear and context-dependent nature of the nexus between institutions and economic performance. Rather than a simple monotonic relationship, the case of patchwork capitalism suggests the existence of trade-offs and thresholds beyond which the benefits of flexibility are outweighed by the costs of institutional ambiguity. Once such thresholds are reached, further growth becomes increasingly dependent on external drivers rather than endogenous institutional and technological upgrading.

The notion of institutional short-sightedness is also relevant for a broader study of comparative capitalism and economic development. In particular, it offers a novel, more comprehensive analytical framework enabling integration of institutional analysis with behavioural dynamics and the temporal dimensions of economic decision-making. The major contributions of this framework may be summarised under three headings.

First, it challenges the dichotomous view of institutions as either *good* or *bad*, suggesting instead that some institutional settings may generate mixed and inconsistent

outcomes. In this respect, it highlights the possibility that the same institutional features may simultaneously enhance and inhibit various domains of economic performance, depending on the temporal horizon and structural context. Second, it contributes to a more nuanced understanding of the institutions – performance nexus by emphasising the role of uncertainty, expectations, and behavioural responses. Third, it complements existing theories of institutional change by highlighting the role of development drift and short-termism as persistent characteristics of certain institutional orders.

Against this backdrop, the conceptualisation of patchwork capitalism can be seen as extending the analytical boundaries of comparative capitalism research by adding a new research category featuring structured heterogeneity and inherent short-termism in decision-making. More broadly, the notion of institutional short-sightedness suggests that temporal orientation should be treated as a core dimension of institutional analysis alongside coordination, complementarity, and governance structures.

6. Comparative advantages and disadvantages of patchwork capitalism

This section synthesises the main findings of the chapter by identifying the key comparative strengths and weaknesses of patchwork capitalism. Rather than treating these features as independent attributes, the discussion interprets them as joint outcomes of its peculiar institutional design, particularly the weakness of institutional fabric, its monadic layout, the resulting incoherence and weak complementarity, and institutional short-sightedness. In this sense, institutional comparative advantages and disadvantages should be perceived as two sides of the same institutional logic rather than as separate characteristics of the patchwork order.

6.1. Institutional sources of comparative advantage

The comparative advantages of patchwork capitalism are not accidental but arise from specific structural features of its institutional design. In particular, they are closely associated with the flexibility, openness, and selective adaptability of this model.

The first key advantage lies in the capability of patchwork capitalism to generate relatively rapid economic growth and income-level convergence. This outcome can be traced to a combination of factors, including relatively low institutional rigidi-

ties and entry barriers making patchwork capitalism an open-access order, coupled with a relatively abundant stock of bonding social capital [Rapacki et al., 2026]. Although these characteristics limit systemic coherence, they enable economic actors to respond rapidly to emerging opportunities through grass-root entrepreneurship and resourcefulness, including during the turbulent times of adverse exogenous crises [Mrozowicki, Gardawski, Burski, Rapacki, 2025]. In the context of catch-up development, this facilitates the smooth absorption of foreign capital, technologies, and organisational practices.

At the same time, the very same mechanism gives rise to a structural trade-off. Growth driven by external inputs and short-term optimisation does not necessarily translate into the development of endogenous capabilities. Consequently, accelerated real convergence becomes inherently linked to dependence on external drivers, which may ultimately constrain the prospects of long-term sustained development.

The second source of comparative advantage in patchwork capitalism is the prominent role of external institutional anchors, particularly those associated with EU membership. These external frameworks provide regulatory standards, funding, and policy guidance that partially compensate for weaknesses in domestic institutional capacity. From an institutional perspective, external anchoring reduces uncertainty and supports coordination in selected domains.

At the same time, reliance on external anchors may weaken incentives for developing more coherent domestic institutional systems. This triggers a substitution effect, whereby external coordination partially crowds out domestic institutional capacity without fully strengthening it. This phenomenon reflects the broader pattern of selective institutional integration characteristic of patchwork capitalism.

The third advantage lies in the high adaptive flexibility of the patchwork order, rooted in its monadic institutional layout. The coexistence of multiple coordination mechanisms allows for pragmatic and selective adjustment to changing economic conditions. Such flexibility constitutes a particularly valuable asset in volatile geoeconomic and geopolitical environments and contributes to the resilience of patchwork capitalism in the face of adverse exogenous shocks.

Nevertheless, high adaptive flexibility comes at the cost of a reduced capacity for long-term coordination. The same institutional features that enable rapid adjustment also limit the ability to implement consistent and forward-looking development strategies. In particular, the absence of a clear hierarchy among coordination mechanisms constrains the formulation of coherent long-term policy frameworks.

Finally, patchwork capitalism benefits from a form of spontaneous, micro-level grass-root resourcefulness, often embedded in informal institutions and social

practices [Mrozowicki et al., 2025]. In environments characterised by institutional loopholes and mismatches, economic actors develop adaptive strategies that enable them to navigate constraints and exploit emerging opportunities [North, 1990]. While such practices may enhance short-term efficiency, they also reinforce the persistence of informal arrangements, potentially undermining the development of formal institutional coherence. As a result, micro-level adaptability coexists with systemic institutional weaknesses.

6.2. Major institutional drawbacks

The major comparative disadvantages of patchwork capitalism are intrinsically linked to the same structural drawbacks that generate its comparative advantages, rooted in its institutional design and reinforced by the mechanisms of institutional short-sightedness.

The most fundamental drawback stems from the weakness of the institutional fabric (in particular the very institution of government), which poorly controls the institutional thread (secondary institutions and organisations) and is unable to consistently enforce formal rules. This weakness generates elevated uncertainty and reduces the credibility and predictability of institutional arrangements. Consequently, economic agents become more risk-averse, face higher transaction costs, and have weaker incentives to engage in long-term, coordination-intensive activities.

Closely related to this drawback is the low level of generalised trust, which further constrains the scope for cooperation and collective action. Large deficits of trust, together with limited stocks of bridging and linking social capital, amplify the effects of uncertainty, strengthening short-term, adaptive behaviour and reducing the effectiveness of both market-based and policy-driven coordination mechanisms.

The third major disadvantage is rooted in the systemic short-termism of patchwork capitalism, as conceptualised in Subchapter 5. Institutional short-sightedness affects both private and public decision-making, leading to underinvestment in areas that are critical for long-term development. This includes low levels of much-needed investment in innovation, human capital, and institutional capacity building.

Another important comparative disadvantage concerns the limited capability for endogenous innovation. While patchwork capitalism is effective in absorbing and adapting imported technologies, it is less successful in generating original, particularly radical, innovations. This reflects the combined effects of risk aversion, compressed decision-making horizons, and weak coordination, which discourage economic agents from engaging in high-risk, long-term innovation activities.

In addition, patchwork capitalism exhibits a limited capacity for learning and self-correction. This drawback is due to its weak institutional memory, which hinders the identification and resolution of systemic problems. As a consequence, the comparative position of the CEE11 countries may become increasingly vulnerable in the face of complex global challenges, such as digital transformation, the skyrocketing growth in the scope of AI application, demographic change, the green transition, and the unfolding poly-crisis in general.

Finally, the coexistence of multiple, divergent coordination mechanisms gives rise to persistent policy inconsistencies and pervasive government failure, further undermining the effectiveness of economic policy and perpetuating macroeconomic imbalances. In this respect, policy failure should be interpreted as a structural feature of the institutional design of patchwork capitalism rather than an episodic deviation.

6.3. Structural trade-offs in patchwork capitalism

The foregoing discussion suggests that the comparative advantages and disadvantages of patchwork capitalism should not be interpreted as independent or isolated attributes of this model. Rather, they should be understood as a derivative of the very logic of its overall design and mode of operation entailing a number of structural trade-offs.

The first such trade-off deals with growth and macroeconomic equilibrium. The design properties of the institutional architecture foster rapid growth and accelerated real convergence, but they do so at the cost of protracted macroeconomic imbalances. This reflects the intrinsic bias of patchwork capitalism towards short-term objectives, due to its institutional short-sightedness.

The second trade-off concerns flexibility and coordination. The institutional design of patchwork capitalism enhances adaptability and responsiveness but limits the capacity for long-term, coordinated collective action in the face of complex development challenges. This trade-off is particularly relevant for innovation and structural transformation.

The third trade-off involves external integration and internal capacity. External anchors support economic growth and modernisation but may weaken incentives for building more coherent institutional systems, leading to a form of dependent development that is susceptible to drift and volatility. From this perspective, external integration both enables and constrains development, reflecting the dual nature of the ideal type of patchwork capitalism.

Importantly, the trade-offs discussed above are neither temporary nor policy-induced phenomena; they are embedded in the institutional logic of patchwork capitalism, and as such, they define the boundaries of feasible economic outcomes within this model. They should therefore be understood as structural constraints that shape both the opportunities and threats of future development of the CEE11 countries.

6.4. Rethinking the comparative institutional advantage: beyond dichotomic assessment

The picture of comparative advantages and disadvantages of patchwork capitalism drawn in the preceding sections calls for a reconsideration of how its economic performance is assessed.

Conventional approaches often assume a simple dichotomic relationship between institutional quality and economic performance, whereby stronger and more coherent institutions are associated with superior outcomes, and weaker institutions with inferior ones [Acemoglu, Robinson, 2012]. However, the evidence presented in this chapter suggests a more complex, non-dichotomic nature of this nexus.

The case of patchwork capitalism demonstrates that some heterogenous institutional orders may generate simultaneously positive and negative economic outcomes, depending on the dimension of performance and the time horizon considered. In particular, such institutional settings may foster strong short- and medium-term growth dynamics while constraining long-term development potential.

This implies that institutional comparative advantages and disadvantages cannot be assessed within a single dimension. Instead, they should be conceived as context-dependent and temporally differentiated, reflecting the interaction between institutional design and operation, behavioural mechanisms, and external conditions. Against this backdrop, the nexus between institutional endowment and economic performance should be examined in terms of trade-offs and dynamic interactions rather than static rankings.

From this perspective, patchwork capitalism can be understood as occupying a distinct intermediate position within the spectrum of possible institutional orders and models of capitalism: one that reconciles dynamic efficiency in the short term with structural constraints of its sustained long-term development. This position is not necessarily set in stone – it may become increasingly problematic as the key preconditions for sustained growth shift towards innovation, coordination and institutional capacity. Consequently, the long-term viability of patchwork capitalism depends critically on its ability to overcome the constraints entrenched in its institutional short-sightedness.

7. Summary and conclusions

This chapter has examined the relationship between institutional design and economic performance in Central and Eastern Europe, with a particular focus on the concept of patchwork capitalism. Drawing on a multidisciplinary theoretical framework and comparative empirical evidence, the analysis has demonstrated that the institutional arrangements emerging from post-socialist transformation constitute a new distinct model of capitalism in its own right, rather than a transitional or hybrid order that is destined to converge towards established Western archetypes.

The central contribution of the chapter lies in identifying and explaining the paradox of economic performance inherent to the ideal type of patchwork capitalism. On the one hand, patchwork capitalism outperformed the Western European models in terms of economic growth and achieved rapid real convergence with the more advanced economies of the EU15, particularly in the post-accession period. On the other hand, this impressive growth and real convergence record has been accompanied by pervasive macroeconomic imbalances and structural drawbacks inhibiting long-term development. The coexistence of dynamism and fragility challenges the conventional shared beliefs in NIE regarding the relationship between institutional quality and economic performance. Importantly, this paradox should be interpreted as a structurally consistent outcome of the institutional design and operation of patchwork capitalism rather than an anomaly or temporary deviation from a standard pattern.

To explain this paradox, the chapter introduced the concept of institutional short-sightedness syndrome as a key explanatory mechanism. The analysis has shown that the particular design features and mode of operation of the institutional architecture of patchwork capitalism systematically shape the behaviour of economic and social actors, creating a bias towards short- and medium-term objectives. This bias arises from elevated levels of perceived uncertainty, low generalised trust, and compressed decision-making horizons, which jointly influence investment patterns, innovation dynamics, human capital formation, and macroeconomic stability. From this perspective, institutional short-sightedness serves as the core explanatory mechanism linking the institutional architecture of patchwork capitalism to its distinctive pattern of economic performance by integrating the various transmission channels through which institutional conditions affect economic outcomes.

By integrating these insights, the chapter contributes to the field of comparative capitalism in several ways. First, it advances the idea of patchwork capitalism as a new analytical category, enlarging the existing typologies that have been developed

primarily on the basis of the experience of advanced Western economies [Amable, 2003; Hall, Soskice, 2001]. Second, it offers a more nuanced explanation of the institutions – economic performance nexus by demonstrating that some heterogenous institutional orders may generate mixed and ambiguous economic outcomes. Third, it introduces the notion of institutional short-sightedness as a conceptual device for capturing the temporal dimension of human behaviour within the framework of a heterogenous institutional environment and its implications for economic performance. Taken together, these contributions position the ideal-typical concept of patchwork capitalism and its empirical applications as a theoretically meaningful and empirically relevant addition to the literature on comparative political economy and comparative capitalism.

Our findings also have broader theoretical implications for institutional research. They suggest that the relationship between institutions and economic performance is multidimensional, multi-layered, and – most importantly – inherently non-dichotomic. In particular, while remaining fully consistent with the core intuition advanced by Acemoglu and Robinson [2019], the experience of patchwork capitalism suggests that the empirical boundaries of the *narrow corridor* may be wider than is often assumed. Sustained growth and real convergence proved feasible for prolonged periods even under institutionally incomplete, incoherent or piecemeal arrangements, provided that favourable external conditions, strong integration anchors, and institutional architecture capable of selective, short-term adjustment are in place [Rapacki et al., 2026].

Our results also highlight the importance of trade-offs between growth and macroeconomic stability, flexibility and coordination, and external integration and internal coherence that are intrinsic to patchwork capitalism. These trade-offs are not merely transitional phenomena but may constitute permanent features of heterogenous institutional orders. This finding calls for a shift away from static evaluations of institutional quality towards a more dynamic examination of institutional architectures and their changing temporal properties.

From a policy perspective, the present study highlights the challenges associated with moving beyond a growth model based on external inputs and short-term optimisation. Enhancing long-term development potential would require strengthening institutional coherence, improving the quality of governance, and fostering conditions conducive to innovation and long-term investment. However, such changes are constrained by the very institutional design and operation of patchwork capitalism, including its loose, monadic layout and high incidence of institutional short-sightedness. This suggests that effective policy interventions must address not only

weaknesses of individual institutions but also the underlying institutional architecture that sustains the short-term bias of the entire patchwork order.

More broadly, the experience of Central and Eastern Europe casts doubt on the widespread belief that the European Union is characterised by an inevitable convergence towards a single model of capitalism. Instead, it points to the persistence of capitalist diversity, including heterogenous models that reconcile strengths and weaknesses in ambiguous and complex ways. Against this backdrop, patchwork capitalism not only represents a new ideal type of a socio-economic order, but also contributes to a more nuanced and in-depth conception of the diversity of contemporary capitalism, including its more versatile typologies. At the same time, the empirical patterns of economic performance established by the CEE11 countries lend support to the broader conjecture that the diversity of institutional designs of contemporary capitalism translates into the diversity of performance of its various models.

Future research could build on the conceptual and empirical framework developed in this chapter by exploring the dynamics of institutional change in patchwork capitalism, the conditions under which institutional short-sightedness may be mitigated, and the implications of unfolding global challenges – such as digitalisation, AI, geopolitical shifts, and the green transition – for the sustainability of this model. Pursuing such a research agenda would further enhance our understanding of the diversity of capitalism and the evolving relationships between institutions and economic performance in the 21st century. In particular, future research should assess whether – and under what conditions – patchwork capitalism can transition towards a more innovation-driven and institutionally coherent development path.

References

Acemoglu, D., Robinson, J.A. (2012). *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. New York: Crown Publishing.

Amable, B. (2003). *The Diversity of Modern Capitalism*. Oxford: Oxford University Press.

Czerniak, A. (2022). Coordination Mechanisms in Patchwork Capitalism – the Example of Housing, *Warsaw Forum of Economic Sociology*, 13(26), pp. 9–28.

Fukuyama, F. (1995). *Trust: The Social Virtues and the Creation of Prosperity*. New York: The Free Press.

Gardawski, J., Rapacki, R. (2021). Patchwork Capitalism in Central and Eastern Europe – A New Conceptualization, *Warsaw Forum of Economic Sociology*, 12(24), pp. 7–106.

Gardawski, J., in collaboration with Rapacki, R. (2022). Extended Conceptualization of "Patchwork Capitalism." In Response to the Discussants, *Warsaw Forum of Economic Sociology,* 13(25), pp. 39–109.

Hall, P.A., Soskice, D. (2001). *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. Oxford: Oxford University Press.

Mrozowicki, A., Gardawski, J., Burski, J., Rapacki, R. (2025). Patchwork Capitalism and the Management of Interlinked Crises by Essential Public Services in Poland, *International Labour Review*, 164(1), pp. 1–19.

North, D.C. (1990). *Institutions, Institutional Change and Economic Performance.* Cambridge: Cambridge University Press.

North, D.C. (2005). Institutions and the Performance of Economies over Time. In: *Handbook of New Institutional Economics* (pp. 21–30), C. Ménard, M.M. Shirley (Eds.). Dordrecht: Springer.

Rapacki, R., in collaboration with Czerniak, A. (Eds.) (2019). *Diversity of Patchwork Capitalism in Central and Eastern Europe*. Abingdon–New York: Routledge.

Rapacki, R., Gardawski, J. (2019). Istota i najważniejsze cechy kapitalizmu patchworkowego w Polsce i krajach Europy Środkowo-Wschodniej. In: *Kapitalizm patchworkowy w Polsce i krajach Europy Środkowo-Wschodniej* (Chapter 11), R. Rapacki (Ed.). Warszawa: Polskie Wydawnictwo Ekonomiczne.

Rapacki, R., Gardawski, J., Czerniak, A., Horbaczewska, B., Karbowski, A., Maszczyk, P., Próchniak, M. (2020). Emerging Varieties of Post-Communist Capitalism in Central and Eastern Europe: Where Do We Stand?, *Europe-Asia Studies*, 72(4), pp. 565–592.

Rapacki, R., Maszczyk, P., Próchniak, M., Lissowska, M., Sulejewicz, A. (2026). *Patchwork Capitalism and Economic Performance. Development Trajectories in Central and Eastern Europe in the 21st Century*. Cheltenham: Edward Elgar [*forthcoming*].

Streeck, W., Thelen, K. (Eds). (2005). *Beyond Continuity: Institutional Change in Advanced Political Economies*. Oxford: Oxford University Press.

Weber, M. (2002). *Economy and Society: An Outline of Interpretive Sociology*. Berkeley: University of California Press.

Williamson, O.E. (2000). The New Institutional Economics: Taking Stock, Looking Ahead, *Journal of Economic Literature*, 38(3), pp. 595–613.

9

Dariusz Mongiało[1]

The Janus-Faced Interest Representation: Role of Lobbying in European Union Governance

Abstract

This article explores the Janus-faced (i.e. ambivalent) nature of lobbying and its role in shaping governance in the European Union. Interest representation is viewed as an integral part of EU governance that both supports policymaking and poses challenges to democratic legitimacy. The study is guided by five research hypotheses concerning the growing importance of lobbying, its varying impact across policy areas, the uneven implementation of transparency mechanisms, the role of informal practices, and its dual effect on policy quality and representation. The analysis is based on a qualitative review of academic literature, EU institutional documents, reports by public and non-governmental organisations, and selected case studies, including Qatargate and the Uber Files. It combines theoretical approaches to interest representation with empirical evidence on lobbying practices within the EU's multi-level governance system. A key contribution of this study is an original dual-factor analytical framework developed by the author, which maps the scale and character of lobbying influence across EU governance principles and policy domains. The findings suggest that lobbying plays an essential necessary role by providing expertise, facilitating participation, and improving regulatory feasibility. At the same time, it contributes to asymmetries in access, risks of regulatory capture, and potential fragmentation of policy coherence. The impact of lobbying differs across governance dimensions. The article argues that understanding the Janus-faced character of lobbying is essential for designing effective EU governance. To transform interest representation from

[1] SGH Warsaw School of Economics (Poland), e-mail: dmongi@sgh.waw.pl.

a potential source of systemic risk into a driver of more legitimate and coherent EU policies, it is crucial to strengthen oversight mechanisms while preserving the benefits of expertise and pluralistic participation.

1. Introduction

Lobbying forms an integral element of governance in the European Union. While often perceived as a mechanism of influence that may distort democratic processes, it simultaneously plays a crucial role in providing expertise, facilitating stakeholder participation, and enhancing the effectiveness of policymaking. Its ambivalent, or *Janus-faced*, character makes lobbying a particularly relevant subject of analysis within the context of the EU's multi-level governance system. This article examines the dual nature of lobbying by combining theoretical insights with empirical evidence. It is guided by five main research hypotheses: (1) lobbying is a structurally embedded and increasingly important component of EU governance; (2) its impact varies across policy areas; (3) transparency mechanisms are unevenly implemented; (4) informal practices play a significant role; and (5) lobbying has a dual effect, simultaneously improving policy quality while generating inequalities in access and influence.

The structure of the article is as follows. The next section outlines the methodological approach. This is followed by a theoretical discussion of interest representation, which provides the conceptual framework for the analysis. The subsequent sections examine the institutional context of EU governance and present empirical evidence based on selected case studies. The article concludes with a discussion of the findings and their implications for future EU governance.

2. Methodology

This study adopts a qualitative research design aimed at examining the role of lobbying within the European Union's system of governance. The analysis is grounded in a combination of theoretical and empirical approaches. According to this concept, insights from the literature on interest representation are integrated with evidence derived from institutional documents and selected case studies. The theoretical component is based on the existing studies of interest groups and public policy. These approaches provide the conceptual basis for understanding lobbying as both a functional and potentially distortive element of governance. Empirically,

the article relies on qualitative content analysis of multiple types of sources, including academic publications, official documents of EU institutions (such as European Commission communications and legislative proposals), reports produced by international organisations and non-governmental actors, and investigative journalism. The sources allow for a more comprehensive and robust assessment of lobbying practices and their effects. In addition, the study employs a case study to illustrate the mechanisms and consequences of lobbying in specific contexts. The cases were selected for high salience and variation across policy domains, enabling the identification of both formal and informal lobbying practices, including transparency mechanisms, access patterns, and instances of regulatory capture. The analytical part of the study is structured around five research hypotheses concerning the role and effects of lobbying in EU governance, with each hypothesis assessed through a combination of theoretical argumentation and empirical illustration. Instead of testing them in a strictly quantitative sense, the study evaluates their plausibility and explanatory power based on the consistency between theoretical expectations and observed patterns. The qualitative design allows for in-depth analysis and contextual understanding, although it does entail certain limitations. The findings are not intended to be statistically generalisable, and the choice of cases may introduce a degree of bias. However, by combining diverse sources and focusing on well-documented and high-profile examples, the study aims to provide analytically robust and substantively meaningful conclusions about the Janus-faced nature of lobbying in the European Union.

3. Theoretical framework

The literature offers numerous interpretations of lobbying, which differ in their assessment of its role in the decision-making process and in their understanding of the relationships between interest groups and public institutions. Interest representation can be treated as an element of a pluralist model of democracy. In this approach, interest groups enable citizens and organisations to influence the shaping of public policies. This perspective is represented by David B. Truman [1951, as cited in Grant, 2015], who argues that interest groups act as intermediaries between society and the state. In this understanding, entities compete with one another and are an integral part of a system that ensures citizen participation.

A related but distinct perspective on lobbying is provided by collective action theory. Olson [1965] argues that in large groups, rational, self-interested members

will not take action for the common good unless coercive mechanisms or other means of mobilisation are present. In the context of lobbying, this suggests that only well-organised and motivated groups are capable of effectively influencing political decisions, while dispersed groups face difficulties in mobilisation.

Another way to interpret lobbying is the public choice theory. It offers a more critical interpretation, suggesting that political processes may be vulnerable to pressure from narrow interest groups that exploit public institutions to achieve their own goals. From this perspective, lobbying can lead to situations where public policies reflect the interests of the best-organised actors rather than the broadly defined public interest.

Lobbying can be perceived more positively as a mechanism that allows for the exchange of resources between decision-makers and interest groups. Bouwen [2002] emphasised that interest groups provide decision-makers with expert knowledge, sectoral data, and information regarding social preferences. Political entities, in turn, offer the opportunity to participate in the decision-making process. Similar assumptions are adopted in the concept of legislative subsidy, according to which interest groups support policymakers by providing analysis, expertise, and information that are useful in the legislative process [Deardorff, Hall, 2006]. In the face of increasing regulatory complexity, such support enhances the institutions' capacity to make knowledge-based decisions.

Contemporary research on interest representation also incorporates a deliberative perspective. According to this concept, interest groups participate in broader public debates, present their arguments, and try to convince decision-makers of their policy solutions. Lobbyists can provide decision-makers with essential expert knowledge and present diverse social perspectives [Bitonti, 2025]. However, some studies also point to the asymmetry of influence, where certain organisations possess significantly greater financial, expert, or organisational resources, which increases their capacity to affect the decision-making process. Beyers and Braun [2014] additionally indicate that it is not only the size of resources but also a group's position in the network of connections among interest organisations that determines access to decision-makers. Groups occupying a central position in coalitions and those linking different networks have a higher chance of contact with both politicians and administrative officials. Under conditions of insufficient regulation and lack of transparency, lobbying can lead to regulatory capture, a situation in which regulatory institutions act in manners that favour certain economic sectors [OECD, 2017].

4. Theoretical context and the evolution of EU governance

The concept of EU governance was formally articulated in the European Commission's 2001 White Paper on European Governance [European Commission, 2001]. According to the EUR-Lex Glossary, the goal of EU governance is to strengthen democracy and bring citizens closer to EU institutions. The framework is based on a set of governance principles, specified therein, including openness and transparency of EU institutions, the active engagement of civil society in policy-making, ensuring coherence and the effective management of policies, a stable and predictable regulatory system that supports economic development and job creation, adherence to the principles of proportionality and subsidiarity, accountability of institutions and member states, and the EU's participation in global governance debates within the international system [European Union, n.d.].

A distinctive feature of the EU governance system is its multi-level and networked nature. Decision-making powers are shared among actors operating at different levels, and are therefore not monopolised by states. It is not a homogeneous system but one that consists of parallel, hybrid subsystems in which the authority and competencies of member states and EU institutions are distributed unevenly, partially overlapping. EU governance takes different forms depending on the policy area. Lucarelli and Sperling [2025] distinguish five main dimensions: social, economic, security, milieu (shaping the rules and relationships with target regions or specific group of states, including their neighbours), and global. Each of these areas exhibits different relationships between the EU, member states, and society, thus having its own *geometry of power*. In the economic sphere, governance is characterised by a hierarchical structure of competences and decision-making. In the social domain governance is more dispersed and heterarchical. Security governance functions as a hybrid system, while milieu governance can be seen as quasi-hierarchical. In the global category, governance has a coordinated form, with the EU acting as a collective agent on behalf of the member states.

The ways in which interest groups form coalitions, compete, and gain access to decision-makers are significantly affected by the institutional environment. Different actors exploit these opportunities in various ways. For lobbyists, EU governance therefore constitutes a diverse field of action in which venue shopping strategies can be pursued. Venue shopping refers to the ability of interest groups to select the institutional venue or member state most conducive to advancing their objectives [Pakull, Marshall, Bernhagen, 2020]. In practice, it can be argued that effective lobbying in the EU relies on the use of all available political channels, depending on the

topic and stage of the decision-making process. European interest advocacy today contains feedback loops and multiple points of entry, and the effectiveness of lobbying depends on the size of the interest group, its budget, country of origin, and the issue for which it lobbies.

The theoretical perspectives presented earlier provide a starting point for analysing the impact of lobbying on EU governance. Building on this framework, the next section examines how lobbying operates in practice through selected empirical cases and in relation to the key principles that shape decision-making in the European Union.

5. Empirical analysis of the impact of lobbying on EU governance

5.1. The impact of lobbying on the principle of openness and transparency of EU institutions

The principle of openness and transparency of EU institutions requires that every citizen should have the right to access information and documents held by EU institutions. Article 11 of the Treaty on European Union explicitly states that EU institutions are obliged to provide citizens and associations with the opportunity to express and publicly exchange opinions, reflecting the central role of dialogue within the EU's operational mechanisms. Every stakeholder has the right to advocate for their interests, and the principle of openness ensures that such influence on EU institutions is conducted publicly, thereby legally permitting interest advocacy. Contemporary supplementary regulations regarding lobbyists' activities toward EU institutions are included in "Interinstitutional Agreement of 20 May 2021 between the European Parliament, the Council of the European Union, and the European Commission on a mandatory transparency register." Despite the inclusion of numerous positive elements in this legal act, one of its weaknesses is the fact that it does not fully encompass all EU bodies and agencies, and its application within the Council of the European Union is somewhat limited. Registration in the Transparency Register is, in practice, a prerequisite for access to certain forms of influence, such as meetings with senior officials from these institutions. At the same time, the obligation to report meetings mainly concerns the highest-level officials. Furthermore, the regulation allows for a degree of interpretive discretion, which affects its practical implementation. Not all contacts are subject to disclosure requirements;

in particular, informal or spontaneous meetings do not need to be recorded. This creates gaps in the transparency system and limited visibility of stakeholders' actual influence on the decision-making process. Although transparency obligations are gradually being extended to lower levels of EU administration, they remain neither uniform nor fully mandatory. In fact, data from the Transparency International EU [n.d.] indicate a growing number of disclosed meetings between European Commission representatives and interest groups. During the terms of the Juncker Commission (2014–2019) and the first von der Leyen Commission (2019–2024), the total number of registered contacts exceeded 50,000. Between the start of the second von der Leyen Commission (2024–2029) and 27 March 2026, nearly 25,000 meetings with lobbyists had already been recorded, a figure comparable to the total number of meetings during von der Leyen's entire first term (26187). Should this trend continue, the total number of meetings at the end of the current term will significantly surpass previous levels. The increase in meetings between lobbyists and EU officials reflects the growing scale of interactions between the European Commission and stakeholders.

Lobbying, as a legal form of influence on decision-making in the EU system, is therefore subject to the principle of transparency and as such should be conducted openly and subject to public scrutiny. However, this has not always been the case.

A clear example is the case of Uber, as revealed in the *Uber Files* investigation, which showed an aggressive, behind-the-scenes lobbying strategy. Uber used confidential contacts with influential politicians, often bypassing official consultation procedures [International Consortium of Investigative Journalists, 2022; The Guardian, 2022]. A further example of transparency disruption in EU governance is the Qatar corruption scandal, which broke out in 2022. The Belgian prosecution alleged that Qatari representatives sought to improve the country's image in the EU before the FIFA 2022 World Cup hosted by Qatar. The country was being criticised internationally for violations of migrant workers' rights, which led it to illegally attempt to influence members of the European Parliament. Several MEPs and their aides were detained following the investigation [Fernández-Torres, Chamizo-Sánchez, 2025]. This case highlighted that high-level institutions such as the European Parliament are exposed to the risk of informal political influence and corruption, which may undermine citizens' trust in transparency and openness in EU decision-making processes. Research in Germany and France indicated that public disclosure of the scandal led to decreased trust in the European Parliament, regardless of respondents' educational level [Hegewald, Schraff, 2024]. This example shows that the boundary between legal, transparent lobbying and corrupt activities is often elusive to the

public. Consequently, even high levels of transparency do not automatically guarantee a positive public perception, as the disclosure of abuse can amplify societal risk perception and scepticism towards EU governance mechanisms. In March 2025, the transparency and ethical functioning of EU institutions were again challenged during an ongoing investigation into lobbying by the Chinese company Huawei. Belgian federal authorities had conducted inquiries since 2021 into alleged corruption and abuse involving Huawei representatives and affiliated persons to gain political favour, resulting in the European Parliament temporarily suspending access for Huawei-affiliated lobbyists to its buildings, and the European Commission announcing it would not hold formal meetings with groups representing Huawei interests until the investigation had concluded [Reuters, 2025].

This may suggest that the openness and transparency of EU institutions require further strengthening to effectively counteract risks of abuse and maintain citizens' trust in democratic processes at the EU level. For this reason, lobbying in the EU can be described as Janus-faced. On the one hand, it allows the inclusion of diverse social actors in decision-making. On the other hand, insufficient regulation and oversight can lead to distortion of political processes through disproportionate influence of actors with significant financial or political resources. Further evidence is provided in experimental studies by Crepaz [2024], which indicate that access to transparency information on lobbying activities by both NGOs and business organisations does not necessarily enhance citizens' trust in public institutions or reduce perceived corruption. Rather, the effects appear to be limited or ambiguous.

5.2. The impact of lobbying on the principle of involving civil society in decision-making

Interest representation also significantly influences the other EU governance principle, namely the concept of involving civil society in decision-making. Lobbying institutionalises dialogue between citizens and decision-makers, enhancing participation. Many NGOs, associations, or interest groups act as representatives of specific social categories, allowing citizens' voices to be expressed more effectively in public consultations conducted by the European Commission, providing an example of civic-oriented lobbying. However, lobbying also contributes to the elitisation of participatory processes, whereby dominant roles are played by actors possessing sufficient financial resources, expertise, and organisational means. As a result, citizen participation is largely indirect and marginalised by specialised actors, resulting in the civil society's exclusion from the decision-making process.

Information on civil society engagement in lobbying at the EU level can be found in the EU Transparency Register. The statistics available in this source distinguish 13 categories of entities. For the purpose of this research the following five are considered as civic-oriented lobbying: (1) NGOs, platforms, networks and similar; (2) think tanks and research institutions; (3) academic institutions; (4) organisations representing churches and religious communities; and (5) trade unions and professional associations. Data from the EU Transparency Register [European Commission, European Parliament, n.d.] demonstrate that between 2022–2024, these categories accounted for approximately 42–43% of all entries, while corporate lobbying (calculated as the sum of "Professional consultancies," "Law firms," "Self-employed consultants," "Companies and groups," and "Trade and business associations") represented, on average, 52% of entries.

To obtain a more comprehensive picture of civil society's involvement in lobbying activities, it is useful to examine data on the number of meetings held with representatives of EU institutions. Data from Integrity Watch EU [IntegrityWatch.eu, n.d.] reveal that the pattern of meetings between members of the European Commission and interest groups remains highly asymmetrical. During the current von der Leyen Commission, civil society actors have participated in only 25% of the total number of meetings, whereas corporate lobbying participation was nearly three times higher (as of 28 March 2026). This asymmetry can be explained by differences in resources and strategies between business actors and civil society organisations. Corporations possess greater resources and professionalisation, resulting in more frequent access to decision-makers and higher participation in consultation processes. The EU's lobby league table report [Corporate Europe Observatory, LobbyControl, 2025] even demonstrates that the most significant lobbying expenditure in the EU refers to corporations and trade associations. The essential role of financial resources in conducting lobbying activities is confirmed by academic research. Stevens and De Bruycker [2020] demonstrate that economic resources significantly enhance lobbying influence, although this edge disappears in the case of issues that attract a high level of media attention. Empirical evidence thus indicates that EU governance mechanisms, while formally supporting citizen participation through transparency and disclosure, do not achieve full pluralisation of access. Resource-rich actors tend to dominate in terms of registered entries, the number of meetings, and available resources, which creates a tension between decision-making efficiency and democratic legitimacy in the EU. Although transparency mechanisms have improved the visibility of interactions, they have not eliminated the structural advantages of well-resourced lobbyists, with inclusivity remaining

a key challenge for the democratic legitimacy of EU policymaking. This issue continues to pose a major challenge to the inclusiveness and democratic legitimacy of EU policymaking.

5.3. The impact of lobbying on the principle of policy coherence and effective governance

To assess the relationship between lobbying and the principle of policy coherence and effective governance, it is first necessary to clarify the meaning of this principle. It refers to the ability of EU institutions to create regulations that complement each other and are coherent both in terms of goals and practical implementation. In this sense, different policy areas, such as agriculture and climate action, should not contradict one another. Maintaining policy coherence is essential for the effective functioning of the European Union. Research on the influence of interest groups in EU decision-making shows that different groups exert varying degrees of influence depending on the stage of the policy process and the interests they represent [Serna-Ortega, Almansa-Martínez, Castillo-Esparcia, 2025]. From this perspective, it should be emphasised that their knowledge and expertise are crucial for shaping effective regulations, which constitutes a positive dimension of interest representation. However, advocacy also has a second, more problematic side. Before continuing with further analysis, it is important to distinguish between sectoral lobbying and silo lobbying. Sectoral lobbying is understood as the engagement of interest groups representing a specific industry in ways that can support policy design and regulatory adaptation, often providing technical expertise and market insights. Silo lobbying, by contrast, occurs when actors focus narrowly on their sectoral interests without considering broader policy coherence, potentially creating conflicts between policy areas and weakening overarching EU objectives. In practice, sectoral lobbying can improve the feasibility and quality of regulations, whereas silo lobbying risks fragmenting policy and prioritising narrow interests over broader public goods.

Empirical analyses of lobbying surrounding the Farm to Fork Strategy indicate that the agricultural and livestock sectors, represented by organisations such as Copa-Cogeca, actively opposed certain ambitious goals of the strategy, particularly those related to livestock production, sustainable diets, and limiting greenhouse gas emissions from agriculture [InfluenceMap, 2024]. This form of sector-specific pressure can be interpreted as an illustration of silo lobbying, although the arguments advanced by these interest groups also reflect broader socio-economic concerns.

In general, intense pressure from lobbyists could weaken the original ambitions of the horizontal strategy and create tensions between different policy objectives. Such dynamics demonstrate that sectoral lobbying, although formally legal and transparent, requires active management to ensure that EU policies remain coherent and capable of achieving common objectives. Effective governance thus requires EU institutions to conduct open and transparent consultations and develop internal coordination and strategic planning mechanisms to balance sectoral interests with overarching EU goals.

5.4. The impact of lobbying on the principle of a stable and predictable regulatory system

Another significant dimension of lobbying concerns its influence on shaping and refining regulatory frameworks. Input from lobbyists can help policymakers clarify draft legislation and identify ambiguities, legal gaps, and implementation challenges already at the legislative stage. This may improve the clarity, coherence and practical applicability of regulations, thereby contributing to a more predictable regulatory environment conducive to economic activity and job creation.

At the same time, intensive lobbying by specific actors may lead to outcomes favouring narrow interests, potentially undermining the stability and predictability of the regulatory system. Frequent adjustments, exemptions or regulatory fragmentation introduced under such influence can reduce legal certainty for market participants and distort fair competition. This dual effect can be illustrated by the legislative process concerning the Euro 6 and Euro 7 emission standards. While Euro 6 introduced limits aimed at reducing harmful emissions from passenger cars and light commercial vehicles, the proposed Euro 7 standards sought to extend and tighten these requirements across a broader range of vehicles [European Commission, 2022]. The Euro 7 negotiations involved a diverse set of actors, reflecting the pluralistic nature of interest representation in the European Union. Industry associations such as ACEA, automotive suppliers and individual manufacturers, including both large firms such as Volkswagen Group and niche producers like Ferrari, actively participated in the consultation and negotiation process. These actors typically emphasised concerns related to regulatory costs, technological feasibility, and the potential impacts on industrial competitiveness [ACEA, 2023; European Commission, 2022; Volkswagen Group, 2022]. At the same time, environmental organisations such as Transport & Environment advocated for more ambitious emission reductions, highlighting public health and climate objectives [Transport & Environment, 2023].

Within this broader landscape, smaller manufacturers, including Ferrari, lobbied for specific exemptions and greater flexibility for low-volume producers [OpenLobby, 2025], while larger industry players such as Volkswagen Group sought to influence the overall calibration of the standards [Volkswagen Group, 2022]. The debate also engaged civil society organisations that pushed in the opposite direction, advocating for stricter regulatory outcomes [InfluenceMap, 2024]. The final form of the Euro 7 regulation reflects this interaction of competing interests, introducing new requirements – particularly for heavy-duty vehicles – but also retaining several elements of existing standards for passenger cars. The final regulation can be seen as a compromise between environmental ambition and industrial feasibility [European Parliament, 2023]. This case illustrates how lobbying can contribute to the technical refinement of regulations by providing expertise and sectoral knowledge, while at the same time, policy outcomes are adjusted in ways that reflect the relative influence of different actors. This example demonstrates how sector-specific interests shape particular elements of regulatory design.

5.5. The impact of lobbying on the principle of accountability of EU institutions

In examining the role of lobbying on EU governance, special attention should be paid to its impact on accountability. Accountability requires EU institutions and their representatives to justify decisions and be answerable to citizens. Lobbying can support accountability by introducing pluralism of interests into the process, compelling decision-makers to confront diverse expectations and justify their choices. The presence of multiple interest groups is a positive factor with regard to EU governance, as decisions taken by the European Parliament and the European Commission are subject to multilateral scrutiny, which increases the pressure on policymakers to explain their actions, thereby potentially enhancing political responsibility. However, lobbying's impact on accountability may be limited, especially in the case of sources of influence that are dispersed or difficult to identify. In such cases, responsibility for political decisions becomes blurred, as decision-makers may reject individual accountability pointing to general systemic constraints. This problem is particularly evident in the complex institutional system of the EU, where multiple actors participate in the legislative process, making it difficult to attribute final decisions unambiguously.

A key mechanism that weakens accountability is the *revolving-door* phenomenon, which refers to situations where officials move to the private sector, including lob-

bying firms or industries they previously regulated. Such transfers are often incentivised by lobbyists offering attractive positions to individuals with knowledge of procedures, contacts and influence opportunities. These practices raise concerns about the ability to hold public officials accountable, blurring the line between public duty and potential private gain. An example is José Manuel Barroso, former President of the European Commission, who joined Goldman Sachs International after leaving office, which raised doubts concerning accountability for his earlier public decisions [Corporate Europe Observatory, 2016; Politico, 2016; Reuters, 2016]. The revolving-door phenomenon was also examined by the European Ombudsman, who found that senior officials from bodies such as the European Banking Authority and the European Defence Agency had moved into private-sector roles closely related to their previous responsibilities [European Ombudsman, 2025], raising concerns about potential conflict of interest. She also found that the European Commission tends to underestimate how such cases can affect public trust. These findings suggest that revolving-door practices can affect both how EU institutions are perceived and how effectively they fulfil their functions.

Besides revolving-door practices, another factor that may undermine the principle of accountability is shadow lobbying. Shadow lobbyists engage in lobbying activities without formally registering as lobbyists and therefore avoiding public disclosure. As a result, their activities remain largely hidden from citizens and public scrutiny. The presence of shadow lobbyists within the system of interest representation negatively affects transparency, making it unclear who influenced the decision-making process. This lack of transparency makes it impossible to map the influence of special interests on specific policy decisions, meaning that shadow lobbying cannot be held accountable. This weakens the connection between advocacy activities and policy outcomes, making it impossible to evaluate whether politicians are acting in the public interest or under undue pressure from special interests. In this sense, lobbying exerts a dual influence on accountability within the EU governance system. On the one hand, it can increase pressure to justify decisions and enhance political responsibility. On the other hand, institutional complexity, asymmetry of influence, and informal practices (including revolving-door practices and shadow lobbying) can blur responsibility and limit enforceability. Ultimately, lobbying does not automatically strengthen or weaken accountability, but transforms the way in which accountability is observed. Due to this fact, the effectiveness of this principle of EU governance depends on the quality of institutional frameworks and on the system's ability to assign responsibility effectively.

5.6. The impact of lobbying on the principle of proportionality and subsidiarity

Lobbying also affects the application of subsidiarity and proportionality principles in the EU. As a general rule, when evaluating the economic, social and environmental effects of different policy options, opinions collected from stakeholders, interviews with companies, and industry reports were used to assess compliance with proportionality (whether the measures were necessary and appropriate) and subsidiarity (whether EU-level action was justified and the goal could not be achieved at a member state level) [European Commission, 2020; European Commission, n.d.]. Lobbyists are among those entitled to submit comments during the policymaking process. Interest groups can persuade EU institutions that regulation should be adopted at the EU level, or that regulatory intervention should be limited. Lobbyists can provide data on the economic or social impact of proposed measures, aiding the assessment of whether EU intervention is necessary (subsidiarity) and to what extent (proportionality). At the same time, powerful interest groups may sometimes push institutions towards excessive intervention or regulatory restraint if EU action favours their sector. The European Commission's proposal for a mandatory USB-C charging standard illustrates these dynamics. This initiative prompted opposition from the iPhone maker Apple, which criticised the initiative on the grounds of potential costs and constraints on innovation. In addition, it argued that mandating a single standard could limit technological evolution and interfere with platform-based ecosystems built around proprietary solutions [Chadwick, Tidey, 2022; Guarascio, 2022; The Week Staff, 2022]. The core of the dispute revolved around the interpretation of the principle of proportionality. Apple argued that mandating a single type of connector could impose significant costs relative to the objective of reducing electronic waste. The company also emphasised that the industry was already moving towards standardisation, suggesting that further regulatory intervention might not be necessary [Chee, 2020]. However, the European Commission maintained that voluntary industry agreements had not been successful in achieving harmonisation, thereby justifying the need for legislative action. From the perspective of the principle of proportionality, this case illustrates how lobbying can influence the assessment of whether regulatory intervention is necessary and justified in relation to its objectives. It also reveals the dual role of lobbying. On the one hand, it exerts pressure on institutions. On the other hand, it strengthens the rationale of legislative decisions, forcing EU institutions to justify that the proposed measures are necessary, proportionate, and add value at the EU

level. In this way, lobbying did not block the policy entirely but shaped its technical and temporal design, ensuring that the regulation remained legally robust while balancing public interest goals with industry concerns.

5.7. The impact of lobbying on the EU's participation in global governance debates within the international system

The impact of lobbying on EU global governance is multifaceted. First, interest groups seek to shape the EU's position in international negotiations by advocating for trade agreements that benefit their interests, which directly affects the EU's global role. Second, through consultations and dialogue with stakeholders, lobbying can enhance the transparency of the EU's international activities, thereby strengthening its credibility as a global actor. Strong private interests, however, may exert disproportionate influence over EU external policies, potentially favouring narrow interests, undermining international legitimacy. Third, lobbying plays an important role in areas where EU regulations acquire global significance through the so-called Brussels Effect. This occurs when the size of the EU market and the consistency of its regulatory framework encourage companies from outside the EU to adopt EU standards, even if not legally required [Bradford, 2020]. Transnational corporate lobbying can accelerate or delay the adoption of these rules. Prominent examples include the General Data Protection Regulation (GDPR), adopted worldwide beyond the EU, which has reinforced global privacy standards [Tamim, 2024]. Another example is the Digital Markets Act (DMA), which attracted extensive lobbying from major digital platforms during consultations as they sought to influence gatekeeper obligations [Cini, Czulno, 2022]. Similarly, during EU AI Act consultations, tech companies, including OpenAI, Google, Meta and Apple, aimed at influencing the terms and conditions of the regulatory framework [Tallberg, Geith, Lundgren, 2024; Time, 2023]. The EU legislative process also involves stakeholders representing third-country interests. According to the annual reports on the functioning of the Transparency Register published in 2023–2025, the largest number of non-EU lobbyists declared headquarters in the United Kingdom, followed by the USA and Switzerland. At the same time, EU-based lobbyists may also represent foreign interests, illustrating the Brussels Effect. The presence of foreign entities that can play a role in shaping EU policies and agenda has been recognised by the European societies. The Flash Eurobarometer 528 survey (conducted in spring 2023 and published in December 2023) found that 81% of Europeans regarded foreign interference in democratic systems as a serious problem. These concerns contributed to the European Commission's

adoption of the *Defence of Democracy* package [European Commission 2023a, 2025]. One of the proposed acts is a draft directive on the transparency of third-country interest representation, which envisages the introduction of harmonised transparency standards for entities that promote the interests of non-EU countries in order to influence EU policy [European Commission 2023b]. Overall, lobbying shapes the global role of the European Union. It enables stakeholders to influence its positions in international negotiations and in the development of regulations that frequently become global standards. At the same time, the presence of actors representing the interests of third countries demonstrates that EU policymaking increasingly reflects the interaction of domestic, European, and global interests. While this enhances the EU's importance in the international arena, it also raises questions concerning legitimacy and transparency. In this respect, lobbying remains a Janus-faced phenomenon: it strengthens the EU's position in global governance while simultaneously imposing the need for control mechanisms capable of preserving the balance between public interest and private influence.

6. Dual-factor comparative analysis of the scale of lobbying influence across EU governance principles and dimensions

Assessing the impact of lobbying on EU governance requires a multidimensional perspective that considers both formal regulatory frameworks and the actual effects of stakeholder influence. Building on the empirical observations described above, this section presents an experimental comparative analysis of lobbying's influence across the EU governance system. To structure this analysis, the article draws on the typology of contemporary governance proposed by Lucarelli and Sperling [2025], which distinguishes five dimensions: social, economic, security, milieu and global governance. These categories are associated with the seven principles of EU governance discussed earlier. Combining governance principles with governance dimensions creates a dual-factor analytical framework that facilitates a more nuanced understanding of lobbying mechanisms across different institutional settings and policy domains. To capture the extent of lobbying influence, four criteria were adopted: (1) the degree of impact on political decision-making, (2) the level of asymmetry in access to decision-making, (3) effects on policy quality and coherence, and (4) influence on global processes. Based on these criteria, a five-point scale ranging from negligible to very strong was applied. The results are summarised in Table 1,

which synthesises the relationships between EU governance principles, governance dimensions, and the nature of lobbying influence.

Table 1. The relationships between EU governance principles, governance dimensions, and the nature of lobbying influence

Governance Principle	Governance dimensions	Strength of the lobbying influence	Nature of influence	Character of impact	
				positive	negative
Active engagement of civil society in policy-making	Social and Milieu	Very strong	Ambivalent (predominantly negative)	Representation of interests, NGO involvement, public consultations	Corporate dominance, resource asymmetry, elitisation of participation
Ensuring coherence and effective management of policies	Economic and Milieu	Very strong	Predominantly negative	Better sectoral alignment	Silo lobbying, conflicts between policies
Accountability	Social	Strong	Mixed, structurally problematic	Expertise supports decision-making, oversight mechanisms	Revolving door phenomenon, conflicts of interest, limited enforceability
Openness and transparency of EU institutions	Social	Strong	Ambivalent	Transparency register, disclosure of meetings	Shadow lobbying, unequal access to information
Stable and predictable regulatory system	Economic and Milieu	Strong	Ambivalent	Regulatory stability, predictability for the market	Exceptions, derogations, legal complexity
Global governance	Global and Security	Strong	Ambivalent	Export of norms (Brussels Effect)	Influence of third countries, risk of protectionism
Subsidiarity and proportionality	Economic and Social	Medium	Ambivalent	Better regulatory adaptation, limitation of overregulation	Instrumentalisation of principles, weakening of regulations

Source: Author's own elaboration.

As demonstrated above, lobbying exerts a complex and ambivalent influence on European Union governance. Its effects vary across the seven key principles.

A very strong influence of interest representation is observed in the case of the involvement of civil society in decision-making experiences, where lobbying can

enhance stakeholder engagement and public consultations but also reinforce corporate dominance and resource asymmetries. A very strong influence, often predominantly negative, also characterises framing and implementing consistent and well-managed policy experiences, as lobbying may improve sectoral alignment but create siloed pressures and inter-policy conflicts.

The impact of lobbying on the accountability of EU institutions can be labelled as strong. The expertise provided by lobbyists supports oversight and informs decision-making, while structural risks, such as revolving-door practices, conflicts of interest, and limited enforceability create negative pressures.

Openness and transparency are also strongly affected by interest representation. In this domain, lobbying can enhance transparency through mechanisms such as transparency registers and meeting disclosures, but may allow for shadow lobbying and unequal access to information.

Shaping and evolving regulatory frameworks is another EU governance principle strongly influenced by lobbying. In this area, interest representation enhances market predictability and regulatory stability, yet it introduces legal complexity, sector-specific exceptions, and potential distortions.

Global governance is likewise strongly influenced by lobbying. In this domain, advocacy can facilitate the international diffusion of EU standards, while simultaneously making the European Union more vulnerable to external influence and protectionist pressures.

Finally, subsidiarity and proportionality are influenced by advocacy to a moderate degree, whereby lobbying allows for flexible and adaptive regulation based on stakeholder input, but can also be used strategically by interest groups to weaken or dilute regulatory measures.

Analysed from the perspective of governance dimensions, lobbying shows different levels of influence depending on both the policy domain and the specific governance function. In the social domain, advocacy is generally very strong due to broad participation and relatively open access to decision-making processes. In the economic domain, its influence is consistently strong but varies across policy functions. In areas related to policy coordination and regulatory framing, lobbying is very strong, while in other regulatory processes it also remains strong, although more ambivalent due to the balance between expertise-based input and the risk of policy fragmentation. The security domain shows moderate influence, since access to decision-making is more restricted and centralised, which limits the number of actors capable of effective participation. The milieu domain is characterised by strong but indirect influence, where interest groups shape outcomes mainly through networks rather than

direct decision-making power. Finally, the global domain demonstrates strong but ambivalent influence, which reflects the EU's involvement in international governance networks, thereby increasing opportunities for advocacy but also exposing policy-making to external lobbying and reducing institutional control over decisions.

Overall, the influence of lobbying varies across governance domains depending on the level of access to decision-making, institutional openness, and the degree of centralisation within each policy area.

7. Conclusions

The analysis supports the view that lobbying exhibits a Janus-faced character within the European Union and is broadly consistent with the five research hypotheses formulated in this study.

First, lobbying is a structurally embedded and increasingly significant element of EU governance. Across institutional settings, it plays a functional role by supplying expertise, facilitating policy formulation, and contributing to the adaptive capacity of EU institutions.

Second, the impact of lobbying varies across policy domains. Areas such as digital regulation, environmental policy, and industrial standards exhibit different patterns of access, influence and regulatory outcomes, reflecting asymmetries in resources and strategies among interest groups.

Third, transparency mechanisms are unevenly implemented. While formal tools such as transparency registers do exist, their effectiveness is constrained by gaps in enforcement, limited coverage of lower-level officials, and interpretive discretion in reporting, leaving significant blind spots in the visibility of influence.

Fourth, informal practices remain a crucial dimension of lobbying. Case studies, including those of Uber, Huawei and Qatar, demonstrate how personal networks, informal contacts, and non-transparent interactions continue to shape policy outcomes, even undermining formal accountability and public trust.

Fifth, lobbying produces a dual effect. It enhances policy quality, feasibility and evidence-based decision-making, while simultaneously generating inequalities in representation, thereby privileging well-resourced actors and increasing the risk of regulatory capture.

A key empirical contribution of this study is the dual-factor comparative table developed by the author, which maps the scale and nature of the influence of lobbying across EU governance principles and policy dimensions, highlighting sectoral

differences, asymmetries in access, and the dual effects of lobbying within EU governance. The table complements the qualitative analysis by offering a clear, evidence-based framework for assessing where lobbying strengthens governance and where it poses risks.

Overall, these findings highlight the need for a balanced regulatory approach. Strengthening transparency, limiting informal influence channels, promoting systematic accountability, and ensuring more inclusive access to decision-making processes would allow the European Union to preserve the functional benefits of lobbying while mitigating its negative consequences for democratic legitimacy, policy coherence, and societal trust.

From a policy perspective, several recommendations emerge from the analysis. First, the EU should extend the existing mandatory transparency framework to cover all institutions and agencies, including meetings at the technical level. There is also a need to strengthen enforcement and monitoring mechanisms, introduce clearer reporting standards, and establish effective sanctions for non-compliance. Second, measures such as financial support mechanisms, capacity-building programmes, or more inclusive consultation formats could help reduce asymmetries in access among interest groups. To limit the scale of shadow lobbying, registration requirements should be expanded and a clearer definition of lobbying activities should be applied. Third, longer and enforceable *cooling-off* periods could help reduce the revolving-door practices, while silo lobbying could be counteracted by strengthening cross-sector coordination and introducing systematic policy coherence checks. Finally, in the context of the EU's global dimension, an important priority is the effective implementation of the proposed directive on third-country lobbying.

References

ACEA (European Automobile Manufacturers' Association) (2023). *Position Papers – Proposals for a Euro 7 Regulation*, https://www.acea.auto/publication/position-papers-proposal-for-a-euro-7-regulation/ (accessed: 31.03.2026).

ASSEDEL (2025). *Between Regulation and Industry: How Lobbying Shaped EU Emissions Standards: Case Study at the Intersection of Power, Policy, and Pollution*. Strasbourg, France, https://assedel.org/between-regulation-and-industry-how-lobbying-shaped-eu-emissions-standards/ (accessed: 30.03.2026).

Beyers, J. (2004). Voice and Access: Political Practices of European Interest Associations, *European Union Politics*, 5(2), pp. 211–240.

Bradford, A. (2020). *The Brussels Effect: How the European Union Rules the World*. New York: Oxford University Press.

Chadwick, L., Tidey, A. (2022). EU Officials Say Common Charger will Help Consumers and Environment, *Euronews*, https://www.euronews.com/my-europe/2022/06/07/eu-officials-say-common-charger-will-help-consumers-and-environment (accessed: 30.03.2026).

Chee, F.Y. (2020). Apple Pushes Back Against EU Common Charger, Warns of Innovation Risks, *Reuters*, https://www.reuters.com/article/technology/apple-pushes-back-against-eu-common-charger-warns-of-innovation-risks-idUSKBN1ZM2EI/ (accessed: 30.03.2026).

Cini, M., Czulno, W. (2022). Digital Platform Regulation in the European Union: The Lobbying Strategies of Big Tech, *Journal of European Integration*, 44(3), pp. 327–343.

Corporate Europe Observatory (2016). Barroso and Goldman Sachs – A Dangerous Liaison, https://corporateeurope.org/en/revolving-doors/2016/07/barroso-and-goldman-sachs-dangerous-liaison (accessed: 29.03.2026).

Corporate Europe Observatory, LobbyControl (2025). *The EU's Lobby League Table: Tech, Banking, Energy, Chemicals Dominate*, https://corporateeurope.org/en/2025/02/eus-lobby-league-table (accessed: 31.03.2026).

Crepaz, M. (2024). Lobbying Transparency and Attitudes Towards Interest Groups: A Survey Experiment, *Interest Groups & Advocacy*, 13(4), pp. 546–568. DOI: 10.1057/s41309-024-00201–1.

De Bruycker, I., Hanegraaff, M. (2024). The People Versus the Money: What Drives Interest Group Influence in the European Union?, *European Journal of Political Research*, 63(1), pp. 26–44.

European Commission (2001). *European Governance: A White Paper [COM (2001) 428 final]*, https://ec.europa.eu/commission/presscorner/detail/en/doc_01_10 (accessed: 29.03.2026).

European Commission (2022). *Proposal for a Regulation of the European Parliament and of the Council on Type-Approval of Motor Vehicles and Engines and of Systems, Components and Separate Technical Units Intended for Such Vehicles, with Respect to their Emissions and Battery Durability (Euro 7) and Repealing Regulations (EC) No 715/2007 and (EC) No 595/2009 (COM/2022/586 final)*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52022PC0586 (accessed: 30.03.2026).

European Commission (2023a). *Communication on Defence of Democracy (COM (2023) 630 final)*, *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52023DC0630* (accessed: 31.07.2026).

European Commission (2023b). *Proposal for a Directive of the European Parliament and of the Council Establishing Harmonised Requirements in the Internal Market on Transparency of Interest Representation Carried out on Behalf of Third Countries and Amending Directive (EU) 2019/1937 COM/2023/637 final*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2023:637: FIN (accessed: 28.03.2026).

European Commission (n.d.). *Better Regulation Toolbox*, https://commission.europa.eu/law/law-making-process/better-regulation/better-regulation-guidelines-and-toolbox/better-regulation-toolbox_en (accessed: 31.07.2026).

European Commission (2020). *Impact Assessment Study on Common Chargers of Portable Devices*, Publications Office of the European Union. DOI: 10.2873/528465.

European Commission, European Parliament (n.d.). EU Transparency Register: Reports and publications, https://transparency-register.europa.eu/find-out-more/reports-and-publications_en

European Ombudsman (2025). *The Importance of Responsible Lobbying* [Speech], https://www.ombudsman.europa.eu/pl/speech/en/205235 (accessed: 31.07.2026)

European Parliament (2023). Euro 7: Deal on New EU Rules to Reduce Road Transport Emissions, https://www.europarl.europa.eu/news/pl/press-room/20231207IPR15740/euro-7-deal-on-new-eu-rules-to-reduce-road-transport-emissions (accessed: 29.03.2026).

European Union (n.d.). EU Governance. Glossary of Summaries, *EUR-Lex*, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:governance (accessed: 27.03.2026).

Fernández-Torres, M.J., Chamizo-Sánchez, R. (2025). Qatargate and Lobbying Crisis in the European Union: Media Analysis and Regulatory Challenges for Institutional Transparency, *Frontiers in Political Science*. DOI: 10.3389/fpos.2025.1532117.

Guarascio, F. (2022). Apple Forced to Change Charger in Europe as EU Approves Overhaul, *Reuters*, https://www.reuters.com/technology/eu-parliament-adopts-rules-common-charger-electronic-devices-2022-10-04/ (accessed: 27.03.2026).

The Guardian (2022). *Uber Broke Laws, Duped Police and Secretly Lobbied Governments, Leak Reveals*, https://www.theguardian.com/news/2022/jul/10/uber-files-leak-reveals-global-lobbying-campaign (accessed: 20.03.2026).

Hegewald, S., Schraff, D. (2024). Corruption and Trust in the European Parliament: Quasi-Experimental Evidence from the Qatargate Scandal, *European Journal of Political Research*, 63(4), pp. 1674–1685.

InfluenceMap (2024). *Analysis of Lobbying on EU Farm to Fork Strategy*, https://europe.influencemap.org/policy/Farm-to-Fork-18790 (accessed: 28.03.2026).

International Consortium of Investigative Journalists (2022). *The Uber Files*, https://www.icij.org/investigations/uber-files/ (accessed: 30.03.2026).

Lucarelli, S., Sperling, J. (2025). Governance and the European Union. In: *Handbook of European Union Governance* (pp. 2–21), S. Lucarelli, J. Sperling (Eds.). Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing.

OECD (2017). *Preventing Policy Capture: Integrity in Public Decision Making*. Paris, France: OECD Publishing.

OpenLobby (2025). *Ferrari Calls for Explicit Euro 7 Exemptions for Small-Volume Manufacturers*, https://www.openlobby.eu/org/ferrari (accessed: 28.03.2026).

Pakull, D., Marshall, D., Bernhagen, P. (2020). Shop Till You Drop? Venue Choices of Business and Non-Business Interests in the European Union, *Interest Groups & Advocacy*, 9(1), pp. 22–45.

Politico (2016). José Manuel Barroso's New Job at Goldman Sachs Angers EU, https://www.politico.eu/article/jose-manuel-barrosos-new-job-at-goldman-sachs-angers-eu/ (accessed: 25.03.2026).

Reuters (2025). Five Charged in European Parliament Huawei Bribery Probe, https://www.reuters.com/world/europe/five-charged-european-parliament-huawei-bribery-probe-2025-03-18/ (accessed: 25.03.2026).

Serna-Ortega, Á., Almansa-Martínez, A., Castillo-Esparcia, A. (2025). Influence of Lobbying in EU Policy Process Phases, *Frontiers in Political Science*, 7. DOI: 10.3389/fpos.2025.1511918.

Stevens, F., De Bruycker, I. (2020). Influence, Affluence and Media Salience: Economic Resources and Lobbying Influence in the European Union, *European Union Politics*, 21(4), pp. 728–750.

Tallberg, J., Lundgren, M., Geith, J. (2024). *AI Regulation in the European Union: Examining Non-State Actor Preferences*. Business and Politics.

Tamim, J. (2024). *The Brussels Effect and the GDPR: EU Institutions as Catalysts for Global Data Protection Norms*. European Digital Policy Institute.

Time (2023). *OpenAI Lobbied EU to Water Down AI Regulation*, https://time.com/6288245/openai-eu-lobbying-ai-act/ (accessed: 30.03.2026).

Transparency International EU. (n.d.). *Integrity Watch EU: Commission meetings*, https://www.integritywatch.eu/ecmeetings (accessed: 27.03.2026).

Transport & Environment (2023). *A Robust Euro 7 will Substantially Improve Air Quality in Europe Report*, https://www.transportenvironment.org/articles/a-robust-euro-7-will-substantially-improve-air-quality-in-europe (accessed: 30.03.2026).

Volkswagen Group (2023). *Appendix to the Principles and Guidelines for Public Affairs*, https://www.volkswagen-group.com/en/publications/more/appendix-to-the-principles-and-guidelines-for-public-affairs-1889 (accessed: 31.07.2026).

The Week Staff (2022). *Pros and Cons of Universal Chargers. The Week*, https://theweek.com/news/954255/pros-and-cons-of-universal-chargers (accessed: 24.03.2026).

10

Maksym Bondar[1]
Iryna Degtyarova[2]
Małgorzata Molęda-Zdziech[3]

Democracy and the Rule of Law in Times of War: Ukraine's Lessons in Resilience for Europe

Abstract

The Russo–Ukrainian war has subjected Ukraine's legal, political and social systems to an unprecedented stress test. Alongside the Armed Forces, public institutions, governance structures and civil society have been forced to rapidly adapt under conditions of existential threat. Ukraine has thus emerged as a unique case study for examining the capacity of liberal constitutional democracy to endure during full-scale war. This article explores how Ukraine has sustained democratic governance under martial law without sliding into authoritarianism. Focusing on institutional continuity in the absence of elections, proportionality of wartime rights restrictions, and the compensatory role of civil society amid executive centralisation, it conceptualises democratic resilience across legal, socio-political and institutional dimensions, identifying transferable lessons for democracies facing existential crises.

1 National University of Kyiv-Mohyla Academy (Ukraine), e-mail: maksym.bondar@ukma.edu.ua.
2 SGH Warsaw School of Economics (Poland), e-mail: idegty@sgh.waw.pl.
3 SGH Warsaw School of Economics (Poland), e-mail: mmoled@sgh.waw.pl.

1. Introduction

The Russo–Ukrainian war has become the most extensive and destructive conflict in Europe since the Second World War, constituting profound challenges to the resilience of legal, political and social systems in Ukraine. Much like the Armed Forces of Ukraine, public institutions, governance, society and the normative framework have all undergone their own *stress test* of adaptability, flexibility and capacity for rapid reform. Ukraine has thus emerged as a valuable case study for examining hypotheses concerning the resilience of liberal democratic order under conditions of existential armed conflict. It now has the potential to be viewed as a model of democratic resilience that the EU may draw upon in its efforts to counter autocratic interference across its neighbourhood [Romanyshyn, 2023]. Russia's full-scale invasion of Ukraine has also changed the attitude of EU decision-makers and institutions towards Russia and its political decisions.

A growing body of scholarship has begun to map this experience, with studies examining the functioning of the Verkhovna Rada under wartime conditions, the performance of local self-government bodies and military administrations at all levels, and the operation of courts and law enforcement agencies [Keudel, Huss, 2023; Rabinovych et al., 2024]. Such research focuses not only on the theoretical foundations but also on the practical dimensions of institutional adaptation and the evolving relationship between state and non-state actors. Existing studies tend to converge on several findings: that Ukraine's legislative, executive and judicial institutions have demonstrated remarkable adaptability under conditions of extreme pressure; that wartime centralisation of executive power, while constitutionally sensitive, has not dismantled the foundational architecture of the separation of powers; and that civil society has continued to function as a compensatory accountability mechanism in the absence of full-scale electoral competition [Venher, Bondar, Doroshenko, Kyrychenko, Ivasyk, 2023].

This article examines how a liberal constitutional democracy can sustain its core institutional commitments under martial law without sliding into authoritarianism, and what lessons can be learnt from Ukraine's experience of resilience. The analysis is guided by three research questions: (1) how should *resilience* be conceptualised across different systems its legal, socio-political, and institutional dimensions; (2) what are the defining characteristics of democratic and rule-of-law resilience in Ukraine's wartime experience; and (3) what lessons from the Ukrainian case may prove transferable to the EU?

2. Pluridisciplinary approaches to the concept of resilience: definitions

2.1. General approaches to resilience in the social sciences

Resilience is a concept used across various social sciences. First, it can be understood in relation to the individual level – individual resilience. (see Table 1).[4]

Second, it is also an important category in regard to institutions and systems (political, social, economic), i.e. it refers to the structural or process level (see Table 1).[5]

Table 1. Definitions of resilience in chronological order

Year	Author / Source	Definition of resilience	Source file (in-text reference)
1979	Rutter	Resilience is defined as a dynamic attribute and an outcome that derives from both environmental and individual factors. It is not a fixed characteristic of the individual and is context-dependent, meaning it is not a universal construct applicable to all domains of life.	Rutter [1979]; OECD [2018]
2001	Masten	Resilience refers to "a class of phenomena characterised by good outcomes in spite of serious threats to adaptation or development."	Masten [2001]; OECD [2018]
2008	Schonert-Reichl, LeRose	Resilience is a construct that encompasses four primary components: (1) the individuals' characteristics, (2) the nature of the context, (3) the risk factors (i.e. the presence of adversity), and (4) the counteracting, protective and compensatory factors.	Schonert-Reichl, LeRose [2008]; OECD [2018]
2017	American Psychological Association (APA)	Resilience is "the process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress."	American Psychological Association [2017]; OECD [2018]
2018	OECD (Organisation for Economic Co-operation and Development)	Being resilient means "bouncing back" from difficult experiences such as challenging family and relationship situations, health problems, or workplace and financial stressors.	OECD [2018]

Source: Authors' own elaboration, based on the definition of resilience from the literature.

4 Definition of Schonert-Reichl & LeRose, 2008.

5 Definition by the American Psychological Association (APA) [2017], OECD [2018].

Both perspectives on resilience are well reflected in the actions taken in Ukraine during Russia's full-scale invasion. The daily struggle, and the resistance shown at both the individual and institutional levels, have both built Ukraine's resilience system.

2.2. Resilience in legal science

The concept of resilience is broadly understood as the capacity of an entity or system to resist shocks, absorb them, recover from them, and move forward to maintain or enhance its identity, if not its structures and functions [Croissant, Lott, 2024; Folke et al., 2004; Stollenwerk, Börzel, Risse, 2021]. At the policy level, this understanding has been progressively institutionalised: the U.S. Presidential Policy Directive on National Preparedness defines resilience as "the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions," including deliberate attacks, accidents, or naturally occurring threats [PPD-8, 2011]. The European Commission extended this framework in 2020 in the Strategic Foresight Report by defining resilience as the ability to not only withstand and cope with challenges but also undergo transitions in a sustainable, fair and democratic manner – a formulation that explicitly links resilience to democratic values rather than treating it as a purely technical capacity [European Commission, 2020].

Within legal science, resilience has been defined as the ability of legal institutions and the legal instruments they create to withstand shocks while retaining, in essence, the same functions, structure, feedback mechanisms and identity [Ruhl, Cosens, Soininen, 2021]. As a system, law exhibits resilience features that can be characterised along the lines of general resilience theory: (a) reliability, (b) efficiency, (c) scalability, (d) modularity, and (e) evolvability [Ruhl et al., 2021].

This systemic understanding of resilience finds its constitutional expression in the concept of constitutional resilience, which Grabenwarter [2018] defines as the ability of constitutions to cope with attacks and, ultimately, to withstand a genuine crisis. Jakab [2023] describes constitutional resilience as the "capacity of a constitutional system to withstand attempts aimed at changing or violating its core elements," further arguing that it "depends on the interaction of the constitutional design and the political-social-cultural context," and that challenges may take the form of sudden external shocks or a gradual processes of erosion. At its heart, constitutional resilience denotes the ability of a constitution not only to withstand a severe shock, but also to enable the legal order to seek recovery within the constraints of its own ground rules [Contiades, Fotiadou, 2015]. A resilient constitution, when faced with a severe crisis, can adapt without losing its normativity,

which allows democracy and the rule of law to also demonstrate resilience through two types of mechanisms: (a) those allowing the constitution to change itself and thus to adapt; and (b) those that allow the legal order to adapt to what is demanded, without actors having to resort to violating or circumventing the constitution [Contiades, Fotiadou, 2015].

Building upon this general understanding, we define democratic resilience as the ability of democratic systems to endure exogenous and endogenous shocks and stressors in a non-violent manner through democratic means of political participation, thereby preventing or recovering from a durable loss of democratic qualities in political institutions, processes and practices [Stollenwerk et al., 2021]. As Holloway and Manwaring [2023] observe, resilience is "not a single property that a democratic system would possess and exhibit in all circumstances, but rather a response process of *patterned adjustments* that a system (or agents within) may demonstrate to a varying degree." Democratic resilience thus encompasses not only state institutions but also a broad range of societal and non-state actors. Crucially, it should be understood as both a process and a state: if democracies are resilient, they are not only able to fend off stressors and crises, but also develop coping mechanisms that allow them to deal with risks over the long term, while preserving, reviving or enhancing their quality of democratic governance [Stollenwerk et al., 2021].

2.3. Resilience in higher education

Resilience in higher education, both at the system and institutional level, is commonly conceptualised as a set of responses, behaviours or capacities at three main stages: anticipation, coping, and adaptation or recovery [Błaszczyk, Kovalisko, Pieńkowski, Pachkovskyy, Ryniejska-Kiełdanowicz, 2025; Duchek, Raetze, S., Scheuch, 2020; Protsyk, 2025] from a crisis, emergency or war. These stages correspond with the timeline, ranging from urgent or immediate to short-, medium-, or long-term, and may also relate to individual behaviours. Such an understanding of resilience is rooted in crisis management theory defined as "planning, organising, motivating and controlling activities related to prevention, preparedness, response and recovery in connection with a crisis situation" [Gromek, 2025].

Resilience in higher education is also the ability to survive disruption, protect people, ensure academic continuity, and transform crises into opportunities for institutional and systemic renewal.

3. The rule of law and democracy in wartime Ukraine: a case study

3.1. Institutional resilience and legitimacy

There is no universally accepted theoretical or legislative definition of *elections* as such. This does not mean, however, that their essential characteristics cannot be identified. Representatives of legal positivism most commonly understand elections through the lens of a practical instrument, and electoral law as a set of normatively defined rules and procedures by which bodies of public authority – parliament, the president, local councils, and so forth – are constituted [Bondar, 2024; Koziubra et al., 2021]. This approach, however, captures only the procedural dimension of elections and does not fully reflect their broader constitutional significance.

Elections are the mechanism through which the state together with its organs of power acquire democratic legitimacy; they constitute an instrument for the free expression of the popular will through individual citizens. In this sense, elections may be understood as "a practical instrument for transforming direct democracy into representative governance." Only on the basis of such an understanding of elections can one speak of legitimate authority as a product of the exercise of popular sovereignty [Bondar, 2024; Koziubra et al., 2021].

On 24 February 2022, the Russian Federation continued the armed aggression against Ukraine that it had initiated with the annexation of the Autonomous Republic of Crimea and the city of Sevastopol in February 2014 and the occupation of parts of Donetsk and Luhansk oblasts, by launching a full-scale armed invasion of Ukraine. In the early months of the war, Russia succeeded in occupying approximately one third of Ukraine's sovereign territory. On that same day, 24 February 2022, the legal regime of martial law was introduced in order "to avert the threat, repel the armed aggression, and ensure national security, eliminate the threat to the state independence of Ukraine and its territorial integrity."[6]

Martial law constitutes a legal acknowledgement of the threat posed by armed aggression against Ukraine. The Law on the Legal Regime of Martial Law, enacted pursuant to the Constitution of Ukraine, defines the specific features of the organisation and powers of public authority during wartime, commonly referred to as *martial* powers [Bondar, 2024]. Crucially, however, this does not entail a fundamental

6 Law on the Legal Regime of Martial Law 2015, Article 1.

transformation of Ukraine's constitutional order; rather, it results in a shift in the relative weight accorded to the principles of constitutionalism within that order.

Article 83(4) of the Constitution of Ukraine addresses the prohibition on holding elections under martial law, providing that "if the term of office of the Verkhovna Rada of Ukraine expires during a state of war or emergency, its powers shall continue until the first meeting of the first session of the Verkhovna Rada of Ukraine elected after the termination of the state of war or emergency." The Law on the Legal Regime of Martial Law further reinforces this, listing among the guarantees of legality under martial law a prohibition of "holding elections of the President of Ukraine, as well as elections to the Verkhovna Rada of Ukraine, the Verkhovna Rada of the Autonomous Republic of Crimea, and local self-government bodies."[7] The broader factual context must also be considered: a significant part of Ukraine's sovereign territory remains under occupation; large numbers of Ukrainian citizens are living under occupation; and the state is objectively unable to protect their rights and freedoms or ensure the effective exercise of their electoral rights.

The legal framework and factual realities together lead to the conclusion that holding parliamentary elections in Ukraine is currently impossible. It is worth noting that there is, as yet, no clear understanding of when and under what circumstances elections of any kind will become feasible – a question that is equally pressing with respect to the presidential elections that were due to be held on 31 March 2024.

Such actions on the part of the public authorities form part of the broader effort to preserve the rule of law and the inviolability of the constitutional order. This situation compels a reconceptualisation of the sources of democratic legitimacy: under conditions of martial law, legitimacy can no longer derive exclusively from the electoral cycle. Instead, as Ukraine's experience illustrates, it shifts to the preservation of popular sovereignty through the maintenance of the constitutional architecture of separated powers and the continuity of the legal nature of institutional mandates. It is precisely this dynamic that makes Ukraine a unique case study testing theories of democratic legitimacy under existential stress. The principle of popular sovereignty is one of the core principles of constitutionalism, under which "even in times of emergency, the people remain sovereign" [Henkin, 1991]. The essential point is that even in conditions of crisis, the regime of representative democracy continues to exist and function without interruption. What is critical for the preservation of the constitutional regime of representative democracy is the continued full functioning of the democratically constituted supreme state organs – parliament,

7 Law on the Legal Regime of Martial Law 2015, Article 19(1).

the government, and the head of state – and, crucially for constitutionalism as the limitation of power by law, the judiciary. Deviations within the subsystem of local bodies (both self-governing and executive) do not undermine the democratic constitutional character of state power, provided that those bodies remain subordinate to the democratically constituted supreme organs of authority and to the constitutional principles governing their operation.

The separation of powers is a foundational principle of constitutional democracy. The system of checks and balances, in turn, is an essential guarantee of the functioning of democratic institutions, the protection of minorities, and the maintenance of the rule of law [Venice Commission, 2025]. The separation of powers presupposes the existence of relatively autonomous and independent branches of government (legislative, executive, and judicial) and the establishment of such relations among them that preclude the usurpation of all or the greater part of state power by any single institution, and still less by any single individual [Koziubra, 2007]. An effective system of checks and balances does not undermine the efficiency of state institutions; on the contrary, efficiency and checks and balances are best understood as mutually reinforcing [Venice Commission, 2025]. Nor does the system of checks and balances conflict with the political obligation of loyal inter-institutional cooperation, as it merely ensures an appropriate distribution of responsibilities among the branches of government [Venice Commission, 2025].

Within Ukraine's constitutional architecture, the Verkhovna Rada (Parliament) occupies a central role as the representative body constituted through the free expression of the will of the Ukrainian people as sovereign. Ukraine is a mixed (parliamentary-presidential) republic in which legislative power is vested exclusively in Parliament [Constitution of Ukraine, Article 75], which also serves as the principal representative of the interests of the Ukrainian people. A defining feature of Ukrainian parliamentarism is that Parliament may not delegate any of its powers to another body, even in extraordinary circumstances. This remains the case even where the executive branch, in the form of the Cabinet of Ministers, might appear capable of regulating certain social relations more efficiently and rapidly. This constitutional non-delegability of legislative power represents a structural safeguard against the concentration of authority in the executive – a safeguard whose significance is heightened, rather than diminished, in wartime.

Here we encounter the first paradox of war. Whereas Sadurski identifies the Polish parliament as one of the principal agents in legitimising and legalising democratic backsliding [Sadurski, 2019], the preservation of the constitutional role and actual operational capacity of the Verkhovna Rada from the moment of Russia's inva-

sion to the present day stands as one of the primary indicators of the preservation of constitutional order in Ukraine. This *constitutional parliamentary resilience* has manifested itself in three concrete ways: (1) the Verkhovna Rada has continued its plenary activity without interruption; (2) it has continued to adopt legislation in compliance with procedural requirements and has exercised its constitutional powers of oversight under the martial law regime; and (3) it has preserved political pluralism, maintaining the distinction between the governing majority and the opposition.

This resilience, however, has not been without significant limitations, which an honest assessment should acknowledge. Parliamentary transparency has noticeably declined: live broadcasting of plenary sessions was suspended on security grounds, in-person public access has been substantially restricted, and the publication of voting results and draft laws was, for an extended period, delayed or curtailed under the same justification [Bondar, 2024]. The increased reliance on accelerated legislative procedures, the bundling of unrelated provisions into bills, and the rapid passage of legislation through both readings on the same day have been criticised by domestic civil society and international observers for eroding the quality of parliamentary deliberation [Venher et al., 2023, Whitmore, 2023]. The parliamentary opposition, while formally preserved, has at times found its capacity for meaningful oversight constrained by both wartime informational regimes and the practical concentration of decision-making within the executive branch. These limitations do not negate the achievement of institutional continuity, but they remind us that formal preservation and substantive vitality are not identical – a distinction that any case-study aspiring to serve as a *lesson* for other democracies needs to carefully draw.

Extraordinary situations – crises, terrorism, natural disasters, war – invariably produce imbalances in seemingly balanced systems, and constitutional systems of power are no exception. The system of checks and balances across the three branches of power is designed to protect against the usurpation of authority by any single branch and, consequently, against the deprivation of the people's sovereignty. This is one of the principles of the rule of law, understood as governance based on law rather than arbitrariness, and it is what allows us to speak of a genuinely liberal democratic regime. Yet extraordinary situations naturally give rise to the need to depart from the *ordinary* or *peacetime* mode of governance in order to respond to exceptional challenges and mitigate their consequences. Put simply, the imperative of addressing the extraordinary situation becomes the primary driver of governmental action, which in turn naturally shifts the established balance among the legislative, executive and judicial branches. The central analytical question, then, is not whether this shift occurs – it inevitably does – but whether it remains bounded

by constitutional principles or crosses into the unconstrained exercise of executive power that Dyzenhaus characterises as a *black hole* of legality.

Constitutional theory has long been preoccupied with limiting power, a concern that scholars describe as *negative* constitutionalism [Barber, 2018]. Yet emergencies have consistently exposed the tension between constraint and capacity. Carl Schmitt's foundational challenge posited that any response to an emergency must, by its very nature, be at least partially exempted from ordinary rule-of-law requirements [Dyzenhaus, 2006]. This logic culminates in the concept of the state of exception: the sovereign, in Schmitt's formulation, is precisely the one who decides when normal rules no longer apply.

Two influential contemporary responses pull in opposing directions. Dyzenhaus rejects the Schmittian premise, arguing that states of emergency can and must be governed by the rule of law. He distinguishes between *black holes* – spaces of entirely unregulated executive discretion – and *grey holes*, where a façade of legality masks the absence of genuine accountability. His central claim is that even in extreme crisis, all state institutions – executive, legislative, and judicial – remain bound by a constitutional *rule-of-law project* that cannot be suspended without destroying the very order it is intended to protect [Dyzenhaus, 2006]. By contrast, Posner and Vermeule's *accommodation model* accepts the inevitability of executive dominance during crises. Legislatures, they argue, are institutionally incapable of acting quickly and with one voice, and during emergencies "the executive governs nearly alone, at least so far as law is concerned" [Posner, Vermeule, 2004; 2011]. From this perspective, checks and balances become a risk factor rather than a guarantee.

In Ukraine, under wartime conditions, a system exists in which the balance among the branches of power is maintained precisely through the absence of any substantive redistribution of constitutionally defined competences. This means that the executive is not vested with legislative authority in contravention of the Constitution, even in circumstances where such a transfer might ostensibly have enhanced the effectiveness of the state's response to wartime challenges and threats. Equally, the President does not *cross* the boundaries of his constitutional prerogatives, but continues to operate within the logic of the system of checks and balances. At the same time, a set of powers conferred upon him by the Law on Martial Law does expand the President's role under wartime conditions, which is entirely natural in view of his position as Commander-in-Chief of the Armed Forces.

This formal preservation of the constitutional balance must not, however, be conflated with an absence of practical asymmetries. The Office of the President has, in fact, accumulated considerable de facto influence over policy coordination, public com-

munication, and the legislative agenda. The Constitutional Court itself, weakened by an unresolved appointments crisis, has not yet recovered its full institutional capacity, leaving an important element of the checks-and-balances architecture in a state of partial *dormancy*. Acknowledging these tensions is not a concession to the black hole thesis, but rather recognition that even a constitutionally disciplined wartime regime may exhibit a degree of drift towards executive predominance – a drift that the post-war institutional reset will need to address explicitly if the Ukrainian experience is to serve as a transferable model for others.

4.2. Human rights and security

The question of balancing security and the protection of human rights is one of the central issues confronting the legal order of a state during an extraordinary situation. At the same time, the principle of respect for human rights presents a different dynamic from that of popular sovereignty. Rather than being suspended, it is temporarily and partially affected by the exigencies of an extraordinary situation through the possible restriction of individual rights and freedoms, with the extent of such restrictions being proportionate to the severity of the emergency. This occurs not through a departure from the principle of respect for human rights as such, but through a shift in priorities within the human rights system itself. Rights such as the right to life, the right to security, and analogous fundamental guarantees assume particular importance, while rights such as freedom of movement, freedom of expression, or the right to leisure may be temporarily subordinated to them.

International human rights law permits states to derogate from certain human rights obligations in conditions of emergency. Article 15 of the European Convention on Human Rights (ECHR) provides that "in time of war or other public emergency threatening the life of the nation, any High Contracting Party may take measures derogating from its obligations under this Convention to the extent strictly required by the exigencies of the situation, provided that such measures are not inconsistent with its other obligations under international law."

On 28 February 2022, Ukraine declared a derogation from the ECHR in accordance with Article 15, covering a number of provisions, including Article 8 (the right to private and family life), Article 9 (freedom of thought, conscience and religion), Article 10 (freedom of expression), Article 11 (freedom of assembly and association), Article 13 (the right to an effective remedy), Article 14 (prohibition of discrimination), Article 4(3) (prohibition of forced or compulsory labour), Article 16 (restrictions on the political activity of foreigners), Article 2 of Protocol No. 4 (freedom of

movement), and Article 1 of Protocol No. 1 (protection of property). However, in April 2024, Ukraine announced that the derogation would no longer apply to Articles 4(3) (related to forced or compulsory labour), 9 (freedom of thought, conscience or religion), 13 (the right to an effective remedy), 14 (prohibition of discrimination), and 16 (restrictions on the political activity of aliens) of the Convention (Note of Information, Council of Europe, 2024).

It should be stressed that the freedom of beliefs and freedom of religion have become among the most challenging issues for Ukraine's democratic governance, largely because the Russian Federation has sought to manipulate human rights and weaponise the Russian Orthodox Church as an institution by incorporating it into the concept of the *Ruskij Mir* (Russian World), and use it to justify Russia's war of aggression, undermine Ukraine's territorial integrity, support anti-Ukrainian activities, and disseminate disinformation [Lytvynchuk, Shevchuk, Hrytsyshena, 2025; Ombudsman of Ukraine, 2026].

A second case concerns the prohibition of pro-Russian political parties in Ukraine, which during the ongoing armed conflict raises substantial complexities under the European Convention on Human Rights, particularly regarding Article 11. Although Ukraine's derogation under Article 15 ECHR following the 2022 full-scale invasion broadens the State's margin of appreciation, the dissolution of pro-Russian parties grounded in self-defence raises new human rights concerns regarding the extent to which European freedom of association standards apply in times of war or public emergency [Bernatskyi, 2024].

From the perspective of domestic law, Article 64 of the Constitution of Ukraine provides that the constitutional rights and freedoms of individuals and citizens may not be restricted except in cases provided for by the Constitution of Ukraine. Under a state of martial law or emergency, certain restrictions on rights and freedoms may be established, provided that the duration of such restrictions is specified. The following rights and freedoms may not be restricted: those guaranteed by Articles 24 (equality), 25 (citizenship), 27 (the right to life), 28 (dignity), 29 (the right to liberty and personal inviolability), 40 (the right of petition), 47 (the right to housing), 51 (marriage), 52 (equality of children and the protection of childhood), 55 (the right to judicial protection), 56 (the right to compensation for damage), 57 (the right to know one's rights and duties), 58 (prohibition of retroactive application of laws), 59 (the right to professional legal assistance), 60 (no obligation to carry out manifestly criminal orders or instructions), 61 (*non bis in idem*), 62 (the presumption of innocence), and 63 (*nemo tenetur seipsum accusare*). This provision serves as the domestic constitutional anchor for measures applied under martial

law, operating in parallel with Ukraine's international framework governing derogations from human rights obligations.

The methodological framework for assessing the proportionality of restrictions on fundamental rights in wartime is the three-part test, which requires that any interference with a Convention right satisfy three cumulative conditions: (1) the interference must be prescribed by law (lawfulness); (2) it must pursue a legitimate aim enumerated in the relevant provision of the Convention; and (3) it must be "necessary in a democratic society" – that is, proportionate to a pressing social need [Council of Europe, 2025]. Proportionality lies at the heart of the necessity requirement: even a measure directed towards a legitimate aim is impermissible where the means employed are excessive, arbitrary, or unjustified.

Two examples illustrate the application of this framework to restrictions introduced in Ukraine during the war. With respect to the freedom of movement (Article 2 of Protocol No. 4), the prohibition on the departure of male citizens of conscription age (generally 22–60 years) satisfies the first two criteria: it is prescribed by law and pursues the legitimate aims of national security and territorial defence. The existence of humanitarian and medical exemptions further supports its proportionality. Nevertheless, questions remain regarding the duration of the measure and the appropriate scope of persons to whom it applies over such a prolonged period. With respect to freedom of expression (Article 10 ECHR), the wartime media framework – encompassing the consolidation of broadcasting, the blocking of websites, and the criminalisation of certain forms of expression deemed to constitute collaboration with the aggressor state – likewise satisfies the requirements of lawfulness and legitimate aim. However, the question of necessity is more contentious, given that a minimal degree of pluralism and freedom of expression must be preserved even under wartime conditions, and account must be taken of both the level of existing threats and the availability of alternative means of countering them.

The unified national telethon *Yedyni novyny*,[8] created in March 2022 by merging the principal nationwide broadcasters into a single 24-hour information programme, illustrates these dilemmas with particular clarity and represents arguably the most contested wartime measure in the field of expression. Initially welcomed as a tool for countering disinformation and ensuring uniform crisis communication, its continued operation more than three years into the war has attracted growing criticism from journalists, civil society organisations, and international media-freedom watchdogs. Critics point to the exclusion of independent and opposition-affiliated channels from

8 Translation to English: United News.

terrestrial broadcasting, the homogenisation of editorial perspectives, and a steady decline in audience trust [Dutsyk, Umland, 2025; Reporters Without Borders, 2024]. Comparable concerns have been raised regarding the continued prohibition on the departure of male citizens of conscription age and aspects of the 2024 mobilisation framework, where the proportionality calculus appears materially different in the fourth year of war than it did in its opening months. These cases illustrate a more general lesson: even measures that were initially proportionate to the exigencies of the situation may, in the absence of regular reassessment and built-in sunset mechanisms, drift toward what Dyzenhaus terms grey holes of legality. This finding does not undermine the broader Ukrainian achievement; on the contrary, it constitutes one of the most practically transferable lessons of the case. The resilience of a rights-respecting wartime regime depends less on the initial design of emergency measures than on the institutional discipline to revisit them.

5. Higher education and the research sector under wartime conditions: a case study of resilience

The challenges that the war poses to democracy and the rule of law are cross-sectoral and can be observed in specific policy domains, including higher education and research.

According to Freedom House,[9] Ukraine's academic freedom was respected in the government-controlled territories before Russia's full-scale invasion in 2022. However, some academics and educators who continued teaching under Russian administration (e.g. during the occupation of parts of Ukrainian territory) became the subject of criminal investigations on allegations of collaboration. Moreover, the language requirements in academia strictly prohibit using Russian, which has raised some concerns and challenges due to the traditional minority language rights. At the same time, the ongoing war has transformed the relationship between minority rights and national security, creating difficult legal and political dilemmas. Amendments proposed in 2023 aim to ease these tensions once martial law is lifted.

One of the most significant challenges Ukraine faces is balancing human and civil rights with national security requirements. Freedom of movement has been significantly restricted by martial law, in particular the right to travel abroad, which

[9] Freedom House, https://freedomhouse.org/country/ukraine/freedom-world/2025 (accessed: 30.01.2026).

constitutes a fundamental precondition for international academic mobility. The applicable rules, restrictions and procedures are regulated by the Government Rules for Crossing the State Border by Citizens of Ukraine (Res. 57, 27 January 1995[10]), and universities play an important role in assisting students and staff in complying with these rules and navigating the relevant procedures (see, for example, Kharkiv Politechnic University[11]). Since August 2025, students and young people up to 22 years old have been allowed to cross the border[12] (Government). Moreover, students, doctoral candidates and academic staff are exempt from mobilisation, although such exemptions do not preclude voluntary service in the Armed Forces of Ukraine.

One of the key dilemmas for Ukraine as a country is the relationship between the centralisation of powers and democratic governance during wartime. Within the higher education system, the Government and the Ministry of Education and Science have traditionally played a significant role. University autonomy has never been absolute, and higher education institutions have always relied on central decisions and subsequently adopted them at the institutional level [EUA (ATHENA), 2015]. However, an increasing role can be observed for the President's Fund of Ukraine for Education, Science and Sport,[13] which has initiated several significant projects, including projects promoted under the auspices of the First Lady, such as the Global Coalition of Ukrainian Studies[14] and the UK-Ukraine Twinning Initiative for university cooperation.[15] In this respect, the enhanced prominence of the presidential institution during wartime has generated tangible benefits for academia. The issue of elections presents a contrasting picture. Unlike national elections, elections of university rectors have not been postponed under martial law, and the Ministry of Education and Science regularly announces such elections, with universities normally conducting the required procedures in accordance with existing legislation. Moreover, in 2024 the Government successfully launched a pilot reform in the universities aimed at increasing institutional autonomy and testing a revised model for the election of rectors.[16]

---

10 https://zakon.rada.gov.ua/laws/show/57-95-%D0%BF?lang=en#Text (accessed: 30.01.2026).

11 Procedures of travel abroad of Kharkiv Politechnic, https://www.kpi.kharkov.ua/ukr/mizhnarodni-zvyazki/erasmus/poryadok-vyyizdu-za-kordon-studentiv-vykladachiv-ta-administratyvnogo-personalu/ (accessed: 30.01.2026).

12 https://www.kmu.gov.ua/en/news/choloviky-vid-18-do-22-rokiv-zmozhut-bezpereshkodno-peretynaty-kordon-pid-chas-voiennoho-stanu-iuliia-svyrydenko (accessed: 30.01.2026).

13 https://presidentfund.gov.ua/en/ (accessed: 30.01.2026).

14 https://presidentfund.gov.ua/en/initiatives/globalna-koalitsiya/ (accessed: 30.01.2026).

15 https://www.twinningukraine.com/

16 https://zakon.rada.gov.ua/laws/show/1029-2024-%D0%BF#Text (accessed: 30.01.2026).

Table 2. Multi-level resilience mechanisms in higher education during wartime

Level	Mechanism type	Description of resilience mechanism	Evidence & examples
System level	Legal & regulatory frameworks	Elaboration of the emergency legislation enabling flexible higher education functioning: Parliament, Government, Ministry of Education and Science of Ukraine (MESU); displacement of institutions, simplified admissions and recognition, school-leaver exams and enrolment, IDP and military families, veteran rights, etc.	Law of Ukraine *On the Legal Regime of Martial Law*; first months – MESU issued more than 10 emergency regulations; legal frameworks on displaced universities and students without documents [Tsymbaliuk, Degtyarova, 2024]
	Maintaining democratic mechanisms in higher education	Ensuring equal rights in admission to universities, exceptions for students, PhD candidates, and staff to participate in mobility; democratic elections of the university authorities during wartime	Supporting university autonomy through strengthening academic management capacity (World Bank, British Council), elections in the universities run by the Ministry [Trofymenko, 2025] and conducting a rector's election pilot [Cabinet of Ministers, 2024]
	European and national strategies for refugee inclusion	Development of coordinated national policies for exiled students & researchers in the EU, in consultation with Ukraine; multi-actor coordination networks with national rectors' conferences, EUA, data exchange, joint decisions	Poland's Special Act and multi-level response as an example [Degtyarova, Kraśniewska, 2025]; CRASP collective leadership [Lis, 2024]
	Transnational alliances & academic diplomacy	International networks, European university alliances supporting continuity of teaching and research and integration into ERA/EHEA	Alliance experiences and good practices [Menu, 2025], CIVICA for Ukraine, academic diplomacy as democratic resilience [CIVICA, 2024]; Rome Declaration and International Coalition, shared resilience [Błaszczyk et al., 2025]
	Financial instruments & recovery funding	Dedicated funding for research, reconstruction, digitalisation, scholarships; access to EU programmes (Erasmus+, Horizon)	Government priority funding for reconstruction-oriented research; ERA4Ukraine; dedicated support from the EC
	System modernisation & reforms	Modernisation accelerated by EU integration processes, policy alignment and updated Strategy	Strategy for Higher Education 2022–2032 [Eurydice, 2022]; reforms in research assessment, digitalisation; implementation of Ukraine's roadmap to EU integration [European Commission, 2025]

Level	Mechanism type	Description of resilience mechanism	Evidence & examples
Institutional level	Crisis governance structures	Crisis teams, accelerated decision-making, coordinated roles across departments	Ukrainian HEIs following the three-phase crisis cycle: reaction – adaptation – recovery/strategy [Tsymbaliuk, Degtyarova, 2024]
	Institutional relocation	Relocation of entire universities (students, staff, archives, servers, governance structures); reconstruction of identity, mission and strategy	18 HEIs relocated in 2014, 29 in 2022; emergence of *phoenix universities* (e.g. Vasyl Stus DonNU, Mariupol University in Kyiv) [Finikov, Lyman, Kovachov, Suchikova, 2025]
	Organisational flexibility	Shifting between online, hybrid and in-person formats based on safety; rapid redesign of academic calendars; decentralised operational autonomy	First half of 2022: 54% Ukrainian HEIs fully online; 35% hybrid; 10% in-person depending on missile threat levels and shelter capacity [Tsymbaliuk, Degtyarova, 2024]
	Infrastructure resilience	Evolution of shelters from a security space to multifunctional teaching spaces; acquisition of generators, Starlink systems; relocation of servers; establishing *Points of Invincibility*	Shelters transformed into classrooms; autonomous electricity sources; digital archiving and cloud backups; Starlink used to ensure continuity of teaching [Tsymbaliuk, Degtyarova, 2024]
	Social resilience	Universities acting as civic hubs, providing assistance to local communities, IDPs, veterans, NGOs; expanding their social role, rebuilding human capital	Ukrainian HEIs supporting municipalities (psychological help, reconstruction planning), new leadership [Protsyk, 2025]
Individual level	Psychological resilience	Coping with trauma, continuous air raid alarms, chronic stress, PTSD; accessing psychological support, counselling and peer-based emotional support	Trauma and mental health challenges among Ukrainian students and staff under missile attacks and displacement [Błaszczyk et al., 2025]
	Multi-role adaptation	Ability to simultaneously study, work, volunteer, care for one's family, or serve in the territorial defence while maintaining academic performance	Ukrainian students and staff combining emergency volunteering and academic duties; male students restricted from travel due to martial law [Degtyarova, 2024]
	Professional resilience and adaptability	Rapid transition to online/hybrid learning despite blackouts, weak internet and infrastructural disruption; acquiring digital teaching/learning competences	79% of HEIs reporting lack of internet during early war months but still resuming online teaching; continuation of courses from shelters or evacuation sites [Tsymbaliuk, Degtyarova, 2024]

Source: Authors' own elaboration, based on the definition of resilience and a review of the literature.

Moreover, wartime challenges have not halted systemic reforms and institutional transformation in higher education, which constitutes a manifestation of its resilience and makes the Ukrainian case particularly interesting. A resilient higher education system should be capable of continuing its core missions – teaching and learning, research, and community engagement – under conditions of crisis or war, in order to cope with new challenges, adapt to a new reality, and recover. Achieving this requires flexible governance structures, rapid decision-making, and institutional frameworks capable of responding effectively to emergencies. To better understand these dynamics, we analyse the resilience mechanisms in Ukrainian higher education from the perspectives of the system, the institution and the individual (Table 2).

In summary, the resilience of Ukrainian higher education demonstrates that resilience is not merely a mechanism for surviving crises, but also a means of enabling development, including the implementation of strategic reforms under extreme conditions. Combining crisis management with change management reveals the high adaptive capacity of the Ukrainian higher education system. It enables universities not only to respond to crises but also to transform them into opportunities for academic and social innovation. Recent reports related to EU integration prove that Ukraine, despite the ongoing war, has successfully implemented a range of required changes in the higher education and research sector [European Commission, 2025; Office of the Deputy Prime Minister for European and Euro-Atlantic Integration, 2026], including reforms in research assessment, academic management development, and Open Science.

Resilience in higher education in Ukraine has been achieved through several interconnected dimensions: system and institutional crisis governance, leadership and adaptability; mechanisms for short-term emergency decision-making and ensuring continuity of academic missions; infrastructure and digital preparedness; and supporting human capital (individual) resilience. Moreover, resilient universities expand their mission beyond education by responding to societal needs, contributing to broader community resilience and enhancing their social mission.

6. The Phenomenon of Ukrainian resilience during the full-scale Russian invasion

The phenomenon of Ukrainian resilience during the full-scale Russian invasion is a highly complex and multi-dimensional construct encompassing military, political, economic, and human dimensions [Chyluk et al., 2025]. This understand-

ing corresponds with Ukraine's Internal Resilience Plan presented to the Ukrainian Parliament in November 2024, with its ten points: "Unity," "Front," "Armament," "Money," "Energy," "Security," "Communities," "Human Capital," "Cultural Sovereignty," and "Heroes Policy" [Office of the President of Ukraine, 2024].

Prior to the invasion, in late 2021, Ukrainian state institutions suffered from low levels of public trust; however, the outbreak of the full-scale war triggered an unprecedented process of social self-organisation and national consolidation [Bendyk, 2026]. A critical turning point in this process was President Volodymyr Zelenskyi's decision to remain in Kyiv despite the existential threat, which served to forge absolute trust between the political leadership, grassroots volunteer movements, and the military [Bendyk, 2026]. Public trust in President Zelenskyi remains comparatively high [KIIS, 2026c], which eliminates concerns regarding the legitimacy or democracy vs centralisation of powers dilemma. At the same time, public trust in the Parliament and the Government remains low, while military and law enforcement agencies continue to enjoy the respect and trust of the Ukrainian people [KIIS, 2026d].

At its core, Ukrainian resilience is deeply rooted in what Bendyk [2025] describes as a *democratic resilience system* driven by an active, subjective civil society, which is reflected in high levels of public trust in volunteer organisations, exceeding those placed in the church and the media. Rather than succumbing to authoritarianism under martial law, Ukrainian society has actively defended its democratic institutions – such as anti-corruption bodies – acting as a mechanism of public accountability and a crucial partner to the state [Bendyk, 2026]. It is also worth noting the active role played by Ukrainian advocacy NGOs (with various focuses, including economic, humanitarian and educational) at the European Union level. As of 2022, there were already several dozen such organisations listed in the European Transparency Register.[17] Furthermore, the country's economic and infrastructural resilience has proven extraordinary. Despite systemic attacks on the energy grid, the Ukrainian economy has functioned as an adaptable, complex system capable of balancing crisis impulses, aided by the rapid, life-saving responses of essential workers [Bendyk, 2026]. As public opinion shows, the majority of Ukrainians clearly see the real intentions of the Russian Federation and understand that "by attacking the energy sector, Russia is trying to leave Ukrainians without electricity and heat, forcing them to surrender" [KIIS, 2026a], and so they do not expect the war to end soon, expressing a willingness "to endure war for as long as necessary" [KIIS, 2026b]. Since Ukrainian citizens do not have faith in the peacekeeping efforts and are somewhat sceptical about the

[17] https://transparency-register.europa.eu (accessed: 30.01.2026).

current negotiations [KIIS, 2026b], resilience is treated as a necessary condition for wartime survival.

Ultimately, this resilience is underpinned by a consolidated civic identity, a remarkable capacity for entrepreneurship and flexibility, and an unwavering determination to survive an existential threat aimed at the eradication of Ukrainian statehood and identity [Chyluk et al., 2025; Bendyk, 2026].

7. Lessons for Europe from Ukraine's experience with resilience

Ukraine's ongoing experience of societal and state resilience offers important lessons for the European Union and the broader European security architecture. Above all, Ukraine demonstrates that it is not merely a passive beneficiary of Western aid, but also an active contributor to regional security by effectively constraining and neutralising the Russian military threat at a fraction of the cost that would be entailed for its allies [Bendyk, 2026]. A critical lesson for European defence is the necessity of modernising military paradigms to reflect contemporary warfare [Bendyk, 2026].

Ukraine's experience under martial law offers lessons of direct relevance to broader debates on the resilience of constitutional democracies under existential pressure. The Ukrainian case demonstrates that democratic legitimacy in extraordinary circumstances, such as wartime, does not dissolve in the absence of elections, provided that the Constitution and the constitutional legal order remain operative, the constitutional architecture of separation of powers is preserved in its essential structure, parliament continues to function as a representative and legislative body, and the democratic character of the state is maintained despite the temporary suspension of elections. This conclusion, however, must be qualified by the limitations identified above. Formal institutional continuity has been accompanied by a measurable decline in parliamentary transparency, and a de facto strengthening of executive coordination. This constitutes a significant qualification of traditional democratic theory, which typically regards elections as the primary indicator of legitimacy. Parliamentary resilience, understood as the uninterrupted discharge of legislative and oversight functions under conditions of existential armed conflict, emerges from Ukraine's experience as an additional measurable indicator of constitutional order, one that operates alongside – rather than in place of – the electoral requirement temporarily suspended under mar-

tial law. The applicability of these findings to other contexts, including European Union policy, remains an open question that warrants further comparative research rather than direct prescription. The capacity to sustain constitutional continuity under conditions of extraordinary pressure may merit consideration as a complementary dimension of democratic quality.

The case of Ukrainian higher education demonstrates that resilience is not only about surviving crises, but also about transforming them into opportunities for reform, rethinking the strategy, advancing digitalisation and internationalisation, and strengthening their role in the social ecosystem. Ukraine's rapid technological innovation – exemplified by the deployment of naval and aerial drones to achieve strategic objectives such as restoring freedom of navigation in the Black Sea – illustrates how asymmetrical disadvantages can be mitigated through continuous adaptation and the scaling of new technologies [Bendyk, 2026; Chyluk et al., 2025].

Furthermore, Europe can learn the immense value of horizontal, decentralised networks in crisis management. In Ukraine, civil society organisations and volunteer foundations bypassed rigid, hierarchical state structures to deliver agile, tailored, and rapid support directly to military units [Bendyk, 2026]. This experience underscores that genuine societal resilience relies heavily on entrepreneurship, flexibility, and strong horizontal ties networks capable of responding to shocks faster than traditional top-down governance mechanisms [Chyluk et al., 2025].

Finally, Ukraine illustrates that resilience is inextricably linked to the defence of human-centric democratic values. Preserving civil liberties, maintaining a strong civil society, and actively combating corruption are essential for sustaining societal morale and unity during prolonged crises [Bendyk, 2026; Truszczyński, 2025].

References

American Psychological Association (2017). *The Road to Resilience*, https://www.apa.org/help-center/road-resilience (accessed: 10.05.2026).

Barber, N.W. (2018). *The Principles of Constitutionalism*. Oxford: Oxford University Press.

Bendyk, E. (2025). *Cena pokoju, koszt przegranej. W odpowiedzi na manifest Przeżyć, wytrwać, zwyciężyć*! Warszawa: Fundacja im. Stefana Batorego, https://www.batory.org.pl/wp-content/uploads/2025/12/Przezyc-wytrwac.pdf (accessed: 10.05.2026).

Bendyk, E. (2026). *Wielka wojna*. Warszawa: Fundacja im. Stefana Batorego.

Bernatskyi, B. (2024). Why and When Democracies Ban Political Parties: A Classification of Democratic State Orientations to Party Bans, *Comparative European Politics*, 22(6), pp. 754–791. DOI: 10.1057/s41295-024-00381-9.

Błaszczyk, M., Kovalisko, N., Pieńkowski, P., Pachkovskyy, Y., Ryniejska-Kiełdanowicz, M. (2025). Coping with Adversity: Mechanisms of Resilience in Ukrainian Universities During the Russian–Ukrainian War – a Perspective from Lviv University Students, *Higher Education*, 91, pp. 1991–2010. DOI: 10.1007/s10734-025-01506-z.

Bondar, M. (2024). Konstytucja Ukrainy i rząd „jedności narodowej" – dyskurs prawny. In: *Ustrojowe konsekwencje przystąpienia Ukrainy do Unii Europejskiej i NATO* (pp. 121–141), K. Eckhardt, P. Stetsyuk (Eds.). Rzeszów: Bonus Liber, WSPiA Rzeszowska Szkoła Wyższa, Monografie nr 45, https://ekmair.ukma.edu.ua/server/api/core/bitstreams/24ba802f-12ce-4012-9a67-bee8a66e4187/content (accessed: 10.05.2026).

Bondar, M. (2026). Constitutionalism and War: from Martial Law to "peace" through a Transitional Period, *NaUKMA Research Papers. Law*, 17, https://nrplaw.ukma.edu.ua/article/view/356282 (accessed: 10.05.2026).

Cabinet of Ministers of Ukraine (2024). Resolution no. 1029 of 6 September 2024 on the Implementation of a Pilot Project to Promote the Autonomy of Certain Institutions of Higher Education / in Ukrainian language: Постанова Кабінету Міністрів України від 6 вересня 2024 р. № 1029 «Про реалізацію експериментального проекту щодо розвитку автономії деяких закладів вищої освіти» (зі змінами), https://zakon.rada.gov.ua/laws/show/1029-2024-%D0%BF#Text (accessed: 10.05.2026).

Chernyshenko, O.S., Kankaraš, M., Drasgow, F. (2018). Social and Emotional Skills for Student Success and Well-being: Conceptual Framework for the OECD Study on Social and Emotional Skills, *OECD Education Working Papers*, 173 (EDU/WKP (2018) 9). Paris: OECD Publishing, https://one.oecd.org/document/EDU/WKP (2018)9/En/pdf (accessed: 10.05.2026).

Chyluk, S., Dlihacz, A., Hrycak, J., Jurczyszyn, J., Kazarin, P., Koluszko, I., Krywda, N., Matwijczuk, O., Ostrowska-Luta, O., Pekar, W., Sotnyk, O., Starodubcew, O., Suszko, O., Wojcicka, W., Wynnycki, M., Zahorodniuk, A., Zerkal, Ł. (2025). Przetrwać, wytrwać, zwyciężyć! Manifest. In: *Cena pokoju, koszt przegranej. W odpowiedzi na manifest Przeżyć, wytrwać, zwyciężyć!* (pp. 4–9), E. Bendyk (Ed.). Warszawa: Fundacja im. Stefana Batorego.

CIVICA for Ukraine, https://www.civica.eu/society/civica-for-ukraine (accessed 10.05.2026).

Constitution of Ukraine (1996). Adopted 28 June 1996 (as amended) by Verkhovna Rada of Ukraine.

Contiades, X., Fotiadou, A. (2015). Resilience and the Constitution, *The Theory and Practice of Legislation*, 3(2), pp. 107–124.

Council of Europe (1950). *European Convention on Human Rights* (as amended by Protocols Nos. 11, 14 and 15), ETS No. 005, Rome, 4 November 1950. Strasbourg: Council of Europe, https://www.echr.coe.int/documents/d/echr/convention_ENG (accessed: 10.05.2026).

Council of Europe, European Court of Human Rights (2025). *Guide on Article 15 of the Convention – Derogation in Time of Emergency, Updated 31 August 2025*. Strasbourg: Council of Europe, https://ks.echr.coe.int/documents/d/echr-ks/guide_art_15_eng (accessed: 10.05.2026).

Croissant, A., Lott, L. (2024). Democratic Resilience in the Twenty-First Century. Search for an Analytical Framework and Explorative Analysis, *Working Paper Series*, 2024(149). The Varieties of Democracy Institute, https://v-dem.net/media/publications/WP_149.pdf (accessed: 10.05.2026).

Degtyarova, I. (2024). Sytuacja doktorantów uczelni ukraińskich podczas agresji Federacji Rosyjskiej na Ukrainę a wsparcie uczelni polskich. In: *Polsko-ukraińska współpraca instytucji przed-*

stawicielskich reprezentujących rektorów, na rzecz doskonalenia działania uczelni. Raport z II Cyklu realizacji Projektu 2022–2024 (pp. 64–81), J. Woźnicki, I. Degtyarova (Eds.). Warszawa: Wydawnictwo Akademickie SEDNO, https://www.ans.pw.edu.pl/content/download/3109/17624/file/RAPORT_IIcykl_realizacji_projektu_PL.pdf (accessed: 10.05.2026).

Degtyarova, I. (2025). *Emergency Management in Higher Education Institutions: Guidelines for Handling Refugee Crises*. AGILE consortium, https://agileproject-erasmus.eu (accessed: 10.05.2026).

Degtyarova, I., Krasniewska, N. (2025). *Polish Academia Emergency Response: Managing Large-Scale Inflow of Ukrainian Refugees in Higher Education Institutions in Poland (2022–2024)*. AGILE consortium, https://agileproject-erasmus.eu/Polish-Academia-Emergency-Response (accessed: 10.05.2026).

de Vries, T. (2014). Resilience in Contract Law. A Proactive/Preventive Law Approach, *Resilienz*. DOI: 10.58079/to58 (accessed: 28.03.2026).

Duchek, S., Raetze, S., Scheuch, I. (2020). The Role of Diversity in Organizational Resilience: A Theoretical Framework, *Business Research*, 13, pp. 387–423. DOI: 10.1007/s40685-019-0084-8.

Dyzenhaus, D. (2006). *The Constitution of Law: Legality in a Time of Emergency*. Cambridge: Cambridge University Press.

ERA4Ukraine (n.d.), https://euraxess.ec.europa.eu/ukraine (accessed: 10.05.2026).

EUA (2015). University Autonomy in Ukraine: Analysis & Roadmap, *ATHENA Erasmus+ Project*, https://www.eua.eu/images/site1/ATHENA/athena-analysis-and-roadmap-for-ukraine.pdf (accessed: 10.05.2026).

European Commission (2025). *Commission Staff Working Document: Ukraine 2025 Report, Accompanying the Document Communication from the Commission to the European Parliament, Council, the European Economic and Social Committee and Committee of the Regions 2025 Communication on EU enlargement policy*, https://enlargement.ec.europa.eu/ukraine-report-2025_en (accessed: 10.05.2026).

European Transparency Register (n.d.), https://transparency-register.europa.eu/search-register-or-update/search-register_en?queryText=Ukraine (accessed: 10.05.2026).

Eurydice (n.d.). Ukraine: National Reforms in Higher Education, https://eurydice.eacea.ec.europa.eu/eurypedia/ukraine/national-reforms-higher-education (accessed: 10.05.2026).

Finikov, T., Lyman, I., Kovachov, S., Suchikova, Y. (2025). Relocated Universities of Ukraine: Spatial-Temporal Mapping, Trajectories, and Lessons from Two Waves of Displacement (2014–2025), *Knowledge and Performance Management*, 9(2), pp. 142–162. DOI: 10.21511/kpm.09(2).2025.11.

Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L., Holling, C.S. (2004). Regime Shifts, Resilience, and Biodiversity in Ecosystem Management, *Annual Review of Ecology, Evolution, and Systematics*, 35(1), pp. 557–581. DOI: 10.1146/annurev.ecolsys.35.021103.105711.

Freedom House (2025). *Freedom in the World 2025: Ukraine*, https://freedomhouse.org/country/ukrain/freedom-world/2025 (accessed: 10.05.2026).

Fund of the President of Ukraine for Education, Science and Sports (n.d.), https://presidentfund.gov.ua/en/ (accessed: 10.05.2026).

Global Coalition for Ukrainian Studies, The (n.d.), https://presidentfund.gov.ua/en/initiatives/globalna-koalitsiya/ (accessed: 10.05.2026).

Grabenwarter, Ch. (2018). Constitutional Resilience, *VerfBlog*. DOI: 10.17176/20190212-110238-0.

Gromek, P. (2025). *Nowe zarządzanie kryzysowe w Polsce*. Warszawa: Difin.

Henkin, L. (1991). New Birth of Constitutionalism: Genetic Influence and Genetic Defects, *Cardozo Law Review*, 14(3), pp. 533–547.

Horizon Europe Office in Ukraine (n.d.). *Specific Support for Ukrainian Research and Innovation*, https://horizon-europe.org.ua/en/about-he/support-for-ukraine/ (accessed: 10.05.2026).

International Coalition for Science, Research, and Innovation in Ukraine (2025). Rome Declaration of Intent for Science, Research and Innovation in Ukraine, https://www.mur.gov.it/sites/default/files/2025-07/RI%20Coalition%20for%20Ukraine%20-%20Declaration%2010072025_online%20version.pdf (accessed: 10.05.2026).

Jakab, A. (2023). *Constitutional Resilience*, SSRN, https://ssrn.com/abstract=4656217 (accessed: 10.05.2026).

Keudel, O., Huss, O. (2023). Polycentric Governance in Practice: The Case of Ukraine's Decentralised Crisis Response during the Russo-Ukrainian War, *Journal of Public Finance and Public Choice*, 39(1), pp. 10–35. DOI: 10.1332/25156918Y2023D000000002.

KIIS (2026a). *Public Opinion in the Context of Russia's Attempts to Plunge Ukraine into Darkness and Cold: Results of a Survey Conducted on January 23–29, 2026*, https://kiis.com.ua/?lang=eng&cat=reports&id=1583&page=4 (accessed: 10.05.2026).

KIIS (2026b). *Trust in Public Institutions*, https://www.kiis.com.ua/?lang=eng&cat=reports&id=1578&page=1 (accessed: 10.05.2026).

KIIS (2026c). *Perception of Negotiations, Attitude to the Offer to Exchange Donetsk Oblast for Security Guarantees, and How Much Longer Are Ready to Endure War: Results of a Survey Conducted on March 1–8, 2026*, https://kiis.com.ua/?lang=eng&cat=reports&id=1597&page=2 (accessed: 10.05.2026).

KIIS (2026d). *Trust in President V. Zelenskyy and Attitude Towards Holding Elections: Results of a Survey Conducted on March 1–8, 2026*, https://kiis.com.ua/?lang=eng&cat=reports&id=1595&page=2 (accessed: 10.05.2026).

Koziubra, M. (2007). Pryntsypy verkhovenstva prava i pravovoi derzhavy: yednist osnovnykh vymoh, Naukovi zapysky NaUKMA, *Yurydychni nauky*, 64, pp. 3–9, https://ekmair.ukma.edu.ua/server/api/core/bitstreams/ee0fef65-20f7-4d0e-8830-e19403bf067d/content / Козюбра, М. (2007). Принципи верховенства права і правової держави: єдність основних вимог, Наукові записки НаУКМА. Юридичні науки, 64, с. 3–9, https://ekmair.ukma.edu.ua/server/api/core/bitstreams/ee0fef65-20f7-4d0e-8830-e19403bf067d/content (accessed: 10.05.2026).

Koziubra, M., Barabash, Y., Boryslavska, O., Venher, V., Lysenko, O., Meleshevych, A. (2021). *Konstytutsiine pravo*. Kyiv: VAITE Козюбра, М., Барабаш, Ю., Бориславська, О., Венгер, В., Лисенко, О., Мелешевич, А. (2021). Конституційне право. Київ: ВАІТЕ.

Kyivskyi natsionalnyi universytet im. Tarasa Shevchenka (n.d.). *Napravlennia ta vidriadzhennia za kordon*, https://international.knu.ua/mozhlyvosti/napravlennia-ta-vidriadzhennia-za-kordon / Київський національний університет ім. Тараса Шевченка (b.d.). Направлення та відрядження за кордон, https://international.knu.ua/mozhlyvosti/napravlennia-ta-vidriadzhennia-za-kordon/ (accessed: 10.05.2026).

Lis, J. (2024). *Koordynacja działań uczelni w zakresie współpracy z Ukrainą*, https://www.krasp.org.pl/files/public/prezentacje%20ZP/ZP/prezentacje_SGHNowyFolder/KRASP_27_06_24_JLis.pdf (accessed: 10.05.2026).

Lytvynchuk, O., Shevchuk, A., Hrytsyshena, Z. (2025). Hybrid War: The Influence of the Russian Orthodox Church on the Ukrainian Media, *Occasional Papers on Religion in Eastern Europe*, 45(6), https://digitalcommons.georgefox.edu/cgi/viewcontent.cgi?article=2665&context=ree (accessed: 10.05.2026).

Masten, A.S. (2001). Ordinary Magic: Resilience Processes in Development, *American Psychologist*, 56(3), pp. 227–238.

Menu, S. (2025). *Towards European and Ukrainian Sustainable Universities Partnerships: Best Practices of European Universities Alliances in Solidarity with Ukraine. 2025 edition*, Zenodo. DOI: 10.5281/zenodo.17094003.

Ministerstvo osvity i nauky Ukrainy (2025). *Nova systema priorytetiv u nautsi ta innovatsiiakh: fokus na oboroni, ekonomitsi ta povoiennomu rozvytku*, https://www.kmu.gov.ua/news/nova-systema-priorytetiv-u-nautsi-ta-innovatsiiakh-fokus-na-oboroni-ekonomitsi-ta-povoiennomu-rozvytku / Міністерство освіти і науки України (2025). Нова система пріоритетів у науці та інноваціях: фокус на обороні, економіці та повоєнному розвитку, https://www.kmu.gov.ua/news/nova-systema-priorytetiv-u-nautsi-ta-innovatsiiakh-fokus-na-oboroni-ekonomitsi-ta-povoiennomu-rozvytku (accessed: 10.05.2026).

Natsionalnyi tekhnichnyi universytet «Kharkivskyi politekhnichnyi instytut» (n.d.). *Poriadok vyizdu za kordon studentiv, vykladachiv ta administratyvnoho personalu*, https://www.kpi.kharkov.ua/ukr/mizhnarodni-zv-yazki/erasmus/poryadok-vyyizdu-za-kordon-studentiv-vykladachiv-ta-administratyvnogo-personalu/ / Національний технічний університет «Харківський політехнічний інститут» (b.d.). Порядок виїзду за кордон студентів, викладачів та адміністративного персоналу, https://www.kpi.kharkov.ua/ukr/mizhnarodni-zv-yazki/erasmus/poryadok-vyyizdu-za-kordon-studentiv-vykladachiv-ta-administratyvnogo-personalu/ (accessed: 10.05.2026).

Office of the Deputy Prime Minister for European and Euro-Atlantic Integration (2026). *Report on Implementation of the Association Agreement Between Ukraine and the European Union for 2025*, https://eu-ua.kmu.gov.ua/wp-content/uploads/AA-implementation-report-for-2025.pdf (accessed: 11.05.2026).

Office of the President of Ukraine (2024). *Volodymyr Zelenskyy Presented Ukraine's Internal Resilience Plan*, https://www.president.gov.ua/en/news/volodimir-zelenskij-predstaviv-plan-vnutrishnoyi-stijkosti-u-94505 (accessed: 10.05.2026).

Ombudsman of Ukraine (2026). *Rosijska Federacija vykorystovuje religiju dlja vypravdannja vijny proty Ukrajiny, 30.01.2026*, https://ombudsman.gov.ua/news_details/rosijska-federaciya-vikoristovuye-religiyu-dlya-vipravdannya-vijni-proti-ukrayini (accessed: 10.05.2026).

Orzhel, O., Trofymenko, M., Porkuian, O., Drach, I., Halhash, R., Stoyka, A. (2023). Displaced Universities in Ukraine: Challenges and Optimal Development Models, *European Journal of Education. Special Issue: Wartime and Postwar Education in Ukraine*, 58(4), pp. 629–646. DOI: 10.1111/ejed.12581.

Posner, E.A., Vermeule, A. (2004). Accommodating Emergencies. In: *The Constitution in Wartime* (pp. 55–85), M. Tushnet (Ed.). Durham: Duke University Press.

Posner, E.A., Vermeule, A. (2011). *The Executive Unbound: After the Madisonian Republic*. New York: Oxford University Press.

Postanova Kabinetu Ministriv Ukrainy vid 27 sichnia 1995 r. № 57 «Pro zatverdzhennia Pravyl peretynannia derzhavnoho kordonu hromadianamy Ukrainy» (zi zminamy), https://zakon.rada.gov.ua/laws/show/57-95-%D0%BF#n11 / Постанова Кабінету Міністрів України від 27 січня 1995 р. № 57 «Про затвердження Правил перетинання державного кордону громадянами України» (зі змінами), https://zakon.rada.gov.ua/laws/show/57-95-%D0%BF#n11 (accessed: 10.05.2026).

Postanova Kabinetu Ministriv Ukrainy vid 2 kvitnia 2024 r. № 366 «Pro vnesennia zminy do Pravyl peretynannia derzhavnoho kordonu hromadianamy Ukrainy», https://zakon.rada.gov.ua/laws/show/366-2024-%D0%BF#Text / Постанова Кабінету Міністрів України від 2 квітня 2024 р. № 366 «Про внесення зміни до Правил перетинання державного кордону громадянами України», https://zakon.rada.gov.ua/laws/show/366-2024-%D0%BF#Text (accessed: 10.05.2026).

Presidential Policy Directive (n.d.). *PPD-8: National Preparedness*, https://www.dhs.gov/presidential-policy-directive-8-national-preparedness (accessed: 10.05.2026).

Price, R.A. (2023). A Review of Resilience in Higher Education: Toward the Emerging Concept of Designer Resilience, *Studies in Higher Education*, 48(1), pp. 83–99. DOI: 10.1080/03075079.2022.2112027.

Protsyk, H. (2025). Higher Education Amid the War: A Resilience Test for Ukraine's Integration into the European Higher Education Area. In: *Ukraine's Thorny Path to the EU* (pp. 279–310), M. Rabinovych, A. Pintsch (Eds.), Palgrave Studies in European Union Politics. Cham: Palgrave Macmillan. DOI: 10.1007/978-3-031-69154-6_12.

Rabinovych, M., Brik, T., Darkovich, A., Savisko, M., Hatsko, V., Tytiuk, S., Piddubnyi, I. (2024). Explaining Ukraine's Resilience to Russia's Invasion: The Role of Local Governance, *Governance*, 37(4), pp. 1121–1140. DOI: 10.1111/gove.12827.

Reporters Without Borders, The Fix (2024). *From Resilience to Recovery: Securing the Future of Ukrainian Media,* https://rsf.org/sites/default/files/medias/file/2024/10/Rapport%20Ukraine%20October%202024.pdf (accessed: 10.05.2026).

Romanyshyn, I. (2023). Ukraine's Total Democratic Resilience in the Shadow of Russia's War, *Carnegie Europe / European Democracy Hub*, https://carnegieendowment.org/europe/research/2023/04/ukraines-total-democratic-resilience-in-the-shadow-of-russias-war (accessed: 10.05.2026).

Ruhl, J.B., Cosens, B., Soininen, N. (2021). Resilience of Legal Systems. In: *Multisystemic Resilience: Adaptation and Transformation in Contexts of Change* (pp. 509–529), M. Ungar (Ed.). Oxford: Oxford University Press. DOI: 10.1093/oso/9780190095888.003.0027.

Rutter, M. (1979). Protective Factors in Children's Responses to Stress and Disadvantage. In: *Primary Prevention in Psychopathology: Vol. 8. Social Competence in Children* (pp. 49–74), M.W. Kent, J.E. Rolf (Eds.). Hanover: University Press of New England.

Sadurski, W. (2019). *Poland's Constitutional Breakdown*. Oxford: Oxford University Press.

Schonert-Reichl, K.A., LeRose, M.R. (2008). *Considering Resilience in Children and Youth: Fostering Positive Adaptation and Competence in Schools, Families, and Communities. The National Dialogue on Resilience in Youth*.

Stollenwerk, E., Börzel, T.A., Risse, T. (2021). Theorizing Resilience-Building in the EU's Neighbourhood: Introduction to the Special Issue, *Democratization*, 28(7), pp. 1219–1238. DOI: 10.1080/13510347.2021.1957839.

Trofymenko, M. (2025). Interview to the Information Agency "Interfaks – Ukraine", 22.12.2025, in Ukrainian language / Трофименко, М. (2025). Інтерв'ю інформаційному агентству «Інтерфакс-Україна», 22.12.2025, https://interfax.com.ua/news/general/1130381.html (accessed: 10.05.2026).

Truszczyński, J. (2025). *Ukraina w drodze do Unii Europejskiej: Jaką część dystansu ma już za sobą, ile pozostaje do przejścia?*. Warszawa: Fundacja im. Stefana Batorego.

Tsymbaliuk, S., Degtyarova, I. (2024). *Perspektywy rozwoju szkolnictwa wyższego w Ukrainie w kontekście wojny i integracji europejskiej. Raport przygotowany w ramach Projektu MNiSW-PW „Polsko-ukraińska współpraca instytucji przedstawicielskich reprezentujących rektorów, na rzecz doskonalenia działania uczelni*". Kijów–Warszawa, https://www.ans.pw.edu.pl/content/download/3476/19675/file/RAPORT_PL_2024.pdf (accessed: 10.05.2026).

UK – Ukraine Twinning Initiative (n.d.), https://www.twinningukraine.com/ (accessed: 10.05.2026).

Umland, A. (2025). *Between Freedom and Censorship: Ukraine's Mass Media in Times of Full-scale War*. SCEEUS, June 2025, https://sceeus.se/en/publications/between-freedom-and-censorship-ukraines-mass-media-in-times-of-full-scale-war/ (accessed: 10.05.2026).

Venher, V., Bondar, M., Doroshenko, B., Kyrychenko, Y., Ivasyk, S. (2023). *Parliament under Conditions of War: Ukraine's Example. An Empirical Report*. Kyiv: USAID RADA: Next Generation Program, Internews-Ukraine, https://pravo.org.ua/en/books/parliament-under-conditions-of-war-ukraines-example-an-empirical-report/ (accessed: 10.05.2026).

Venice Commission (2025). *Updated Rule of Law Checklist, CDL-AD (2025) 002*. Strasbourg: Council of Europe.

Whitmore, S. (2023). *Ukraine's Parliament: One Year At War*, Hansard Society Blog, https://www.hansardsociety.org.uk/blog/ukraines-parliament-one-year-at-war (accessed: 10.05.2026).

Wise, C.R., Suslova, O., Brown, T.L. (2024). Ukraine's Parliament in War: The Impact of Russia's Invasion on the Verkhovna Rada's Ability and Efforts to Legislate Reforms and Join the European Union, *The Theory and Practice of Legislation*, 12(1), pp. 1–20. DOI: 10.1080/20508840.2023.2299080.

World Bank (2019). *Ukraine Improving Higher Education for Results Project*, https://projects.worldbank.org/en/projects-operations/project-detail/P171050 (accessed: 10.05.2026).

Zakon Ukrainy «Pro pravovyi rezhym voiennoho stanu» vid 12 travnia 2015 r. № 389-VIII (zi zminamy), https://zakon.rada.gov.ua/laws/show/en/389-19#Text / Закон України «Про правовий режим воєнного стану» від 12 травня 2015 р. № 389-VIII (зі змінами), https://zakon.rada.gov.ua/laws/show/en/389-19#Text (accessed: 10.05.2026).

11

Małgorzata Molęda-Zdziech[1]
Kinga Torbicka[2]

The War in Ukraine as an Anomie of Values. A Case Study of Poland and France in the European Context

Abstract

This article interprets the war in Ukraine as a symptom of a broader crisis of values within the European order. European integration was built on the assumption that economic and political cooperation would guarantee peace, stability and security on the continent. The Russian aggression against Georgia in 2008, the annexation of Crimea in 2014, the prolonged phase of hybrid pressure directed against EU and NATO states, and, finally, the full-scale invasion of Ukraine in 2022 revealed the erosion of this normative foundation. The authors draw on the analytical category of anomie to capture the tension between declared values and those actually realised in political and social practice. On the basis of a comparative case study of Poland and France, the differences in the social perception of war, institutional responses and the relationship between state strategies and civic mobilisation are analysed. The war significantly challenged the European axiological order and exposed a growing inconsistency between the rhetoric of peace, economic pragmatism, and security practice. Poland and France illustrate two different ways of responding to this incoherence. In Poland, broad social solidarity initially overtook institutional preparedness, while in France, the strategic activism of the state coexisted with greater social ambivalence and a lower willingness to bear the costs of a protracted conflict. In this sense, the war in Ukraine appears to be both a consequence of, and a catalyst for, value anomie within Europe.

1 SGH Warsaw School of Economics (Poland), e-mail: mmoled@sgh.waw.pl.
2 University of Warsaw (Poland), e-mail: kinga.torbicka@uw.edu.pl.

1. Introduction

The current war in Ukraine is more than merely a military conflict over territory, sovereignty and the balance of power in Eastern Europe. In normative terms, it also represents a crisis of values that affects the foundations of European integration. Following the Second World War, the European integration project was conceived as a means of preventing further armed conflicts on the continent. The European Union (EU) emerged as a peace project, seeking to replace war through international cooperation, common development, and fundamental values such as democracy, human rights, equality and respect for diversity. The EU defends its values as enshrined in the Maastricht Treaty [Treaty on European Union] and wishes to remain a *liberal power* and a *democratic empire* [Moreau-Defarges, 2002]. These provisions reflect the axiological dimension of European integration, inscribing the aforementioned values at its core. However, the Russian-Ukrainian war has revealed that this core has been eroding for many years. Russia's aggression against Georgia in 2008, the annexation of Crimea and the destabilisation of the Donbas in 2014, followed by intensified hybrid actions – from energy pressure to cyber attacks, disinformation, and the instrumentalisation of migration – did not lead to a lasting overhaul of European security thinking. The responses of the European Union and many Western states have been significant, although mostly late, fragmented or insufficient in relation to the scale of the threat. It is this discrepancy between the declared defence of peace and political practice that constitutes one of the most important manifestations of the anomie of values in contemporary Europe.

The concept of anomie, originally developed by Emil Durkheim and later reinterpreted by Robert K. Merton, refers to the weakening or disruption of the system of norms regulating the behaviour of individuals and collectivities.

In this article, the concept is transferred to the field of political and international analysis. It does not denote a total disappearance of values in Europe, but a state of growing incoherence between the order of declaration and the order of action; between a commitment to peace and solidarity and political practices subordinated to short-term calculation, convenience, and the logic of institutional survival. In this view, the war in Ukraine can be understood as both an effect of and a catalyst for value. It is a consequence because Russia's full-scale aggression was made possible, among other factors, by earlier signals of Western weakness and inconsistency. It also acts as a catalyst because it has forced European states to redefine their own hierarchies of values, the relationship between security and prosperity, and the balance between national policy and responsibility for the European order.

The comparative case study of Poland and France is particularly justified in this context. Poland is a border state, directly affected by the war and, at the same time, a society in which solidarity with Ukraine following 24 February 2022 assumed a particularly strong grassroots character. France, by contrast, is a founding state of European integration, a nuclear power, and one of the main creators of the debate on Europe's strategic autonomy. Both cases reveal different configurations of the relationship between the state, society and European values, and their comparison allows us to better understand the complex nature of anomie.

The aim of the article is therefore to interpret the war in Ukraine as a particular manifestation of axiological crisis in Europe and to examine how Poland and France have responded to this crisis at both the social and institutional level. The authors offer a coherent interpretation combining normative, social and institutional levels. The concept of anomie is used here as a precise analytical tool to explore the fractures between recognised collective goals and the means of achieving them.

Three research questions guide the analysis: (1) In what sense can the war in Ukraine be interpreted as a manifestation of value anomie in Europe?; (2) What differences exist between Poland and France in terms of their social and institutional responses to the war?; (3) Do these differences support the thesis of a growing tension between declared values and those realised in the European Union? The thesis assumes that both countries remain formally committed to European values, yet realise them in different ways. In Poland, intense social mobilisation has been accompanied by initially limited institutional preparedness, whereas in France a stronger strategic activism of the state is evident with greater social distance from the costs of war and a more ambivalent understanding of national self-interest.

The article adopts a qualitative comparative approach set within a sociological-political perspective. The starting point is an analysis of the concept of anomie and its adaptation to the study of tensions between the declared normative order and the practice of states and societies under conditions of war. A comparative case-study method is employed, focusing on Poland and France, which represent different geopolitical positions, traditions of statehood, and strategic cultures. The timeframe of the analysis covers the period 2014–2024, with a particular focus on the period after 24 February 2022. The year 2014 is treated as a watershed moment, as the annexation of Crimea and the outbreak of the war in Donbas undermined the previous European security paradigm, but did not yet lead to its full revision. Instead, 2022 marks the beginning of a full-scale war that has rendered previous tensions visible and politically irremovable.

2. Anomie and its analytical utility

In the classical sociological tradition, anomie refers to the weakening, or even disintegration, of the norms that regulate social life. For Emile Durkheim [2006, pp. 320–325], it was a state of disorganisation of the normative order that occurs during periods of rapid social change, when established rules lose their regulatory force and new ones have not yet been internalised. Robert K. Merton [1982, pp. 197–199] shifted the focus to the relationship between culturally recognised goals and the institutionally available means of achieving them. Anomie arises when the social system demands the realisation of certain values, but either fails to provide the adequate means for their attainment or distributes them unevenly. In this sense, anomie signifies not only the absence of norms, but also their ineffectiveness or contradiction with regard to the realities of social life. The concept is analytically valuable because it enables the study of situations in which individuals lose confidence in the applicable rules of action and the limits of socially acceptable behaviour. This allows a better understanding of the sources of social tensions, feelings of insecurity, and frustration. Anomie thus becomes an important tool for interpreting societies in a state of crisis, transition or profound destabilisation. It also helps explain how the weakening of institutions and norms affects social cohesion and the community's ability to sustain social order.

For the purposes of this article, value anomie refers to a state in which European and national political communities continue to declare a commitment to peace, security, solidarity, sovereignty and international law, but do not consistently translate these commitments into strategic, institutional and societal actions. In this view, anomie is not the absence of values, but their selective and inconsistent realisation. Some values are exposed symbolically, others are relativised, while still others are subordinated to the logic of economic costs or short-term political competition.

Analysing the war in Ukraine through the lens of anomie makes it possible to capture several overlapping levels of tension, as the norms that regulate social order are weakened in a situation of violent war crisis and the relationship between socially recognised goals and the available means of achieving them is shaken [Durkheim, 2006, pp. 320–332; Merton, 1982, pp. 197–199]. At the international level, this is reflected in a weakening of the belief that border inviolability and peaceful coexistence in Europe are sustainable, which may lead to a breakdown of the existing normative order. At the European level, a contradiction emerges between the rhetoric of a community of values and the asymmetrical willingness to bear the costs of security. At the national level, disparities become visible between societal expec-

tations and the state's ability to respond quickly and coherently. Finally, at the societal level, war activates conflicts of memory, interest and identity, which can both reinforce solidarity and accelerate its erosion.

Merton's concept of anomie also provides a useful framework for describing different adaptations to crisis situations. When a political community accepts the declared goals but finds the existing means insufficient, forms of innovation, substitute mobilisation, or pressure for institutional change may emerge [Szafraniec, 1999]. Conversely, when goals are recognised only at the symbolic level while their practical implementation gives way to conservatism, then patterns of ritualism or disengagement are likely to prevail [Merton, 1982, pp. 203–206].

3. The war in Ukraine as an axiological crisis of European integration

The European Union was founded as a peace project. Historically, its origins lay not only in the need for economic reconstruction, but above all the conviction that close cooperation between former rivals could prevent a return to war. Peace, democracy, human rights, respect for international law and solidarity between states are among the EU's constitutive values. In this sense, war in Europe is not merely an external security problem for the EU, but an event that undermines its normative identity.

From this perspective, the significance of 2022 lies not only in the brutality of the Russian aggression, but also in the fact that it highlighted the inadequacy of previous European responses. The Western response to the 2008 Russo–Georgian war did not lead to a lasting paradigm shift, even though the EU played an important diplomatic role in managing the crisis and facilitating a ceasefire [Herd, Flesch, 2008]. A similar pattern emerged following the annexation of Crimea and the outbreak of war in Donbas in 2014. While the EU launched sanctions and diplomacy, and the logic of sanctions was linked to the implementation of the Minsk agreements, this did not translate into a unified and long-term EU-wide deterrence strategy [European Council, EU Council, 2026; Kurnyshova, 2025]. In many European states, the belief persisted that economic (including energy) relations with Russia could stabilise security, which was linked, among other things, to an approach described as *change through trade* and a belief in *civilising* relations through interdependence [Lutz, 2024]. However, the full-scale war exposed the illusory nature of this assumption, revealing the structural weaknesses of European security policy and the limitations of the existing tools of the Common Foreign and Security Policy. In a symbolic

sense, it marked the end of an era in which much of Europe was able to treat security as a stagnant good, rather than one requiring constant investment and political preparedness. Practically, it forced the EU to expand its policy toolkit: further sanction packages, macro-financial support, the supply of military equipment financed indirectly through EU instruments,[3] and the acceleration of the debate on strategic autonomy [Versailles, 2022], the defence industry, and energy security.

At the same time, the EU response did not immediately resolve the previous contradictions. The 2022 Eurobarometer survey of European public opinion revealed very high public support for humanitarian support for Ukraine, the reception of refugees, and sanctions against Russia, while simultaneously recording growing economic and cost-related concerns. According to the survey conducted in June and July 2022, 93% of respondents across the EU supported humanitarian aid to Ukraine, 91% supported accepting refugees fleeing the war, and 80% supported economic sanctions against Russia. At the same time, concerns about the economic impact of the war were increasing, with 34% of respondents at the EU-level citing rising prices, inflation and the cost of living, an increase of 10 percentage points compared to February 2022. By contrast, 28% of respondents were concerned about energy supply issues, which reflects an increase of 12 percentage points. At the national level, cost-of-living issues were cited by 54% of respondents and energy problems by 22%, both recording a significant increase compared to the beginning of 2022. In addition, 62% of Europeans declared that the war in Ukraine had serious consequences for their personal finances [Eurobarometer, 2022]. This duality is significant: support for values does not disappear, but becomes contingent, depending on the perception of the threat, the material situation, and national political disputes. Value anomie, therefore, does not imply a lack of solidarity, but rather its fragility and uneven rootedness. The 2022 Eurobarometer data illustrate precisely this: alongside overwhelming support for humanitarian assistance, sanctions, and refugee reception, concerns regarding inflation, energy security, and the cost of living were also intensifying. In this sense, the war in Ukraine has redefined the European order not only geopolitically, but also axiologically. It reveals a situation resembling anomie in the sense described by Robert K. Merton: the values to which the European Union appeals – peace, solidarity, freedom, and respect for international law – remain formally recognised, but their practical implementation faces growing political, economic and social barriers. Thus, it is not a question of the

[3] In particular, these were the European Peace Facility (EPF) and the Macro-Financial Assistance (MFA) [European Commission, 2025].

disappearance of these values, but of a growing tension between the normative goals of integration and the possibilities of realising them under conditions of war and crisis. The comparison between Poland and France demonstrates that Member States differ not only in their perception of the scale of the threat but also in how to defend the European order of values.

4. Poland: social solidarity, security pressures, and institutional constraints

As an immediate neighbour of Ukraine and a country historically burdened by the experience of Russian imperialism, Poland has from the beginning perceived the war not as a regional conflict, but as a threat to both its own security and to the European order. A CBOS survey shows that as early as in March 2022, 85% of respondents believed that the war threatened Poland's security, while in April that year this percentage remained significantly high at 79%. In March 2022, CBOS found that 94% of respondents supported accepting refugees from Ukraine, the highest level recorded in the survey, while in the spring of 2023 this figure still stood at around 80%, although at the same time the sensitivity to the costs of a prolonged conflict was on the rise [CBOS, 2022a; CBOS, 2022b; CBOS, 2023a; CBOS, 2023b].

The first and most prominent feature of the Polish response was the scale of grassroots mobilisation. In the first weeks after 24 February 2022, aid was organised spontaneously: at borders, railway stations, airports, schools, local governments and private homes [Baszczak, Kiełczewska, Kukołowicz, Wincewicz, Zyzik, 2022; Report, 2022; UNHCR, 2023a,b,c], with the Polish civil society, NGOs, informal groups and individuals assuming much of the responsibility for the first stage of refugee reception [Kuczynski, Latecka, Szczepaniak, 2023]. CBOS surveys from the spring and summer of 2022 showed that a significant proportion of respondents were materially or organisationally involved in helping – donating money, food, hygiene products, organising collections, providing housing, and supporting refugees in dealing with official matters [CBOS, 2022c,d].

It should be emphasised that the humanitarian crisis in Poland, and indeed across Europe, triggered by the outbreak of full-scale war in Ukraine in February 2022, as well as the resulting mass migration, was averted thanks to the spontaneous and immediate response of the Polish people and Polish non-governmental organisations. According to the authors of a report by the Polish Economic Institute, in the first months of the war as many as 77% of Poles provided assistance to Ukraine

in various forms. Among others, 35% were involved in organisational activities and voluntary work, 7% took refugees into their own homes, and around 10% provided assistance with learning Polish or finding work and schools. In the first three months of the full-scale invasion of Ukraine alone, Poles allocated PLN 9–10 billion from private funds to aid efforts.

Grassroots fundraising initiatives for humanitarian and military aid generated an overwhelming public response. At the same time, qualitative research showed that from around the summer of 2022, a phenomenon of *helper fatigue* (so-called *compassion fatigue*) and emotional burnout began to emerge among those providing aid and non-governmental organisations involved in supporting refugees, linked to overwork or prolonged exposure to challenging issues [PIE, 2022]. This process is known to occur in similar social situations, highlighting the need to provide support not only to beneficiaries but also to those delivering assistance.

This model of response can be interpreted as a particular form of institutional compensation. The Polish state was relatively quick to adopt legal solutions regarding the residence status of Ukrainian citizens,[4] although during the first stage of the war these actions were largely reactive rather than pre-planned. Grassroots social mobilisation overtook the administrative apparatuses, which only over time began to assume some of the organisational burden. In terms of anomie, this represents a temporary disconnect between a widely shared goal – solidarity with a war-affected nation, protection of lives, support for a struggling Ukraine – and the insufficiently prepared institutional means of achieving it.

In the case of Poland, the relationship between the experience of security and axiology is also significant. Support for Ukraine had a moral dimension, but was also widely seen as an investment in one's own security [Maciejewska-Mieszkowska, 2023]. In March 2022, 90% of respondents supported the provision of military equipment and armaments to Ukraine, while 93% supported financial assistance [CBOS, 2022a]. At the same time, more than 90% endorsed diplomatic pressure on, and the

[4] In response to the massive influx of war refugees, Poland established the legal basis for the legalisation of residence of Ukrainian nationals: the Law of 12 March 2022 (*specustawa*) was adopted, regulating, *inter alia*, specific rules for the legalisation of residence of persons who arrived in Poland in connection with the war starting from 24 February 2022 [Law of 12 March 2022, 2022]. In administrative practice, the PESEL number with the status 'UKR' has become a key instrument, which constitutes an official certification of entitlement to reside in Poland [Office for Foreigners, 2022]. In parallel, mechanisms *by law* maintaining the legality of residency and the validity of selected documents (e.g. national visas and temporary residence permits) were introduced and extended, and after the amendments of 5 March 2026 entered into force, further extensions of some of the deadlines until 4 March 2027 were indicated [Office for Foreigners, 2025; Office for Foreigners, 2026]. Complementarily, the possibility of an optional transition of some beneficiaries of temporary protection to the indicated residence titles from 1 April 2023 was maintained [Office for Foreigners, 2023].

isolation of, Russia. This reflects a very high level of congruence between axiological orientation and perceptions of strategic interest. Within the Polish debate, the defence of Ukraine was often presented as a defence of Poland, the wider region, and NATO's eastern flank.[5] However, this did not imply the absence of tensions. As the war prolonged, disputes began to emerge over Ukraine's grain policy [OSW, 2023], Polish-Ukrainian historical memory [Stryjek, 2024], the social costs of hosting refugees, labour-market competition, and assessing the pace of integration of Ukrainian citizens [PIE, 2023]. Public support remained high, but was becoming less unconditional than in the first months of the war. The growing complexity of the problem revealed that solidarity does not eliminate the tensions of interest, but only temporarily suspends them.

In Merton's terms, the Polish response clearly illustrates the tension between strongly accepted goals and limited institutional means. The objective was solidarity with, and tangible support for, Ukraine, further reinforced by a sense of threat to Poland. At the same time, in the first months of the war, neither the administration nor the existing coordination mechanisms were prepared for the scale of the challenge. The result was a gap between clearly articulated social expectations and the institutional capacity available to meet them. This gap, however, did not lead to passivity, but rather to what Merton would describe as innovation: grassroots mobilisation and informal support networks that temporarily compensated for the weakness of institutions. As the war prolonged, tensions increased and solidarity became more contingent, confirming that this was an institutional anomie offset by social activism rather than a sustained coherence between norms and state capacities.

---

5 The Polish authorities' narrative during the initial phase of the war often included the message that the defence of Ukraine was simultaneously the defence of Poland, the wider region, and NATO's eastern flank. Within the circle surrounding the then President Andrzej Duda, it was explicitly emphasised that support for Kyiv stemmed from the conviction that "Ukraine defends Poland" because it halts Russian expansion before it reaches the Polish border [Chancellery of the President of the Republic of Poland, 2022]. The President himself emphasised that the success of Ukraine's defence was "of fundamental importance" for Poland's security, and that by fighting Russia "Ukraine today defends Europe, including us" [Chancellery of the President of the Republic of Poland, 2023]. At the same time, the National Security Office indicated that Ukraine was fighting "also in the name of the security of Poland and our region" [National Security Office, 2022]. Representatives of the then government also made similar statements. Prime Minister Mateusz Morawiecki linked Russia's deterrence to the strengthening of "Poland and NATO's eastern flank, but also Ukraine" [Polskie Radio, 2022], while Defence Minister Mariusz Blaszczak linked supporting Ukraine to the security of countries on NATO's eastern flank and to preventing aggression against countries such as Poland [Małecki, Boguszewski, 2023].

5. France: between state strategic activism and social ambivalence

France is a founding member of the European Communities, a permanent member of the United Nations Security Council (UNSC), and a nuclear power. It possesses significant strategic resources and a strong sense of its own role in shaping the European order. At the same time, French strategic culture combines a commitment to liberal democratic values – legal order, sovereignty, and territorial integrity – with a tradition of autonomy of decision, diplomatic balancing, and a strong role for the state. Consequently, this influenced and shaped Paris' position towards Ukraine between 2014 and 2024. It remained consistent but also ambiguous: France reacted in the logic of managing the conflict and maintaining European cohesion, rather than in the logic of immediate confrontation with Russia. The Russian war against Ukraine thus became, for the EU and indirectly for France, a test of the limits of a *liberal power* [Lefebvre, 2023], capable of defending values with hard instruments (sanctions, military support), but constrained by political and institutional limitations.

Following the annexation of Crimea in 2014, France stepped in as a co-guarantor of the diplomatic process, co-creating the so-called Normandy format with Germany and participating in the negotiations of the Minsk agreements. From Paris' perspective, the priority was to maintain European unity, limit the risk of escalation, and preserve channels of communication with Moscow, which corresponded to the French diplomatic tradition and vision of Europe as an entity capable of moderating conflicts on the continent [Torbicka, 2025]. At the same time, in Central and Eastern Europe this approach was viewed as too conservative and insufficient in the face of the Kremlin's imperial policy [Torbicka, 2024]. The full-scale invasion of 2022 prompted a partial redefinition of this strategy, with France unequivocally condemning Russia's aggression and supporting EU sanctions, macro-financial and military support for Ukraine, and participating in measures to strengthen Europe's security. According to the French Ministry of Europe and Foreign Affairs, by 1 September 2024 France had provided more than €434 million in humanitarian aid to Ukraine and, according to the Ministry of the Armed Forces, the value of donated military equipment exceeded €3 billion by 2024 [Ministère de l'Europe et des Affaires étrangères, 2024; Ministère des Armées, 2024]. In parallel, the strategic discourse was linked to the project of strategic autonomy for Europe. In his Sorbonne speech of 25 April 2024, Emmanuel Macron argued that the war demonstrated the need to build a Europe capable of autonomous action in defence, industry and security, and that solidarity with Ukraine constituted a "test of the EU's subjectivity" [Macron, 2024].

At the societal level, the picture is more complex and reveals significant axiological tensions. Research by the French Institute for Public Opinion Research (Institut français d'opinion publique, IFOP) in 2024 indicated a limited willingness to support direct military intervention: only 27% of respondents supported French participation in a European coalition intervening in Ukraine, while 22% favoured sending troops as part of a land-based intervention. At the same time, there was a clear differentiation according to political affiliation, with polls clearly indicating greater acceptance among supporters of the presidential camp than among voters of the main opposition parties. Supporters of *Renaissance* were significantly more inclined to support the deployment of French troops (50% in favour) than supporters of the opposition parties (13% of supporters of the National Rally (*Rassemblement National*) and 27% of supporters of *France Insoumise* [IFOP, 2024a]. These figures do not indicate a rejection of Ukraine, but demonstrate the growing importance of questions concerning the costs and limits of engagement and the normalisation of the war in the public consciousness.

It is also worth noting the erosion of political trust in France. The CEVIPOF trust barometer indicates a structurally high level of distrust of the political class,[6] which limits the ability of elites to produce long-term public consensus around foreign and security policy [Baromètre, 2024]. Under these conditions, even an active and relatively efficient state policy does not necessarily translate into a strong social identification of the war in Ukraine with the defence of France's *own* values. This phenomenon is consistent with broader observations on the evolution of public opinion in Europe: support for EU action remains high,[7] but is prone to *subtle erosion* due to socio-economic costs [Debomy, 2023] and crisis fatigue.

As a result, the *French anomie of values* does not imply a simple rejection of Ukraine or an unequivocal pro-Russianism, but rather a tension between the high legitimacy of France's state role in Europe and the limited social willingness to bear the costs of war in the long term. In terms of Merton's adaptation, the French case approximates ritualism: values such as sovereignty, international law and solidarity are upheld symbolically and institutionally, but not always internalised socially as a direct imperative for escalating action. This asymmetry distinguishes France from Poland, where, in the initial phase of the war, social mobilisation preceded the

6 According to the 2024–2025 Cevipof survey, only 25% trust, and 46% do not trust, political institutions. Trust in the government is declining (28%), with the French defining themselves as *distrustful* (38%) [Baromètre, 2024].

7 A majority of Europeans believe that since the outbreak of the war, the EU has shown solidarity (79%), been united (63%) and responded quickly (58%). The Russian threat is clearly perceived by the majority of citizens, and it does not affect Ukraine alone, but Europe as a whole [Eurobarometer, 2022].

institutional response. In France, on the other hand, the state (i.e. its institutions) is more often ahead of social acceptance for the escalating scale of engagement, which is undoubtedly a key element in the comparison between the two case studies.

6. Poland and France against the European background

The comparison between Poland and France reveals the multidimensional nature of European value anomie. In both countries, the official level of declaration remains broadly in line with the normative order of the European Union: both recognise Russian aggression as a violation of international law, support the sovereignty of Ukraine, and participate in aid activities. However, differences emerge at the level of the relationship between society, the state, and the experience of war.

The differences are not only the result of their different geographical location. They also reflect deep historical, institutional and cultural factors. Poland is a country whose political experience has been shaped by partitions, the struggle for independence, occupation, communism and democratic transformation. In such a context, security has an existential dimension. Sovereignty, borders and the ability to defend oneself belong to categories saturated with historical memory. Consequently, the war in Ukraine has been interpreted in Poland not only as a violation of international law, but as the return of a historically familiar Russian threat. France, by contrast, is characterised by long institutional continuity, a strong political centre, and a deeply internalised conception of the role of the state as the organiser of collective life. Its experience of the twentieth century is different from Poland's, lacking historical proximity to Russia. The French strategic debate is more strongly linked to categories of multipolarity, balance of power, decision-making autonomy and the role of Europe as a geopolitical power. As a result, the French response to the war has more often been formulated as a geopolitical responsibility than an actual threat.

In the two cases discussed, the perception of the threat is distributed differently. In Poland, the war was interpreted from the outset as a direct threat, concerning not only Ukraine but also the security of Poland, the region, and Central and Eastern Europe as a whole. In France, the conflict was more often interpreted as a serious but nevertheless indirect crisis, threatening the European order and French interests in a less direct, more strategic than existential way. Differences in geographical location and historical experience contribute to distinct understandings of security and its relative importance within the two societies. The relationship between society and institutions also remains different. France has an extensive administration

and a strong statist tradition. In crisis situations, citizens are more likely to expect the state to organise a response and prepare the framework for action. Poland, especially after 1989, developed under conditions of a partial deficit of trust in institutions, which encouraged practices of self-organisation and local resourcefulness. In the initial phase of the war, this difference became clear: in Poland, the strength of the social response was derived not only from empathy, but also from an ingrained practice of acting outside or alongside the state. Poland revealed the advantage of civic mobilisation over state preparedness, while France revealed the advantage of state capacity over social readiness to identify with the logic of war. In the first case, anomie took the form of a tension between a widely shared goal and an institutional apparatus that was not fully prepared, whereas in the second it manifested itself in a gap between institutional activism and social ambivalence towards the costs and scale of engagement.

It is worth noting that the status of European values in the collective memory is also different in the two countries. For Poland, values such as sovereignty, borders, and defence of the state have strong historical and existential roots, while for France, universalist republican categories such as rights, equality and citizenship remain equally important, but are embedded in a different tradition of statehood, less directly linked to the experience of being a frontline state. Hence, French support for Ukraine is more often seen through the prism of raison d'état, Europe's position in the world, and the role of the state, whereas in Poland it is more strongly linked to a sense of common destiny and proximity to danger. As a result, both cases show a certain conditionality of European values. Europe has not stopped referring to peace, solidarity or sovereignty: the problem is that these values are activated with different intensities, in different sequences, and under different stimuli. Poland and France show that the European community of norms is not a space of complete homogeneity, but a field of negotiation between the experience of the periphery and the centre, between the logic of immediate threat and the logic of strategic responsibility. On a broader level, this confirms the thesis that the war in Ukraine has become a test not so much of the very existence of European values, but rather of the capacity to hierarchise and institutionalise them. The greatest danger in this case is not the total disappearance of norms, but their selective activation, leading to an erosion of political cohesion and a growing sense that the European community reacts strongly only when the cost of inaction becomes higher than the cost of action.

This comparison should also be interpreted dynamically, because attitudes towards Ukraine and Ukrainians did not remain unchanged after the first months of the war. In Poland, the initial moral shock, the historical memory of Russian

imperialism, and everyday practices of neighbourly solidarity led to exceptionally strong pro-Ukrainian mobilisation; however, over time, this solidarity became increasingly conditional under the pressure of inflation, the grain crisis, labour-market tensions, and disputes over historical memory. CBOS data show that support for accepting Ukrainian refugees fell from 94% in March 2022 to 73% in April 2023 and 53% in autumn 2024, which confirms that solidarity evolved from an emotional and almost universal reaction into a more selective and politically conditioned attitude [CBOS, 2023c; CBOS, 2024].

In France, this evolution took a different form: public opinion was less strongly shaped by the experience of an existential threat, while the state consistently framed support for Ukraine in terms of strategic autonomy, European responsibility, and the defence of international law. At the same time, the behaviour of the majority of French companies operating on the Russian market revealed another form of value anomie: despite France's official support for sanctions and condemnation of Russian aggression, some firms maintained their presence in Russia, only partially reduced their activities, or used ownership transfers and local management structures to minimise reputational and legal costs while preserving economic interests [B4Ukraine, 2025; Euronews, 2025; Yale School of Management, 2024; PISM, 2024].[8] The list of the top 20 companies by revenue in Russia in 2024 includes French companies: Leroy Merlin (3rd place), Auchan (8th), and Spar (19th). In the EU Corporate Profit Tax Ranking for Russia, France ranked second in this regard in 2024, behind Germany [B4Ukraine, 2025].

These examples demonstrate that both the Polish and French responses were shaped not only by state policy, but also by historically rooted political cultures and everyday social practices: Polish society tended to respond through grassroots mobilisation and solidarity based on the proximity of experience, whereas the French response more often channelled through the state, strategic considerations, and the tension between universalist declarations and economic pragmatism.

8 As of July 2025, according to the Kyiv School of Economics, only 503 (or 12% of the operating in Russia at the beginning of 2022) had completely withdrawn from the Russian market by selling or liquidating their business. The majority – 2,326 firms (55%) – continued to do business in Russia. A further 1,377 companies (33%) had officially declared plans to completely shut down, or temporarily reduce operations, but had not yet completed their withdrawal [B4Ukraine, 2025].

Table 1. A comparative analysis of Polish and French societal and institutional responses to the war in Ukraine using Robert K. Merton's adaptation patterns of anomie

Adaptation style	Cultural goals	Cultural objectives	Institutionalised measures	Institutionalised measures
	Poland	France	Poland	France
Conformism	Strong acceptance of values such as Ukraine's sovereignty, European security, solidarity with victims of aggression, and support for refugees.	Acceptance of the principles of international law, the sovereignty of states, and the need to defend the European order, as well as support for Ukraine at the declarative level.	Institutional state aid developed belatedly, later inclusion of state apparatus in humanitarian, political and military assistance; cooperation within EU and NATO.	Diplomatic action, support for sanctions, humanitarian, economic and military assistance, French activity in the EU and within the concept of strategic autonomy.
Innovation	Preservation of objectives in the absence of efficient institutional means: grassroots self-organisation of citizens, assistance at borders, stations, airports, public reception of refugees at one's own home.	Preserving objectives while seeking new political means: attempts to redefine France's role in Europe, strengthen European strategic autonomy, diplomatic initiatives (e.g. the European Political Community).	The public partly replaces the state in the first phase of the crisis; civic action compensates for the delay of public institutions.	Political elites are modifying the scope of action, attempting to combine support for Ukraine with maintaining France's position as a major strategic actor in Europe.
Ritualism	Maintaining official support for Ukraine and European security with a gradual bureaucratisation of actions and a weakening of the initial social mobilisation.	Maintaining declarations of solidarity and support for Ukraine, but with a cautious, conservative public approach to deepening real military engagement.	Proceduralisation of state aid and actions; dominance of formal mechanisms over the original solidarity impulse.	Attachment to state procedures, diplomacy and limited institutional consensus, despite weaker public support for stronger action.
Withdrawal	Limited incidence; may manifest as social fatigue with war and a waning of some forms of engagement as the conflict prolongs.	More frequent public distancing from the war perceived as a regional conflict; reluctance for France to engage directly.	Low willingness of some citizens to sustain high levels of aid mobilisation in the long term.	Low acceptance of sending troops and direct intervention; preference for limited support without high political and military costs.

cont. Table 1

Adaptation style	Cultural goals	Cultural objectives	Institutionalised measures	Institutionalised measures
	Poland	France	Poland	France
Rebellion	Possibility of questioning not only the means but also the way security is defined by state institutions; tension between social solidarity and the insufficient institutional response.	Criticism of the existing European security model and the need to rebuild it; at the same time, part of society rejects the escalation of engagement proposed by the elites.	Bottom-up social pressure forcing state activity; potential questioning of institutional ineffectiveness in the face of a crisis of values and security.	Attempts by French elites to redefine the European security order, with public dispute over the scope and meaning of this change.

Source: Authors' own elaboration based on CBOS; IFOP; Eurobarometer; CEVIPOF; Merton [1982].

7. Summary

The war in Ukraine has revealed a manifestation of value anomie in Europe, understood as a tension between declared values and their actual realisation.

The European Union continues to invoke the values of peace, solidarity, sovereignty and international law, but the war has revealed that their defence is not always coherent, unified and free from political and economic constraints. It has exposed a gap between Europe's normative identity and the practical realities of state and institutional action. The responses to Russian aggression in 2008 and 2014 proved inadequate, demonstrating the weakness of the previous European security model.

A comparison between Poland and France confirms that the two countries have responded differently to the same crisis. In Poland, strong social mobilisation and a sense of immediate threat were evident, but with initially limited institutional efficiency. In France, the state and its strategic activity played a greater role, while public support for bearing the costs of the war was more limited and ambivalent. The differences between Poland and France confirm the growing tension in the EU between values that are formally recognised and those that are consistently translated into practice. Both countries formally remain faithful to the European normative order, but provide a different political and social content. The conflict in Ukraine has therefore not undermined European values, but has revealed their fragility, conditionality, and uneven rootedness. The primary challenge is not the lack of norms, but the difficulty of their consistent implementation under conditions of prolonged crisis. In this sense, the war has become not only a conflict of

geopolitical significance, but also a test of Europe's axiological coherence, with the revealed anomie of values both a consequence and a cause.

References

Agnew, R., Passas, N. (Eds.). (2007). *The Future of Anomie Theory*. Boston: Northeastern University Press.

Baszczak, Ł., Kiełczewska, A., Kukołowicz, P., Wincewicz, A., Zyzik, R. (2022). *Pomoc polskiego społeczeństwa dla uchodźców z Ukrainy*. Polish Economic Institute, https://pie.net.pl/wp-content/uploads/2022/07/Pomoc-pol-spol-UKR-ENG-22.07.2022-C.pdf (accessed: 22.12.2025).

B4Ukraine (2025). *Corporate Russian Roulette: Why France Must Issue Guidance Calling on French Companies to Leave Russia*, https://b4ukraine.org/whats-new/corporate-russian-roulette (accessed: 28.04.2026).

CBOS (2022a). *Polacy wobec rosyjskiej inwazji na Ukrainę: Komunikat z Badań nr 38/2022*, https://www.cbos.pl/SPISKOM.POL/2022/K_038_22.PDF (accessed: 04.01.2026).

CBOS (2022b). *Polacy o wsparciu dla walczącej Ukrainy: Komunikat z Badań nr 54/2022*, https://www.cbos.pl/SPISKOM.POL/2022/K_054_22.PDF (accessed: 04.01.2026).

CBOS (2022c). *Polacy w obliczu wojny na Ukrainie: Komunikat z Badań nr 86/2022*, https://www.cbos.pl/SPISKOM.POL/2022/K_086_22.PDF (accessed: 04.01.2026).

CBOS (2022d). *Polacy o wojnie na Ukrainie i pomocy dla uchodźców: Komunikat z Badań nr 152/2022*, https://www.cbos.pl/SPISKOM.POL/2022/K_152_22.PDF (accessed: 05.01.2026).

CBOS (2023a). *Polacy wobec wojny na Ukrainie: Komunikat z Badań nr 41/2023*, https://www.cbos.pl/SPISKOM.POL/2023/K_041_23.PDF (accessed: 05.01.2026).

CBOS (2023b). *Polacy wobec wojny na Ukrainie i ukraińskich uchodźców: Komunikat z Badań nr 54/2023*, https://www.cbos.pl/SPISKOM.POL/2023/K_054_23.PDF (accessed: 05.01.2026).

CBOS (2023c). *Attitude Towards Ukrainian Refugees: Polish Public Opinion, No. 4/2023,* https://www.cbos.pl/PL/publikacje/public_opinion/2023/04_2023.pdf (accessed: 05.01.2026).

CBOS (2024). *Ukrainians in Poland and the War in Ukraine: Polish Public Opinion, No. 10/2024*, https://www.cbos.pl/PL/publikacje/public_opinion/2024/10_2024.pdf (accessed: 05.01.2026).

Centre for Eastern Studies (2023). *Sąsiedzkie waśnie. Problem ukraińskiego zboża na rynkach Europy Środkowej*, https://www.osw.waw.pl/pl/publikacje/komentarze-osw/2023-10-26/sasiedzkie-wasnie-problem-ukrainskiego-zboza-na-rynkach-europy (accessed: 09.12.2026).

CEVIPOF (2024). *Baromètre de la confiance politique, vague 15, janvier 2024*, Sciences Po CEVIPOF, https://www.sciencespo.fr/cevipof/sites/sciencespo.fr.cevipof/files/BConf_V15_Extraction1_modif.pdf (accessed: 06.01.2026).

Chair of Social Policy at the UW CISM (2022). *Inwazja Rosji na Ukrainę. Społeczeństwo i polityka wobec kryzysu uchodźczego w pierwszym miesiącu wojny*. Warszawa: CISiSM UW, https://wnpism.uw.edu.pl/wp-content/uploads/2022/04/Kryzys-uchodzczy-2022-raport-KPS.pdf (accessed: 21.01.2026).

Council of the European Union (2022). *Council Implementing Decision (EU) 2022/382 of 4 March 2022 Establishing the Existence of a Mass Influx of Displaced Persons from Ukraine Within the Meaning of Article 5 of Directive 2001/55/EC, and Having the Effect of Introducing Temporary Protection*, Official Journal of the European Union, https://eur-lex.europa.eu/eli/dec_impl/2022/382/oj/eng (accessed: 10.01.2026).

Debomy, D. (2023). *L'Europe garde les faveurs de l'opinion face à la guerre en Ukraine*. Institut Jacques Delors, https://institutdelors.eu/publications/leurope-garde-les-faveurs-de-lopinion-face-a-la-guerre-en-ukraine (accessed: 02.01.2026).

Durkheim, É. (2006). *Samobójstwo. Studium z socjologii*. Warszawa: Oficyna Naukowa.

Euronews (2025). *Payer le prix de rester ou celui de partir: le dilemme des entreprises françaises en Russie*, Euronews, https://fr.euronews.com/2025/11/04/payer-le-prix-de-rester-ou-celui-de-partir-le-dilemme-des-entreprises-francaises-en-russie (accessed: 28.04.2026).

European Commission (2022). *Standard Eurobarometer 97: EU Response to Russia's Invasion of Ukraine*, https://europa.eu/eurobarometer/surveys/detail/2693 (accessed: 12.01.2026).

European Commission (2025). *Ukraine*, https://economy-finance.ec.europa.eu/international-economic-relations/candidate-and-neighbouring-countries/neighbouring-countries-eu/neighbourhood-countries/ukraine_en (accessed: 01.02.2026).

European Council (2022). *Versailles Declaration*, https://www.consilium.europa.eu/media/54773/20220311-versailles-declaration-en.pdf (accessed: 19.02.2026).

European Council, Council of the European Union (2026). *Russia's War Against Ukraine: EU Sanctions*, https://www.consilium.europa.eu/pl/policies/sanctions-against-russia/ (accessed: 18.03.2026).

Giddens, A. (2004). *Socjologia*. Warszawa: Wydawnictwo Naukowe PWN.

Herd, G.P., Flesch, D.A. (2008). The Georgia Crisis: Implications for the Partnership for Peace, *Connections*, 8(1), pp. 1–10, http://www.jstor.org/stable/26326157 (accessed: 12.12.2025).

IFOP, Fondation Jean-Jaurès, Yalta European Strategy (2022). *Les peuples européens derrière l'Ukraine: La guerre en Ukraine vue de France, d'Allemagne, de Pologne et d'Italie*, *https://www.jean-jaures.org/wp-content/uploads/2022/03/Lespeupleseuropeensderrierelukraine.pdf* (accessed: 20.01.2026).

IFOP, Fondation Jean-Jaurès (2024a). *Le regard des Français sur la crise en Ukraine: Vague 6*, *https://www.jean-jaures.org/wp-content/uploads/2024/02/Resultats-enquete-2024.pdf* (accessed: 20.01.2026).

IFOP, Fondation Jean-Jaurès (2024b). *Regards européens sur la crise en Ukraine: Vague 7*, *https://www.jean-jaures.org/wp-content/uploads/2024/05/7eVagueUkraine_FR_AL_RU.pdf* (accessed: 20.01.2026).

Kuczynski, P., Latecka, M., Szczepaniak, I. (2023). Niecodzienność. Doświadczenia NGO-sów i inicjatyw obywatelskich pomagających emigrantom z Ukrainy w pierwszym okresie wojny, *Kultura i Społeczeństwo*, 67(3), pp. 65–90. DOI: 10.35757/KiS.2023.67.3.3.

Kurnyshova, Y. (2025). Deterrence, Coercion, Desecuritization: Three Lessons from the Russo-Ukrainian War, *Journal of Contemporary Central and Eastern Europe*, 34(1), pp. 163–176. DOI: 10.1080/ 25739638.2025.2599339.

Law of 12 March 2022 on Assistance to Citizens of Ukraine in Connection with the Armed Conflict on the Territory of Ukraine (2022). Journal of Laws, 2022, item 583, https://dziennikustaw.gov.pl/DU/2022/583 (accessed: 29.01.2026).

Lefebvre, M. (2023). *L'Union européenne face à la guerre en Ukraine: La puissance libérale et ses limites* (Questions d'Europe No. 651). Fondation Robert Schuman, https://www.robert-schuman.eu/questions-d-europe/0651-l-union-europeenne-face-a-la-guerre-en-ukraine-la-puissance-liberale-et-ses-limites (accessed: 29.01.2026).

Lutz, M. (2024). An Avoidable Dependency? Russian Gas and German Complacency in the History of East-West Energy Relations, *Neue Politische Literatur*, 69, pp. 10–33. DOI: 10.1007/s42520-024-00568-0.

Maciejewska-Mieszkowska, K. (2023). Eskalacja wojny w Ukrainie jako czynnik determinujący poczucie zagrożenia bezpieczeństwa Polski w ocenie społecznej, *Środkowoeuropejskie Studia Polityczne*, 2, pp. 217–236. DOI: 10.14746/ssp.2023.2.12.

Małecki, M., Boguszewski, M. (2023). *Szef MON: wspieranie Ukrainy jest ważne dla niepodległości Polski i Rumunii*, Polish Press Agency, https://www.pap.pl/aktualnosci/news%2C1519614%2Cszef-mon-wspieranie-ukrainy-jest-wazne-dla-niepodleglosci-polski-i-rumunii (accessed: 19.01.2026).

Merton, R.K. (1982). *Teoria socjologiczna i struktura społeczna*. Warszawa: Wydawnictwo Naukowe PWN.

Ministère de l'Europe et des Affaires étrangères (2024). *Aide humanitaire de la France à l'Ukraine, https://www.diplomatie.gouv.fr/fr/dossiers-pays/ukraine/guerre-en-ukraine-l-action-diplomatique-de-la-france/aide-humanitaire-de-la-france-a-l-ukraine/* (accessed: 15.02.2026).

Ministère des Armées (2024). *Ukraine: La France dresse le bilan des équipements militaires livrés*, https://www.defense.gouv.fr/actualites/ukraine-france-dresse-bilan-equipements-militaires-livres (accessed: 17.01.2026).

Moreau Defarges, P. (2002). *L'Union européenne, empire démocratique?* Paris: Institut français des relations internationales (IFRI).

Office for Foreigners (2023). *Residence Permits for Ukrainian Citizens Under Temporary Protection*, https://www.gov.pl/web/udsc/zezwolenia-na-pobyt-dla-obywateli-ukrainy-objetych-ochrona-czasowa (accessed: 02.01.2026).

Office for Foreigners (2025). *Extension of Legal Stay of Ukrainian Citizens Due to Armed Conflict on the Territory of Ukraine*, https://www.gov.pl/web/udsc/przedluzenie-legalnego-pobytu-obywateli-ukrainy-w-zwiazku-z-konfliktem-zbrojnym-na-terytorium-tego-panstwa (accessed: 02.01.2026).

Office for Foreigners (2026). *Amendments to the Special Rules on the Legality of the Stay of Ukrainian Citizens in the Territory of the Republic of Poland*, https://www.gov.pl/web/udsc/zmiany-w-szczegolnych-zasadach-dotyczacych-legalnosci-pobytu-obywateli-ukrainy-na-terytorium-rzeczypospolitej-polskiej (accessed: 04.01.2026).

Office for Foreigners (2026). *Temporary Protection in the Special Law: Explanation. Case Service Module*, https://mos.cudzoziemcy.gov.pl/informacje/ochrona-czas-specjalna/objasnienie (accessed: 04.01.2026).

Office of the President of the Republic of Poland (2022). *Polityka zagraniczna Andrzeja Dudy – podsumowanie 2022 r. i plany na następny rok*, https://www.prezydent.pl/kancelaria/

archiwum/andrzej-duda/kancelaria/aktywnosc-ministrow/polityka-zagraniczna-andrzeja-dudy--podsumowanie-2022-roku-i-plany-na-nastepne-miesiace%2C62771 (accessed: 25.01.2026).

National Security Office (2022). *To the Participants of the Celebration of the Operational Command of the Armed Forces*, https://www.bbn.gov.pl/pl/wydarzenia/9451%2CDo-uczestnikow-Swieta-Dowodztwa-Operacyjnego-Rodzajow-Sil-Zbrojnych.html (accessed: 02.01.2026).

Office of the President of the Republic of Poland (2023). *Andrzej Duda w TVN24: Ukraina broni dziś Europy*, https://www.prezydent.pl/kancelaria/archiwum/andrzej-duda/aktualnosci/wypowiedzi-prezydenta-rp/wywiady/andrzej-duda-w-tvn24-ukraina-broni-dzis-europy%2C65084 (accessed: 02.02.2026).

Polish Economic Institute (2022). *Polacy mogli wydać nawet 10 mld PLN na pomoc udzielaną uchodźcom z Ukrainy w pierwszych miesiącach wojny*, https://pie.net.pl/polacy-mogli-wydac-nawet-10-mld-pln-na-pomoc-udzielana-uchodzcom-z-ukrainy-w-pierwszych-miesiacach-wojny/ (accessed: 12.12.2025).

Polish Economic Institute (2023). *Uchodźcy z Ukrainy na polskim rynku pracy: możliwości i przeszkody,* https://pie.net.pl/wp-content/uploads/2024/01/Uchodzcy-z-Ukrainy-.pdf (accessed: 23.01.2026).

Polish Institute of International Affairs (PISM) (2024). *Hundreds of Western Companies Still Operating in Russia*, https://pism.pl/publications/hundreds-of-western-companies-still-operating-in-russia (accessed: 22.12.2025).

Polish Radio (2022). *Mateusz Morawiecki o sytuacji na Ukrainie: chcąc pokoju, trzeba się szykować na wojnę*, PolskieRadio.pl, https://www.polskieradio.pl/399/7975/artykul/2901692%2Cmateusz-morawiecki-o-sytuacji-na-ukrainie-chcac-pokoju-trzeba-sie-szykowac-na-wojne (accessed: 18.01.2026).

President of the French Republic (2024). *Discours sur l'Europe à la Sorbonne*, https://www.elysee.fr/emmanuel-macron/2024/04/24/discours-sur-leurope (accessed: 28.01.2026).

Stryjek, T. (2024). An Unexploded Mine: Explaining the Sources of the Contemporary Memory Conflict Between Poland and Ukraine, *Political Studies*, 52(3), pp. 257–287. DOI: 10.35757/STP.2024.52.3.11.

Szacka, B. (2003). *Wprowadzenie do socjologii*. Warszawa: Oficyna Naukowa.

Szacki, J. (2002). *Historia myśli socjologicznej*. Warszawa: Wydawnictwo Naukowe PWN.

Szafraniec, K. (1998). Anomia. In: *Encyklopedia socjologii,* Vol. 1 (pp. 32–35), W. Morawski et al. (Eds.). Warszawa: Oficyna Naukowa.

Sztompka, P. (2002). *Socjologia. Analiza społeczeństwa*. Kraków: Znak.

Torbicka, K. (2024). Ewolucja stanowiska Francji wobec Ukrainy w latach 2014–2022 jako przykład gry geopolitycznej mocarstw na obszarze Europy Wschodniej, *Studia Polityczne*, 52(1), pp. 57–73. DOI: 10.35757/STP.2024.52.1.03.

Torbicka, K. (2025). Between Support and Autonomy: The Dualism of France's Policy Towards Ukraine (2022–2024) as an Implication of the Fifth Republic's Strategic Culture, *Romanian Journal of European Affairs*, 25(2), pp. 5–25, https://rjea.ier.gov.ro/wp-content/uploads/2025/12/RJEA_vol.-25_no.-2_2025_Article-1.pdf (accessed: 02.03.2026).

Treaty on the European Union (2020). EUR-Lex, https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:02016M/TXT-20200301 (accessed: 18.12.2025).

UNHCR (2023a). *Poland Country Assessment: Safeguarding Support for Ukrainian Refugees. Resource and Support Hub, Eastern Europe*, https://safeguardingsupporthub.org/sites/default/files/documents/Country%20Assessment%20Poland%20FINAL%20CORRECTED%20052023.pdf (accessed: 14.01.2026).

UNHCR (2023b). *Poland Operational Update* (15 September 2023), https://data.unhcr.org/en/documents/details/103863 (accessed: 22.01.2026).

UNHCR (2023c). *Poland Chapter. In Ukraine Situation Regional Refugee Response Plan*, January – December 2023, pp. 177–199, https://reliefweb.int/report/poland/ukraine-situation-regional-refugee-response-plan-january-december-2023 (accessed: 23.12.2025).

Yale School of Management (2024). *Over 1,000 Companies Have Curtailed Operations in Russia – But Some Remain*, https://som.yale.edu/story/2022/over-1000-companies-have-curtailed-operations-russia-some-remain (accessed: 28.04.2026).

12

Beny Saputra[1]

Credit as a Conservation Policy in EU Green Finance

Abstract

This study starts from a paradox. The European Union has developed a sustainable finance framework centred on the Taxonomy Regulation, disclosure obligations, and prudential guidance, yet the system continues to rely more on transparency and risk management than on binding ex ante limits on credit allocation. As a result, climate- and nature-related risks are becoming more visible on banks' balance sheets, while credit continues to support environmentally harmful activity. Using qualitative doctrinal analysis and institutional mapping, this study examines how EU law can make more deliberate use of banks' credit assessment and disbursement processes as an instrument of green finance. It identifies three structural limits in the current framework: an environmental harm finance gap, a downstream due diligence gap, and an ex ante steering gap. In response, the study develops the concept of credit as conservation policy as a governance lens through which lending decisions are understood as an ex ante lever of environmental governance. Rather than replacing existing EU rules, the study proposes an environmental lending toolkit that complements current approaches by linking taxonomy, disclosure, prudential supervision, and due diligence more directly to credit screening, tiered due diligence, monitoring, escalation, and audit trails. In doing so, it demonstrates how the EU's existing legal architecture can be deployed more coherently and more preventively to steer financial flows away from environmentally harmful activity.

[1] Central European University (Austria), e-mail: saputra_beny@phd.ceu.edu.

1. Introduction

Despite the EU's green finance ambitions, EU-based financial institutions provided approximately EUR 256 billion in credit between 2016 and early 2023 to major corporate groups active in sectors linked to environmental harm, accounting for 22.1% of identified global credit.[2] Much of the associated harm lies beyond Europe, placing the EU within cross-border financial flows linked to ecosystem destruction both inside and outside its borders. WWF's 2023 briefing demonstrates why this should be understood not merely as a troubling statistic, but also as a legal and governance challenge.[3] Although the EU has developed a more transparent sustainability framework, it still does not impose sufficiently robust legal obligations on financial institutions to use this information to prevent or mitigate environmental harm in their financing decisions. The result is a system that has become more effective at disclosing harmful financial flows than at steering capital away from them. This study begins from that contradiction.

This tension is not only the result of weak enforcement, but also of the way the current EU framework has been designed. The EU sustainable finance framework relies heavily on classification tools,[4] and is also built around disclosure obligations.[5] In addition, it places growing emphasis on making climate- and nature-related risks more visible within financial supervision.[6] These developments are important, but they operate primarily through information, transparency and risk signalling.[7] They are less effective when the issue is whether finance should be restricted, conditioned or redirected before environmentally harmful activity receives credit. As a result, the framework has become more capable of identifying harmful financial patterns than

---

2 Greenpeace International, Harvest, Milieudefensie (2024). *New Report: Bankrolling Ecosystem Destruction*, https://www.banktrack.org/article/new_report_bankrolling_ecosystem_destruction.

3 WWF European Policy Office, *Banking on Destruction: How European Financial Institutions Fuel Environmental Crises* (WWF – World Wide Fund for Nature, 2023).

4 European Commission, "EU Taxonomy for Sustainable Activities," European Commission, n.d., accessed 11 January 2026, https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en.

5 European Commission, "Sustainability-Related Disclosure in the Financial Services Sector," Web Page, European Commission, 20 November 2025, https://finance.ec.europa.eu/sustainable-finance/disclosures/sustainability-related-disclosure-financial-services-sector_en.

6 European Banking Authority, *Final Report on Guidelines on the Management of Environmental, Social and Governance (ESG) Risks*, EBA/GL/2025/01 [European Banking Authority, 2025], https://www.eba.europa.eu/sites/default/files/2025-01/fb22982a-d69d-42cc-9d62-1023497ad58a/Final%20Guidelines%20on%20the%20management%20of%20ESG%20risks.pdf.

7 Iris H.Y. Chiu (2022). The EU Sustainable Finance Agenda: Developing Governance for Double Materiality in Sustainability Metrics, *European Business Organization Law Review*, 23(1), pp. 87–123, DOI: 10.1007/s40804-021-00229-9.

preventing them. The challenge is therefore not merely operational but also structural: EU law stops short of turning sustainability information into sufficiently clear ex ante limits on lending decisions.

Against this background, the study asks how EU law can make more deliberate use of banks' credit allocation function as an instrument of green finance. Its central argument is that the current framework is limited not only by implementation challenges, but also by three structural gaps that reduce its ability to influence financing decisions before harm occurs. The first is an environmental harm finance gap, in which lenders remain largely outside legal regimes addressing climate and biodiversity impacts, even though financing can enable high-impact activity.[8] The second is a downstream due diligence gap, in which financial institutions continue to face limited obligations regarding the environmental consequences of the companies and projects they finance.[9] The third is an ex ante steering gap, in which sustainability objectives have expanded across the regulatory framework, yet binding mechanisms to restrict, condition or redirect credit before environmentally harmful activity is funded remain scarce.[10] Taken together, these gaps help explain why EU sustainable finance law has become more effective at tracing harmful financial patterns than at preventing them.

This study develops credit as conservation policy as its core governance lens. The concept rests on the premise that credit should not be understood only as a financial resource, but also as a legal and institutional mechanism that shapes which activities become possible, scalable, and durable within the real economy. Decisions concerning whether credit is approved, structured, priced, monitored or withheld do not merely allocate capital; they influence whether environmentally harmful activity can proceed with financial support. From this perspective, lending is not external to environmental governance. Rather, it constitutes one of the key points at which environmental governance can intervene in advance. This framing allows the study to move beyond a disclosure-centred account of sustainable finance

---

8 Organisation for Economic Co-operation and Development, *Biodiversity, Natural Capital and the Economy: A Policy Guide for Finance, Economic and Environment Ministers*, no. 26, OECD Environment Policy Papers (OECD, 2021), https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/05/biodiversity-natural-capital-and-the-economy_940af1d4/1a1ae114-en.pdf.

9 Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on Corporate Sustainability Due Diligence and Amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859, Directive (EU) 2024/1760 2024/1760(2024), https://eur-lex.europa.eu/eli/dir/2024/1760/oj/eng.

10 European Central Bank, *Guide on Climate-Related and Environmental Risks: Supervisory Expectations Relating to Risk Management and Disclosure* (European Central Bank, 2020), https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.202011finalguideonclimate-relatedandenvironmentalrisks~58213f6564.en.pdf.

and towards a more direct understanding of how financial law can influence environmental outcomes before harm occurs.

Methodologically, this study combines qualitative doctrinal analysis with institutional mapping. Doctrinal analysis is used to examine the content, structure and legal effects of the relevant EU instruments. Institutional mapping, as employed here, does not refer to the study of formal organisations as such. Rather, it refers to the practice of tracing how different regulatory instruments interact across legal and supervisory settings, identifying the governance functions they perform, the gaps they leave unresolved, and the points at which they could be connected more coherently around a shared regulatory objective. Together, these two methods allow the study to move between close analysis of legal texts and a broader assessment of how the framework operates as a whole. Rather than reading taxonomy, disclosure, prudential supervision and due diligence as separate regulatory fields, it brings them together to show how they collectively shape the governance of finance.[11] From this perspective, the study argues that EU law already contains the foundations of an emerging regime of environmental governance through finance, even if that regime remains fragmented and only partly recognised in current legal debate.[12] The difficulty, therefore, is not the absence of legal instruments, but the absence of a coherent account of how these instruments can be connected to the ex ante steering of credit away from environmentally harmful activity. By reconstructing those links, this study seeks to make that underlying regulatory logic more visible.

Building on this analysis, the study proposes an ex ante lending toolkit that places credit assessment and disbursement within the legal framework of environmental governance. It draws on familiar compliance practices, such as screening triggers, tiered due diligence, monitoring, escalation, and audit trails, and adapts them to the environmental context of EU green finance. Its purpose is not to replace the existing framework, but to enable it to work more coherently and more preventively at the point where financing decisions are made. At the same time, the study stresses that any move towards credit steering must remain reviewable and accountable, particularly where decisions on risk, collateral and capital allocation may render certain individuals, firms, or regions effectively unbankable, affect local communities, or raise broader concerns of democratic oversight. The discussion therefore moves from diagnosis to proposal. It begins by identifying the structural limits of

11 Dirk A. Zetzsche, Linn Anker-Sørensen (2022). Regulating Sustainable Finance in the Dark, *European Business Organization Law Review*, 23(1), pp. 47–85. DOI: 10.1007/s40804-021-00237-9.

12 Agnieszka Smoleńska, Jens Van 'T Klooster (2022). A Risky Bet: Climate Change and the EU's Microprudential Framework for Banks, *Journal of Financial Regulation*, 8(1), pp. 51–74. DOI: 10.1093/jfr/fjac002.

the current framework, then develops the concept of credit as conservation policy, reconstructs the emerging regime of environmental governance through finance, and finally presents an ex ante lending model together with the safeguards needed to keep it legally disciplined and institutionally legitimate.

2. The limits of the current EU sustainable finance framework

A common view is that the European Union already possesses a coherent sustainable finance framework and that the principal challenge is to simply implement it more effectively. The reality is more complex. Although the framework is extensive, it remains centred mainly around classification, disclosure, reporting and prudential risk management rather than on clear ex ante limits on lending to environmentally harmful activity.[13] This design is not accidental. The European Commission itself defines sustainable finance as the integration of environmental, social and governance considerations into financial decision-making, including the management of related risks.[14] At the core of this framework are the Taxonomy Regulation, the Sustainable Finance Disclosure Regulation (SFDR), and the Corporate Sustainability Reporting Directive (CSRD).[15] Alongside them, the prudential layer has pushed climate, environmental and broader ESG concerns into banks' governance, risk management, and monitoring processes.[16] Together, these instruments form a dense and increasingly connected regime. Nevertheless, they remain more effective at generating sustainability information and making risks visible than at determining when credit should be withheld, conditioned or redirected before harmful activity receives financing.

The current EU framework is not built around a single law or a unified theory of green finance. Instead, it consists of a range of regulatory tools, each designed to perform a distinct function. The Taxonomy Regulation provides the basic classification

---

13 Dimitri Demekas, Pierpaolo Grippa (2022). Walking a Tightrope: Financial Regulation, Climate Change, and the Transition to a Low-Carbon Economy, *Journal of Financial Regulation*, 8 (2), pp. 203–229. DOI: 10.1093/jfr/fjac010.

14 European Commission, "Overview of Sustainable Finance," European Commission, n.d., https://finance.ec.europa.eu/sustainable-finance/overview-sustainable-finance_en.

15 Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment (EU Taxonomy Regulation), OJ L 198, 22.6.2020; Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (SFDR), OJ L 317, 9.12.2019; Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Directive 2013/34/EU as regards corporate sustainability reporting (CSRD), OJ L 322, 16.12.2022.

16 European Banking Authority, *Final Report on Guidelines on the Management of Environmental, Social and Governance (ESG) Risks*.

system. The SFDR focuses on disclosure by financial market participants and advisers. The CSRD increases the amount of sustainability information that companies must report to the market. Alongside these rules, the prudential side of the framework has pushed climate, environmental and broader ESG issues into governance, internal controls, risk management and supervision.[17] More recently, EU law has also moved towards due diligence obligations, adding another layer to the broader sustainability architecture.[18] What matters for this study is that these instruments do not operate in the same way. Some classify economic activities, some disclose information, some generate data, while others incorporate sustainability concerns into supervisory processes. As a result, the framework can appear comprehensive at first glance, while still leaving financial institutions without clear legal guidance with regard to financing environmentally harmful activity.[19]

Table 1 identifies the core EU instruments most relevant to this study, focusing on the elements of the sustainable finance framework that shape classification, disclosure, reporting, bank risk management, and due diligence.

Table 1. Core EU sustainable finance instruments

Instrument	Core Function
EU Taxonomy Regulation (Regulation (EU) 2020/852)	Establishes the EU classification system for environmentally sustainable activities.
SFDR (Regulation (EU) 2019/2088)	Requires financial market participants and advisers to disclose how they consider sustainability risks and principal adverse impacts.
CSRD and ESRS	Expands corporate sustainability reporting and standardises sustainability information available to markets and financial institutions.
Banking prudential layer: CRR3 / CRD6, EBA Guidelines on the Management of ESG Risks, and the ECB Guide on Climate-related and Environmental Risks	Brings climate, environmental and broader ESG issues into bank governance, internal controls, risk management, supervision, and credit processes.
CSDDD (Directive (EU) 2024/1760)	Introduces sustainability due diligence obligations regarding human rights and environmental adverse impacts.

Source: Author's own compilation based on the European Commission sustainable finance overview, the EU Taxonomy Regulation, SFDR, CSRD and ESRS, the EBA Guidelines on the Management of ESG Risks, and Directive (EU) 2024/1760.

17 María J. Nieto, Chryssa Papathanassiou (2024). Financing the Orderly Transition to a Low Carbon Economy in the EU: The Regulatory Framework for the Banking Channel, *Journal of Banking Regulation*, 25(2), pp. 112–126. DOI: 10.1057/s41261-023-00219-6.

18 Daniel Litwin, Elsa Savourey (2025). Human Rights in EU Sustainable Finance, *Journal of Financial Regulation*, 11(1), pp. 41–72. DOI: 10.1093/jfr/fjaf001.

19 Alperen A. Gözlügöl (2025). Credit Substitution in Sustainable Finance: An Achilles Heel?, *Journal of Financial Regulation*, 12(1), pp. 34–66. DOI: 10.1093/jfr/fjaf011.

What matters at this stage is that a broad framework is not the same as a preventive one. Much of the current EU approach is designed to improve classification, transparency, comparability and risk visibility. These functions are important, but they do not in themselves tell banks when lending should be restricted, conditioned or refused before environmentally harmful activity receives funding. This is where the framework's central weakness becomes clear. It is neither empty nor irrelevant, but it remains better equipped to make sustainability concerns legible than to turn them into clear ex ante consequences for credit allocation.

2.1. Three structural gaps in EU sustainable finance

The weaknesses of the current EU framework do not manifest themselves in a single form. Rather, they emerge through three connected structural gaps that limit the framework's ability to influence financing decisions before environmental harm occurs. Together, these gaps help explain why EU sustainable finance law has become more effective at identifying environmentally harmful financial patterns than at preventing the flow of credit that could sustain them.

The first structural weakness is the environmental harm finance gap. The problem is not that finance sits entirely outside the EU sustainability framework. Rather, the problem is that lenders are still not fully treated as actors within legal regimes that address environmental harm as harm, even though financing can make harmful activity possible, scalable, and durable. In practice, the framework more often treats banks as institutions managing their own exposure to climate, environmental and broader ESG risks than as institutions whose lending decisions may help sustain environmentally damaging activity.[20] That difference matters. A system primarily focused on financial risk asks whether environmental harm may create financial consequences for the lender. It does not necessarily ask – or at least not clearly enough – whether the financed activity should proceed in the first place.

This gap becomes especially visible in activities linked to deforestation, biodiversity loss, and ecosystem degradation.[21] In such contexts, credit is rarely neutral. It can help projects move forward, expand or remain economically viable. Yet the current legal architecture still stops short of attaching clear ex ante consequences

---

20 Marlena Smuda-Kocoń (2025). Reconfiguring the Risk of Financial Organizations as a Consequence of the Green Transition and a Potential Source of 'Green Swan Events', *Journal of Management and Financial Sciences*, 53, pp. 85–102. DOI: 10.33119/JMFS.2024.53.5.

21 Organisation for Economic Co-operation and Development, *Biodiversity, Natural Capital and the Economy: A Policy Guide for Finance, Economic and Environment Ministers*.

to decisions to finance such activity. Sustainability concerns may enter the decision-making process through disclosure obligations, data generation, or risk management requirements, but they do not consistently provide a legal basis for restricting, conditioning or refusing credit before harm is further enabled. This is the core problem identified here. EU sustainable finance law increasingly makes environmental harm visible, but it still does not clearly treat the financing of that harm as a point of legal intervention in its own right.[22]

The problem becomes particularly visible when a European bank extends a credit facility to a company whose supply chain involves significant land clearance in a high biodiversity region. Under the current framework, the bank may disclose its exposure, classify part of its portfolio against the Taxonomy, and identify the risk in its ESG governance reporting. Yet none of those steps requires it to ask, in a structured and legally consequential way, whether the financing should proceed at all. The credit can still be extended, and the environmental concern remains visible without becoming decisive.

The second structural weakness is the downstream due diligence gap. The issue here is not simply whether sustainability due diligence exists in EU law; it clearly does. Rather, the problem is that financial institutions continue to face limited obligations when it comes to the downstream environmental consequences of the companies, projects and activities they finance. In other words, the legal framework has moved significantly towards recognising due diligence as an element of responsible business conduct, but it still does not fully translate that logic into the financing relationship itself. This leaves a substantial distance between the act of lending and the environmental effects that lending may help sustain.

That distance matters because finance does not sit outside the life cycle of environmentally harmful activity. It often helps make such activity possible in the first place and, just as importantly, helps keep it economically viable over time. Yet the law continues to focus more on the borrower's conduct than on the lender's role in enabling that conduct. Even where due diligence obligations have expanded, they do not consistently require banks and other financial institutions to examine, with the same degree of scrutiny, the downstream environmental consequences of what they finance. The result is a framework in which environmental harm may be easier to identify than to interrupt through the lending process itself.

---

22 Sebastian Steuer, Tobias H. Tröger (2022). The Role of Disclosure in Green Finance, *Journal of Financial Regulation*, 8(1), pp. 1–50. DOI: 10.1093/jfr/fjac001.

A straightforward example is project finance extended to infrastructure development in a sensitive ecosystem. The lender may undertake general due diligence on the borrower's financial health and legal standing. It may also review environmental permits or controversy indicators within the credit assessment process. However, there is no clear legal obligation requiring it to examine whether its financing materially enables the environmental harm associated with that project, or to treat that examination as capable of changing the lending decision. The gap between what is financed and what the law requires the lender to consider about the downstream environmental consequences of that financing therefore remains substantial.

The third structural weakness is the ex ante steering gap. This is where the limitations of the current framework become most apparent. Sustainability considerations now run through much of EU financial regulation. Environmental risks must be disclosed, classified, measured, monitored and increasingly discussed inside institutions. Yet this does not mean that the law provides banks with equally clear guidance on what should happen before credit is approved or disbursed. The framework is rich in sustainability language, yet still comparatively thin when it comes to binding mechanisms that would require lenders to restrict, condition, escalate, or refuse financing on environmental grounds.

This gap is easy to overlook because disclosure and risk management can create the appearance of strong control. In practice, however, they often stop at visibility. A bank may possess more information about a borrower's environmental exposure, receive higher-quality sustainability data, and integrate those concerns into internal governance. Even so, the law rarely specifies when such information must lead to a different lending outcome. More information does not automatically produce more guidance. That is the less obvious weakness of the current framework: it improves legibility without necessarily producing binding ex ante consequences for credit allocation.

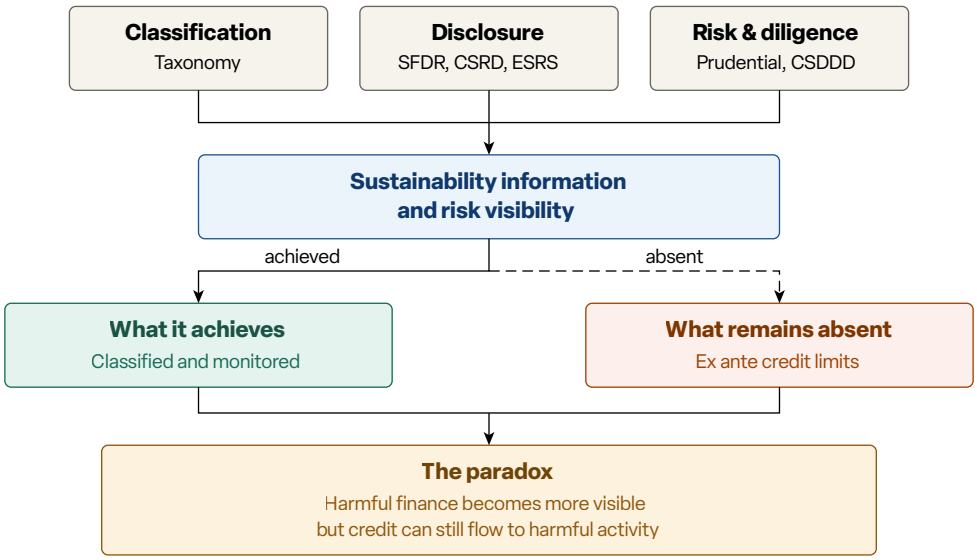
This becomes visible whenever a lender receives improved sustainability disclosures from a borrower operating in a high-risk sector, integrates that information into its ESG risk dashboard, and nevertheless proceeds with financing on standard terms. The information has improved the institution's visibility, but it has not altered the lending outcome. This gap between knowledge and action is precisely what the ex ante steering gap describes, and it is the gap that the toolkit proposed in Section IV is designed to close.

Taken together, these three gaps reveal a common pattern. The current EU framework is broad, increasingly sophisticated, and no longer peripheral to financial regulation. It can classify sustainable activity, generate substantial amounts

of sustainability information, and translate environmental concerns into governance and risk management language. What it still does not do clearly enough is connect those tools to the lending decision itself. The framework is therefore better equipped at making harmful finance visible than preventing it before capital is committed. This diagnosis also clarifies the next step in the argument. The problem is not the complete absence of legal materials, nor merely a matter of weak implementation. The deeper issue is that the existing framework has not yet been reconstructed around the idea that credit allocation itself can function as a mechanism of environmental governance.

Figures 1 and 2 summarise this diagnosis by demonstrating, first, the paradox of the current framework and, second, the three structural gaps that limit its preventive capacity.

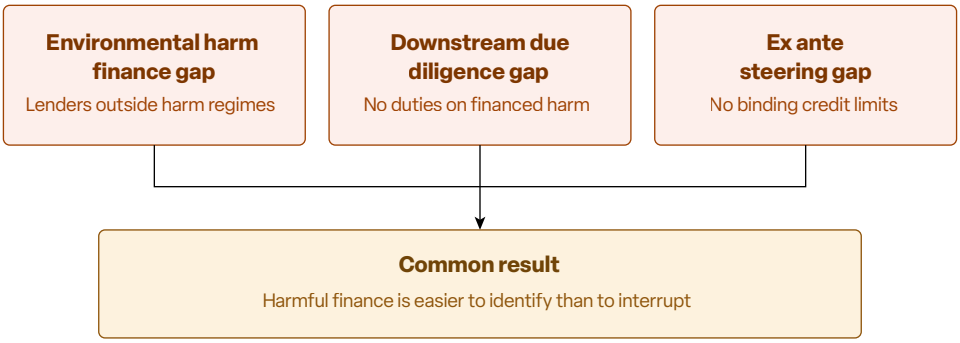
Figure 1. The paradox of EU sustainable finance



Source: Author's own elaboration.

Figure 1 shows the basic paradox of EU sustainable finance: more visibility does not necessarily translate into more prevention. That weakness does not arise in one single place: it emerges through three connected structural gaps, each of which limits the framework's ability to influence lending decisions before harm occurs. Figure 2 brings these gaps together and demonstrates how they produce a common result: harmful finance becomes easier to identify than to interrupt.

Figure 2. The three structural gaps in EU sustainable finance



Source: Author's own elaboration.

3. Credit as a conservation policy

The argument of this study begins from a simple point that is often overlooked in discussions of sustainable finance: credit is not neutral. It does not merely reflect economic activity that already exists; it helps determine which activities become possible, scalable, and durable in the first place. When a bank approves, structures, prices, monitors or withholds financing, it does more than allocate capital. It also influences whether a project, business model, or course of activity can proceed with institutional support. In this sense, lending is not external to environmental governance. Rather, it represents one of the key points at which environmental governance can operate before harm is further enabled through the allocation of financing.

This matters because the analysis in Section II demonstrated that the current EU framework is already rich in classification, disclosure, reporting and prudential oversight, yet remains weak in one crucial respect: it does not connect these tools clearly enough to the lending decision itself. The problem, therefore, is not simply that environmentally harmful finance continues despite the presence of sustainable finance rules. The deeper issue is that the law still tends to treat sustainability information as something to be generated, disclosed and managed, rather than as something that should influence whether financing should proceed at all. If that diagnosis is correct, then the next step is not only to identify additional gaps. It is to rethink the legal significance of lending itself.

This is where the ex ante dimension becomes important. In this study, ex ante credit steering refers to environmental assessment conducted before credit is approved and before funds are disbursed. The key question is not merely whether environmental

harm becomes visible after financing is extended, but whether the lender should intervene at the stage where it still has meaningful control over whether financing proceeds, on what terms, and subject to which conditions. This timing point is critical. Once funds have been disbursed, the lender's practical and legal leverage tends to narrow rapidly and becomes harder to exercise. If environmental governance is to be preventive rather than merely descriptive, it must matter at the point of approval and disbursement.[23]

This study draws institutional inspiration from a logic already deeply embedded in banking practice: the preventive approach that financial institutions apply before money moves in anti-money laundering (AML) and counter-terrorist financing (CFT) controls. The key point is not the full architecture of those controls, but one specific feature of how they work. When a bank identifies a transaction as high risk, it does not simply record that finding and proceed.[24] It pauses. It asks whether the transaction should proceed at all, on what terms, and subject to what level of additional scrutiny.[25] In some cases, it refuses or delays disbursement entirely. The argument here is that a similar moment of structured institutional pause can be incorporated into the lending process for environmentally harmful credit. The concern would not be illicit finance, but the potential enabling of serious environmental damage. The analogy, therefore, does not collapse environmental law into AML.[26] Rather, it illustrates that banks already have an institutional model, tested in daily practice, for exercising judgment before money moves.

On that basis, this study develops credit as conservation policy as its central governance concept. The core idea is that the lending process itself becomes part of the legal architecture of environmental prevention. Rather than treating screening, due diligence, and disbursement controls as purely internal banking techniques, the concept asks what those stages should acquire when proposed financing is linked to serious environmental harm.[27] Credit as conservation policy does not mean that

---

23 Leonie Reins, Tellervo Ala-Lahti (2025). Innovation, Precaution, and Sustainable Development in EU Environmental Law – a False Trichotomy?, *Journal of Environmental Law*, eqaf032. DOI: 10.1093/jel/eqaf032.

24 Financial Action Task Force, *International Standards on Combating Money Laundering and the Financing of Terrorism & Proliferation: The FATF Recommendations* (Financial Action Task Force, 2012), https://www.fatf-gafi.org/content/dam/fatf-gafi/recommendations/Feburary%202025%20FATF%20Recommendations.pdf.

25 Financial Action Task Force, *Guidance for a Risk-Based Approach: The Banking Sector* (Financial Action Task Force, 2014), https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Risk-Based-Approach-Banking-Sector.pdf.coredownload.pdf.

26 Beny Saputra (2021). Modelling Australian Transaction Reports and Analysis Centre (AUSTRAC) for Indonesia in Order to Combat Financial Crime, *NEGREI: Academic Journal of Law and Governance*, 1(2), 81. DOI: 10.29240/negrei.v1i2.3822.

27 European Banking Authority (2020). *Final Report. Guidelines on Loan Origination and Monitoring*, EBA/GL/2020/06 (European Banking Authority, 2020), https://www.eba.europa.eu/sites/default/files/document_library/Publications/Guidelines/2020/Guidelines%20on%20loan%20origination%20and%20

every environmental concern automatically results in refusal. Instead, it means that the lending decision becomes a legally meaningful point at which environmental concerns can produce differentiated credit consequences, conditioning, escalation, enhanced review, or in appropriate cases refusal, before harm is further enabled through the movement of funds.

This concept also needs to be distinguished from several adjacent ideas. Conservation finance typically focuses on directing capital towards projects that generate environmental benefits,[28] restoration, biodiversity offsets, or green infrastructure. That is a different question from the one addressed in this study. Green credit policy, in its broadest sense, concerns how lending systems can support sustainable economic transitions, but it does not necessarily address what a lender should do when facing a specific financing decision linked to potential environmental harm. Disclosure-based sustainable finance, which underpins much of the current EU framework, improves what markets and supervisors can see, but it does not by itself determine what follows from that visibility at the moment of credit approval.[29] Credit as conservation policy asks a more specific question than any of these approaches. It focuses on the lending decision prior to approval and disbursement and examines what existing legal tools should require, enable, or structure when proposed financing is linked to significant environmental harm. This is the original move. It lies not simply in directing capital towards more sustainable outcomes. It is about deciding, in a structured and legally reviewable way, when harmful activity should not proceed on ordinary financing terms.

What makes this framing genuinely distinct from earlier approaches is its focus on the individual credit decision as the operative legal moment, rather than on portfolio alignment, system-level taxonomy reform, or post-disbursement accountability. Existing contributions to green credit theory have largely addressed the financial system at the aggregate level, asking how lending portfolios can be steered towards sustainability over time through classification systems, pricing incentives, or capital charges. This study asks a more targeted question: what should happen before a specific credit facility is approved, at the point where the lender still holds real institutional leverage over whether a potentially harmful activity proceeds with financial

monitoring/884283/EBA%20GL%202020%2006%20Final%20Report%20on%20GL%20on%20loan%20origination%20and%20monitoring.pdf.

28 Simona Cosma, Giuseppe Rimo, Stefano Cosma. (2023). Conservation Finance: What Are We Not Doing? A Review and Research Agenda, *Journal of Environmental Management*, (336), 117649. DOI: 10.1016/j.jenvman.2023.117649.

29 Nadia Ameli, Paul Drummond, Alexander Bisaro, Michael Grubb, Hugues Chenet. (2020). Climate Finance and Disclosure for Institutional Investors: Why Transparency Is Not Enough, *Climatic Change*, 160(4), pp. 565–589. DOI: 10.1007/s10584-019-02542-2.

support. This shift in analytical focus, from the portfolio to the lending decision, from the system to the institution, and from transparency to prevention, is what credit as conservation policy contributes as a governance concept rather than simply a policy aspiration.

This reframing matters because it changes the legal focus. Once lending is treated as a point of environmental governance, sustainability law no longer appears limited to what firms disclose, what markets know, or what supervisors can observe after the fact. Instead, it extends to the institutional moment at which financing is screened, assessed, escalated, conditioned or refused. That represents a significant shift. The central issue is no longer merely whether environmental risk becomes visible within financial markets, but whether that visibility generates consequences before funds are released.[30] Put differently, the concern is no longer only what the market knows, but also what the lender should do with that knowledge.

This does not require discarding the current EU framework or imagining banks as free-floating environmental regulators. The argument is narrower and more grounded. EU law already contains several legal elements that make this approach plausible. The Taxonomy provides a classification structure. Disclosure and reporting rules generate sustainability information and comparability. Prudential supervision incorporates climate, environmental and broader ESG considerations into governance, controls, and internal decision-making processes. Due diligence introduces a responsibility-oriented logic that begins to connect economic activity with environmental harm. None of these instruments, taken in isolation, creates a full ex ante environmental lending regime. Taken together, however, they already point towards a more integrated understanding of how finance can function as a site of environmental governance.

Credit as conservation policy is therefore not a departure from the existing EU framework.[31] Rather, it offers a way of reconstructing its scattered elements around the one point where environmental governance can still shape whether money moves at all. The concept helps explain why the current framework can appear incomplete despite its growing density: its instruments classify, disclose and manage, but they do not yet converge at the lending decision in a sufficiently clear or structured way.

---

30 Enrico Partiti (2024). Addressing the Flaws of the Sustainable Finance Disclosure Regulation: Moving from Disclosures to Labelling and Sustainability Due Diligence, *European Business Organization Law Review*, 25(2), pp. 299–332. DOI: 10.1007/s40804-024-00317-6.

31 See Regulation (EU) 2020/852 (Taxonomy Regulation); Regulation (EU) 2019/2088 (SFDR); Directive (EU) 2022/2464 and Commission Delegated Regulation (EU) 2023/2772 (CSRD and ESRS); European Banking Authority, *Final Report. Guidelines on the Management of ESG Risks*, EBA/GL/2025/01(2025); and Directive (EU) 2024/1760 (CSDDD).

The next section builds on this diagnosis and translates the concept into a concrete ex ante environmental lending model for credit assessment, disbursement, monitoring and review.

4. An ex ante environmental lending toolkit for EU green finance

The argument so far has been primarily conceptual. This section turns to the more difficult question of institutional design. If credit is understood as a site of environmental governance, the next step is to consider how that idea can actually shape the processes through which banks assess, approve, condition and disburse financing. The aim is not to build an entirely new body of law from scratch. Rather, it is to show how existing legal materials can be drawn more directly into the lending process so that environmental concerns matter before funds are released, rather than appearing only later through disclosure, controversy or financial loss.

The model proposed here draws on something that financial institutions already understand and apply.[32] They already make consequential judgments before funds are transferred. Within AML and CFT systems,[33] they screen transactions, classify risk, escalate cases of concern, and in some situations delay or refuse the transfer of funds before a transaction is completed.[34] The proposal advanced here adapts that preventive logic to the environmental context. The issue is no longer illicit finance, but whether a proposed credit facility would enable, sustain, or expand activity associated with serious environmental harm. In practical terms, this is what ex ante environmental credit steering entails: environmental assessment becomes an integral part of the credit decision itself, before approval and disbursement.

At this point, the central issue is no longer whether sustainable finance should generate better data or greater transparency. Those debates are already well established. The more important question is what lenders should actually do with

---

32 Financial Action Task Force, *International Standards on Combating Money Laundering and the Financing of Terrorism & Proliferation: The FATF Recommendations*.

33 Directive (EU) 2015/849 of the European Parliament and of the Council of 20 May 2015 on the Prevention of the Use of the Financial System for the Purposes of Money Laundering or Terrorist Financing, Amending Regulation (EU) No 648/2012 of the European Parliament and of the Council, and Repealing Directive 2005/60/EC of the European Parliament and of the Council and Commission Directive 2006/70/EC Authority: European Parliament and Council of the European Union, Directive (EU) 2015/849(2015), https://eur-lex.europa.eu/eli/dir/2015/849/oj/eng.

34 See Directive (EU) 2015/849, as amended by Directive (EU) 2018/843, and Financial Action Task Force, *The FATF Recommendations*; see also Regulation (EU) 2024/1624 and Directive (EU) 2024/1640.

environmental information when it matters most, namely when deciding whether, and on what terms, to extend credit. The model developed in this study proposes a structured environmental lending toolkit that moves environmental assessment from the edge of the process to its operational centre. Under this approach, serious environmental red flags should be capable of triggering differentiated lending consequences in a way that is proportionate, reviewable and legally disciplined.

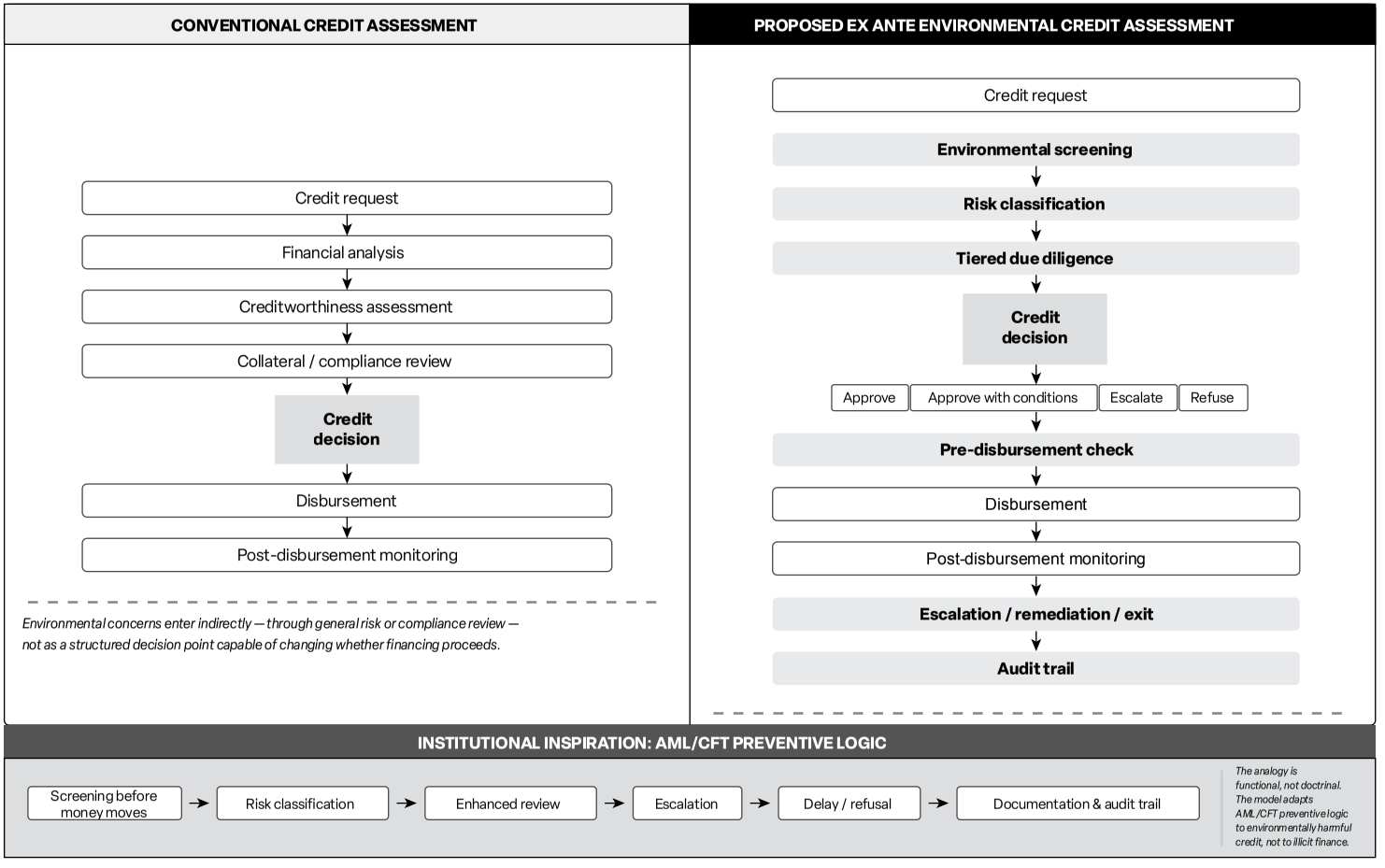
Figure 3 illustrates this shift by contrasting the conventional credit process with the proposed ex ante environmental lending model.

Figure 3 illustrates the core distinction. In the conventional model, environmental concerns may still arise, but they typically appear indirectly through general risk, compliance, or reputational review. In the proposed model, by contrast, environmental assessment becomes a structured decision point inside the credit process itself. This shift represents the central contribution of the toolkit. It does not replace traditional financial analysis, creditworthiness review, or collateral assessment. It adds a distinct layer of environmental screening and escalation before approval and before disbursement, at the stage where the lender still retains meaningful influence over whether financing proceeds at all.

The process begins with initial environmental screening. This stage is designed to identify whether the borrower, project, or activity raises environmental red flags serious enough to require closer review. The purpose is not to deliver a final judgment at the outset but to prevent environmental concerns from remaining invisible or being absorbed too quickly into generic risk language. At this stage, the lender asks a basic but important question: does the proposed financing involve sectoral exposure, geographic sensitivity, biodiversity risk, deforestation indicators, controversy history, or a mismatch between sustainability claims and the underlying activity? If the answer is yes, the file should not proceed as if nothing unusual was at stake.

The next step is environmental risk classification, and its importance lies precisely in the differentiation it creates. A low-risk case may proceed through ordinary review, while medium- or high-risk cases should trigger deeper scrutiny. In particularly serious cases, the activity may fall into a category of unacceptable risk altogether. By creating a structured basis for these distinctions, the model avoids a false choice between automatic approval and automatic refusal. More importantly, it emphasises that environmental concerns can alter the pathway of credit assessment before funds are released, rather than remaining only as background information on file.

Figure 3. From Conventional Credit Assessment to Ex Ante Environmental Credit Assessment



Source: Author's own elaboration.

Where the screening and classification stages identify more serious concerns, the model moves to tiered due diligence, where the lender calibrates the level of scrutiny to the degree of environmental risk. In lower risk cases, standard review may be enough, but in more serious cases, the lender should require enhanced documentation, closer examination of the borrower's environmental profile, project-level impacts, governance arrangements, and the credibility of any mitigation or transition commitments. This is also the stage at which specialist input or escalation to more senior review may become necessary. This calibrated approach already has empirical precedent in international banking practice. The Equator Principles, adopted by over 130 financial institutions worldwide,[35] require project finance lenders to conduct an environmental and social impact assessment at loan origination for projects exceeding specific thresholds, with the depth of review calibrated to the environmental sensitivity of both the project and its location.[36] The proposed toolkit adapts that same logic from the specialised project finance context to the broader field of corporate lending, where no equivalent structured environmental assessment currently exists at the level of individual credit decisions under EU law. The gap between what the Equator Principles achieve in project finance and what EU law currently requires in general corporate lending is itself a measure of how far the framework still has to travel. Due diligence is no longer external to the lending decision. Instead, it becomes part of the decision architecture that determines whether the credit should proceed, under what conditions, and with what safeguards.

Where the model most clearly departs from conventional practice is at the credit decision and pre-disbursement stage. Rather than confronting only a binary choice between approval and refusal, the lender can approve, approve with conditions, escalate for further consideration, or refuse financing where the environmental concerns are too serious to justify ordinary financing. Even where approval is granted, disbursement should not be treated as automatic. A pre-disbursement review should confirm that any environmental conditions, documentary requirements, or escalation measures have actually been satisfied before funds are released. This is what gives the model its genuinely ex ante character. Environmental assessment matters at the point when the lender still has legal and practical influence over whether financing proceeds at all.

---

35 Equator Principles Association, *Equator Principles Activity Report 2023* (Equator Principles Association, 2024), https://equator-principles.com/app/uploads/Equator-Principles-Activity-Report-2023-FINAL.pdf.

36 Equator Principles Association, *The Equator Principles: A Financial Industry Benchmark for Determining, Assessing and Managing Environmental and Social Risk in Projects*, EP4 (Equator Principles Association, 2020), https://equator-principles.com/app/uploads/The-Equator-Principles_EP4_July2020.pdf.

The process should not end at disbursement. A preventive model loses credibility if environmental concerns disappear the moment funds have been released. Post-disbursement monitoring therefore remains essential and may include covenant review, updated sustainability information, and controversy monitoring. Where new red flags emerge, the lender should be able to escalate the case, require corrective action, tighten conditions, or, in serious situations, reconsider the relationship altogether. Equally important is the existence of a clear audit trail. Decisions should be documented, reasons should be traceable, and the exercise of judgment should remain reviewable. Without that discipline, environmental credit steering risks becoming arbitrary; with it, the model becomes more legally credible and institutionally defensible.

What this toolkit offers is not a substitute for public environmental regulation, nor a claim that banks alone can address ecological harm through private decision-making. Its contribution is narrower and more practical. It identifies the lending process as a point at which existing legal instruments can be organised into a more preventive structure, one that asks not only what environmental harm might mean for the bank, but also what the bank should do before financing helps that harm proceed. In this sense, the ex ante environmental lending toolkit represents the operational expression of credit as conservation policy.

That claim, however, is persuasive only if the toolkit can be grounded in existing legal materials rather than presented as something entirely new. The model proposed here is not assembled from scratch. Each of its core components finds support, to varying degrees, within EU legal instruments already in force. Read together, they reveal an emerging but still fragmented legal foundation for ex ante environmental credit governance.

The initial environmental screening stage draws most directly on the EU Taxonomy Regulation, which establishes a classification system for environmentally sustainable economic activities based on defined technical screening criteria. Where a borrower's activities fall outside taxonomy alignment, or where alignment is claimed but difficult to verify, that classification gap is itself an environmental red flag warranting closer review. The Taxonomy does not currently require lenders to conduct such screening at the point of credit approval, but its classification logic supplies the substantive criteria on which a screening mechanism could be built.

The environmental risk classification stage finds support in the EBA Guidelines on the Management of ESG Risks, which require institutions to develop methodologies for identifying, measuring and managing environmental risks across their credit portfolios. These guidelines already contemplate sector-based and exposure-based risk differentiation and expect institutions to translate ESG risk assessments into their

credit processes. The proposed toolkit formalises what the EBA Guidelines already point towards: a structured basis for classifying borrowers and activities according to their environmental risk profile before credit is approved and disbursed.

The tiered due diligence stage builds on both the EBA Guidelines and the ECB Guide on Climate-Related and Environmental Risks, which sets out supervisory expectations for how banks should integrate environmental considerations into their lending and internal governance processes.[37] The ECB Guide explicitly envisages enhanced due diligence in situations involving elevated climate or environmental risk, including at the loan origination stage. The proposed toolkit translates that supervisory expectation into a legal design that calibrates the depth of environmental review to the degree of risk identified during the classification stage.

The credit decision consequences stage, particularly the four-outcome framework of approval, approval subject to conditions, escalation, and refusal, draws on the existing architecture of credit risk governance under the Capital Requirements Regulation and CRD framework, which already require institutions to maintain sound credit-granting criteria and documented decision-making processes. The incorporation of environmental conditionality as a structured lending consequence is consistent with the existing framework, even if it extends beyond what current law explicitly requires.

The pre-disbursement review and audit trail requirements find support in the EBA Guidelines on Loan Origination and Monitoring, which already require institutions to maintain robust documentation of credit decisions, monitor loan covenants, and retain records that enable supervisory review. Extending these documentation and monitoring obligations to environmental conditions represents a natural development within the existing prudential framework rather than a departure from it.

Finally, the due diligence logic of the Corporate Sustainability Due Diligence Directive (CSDDD), while currently limited in its direct application to financial institutions, introduces a responsibility-oriented framework that increasingly connects economic relationships with environmental harm. Its underlying principle – that actors in a value chain bear some responsibility for the downstream consequences of their decisions – is directly relevant to the lending relationship and points towards a legal trajectory in which pre-disbursement reviews could eventually become a statutory requirement rather than merely a supervisory expectation.

---

37 European Central Bank, *ECB 2022 Thematic Review: Walking the Talk: Banks Gearing up to Manage Risks from Climate Change and Environmental Degradation: Results of the 2022 Thematic Review on Climate-Related and Environmental Risks* (European Central Bank, 2022), https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.thematicreviewcerreport112022~2eb322a79c.en.pdf.

Taken together, these instruments do not yet constitute a complete ex ante environmental lending regime. They do, however, supply the legal vocabulary, classification logic, risk methodology, and documentation standards upon which such a regime could be built. The toolkit proposed here is therefore less a departure from EU law than a reorganisation of elements already embedded within it.

This toolkit is persuasive only to the extent that it remains constrained by clear safeguards. The objective is not to give lenders unlimited discretion to deny financing whenever environmental concerns arise, nor to convert banks into general environmental regulators operating without legal limits. A workable model must remain proportionate, reviewable, and anchored in identifiable criteria. Environmental screening should therefore rely on structured indicators rather than vague moral judgment, risk classification should follow articulated thresholds, and any escalation or refusal should be tied to reasons that can be documented and defended. Without such constraints, the model would invite arbitrariness. With them, it becomes a disciplined form of ex ante environmental credit governance.

A second safeguard concerns the risks of unbankability and broader distributive effects. Any attempt to steer credit away from environmentally harmful activity creates the risk that borrowers, sectors or communities may be excluded from finance in ways that are too blunt or socially disruptive. This concern should be taken seriously. It is one reason why the model proposed here does not treat every environmental concern as a basis for automatic refusal. A more defensible approach is one of differentiated response: standard review where risk is limited, enhanced scrutiny where concerns are more serious, conditionality where mitigation is plausible, and refusal only where the environmental risk is sufficiently grave that ordinary financing cannot be justified. Viewed in this way, the toolkit is not designed to produce blanket exclusion. Rather, it seeks to make the consequences of environmental risk more structured, more transparent, and more accountable at the point of lending.

A third safeguard concerns accountability beyond the financial institution itself. Decisions of this kind can affect not only the institution and the borrower, but also workers, local communities, and broader patterns of economic activity. For that reason, the proposed model should not be understood as a purely technical exercise in internal credit governance. Its legitimacy depends on traceable reasoning, auditable processes, and the possibility of review. Environmental credit steering should therefore remain connected to broader principles of legal certainty, procedural fairness, and democratic oversight. The aim is not to privatise environmental governance. Rather, it is simply to acknowledge that where financing plays a constitutive

role in enabling harmful activity, the lending process cannot pretend that responsibility stops at the bank's front door.

A legitimate question arising from the proposed toolkit is what legal form its adoption would realistically take. The model does not require entirely new primary legislation, which is a feature rather than a weakness. The most direct institutional pathway would be an elaboration of the EBA Guidelines on Loan Origination and Monitoring, which already establish supervisory expectations for credit granting criteria, documentation processes, and post-disbursement monitoring. Incorporating environmental screening triggers and tiered due diligence requirements into those guidelines would give the toolkit practical effect through the comply-or-explain mechanism that governs EBA soft law across the EU banking sector. A parallel pathway exists through the ECB's supervisory activities under the Single Supervisory Mechanism, which has already used its Guide on Climate-Related and Environmental Risks to set binding expectations for significant institutions in the euro area. Either vehicle would allow the core elements of the toolkit to take effect without waiting for primary legislative reform, making the model institutionally realistic in the short term. Over a longer horizon, a European Commission recommendation under the sustainable finance action plan could formalise environmental credit screening as a standard component of lending practice across the EU, embedding the toolkit within the broader green finance governance framework already in place.

Under those conditions, the toolkit holds together as both ambitious and appropriately limited. It is ambitious because it relocates environmental assessment to the point where financing can still be shaped before funds are committed. It is limited because it does not assume that bank lending can substitute for public environmental law, democratic regulation, or the broader responsibilities of the state in environmental protection. What it offers is more precise than that: a way to organise existing EU legal materials into a preventive decision structure, one that enables environmental concerns to influence financing outcomes at the stage where lenders still retain meaningful control over whether and on what terms money is released. That is a narrower claim than solving the climate crisis through finance alone.

5. Conclusion

This study began from a paradox. The European Union has developed an increasingly dense sustainable finance framework around classification, disclosure, reporting and prudential supervision, yet that framework still remains too weak

at shaping whether environmentally harmful finance proceeds before funds are committed. It has become more effective at making harmful finance flows visible, generating sustainability information, and translating environmental concerns into the language of financial risk. What it still does not do clearly enough is connect those tools to the lending decision itself. That gap is not merely technical. It is structural. As this study has argued, the current framework remains more effective at tracing harmful financial patterns than at preventing the flow of credit that can sustain them.

The analysis developed this argument through the identification of three structural gaps that, taken together, help explain why the existing framework remains incomplete despite its growing sophistication. First, lenders are still treated primarily as institutions managing their own exposure to environmental risk, rather than as actors whose financing decisions may themselves help enable harmful activity. Second, financial institutions continue to face only limited obligations regarding the environmental consequences of what they finance downstream. And third, although sustainability language has expanded considerably across the framework, binding mechanisms that would require lenders to restrict, condition, escalate or refuse financing before approval and disbursement remain scarce. The result is a framework that can increasingly classify, disclose, monitor and manage. What it still stops short of doing is clearly determining when environmentally harmful activity should not proceed on ordinary financing terms.

Against that background, the central conceptual contribution of this study has been to develop credit as conservation policy. The core claim is that credit is not neutral. It does not merely reflect economic activity that already exists; it helps determine which activities become possible, scalable and durable within the real economy. For that reason, the lending process should not be treated as external to environmental governance. It represents one of the points at which environmental governance can operate: environmentally harmful activity receives financial support. This reframing matters because it changes the legal focus. The issue is no longer confined to what markets, supervisors or institutions can see. It also concerns what lenders should do with that information at the moment financing is being assessed, approved, conditioned or withheld.

The practical contribution of this study has been to translate that insight into an ex ante environmental lending toolkit. Drawing institutional inspiration from the preventive logic already embedded in banking practice, especially in AML and CFT controls, the proposed model places environmental screening, risk classification, tiered due diligence, decision consequences, pre-disbursement review,

monitoring, escalation and auditability inside the credit process itself. Its purpose is not to turn banks into free-floating environmental regulators, nor to suggest that private finance can replace public environmental law. Its goal is narrower and more realistic. It is to demonstrate how existing EU legal materials can be organised into a more preventive structure, one that enables environmental concerns to influence financing decisions at the point where the lender still has meaningful control over whether credit is extended and under what conditions. Under that approach, serious environmental concerns do not automatically lead to refusal, but they do become capable of generating differentiated and reviewable lending consequences.

Several limitations of this study warrant acknowledgement, although the most significant of them has been partially addressed through the incorporation of empirical references throughout the analysis. The documented findings of the ECB's 2022 thematic supervisory review, the BankTrack and Greenpeace report on European banks' financing of ecosystem destruction, and the institutional experience of ING's Terra approach each help ground the three structural gaps in observed banking behaviour rather than in theoretical construction alone. Beyond these illustrative examples, however, the proposed toolkit remains conceptual and normative in character, and has not been tested against the operational realities of specific lending institutions or banking systems. The analysis is anchored in EU law and does not resolve how the model would need to be adapted for other jurisdictions, where the regulatory context, institutional culture, and legal tradition differ in important ways. In addition, the study does not resolve how environmental risk classification thresholds should be calibrated in practice, which would require empirical, sectoral and technical expertise extending beyond legal analysis alone. Finally, the interaction between the proposed toolkit and existing EU prudential regulation, particularly capital requirements and supervisory expectations under CRR and CRD, would need further elaboration before the model could be translated into binding legal instruments. These are genuine constraints, and they point towards the research agenda that this study opens rather than closes.

In that sense, the argument advanced in this study is both ambitious and appropriately limited. It is ambitious because it asks sustainable finance law to move beyond a predominantly transparency-based model and engage more directly with the institutional mechanics of credit allocation. It is limited because it does not claim that finance alone can resolve environmental harm, nor that every environmentally contested activity should become unfinanceable. What it does claim is more precise. Where financing plays a constitutive role in enabling harmful activity, the lending

process cannot remain insulated from environmental responsibility. If financing helps make environmentally harmful activity possible, then the lending process itself should become part of the legal architecture that prevents it.

References

Ameli, N., Drummond, P., Bisaro, A., Grubb, M., Chenet, H. (2020). Climate Finance and Disclosure for Institutional Investors: Why Transparency Is Not Enough, *Climatic Change*, 160(4), pp. 565–589. DOI: 10.1007/s10584-019-02542-2.

Chiu, I.H.-Y. (2022). The EU Sustainable Finance Agenda: Developing Governance for Double Materiality in Sustainability Metrics, *European Business Organization Law Review*, 23(1), pp. 87–123. DOI: 10.1007/s40804-021-00229-9.

Cosma, S., Rimo, G., Cosma, S. (2023). Conservation Finance: What Are We Not Doing? A Review and Research Agenda, *Journal of Environmental Management*, 336, 117649. DOI: 10.1016/j.jenvman.2023.117649.

Demekas, D., Grippa, P. (2022). Walking a Tightrope: Financial Regulation, Climate Change, and the Transition to a Low-Carbon Economy, *Journal of Financial Regulation*, 8(2), pp. 203–229. DOI: 10.1093/jfr/fjac010.

Directive (EU) No 2015/849. *Directive (EU) 2015/849 of the European Parliament and of the Council of 20 May 2015 on the Prevention of the Use of the Financial System for the Purposes of Money Laundering or Terrorist Financing, Amending Regulation (EU) No 648/2012 of the European Parliament and of the Council, and Repealing Directive 2005/60/EC of the European Parliament and of the Council and Commission Directive 2006/70/EC Authority: European Parliament and Council of the European Union, Directive (EU) 2015/849(2015),* https://eur-lex.europa.eu/eli/dir/2015/849/oj/eng (accessed: 03.09.2026).

Directive (EU) No 2022/2464. *Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 Amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as Regards Corporate Sustainability Reporting, Directive (EU) 2022/2464(2022),* https://eur-lex.europa.eu/eli/dir/2022/2464/oj/eng (accessed: 03.09.2026).

Directive (EU) No 2024/1640. *Directive (EU) 2024/1640 of the European Parliament and of the Council of 31 May 2024 on the Mechanisms to Be Put in Place by Member States for the Prevention of the Use of the Financial System for the Purposes of Money Laundering or Terrorist Financing, Amending Directive (EU) 2019/1937, and Amending and Repealing Directive (EU) 2024/849(2024)*, https://eur-lex.europa.eu/eli/dir/2024/1640/oj/eng (accessed: 03.09.2026).

Directive (EU) No 2024/1760. *Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on Corporate Sustainability Due Diligence and Amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859, Directive (EU) 2024/1760(2024),* https://eur-lex.europa.eu/eli/dir/2024/1760/oj/eng (accessed: 03.09.2026).

Equator Principles Association (2020). *The Equator Principles: A Financial Industry Benchmark for Determining, Assessing and Managing Environmental and Social Risk in Projects* [EP4], https://equator-principles.com/app/uploads/The-Equator-Principles_EP4_July2020.pdf (accessed: 03.09.2026).

Equator Principles Association (2024). *Equator Principles Activity Report 2023*, https://equator-principles.com/app/uploads/Equator-Principles-Activity-Report-2023-FINAL.pdf (accessed: 03.09.2026).

European Banking Authority (2020). *Final Report. Guidelines on Loan Origination and Monitoring* (EBA/GL/2020/06), https://www.eba.europa.eu/sites/default/files/document_library/Publications/Guidelines/2020/Guidelines%20on%20loan%20origination%20and%20monitoring/884283/EBA%20GL%202020%2006%20Final%20Report%20on%20GL%20on%20loan%20origination%20and%20monitoring.pdf (accessed: 03.09.2026).

European Banking Authority (2025). *Final Report. Guidelines on the Management of Environmental, Social and Governance (ESG) Risks* (EBA/GL/2025/01), https://www.eba.europa.eu/sites/default/files/2025-01/fb22982a-d69d-42cc-9d62-1023497ad58a/Final%20Guidelines%20on%20the%20management%20of%20ESG%20risks.pdf (accessed: 03.09.2026).

European Central Bank (2020). *Guide on Climate-related and Environmental Risks: Supervisory Expectations Relating to Risk Management and Disclosure*, https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.202011finalguideonclimate-relatedandenvironmentalrisks~58213f6564.en.pdf (accessed: 03.09.2026).

European Central Bank (2022). *ECB 2022 Thematic Review Walking the talk: Banks gearing up to manage risks from climate change and environmental degradation: Results of the 2022 thematic review on climate-related and environmental risks*, https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.thematicreviewcerreport112022~2eb322a79c.en.pdf (accessed: 03.09.2026).

European Commission (n.d.-a). *EU Taxonomy for Sustainable Activities*, https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en (accessed: 11.01.2026).

European Commission (n.d.-b). *Overview of Sustainable Finance*, https://finance.ec.europa.eu/sustainable-finance/overview-sustainable-finance_en (accessed: 03.09.2026).

European Commission (2025). *Sustainability-Related Disclosure in the Financial Services Sector*, https://finance.ec.europa.eu/sustainable-finance/disclosures/sustainability-related-disclosure-financial-services-sector_en (accessed: 03.09.2026).

Financial Action Task Force (2012). *International Standards on Combating Money Laundering and the Financing of Terrorism & Proliferation: The FATF Recommendations*, https://www.fatf-gafi.org/content/dam/fatf-gafi/recommendations/Feburary%202025%20FATF%20Recommendations.pdf (accessed: 03.09.2026).

Financial Action Task Force (2014). *Guidance for a Risk-Based Approach: The Banking Sector*, https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Risk-Based-Approach-Banking-Sector.pdf.coredownload.pdf (accessed: 03.09.2026).

Gözlügöl, A.A. (2025). Credit Substitution in Sustainable Finance: An Achilles Heel?, *Journal of Financial Regulation*, 12(1), pp. 34–66. DOI: 10.1093/jfr/fjaf011.

Greenpeace International, Harvest, Milieudefensie (2024). *New Report: Bankrolling Ecosystem Destruction*, BankTrack, https://www.banktrack.org/article/new_report_bankrolling_ecosystem_destruction (accessed: 03.09.2026).

ING (n.d.). *Terra Approach*, https://ing.com/sustainability/climate-action/terra-approach (accessed: 03.09.2026).

Litwin, D., Savourey, E. (2025). Human Rights in EU Sustainable Finance, *Journal of Financial Regulation*, 11(1), pp. 41–72. DOI: 10.1093/jfr/fjaf001.

Nieto, M.J., Papathanassiou, C. (2024). Financing the Orderly Transition to a Low Carbon Economy in the EU: The Regulatory Framework for the Banking Channel, *Journal of Banking Regulation*, 25(2), pp. 112–126. DOI: 10.1057/s41261-023-00219-6.

Organisation for Economic Co-operation and Development (2021). Biodiversity, Natural Capital and the Economy: A Policy Guide for Finance, Economic and Environment Ministers, *OECD Environment Policy Papers*, 26, https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/05/biodiversity-natural-capital-and-the-economy_940af1d4/1a1ae114-en.pdf (accessed: 03.09.2026).

Partiti, E. (2024). Addressing the Flaws of the Sustainable Finance Disclosure Regulation: Moving from Disclosures to Labelling and Sustainability Due Diligence, *European Business Organization Law Review*, 25(2), pp. 299–332. DOI: 10.1007/s40804-024-00317-6.

Regulation (EU) No 2023/2772. *Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 Supplementing Directive 2013/34/EU of the European Parliament and of the Council as Regards Sustainability Reporting Standards, Commission Delegated Regulation (EU) 2023/2772(2023)*, https://eur-lex.europa.eu/eli/reg_del/2023/2772/oj/eng (accessed: 03.09.2026).

Reins, L., Ala-Lahti, T. (2025). Innovation, Precaution, and Sustainable Development in EU Environmental Law – A False Trichotomy?, *Journal of Environmental Law*, eqaf032. DOI: 10.1093/jel/eqaf032.

Saputra, B. (2021). Modelling Australian Transaction Reports and Analysis Centre (AUSTRAC) for Indonesia in Order to Combat Financial Crime, *NEGREI: Academic Journal of Law and Governance*, 1(2), 81. DOI: 10.29240/negrei.v1i2.3822.

Smoleńska, A., Van 'T Klooster, J. (2022). A Risky Bet: Climate Change and the EU's Microprudential Framework for Banks, *Journal of Financial Regulation*, 8(1), pp. 51–74. DOI: 10.1093/jfr/fjac002.

Smuda-Kocoń, M. (2025). Reconfiguring the Risk of Financial Organizations as a Consequence of the Green Transition and a Potential Source of 'Green Swan Events.', *Journal of Management and Financial Sciences*, 53, pp. 85–102. DOI: 10.33119/JMFS.2024.53.5.

Steuer, S., Tröger, T.H. (2022). The Role of Disclosure in Green Finance, *Journal of Financial Regulation*, 8(1), pp. 1–50. DOI: 10.1093/jfr/fjac001.

WWF European Policy Office (2023). *Banking on Destruction: How European Financial Institutions Fuel Environmental Crises*.

Zetzsche, D.A., Anker-Sørensen, L. (2022). Regulating Sustainable Finance in the Dark, *European Business Organization Law Review*, 23(1), pp. 47–85. DOI: 10.1007/s40804-021-00237-9.

13

Florina Pînzaru[1]
Alexandra Zbuchea[2]

AI Literacy, Technological Anxiety, and Career Adaptability among Generation Z: An Empirical Framework for Career Resilience in AI-Driven Environments

Abstract

Rapid advances in artificial intelligence (AI) are generating significant changes in the structure of work. Although Generation Z is often considered digitally savvy, frequent engagement with digital technology does not necessarily translate into a clear understanding of how AI works, its limitations, or its labour-market implications. The purpose of this study is to examine the relationships between AI knowledge, AI usage behaviour, behaviour, and AI career resilience among Generation Z within a context shaped by AI literacy, potential technological anxiety, and preparedness for the AI-driven labour market. The study addresses research questions: (1) To what extent does AI knowledge influence AI usage behaviour among Generation Z? (2) How does AI usage behaviour contribute to career-related outcomes, such as career confidence and AI career resilience? And (3) Does AI literacy, conceptualised through knowledge and usage behaviour, enhance career adaptability in the context of emerging AI-driven labour-market demands?

1 National University of Political Studies and Public Administration – SNSPA (Romania), e-mail: florina.pinzaru@facultateademanagement.ro.
2 National University of Political Studies and Public Administration – SNSPA (Romania), e-mail: alexandra.zbuchea@facultateademanagement.ro.

The study is based on an exploratory self-administered survey conducted among 115 Romanian students aged 18–29 and enrolled in management and social science programmes. These fields prepare graduates for non-routine cognitive, decision-making, coordination and communication tasks, all of which are increasingly affected by AI-driven transformation. Romania provides a relevant empirical setting due to the combination of widespread basic digital technology use, comparatively low advanced digital skills, and a growing concentration of employment in the service sector, making it well-suited for analysing young people's responses to AI-driven change in office-based and knowledge-intensive occupations. As such, the respondents combine heightened perceived vulnerability to occupational change with substantial potential for adaptation through the development of transferable skills. Survey data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results indicate that AI knowledge significantly predicts AI usage behaviour and directly contributes to AI career resilience. Furthermore, AI usage behaviour has a strong positive effect on career resilience, whereas its effect on career confidence is not statistically significant.

This exploratory study contributes to the literature on management by highlighting the role of AI literacy as a multidimensional construct and by emphasising career resilience as a key mechanism through which Generation Z navigates uncertainty in AI-driven work environments.

1. Introduction

The rapid development of artificial intelligence (AI) has reshaped how individuals acquire knowledge, interact with technology, and prepare for their careers. In this context, AI literacy has emerged as a critical capability. This is particularly true for members of Generation Z (also called Gen Z), who are entering a labour market characterised by continuous technological disruption and what the business press has termed the *job apocalypse* – the postponement of hiring junior employees as companies wait for further advances in AI that might replace entry-level roles [Roose, 2025]. AI literacy goes beyond the ability to use this technology and is increasingly conceptualised as a multidimensional construct that includes cognitive components such as knowledge of AI and higher-order thinking skills, along with behavioural components such as actual usage of AI technology. This framework is nuanced by human-centred considerations, such as ethics, accountability and safety [Ng, Leung, Chu, Qiao, 2021]. Individuals' responses to technological change may also be influenced by factors such as technological anxiety, which can influence how knowledge and usage translate into career-related outcomes. Previous research suggests that

much of this anxiety is associated with the fear of "AI programmes leaving humans out of the picture" [Johnson, Verdicchio, 2017].

Building on these perspectives, this study examines the relationships between AI knowledge, AI usage behaviour, career confidence, and AI career resilience as key dimensions associated with career adaptability in an AI-driven environment, understood in the broader context of technological anxiety. The study investigates the constructs most likely to be shaped by a latent technology anxiety among Generation Z, a population particularly exposed to technology-induced uncertainty: AI knowledge, AI usage behaviour, and career outcomes. The type of anxiety experienced by Gen Z is different from previous technology anxieties: rather than concerns about the ability to use new technology, it is increasingly associated with uncertainty about the consequences of technological adoption for career prospects and professional identity [Barth, 2025; Needleman, 2026].

2. Theoretical background

AI adoption has spread at a pace unmatched by any other technology, becoming integrated by employees worldwide for a wide range of workplace tasks. Recent studies show that users increasingly rely on AI not only to retrieve information but also to perform more complex activities. According to Anthropic [2025], approximately four in ten users instruct AI systems to complete tasks on their behalf. Adoption rates are particularly high among higher-income and tech-savvy individuals, which explains the geographical and intersectoral gaps related to the use of AI. These differences are not only based on revenue and propensity for technology, but also have a generational dimension, since Gen Z employees are often early adopters of AI technology and tend to use it in a more complex way, including delegating more tasks to AI.

The growing use of AI translates into endangered jobs and the transformation of roles. Anthropic's 2026 *observed exposure* framework on the impact of AI on jobs indicates that some of the most exposed roles are those in the field of computer programming, IT and customer service [Anthropic, 2026]. Exposure, however, does not necessarily imply job displacement. Rather, it suggests that the content of work, skill requirements, and patterns of employment within these occupations may undergo significant transformation. Entry-level positions may be particularly affected, as some routine tasks traditionally assigned to junior employees will become increasingly automated.

AI literacy is a particularly relevant concept in the workplace context, since AI is not only a support technology but also a structural part of the work mechanism, changing the relationship between humans and technology. Consequently, AI literacy is not limited to merely understanding this technology, but also knowing how to function and engage with AI [Miao, Holmes, 2023]. From this perspective, AI literacy contributes to increased performance and productivity [Lee, Jeon, 2025]. AI literacy is a multidimensional concept, integrating cognitive, behavioural and ethical elements. Miao and Holmes [2023] identify three core components of AI literacy: learning about AI, understanding how AI operates, and the ability to interact with AI both effectively and ethically. Ng et al. [2021] stress that AI knowledge is essential in this construct, influencing the level of understanding of AI functionality. A high level of AI literacy contributes to a better understanding of AI systems, as well as more efficient use and decreased technological anxiety. AI anxiety is a normal response to the unknown and unfamiliar. It is associated with negative emotions and attitudes in the context of AI use and limited use of AI tools [Pan, Luo, Gu, 2025]. Among students, higher levels of AI literacy and a positive AI attitude contribute to decreased AI anxiety, including concerns associated with job-seeking behaviour [Li, Ouyang, Lin, 2025].

Considering the specific characteristics of Gen Z as digital natives, it is reasonable to expect a higher level of AI literacy, with users more open to its use and less anxious. Previous exposure to digital technology leads to increased familiarity with emerging technologies, such as AI [Katz, Ogilvie, Shaw, Woodhead, 2021]. Familiarity reduces the perceived complexity and increases the perceived utility of AI [Gross-Gołacka, Kavoura, Pawłowski, 2024]. Perceived usefulness and trust have also been identified as strong drivers towards AI adoption in the workplace among Gen Z [Țuclea, Poenaru, 2026].

Consistent with these findings, Gen Z appears particularly receptive to adopting AI tools in professional contexts: studies report positive perceptions of AI, especially among young adults, regarding its positive impact on decision-making, efficiency and productivity [Aithor, 2025; Chan, Lee, 2023; Kenney, 2026]. Gen Z view AI as a career enabler, even if certain concerns are manifested, especially those related to ethical use and reliability, as well as overreliance and job security. Gen Z are aware of the ethical aspects, but also desire further training in this regard, with business students being among those most enthusiastic about AI [Wilson et al., 2024].

Nevertheless, the phenomenon remains complex. Statistics show that 65% of Gen Z employees experience career uncertainty due to AI and believe that a university degree does not protect them against AI-induced labour-market changes. Further-

more, 43% have altered their career plans, while 18% are uncertain about the future relevance of their roles [Escalera, 2025]. At the same time, many Gen Z employees seem to be embracing AI both at work and in their personal lives. Indeed, 79% of Gen Z use AI tools and are optimistic about its impact on the workplace [Gallup, 2025], while 41% of American Gen Z respondents report trusting AI more than their co-workers [Robinson, 2025]. Gen Z employees are also redefining work values and expectations in terms of ethics, sensitivity to working conditions, autonomy, purpose, and alignment with their personal values and desired career paths [Lazăr, 2025].

Gen Z tend to be more resilient in AI-enabled work environments, with better levels of understanding and skills. However, confidence in the future of their careers seems less certain. They may fear AI more and experience higher levels of anxiety due to psychological and personal traits, as well as workplace-related factors. Career resilience differs from career confidence, although the two concepts may be related. Career resilience is the ability to adapt and flourish in a career, despite ongoing changes and disruptions. It involves recovering from significant challenges and demonstrating adaptability, persistence and confidence in their career [McMahon, Abkhezr, 2025]. Career confidence refers to an employee's belief in their ability to perform effectively in their career and achieve their career aspirations [Alkal, 2025]. Understanding these concepts in the case of Gen Z employees is important for organisations seeking to better design training programmes that develop both resilience and confidence. In the context of digital transformation, Gen Z may be better equipped to cope with disruption and therefore demonstrate a higher level of career resilience. However, continuous learning and suitable talent management strategies remain essential [Lazăr, 2023].

3. Constructs and conceptual model development

AI literacy encompasses multiple dimensions, summarised by UNESCO into learning about AI, learning how AI works, and learning to live with AI [Miao, Holmes, 2023]. Within the broader framework of AI literacy, AI knowledge represents the cognitive dimension that reflects individuals' understanding of artificial intelligence concepts, functionalities and potential applications [Ng et al., 2021]. Beyond merely understanding AI, individuals also need to be able to critically evaluate AI technologies, communicate with AI, and use AI effectively [Long, Magerco, 2020], as AI has a much deeper impact on human cognition and ethical frameworks than previous revolutionary technologies [Bostrom, 2014].

Individuals with higher levels of AI knowledge are more likely to understand the capabilities and limitations of AI tools [Long, Magerco, 2020], which can reduce uncertainty and increase familiarity with these technologies [Hoff, Bashir, 2015]. At the same time, technological anxiety, defined as feelings of discomfort or uncertainty when interacting with advanced technologies [Meuter, Ostrom, Bitner, Roundtree, 2003; Parasuraman, 2000], may influence how individuals engage with AI, particularly in the context of broader societal concerns surrounding technological change [Mokyr, Vickers, Ziebarth, 2015]. In the case of Generation Z, high levels of digital exposure [Katz et al., 2021] might lead to an increased propensity to integrate AI technologies into their everyday activities, including academic and professional tasks. Familiarity with digital environments may reduce the perceived complexity of AI and enhance its perceived usefulness, while still allowing users to remain aware of its potential negative consequences [Gross-Gołacka et al., 2024]. In this study, AI usage behaviour is conceptualised as the extent to which individuals engage with AI tools in their daily activities, reflected in both the frequency of use and in the diversity and complexity of applications for which these tools are employed.

Therefore, the following hypothesis is proposed:

H1: AI Knowledge and Skills positively influence AI Usage Behaviour.

AI knowledge may also influence individuals' perceptions of their professional future, as understanding emerging technologies can contribute to a sense of preparedness in a rapidly changing labour market [Tian, Ou, Chen, 2025]. Individuals who possess greater knowledge of AI and perceive themselves as having the appropriate AI-related skills may view themselves as better equipped to navigate technological transformations [Skrbiš, Laughland-Booÿ, 2019]. However, career confidence is a complex construct [Lent, Ireland, Penn, Morris, Sappington, 2017] that depends on multiple factors beyond knowledge alone, including psychological characteristics such as technological anxiety, uncertainty regarding future job roles, and perceptions of the broader labour-market conditions. Even in the case of individuals who are knowledgeable about AI, these contextual factors may limit the direct impact of that knowledge on confidence, as seen in studies on uncertainty about future roles in the context of the emergence of AI [Selenko, Bankins, Shoss, Warburton, Restubog, 2022]. As a result, although a positive relationship between AI knowledge and associated skills and career confidence may be expected, it is likely to be relatively weak and not necessarily direct. Although AI knowledge leads to a better understanding of the technology, it also encompasses the potential negative consequences, while career confidence depends on factors beyond technological knowledge (emotional,

economic, etc.). In the case of Generation Z, however, high levels of digital exposure and habitual engagement with digital environments lead to a better understanding of tasks performed in AI-related contexts [E&Y, 2024], which may increase the likelihood of AI knowledge and skills translating into a perceived sense of professional readiness, making this relationship more plausible for this cohort than for older generations [Nabilla, Suhandiah, Supriyanto, 2025].

Therefore, the following hypothesis is formulated:

H2: AI Knowledge and Skills are positively associated with Career Confidence.

Beyond confidence, AI knowledge plays a pivotal role in shaping individuals' ability to adapt to technological change, as it enables them to understand how AI can be integrated into professional contexts [Ng et al., 2021] and how it may reshape job requirements [Long, Magerco, 2020]. This understanding can support the development of career resilience in AI-transformed contexts, defined as the ability to adjust, remain flexible, and cope with AI-driven technological disruptions in the labour market [Selenko et al., 2022]. Individuals with higher levels of AI knowledge are more likely to anticipate change and respond proactively, thereby strengthening their adaptability [Kossek, Perrigino, 2016; Burhan, 2025]. In this sense, career resilience represents a key dimension of career adaptability in AI-driven environments.

Therefore, the following hypothesis is proposed:

H3: AI Knowledge and Skills positively influence AI Career Resilience.

Complementing the cognitive dimension of AI literacy, AI usage behaviour reflects the practical and experiential dimension, capturing how individuals actively engage with AI tools [Tang et al., 2023]. Skills develop in time through experience and practice [Anderson, 1982], thus regular interaction with AI technologies allows individuals to develop hands-on skills, experiment with new applications, and become more comfortable in technology-driven environments. Through repeated use, individuals may develop not only technical competence but also adaptive capabilities, essential for responding to ongoing technological change [Venkatesh, Thong, Xu, 2016]. In this context, AI usage behaviour contributes to career resilience by enabling individuals to translate knowledge into practice and better cope with labour-market uncertainty.

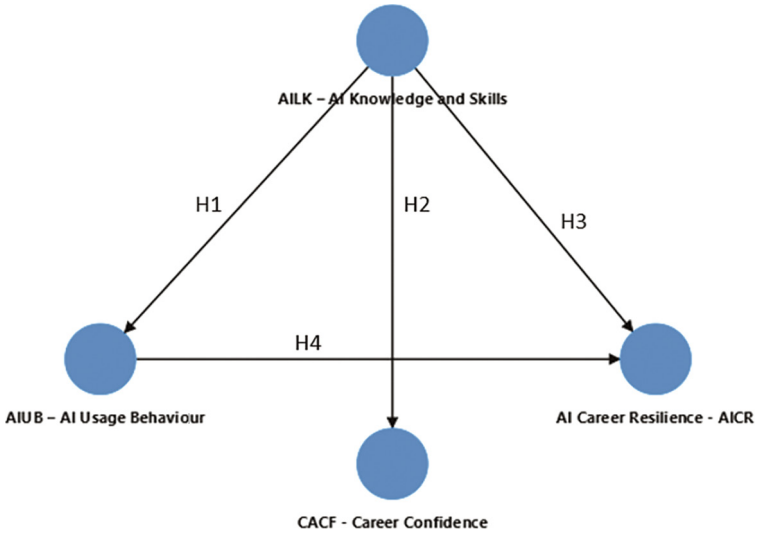
Accordingly, the following hypothesis is proposed:

H4: AI Usage Behaviour positively influences AI Career Resilience.

Based on the above-presented hypothesis, Figure 1 depicts the conceptual framework developed for this study, incorporating four constructs (AI Knowledge and

Skills, AI Usage Behaviour, AI Career Resilience, and Career Confidence) and the hypothesised relationships examined in the analysis.

Figure 1. Conceptual model



Source: Authors' own elaboration.

4. Materials, methods and findings

To investigate the above-mentioned hypothesis, the authors conducted an empirical analysis based on survey data collected from Romanian members of Generation Z enrolled in bachelor's and master's programmes. The survey focused on their perceptions and use of AI tools and their implications for career development. Gen Z are often described as digital natives, characterised by their extensive exposure to digital technology [Prensky, 2001], which influences their attitudes towards, and engagement with, emerging technologies such as AI. In the context of the acceleration of AI adoption, members of Generation Z may face longer waiting periods before securing their first job because companies are putting off hiring decisions while balancing investments in human capital against investments in AI – a trend especially strong in white-collar jobs [Leopold, 2025]. Romania represents an example of an economy that relies on outsourcing for much of its white-collar labour force [European Commission, 2023], which could lead to challenges for Gen Z pursuing such careers, as many cognitive outsourcing-based roles are

increasingly susceptible to AI-driven automation and restructuring [Frey, Osborne, 2017; OECD, 2021].

The initial dataset contained 119 responses collected through a self-administered online questionnaire in January and February 2026. Following data-cleaning procedures, responses from individuals outside the target age range, as well as incomplete responses, were removed. The final dataset consisted of 115 valid respondents aged between 18 and 29, with a mean age of approximately 21.5 years old. The gender distribution included 77 female respondents and 38 male respondents. Regarding educational background, 83 participants were undergraduate students and 32 were master's students. In terms of professional experience, respondents reported varying levels of exposure to the labour market: 32 had no work experience, 31 had volunteer experience, 16 had part-time work experience, and 36 had full-time work experience. The dominant academic or professional background within the sample was management, business and economics, accounting for 86 respondents out of the total sample, which is consistent with the focus of the study on entry-level white-collar careers in the Romanian context, where such fields are strongly associated with the above-presented employment opportunities.

The sample structure reflects a population that is highly relevant for studying AI adoption and career-related perceptions, as Generation Z represents the cohort entering the labour market during a period of rapid technological transformation. Given the sampling design and composition, the findings of this study apply to a specific population, namely Romanian Generation Z individuals enrolled in higher education (bachelor's and master's programmes), primarily in business, management and economics fields, who are at the early stages of their career development and are potential entrants into white-collar labour markets affected by AI adoption. Although the sample size of 115 respondents may be considered modest, it is adequate given the exploratory nature of the analysis and the characteristics of the proposed model. In particular, the sample size is sufficient for the application of Partial Least Squares Structural Equation Modelling and for identifying meaningful relationships. Nevertheless, the results should be interpreted with caution.

The research model includes four latent constructs related to the use of artificial intelligence and career development among Generation Z: AI Usage Behaviour (AIUB), AI Knowledge and Skills (AILK), Career Confidence (CACF), and AI Career Resilience (AICR).

AI Usage Behaviour (AIUB) captures the frequency and nature of respondents' use of AI tools, reflecting how individuals actively engage with generative AI technologies in everyday contexts [Tang et al., 2023; Venkatesh et al., 2016]. Each item reflects

a distinct everyday application of AI technologies, consistent with commonly identified uses of AI in educational and professional settings [Holmes, Miao, 2023; Ng et al., 2021]: information search (AIUB1), text and image generation (AIUB2), text correction and structuring (AIUB3), translation (AIUB4), and the summarisation of longer texts (AIUB5). Taken together, these indicators represent the breadth of practical AI engagement in academic and daily contexts.

AI Knowledge and Skills (AILK) captures respondents' understanding of artificial intelligence technologies and their functionality [Ng et al., 2021; Long, Magerko, 2020]. The construct was measured using seven indicators (AILK1 – AILK7), reflecting both conceptual knowledge and AI-related self-efficacy. Specifically, AILK1 assesses general understanding of how AI systems work; AILK2 reflects awareness of both the advantages and limitations of AI; AILK3 captures consciousness of the ethical implications of AI use; AILK4 measures the perceived ability to evaluate the accuracy of AI-generated information; and AILK5 reflects knowledge of when the use of AI is appropriate and when it is not. Two additional indicators address the self-efficacy dimension: AILK6 assesses the perceived ability to quickly learn how to use new AI tools, while AILK7 captures confidence in possessing the necessary skills to use AI effectively in a future profession.

Career Confidence (CACF) reflects respondents' confidence in their professional future and career development in the context of AI-accelerated technological change and increasing uncertainty [Lent et al., 2017; Skrbiš, Laughland-Booÿ, 2019]. The construct was initially operationalised using seven indicators. Four positively worded items (CACF1-CACF4) addressed active career planning, openness to exploring new professional options, decision-making under uncertainty, and readiness to adjust career plans. Three negatively worded items (CACF5R, CACF6R and CACF7R) assessed AI-related concerns, including perceived threats to employment, feelings of insecurity due to the growing use of AI, and anxiety regarding its potential impact on one's career, consistent with prior research on technological anxiety and career uncertainty [Johnson, Verdicchio, 2017; Selenko et al., 2022]. Reverse coding was applied using the transformation 6 – x to ensure that all items were aligned in the same direction, as recommended in scale development and PLS-SEM procedures [Hair et al., 2021; DeVellis, Thorpe, 2021]. Following the assessment of outer loadings, CACF1-CACF4 were removed due to insufficient indicator reliability. The final construct was therefore measured using the three reverse-coded items (CACF5R_rev, CACF6R_rev, CACF7R_rev), which, after inversion, reflect reduced anxiety and greater confidence in one's career prospects in an AI-driven environment.

AI Career Resilience (AICR) captures the ability of individuals to adapt to technological change and remain professionally resilient in the context of artificial intelligence [Kossek, Perrigino, 2016; Selenko et al., 2022; Burhan, 2025]. The construct was measured using eight indicators (AICR1-AICR8), which reflect four interrelated dimensions: proactive skill development (AICR1 – intention to develop AI-related competencies; AICR2 – willingness to attend AI-related courses or training); active information seeking regarding AI's impact on one's field of study (AICR3) and current experimentation with AI tools for academic tasks (AICR4); behavioural flexibility in career planning (AICR5 – willingness to radically change one's career plans if required by technology; AICR8 – updating career plans as new AI technologies emerge within one's field); and positive reframing of AI adoption (AICR6 – viewing AI learning as a means of reducing professional uncertainty; AICR7 – perceived ability to find ways to collaborate with AI in future employment.

All constructs were specified as reflective constructs and measured using multi-item Likert scales (see the questionnaire in the appendix). The measurement model was evaluated in terms of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity, following the guidelines of Hair et al. [2021]. The data were analysed using PLS-SEM, following a two-step approach. First, the measurement model was evaluated in terms of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Second, the structural model was assessed by examining path coefficients, their significance using bootstrapping with 5,000 resamples, and the coefficients of determination (R^2).

Most indicator loadings exceeded the recommended threshold of 0.70. Two indicators, AICR3 and AIUB2, were retained despite loadings below 0.70 because they remained above the minimum acceptable threshold and did not compromise construct reliability or convergent validity. Moreover, their inclusion is theoretically justified and contributes to the content validity of the constructs [Hair et al., 2021]. As mentioned earlier, following reverse coding, indicators CACF1-CACF4 were removed from the measurement model due to insufficient outer loadings (below the acceptable threshold), which fell below the criteria for indicator reliability. The final Career Confidence construct was therefore measured using three indicators (CACF5R_rev, CACF6R_rev, CACF7R_rev). Composite reliability values exceeded the recommended threshold, while AVE values were above 0.50 for all constructs, indicating satisfactory internal consistency and convergent validity. Discriminant validity was also established, as all HTMT values remained below the conservative threshold.

Table 1. Measurement model: outer loadings

Construct	Item	Loading
AI Career Resilience (AICR)	AICR1	0.829
	AICR2	0.740
	AICR3	0.692
	AICR4	0.776
	AICR5	0.706
	AICR6	0.816
	AICR7	0.846
	AICR8	0.731
AI Knowledge and Skills (AILK)	AILK1	0.788
	AILK2	0.826
	AILK3	0.774
	AILK4	0.792
	AILK5	0.799
	AILK6	0.824
	AILK7	0.750
AI Usage Behaviour (AIUB)	AIUB1	0.789
	AIUB2	0.617
	AIUB3	0.741
	AIUB4	0.717
	AIUB5	0.812
Career Confidence (CACF)	CACF5R_rev	0.974
	CACF6R_rev	0.763
	CACF7R_rev	0.792

Source: Authors' own calculations.

Table 2 presents the results of the assessment of internal consistency reliability and convergent validity. Cronbach's alpha and composite reliability values exceed the recommended threshold of 0.70 for all constructs, indicating satisfactory internal consistency. In addition, the average variance extracted (AVE) values are above the threshold of 0.50, confirming adequate convergent validity of the measurement model.

Discriminant validity was assessed using the HTMT criterion (Table 3). All HTMT values are below the conservative threshold of 0.85, confirming discriminant validity.

Table 2. Construct reliability and validity

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
AI Career Resilience – AICR	0.901	0.920	0.591
AILK – AI Knowledge and Skills	0.902	0.923	0.630
AIUB – AI Usage Behaviour	0.792	0.856	0.545
CACF – Career Confidence	0.853	0.884	0.719

Source: Authors' own calculations.

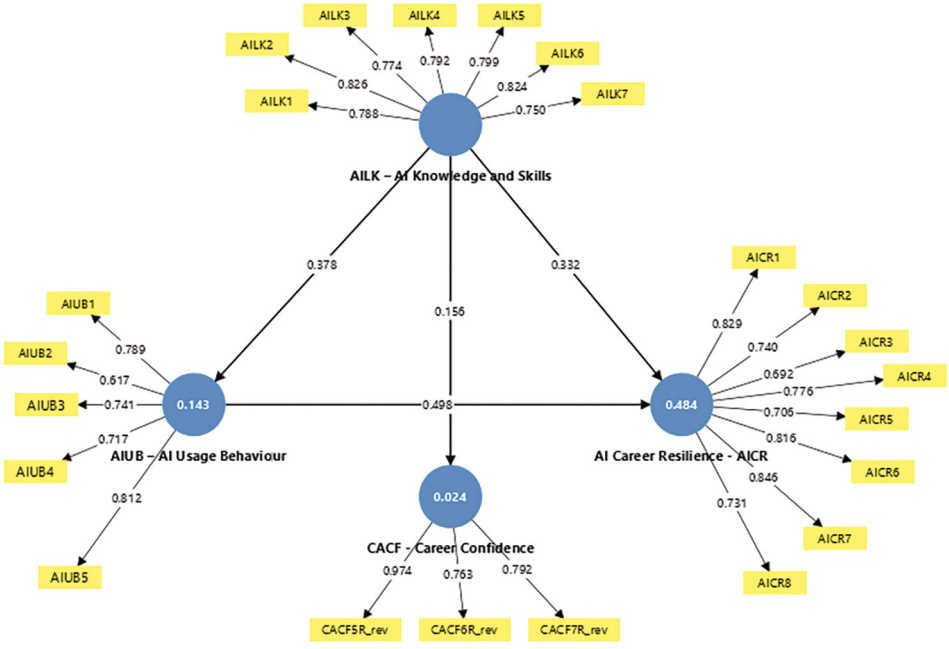
Table 3. Discriminant validity (HTMT)

Construct	AICR	AILK	AIUB	CACF
AI Career Resilience (AICR)	–			
AI Knowledge and Skills (AILK)	0.549	–		
AI Usage Behaviour (AIUB)	0.702	0.417	–	
Career Confidence (CACF)	0.110	0.172	0.193	–

Source: Authors' own calculations.

The structural model is presented in Figure 2.

Figure 2. Structural model



Source: Authors' own calculations.

The structural model results provided support for three hypotheses: H1, H3 and H4.

The analysis revealed that AI Knowledge and Skills have a positive and significant effect on AI Usage Behaviour ($\beta = 0.378$, $p < 0.001$), supporting H1. This result is consistent with well-established expectations, as familiarity with a technology naturally increases the likelihood of its use [Ng et al., 2021; Venkatesh et al., 2016]. As students of the Gen Z cohort are highly exposed to digital technologies and engaged in higher education, they are more likely to possess greater knowledge of AI and a better understanding of its functionalities, capabilities, and appropriate applications. This understanding reduces the perceived complexity and increases the perceived usefulness, thereby encouraging more frequent and diverse usage. Consequently, support for H1 primarily serves as a validation of the proposed measurement approach and the internal consistency of the model.

AI Knowledge and Skills also have a positive and significant effect on AI Career Resilience ($\beta = 0.332$, $p < 0.001$), supporting H3. This finding is consistent with previous studies indicating that knowledge and understanding of emerging technologies enhance individuals' ability to adapt to technological change [Burhan, 2025; Selenko et al., 2022]. Thus, educated Gen Z individuals are better equipped to respond to the impact of technological change on their future careers.

AI Usage Behaviour also positively influences AI Career Resilience ($\beta = 0.498$, $p < 0.001$), providing support for H4. This finding is consistent with experiential learning perspectives, which suggest that active engagement with technology fosters adaptive capabilities [Tang et al., 2023]. As Kold [2014] argues, learning occurs through the transformation of experience. Through repeated interaction with AI tools, individuals develop practical skills and adaptive responses, which further enhance their perceived ability to cope with AI-augmented technological change.

However, the effect of AI Knowledge and Skills on Career Confidence is positive but not statistically significant ($\beta = 0.156$, $p = 0.331$), leading to the rejection of H2. This finding suggests that possessing AI knowledge and skills does not automatically translate into confidence about one's professional future and is consistent with the theoretical framework developed in this study, which anticipated that the relationship could be limited by contextual factors such as technological anxiety, labour-market uncertainty, and psychological dimensions of career confidence [Lent et al., 2017; Skrbiš, Laughland-Booÿ, 2019; Selenko et al., 2022]. The result also reinforces the importance of distinguishing between what individuals know about AI and how secure they feel about their careers in AI-driven contexts: whereas knowledge and skills may contribute to career confidence, their effects appear to depend on various factors that shape their professional contexts.

Table 4. Hypothesis and structural model

Hypothesis	Relationship	β (Original Sample)	T	p	Result
H1	AILK → AIUB	0.378	3.695	< 0.001	Supported
H2	AILK → CACF	0.156	0.972	0.331	Not supported
H3	AILK → AICR	0.332	4.562	< 0.001	Supported
H4	AIUB → AICR	0.498	6.403	< 0.001	Supported

Source: Authors' own calculations.

The model explains 48.4% of the variance in AI Career Resilience, indicating moderate explanatory power. By contrast, the explained variance is weaker for AI Usage Behaviour ($R^2 = 0.143$) and very low for Career Confidence ($R^2 = 0.024$).

5. Limitations

The main limitations of the study relate to the sample, which is based on a relatively small number of respondents and is restricted to Romanian Generation Z students enrolled in higher education, predominantly in business, management and economics fields. As such, the findings cannot be readily generalised to the broader Gen Z population. Similar to other online studies, the percentage of female respondents was higher than that of male respondents. In addition, the use of a self-administered online questionnaire may have introduced self-selection bias. Nevertheless, the sample size is adequate for a PLS-SEM analysis and generates valuable insights for the specific population investigated, namely highly educated young individuals with an economic and business-oriented background. Furthermore, the use of self-report questionnaires means the data reflect subjective perceptions, which is relevant in the context of understanding how Gen Z perceives AI's impact on career development, career confidence, and career resilience. In this respect, the findings offer insights into the attitudes and beliefs that may shape decision-making and adaptation in real-life career contexts.

The study provides valuable insights through its geographical focus on Romanian entry-level white-collar careers, especially in the fields of economics and business. It offers context-specific evidence that may support future research and interventions in training, higher education, and human resources. The findings may also be relevant for exploratory studies on similar markets.

6. Conclusions and discussions

The research indicates a positive relationship between AI Knowledge and Skills and Career Confidence, although not significant. Previous studies suggest that stronger belief in one's knowledge and skills is associated with greater confidence in their career choices [Lee, Jung, Baek, Lee, 2022; Tong et al., 2025]. The present study, however, suggests that among young Romanians, AI knowledge and skills do not automatically translate into confidence in one's own future career path. Several factors might help explain this finding. First, additional contextual factors such as optimism and industry news can influence career confidence [Lestari, Sunaryo, 2025]. Second, psychological characteristics may play an important role. Previous research highlights the influence of factors such as social support [Liu, Ping, Fan, Mo, Wang, 2026], confidence in oneself and perceived preparedness for career transitions [Lee et al., 2022; Tong et al., 2025], a growth mindset [Liu et al., 2026], and emotional intelligence [Zhou, Peng, Zhou, 2023]. An additional explanation may be that greater knowledge and skills lead to a deeper understanding and potentially more cautious evaluation of the challenges and uncertainties ahead.

Career confidence remains a relatively underexplored concept in the academic literature, which tends to be oriented more towards career self-efficacy. A better understanding of the broader concept of career confidence, which encompasses dimensions beyond career self-efficacy, may improve our understanding of how individuals navigate professional challenges and uncertainties, which are increasingly numerous, especially in relation to digital transformation and AI development. The study also contributes by highlighting, among Romanian members of Gen Z, the distinction between career resilience and career confidence in the context of AI literacy.

The study further suggests that AI literacy is a behavioural resource, contributing to increased adaptability. In this respect, career development theories that identify adaptability as an important predictor of career success [Zacher, 2014] may benefit from incorporating a technological dimension. The result also enhances the idea that repeated use and integration of AI in professional activity increases career resilience.

The findings also suggest that high levels of AI knowledge and skills do not guarantee a decrease in AI-related anxiety. This may indicate that AI anxiety is not primarily a technical concern but a career-related one. At the same time, AI skills and knowledge strengthen career resilience. To reduce AI-related anxiety, on top of technical AI training, organisations may need to be more open to providing clear career pathways and organisational support, as well as mentoring programmes or coaching for Gen Z to enhance their confidence in their career prospects.

The findings further suggest that employees who actively use AI and possess a stronger understanding of its capabilities tend to demonstrate higher levels of career resilience, a characteristic that may contribute positively to organisational performance and adaptability. They may represent an important group for retention and talent development initiatives. Findings suggest that retention strategies targeting Gen Z should consider an organisational culture-oriented adaptation that fosters trust in their growth potential.

At the same time, higher education institutions should consider integrating AI and digital competencies into their curricula. An increase in AI literacy comes with significant practical experience, in addition to knowledge. Practical experience opportunities should therefore also be considered. Discussions on AI-related anxiety and a better understanding of market realities can also help develop a more resilient and confident future workforce.

Acknowledgement

Use of generative AI and AI-assisted technologies in the writing process: The authors used ChatGPT to improve the language of this paper. The content was reviewed and revised by the authors, who take full responsibility for its final version.

Appendix. Research questionnaire

The questionnaire was originally administered in Romanian and subsequently translated into English for the purpose of this paper. *All items were measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree).*

Section 1. AI Usage Behaviour (AIUB)

Please indicate the extent to which you agree with the following statements regarding your use of AI tools.

AIUB1: I use AI tools for information search.
AIUB2: I use AI tools for generating text or images.
AIUB3: I use AI tools for text correction and structuring.
AIUB4: I use AI tools for translation.
AIUB5: I use AI tools for summarising longer texts.

Section 2. AI Knowledge and Skills (AILK)

Please indicate your level of agreement with the following statements.

AILK1: I understand, in general terms, how AI systems work.
AILK2: I am aware of both the advantages and limitations of AI.
AILK3: I am aware of the ethical implications of AI use.
AILK4: I can evaluate whether AI-generated information is accurate.
AILK5: I know when it is appropriate to use AI and when it is not.
AILK6: I am able to quickly learn how to use new AI tools.
AILK7: I have the necessary skills to effectively use AI in my future profession.

Section 3. Career Confidence (CACF)

Please indicate the extent to which you agree with the following statements regarding your career perceptions.

CACF1: I actively think about how my career might evolve in the future. *(removed from the final model)*
CACF2: I am curious to explore new professional options. *(removed from the final model)*
CACF3: I can make career-related decisions even when the future is uncertain. *(removed from the final model)*
CACF4: I am prepared to adjust my career plans if unexpected changes occur. *(removed from the final model)*
CACF5R: I am concerned about the impact of AI on the future of jobs.
CACF6R: The increasing use of AI makes me feel insecure.
CACF7R: I feel anxious when thinking about how AI might affect my career.
Note: Items CACF5R–CACF7R were reverse-coded prior to analysis (transformation: 6 – x). Items CACF1–CACF4 were removed from the final measurement model due to insufficient indicator reliability (outer loadings below the acceptable threshold).

Section 4. AI Career Resilience (AICR)

Please indicate the extent to which you agree with the following statements.

AICR1: I intend to develop AI-related competencies in the future.
AICR2: I am willing to attend AI-related courses or training.
AICR3: I actively seek information about how AI is transforming my field of study.
AICR4: I already experiment with AI tools for academic tasks.
AICR5: I am prepared to adjust my career plans if unexpected changes occur.

AICR6: I see learning AI tools as a way to reduce professional uncertainty.
AICR7: I believe I can find ways to collaborate with AI in my future job.
AICR8: I update my career plans as new AI technologies emerge in my field.

Section 5. Demographic Information

Age (in years)
Gender (Female / Male / Other / Prefer not to say)
Field of study
Level of study (Bachelor's / Master's / PhD)
Work experience (none / volunteer / part-time / full-time / freelancer)

References

Aithor (2025). *How Many People Use AI? 2025 Statistics and AI Adoption Among Gen Z*, https://aithor.com/blog/how-many-people-use-ai-2025-statistics-and-ai-adoption-among-gen-z (accessed: 03.09.2026).

Alkal, A. (2025). Relationships Among Resilience, Career Adaptability and Career Decision Self-Efficacy in University Students: A Two-Wave Longitudinal Mediation Study, *BMC Psychology*, 13(1), 1146. DOI: 10.1186/s40359-025-03456-8.

Anderson, J.R. (1982). Acquisition of Cognitive Skill, *Psychological Review*, 89(4), pp. 369–406.

Anthropic (2025). *Anthropic Economic Index Report: Uneven Geographic and Enterprise AI Adoption* (September 2025 Report), https://www.anthropic.com/research/anthropic-economic-index-september-2025-report (accessed: 03.09.2026).

Anthropic (2026). *Labor Market Impacts of AI: A New Measure and Early Evidence*, https://www.anthropic.com/research/labour-market-impacts (accessed: 03.09.2026).

Barth, J. (2025). Why Gen Z Hides Their AI Use: The Anxiety Behind Adoption, *HR Executive,* https://hrexecutive.com/why-gen-z-hides-their-ai-use-the-anxiety-behind-adoption/ (accessed: 03.09.2026).

Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford: OUP Oxford.

Burhan, QUA. (2025). Unraveling the AI Enigma: How Perceptions of Artificial Intelligence Forge Career Adaptability Through the Crucible of Career Insecurity and Skill Development, *Management Research Review,* 48(3), pp. 470–488. DOI: 10.1108/MRR-01-2024-0022.

Chan, C.K.Y., Lee, K.K. (2023). The AI Generation Gap: Are Gen Z Students More Interested in Adopting Generative AI Such as ChatGPT in Teaching and Learning Than Their Gen X and Millennial Generation Teachers?, *Smart Learning Environments*, 10(1), 60. DOI: 10.1186/s40561-023-00269-3.

DeVellis, R.F., Thorpe, C.T. (2021). *Scale Development: Theory and Applications*. Thousand Oaks: Sage Publications.

E&Y (2024). *How Can We Upskill Gen Z As Fast As We Train AI?*, https://www.ey.com/en_gl/about-us/corporate-responsibility/how-can-we-upskill-gen-z-as-fast-as-we-train-ai (accessed: 03.09.2026).

Escalera, J. (2025). *65% of Gen Z Say College Degrees Won't Protect Them from AI*, *Zety*, https:// zety.com/blog/genz-reroute-report (accessed: 03.09.2026).

European Commission (2023). *2023 Country Report Romania,* https://economy-finance.ec.europa.eu/system/files/2023-06/ip247_en.pdf (accessed: 03.09.2026).

Frey, C.B., Osborne, M.A. (2017). The Future of Employment: How Susceptible Are Jobs to Computerisation?, *Technological Forecasting and Social Change*, 114, pp. 254–280. DOI: 10.1016/j.techfore.2016.08.019.

Gallup & Walton Family Foundation (2025). *Gen Z Research: Voices of Gen Z Study*, https://www.gallup.com/analytics/651674/gen-z-research.aspx (accessed: 03.09.2026).

Gross-Gołacka, E., Kavoura, A., Pawłowski, K. (2024). Perception of Artificial Intelligence by Generation Z – Results of a Pilot Study in Poland. In: *The International Conference on Strategic Innovative Marketing and Tourism* (pp. 853–861), A. Kavoura, V.-A. Briciu, A. Briciu (Eds.). Cham: Springer Nature Switzerland.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., Danks, N.P., Ray, S. (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook*. Cham: Springer International Publishing.

Hoff, K.A., Bashir, M. (2015). Trust in Automation: Integrating Empirical Evidence on Factors That Influence Trust, *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 57(3), pp. 407–434. DOI: 10.1177/0018720814547570.

Holmes, W., Miao, F. (2023). *Guidance for Generative AI in Education and Research*. Paris: UNESCO Publishing.

Johnson, D.G., Verdicchio, M. (2017). AI Anxiety, *Journal of the Association for Information Science and Technology*, 68(9), pp. 2267–2270. DOI: 10.1002/asi.23867.

Katz, R., Ogilvie, S., Shaw, J., Woodhead, L. (2021). *Gen Z, Explained: The Art of Living in a Digital Age*. Chicago: University of Chicago Press. DOI: 10.7208/chicago/9780226814988.

Kenney, S. (2026). *How Every Generation Uses AI, From Boomers To Gen Z*, Phys.org, https://phys.org/news/2026-01-generation-ai-boomers-gen.html (accessed: 03.09.2026).

Kolb, D.A. (2014). *Experiential Learning: Experience As the Source of Learning and Development*. Upper Saddle River: FT Press.

Kossek, E.E., Perrigino, M.B. (2016). Resilience: A Review Using a Grounded Integrated Occupational Approach, *Academy of Management Annals*, 10(1), pp. 729–797. DOI: 10.5465/19416520.2016.1159878.

Lazăr, M.A. (2023). Adapting to VUCA: An Exploratory Study on Talent Resilience in the IT Industry and Generation Z Workforce, *Revista de Management Comparat Internațional*, 24(5), pp. 792–814.

Lazăr, M.A. (2025). Generation Z's Work Ethic in a Digitally Disrupted World, *Ecoforum*, 14(2), pp. 1–8.

Lee, J.-H., Jeon, J.-H. (2025). Examining the Impact of AI Literacy and Its Antecedents on Job Performance in the Context of South Korea, *Asia Pacific Business Review*, pp. 1–25. DOI: 10.1080/13602381.2025.2487780

Lee, S., Jung, J., Baek, S., Lee, S. (2022). The Relationship Between Career Decision-Making Self-Efficacy, Career Preparation Behaviour and Career Decision Difficulties Among South Korean College Students, *Sustainability*, 14(21), 14384. DOI: 10.3390/su142114384.

Lent, R.W., Ireland, G.W., Penn, L.T., Morris, T.R., Sappington, R. (2017). Sources of Self-Efficacy and Outcome Expectations for Career Exploration and Decision-Making: A Test of the Social Cognitive Model of Career Self-Management, *Journal of Vocational Behavior*, 99, pp. 107–117. DOI: 10.1016/j.jvb.2017.01.002.

Leopold, T. (2025). How AI is Reshaping the Career Ladder, and Other Trends in Jobs and Skills on Labour Day, World Economic Forum, https://www.weforum.org/stories/2025/04/ai-jobs-international-workers-day/ (accessed: 03.09.2026).

Lestari, D.T., Sunaryo, S. (2025). The Impact of Positive Career Shock on Career Optimism: Examining the Mediating Role of Career Decision Making Self Efficacy and the Moderating Role of Consideration Future Consequences – Immediate, *International Journal of Economics, Business and Management Research,* 9(5), pp. 518–534. DOI: 10.51505/IJEBMR.2025.9533.

Li, R., Ouyang, S., Lin, J. (2025). Mediating Effect of AI Attitudes and AI Literacy on the Relationship Between Career Self-Efficacy and Job-Seeking Anxiety, *BMC Psychology*, 13(1), 454. DOI: 10.1186/s40359-025-02757-2.

Liu, S., Ping, Z., Fan, C., Mo, Y., Wang, Y. (2026). Impact of Growth Mindset on College Students' Career Decision-Making Self-Efficacy: The Chain-Mediating Roles of Perceived Social Support and Meaning in Life, *Frontiers in Psychology*, 17, 1710494. DOI: 10.3389/fpsyg.2026.1710494.

Long, D., Magerko, B. (2020). What Is AI Literacy? Competencies and Design Considerations. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1–16).

McMahon, M., Abkhezr, P. (2025). Career Adaptability and Career Resilience: A Systems Perspective, *International Journal for Educational and Vocational Guidance*, 26, pp. 701–722. DOI: 10.1007/s10775-025-09739-1.

Meuter, M.L., Ostrom, A.L., Bitner, M.J., Roundtree, R. (2003). The Influence of Technology Anxiety on Consumer Use and Experiences With Self-Service Technologies, *Journal of Business Research,* 56(11), pp. 899–906. DOI: 10.1016/S0148-2963(01)00276-4.

Mokyr, J., Vickers, C., Ziebarth, N.L. (2015). The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?, *Journal of Economic Perspectives*, 29(3), pp. 31–50. DOI: 10.1257/jep.29.3.31.

Nabilla, G.D., Suhandiah, S., Supriyanto, A. (2025). Generation Z's Work Readiness in the Digital Era: Exploring the Role of Internship Experience and Digital Literacy, with Psychological Capital as a Mediator, *International Conference on Digital Business Innovation and Technology Management (ICONBIT)*, 1(2), pp. 1088–1099.

Needleman, S.E. (2026). *Gen Z Uses AI a Lot – Even Though It Freaks Them Out, a New Study Shows*, *Business Insider,* https://www.businessinsider.com/ai-gen-z-job-killer-or-opportunity-2026-1 (accessed: 03.09.2026).

Ng, D.T.K., Leung, J.K.L., Chu, S.K.W., Qiao, M.S. (2021). Conceptualizing AI Literacy: An Exploratory Review, *Computers and Education: Artificial Intelligence*, 2, 100041. DOI: 10.1016/j.caeai.2021.100041.

OECD (2021). *AI and Employment. New Evidence From Occupations Most Exposed to AI*, https://www.oecd.org/en/publications/ai-and-employment_73c095f6-en.html (accessed: 03.09.2026).

Pan, L., Luo, H., Gu, Q. (2025). Incorporating AI Literacy and AI Anxiety into TAM: Unraveling Chinese Scholars' Behavioral Intentions Toward Adopting AI-Assisted Literature Reading, *IEEE Access,* 13, pp. 38952–38963.

Parasuraman, A. (2000). Technology Readiness Index (TRI): A Multiple-Item Scale to Measure Readiness to Embrace New Technologies, *Journal of Service Research*, 2(4), pp. 307–320. DOI: 10.1177/109467050024001.

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 2: Do They Really Think Differently?, *On the Horizon*, 9(6), pp. 1–6. DOI: 10.1108/10748120110424843.

Robinson, B. (2025). Gen Z Trust AI More Than Humans in Their Careers, New Study Shows, *Forbes*, https://www.forbes.com/sites/bryanrobinson/2025/02/19/gen-z-trust-ai-over-humans-in-their-careers-new-study-shows (accessed: 03.09.2026).

Roose, K. (2025). For Some Recent Graduates, the A.I. Job Apocalypse May Already Be Here, *New York Times,* https://www.nytimes.com/2025/05/30/technology/ai-jobs-college-graduates.html (accessed: 03.09.2026).

Selenko, E., Bankins, S., Shoss, M., Warburton, J., Restubog, S.L.D. (2022). Artificial Intelligence and the Future of Work: A Functional–Identity Perspective, *Current Directions in Psychological Science,* 31(3), pp. 272–279. DOI: 10.1177/09637214221091823.

Skrbiš, Z., Laughland-Booÿ, J. (2019). Technology, Change, and Uncertainty: Maintaining Career Confidence in the Early 21st Century, *New Technology, Work and Employment*, 34(3), pp. 191–207. DOI: 10.1111/ntwe.12151.

Tang, P.M., Koopman, J., Mai, K.M., De Cremer, D., Zhang, J.H., Reynders, P., Ng, C.T.S., Chen, I.H. (2023). No Person Is an Island: Unpacking the Work and After-Work Consequences of Interacting with Artificial Intelligence, *Journal of Applied Psychology,* 108(11), pp. 1766–1789.

Tian, H., Ou, R., Chen, Q. (2025). Artificial Intelligence Opportunity Perception and Career Sustainability: The Mediating Role of Personal Knowledge Management, *Career Development International*, 31(3), pp. 284–311. DOI: 10.1108/CDI-11-2024-0503.

Tong, Y., Zhong, M., Yang, J., Liu, X., Yang, D., Zhao, X., Hou, Y. (2025). The Influence of Self-Efficacy on Career Maturity in College Students: Mediating the Moderation of Creativity Tendency and Achievement Motivation, *Frontiers in Psychology*, 16, 1585195. DOI: 10.3389/fpsyg.2025.1585195.

Țuclea, C.E., Poenaru, L.F. (2026). Generation Z Employees' Acceptance and AI Use Intensity: A Moderated Mediation Model of Psychological Safety, Technostress, and Trust, *Merits*, 6(1), 7. DOI: 10.3390/merits6010007.

Venkatesh, V., Thong, J., Xu, X. (2016). Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead, *Journal of the Association for Information Systems*, 17(5), pp. 328–376.

Wilson, J., Ferrer, S., Burchfiel, S., Coplon, J.M., Ashton, E., Verdiyan, A. (2024). *What Gen Z Thinks About AI in Higher Ed*, Boston Consulting Group, https://www.bcg.com/publications/2024/ gen-z-and-ai-in-higher-ed (accessed: 03.09.2026).

Zacher, H. (2014). Career Adaptability Predicts Subjective Career Success Above and Beyond Personality Traits and Core Self-Evaluations, *Journal of Vocational Behavior*, 84(1), pp. 21–30. DOI: 10.1016/j.jvb.2013.10.002.

Zhou, D., Peng, Z., Zhou, H. (2023). The Influence of Career Decision-Making Self-Efficacy on Employability of Higher Vocational Students: Mediated by Emotional Intelligence, *Frontiers in Education,* 8, 1274430. DOI: 10.3389/feduc.2023.1274430.

14

Rebeca Cojocaru[1]
Alexandra Zbuchea[2]
Bogdan Hrib[3]

Substance Use Prevention and Democratic Governance: Perceptions from Generation Z in Romania

Abstract

Despite a century of evolution in drug use prevention, consumption continues to rise. Recent reports and academic studies indicate a decreasing age of first consumption, including in Romania. Generation Z individuals exhibit specific vulnerabilities in this regard, given their reliance on peer influence, interactive digital socialising, and entertainment. Prevention strategies, therefore, need to adapt to their social and digital realities. This study aims to understand the perceptions of the Romanian Generation Z on how prevention should be communicated. The research database was compiled from responses to a questionnaire specifically designed for this investigation, which sought to analyse young people's perceptions of drug use prevention, prevention messages, the role of institutions, youth participation in preventive processes, and the social and individual perception of drug use. The results demonstrate that the Romanian Gen Z has limited trust in and engagement with prevention messages perceived as moralising, top-down, and disconnected from their realities. Conversely, realistic, supportive and participatory approaches are more positively received.

1 University of Bucharest (Romania), e-mail: cojocarurebeca7@gmail.com.
2 National University of Political Studies and Public Administration – SNSPA (Romania), e-mail: alexandra.zbuchea@facultateademanagement.ro.
3 National University of Political Studies and Public Administration – SNSPA (Romania), e-mail: bogdan.hrib@facultateademanagement.ro.

1. Introduction

Substance use prevention has become an increasingly significant public policy priority across the European Union, particularly amid growing concerns regarding youth mental health, social vulnerability, and the diversification of psychoactive substances. While prevention strategies have traditionally relied on institutional campaigns, educational programmes and public awareness initiatives, recent debates highlight the necessity of re-evaluating these approaches through the lens of democratic governance and participatory public policy. From this perspective, young people are not merely the target of prevention policies but also potential contributors to the design, communication and evaluation of preventive interventions.

In Romania, substance use prevention programmes have primarily developed within institutional frameworks, involving schools, public health agencies and law enforcement bodies. However, despite sustained efforts to disseminate preventive messages, recent research and public debates suggest that the effectiveness of such campaigns may be limited by a mismatch between institutional communication strategies and the lived experiences of young people. Prevention messages are sometimes perceived as overly moralising, rigid or insufficiently connected to the social and emotional realities that shape young people's decision-making processes [Ti, Fast, Small, Kerr, 2017], with messages from peers often considered more credible [Hashemi, Vogel, 2024].

Considering this framework, the present study aims to examine how members of Generation Z relate to current prevention campaigns to design more effective strategies. The methodology is based on quantitative research targeting Generation Z individuals in Romania. To contextualise the analysis, an overview of existing prevention approaches is provided, alongside an evaluation of the key characteristics of the target population and a brief analysis of drug consumption among young Romanians. The methodological section is followed by a data analysis and a discussion of the main implications.

2. Historical background

Although nations have been striving to control and combat both drug trafficking and use for over a century, the phenomenon continues to evolve within human society, which necessitates continuous adaptation from state and international bodies as new generations are affected. More than 100 years have passed since

1912, when the first organisation to control drug use – the Opium Convention – was established in The Hague. This followed the first international meeting on the issue – the Opium Commission – which convened in Shanghai in 1909 [UNODC, 2008]. The latest official data includes some alarming key figures: over the last ten years, the number of people using substances has increased by 28%, reaching 316 million. Categorised, this includes 244 million using cannabis, 24 million using opioids, 31 million using amphetamines, 25 million using cocaine, and 21 million using "ecstasy" [UNODC, 2025].

In Romania, the high importance of this topic is also linked to studies conducted by the National Anti-Drug Agency (ANA) regarding a worrying increase in the consumption of psychoactive substances. Statistics issued in 2022, pertaining to 2021, showed that 1 in 10 people aged 15–64 had consumed at least one type of illicit drug during their lifetime. Concurrently, the age of onset of consumption has continuously decreased, reaching as low as 12 for new psychoactive substances [ANA, 2022, pp. 23–53].

Against this background, researchers have begun exploring alternative approaches to prevention communication. A recent study suggests that life stories could be a valuable tool in drug prevention campaigns, offering an authentic, emotional connection with the audience. The analysis concludes that they manage to transform theoretical information into concrete life lessons, contributing to a better understanding of risks and the formation of informed decisions regarding consumption [Moldoveanu, 2025].

Recent research in Romania indicates that drug prevention is predominantly approached from an institutional and informative perspective, although its effectiveness is perceived as limited. Studies show that prevention is integrated into public health policies and mainly aims to inform the population about the effects of consumption, as well as to develop educational programmes and assistance services for consumers [Baciu, Alexandru, Pungă, 2019]. However, the perception of beneficiaries and young people suggests that interventions are insufficient and inadequately adapted to real needs, with many participants stating that they did not have relevant information about drugs before the onset of consumption and that prevention should be carried out earlier, especially in the school environment. Other research also highlights that although prevention campaigns have increased in intensity, they are often sporadic and fail to significantly reduce consumption, especially among young people [Baciu, 2024].

3. Characteristics of Generation Z

Generation Z is widely recognised as the first generation of digital natives. Numerous studies highlight the consequences of this, including distinctive learning behaviours, specific consumption patterns, and high integration into digital environments [Buzzetto-Hollywood, Quinn, 2024; Chardonnens, 2025; Febliza, Kadarohman, Aisyah, Abdullah, 2025; Mohr, Mohr, 2017; Rosnerova, Ponisciakova, Kicova, Strenitzerova, 2025]. Despite being *digital natives*, members of this generation are not automatically assumed to possess advanced digital competencies and continue to require formal training in digital technologies [Porat, Blau, Barak, 2018; Reid, Button, Brommeyer, 2023]. Nevertheless, they generally report high levels of confidence in their own digital skills [Porat et al., 2018]. Another important consideration is that, for Gen Z, processing online information is a significant aspect of their social practices [Hassoun et al., 2023].

They are also widely credited with being more focused on values and experiences than on money and possessions [Grénman, Hakala, Mueller, Uusitalo, 2024; Jain, Joy, Sharma, 2024; PwC, 2025]. They are considered authentic [Prasanna, Priyanka, 2024] and community-oriented [Sengupta, Mathews, Bridges, D'Costa, Bastian, 2024]. Although they are perceived as consumerist, Gen Z believe that a good life includes healthy behaviours, positive and meaningful relationships, and happiness [Grénman et al., 2024]. They consider well-being a combination of positive emotions, engagement in pleasant and creative tasks, meaningful relationships and social connections, having a purpose in life, enjoying accomplishments, healthy routines, *me* time, and autonomy [Grénman et al., 2024, p. 9].

Considering their anticipated substantial impact on both society and the economy, Generation Z has attracted considerable attention from sociologists, researchers, policymakers and economists. Several large-scale studies conducted in recent years are summarised below.

Gen Z communicates differently from previous generations. They have a clear preference for visual and interactive content and are more impatient [Rosnerova et al., 2025]. They have shorter attention spans and tend to multitask more effectively than other generations [Buzzetto-Hollywood, Quinn, 2024]. Studies show that Gen Z do not make a clear distinction between *online* and *offline* [Katz, Ogilvie, Shaw, Woodhead, 2021]. They evaluate information using traditional criteria such as relevance, social meaning and visibility, which can lead to vulnerabilities in detecting misinformation despite high self-confidence in their digital skills. At the same time, their practices reflect a complex tension: they are capable of sophisticated strategies and adaptive behaviours in real-world contexts, yet experience overload, scepticism

and selective disengagement due to the overwhelming and socially embedded nature of digital information environments [Hassoun et al., 2023]. Additionally, they tend not to finalise reasoning and checking processes, as the extra energy required is not considered worth the effort to find the most accurate information.

4. Drug consumption

Longitudinal studies indicate a significant increase in alcohol and drug use among young people with age [University College London, 2026]. Specifically, cannabis use rose from 31% to 49% between the ages of 17 and 23, while experimentation with harder drugs increased from 10% to 32% within the same age range. In contrast, long-term evaluations of substance use in the EU generally present a different trend [Arfini, 2026]. While the use of substances such as alcohol, cigarettes and cannabis has declined among teenagers, there has been a recent increase in the consumption of e-cigarettes, non-medical pharmaceutical drugs, and (online) gambling.

In Romania, Generation Z exhibits a higher propensity to experiment with illicit drugs compared to older adults. Data from MetropolaTV [2023] demonstrates that 10.7% of Romanians aged 15–64 have used drugs, with 6% reporting substance use in the past year. A study by the European Union Drug Agency revealed that 6% of Romanian students have tried illicit drugs, with cannabis being the most common and easily obtainable, followed by cocaine and non-prescribed tranquillisers. Alcohol and tobacco use are widespread: 81% have consumed alcohol at least once, 41% in the last month, and 26% of 15–16-year-olds smoked in the past 30 days, exceeding the European average. Additionally, Grigoriu [2025] reports that 25% of students engaged in gambling over the past year, over half of Romanian youth report excessive social media use, and one-quarter struggle to control gaming time.

Substance consumption and addiction are broad and complex phenomena. For Generation Z, the digital environment and specific socio-emotional context are considered significant contributing factors [Szasz, 2025].

5. Methodology

This study employs an exploratory research design, combining quantitative and qualitative methods to examine young people's perceptions of substance use prevention and its democratic dimensions.

The research adopts a mixed-methods approach, utilising a questionnaire as the primary data-collection tool, supplemented by qualitative insights from two open-ended responses. Convenience sampling, a non-probability sampling strategy based on accessibility and voluntary participation, was used, with data collected through an online questionnaire distributed via social media and educational networks. Participation was voluntary and anonymous. The questionnaire targeted young people aged 14–29, and data were collected between January and April 2026.

The questionnaire included both closed-ended items, using a five-point Likert-type scale (1 = strongly disagree, 5 = strongly agree), and open-ended questions that allowed respondents to elaborate on their views. Key concepts such as prevention, participation, trust, and top-down approaches were operationalised through multiple indicators, including perceived inclusion in prevention efforts, attitudes towards rules and prohibitions, and evaluations of dialogue-based approaches.

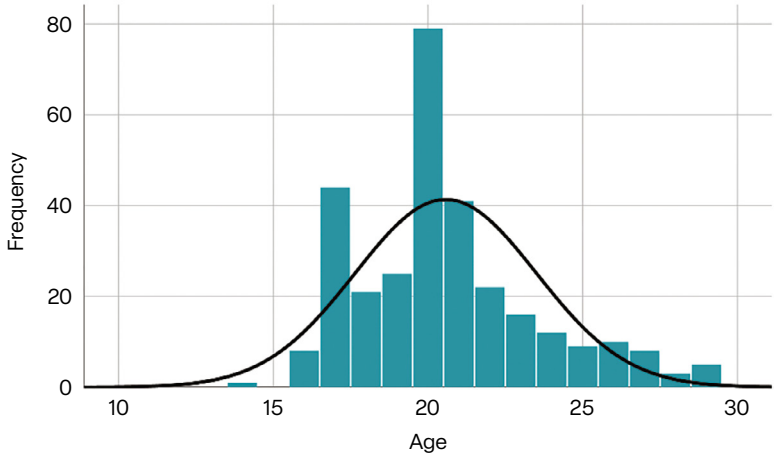
A preliminary section focused on respondents' exposure to drug prevention messages or campaigns, the frequency of contact with such messages, the channels through which they were received, participation in organised prevention activities, and personal contact with individuals who use drugs. These variables provided relevant information for both describing the context of exposure and testing hypotheses regarding the relationship between exposure and risk awareness.

The database's core comprises Likert-type items, structured into six theoretical dimensions. The first dimension, "Quality of prevention messages," assesses respondents' perceptions of message usefulness, clarity, realism, and non-judgemental nature. It also gauges their ability to stimulate reflection and increase interest in consumption. The second dimension, "Trust in institutions," measures how respondents perceive public institutions regarding legitimacy, transparency, fairness, and their commitment to providing genuine support to young people. The third dimension, "Youth participation," evaluates attitudes towards youth involvement in developing prevention campaigns and the importance of dialogue over strictly hierarchical approaches. The fourth dimension, "Preferred message style and format," captures respondents' preferences for messages that are open, realistic, non-moralising, and sensitive to the emotional aspects of vulnerability. The fifth dimension, "Preferred type of prevention strategy," includes items on the role of counselling, schools, family, periodic intervention evaluations, and the acceptance of punitive measures. The sixth dimension, "Perception of drug use," explores respondents' views on drug accessibility, the prevalence of use among young people, the seriousness of associated risks, and any tendency to minimise or exaggerate the dangers of drug use.

In addition to these closed items, the instrument features two open-ended questions. These aim to capture more nuanced opinions on necessary changes in drug prevention and the types of messages or communication formats that would genuinely engage young people.

Regarding the respondents' profile, a descriptive analysis of age revealed that the sample consisted of 304 participants, with no missing values. The mean age was 20.57 years ($M = 20.57$), and the median was 20.00 years, indicating a distribution centred around 20. A standard deviation of 2.934 suggests moderate age variability within the group. While respondents belong to the same broad youth segment, there is some internal age diversity. The age range was 14–29 years, but the sample is concentrated in late adolescence and young adulthood (Figure 1). Therefore, these results should not be interpreted as representative of the entire 14–29 population, but rather as reflecting the perceptions of the specific convenience sample investigated. The proximity of the mean and median indicates a relatively balanced age distribution, without significant asymmetry.

Figure 1. Respondent age distribution



Source: Authors' own elaboration.

The total sample comprised 304 respondents. However, the number of valid cases varies across questions because some respondents selected "prefer not to answer" or did not respond. Thus, N = 304 refers to the total sample, whereas lower values, such as N = 299 for gender, represent only the valid responses for that specific variable.

Looking exclusively at the valid responses, 205 respondents, representing 68.6% of the total validated data, identified as women, while 92 respondents, representing

30.8%, identified as men. The "Other gender/non-binary" category was selected by 2 respondents, representing 0.7% of the valid responses. These results highlight an imbalance in the sample's gender structure, with a significantly higher representation of female participants.

Table 1. Awareness of drug use prevention messages in the previous 12 months

In the last 12 months, have you encountered messages/ information about drug use prevention?	Frequency	Percentage
Yes	242	79.6%
I don't know / I don't remember	62	20.4%
Total	304	100.0%

Source: Authors' own elaboration.

The distribution in Table 1 suggests that most young people in the sample were exposed, at least declaratively, to forms of preventive communication during the analysed period. However, the proportion of over a fifth who do not remember or cannot specify whether they encountered such messages is also relevant. This may indicate either low or inconsistent exposure, insufficient campaign visibility, or that preventive messages did not have a strong enough impact to be retained and subsequently recognised by respondents.

Bucharest, the Romanian capital, and its immediate metropolitan area account for 84.6% of the entire sample. Respondents from outside Bucharest and its metropolitan area were retained because the study is exploratory and does not aim to estimate population-level parameters. However, their small number does not allow for separate regional comparisons. The findings should therefore be read primarily as reflecting a Bucharest-centred urban sample.

The remaining participants are distributed across various isolated localities in Romania. This sample structure confirms the highly localised nature of the data collection. It suggests that the results mainly reflect the perceptions of young people from the large urban and peri-urban areas surrounding Romania's capital.

6. Main findings

To assess whether *young people's rejection of prevention campaigns is associated more with the way they are communicated (top-down) than with the rejection of the idea of prevention itself*, two distinct composite constructs were operationalised. These were

built based on questionnaire items that capture, on the one hand, attitudes towards the communication style of the campaigns, and on the other hand, the acceptance of prevention as a legitimate and useful approach.

The first construct, "Criticism of the top-down style of campaigns," was designed to capture respondents' preference for participatory, open, tailored, and non-moralising preventive communication, as opposed to a style perceived as unilateral, rigid, moralising, or fear-based. In its final form, this composite score was constructed from six items: 4.5 *("I would have more confidence in campaigns if they were also carried out with young people")*, 4.6 *("It is important that messages are tailored for different groups of young people")*, 4.7 *("I prefer that prevention also includes dialogue, not just presentations")*, 5.1 *("Messages that use fear or shock are less convincing")*, 5.2 *("Messages that include open discussions are more effective")*, and 5.3 *("Moralising messages are easy to ignore")*. Initially, items 3.4 and 3.7, which address perceptions that institutions understand young people's problems and listen to their opinions, were considered for inclusion in the scale. However, fidelity analysis showed they correlated poorly with the other items and reduced the scale's internal consistency. Consequently, they were eliminated, and the final version of the construct demonstrated satisfactory internal consistency (Cronbach's Alpha = 0.729), supporting its use in subsequent analyses.

The second construct, "Acceptance of prevention itself," was developed to measure respondents' support for prevention as a social and educational strategy, independent of the specific communication style of the campaigns. It included seven items: 5.4 ("It is useful for drug prevention to also discuss stress, anxiety and other emotional problems"), 5.5 ("It is useful for prevention to include information about psychological support and resources for help"), 6.1 ("Realistic information is important in drug prevention"), 6.2 ("Access to counselling should be a component of prevention"), 6.3 ("Schools should constantly include health education and prevention"), 6.4 ("Family involvement is important in prevention"), and 6.6 ("It is important for prevention to be evaluated periodically, based on feedback from young people"). Reliability analysis indicated high internal consistency for this scale (Cronbach's Alpha = 0.868), suggesting that the included items coherently reflect a single latent dimension and justify the use of a single composite score.

The association between the acceptance of prevention itself and criticism of top-down campaign styles was examined through correlation analysis. The results indicate a positive association between the two constructs. This should be interpreted as a relationship between attitudes, not as evidence of a causal or predictive effect. Construct validation was performed using an integrated set of psychometric and statistical indicators. The internal consistency of the scales was assessed using Cronbach's

α coefficient, indicating an adequate level of reliability. Data distributions were examined both descriptively (mean, median, standard deviation) and inferentially, using Kolmogorov–Smirnov and Shapiro–Wilk normality tests. Differences between constructs were tested using parametric and non-parametric methods (paired samples t-test and Wilcoxon test), and their practical relevance was assessed using effect size (Cohen's d). The relationship between variables was analysed using Pearson correlation and linear regression, confirming the empirical coherence of the model.

The data indicate that young people do not reject the concept of prevention; on the contrary, they evaluate it very favourably. The primary issue appears to be the communication of campaigns, particularly when perceived as rigid, moralising, fear-based or inadequately adapted to the experiences and language of the younger generation. The substantial difference between the two scores, the medium-to-large effect size, and the positive relationship between the constructs support the interpretation that respondents' reservations pertain mainly to the form, rather than the substance, of preventive communication. Consequently, the effectiveness of prevention campaigns seems to depend not only on the existence of preventive messages but also on their capacity to be formulated in a participatory, realistic and dialogue-oriented manner.

To assess whether *the more young people are exposed to prevention messages, the higher their awareness of risks*, a composite construct called "Perception of drug use" was operationalised as the dependent variable. It was built from six items of the questionnaire: 7.1 *("There are people in my circle of friends who use drugs")*, 7.2 *("If someone wanted to, it would be easy to get drugs")*, 7.3 *("Most young people my age have tried drugs")*, 7.4 *("Some drugs are not as dangerous as they say")*, 7.5 *("In the media, the risks of drug use are sometimes exaggerated")*, and 7.7 *("Drug use is criminalised too much")*. Reliability analysis showed that this scale has good internal consistency, with Cronbach's Alpha = 0.800 for the six items, supporting the use of the composite score in subsequent analyses. Additionally, the corrected item-total correlations, ranging from 0.523 to 0.604, indicate that each item contributes adequately to the internal structure of the scale.

The data indicate that a higher frequency of exposure to prevention messages is associated with higher scores on the "Perception of drug use" construct. This relationship is confirmed by both parametric and non-parametric analyses. However, the effect size is small, and significant differences primarily emerge for respondents with very high levels of exposure. Therefore, the results suggest that simple exposure frequency to prevention messages may increase perceptions of drug use, but this factor explains only a small proportion of the total variance in the score and should

be interpreted alongside other relevant determinants. The "Perception of drug use" construct was assessed using descriptive indicators (mean, median, standard deviation), which indicate a moderate level of scores. The data distribution was tested using Kolmogorov–Smirnov and Shapiro–Wilk tests, highlighting deviations from normality. We analysed whether the frequency of exposure to prevention messages influences the studied outcome using both parametric methods (ANOVA with Bonferroni post hoc tests) and non-parametric methods (Kruskal–Wallis test), both of which indicated similar conclusions. The analysis was completed by linear regression and Pearson correlation, which indicated a positive but weak association between the variables.

From a substantive perspective, these findings suggest that more frequent exposure to preventative messages can shape young people's perceptions of drug use, although the impact is limited when considered in isolation. Consequently, the effectiveness of prevention appears to depend not solely on message frequency, but also on its content, the source transmitting it, its credibility, and the extent to which messages are adapted to the target audience's experience and language.

Young people who have greater trust in institutions are more willing to seek help with drug-related problems. A composite score, "Trust in institutions," was constructed as an associated variable. "Willingness to seek help" through official services or institutions was treated as a comparison variable, derived from item 3.6: *"If I had a problem related to consumption (myself or someone close to me), I would have the confidence to seek help through official services or institutions."* The "Trust in institutions" construct was defined based on six items: 3.1 (*"I trust that public institutions pursue the good of young people"*), 3.2 *("Institutions communicate transparently about drug prevention"*), 3.3 *("Drug regulations are generally fair"),* 3.4 *("Institutions understand the problems that young people currently face")*, 3.5 *("I believe that prevention is done more to support than to control")*, and 3.7 *("In general, institutions listen to the opinions of young people").*

Both correlational analyses and regression models demonstrate that trust in institutions is a strong and significant associated variable for willingness to seek help through official services or institutions. In other words, young people who perceive institutions as more well-intentioned, transparent, fair, attentive to their problems, and willing to listen to their opinions are significantly more inclined to seek formal support for drug-related issues. The "Trust in Institutions" scale was validated using Cronbach's α (0.905), inter-item, and item-total correlations, all indicating very high internal consistency. The distribution of scores was assessed through descriptive indicators and the Kolmogorov–Smirnov and Shapiro–Wilk normality tests.

The relationship with willingness to seek help was analysed using Pearson and Spearman correlations, and predictive capacity was tested with linear regression, with the model indicating a strong and significant effect ($R^2 = 0.589$; $p < 0.001$).

Messages that realistically discuss the risks of drug use are perceived as more effective than alarmist messages. A composite score, "Quality of prevention messages," was used as the comparison variable. This construct was created by aggregating the mean of the following seven statements: 2.1 "*Drug prevention messages provide useful information for young* people." 2.2 "*Messages explain the risks in an easy-to-understand* way." 2.3 "*Messages provide examples or situations close to the reality of young* people." 2.4 *"Messages have information about where you can ask for help if you need* it." 2.5 "*Messages inform without judging* people." 2.7 "*Messages made me think more seriously about this* topic." 2.8 "*Messages made me aware of the risks of drug* use." Item 2.6 *("Messages present information in a realistic way, without exaggeration")* was excluded from the composite score and treated separately as an associated variable. This methodological decision was made to prevent overlap between the associated and comparison variables, which could artificially inflate the statistical relationship.

The realism of the messages appears to be the decisive factor in the positive evaluation of their quality. The "Quality of prevention messages" construct was validated by analysing internal consistency (Cronbach's $\alpha = 0.910$), inter-item, and item-total correlations, all of which indicated very high fidelity. The distribution of scores was evaluated using descriptive indicators (mean, median, standard deviation) and the Kolmogorov–Smirnov and Shapiro–Wilk normality tests to identify deviations from normality. Relationships between variables were analysed using Spearman correlations, and predictive capacity was tested with simple and multiple linear regressions; the final model demonstrated high explanatory power ($R^2 = 0.559$).

Both the perception that messages are formulated realistically and without exaggeration, and the value of realistic information in prevention, are positively associated with the comparison score. By contrast, the simple rejection of fear-based messages does not significantly explain perceived quality. Furthermore, the preference for open messages makes a reduced, insignificant contribution when realism is simultaneously introduced into the model. These results suggest that in respondents' perception, what truly distinguishes a quality prevention message is not merely the absence of alarmism, but particularly the presence of balanced, credible and unexaggerated communication.

Therefore, the initial statement is partially supported: messages that realistically discuss the risks of consumption are more strongly associated with favourable evaluations of the quality of preventive messages than fear-based messages. However,

not all theoretically relevant components of an open or non-alarmist style retain their significance when analysed simultaneously. The overall result supports the idea that communication realism constitutes the most important dimension of the perceived effectiveness of preventive messages.

To test the hypothesis that *drug prevention is perceived as more effective when it involves both school and family*, items 6.3 (*"School should constantly include health education and* prevention") and 6.4 (*"Family involvement is important in* prevention") were used as associated variables. For comparison, a composite score was created, termed "Efficiency/preference for supportive and realistic prevention," by averaging the following five statements: 5.4 (*"It is useful that in drug prevention, stress, anxiety and other emotional problems are also* discussed"), 5.5 ("*It is useful that prevention includes information about psychological support and resources for* help"), 6.1 ("*Realistic information is important in drug* prevention"), 6.2 ("*Access to counselling should be a component of* prevention"), and 6.6 ("*It is important that prevention is evaluated periodically, based on feedback from young* people").

The results clearly support the initial premise. Both the role of the school and the role of the family are positively and significantly associated with a preference for prevention perceived as realistic, supportive, and help-oriented. The construct "Efficiency/preference for supportive and realistic prevention" was validated using Cronbach's α (0.861), which indicated high internal consistency. This was complemented by descriptive statistics (mean, median, standard deviation). The distribution of scores was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk normality tests, alongside shape indicators (skewness, kurtosis), to identify any deviations from normality. Relationships between variables were analysed using Spearman correlations, and predictive capacity was tested through simple linear regressions, based on R^2, α coefficients, and the statistical significance of the models. In essence, respondents who believe that schools and families should be involved in drug use prevention simultaneously tend to more strongly support prevention based on counselling, psychological support, balanced information and continuous evaluation.

However, the results indicate that the school's role is a stronger predictor than the family's, both in the correlational analysis and in the linear regression. This suggests that, in respondents' perceptions, the school environment is a particularly important setting for implementing preventive strategies. This is likely due to constant access to young people, the possibility of early intervention, and the formal, organised nature of health education. Concurrently, the positive and significant association between family involvement and the analysed comparison suggests that

effective prevention is also perceived as a process that must be supported beyond institutional spaces through the participation of close family members.

Therefore, the data support the idea that the effectiveness of prevention is perceived as higher when the intervention is not limited to the simple transmission of information, but is integrated into a broader framework. In this framework, both the school and the family contribute to building a realistic, supportive, and youth-centred prevention model. Thus, the hypothesis is confirmed and the results suggest that a preventive strategy perceived as effective involves both the institutionalisation of preventive education in schools and significant family participation.

To examine whether participation in organised drug prevention activities is associated with significant differences in the main dimensions investigated, two groups of respondents were compared: those who reported participating in such activities and those who did not. Given the non-normal nature of some of the distributions analysed, comparisons were made using the Mann-Whitney U test. Overall, the comparative analysis shows that participation in organised prevention activities is significantly associated with:

- a higher level of trust in institutions;
- a more favourable assessment of the quality of preventive messages;
- a greater willingness to ask for institutional help.

By contrast, participation in such activities does not appear to significantly alter:

- the acceptance of prevention itself;
- the perception of drug use;
- the preference for general prevention styles and strategies.

From an interpretive perspective, these results suggest that direct experience with preventive interventions does not necessarily change respondents' general attitudinal foundations towards prevention. However, it does contribute to a better relationship with its institutional and practical dimensions. Specifically, those who participated in preventive activities tend to have more trust in institutional actors, to evaluate the messages they receive more positively, and to demonstrate a greater willingness to seek official help. This may indicate that concrete participation in prevention activities increases the perceived familiarity, credibility and accessibility of the support system, even if it does not radically transform the general vision of prevention.

For the open-ended question, "If you could change just one thing about drug prevention, what would it be?," responses were analysed using a thematic coding scheme with seven categories. These categories were developed to group responses according to dominant directions of meaning: changing the way of communica-

tion, support and empathy, involving young people and people with real experience, education and information about risks, control and sanctions, decriminalisation/legalisation, and non-codable responses.

The most frequently identified category was "Education and real information about risks," with 95 mentions, representing 23.4% of the total coded responses and 31.5% of the total respondents. This result suggests that the main expectation expressed by the respondents is aimed at strengthening the educational component of prevention, through clearer, more concrete, more realistic information, and better anchored in the actual consequences of consumption.

In second place was the category "Changing the way prevention is communicated," with 88 mentions, i.e. 21.7% of the total responses and 29.1% of the total cases. The high share of this theme shows that respondents do not necessarily dispute the idea of prevention, but especially the form in which it is communicated. The emphasis seems to fall on the need for more authentic messages, less moralising, less fear-based, and closer to the language and experiential universe of young people.

Another important category, "Involvement of young people, family, and people with real experience," received 61 mentions, accounting for 15.0% of total responses and 20.2% of total respondents, which indicates that a significant portion of participants believe a participatory reconfiguration of prevention is necessary. This would involve consulting young people and giving individuals with direct experience or family members a more prominent role in developing and transmitting messages.

Overall, the content analysis reveals that respondents' answers primarily focus on three areas: education and accurate information about risks, changing how prevention is communicated, and involving relevant and credible actors in campaigns. Calls for control and sanctions were less frequent, and positions explicitly favouring decriminalisation were marginal. This suggests that young people, in particular, value credible, realistic, participatory, and moralising prevention over approaches focused on coercion or simple repression of the phenomenon.

For the two open-ended questions, answers were coded as multiple responses, meaning a single respondent could mention more than one theme. Therefore, the totals in Tables 2 and 3 refer to coded responses, not individual respondents, which explains why the number of coded responses exceeds the total sample size.

The results for the open-ended question, "What type of message or communication format would make you more attentive to drug prevention?," were analysed using a 7-category thematic coding scheme. This scheme was designed to transform qualitative responses into statistically comparable response classes. The categories were: real and clear messages; empathy and support; real stories and people with

direct experience; dialogue and interactivity; media/online formats; messages focused on risks and consequences; and vague or uncodable responses.

Table 2. Suggested changes to drug prevention strategies reported by respondents

If you could change one thing about drug prevention, what would it be?				
		Answers		Percentage of respondents mentioning the category[4]
		N	Percent	
If you could change one thing about drug prevention, what would it be?	Changing the way prevention is communicated	88	21.7%	29.1%
	Support, empathy and a non-judgemental approach	5	11.1%	14.9%
	Involving young people, family and people with real experience	1	15.0%	20.2%
	Education and real information about risks	5	23.4%	31.5%
	Control, sanctions and legislative measures	9	9.6%	12.9%
	Decriminalisation / legalisation / a less punitive approach	3	3.2%	4.3%
	I don't know / nothing / no useful answer / uncodable	5	16.0%	21.5%
Total		116	100.0%	134.4%

Source: Authors' own elaboration.

The most frequent category identified was "Don't know / none / vague answer," with 86 mentions, representing 20.8% of the total coded responses and 28.3% of the total respondents. This relatively high proportion suggests that a significant number of participants did not have a clearly formulated preference for the type of message or communication format that would make them more attentive to prevention. From an interpretative perspective, this result may signal either a distance from the subject or a difficulty in spontaneously articulating a concrete expectation regarding preventive communication.

Among the categories with substantial thematic content, "Real stories / former users / people with direct experience" was the most frequent, with 66 mentions, representing 15.9% of total responses and 21.7% of total respondents. This indicates that the authenticity of the message's source is a key expectation among respond-

[4] Note. Percent refers to the share of all coded responses. The percentage of respondents indicates the proportion of respondents who mentioned each category. Because multiple answers were allowed, this column may exceed 100% in total.

ents. Participants appear to believe that direct testimonies, real experiences, and the voices of individuals who have overcome addiction are more persuasive than general or impersonal messages.

Three distinct categories recorded similar values. The category "Real, sincere, clear, no exaggerated messages" received 62 mentions, accounting for 15.0% of total responses and 20.4% of total cases. This suggests that respondents particularly value messages that are direct, balanced, and free from unnecessary dramatisation. Similarly, "Dialogue, interactive discussions, face-to-face format" also had 62 mentions (15.0% of responses, 20.4% of cases), indicating a strong preference for interactive communication over the unilateral transmission of information. Concurrently, "Social media / video / online / visual formats" recorded 61 mentions (14.7% of responses, 20.1% of cases), highlighting digital and visual media as particularly relevant channels for capturing young people's attention.

Table 3. Preferred message types and communication formats that increase attention to drug prevention

What type of message or communication format would make you more attentive to drug prevention?				
		Answers		Percentage of respondents mentioning the category[5]
		N	Percent	
What type of message or communication format would make you more attentive to drug prevention?	Real, sincere, clear messages, without exaggeration	62	15.0%	20.4%
	Empathy, support, lack of judgement, emphasis on helping	31	7.5%	10.2%
	Real stories / former consumers / people with direct experience	66	15.9%	21.7%
	Dialogue, interactive discussions, face-to-face format	62	15.0%	20.4%
	Social media / video / online / visual formats	61	14.7%	20.1%
	Messages focused on risks, consequences, strong emotional impact	46	11.1%	15.1%
	I don't know / none / vague answer	86	20.8%	28.3%
Total		414	100.0%	136.2%

Source: Authors' own elaboration.

[5] Note. Percent refers to the share of all coded responses. The percentage of respondents indicates the proportion of respondents who mentioned each category. Because multiple answers were allowed, this column may exceed 100% in total.

Overall, the results of this thematic analysis demonstrate that respondents primarily favour messages and communication formats that are authentic, clear, based on real experiences, interactive, and adapted to the digital environments commonly used by young people. In contrast, messages focused strictly on shock, fear or dramatisation do not appear to be a dominant preference. The prominence of real stories, dialogue, and visual/online formats among the most frequent themes suggests that the perceived effectiveness of preventive communication depends not only on the message's content but also on the source's credibility, the narrative style, and the transmission channel.

In conclusion, the analysis of responses to open question 2 supports the idea that young people place greater importance on realism, authentic experience, dialogue, and adaptation to digital culture. Preferences for purely punitive or exclusively alarmist messages appear less pronounced (see Table 3). These findings complement the quantitative research results and offer significant interpretive support for formulating recommendations to optimise preventive communication.

7. Conclusion and implications

Overall, the results suggest that respondents do not reject prevention as a principle. Instead, they challenge rigid, moralising, poorly participatory, or insufficiently adapted forms that fail to align with their social and emotional realities. The main issue is not young people's rejection of prevention, but rather the inadequacy of a significant portion of preventive communication and a deficit in institutional trust. Young people clearly support prevention when it is formulated realistically, without exaggeration and oriented towards support, dialogue, counselling and participation. By contrast, campaigns perceived as moralising, overly top-down, insufficiently rooted in their reality, and poorly participatory tend to be evaluated more reservedly. Therefore, within the limits of this exploratory sample, the findings suggest that prevention perceived as more appropriate by respondents is associated with four central dimensions: message realism, youth participation, institutional trust, and support interventions through school, family and accessible psychological resources.

The first limitation of the present research concerns the characteristics of the sample analysed. Participants primarily come from Bucharest and its metropolitan area, and the gender distribution is predominantly female, which may reduce the generalisability of the results to the entire youth population in Romania. Additionally, the

data are based on self-reporting, which may introduce distortions due to respondents' desire to provide socially acceptable answers or memory errors. The study's cross-sectional design does not allow for firm causal inferences between the variables analysed, only for identifying statistical associations. Furthermore, the low frequency of exposure to preventive messages among a significant proportion of respondents, as well as the very small size of some subgroups (for example those exposed almost daily to preventive messages), necessitates caution when interpreting certain comparisons. Because the sample was non-probabilistic, geographically concentrated, predominantly female and based on voluntary participation, the findings cannot be generalised to the entire population of young people aged 14–29 in Romania. They should be interpreted as exploratory results referring to the respondents included in this study. The cross-sectional design does not allow for causal inference, and some observed associations may be influenced by unobserved third variables that simultaneously affect both constructs.

The implications for governmental institutions include the need to transform top-down campaigns into participatory ones oriented towards dialogue. Increased transparency and institutional trust are important facilitators for young Romanians to seek help. Additionally, prevention could be integrated into a more comprehensive system offering counselling, psychological support, and resources for consumers.

NGOs could base their interventions more on real experiences and storytelling. Greater interaction and co-creation with young people might encourage them to engage in dialogue and listen to the message, thereby increasing the impact of prevention campaigns. They could also make greater use of the digital environment.

Schools and families might be more important actors. Programmes could focus more on emotional support and counselling, rather than solely on information. Participatory approaches might increase trust and openness to involvement. The key to success lies not in communicating more, but in the credibility and relevance of communicators and messages.

APPENDIX A. QUESTIONNAIRE

The questionnaire was anonymous. Respondents were informed that there are no correct or incorrect answers and were asked to select the option that best reflects their opinion. All items were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

1. In the last 12 months, have you encountered messages/information about drug use prevention?
   – Yes
   – I don't know / I can't remember
2. (If yes) Through which channels did you encounter these messages? (multiple answers allowed)
   – Educational institutions (school / secondary school / university)
   – Online (social media, websites)
   – TV / radio / press
   – Police / gendarmerie
   – NGO / community
   – Family / friends
   – Other
   – I don't know / I can't remember
3. In the last 12 months, how often did you encounter such messages?
   – Never
   – Once or a few times
   – Monthly
   – Weekly
   – Almost daily
   – I don't know / I can't remember
4. Have you participated in a drug prevention activity (workshop, presentation, school campaign)?
   – Yes
   – No
   – I don't know / I can't remember
5. Do you personally know close people who use drugs?
   – No
   – Yes, occasionally
   – Yes, frequently

– Prefer not to answer
– I don't know

SECTION II. Quality of prevention messages (Likert scale)

2.1 Messages provide useful information
2.2 Messages explain risks clearly
2.3 Messages reflect young people's reality
2.4 Messages provide help resources
2.5 Messages are non-judgemental
2.6 Messages are realistic
2.7 Messages stimulate reflection
2.8 Messages reduce interest in trying drugs

SECTION III. Trust in institutions (Likert scale)

3.1 Institutions pursue young people's well-being
3.2 Institutions communicate transparently
3.3 Drug regulations are fair
3.4 Institutions understand youth problems
3.5 Prevention is supportive, not controlling
3.6 I would seek help from institutions
3.7 Institutions listen to young people

SECTION IV. Youth participation (Likert scale)

4.1 Youth should be involved in campaigns
4.2 I would participate in consultations
4.3 Participation increases effectiveness
4.4 Youth currently have enough opportunities
4.5 Campaigns involving youth increase trust
4.6 Messages should be tailored
4.7 Prevention should include dialogue

SECTION V. Preferred communication style (Likert scale)

5.1 Fear-based messages are less convincing
5.2 Open messages are more effective
5.3 Moralising messages are ignored
5.4 Emotional topics should be included
5.5 Prevention should include psychological support

SECTION VI. Prevention strategies (Likert scale)

6.1 Realistic information is important
6.2 Counselling should be included
6.3 Schools should include prevention
6.4 Family involvement is important
6.5 Sanctions are necessary
6.6 Prevention should be evaluated

SECTION VII. Perception of drug use (Likert scale)

7.1 Friends use drugs
7.2 Drugs are easy to access
7.3 Most young people tried drugs
7.4 Some drugs are not dangerous
7.5 Risks are exaggerated
7.6 Occasional use can be serious
7.7 Drug use is over-criminalised

SECTION VIII. Open-ended questions

8.1 If you could change one thing about prevention, what would it be?
8.2 What type of message would attract your attention?

SOCIO-DEMOGRAPHIC DATA

– Age
– Gender
– Status (student / employed / other)
– Place of residence
– School performance
– Financial situation

APPENDIX B. DISTRIBUTION OF RESPONSES

This appendix presents the distribution of responses for the main Likert-scale items used in the analysis. Values are reported as frequencies (N) and percentages (%).

Table B1. Quality of prevention messages (Section II)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Drug prevention messages provide useful information for young people.	14 (4.6%)	33 (10.9%)	72 (23.7%)	115 (37.8%)	70 (23.0%)
The messages explain the risks in an easy-to-understand way.	11 (3.6%)	32 (10.5%)	55 (18.1%)	143 (47.0%)	63 (20.7%)
The messages provide examples or situations close to young people's reality.	33 (10.9%)	41 (13.5%)	72 (23.7%)	111 (36.5%)	47 (15.5%)
The messages include information about where you can seek help if needed.	18 (5.9%)	32 (10.5%)	62 (20.4%)	123 (40.5%)	69 (22.7%)
The messages inform without judging people.	37 (12.2%)	48 (15.8%)	81 (26.6%)	90 (29.6%)	48 (15.8%)
The messages present information in a realistic way, without exaggeration.	36 (11.8%)	49 (16.1%)	88 (28.9%)	89 (29.3%)	42 (13.8%)
The messages made me think more seriously about this topic.	37 (12.2%)	43 (14.1%)	102 (33.6%)	76 (25.0%)	46 (15.1%)
The messages made me more aware of the risks of drug use.	30 (9.9%)	35 (11.5%)	58 (19.1%)	103 (33.9%)	78 (25.7%)

Table B2. Trust in institutions (Section III)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I trust that public institutions act in the best interest of young people.	45 (14.8%)	59 (19.4%)	88 (28.9%)	81 (26.6%)	31 (10.2%)
Institutions communicate transparently about drug use prevention.	47 (15.5%)	58 (19.1%)	98 (32.2%)	79 (26.0%)	22 (7.2%)
Drug-related rules are generally fair.	34 (11.2%)	53 (17.4%)	71 (23.4%)	97 (31.9%)	49 (16.1%)
Institutions understand the problems young people face today.	85 (28.0%)	75 (24.7%)	86 (28.3%)	41 (13.5%)	17 (5.6%)
I believe prevention efforts are aimed more at supporting than controlling.	41 (13.5%)	42 (13.8%)	100 (32.9%)	87 (28.6%)	34 (11.2%)
If I had a problem related to substance use (myself or someone close), I would trust official services/institutions enough to ask for help.	71 (23.4%)	63 (20.7%)	74 (24.3%)	61 (20.1%)	35 (11.5%)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
In general, institutions listen to young people's opinions.	83 (27.3%)	77 (25.3%)	89 (29.3%)	39 (12.8%)	16 (5.3%)

Table B3. Youth participation (Section IV)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Young people should be involved in planning prevention campaigns.	4 (1.3%)	1 (0.3%)	30 (9.9%)	126 (41.4%)	143 (47.0%)
If I were invited, I would participate in a consultation about prevention (online or face-to-face).	12 (3.9%)	16 (5.3%)	101 (33.2%)	115 (37.8%)	60 (19.7%)
Youth participation would increase the effectiveness of campaigns.	3 (1.0%)	5 (1.6%)	36 (11.8%)	140 (46.1%)	120 (39.5%)
Currently, young people have enough opportunities to express their opinions about prevention.	36 (11.8%)	69 (22.7%)	96 (31.6%)	73 (24.0%)	30 (9.9%)
I would have more trust in campaigns if they were also developed with young people.	3 (1.0%)	6 (2.0%)	55 (18.1%)	133 (43.8%)	107 (35.2%)
It is important that messages are tailored to different groups of young people (age, background, experiences).	3 (1.0%)	0 (0.0%)	23 (7.6%)	103 (33.9%)	175 (57.6%)
I prefer prevention efforts to include dialogue (Q&A, discussions), not just presentations.	3 (1.0%)	4 (1.3%)	31 (10.2%)	103 (33.9%)	163 (53.6%)

Table B4. Message style (Section V)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Messages that use fear or shock are less convincing.	17 (5.6%)	48 (15.8%)	89 (29.3%)	73 (24.0%)	77 (25.3%)
Messages that encourage open discussion are more effective.	3 (1.0%)	3 (1.0%)	34 (11.2%)	127 (41.8%)	137 (45.1%)
Moralising messages are easy to ignore.	10 (3.3%)	17 (5.6%)	101 (33.2%)	105 (34.5%)	71 (23.4%)
It is useful for drug prevention to also address stress, anxiety, and other emotional issues.	4 (1.3%)	1 (0.3%)	20 (6.6%)	88 (28.9%)	191 (62.8%)
It is useful for prevention efforts to include information about psychological support and help resources.	4 (1.3%)	2 (0.7%)	24 (7.9%)	79 (26.0%)	195 (64.1%)

Table B5. Prevention strategies (Section VI)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Realistic information (benefits/risks, without exaggeration) is important in drug use prevention.	2 (0.7%)	3 (1.0%)	28 (9.2%)	97 (31.9%)	174 (57.2%)
Access to counselling should be a component of prevention.	2 (0.7%)	0 (0.0%)	30 (9.9%)	84 (27.6%)	188 (61.8%)
Schools should consistently include health education and prevention.	2 (0.7%)	0 (0.0%)	33 (10.9%)	87 (28.6%)	182 (59.9%)
Family involvement is important in prevention.	3 (1.0%)	7 (2.3%)	55 (18.1%)	77 (25.3%)	162 (53.3%)
Sanctions/punitive measures are necessary to reduce drug use.	44 (14.5%)	51 (16.8%)	73 (24.0%)	70 (23.0%)	66 (21.7%)
It is important that prevention efforts are periodically evaluated based on young people's feedback.	2 (0.7%)	3 (1.0%)	38 (12.5%)	115 (37.8%)	146 (48.0%)

Table B6. Perception of drug use (Section VII)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
In my circle of friends, there are people who use drugs.	111 (36.5%)	29 (9.5%)	61 (20.1%)	63 (20.7%)	40 (13.2%)
If someone wanted to, it would be easy to obtain drugs.	16 (5.3%)	26 (8.6%)	80 (26.3%)	105 (34.5%)	77 (25.3%)
Most people my age have tried drugs.	20 (6.6%)	28 (9.2%)	83 (27.3%)	101 (33.2%)	72 (23.7%)
Some drugs are not as dangerous as people say.	62 (20.4%)	56 (18.4%)	86 (28.3%)	61 (20.1%)	39 (12.8%)
In the media, the risks of drug use are sometimes exaggerated.	39 (12.8%)	43 (14.1%)	101 (33.2%)	67 (22.0%)	54 (17.8%)
Occasional drug use can have serious consequences.	9 (3.0%)	18 (5.9%)	54 (17.8%)	96 (31.6%)	127 (41.8%)
Drug use is overly criminalised.	55 (18.1%)	54 (17.8%)	89 (29.3%)	56 (18.4%)	50 (16.4%)

References

Agenția Națională Antidrog (ANA), European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). (2022). *Raport național privind situația drogurilor – noi evoluții și tendințe [National Report on the Drug Situation – New Developments and Trends]*, https://ana.gov.ro/wp-content/uploads/2025/01/RN_2022.pdf (accessed: 03.09.2026).

Arfini, L. (2026). *The Changing Attitudes of Generation Z Towards Substance Use and Risky Behaviours*, European Science-Media Hub, https://sciencemediahub.eu/2026/02/11/the-changing-attitudes-of-generation-z-towards-substance-use-and-risky-behaviours (accessed: 03.09.2026).

Baciu, A. (2024). Aspects of Drug Consumption Among Youth in Bucharest. A Medical Anthropology Perspective, *Proceedings of the Romanian Academy, Series B,* 26(2), pp. 55–63.

Baciu, A., Alexandru, M., Pungă, A. (2019). Prevention of Drug Use in Romania – Priority of Health Policies, *Romanian Journal of Legal Medicine,* 27(2), pp. 142–148.

Bucharest (2025). *Alarming Situation Regarding Alcohol and Drug Use Among Bucharest Teenagers*, https://www.bucharest.ro/news/alarming-situation-regarding-alcohol-and-drug-use-among-bucharest-teenagers-18 (accessed: 03.09.2026).

Buzzetto-Hollywood, N., Quinn, K. (2024). Technology Behaviors of Generation Z Learners, *Journal of Education and Human Development*, 13, pp. 61–67. DOI: 10.15640/jehd.v13p6.

Chardonnens, S. (2025). Adapting Educational Practices for Generation Z: Integrating Metacognitive Strategies and Artificial Intelligence, *Frontiers in Education,* 10, 1504726. DOI: 10.3389/feduc.2025.1504726.

Drăgan-Moldoveanu, A.-G. (2025). Prevenirea consumului de droguri în România cu ajutorul poveștilor de viață: Avantaje și dileme [Prevention of Drug Use in Romania Through Life Stories: Advantages and Dilemmas], *Revista de Asistență Socială,* 24(4), pp. 61–73.

Edelman (2024). *2024 Edelman Trust Barometer: Innovation in Peril*, https://www.edelman.com/trust/2024/trust-barometer (accessed: 03.09.2026).

Edelman (2025). *2025 Edelman Trust Barometer: APAC Regional Report,* https://www.apac.edelman.com/sites/g/files/aatuss881/files/2025-03/2025%20Edelman%20Trust%20Barometer_APAC%20Regional%20Report.pdf (accessed: 03.09.2026).

ESADE Business School (2024). *Young People Trust NGOs Less Than Older People, Reveals Survey by ESADE and the PwC Foundation*, https://www.esade.edu/en/news/young-people-trust-ngos-less-older-people-reveals-survey-by-esade-and-the-pwc-foundation (accessed: 03.09.2026).

Febliza, A., Kadarohman, A., Aisyah, S., Abdullah, N. (2025). Generation Z and the Use of Digital Technology: A Review from 2014 to 2023, *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 13(1), pp. 53–67.

Grénman, M., Hakala, U., Mueller, B., Uusitalo, O. (2024). Generation Z's Perceptions of a Good Life Beyond Consumerism: Insights from the United States and Finland, *International Journal of Consumer Studies*, 48(1), e12994. DOI: 10.1111/ijcs.12994.

Grigoriu, N. (2025). *Alarming Statistics! 6% of Students in Romania Have Used Drugs, 81% Have Drunk Alcohol, and 25% Have Played Gambling Games*, Transilvania 365, https://transilvania365.ro/statistici-alarmante-6-dintre-elevii-din-romania-au-consumat-droguri-81-au-baut-alcool-iar-25-au-jucat-jocuri-de-noroc (accessed: 03.09.2026).

Hashemi, R., Vogel, E.A. (2024). Adolescents' Perceptions of Substance Use Messaging in the Age of Social Media: Resolving Cognitive Dissonance, *Health Education Research*, 39(1), pp. 1–11. DOI: 10.1093/her/cyad046.

Hassoun, A., Beacock, I., Consolvo, S., Goldberg, B., Kelley, P.G., Russell, D.M. (2023). Practicing Information Sensibility: How Gen Z Engages with Online Information. In: *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (pp. 1–17). DOI: 10.1145/3544548.3581328.

Jain, V.K., Joy, V., Sharma, P. (2024). Minimalistic Consumption Practices and Well-Being Among Generation Z: Exploring Mediating Role of Satisfaction and Happiness, *Environment, Development and Sustainability*, 28(8), pp. 19453–19475. DOI: 10.1007/s10668-024-05722-y.

Katz, R., Ogilvie, S., Shaw, J., Woodhead, L. (2021). *Gen Z, Explained: The Art of Living in a Digital Age*. Chicago: University of Chicago Press. DOI: 10.7208/chicago/9780226814988.

MetropolaTV (2023). *Raport privind situația consumului de droguri în România [Report on the Situation of Drug Use in Romania]*, https://www.metropolatv.ro/articol-principal/raport-privind-situatia-consumului-de-droguri-in-romania (accessed: 03.09.2026).

Mohr, K.A., Mohr, E.S. (2017). Understanding Generation Z Students to Promote a Contemporary Learning Environment, *Journal on Empowering Teaching Excellence*, 1(1), 9. DOI: 10.15142/T3M05T.

Porat, E., Blau, I., Barak, A. (2018). Measuring Digital Literacies: Junior High-School Students' Perceived Competencies Versus Actual Performance, *Computers & Education*, 126, pp. 23–36. DOI: 10.1016/j.compedu.2018.06.030.

Prasanna, M., Priyanka, A.L. (2024). Marketing to Gen Z: Understanding the Preferences and Behaviors of Next Generation, *International Journal for Multidisciplinary Research*, 6(4), pp. 1–8.

PwC (2025). *The Gen Z Paradox: Spending Less, Expecting More*, https://www.pwc.com/us/en/industries/consumer-markets/library/gen-z-consumer-trends.html (accessed: 03.09.2026).

Reid, L., Button, D., Brommeyer, M. (2023). Challenging the Myth of the Digital Native: A Narrative Review, *Nursing Reports*, 13(2), pp. 573–600. DOI: 10.3390/nursrep13020052.

Rosnerova, Z., Ponisciakova, O., Kicova, E., Strenitzerova, M. (2025). The Impact of the Digital World on the Buying Behaviour of Generation Z, *Administrative Sciences*, 15(12), 459. DOI: 10.3390/admsci15120459.

Sengupta, D., Mathews, M., Bridges, L., D'Costa, R., Bastian, B.L. (2024). Sustainability Orientation of Generation Z and Its Role in Their Choice of Employer. A Comparative Qualitative Inquiry of India and United States, *Administrative Sciences*, 14(10), 249. DOI: 10.3390/admsci14100249.

Szasz, I. (2025). The Contributing Factors of Gen Z Prevalent Addictions, *SCIENTIA MORALITAS International Journal of Multidisciplinary Research*, 10(1), pp. 169–186.

Ti, L., Fast, D., Small, W., Kerr, T. (2017). Perceptions of a Drug Prevention Public Service Announcement Campaign Among Street-Involved Youth in Vancouver, Canada: A Qualitative Study, *Harm Reduction Journal*, 14(1), 3. DOI: 10.1186/s12954-017-0132-7.

United Nations Office on Drugs and Crime (2008). *A Century of International Drug Control: An Extended Version of Chapter 2 of the World Drug Report 2008*.

United Nations Office on Drugs and Crime (2025). *World Drug Report 2025: Special Points of Interest*, pp. 2–4, https://www.unodc.org/documents/data-and-analysis/WDR_2025/WDR25_Special-Points_web.pdf (accessed: 03.09.2026).

University College London (2026). *Substance Use on the Rise Among Gen Z in Their Early 20s*. UCL News, https://www.ucl.ac.uk/news/2026/mar/substance-use-rise-among-gen-z-their-early-20s (accessed: 03.09.2026).

15

Krzysztof Siegieda[1]
Mateusz Zawisza[2]

Memory Arms Race in Q-Learning: How Memory Asymmetry Shapes Algorithmic Collusion in Sequential Pricing

Abstract

This paper investigates how memory asymmetry – differences in the depth of state representation – affects algorithmic collusion in a sequential pricing duopoly where Q-learning agents learn to coordinate. We first extend the framework of Klein [2021] by confirming that symmetric one-period memory algorithms converge to collusive outcomes in about two-thirds of simulations, establishing a robust baseline. We then introduce two asymmetric configurations: (i) one algorithm has no memory while the other has one-period memory; (ii) one algorithm has one-period memory while the other has two-period memory. In the first asymmetric case, both agents earn equal supra-competitive profits and always converge to a Nash equilibrium – a substantially more stable outcome than the symmetric benchmark. In the second, the deeper-memory agent earns a modest profit advantage, and Nash equilibrium rates remain high (over 95%), but learning is significantly slower due to the larger state space. These results reveal a positive externality: a firm's profit depends on its rival's memory depth, creating an incentive for a memory arms race – firms benefit when competitors adopt deeper memory. Yet, contrary to the concern that heterogeneity undermines collusion, we find that memory asymmetry can actually stabilise

1 SGH Warsaw School of Economics (Poland), e-mail: ks142569@student.sgh.waw.pl.
2 SGH Warsaw School of Economics (Poland), e-mail: mzawisz@sgh.waw.pl.

collusion, shifting coordination from prices to algorithm design. This *meta-game* of algorithmic sophistication carries important implications for competition policy.
Code and data: All codes, scripts, and experimental notebooks required to replicate the results are available in the GitHub repository: https://github.com/cynda11/algorithmic-collusion-memory-asymmetry. The project is fully replicable.

1. Introduction

The increasing prevalence of algorithmic pricing in online and offline markets has raised concerns about autonomous collusion – the possibility that self-learning algorithms may discover how to sustain supra-competitive prices without explicit communication or agreement. Recent work by Calvano, Calzolari, Denicolò, Pastorello, [2020b] and Klein [2021] demonstrates that Q-learning algorithms can indeed learn to collude in both simultaneous and sequential move settings, achieving monopoly-like profits through reward–punishment strategies.

However, these findings are largely based on symmetric environments where identical algorithms learn together from scratch. Real markets are characterised by heterogeneity: firms use different pricing algorithms, update prices at different frequencies, and possess varying degrees of strategic sophistication. Whether algorithmic collusion persists when learners face strategically diverse competitors remains an open question with important implications for competition policy.

This paper addresses this gap by investigating how memory asymmetry – differences in the depth of historical information that algorithms use – affects collusive outcomes in a sequential pricing duopoly. We compare three configurations: (1) symmetric one-period memory (both algorithms condition on the competitor's last price); (2) one algorithm with one-period memory versus a memoryless algorithm; and (3) one algorithm with one-period memory versus an algorithm with two-period memory (i.e. one that conditions on the competitor's last price and its own last price). This setup allows us to assess both the vulnerability of less sophisticated algorithms and the potential benefits – and costs – of greater strategic sophistication. Our results show that algorithmic collusion is robust to such asymmetries, though deeper memory confers a profit advantage at the expense of slower learning.

2. Literature review

2.1. Foundations of algorithmic collusion and sequential pricing

Price competition has long been a central topic in industrial organisation, beginning with the Bertrand framework and extending to dynamic models of oligopoly interaction [Tirole, 1988]. Seminal work by Maskin and Tirole [1988] showed that sequential price competition can generate persistent Edgeworth cycles and multiple equilibria even in simple oligopoly settings. Subsequent research emphasised the roles of switching costs, imperfect information, and bounded rationality in sustaining supra-competitive prices and heterogeneous pricing dynamics [Belleflamme, Peitz, 2015]. Simulation-based studies by Zawisza, Kamiński, Witkowski, [2011] and Zawisza and Kamiński [2013] further demonstrated that switching costs, uncertainty, customer inertia, and firms' planning horizons can substantially shape equilibrium pricing patterns and facilitate coordination. This literature suggests that oligopoly pricing outcomes are inherently heterogeneous and path-dependent, making them particularly suitable for analysis through learning and simulation-based approaches.

Research on algorithmic collusion has developed rapidly at the intersection of industrial organisation, computer science, and competition policy. A foundational contribution is Calvano et al. [2020b], who demonstrate that two independent Q-learning agents can autonomously learn to sustain supra-competitive prices in a simultaneous-move duopoly. Their algorithms discover that short-run gains from undercutting are outweighed by the long-run rewards of maintaining high prices, generating reward–punishment dynamics. In a related policy-oriented piece, Calvano, Calzolari, Denicolò, Harrington, Pastorello, [2020a] emphasise that such autonomously learned collusive strategies require neither communication nor intent, challenging competition policy frameworks that rely on evidence of explicit agreements.

Klein [2021] extends this analysis to sequential pricing, arguing that an alternating-move structure better reflects real-world algorithmic price adjustment. Within the framework of Maskin and Tirole [1988], he shows that Q-learning agents with one-period memory frequently coordinate on collusive stationary prices when the price grid is coarse, and otherwise converge to deterministic Edgeworth cycles that keep average prices above competitive levels. His findings – that approximately two-thirds of runs converge to a Nash equilibrium and that learned strategies exhibit reward–punishment properties – provide the benchmark that our asymmetric treatments build upon.

2.2. Broader simulation and empirical evidence

Beyond these core studies, simulation results also point to the possibility of algorithmic collusion. Waltman and Kaymak [2008] show that Q-learning can produce persistent supra-competitive quantities in a Cournot oligopoly. Similarly, Dogan and Güner [2013] find supra-competitive outcomes in mixed inventory–pricing environments when algorithms condition on past prices.

Empirical evidence, though limited, points in the same direction. Assad, Clark, Ershov, Xu, [2020] document that German retail petrol stations adopting algorithmic pricing gradually experience increased margins, consistent with learning-driven coordination. Legal and policy analyses [e.g., Harrington, 2018; Ezrachi, Stucke, 2016, 2017] argue that autonomously learned collusive strategies may fall outside existing antitrust frameworks, even though they produce equivalent economic harm to human collusion.

2.3. State representation, memory and heterogeneity

A key design feature in reinforcement-learning models is state representation. Most existing work, including Calvano et al. [2020b] and Klein [2021], assumes one-period memory, where each algorithm conditions only on the competitor's last price. While consistent with the Markov-perfect structure of Maskin and Tirole [1988], this approach limits strategic richness. Although some authors study richer state representations, such as multi-period memory [e.g. Waltman, Kaymak, 2008], such expansions increase the state space and slow convergence. Abada, Harrington, Lambin Meylahn, [2025] emphasise that little is known about how heterogeneity in memory depth affects the emergence or stability of algorithmic collusion.

More broadly, relaxing symmetry produces mixed evidence. Den Boer, Meylahn, Schinkel, [2022] show that Q-learning algorithms can be exploited by simpler bandit algorithms such as Exp3. Bichler, Durmann, Oberlechner, [2024] find that various online optimisation algorithms outperform Q-learning in repeated price competition, leading to more competitive pricing whenever algorithmic types differ. Abada, Lambin, Tchakarov, [2024] show that neural-network-based policy-gradient algorithms tend to behave competitively and can exploit standard Q-learners. These findings suggest that symmetry may be important for stable algorithmic collusion. However, as Abada et al. [2025] stress, existing evidence concerns heterogeneity across algorithm classes, not within Q-learning itself. No prior study systematically examines whether Q-learning agents differing only in memory depth can still sustain collusion.

2.4. The present contribution

This paper addresses this gap by studying algorithmic collusion under controlled memory asymmetry. Building on the sequential framework of Klein [2021], we compare symmetric one-period memory against two asymmetric setups: one-period versus zero memory, and one-period versus two-period memory. We find that algorithmic collusion remains robust even when memory depths differ. Higher-memory algorithms systematically earn higher profits, demonstrating a strategic advantage, while deeper memory significantly slows learning due to state-space expansion. Heterogeneity does not therefore eliminate collusion; it reshapes its distributional consequences and introduces novel dynamics in convergence speed.

In addition to the asymmetry analysis, we provide a deeper empirical exploration of the symmetric baseline. While Klein [2021] reports convergence frequencies and representative paths, we extend his work with richer visualisations, distributional analyses, volatility measures, temporal clustering, and unsupervised classification of dynamic regimes. These diagnostics validate the reward–punishment patterns and Edgeworth cycle dynamics while revealing previously undocumented variation within symmetric environments. Combining an enriched replication with the first systematic exploration of memory asymmetry advances our understanding of how reinforcement-learning algorithms coordinate and maintain supra-competitive pricing.

3. Model and methodology

3.1. Sequential pricing duopoly

We follow the sequential price – setting framework of Maskin and Tirole [1988], as adapted by Klein [2021]. The model features two firms producing a homogeneous good at zero marginal cost. Time is discrete and infinite. In each period, only one firm updates its price while the other keeps its previous price, generating an alternating – move structure: Firm 1 chooses in periods $t = 1, 3, 5, \ldots$, and Firm 2 chooses in periods $t = 2, 4, 6, \ldots$. As illustrated in Figure 1, the timing of moves implies that each firm conditions its decision on the last observed action of its competitor, creating a one-step Markovian environment in which the state relevant for optimisation is simply the rival's most recent price. This structure captures markets in which firms do not update prices simultaneously, but react to one another with small

delays – an assumption that aligns closely with the behaviour of real-world algorithmic pricing systems.

Prices belong to a discrete grid

$$P = \{0, 1/k, 2/k, \ldots, 1\},$$

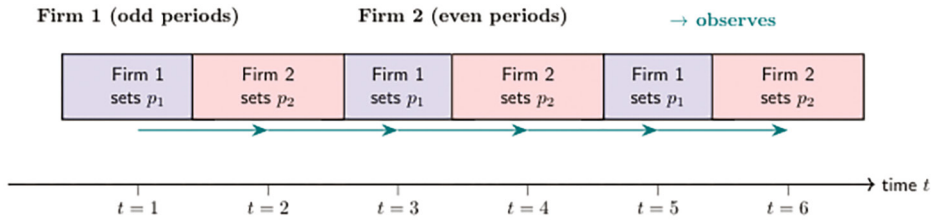
with k price intervals. When firm i sets price p_i and its rival sets price p_j, demand for firm i follows the standard undercutting rule used in Klein [2021]:

$$D_i(p_i, p_j) = \begin{cases} 1 - p_i & \text{if } p_i < p_j, \\ \frac{1}{2}(1 - p_i) & \text{if } p_i = p_j, \\ 0 & \text{if } p_i > p_j. \end{cases}$$

Firm i's stage profit is therefore

$$\pi_i(p_i, p_j) = p_i D_i(p_i, p_j).$$

Figure 1. Sequential price-setting in the alternating-move duopoly



Source: Authors' own elaboration.

The monopoly price is $p^m = 0.5$ with associated profit 0.125. The competitive (static Nash) benchmark is the lowest feasible price in the grid, which is $1/k$. Because only one firm moves at a time, the relevant state variable for the acting firm is simply the competitor's most recent price. This property makes the environment Markov and particularly well – suited to reinforcement learning.

3.2. Learning environment and state representation

Unlike the classical game-theoretic approach, the firms we consider do not possess analytical reaction functions. Instead, each firm is represented by a reinforcement-learning agent attempting to maximise the discounted sum of future profits. At each decision point, the agent observes a state, chooses a price, receives a profit, and updates its estimate of the long-run value. In the baseline specification, we adopt

the one – period memory used by Klein [2021]. There are two firms $i, j \in \{1, 2\}$, and in every period t exactly one of them moves. The identity of the active firm alternates deterministically according to

$$i_t = (t \bmod 2) + 1, j_t = 3 - i_t,$$

so that j_t denotes the competitor of the firm moving at time t.

The state observed by firm i_t is the last price chosen by its competitor:

$$s_t = p_{j_t, t-1}.$$

This formulation captures the Maskin-Tirole-style sequential structure: each firm conditions its action only on the most recent action of the opponent. Later sections extend this structure to asymmetric environments, allowing one firm to have no memory and another to have two-period memory. These variants only modify the dimensionality of the state variable; the underlying learning dynamics remain identical.

3.3. Q-Learning dynamics

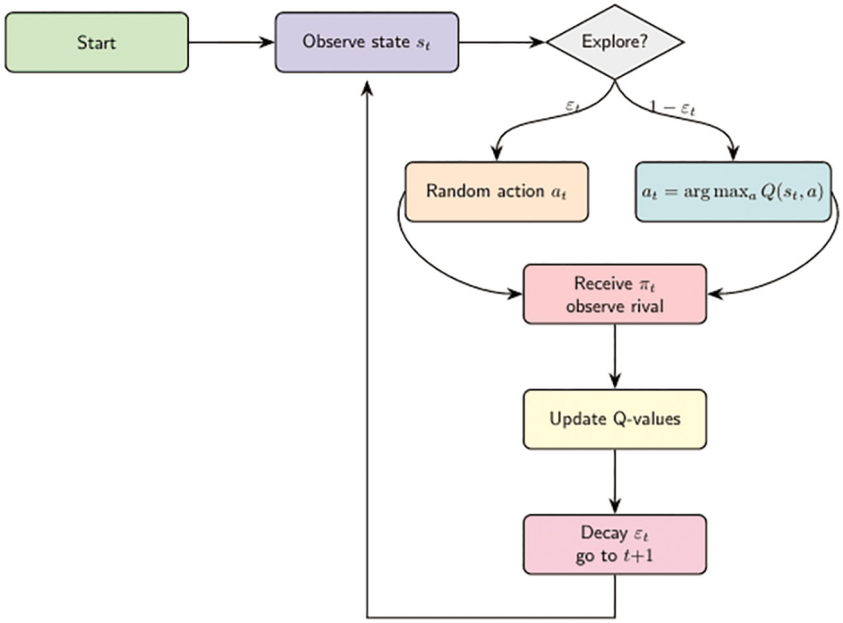
Each firm uses the tabular Q-learning algorithm introduced by Watkins and Dayan [1992]. For every feasible state – action pair (s, a), the firm maintains an estimate $Q(s, a)$ of the long – run discounted value of choosing action a when the state is s. Q-learning updates these values recursively according to

$$Q(s, a) \leftarrow (1 - \alpha) Q(s, a) + \alpha \left[\pi + \delta \pi' + \delta^2 \max_{a'} Q(s', a') \right],$$

where α is the learning rate, δ is the discount factor, π is the firm's immediate profit from choosing a, π' is the profit earned when the rival subsequently updates its price, and s' is the successor state. This formulation follows exactly the two – step update structure in Klein [2021]: because firms act sequentially, the acting firm observes both its own payoff and one subsequent period before updating the pending Q-value.

Figure 2 visualises this decision process, showing how, in each period, the agent first observes the current state – defined in this setting by the competitor's last posted price – and then decides between exploration and exploitation under the greedy rule. The diagram highlights the flow of information: after choosing a price and observing the rival's response, the agent updates the corresponding Q-entry using both the immediate payoff and the continuation value implied by the next state. This representation makes explicit the Markovian structure of the problem and clarifies how sequential interaction produces a two-step learning cycle.

Figure 2. Q-learning decision cycle in the sequential pricing environment



Source: Authors' own elaboration.

Action selection follows an ε-greedy strategy. With probability ε_t the firm explores by choosing a price uniformly at random, and with probability $1 - \varepsilon_t$ it exploits by selecting an action that maximises $Q(s, a)$. The exploration rate decays over time according to

$$\varepsilon_t = (1 - \theta)^t,$$

where θ is calibrated such that exploration is frequent in early periods but becomes negligible in the limit. This ensures that the algorithm initially experiments widely, but progressively stabilises around actions it has learned to be profitable.

3.4. Implementation and simulation design

We implement the learning dynamics using Python and NumPy. For each simulation run, both firms begin with randomly initialised prices. Their Q-tables are initialised at zero and updated according to the rule above. The code precisely follows the state – transition logic of the sequential game: when Firm 1 moves, Firm 2's previous action is treated as the state; when Firm 2 moves, the relevant state is Firm 1's most recent price.

Each simulation runs for $T = 500{,}000$ periods, following Klein [2021]. To evaluate long-run performance, we focus on the final 10% of observations. For each run we compute average prices, average profits, the most frequent price pair, the amplitude of price cycles, and the number of large price jumps. Across all scenarios we perform 1,000 independent runs with distinct random seeds. This not only replicates the stochastic heterogeneity in Klein [2021] but also permits a richer analysis of distributional patterns, convergence behaviour, and cycle dynamics.

The simulation framework is extended beyond the baseline in two ways. First, we allow firms to differ in the depth of memory encoded in their state representations, enabling a direct investigation of how asymmetric information processing affects collusive learning. Second, we log complete price and profit trajectories, which allows us to examine dynamic patterns such as volatility, temporal clustering, price – cycle length, and transitions between collusive and non-collusive regimes. These diagnostics provide a more granular view of the learning process than is available in the original study.

To assess the role of memory asymmetry in algorithmic collusion, we compare three experimental scenarios, each comprising 1,000 independent simulation runs. All runs follow the sequential pricing environment described in Section 3.1 and use the Q-learning implementation detailed in Sections 3.3 and 3.4, with parameters $\alpha = 0.3$, $\delta = 0.95$, and the same exploration decay schedule

$$\varepsilon_t = (1 - \theta)^t,$$

where the decay parameter θ is calibrated as in Klein [2021] so that $\varepsilon_0 = 1$, $\varepsilon_{0.5T} = 0.001$, and $\varepsilon_T = 10^{-6}$. The only variation across scenarios is the memory depth of the competing agents.

1. Symmetric baseline. Both agents use one-period memory and condition their actions on the competitor's most recent price. Formally, each firm has memory depth $m_1 = m_2 = 1$. This configuration replicates the setup of Klein [2021] and serves as the benchmark for the asymmetric treatments.
2. Asymmetry I: one-period vs no memory. The first agent retains one-period memory ($m_1 = 1$), whereas the second agent ignores the competitor's price history and conditions its actions solely on the current-period state ($m_2 = 0$). This scenario tests whether a memoryless learner can be exploited – or alternatively – whether it can still sustain collusive outcomes.
3. Asymmetry II: one-period vs two-period memory. The first agent again uses one-period memory ($m_1 = 1$), while the second agent conditions its actions on the competitor's last two prices ($m_2 = 2$). This treatment examines whether deeper

memory provides a strategic advantage and whether an expanded state space hampers learning.

For each scenario, we record full price and profit trajectories and compute the performance metrics defined in Section 3.5. By comparing the outcomes across scenarios, we can isolate the effects of memory heterogeneity on the stability, profitability and distributional consequences of algorithmic collusion.

3.5. Performance metrics

To evaluate the behaviour and outcomes of the learning algorithms across different memory configurations, we employ several metrics that capture both static equilibrium properties and dynamic pricing patterns. Following the approach in Klein [2021], we assess performance along four dimensions: average prices, profitability, optimality relative to best-response behaviour, and convergence to Nash equilibrium. These metrics are computed from the final 10% of each simulation run, allowing the algorithms sufficient time to stabilise while capturing the long-run outcome.

3.5.1. Average price

The average price provides a direct measure of market outcomes and serves as a proxy for consumer welfare. For each firm i we compute

$$\bar{p}_i = \frac{1}{M} \sum_{t=T-M+1}^{T} p_{i,t},$$

where $M = 500{,}000$ periods (the final 10% of the simulation horizon $T = 500{,}000$). We also report the market-wide average $\bar{p} = (\bar{p}_1 + \bar{p}_2)/2$. This metric captures both collusive outcomes (where prices approach the monopoly level of 0.5) and competitive outcomes (where prices gravitate toward marginal cost).

3.5.2. Profitability

Profitability measures the actual per-period profits realised at the end of the learning process. For firm i, profitability is defined as

$$\Pi_i = \frac{1}{M} \sum_{t=T-M+1}^{T} \pi_i(p_{i,t}, p_{j,t}).$$

We benchmark these profits against two reference points: the joint-profit maximising (collusive) level of 0.125, which corresponds to both firms setting the monopoly price $p = 0.5$; and the competitive benchmark derived from the most competitive Edgeworth price cycle described by Maskin and Tirole [1988], which yields average per-period profits of approximately 0.0611 for the baseline price grid with $k = 6$ intervals. This competitive benchmark represents the lowest sustainable supra-competitive outcome in the sequential pricing environment and provides a conservative threshold for identifying collusive outcomes. In the baseline configuration with $k = 6$ and symmetric one-period memory, the algorithms converge to fixed-price collusive equilibria rather than cycles. As shown by Klein [2021], Edgeworth price cycles emerge when the price grid is finer (e.g., $k = 24$).

3.5.3. Optimality

Optimality captures how close each firm's learned behaviour is to a best response given its competitor's strategy. Following Klein [2021], we define the optimality ratio as

$$\Gamma_i = \frac{Q_i(p_{i,T}, s_T)}{\max_{p \in P} Q_i(p, s_T)},$$

where Q_i is the firm's estimated Q-value at the end of the simulation, and s_T is the state observed in the final period. This ratio, evaluated at the prevailing price and state, indicates the percentage of discounted future profits the firm captures relative to the best possible action given its current beliefs. When $\Gamma_i = 1$ (within a tolerance of 10^{-5}), the firm is playing a best response to its competitor's strategy.

3.5.4. Nash equilibrium criterion

We consider a simulation outcome to constitute a Nash equilibrium if both firms satisfy the optimality condition simultaneously: $\Gamma_1 = \Gamma_2 = 1$ (subject to numerical tolerance). This condition implies that neither firm can unilaterally improve its expected discounted profits by deviating from its current pricing strategy, given the strategy of its competitor. While this criterion does not guarantee subgame perfection – a stronger requirement that would involve off-equilibrium path behaviour – it provides a necessary condition for stable collusive outcomes and aligns with the equilibrium concept used in Klein [2021] and Calvano et al. [2020b].

3.5.5. Additional diagnostics

Beyond these core metrics, we also track the persistence of pricing patterns and the frequency of price adjustments. For runs that do not converge to a Nash equilibrium, we characterise the dynamic regimes – typically Edgeworth price cycles – by measuring cycle length, the amplitude of price jumps, and the frequency with which each firm initiates price resets. These additional diagnostics help distinguish between stable collusive equilibria and dynamic cycling patterns that nonetheless sustain supra-competitive average prices.

All metrics are computed across 1,000 independent simulation runs for each experimental condition, allowing us to report not only average performance but also the distribution of outcomes across random seeds. This approach accounts for the stochastic nature of the learning process and provides a more complete picture of algorithmic behaviour under both symmetric and asymmetric memory configurations.

4. Results

4.1. Symmetric baseline: one-period memory

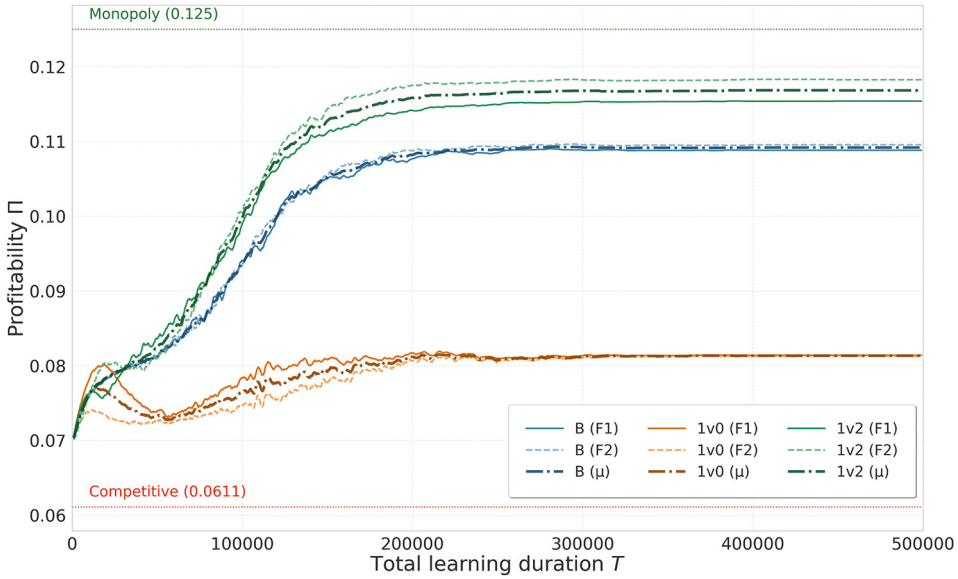
We first establish the benchmark by simulating the symmetric environment in which both agents condition their decisions on the competitor's most recent price (one-period memory). Over 1,000 independent runs of 500,000 periods each, we obtain results that closely mirror those reported by Klein [2021]. As illustrated in Table 1, the average per-period profit across both firms in the baseline scenario is 0.1092, substantially above the competitive benchmark of 0.0611 and approaching the joint-profit-maximising level of 0.125. Consistent with this, the corresponding average market price – reported in Table 2 – is 0.4237, indicative of collusive or near-collusive outcomes. Measures of optimality and convergence in Table 3 further confirm that nearly 70% of all runs converge to a Nash equilibrium with high optimality ($\bar{\Gamma} \approx 0.98$), again aligning closely with the patterns documented by Klein [2021].

Figure 3 displays the distribution of final profits across runs. Most runs cluster near the monopoly profit level, although a nontrivial fraction exhibits asymmetric outcomes where one firm earns less than the other. Approximately 69.9% of runs converge to a Nash equilibrium – defined as both firms playing a best response to each other's strategies within a tolerance of 10^{-5}. The average optimality ratio $\bar{\Gamma}$

reaches 0.982 by the final period, indicating that learned strategies are very close to best responses.

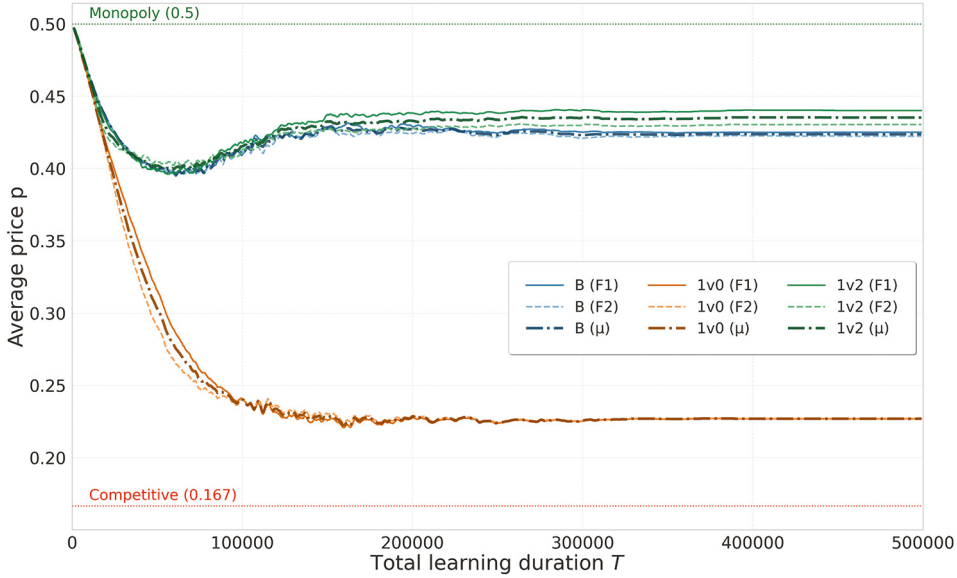
Figure 5 illustrates the evolution of optimality, while Figure 6 demonstrates the Nash equilibrium rate over the course of learning. Both metrics increase steadily, with optimality plateauing around 0.98 after approximately 300,000 periods and the Nash rate exceeding 65% in the later stages. Representative price paths (Figure 4) illustrate that when Nash equilibrium is achieved, prices stabilise at a fixed collusive level $p \approx 0.425$; in the remaining runs, the dynamics often exhibit Edgeworth cycles where prices gradually decline before being reset by a large upward jump – a pattern also documented by Klein [2021]. These results confirm the robustness of algorithmic collusion in the symmetric one-period memory setting and provide a reliable benchmark for assessing the impact of memory asymmetry.

Figure 3. Evolution of average profitability over the learning horizon. Smoothed average profits (rolling window) are shown for three memory configurations: baseline with both agents having one-period memory (B), one-period vs no memory (1v0), and one-period vs two-period memory (1v2). For each configuration, solid lines represent Firm 1 (F1), dashed lines Firm 2 (F2), and thick dash-dot lines the mean profit (μ). Horizontal dashed lines indicate the competitive benchmark (0.0611) and the monopoly profit (0.125). The two-period memory agent exhibits slower convergence, but all configurations eventually reach supra-competitive profits



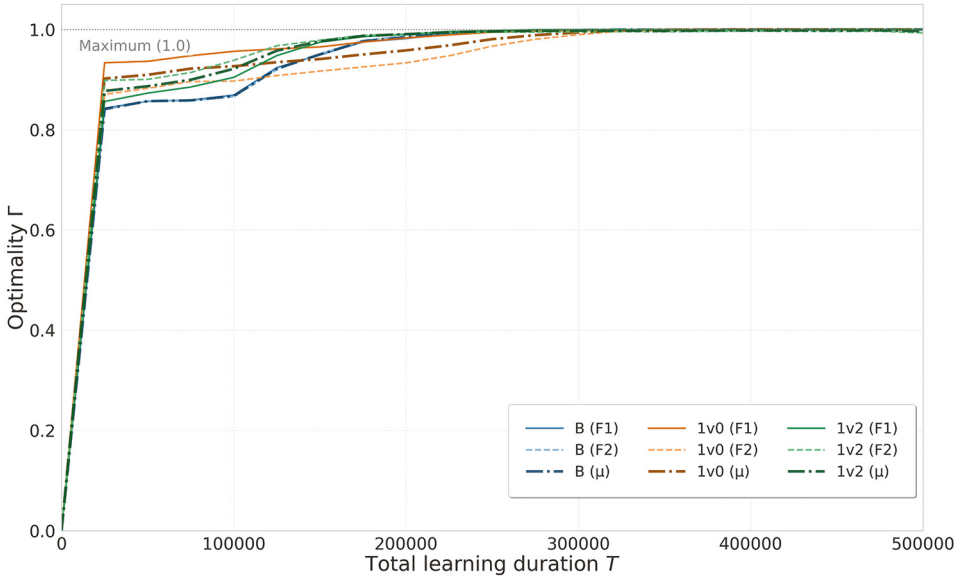
Source: Authors' own elaboration.

Figure 4. Evolution of average prices over the learning horizon. Smoothed average prices (rolling window) are shown for three memory configurations: baseline (B), one-period vs no memory (1v0), and one-period vs two-period memory (1v2). For each configuration, solid lines represent Firm 1 (F1), dashed lines Firm 2 (F2), and thick dash-dot lines the mean price (μ). Horizontal dashed lines indicate the competitive benchmark (average price of the most competitive Edgeworth cycle, approximately 0.1667) and the monopoly price (0.5). The 1v0 scenario stabilises at a lower price (approx. 0.23) than the other two configurations, while the 1v2 scenario exhibits slower convergence similar to the profit dynamics



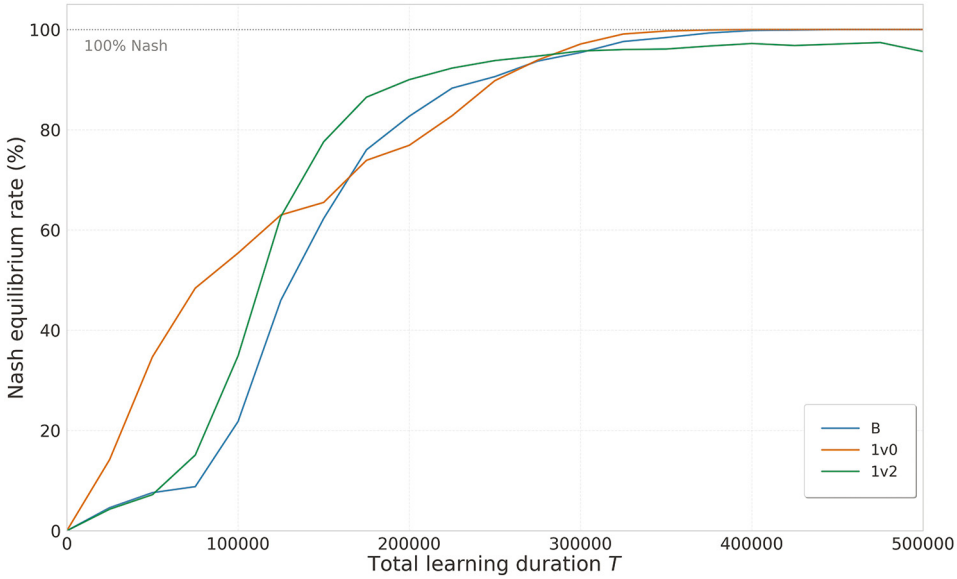
Source: Authors' own elaboration.

Figure 5. Evolution of Optimality over the Learning Horizon. The figure shows the average optimality ratio across runs for three memory configurations: baseline (B), one-period vs no memory (1v0), and one-period vs two-period memory (1v2). For each configuration, solid lines represent Firm 1 (F1), dashed lines Firm 2 (F2), and thick dash-dot lines the mean (μ). All curves start at $\Gamma = 0$ and approach the maximum value of 1, indicating that the learned strategies converge to best responses. The two-period memory agent exhibits slower convergence, consistent with its larger state space



Source: Authors' own elaboration.

Figure 6. Evolution of the Nash equilibrium rate over the learning horizon. The figure shows the percentage of runs (out of 1,000) in which both agents satisfy the Nash criterion ($\Gamma_i > 0.9999$) for three memory configurations: baseline (B), one-period vs no memory (1v0), and one-period vs two-period memory (1v2). All curves start at 0% and approach the maximum 100%, indicating that a large share of simulations eventually converge to a Nash equilibrium. The two-period memory scenario exhibits slower convergence, consistent with its larger state space, but ultimately reaches a similar high rate



Source: Authors' own elaboration.

4.2. Memory asymmetry: one-period versus no memory

We now introduce the first form of memory asymmetry: the first agent retains the ability to condition on the competitor's most recent price (one-period memory), while the second agent conditions its decisions on no past information – it effectively operates with a trivial state space that is constant across all periods (zero memory). This configuration tests whether a memory-less algorithm can be exploited or whether it remains capable of sustaining supra-competitive outcomes.

The results are striking. Both agents achieve nearly identical average profits of 0.08 (monopoly: 0.125; competitive: 0.0), which is significantly above the competitive benchmark yet well below the monopoly level. Average prices are similarly symmetric at 0.23. The profit distribution (Figure 3) is tightly concentrated around this

value, with almost no dispersion across runs. Crucially, every simulation converges to a Nash equilibrium: the optimality ratio equals 1 for both firms in all runs, and the Nash equilibrium rate (Figure 6) reaches 100% early in the learning process and remains there.

Representative price paths (Figure 4) indicate that both firms settle on a fixed collusive price, rather than engaging in Edgeworth cycles. The equilibrium appears to be a mutually beneficial focal price, albeit less profitable than the monopoly outcome. The fact that the memory-less agent is not systematically exploited suggests that the one-period memory agent also finds it optimal to accommodate the simpler rival. This may be because undercutting would trigger a punishment, ultimately lowering its own long-run payoff.

Memory asymmetry does therefore not preclude collusion; instead, it leads to a different – yet stable – equilibrium in which both firms share the market equally and earn supra-competitive profits. The absence of strategic depth in one agent does not undermine coordination but does reduce overall profitability relative to the symmetric baseline. This outcome highlights an important nuance: a less sophisticated algorithm does not necessarily become a victim; rather, it can anchor a stable, albeit less profitable, collusive arrangement.

4.3. State-space asymmetry: one-period vs two-period memory

In the final treatment, we examine a deeper form of memory asymmetry: one agent retains one-period memory, while the other conditions its decisions on the competitor's last two prices (two-period memory). This expands the state space for the deeper-memory agent, potentially slowing learning but also offering richer strategic possibilities.

Despite this complexity, the results remain strongly supra-competitive. Average profits are 0.1168 – slightly above the symmetric baseline – with the two-period memory agent earning a modestly higher profit (0.1182) than its one-period counterpart (0.1154). Average prices are 0.4353. The Nash equilibrium rate is 95.6%, and the average optimality $\bar{\Gamma}$ reaches 0.997, indicating near-best-response behaviour. Figure 3 shows that most runs cluster near the monopoly profit level, though a small fraction of runs exhibit asymmetric profit splits.

The key difference from the previous asymmetric treatment lies in learning dynamics. Figure 5 reveals that optimality evolves more slowly for the two-period memory agent, reflecting the larger state space that requires more exploration to converge. However, by the end of the 500,000 period horizon, both agents have

learned effective strategies. Representative price paths (Figure 4) show that convergence is often to a fixed collusive price, though some runs display Edgeworth cycles with a longer period than in the baseline.

Deeper memory does therefore not eliminate collusion; rather, it confers a slight profit advantage at the cost of slower learning. The overall capacity to sustain supra-competitive pricing remains robust even when agents differ in the amount of historical information they exploit. This finding suggests that firms may have an incentive to invest in more sophisticated algorithms, but the associated learning lag may temper the immediate competitive advantage.

4.4. Summary of results

Tables 1–3 summarise the key findings across all three configurations. Contrary to the expectation that heterogeneity undermines collusion, we find that algorithmic collusion persists in both asymmetric treatments. However, the nature of collusion changes: in the one-period vs no-memory case, both firms earn equal but lower supra-competitive profits with perfect stability; in the one-period vs two-period case, the deeper-memory agent enjoys a modest profit advantage at the cost of slower convergence.

Table 1. Summary of results – average profit

Scenario	Avg. Profit (Firm 1)	Avg. Profit (Firm 2)	Avg. Profit
Baseline (1-period vs 1-period)	0.1088	0.1095	0.1092
1-period vs no memory	0.0813	0.0813	0.0813
1-period vs 2-period	0.1154	0.1182	0.1168

Source: Authors' own calculations.

A first key observation concerns the role of *collective memory*. When both firms possess symmetric one-period memory, profits are substantially higher than in the asymmetric 1v0 case. This indicates that mutual algorithmic sophistication drives collusion closer to the monopoly outcome. Moreover, the fact that collusion persists even when one agent has zero memory suggests that firms may effectively coordinate not only on prices but also on the level of algorithmic sophistication – or even indirectly through common algorithm vendors. From a detection perspective, this implies that collusive arrangements might be identifiable by monitoring algorithmic specifications rather than relying solely on evidence of explicit price communication.

Table 2. Summary of results – average price

Scenario	Avg. Price (Firm 1)	Avg. Price (Firm 2)	Avg. Price
Baseline (1-period vs 1-period)	0.4251	0.4224	0.4237
1-period vs no memory	0.2269	0.2269	0.2269
1-period vs 2-period	0.4401	0.4305	0.4353

Source: Authors' own calculations.

Table 3. Summary of results – convergence and optimality

Scenario	Nash Eq. (%)	Avg. Optimality	Fixed Prices
Baseline (1-period vs 1-period)	69.9	0.982	yes (mixed with cycles)
1-period vs no memory	100	1.000	yes
1-period vs 2-period	95.6	0.997	yes (mixed with cycles)

Source: Authors' own calculations.

A second important pattern concerns diminishing marginal returns to memory depth. Moving from symmetric one-period memory to the asymmetric 1v2 configuration – which approximates a setting where one firm adopts deeper memory while the other remains at one-period – yields a further, albeit much smaller, increase in profits relative to the jump from 1v0 to symmetric one-period. This suggests that the marginal benefit of deeper memory declines rapidly. Consequently, a firm has little incentive to push its competitor to adopt a substantially more sophisticated algorithm, as the resulting profit gain would be modest. Conversely, having a competitor that is *too dumb* (zero memory) actually constrains the more sophisticated firm from achieving higher collusive prices. Hence, while firms may have an incentive to invest in their own algorithmic capabilities, they also benefit from ensuring that their rivals are not too far behind in sophistication – a nuance that could shape competitive dynamics in markets where pricing algorithms are prevalent.

5. Discussion and conclusion

5.1. Summary of findings

This paper provides the first systematic investigation of how memory asymmetry affects algorithmic collusion in a sequential pricing duopoly. We compare three configurations: (i) symmetric one-period memory (where both agents condition

on the competitor's last price); (ii) one-period memory versus no memory; and (iii) one-period memory versus two-period memory. The results, summarised in Tables 1–3, yield three main findings.

5.1.1. Symmetric baseline

When both agents have one-period memory, we successfully replicate the findings of Klein [2021]. As shown in Table 1, average per-period profit is 0.1092, well above the competitive benchmark (0.0611) but below the monopoly level (0.125). Table 2 reports an average price of 0.4237. Convergence is not perfect: Table 3 shows that 69.9% of runs reach a Nash equilibrium, with an average optimality of 0.982. The remaining runs exhibit Edgeworth cycles, a pattern also documented by Klein [2021]. This benchmark confirms that our implementation is consistent with prior work and provides a reliable basis for assessing asymmetry.

5.1.2. Asymmetry: one-period versus no memory

In this configuration, one agent has one-period memory while the other has no memory, meaning it conditions its decision on no past information and effectively operates with a constant state. The results are striking (Tables 1–3). Both agents earn identical average profits, which are supra-competitive but significantly lower than in the symmetric baseline. Crucially, every run converges to a Nash equilibrium (100%), and the optimality ratio reaches unity. Unlike the symmetric case, there are no Edgeworth cycles; the market settles on a stable, fixed collusive price. This shows that a memoryless algorithm does not necessarily become a victim; instead, it can anchor a stable, albeit less profitable, collusive arrangement. The fact that the one-period memory agent does not exploit its simpler rival suggests that undercutting would trigger a punishment that ultimately lowers its own long-run payoff.

5.1.2.1. Asymmetry: one-period versus two-period memory

In the final treatment, one agent has one-period memory while the other conditions on the competitor's last two prices (two-period memory). This expands the state space for the deeper-memory agent from $k = 6$ to $k^2 = 36$states. Table 1 shows that average profits rise to 0.1168 – slightly above the symmetric baseline – with the two-period memory agent earning a modest premium (0.1182 vs 0.1154). Average price is 0.4353 (Table 2). The Nash equilibrium rate is 95.6%, and optimality reaches

0.997 (Table 3). The key difference lies in learning dynamics: the two-period memory agent learns significantly slower due to its larger state space, as seen in the evolution of optimality and the Nash rate (Figures 5 and 6). Deeper memory thus confers a modest strategic advantage – enabling finer punishment strategies – but at the cost of requiring many more periods to learn.

5.2. What these results reveal about algorithmic collusion

Taken together, the three scenarios paint a nuanced picture. Algorithmic collusion is remarkably resilient to memory heterogeneity: even when agents differ fundamentally in the information they use, they still coordinate on supra-competitive outcomes in the vast majority of runs. This resilience stems from the reward-punishment logic embedded in Q-learning, which can accommodate asymmetries as long as the environment remains Markovian and the action space is discrete.

A striking observation is that asymmetry can actually stabilise collusion. In the symmetric baseline, about one-third of runs fail to reach a Nash equilibrium, often because the two identical agents get trapped in Edgeworth cycles where each tries to undercut the other. By contrast, in both asymmetric treatments, the Nash rate is substantially higher (100% in the one-period vs no-memory case, 95.6% in the one-period vs two-period case), and Edgeworth cycles are rare or absent. This suggests that when agents are not perfectly symmetric, the "illusion of being able to outsmart the rival" disappears: the weaker agent cannot profitably undercut, and the stronger agent has no incentive to deviate because it already enjoys a stable, if not maximal, profit. Thus, heterogeneity within the learning family may paradoxically strengthen collusive stability.

The results also reveal a positive externality of the rival's memory. Profits in the one-period vs no-memory scenario (0.0813) are far below those in the symmetric one-period baseline (0.1092), and the one-period vs two-period scenario yields a further small increase (0.1168). This ordering implies that a firm's own profit depends not only on its own memory depth but crucially on its competitor's memory. A rival with no memory constrains the more sophisticated firm to a lower collusive price; a rival with two-period memory lifts both firms' profits. Hence, there is a strategic complementarity: each firm benefits when the other adopts a deeper memory.

This dynamic can drive a coordinated arms race in algorithmic sophistication. Firms have an incentive to adopt, or even coordinate on, common algorithmic specifications – for instance, through shared software vendors – to lift industry profits. Such coordination would occur at the meta-game level of algorithm choice rather

than at the level of specific prices. Yet its ultimate effect on consumer welfare is equally harmful. The fact that the one-period vs two-period scenario yields profits close to the monopoly level underscores that this indirect coordination can be highly effective.

5.3. Relation to the existing literature

Our results extend the foundational work of Calvano et al. [2020b] and Klein [2021] by demonstrating that collusion does not require symmetry. While previous studies assumed identical algorithms, we show that even when memory depths differ, Q-learning agents find ways to coordinate. This aligns with the speculation of Abada et al. [2025] that heterogeneity within a learning family may be less disruptive than cross-class heterogeneity. At the same time, our findings echo the exploitation results of den Boer et al. [2022] and Bichler et al. [2024]: the more sophisticated agent can earn higher profits, but the effect is modest compared to switching to an entirely different algorithm class.

The slower learning of the two-period memory agent confirms a well-known trade-off in reinforcement learning: larger state spaces require more exploration. This has been noted in passing by Waltman and Kaymak [2008] and Calvano et al. [2020b], but our controlled comparison isolates the effect of memory depth while holding all other parameters constant. The fact that the deeper-memory agent eventually achieves similar optimality and a slightly higher profit suggests that the additional information is valuable – but only after a long learning phase, which may be impractical in many real-world markets.

5.4. Implications for competition policy and market design

Our findings reveal a counter-intuitive pattern: memory asymmetry can increase the stability of algorithmic collusion. In the symmetric baseline, only 69.9% of runs converge to a Nash equilibrium, whereas in the asymmetric treatments the Nash rate reaches 100% (one-period vs no memory) and 95.6% (one-period vs two-period memory). This suggests that heterogeneity within the Q-learning family may paradoxically stabilise coordination by eliminating the symmetric *undercutting traps* that lead to Edgeworth cycles. For competition policy, this means that even markets populated by algorithms with different levels of sophistication may be more, not less, prone to stable collusive outcomes – a nuance that challenges the intuition that diversity of algorithms automatically safeguards competition.

Beyond this stabilising effect, our findings carry several additional implications for policymakers concerned about algorithmic pricing.

5.4.1.1. Resilience to heterogeneity

The persistence of collusion under memory asymmetry implies that regulators cannot rely on diversity of algorithms to restore competition. Even a market with a mix of sophisticated and simple pricing tools may still experience supra-competitive prices. Antitrust authorities should be alert that heterogeneity does not guarantee competitive outcomes.

5.4.1.2. Coordinated arms race and the meta-game

The positive externality of a rival's memory creates a powerful incentive for firms to ensure that their competitors adopt similarly (or even more) sophisticated algorithms. This may lead to explicit or tacit coordination on algorithmic specifications – for example, through the use of the same third-party pricing software. Such coordination would not involve direct communication about prices, yet it would raise prices to the benefit of all firms. Competition authorities may need to scrutinise the algorithmic choices of firms, including the practices of software vendors that supply algorithms to multiple competitors. The recent literature on *hub-and-spoke* collusion through common algorithm vendors provides a relevant precedent.

5.4.1.3. Market dynamism as a safeguard

The slower convergence of the two-period memory agent suggests that markets with frequent entry, exit, or structural change may be less vulnerable to persistent algorithmic collusion. If the environment shifts before learning is complete, the sophisticated algorithm may never realise its potential advantage. Policies that promote market dynamism – such as lowering barriers to entry or encouraging innovation – may therefore indirectly mitigate the risk of algorithmic collusion.

5.4.1.4. Detectability and auditing

Unlike human collusion, algorithmic collusion leaves a trace in the code and the learned Q-values. Since algorithms are auditable, competition authorities could develop testing protocols (e.g. forced deviation tests, as in Section 4) to detect

whether deployed pricing algorithms employ reward-punishment strategies characteristic of collusion. Such ex-post testing could complement traditional evidence of communication.

5.4.1.5. Caveats on simple remedies

The one-period versus no-memory scenario produced lower profits than the baseline, yet these profits remained supra-competitive. A simple remedy, such as forcing firms to ignore competitor prices, might reduce profits but would not eliminate collusion. More targeted measures, such as requiring algorithms to use only a fixed set of random prices for exploration or imposing periodic resets, might be necessary to break coordination entirely. The effectiveness of such interventions would need to be evaluated within the specific market context.

5.5. Limitations and future research

Our study has several limitations that suggest avenues for future work. We focus on tabular Q-learning with a discrete price grid. Real-world algorithms often use function approximation (e.g. deep neural networks) and may exhibit different dynamics. Extending our analysis to deep Q-networks or policy-gradient methods would be valuable.

We also restrict our attention to memory depth as the sole dimension of asymmetry. In practice, firms may differ in learning rates, discount factors, exploration schedules, or the timing of price updates. A comprehensive typology of algorithmic heterogeneity would help in understanding which differences are most significant.

Our simulations run for a fixed horizon of 500,000 periods. While sufficient for convergence in our setting, real markets are non-stationary. Future work could investigate how memory asymmetry affects collusion under demand shocks, cost changes, or entry/exit.

Finally, we focus on profits and Nash equilibrium. A full welfare analysis would be needed to assess the consumer impact of the different equilibria we observe, especially given that the one-period versus no-memory scenario yields lower profits (and hence likely lower prices) than the symmetric baseline. Such an analysis could inform whether the stability of that equilibrium offsets its lower profitability from a consumer welfare perspective.

5.6. Concluding remarks

This paper has demonstrated that algorithmic collusion is remarkably robust to memory asymmetry. In a sequential pricing duopoly, Q-learning agents with different memory depths consistently achieve supra-competitive profits and high rates of Nash equilibrium convergence. While deeper memory confers a small profit advantage, it also slows learning, and a memory-less agent can still coordinate on a stable but less profitable equilibrium. These findings advance our understanding of how heterogeneous algorithms interact and provide a foundation for more nuanced policy interventions in the age of artificial intelligence.

References

Abada, I., Harrington, J.E., Lambin, X., Meylahn, J.M. (2025). *Algorithmic Collusion: Where Are We and Where Should We Be Going?*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4891033 (accessed: 03.09.2026).

Abada, I., Lambin, X., Tchakarov, N. (2024). Collusion by Mistake: Does Algorithmic Sophistication Drive Supra-Competitive Profits?, *European Journal of Operational Research*, 318(3), pp. 927–953.

Assad, S., Clark, R., Ershov, D., Xu, L. (2020). Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market, *CESifo Working Paper*, No. 8521.

Belleflamme, P., Peitz, M. (2015). *Industrial Organization: Markets and Strategies*. Cambridge: Cambridge University Press.

Bichler, M., Durmann, J., Oberlechner, M. (2024). Online Optimization Algorithms in Repeated Price Competition: Equilibrium Learning and Algorithmic Collusion, *arXiv*, 15707, https://arxiv.org/abs/2412.15707 (accessed: 03.09.2026).

Calvano, E., Calzolari, G., Denicolò, V., Harrington, J.E., Pastorello, S. (2020a). Protecting Consumers From Collusive Prices Due To AI, *Science*, 370(6520), pp. 1040–1042.

Calvano, E., Calzolari, G., Denicolò, V., Pastorello, S. (2020b). Artificial Intelligence, Algorithmic Pricing, and Collusion, *American Economic Review*, 110(10), pp. 3267–3297.

den Boer, A.V., Meylahn, J.M., Schinkel, M.P. (2022). Artificial Collusion: Examining Supracompetitive Pricing by Q-Learning Algorithms, *Amsterdam Law School Legal Studies Research Paper No. 2022-25*.

Dogan, I., Güner, A.R. (2013). A Reinforcement Learning Approach to Competitive Ordering and Pricing Problem, *Expert Systems*, 32(1), pp. 39–48.

Ezrachi, A., Stucke, M.E. (2016). *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*. Cambridge: Harvard University Press.

Ezrachi, A., Stucke, M.E. (2017). Artificial Intelligence & Collusion: When Computers Inhibit Competition, *University of Illinois Law Review*, pp. 1775–1810.

Harrington, J.E. (2018). Developing Competition Law for Collusion by Autonomous Price-Setting Agents, *Journal of Competition Law & Economics*, 14(3), pp. 331–363.

Klein, T. (2021). Autonomous Algorithmic Collusion: Q-Learning Under Sequential Pricing, *RAND Journal of Economics*, 52(3), pp. 538–558.

Maskin, E., Tirole, J. (1988). A Theory of Dynamic Oligopoly II: Price Competition, Kinked Demand Curves, and Edgeworth Cycles, *Econometrica*, 56(3), pp. 571–599.

Tirole, J. (1988). *The Theory of Industrial Organization*. Cambridge: MIT Press.

Waltman, L., Kaymak, U. (2008). Q-Learning Agents in a Cournot Oligopoly Model, *Journal of Economic Dynamics and Control*, 32(10), pp. 3275–3293.

Watkins, C.J.C.H., Dayan, P. (1992). Q-Learning, *Machine Learning*, 8(3–4), pp. 279–292.

Zawisza, M., Kamiński, B. (2013). Price Patterns in an Oligopoly with Switching Cost and Uncertain Demand, *Operations Research and Decisions*, 23(3), pp. 71–89.

Zawisza, M., Kamiński, B., Witkowski, D. (2011). Konkurencja firm o różnym horyzoncie planowania w modelu Bertrand z kosztem decyzji i ograniczoną świadomością cenową klientów, *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu Zastosowania badań operacyjnych: Zarządzanie projektami, decyzje finansowe, logistyka*, pp. 263–295. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

The publication is conceived as an interdisciplinary reflection on the transformations of the European Union's economy and society in the 21st century. This perspective allows for the analysis of processes taking place in Europe not as separate and isolated phenomena, but as interrelated elements of a broader structural change. Particular mention should be made of the monograph's placement within the context of contemporary tensions and uncertainties, including the consequences of the war in Ukraine, accelerated development of artificial intelligence, challenges of green transition, issues of economic security, and changes in the labour market. Another strength of the volume lies in its international and multi-perspective nature, stemming both from the publication's post-conference origins and from its links to academic collaboration within the CIVICA alliance.

The structure of this peer-reviewed monograph reflects its multi-authored and post-conference nature. The first thematic area can be identified in chapters devoted to the institutional foundations of the European economy and the mechanisms of economic governance within the EU. The second thematic area centres on security, green transition, and the role of institutions and funding in shaping new conditions for economic development. The third distinct thematic block concerns digitalisation, artificial intelligence and their socio-economic consequences. The fourth thematic area comprises chapters devoted to democracy, the rule of law, social values, institutional resilience and relationship between citizens and public institutions.

The monograph is a valuable contribution to the debate on the economy and society of the European Union in the 21st century. As a whole, the volume has clear academic, educational and expert potential, and its publication contributes to deeper reflection on the directions of Europe's development in the context of growing uncertainty, technological transformation and institutional pressure.

European Funds for Social Development
Republic of Poland
Co-funded by the European Union
NAWA POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE

THE POLISH NATIONAL AGENCY FOR ACADEMIC EXCHANGE (NAWA)
is implementing the project entitled: Support for European Universities
(nr FERS.01.05-IP.08-0219/23).

EU funding for the project: PLN 62,705,297.60

mapadotacji.gov.pl

SGH PUBLISHING HOUSE
SGH WARSAW SCHOOL OF ECONOMICS
www.wydawnictwo.sgh.waw.pl

ISBN 978-83-8030-808-4