



Macroeconomic Stability Modelling

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Preface

Macroeconomic stability is the foundation of long-term economic development and a key objective of economic policy in most countries around the world. In a dynamically changing and globally interconnected economy, ensuring a balance between economic growth and stability is becoming an increasingly complex challenge. Macroeconomic stability is not only about maintaining low inflation or a balanced budget, but also about the ability to anticipate and counteract external shocks that may disrupt the functioning of the economy. Achieving this stability requires skillfully combining monetary policy, fiscal policy, and financial system management to counter destabilizing internal and external factors. Achieving macroeconomic stability creates favorable conditions for investment, innovation, and efficient resource allocation, which in the long term translates into improved quality of life for citizens and sustainable socio-economic development.

In the face of global challenges such as climate change, aging populations, ongoing digitization, and political instability, managing the economy requires new analytical tools and theoretical approaches. Traditional macroeconomic models need to be supplemented with modern data analysis techniques and forecasting tools that enable a better understanding of the dynamic interactions occurring within the economy. Sound macroeconomic policy, based on solid theoretical foundations and supported by modern analytical methods, becomes a key element in building economies resilient to future crises.

The book “Modeling Macroeconomic Stability” aims to provide a comprehensive presentation of the issue of macroeconomic stability, covering not only traditional methods of measuring it and the factors influencing this key area, but also modern approaches to modeling stability using advanced data analysis techniques, such as machine learning. The book also aims to demonstrate how innovative modeling methods can increase forecasting accuracy and enable more effective economic policy management in the face of dynamically changing global

challenges, while also impacting social welfare, human capital development, and institutional efficiency.

In the first chapter of the book, titled “The Essence of Macroeconomic Stability and Methods of Its Measurement,” the theoretical foundations of macroeconomic stability are presented, integrating classical and Keynesian perspectives. Key aspects of stability, such as price, fiscal, and financial stability, as well as the role of monetary and fiscal policy in maintaining economic balance, are discussed. Key macroeconomic indicators that allow for an assessment of the state of the economy are also described, along with examples of policies that support stability under various economic conditions. This chapter provides solid theoretical frameworks and practical tools for assessing economic health in a global context, as well as indicators for measuring and monitoring stability.

The second chapter, titled “Factors Determining Macroeconomic Stability,” analyzes the importance of this stability for the economy and identifies the factors that shape it. It begins with a definition of macroeconomic stability in its key aspects and then, based on the literature, discusses both internal and external factors influencing it. The chapter also presents institutional safety mechanisms, such as prudential regulations and the economic policies of individual countries, that help maintain stability. The financial system, responsible for resource allocation and risk mitigation, plays a particularly important role. The chapter consists of three parts: a review of literature on measurable factors of macroeconomic stability, a description of institutions forming the financial safety net, and a summary with conclusions and recommendations regarding macroeconomic stability.

The third chapter, titled “Comparative Analysis: Economic Development and Macroeconomic Stability,” discusses the complex relationship between economic growth and stability. This chapter examines whether these two objectives are complementary or may conflict. The analysis includes data from the past decade, highlighting situations where stability supported long-term development, but also cases where the lack of regulatory reforms and effective management weakened growth potential. The analysis shows that while stability is a necessary condition, it is not always sufficient to achieve sustainable development. This chapter emphasizes the need for a flexible approach to economic policy that combines stability with reforms.

The fourth chapter, titled “Macroeconomic Modeling from a Behavioral Economics Perspective,” focuses on the role of behavioral factors in modern macroeconomic process modeling. It shows how traditional models, based on the assumption of full rationality, often overlook the impact of emotions and biases on economic decisions. This chapter introduces readers to the world of behavioral

economics and demonstrates how incorporating a behavioral approach into macroeconomic analysis allows for a better understanding of the causes of instability and crises, particularly in the context of unpredictable phenomena such as financial crises and their social effects.

The final, fifth chapter, titled “Modeling Macroeconomic Stability Using Machine Learning,” is the culmination of the work, introducing modern data analysis tools to assess economic stability. It describes an innovative iterative stability assessment model that uses techniques such as cluster analysis and Bayesian inference, enabling more precise and dynamic formulation of economic policies. This chapter discusses in detail how machine learning tools can identify non-obvious patterns in macroeconomic data and predict long-term stability, considering changing global conditions, such as the COVID-19 pandemic or new geopolitical conflicts. By utilizing machine learning tools, the presented methodology allows for more precise assessments of economic risks and the formulation of appropriate policies in a changing global environment. The application of these techniques in forecasting and modeling macroeconomic stability can be particularly valuable for economic decision-makers who must make decisions under conditions of risk, making this chapter crucial to the entire book.

Through its interdisciplinary approach, this book combines traditional economic theories with modern analytical methods, offering the tools and perspectives necessary to understand and shape contemporary macroeconomic policies. Aimed at decision-makers, researchers, and students, it makes a significant contribution to the debate on macroeconomic stability in the context of global economic challenges. With a deep understanding of economic phenomena and modern analytical tools, this book has the potential to become not only a valuable source of knowledge but also a practical guide for those responsible for shaping macroeconomic policies that affect societal well-being and economic development.

The essence of macroeconomic stability and its measurement methods

Michał Wielechowski

Introduction

In an increasingly interconnected global economy, the pursuit of macroeconomic stability has emerged as a cornerstone for sustainable economic growth and development. This chapter delves into the essence of macroeconomic stability, exploring its multifaceted definition, theoretical foundations, and diverse methodologies employed to measure and maintain it. Macroeconomic stability, as defined by leading institutions, such as the International Monetary Fund (IMF) and the Organisation for Economic Co-operation and Development (OECD), represents a state where the economy operates near its potential output with low inflation, sustainable fiscal policies, and a resilient financial system. The importance of this stability cannot be overstated as it underpins the ability of economies to achieve high and sustainable rates of economic growth, which is a fundamental objective for policymakers globally.

This chapter begins by providing a definition of macroeconomic stability, integrating perspectives from both classical and Keynesian economic theories. Classical economics, with its roots in the seminal works of Adam Smith, David Ricardo, and later John Stuart Mill, views capitalism as a self-regulating and self-correcting system. In contrast, Keynesian economics, which gained

prominence after the Great Depression and further solidified its influence post-World War II, advocates for a more active role of government in managing the economy.

The discussion then shifts to the key aspects of macroeconomic stability, including price stability, fiscal stability, and financial stability. Price stability, characterised by low and predictable inflation rates, is crucial for economic confidence and resource allocation. Fiscal stability, on the other hand, refers to the management of government budgets so as to avoid excessive deficits and debt accumulation, ensuring long-term fiscal sustainability. Financial stability, which entails a robust financial system capable of withstanding shocks, is essential for maintaining the smooth functioning of financial intermediation processes.

Further on, the chapter highlights the pivotal role of policy in maintaining macroeconomic stability, with a particular focus on the intricate interplay between monetary and fiscal policies.

While there is a long-standing consensus among economists that monetary policy should be the primary tool for stabilisation, particularly due to its ability to produce immediate effects, the effectiveness of these policies is contingent on their coordination. Fiscal policies, while often slower to manifest results, are crucial in complementing monetary measures, especially in situations where monetary policy alone may be insufficient to stabilise the economy. This delicate balance between the two types of policies is essential for ensuring long-term economic stability and public welfare.

The chapter also addresses the methods of measuring macroeconomic stability, which involve a range of indicators that together provide a comprehensive picture of an economy's health and resilience. These indicators include GDP growth rate, inflation rate, unemployment rate, fiscal balance, and public debt levels, among others. Each of these measures offers valuable insights into different dimensions of economic stability, guiding policymakers in their efforts to sustain stability and mitigate potential risks. For instance, a stable GDP growth rate indicates a healthy economy with sustained production and consumption, while a low unemployment rate reflects effective utilisation of the labour force.

Ultimately, this chapter aims to provide a holistic understanding of macroeconomic stability, emphasising its importance and the complex interplay of policies and indicators used to maintain it. By examining both theoretical perspectives and practical measurement methods, the chapter offers a framework for analysing the intricacies of achieving and sustaining macroeconomic stability in today's globalised economy. This understanding is not only important for policymakers but also for stakeholders across the economic spectrum as it underscores the

fundamental conditions necessary for fostering a stable and prosperous economic environment.

1.1 Definition of macroeconomic stability

Macroeconomic stability is generally defined as a condition in which an economy operates near its potential output with low inflation, sustainable fiscal policies, and a stable financial system. According to the International Monetary Fund (IMF), macroeconomic stability is essential for achieving high and sustainable rates of economic growth. The IMF emphasises the importance of stable macroeconomic policies, including sound fiscal and monetary policies, to maintain economic stability (Davoodi *et al.*, 2021). The OECD defines macroeconomic stability as the avoidance of significant fluctuations in economic activity, particularly in terms of GDP growth, inflation, and unemployment rates. The OECD also highlights the role of fiscal and monetary policies in achieving this stability (Sutherland and Hoeller, 2014).

The literature on macroeconomic stability often integrates different perspectives. For instance, the concept includes internal and external balances as well as the roles of fiscal, monetary, and exchange rate policies. Internal balance refers to full employment and price stability within the economy, while external balance pertains to a sustainable current account position (Joshi, 2017).

The concept of macroeconomic stability is often based on the evaluation of several key macroeconomic indicators. These include the level of GDP growth, unemployment rate, inflation rate, budget balance of the state to GDP, and balance of the current turnovers size to GDP (Kamguia *et al.*, 2024).

Some studies propose a broader concept where “sound macroeconomic frameworks” encompass not just price stability and fiscal prudence, but also the following (Borio, 2014; Fahr and Fell, 2017; Kahou and Lehar, 2017):

- ✦ a well-functioning real economy,
- ✦ sustainable debt levels, and
- ✦ healthy private and public sector balance sheets.

The concept of macroeconomic stability can also be extended to the sectoral mesoeconomic systems, such as railway transport, where the methodology for assessing economic stability includes both qualitative and quantitative assessment of relevant factors (Nekhoroshkov *et al.*, 2022). The aim of macroeconomic stabilisation is restoring price stability and reducing monetary, fiscal,

and balance-of-payment imbalances. Macroeconomic stabilisation is particularly needed when a country suffers from high inflation or hyperinflation (Dąbrowski, 2019). It also discusses the impact of price rigidity and flexibility on macroeconomic stability, highlighting the need to reconsider macroeconomic models after the 2008 recession (Singh, 2018).

Macroeconomic stability in today's globalised world is a complex issue, but one that can be broken down into three dimensions. The first – nominal dimension – refers to price stability and the consequences of its absence, such as excessive inflation or, worse, hyperinflation, and in a small number of cases, deflation. The second dimension – real stability – refers to the stability of economic activity and employment; its loss produces cyclical volatility and, in worst case scenarios, recessions or depressions. The third dimension is external stability, namely the sustainability of balance-of-payments accounts, and its loss can be evidenced by reversals of the balance-of-payments current account balance after reaching unsustainable levels. The causes and effects of each of these dimensions of instability manifest themselves in the financial system and are highly complex and important; however, examining them is beyond the scope of this chapter, so it is preferable to leave the discussion of financial stability for another occasion (Varela *et al.*, 2020).

1.2 Theoretical concepts of stability from the perspective of two main economic schools of thought

Classical economics

Classical economics, originating from the works of Adam Smith and further developed by economists, such as David Ricardo and John Stuart Mill (Burbridge, 2017; Kates, 2014; Negishi *et al.*, 2014; Samuelson and Turner, 2015), is based on several key principles that have implications for macroeconomic stability.

Classical and neo-classical economists view capitalism as a self-regulating and self-sustaining system, where the market operates efficiently without the need for significant intervention (Ginzberg, 2017). The classical economic system operates on Say's law of markets or Walrasian general equilibrium lines, where the market operates efficiently without instability, and the full utilisation of available resources keeps the economy on a steady-state growth path. Historical evidence suggests that the stability of capitalism depends on state facilitation and direct intervention in economic affairs, particularly in ensuring the stability of capital accumulation

(Schumpeter and Swedberg, 2021; Singh and Tiwana, 2020). Classical economists believe in the long-term neutrality of money, meaning that, in the long run, changes in the money supply only affect nominal variables (like prices and wages) and not real variables (like output and employment). In the short run, monetary policy may have some impact, but these effects are temporary and will be neutralised as prices and wages adjust (Niehans, 1987). It posits that, in the long run, monetary policy is ineffective in influencing real economic activity. Its primary role is to control inflation by managing the money supply. The focus is on maintaining price stability rather than targeting output or employment levels (Dornbusch, 1990). In the classical theory, the labour market operates based on the principles of supply and demand, determining the equilibrium between wages and the number of employees (Fabris, 2013). Furthermore, classical theory suggests that attempts to manipulate interest rates through monetary policy can lead to inflation without improving real economic outcomes. The primary concern is to avoid inflationary pressures by controlling the growth of the money supply (Orphanides, 2004).

The classical view of money as neutral and playing no independent role has been criticised, particularly in light of the dominant role of money and finance in market capitalism (Peterson, 2019). Critics argue that cyclical instability is a fundamental tendency of the capitalist economic structure, challenging the classical view of a self-regulating market (Singh and Tiwana, 2020).

Keynesian economics

The Keynesian state's macro-economic form of intervention, developed after the Second World War, was derived from classical economic theories, indicating the lasting impact of classical economics on macroeconomic stability (Keynes, 1937; Veggeland, 2018). Keynesian economics focuses on the theoretical issue of involuntary unemployment in macroeconomic equilibrium, often requiring assumptions about sticky wages, prices, or interest rates. Keynesians prioritise using fiscal and monetary policies to pursue macroeconomic goals of full employment, price stability, and economic growth, rather than focusing on removing market imperfections (Forstater, 2019).

The New Keynesian macroeconomics consensus emphasises the efficacy of monetary policy in maintaining both price and output stability. This consensus relies on three key relationships: demand's inverse dependence on the interest rate, inflation's positive relationship with the output gap, and the central bank's ability to control interest rates to achieve an optimal combination of price and

output. However, a theoretical critique from the “Old” Keynesian perspective raises fundamental objections to each of these relationships (Azad, 2016). Additionally, the Old Keynesian view regards nominal rigidity as a stabilising factor, reducing fluctuations in income and aggregate demand, thus contributing to macroeconomic stability (Takahashi and Okada, 2020). Furthermore, the adaptation of the General Theory into the Keynesian-neoclassical synthesis neglected vulnerabilities of the resultant model, divorcing macroeconomists from working on financial stability and constraining macroeconomics. However, the crash of 2008 led to a belated acknowledgment of the importance of macro stability, making it a vibrant research frontier in economics. In detail, it highlights the need for a more nuanced approach to macroeconomic stability, incorporating both fiscal and monetary policies to achieve full employment, price stability, and stable economic growth (Akerlof, 2019).

Key principles of macroeconomic stability in the Keynesian theory include an active fiscal policy, the role of monetary policy, involuntary unemployment and market imperfections, price-wage rigidity, together with uncertainty and sticky prices. The New Keynesian principles suggest that active fiscal policy can contribute to macroeconomic stability by reducing the frequency of hitting the zero lower bound on interest rates (Le *et al.* 2024). While Keynes was skeptical of the efficacy of monetary policy, the current mainstream macroeconomic consensus, the “New” Keynesian macroeconomics, accords it primacy in maintaining both price and output stability (Azad, 2016). Keynes’s theory demonstrates that there can be involuntary unemployment in macroeconomic equilibrium due to market imperfections, such as sticky wages, prices, and interest rates (Forstater, 2019). The Old Keynesian view regards nominal rigidity as a stabilising factor, reducing fluctuations in income and aggregate demand, contributing to long-run stability (Christiano *et al.*, 2005; Takahashi and Okada, 2020). Modelling a macroeconomy with qualitative uncertainty and sticky prices can improve economic activity and contribute to macro-stability in the Keynesian theory (Larson, 2019).

Keynesians have tended to be pragmatic when it comes to economic policy, preferring to use fiscal and monetary policies to pursue macro goals of full employment, price stability, and stable economic growth, rather than focusing on efforts to remove imperfections that would permit market forces to work out short-term Keynesian troubles. This pragmatic approach has policy implications for the use of fiscal and monetary policies in achieving macroeconomic stability (Forstater, 2019). Keynes’ denial of the conflictual nature of capitalism has been identified as a fundamental flaw in his thinking, which has implications for the explanatory power of Keynesian economics in understanding the current tendency to stagnation (Palley,

2023). The adaptation of The General Theory into the Keynesian-neoclassical synthesis neglected vulnerabilities of the resultant model, leading to the dismissal of anomalous observations that indicated the need for new economic thinking. This has put constraints on macroeconomics and divorced macroeconomists from working on financial stability, indicating a theoretical criticism of the Keynesian-neoclassical synthesis (Akerlof, 2019).

1.3 Aspects of macroeconomic stability

Price stability

Price stability is a key aspect of macroeconomic stability that refers to the condition where the general price level of goods and services in an economy does not experience significant inflation or deflation over a period. Price stability is crucial for fostering economic confidence, promoting efficient resource allocation, and supporting sustainable economic growth (Svensson, 1999). It also contributes to achieving high levels of economic activity and employment by creating a stable economic environment (Burdekin and Willett, 2019). Price stability is characterised by low and predictable inflation rates, typically aimed at below but close to 2% annually in many developed economies (Aursulesei and Maha, 2019). Targeting asset prices can be an effective way to contain financial instabilities and economic slumps (Bernanke, 2007; Nair and Anand, 2020). It is considered a policy target rather than an assumption in the model and maintaining price stability is crucial for achieving macroeconomic stability (Singh, 2018).

Monetary policy plays a crucial role in maintaining price stability within the context of macroeconomic stability. The efficacy of monetary policy in achieving price stability is a critical consideration, with concerns raised about the credibility of inflation targeting frameworks and the forecasting quality of central banks (Fisher, 2016). Expansionary monetary policy leads to output growth, while tightening monetary policy leads to price stability (Sui *et al.*, 2022).

Price stability should be the primary objective of monetary policy (Goodfriend and King, 2001). Central banks often prioritise price stability alongside other objectives, such as full employment, recognising the potential trade-offs and conflicts between these goals (Burdekin and Willett, 2019). While price stability is a primary goal, monetary policy also needs to consider financial stability objectives, especially in the context of the recent financial crisis, where it was observed

that price stability alone would not ensure financial stability (Karfi and Mentagui, 2020).

To achieve and maintain price stability, central banks employ various monetary policy tools, such as open market operations, adjusting interest rates, and setting reserve requirements for commercial banks. During the euro-crisis, the ECB developed new instruments, such as targeted long-term refinancing operations and quantitative easing, to address challenges in maintaining price stability (Pantazatou and Asimakopoulos, 2019).

Price stability is considered a crucial aspect of macroeconomic stability for several reasons:

- ✦ Price stability contributes to achieving high levels of economic activity and employment by creating a stable economic environment (Burdekin and Willett, 2019).
- ✦ Stable prices allow businesses and consumers to make long-term financial plans and investment decisions without worrying about unpredictable changes in the purchasing power of money (ECB, 2006).
- ✦ Low and stable inflation helps to keep interest rates at lower levels, encouraging borrowing and investment. High inflation typically leads to higher interest rates, which can stifle investment and economic growth (Bernanke, 2007).
- ✦ When prices are stable, resources can be allocated more efficiently. Inflation can distort price signals, leading to suboptimal investment and consumption decisions (Friedman, 1970).

Fiscal stability

Fiscal stability refers to the condition where a government's budgetary operations are managed in a manner that avoids excessive deficits and debt accumulation, ensuring long-term fiscal sustainability (Buckle and Cruickshank, 2013). Fiscal stability is achieved when a government maintains a balanced budget or manageable fiscal deficits, and the public debt remains at sustainable levels relative to GDP. This ensures that the government can meet its current and future obligations without compromising economic stability or growth. It is a crucial aspect of macroeconomic stability as it impacts the country's ability to finance its obligations without resorting to excessive borrowing, which can lead to economic instability (Ocampo, 2008).

Fiscal stability is integral to macroeconomic stability, influencing factors such as investment, aggregate demand, and economic growth (Munir and Riaz, 2019).

On the other hand, fiscal policy instability, such as uncertainties in government expenditures and budget uncertainty, has been shown to significantly impede economic growth (Farooq and Yasmin, 2017).

The cyclicity of economic recessions worsens fiscal stability and increases vulnerability to future shocks. Thus, fiscal stability is essential for the government's ability to respond to economic shocks without compromising long-term fiscal health (Rao *et al.*, 2023). The effectiveness of fiscal policy in enhancing economic resilience varies across countries and is influenced by factors, such as trade openness, financial development, and government size (Afonso and Carvalho, 2022; Eichengreen *et al.*, 2024).

The importance of fiscal stability is reflected in the following issues:

- ✦ Fiscal stability ensures that public debt levels are sustainable, reducing the risk of a debt crisis. Sustainable debt levels mean that the government can continue to service its debt without resorting to drastic fiscal adjustments (Aldama and Creel, 2019; Aboelnaga *et al.*, 2023; Menguy, 2024).
- ✦ Stable fiscal policies build confidence among investors and consumers, fostering an environment conducive to economic growth (McCausland and Theodossiou, 2015; Beetsma *et al.*, 2015; Horne, 2017).
- ✦ Fiscal stability provides the government with the flexibility to respond to economic shocks without compromising long-term fiscal health. This includes the ability to implement counter-cyclical policies during economic downturns (Bonam and Lukkezen, 2019; Jalles, 2020).
- ✦ Maintaining fiscal stability helps to keep borrowing costs low. When interest rates are low due to an increased preference for saving, fiscal sustainability facilitates the increase in debt in a period of low interest rates. Conversely, excessive deficits and high debt levels can lead to higher interest rates, increasing the cost of borrowing for both the government and private sector (Garín *et al.*, 2019).

Financial stability

Financial stability is an aspect of macroeconomic stability that refers to the condition where the financial system – comprising financial institutions, markets, and market infrastructures – is capable of withstanding shocks and the unravelling of financial imbalances. This ensures that financial intermediation processes, such as the provision of credit and other financial services, continue to function smoothly, thereby supporting economic growth and stability (Fisher, 2016). Financial stability is crucial for sustainable macroeconomic growth (Harun and Gunadi, 2022).

Governance, macroeconomic conditions, interest rates, GDP growth, regulatory quality, control of corruption, and bank competition are key components that contribute to financial stability (Khan, 2022; Ullah *et al.*, 2024). Simultaneously, financial stability impacts economic growth, with stable macroeconomic environments, institutional quality, and optimum financial and economic development being necessary conditions for finance to accelerate growth (Ehigiamusoe and Samsurijan, 2021).

Financial stability is achieved when the financial system is resilient to economic shocks, capable of efficiently allocating resources, managing financial risks, and maintaining employment levels close to the economy's natural rate. It also involves the elimination of excessive movements in the prices of real or financial assets that could disrupt monetary stability or employment levels (Schinasi, 2004).

The structure of financial systems, such as bank-based and market-based structures, significantly affects the financial and macroeconomic stability of economies. For instance, bank-based financial systems contribute to instability in the financial sectors and currency market, while stock markets lead to a reduction in such pressure (Singh and Sarma, 2020). Higher levels of bank competition promote macroeconomic stability by reducing output growth volatility, fluctuations in private credit, and the probability of bank default. Financial development enhances the positive impact of bank competition on macroeconomic stability (Khan, 2022).

Central banks and regulatory authorities play a crucial role in shaping the country's economic trajectory through instruments like monetary policy, guarantees of financial stability, and regulatory frameworks (Warjiyo, 2016; Dhabliya *et al.*, 2024). Central banks need to maintain a careful eye on the financial system and how interest rate policy affects incentives for financial markets and institutions to promote financial stability (George, 2014). Regulatory governance has a significant positive influence on financial stability, with central bank independence and economic independence having a statistically significant effect on financial stability (Ullah *et al.*, 2022).

Systemic risk, which arises from different elements of the financial system and the macroeconomic environment, can distress the economy and is a crucial measure in macroeconomic risks (Harun and Gunadi, 2022). Loose financial conditions maintained for a long time can lead to a build-up of financial vulnerabilities causing potentially costly macro consequences, posing risks to macroeconomic stability (Liang, 2019). Additionally, the financial stability of individual companies can significantly impact the country's overall financial stability, highlighting the interdependence between financial indicators at the macro level and those of individual companies (Borisova *et al.*, 2022; Zajac *et al.*, 2023).

1.4 Role of policy in maintaining macroeconomic stability

Macroeconomic policies can be grounded in either monetary or fiscal policies. Economists often favour monetary policies over fiscal policies – here is a long-standing consensus that macroeconomic stabilisation should rely on monetary policy, not fiscal policy (Kocherlakota, 2022). Monetary policies are executed by central banks rather than political institutions that manage fiscal policy. Consequently, central banks are not influenced by political considerations when making decisions. Monetary policies can produce immediate effects, whereas fiscal policies typically take longer to manifest results (Mayer & Thomas, 2002; Snowdon *et al.*, 2005; Morutan, 2015). However, the effectiveness of each policy depends on various factors, and their coordination is crucial for better functioning of the general economy (Guler, 2019). In standard macroeconomic models, equilibrium stability and uniqueness require monetary policy to actively target inflation and fiscal policy to ensure long-run debt sustainability (Bonam and Lukkezen, 2019). Both monetary and fiscal policies have the ability to positively influence macroeconomic stability, and a combination of both policies may be necessary to achieve this stability (Almerri, 2023). In detail, coordination between fiscal and monetary policies is crucial for maintaining long-term macroeconomic stability and public welfare, with a focus on creating favourable monetary conditions for fiscal measures and forming a balanced budget for monetary regulation (Arestis, 2015; Chugunov *et al.*, 2021)

Monetary policy

Monetary policy significantly influences economic growth and macroeconomic stability by affecting the level of prices, exchange rates, interest rates, and the structure of production of goods and services (Doroftei and Păun, 2013). It focuses on controlling money flow, maintaining price stability, and controlling inflation (Shahid and Gaur, 2015; Hussain and Hoang, 2014). It influences savings and consumption decisions through short-term interest rates (Guler, 2019). Moreover, monetary policy aims to maintain price stability, purchasing power of money, economic growth, increased foreign trade, employment, and improved balance of payments positions (Lazopoulos and Gabriel, 2019; Turkeshi and Dardhishta, 2013). Monetary policy interventions can contribute to financial stability by correcting asset mispricing, controlling fluctuations in the real business cycle, and taming credit cycles (Venter, 2020; Sui *et al.*, 2022). Monetary policy rules responding

to the financial sector are ex-ante stabilising as they decrease the likelihood of crises and boost leverage during downturns, thereby promoting financial stability and improving household welfare (Chen and Phelan, 2023). Expansionary monetary policy leads to output growth, while tightening monetary policy leads to price stability, and both expansionary quantitative monetary policy and tight price-based monetary policy are effective in maintaining financial stability (Sui *et al.*, 2022). However, in some cases, the impact of monetary policy on output growth may be limited, and external factors, such as shocks to risk aversion and global growth, may have a stronger impact on economic activity (Domac, 2019). Moreover, the effectiveness of monetary policy depends on the extent to which it is supported by fiscal policy, and the existence of a strong coordination mechanism between the two policies is crucial for the better functioning of the general economy (Guler, 2019).

Fiscal policy

Fiscal policy deals with revenue generation and public spending, aiming at economic growth and income distribution justice through tools, such as taxes and public expenditures. It is the government's prerogative, and it aims at economic growth and income distribution justice. Fiscal policy affects the consequences of monetary policy by the size of the fiscal deficit and its financing method (Shahid and Gaur, 2015; Guler, 2019). Fiscal policy has been shown to be an effective tool in curing unemployment and maintaining macroeconomic stability. DSGE models based on the New Keynesian principles suggest that active fiscal policy can contribute to macroeconomic stability and welfare by reducing the frequency of hitting the zero lower bound on interest rates (Le *et al.*, 2024). Strong and properly designed numerical rules act as an anchor for fiscal policymakers and contribute to more stable discretionary fiscal policy (Reuter *et al.*, 2022). The study of South Asian countries suggests that discretionary fiscal policy has a stabilising impact on economies and requires efficient government intervention for sustainable economic growth (Munir and Riaz, 2019). The aggressive use of discretionary fiscal policy, particularly government consumption items, can lead to higher volatility of output and inflation, but strict fiscal rules can make discretionary policy output-stabilising rather than destabilising (Sacchi and Salotti, 2015). The study of Asian economies over the period of 1974–2007 reveals that fiscal policy has a more powerful effect on output than monetary policy, indicating the importance of fiscal instruments for macroeconomic stabilisation (Hussain and Hoang, 2014).

Expansionary and contractionary fiscal policies have distinct impacts on macroeconomic stability. The main objective of expansionary fiscal policy is to boost economic growth and aggregate demand (Ubide, 2016; Polat and Polat, 2022). It aims to achieve this by increasing government spending and/or reducing taxes. Expansionary fiscal policy involves increases in aggregate output and consumption through shifts in fiscal policy, such as expenditure and tax changes (Hazakis, 2018). It can lead to economic growth, stimulate private sector investment, and may have contemporaneous positive effects on the economy, particularly when coordinated with monetary policy (Tule *et al.*, 2020). An expansionary monetary policy shock raises inflation and output, but only when accompanied by expansionary fiscal policy (Kloosterman *et al.*, 2024).

In contrast, the primary goal of contractionary fiscal policy is to reduce inflation and cool down an overheated economy by decreasing government spending and/or increasing taxes (Polat and Polat, 2022; Hazakis, 2018). It is suggested that fiscal contraction tends to reduce output and employment in the short term (Paula and Pires, 2013).

From the Keynesian perspective, reduction in government expenditures or increased taxation has contractionary effects on aggregate demand. Fiscal contraction is detrimental to economic growth in certain economies (Hazakis, 2018). Fiscal policy is more potent during downturns, with the fiscal multiplier being greater than one, compared to expansions where the multiplier is less than one (Karras, 2014; Wielechowski, 2019).

The introduction of strict fiscal rules can transform discretionary policy from output-destabilising to output-stabilising, with balanced budget rules being particularly effective in achieving this result (Sacchi and Salotti, 2015). Strong, properly designed numerical rules act as an anchor for fiscal policy makers and contribute to more stable discretionary fiscal policy, even if actual compliance with fiscal rules seems to play no systematic role (Reuter *et al.*, 2022).

Recent theoretical and empirical developments suggest that fiscal policy is an effective macroeconomic tool in influencing the economy, especially during the liquidity trap, and can contribute to curing unemployment when coordinated with monetary and financial stability policies (Arestis, 2015; Beyene and Kotosz, 2021).

Fiscal policy, when coordinated closely with monetary policy and financial stability policies, can contribute to curing unemployment and reducing income inequality, thus playing a crucial role in macroeconomic stability (Arestis, 2015).

1.5 Methods of measuring macroeconomic stability

Macroeconomic stability is assessed through various indicators that reflect the health and resilience of an economy. These measures help policymakers and economists to evaluate whether the economy is on a stable growth path or facing potential risks.

Gross Domestic Product (GDP) growth rate

GDP growth rate is one of the key indicators used to evaluate macroeconomic stability (Fischer, 1992; Czech, 2014; Javed, 2016). GDP is the traditional indicator for measuring the country's economic prosperity and is considered the quintessential measure of economic growth (Czech, 2014). It reflects the overall increase in the production and consumption of goods and services in the economy. GDP growth rates facilitate comparisons of economic performance across countries, providing insights into relative economic stability and competitiveness. The ideal GDP growth rate varies depending on the country's economic circumstances and development stage. Generally, a moderate and stable growth rate is considered beneficial for macroeconomic stability.

Higher GDP growth rate is generally associated with positive economic welfare and stability (Erić *et al.*, 2020). Strong GDP growth is often associated with job creation and increased income levels. This can lead to higher consumer spending and further economic stimulation (Nayyar, 2014; Causa *et al.*, 2015). Robust and stable growth can attract both domestic and foreign investment, contributing to economic stability (Hermes and Lensink, 2003; Albu, 2013; Cakici, 2023).

Monetary policy affects GDP growth by influencing macroeconomic variables, such as interest rates, inflation, and money supply (Balaji *et al.*, 2023). The impact of financial sector stability on economic growth is also discussed. It is noted that stable financial development is essential for promoting economic growth, with the level of stability playing a significant role in this relationship (Próchniak and Wasiak, 2017).

However, it is important to note that GDP growth rate alone may not fully capture macroeconomic stability as it is just one of the factors in the evaluation of stability and it should be complemented by other measures (Lyeonov *et al.*, 2018). Furthermore, while GDP growth is commonly used as a measure of economic development, it is noted that this measure has limitations. It includes factors, such as earnings by foreigners and investments, that may not directly reflect

the well-being of the country's citizens. GDP is also criticised for not covering various social practices relevant for human welfare, environmental damage, and depletion of natural resources (Laurent, 2022). The Stiglitz-Sen-Fitoussi Report emphasises the need for alternative indicators to GDP to represent sustainable development and well-being (Fasolo *et al.*, 2013).

Inflation

Inflation is defined as a persistent and sustained increase in the aggregate or average price level of goods and services in an economy (O'Neill *et al.*, 2017). Commonly, research studies highlight the importance of low and stable inflation as an indicator of macroeconomic stability (Akerlof *et al.*, 1996; Lopez, 2005; Bilali *et al.*, 2024). Furthermore, as a measure of macroeconomic stability, inflation provides several important insights:

- ✦ Moderate and stable inflation is often associated with healthy economic growth. It can indicate increased demand for goods and services, potentially leading to higher production and employment levels (Andrés and Hernando, 1999; Woodford, 2012; Kahn and Naushad, 2020; Meyer and Hassan, 2024).
- ✦ Central banks closely monitor inflation rates to gauge the effectiveness of their monetary policies. The inflation rate helps to determine whether adjustments to interest rates or other monetary tools are necessary to maintain price stability (Gryzunova *et al.*, 2018; Álvarez and Sánchez, 2020; Kahn and Parish, 2020).
- ✦ Consumer Purchasing Power: Inflation directly affects consumers' ability to purchase goods and services. High or volatile inflation can erode purchasing power, potentially leading to economic instability and reduced consumer confidence (Juster *et al.*, 1972; Georganas *et al.*, 2014; Malmendier and Nagel, 2016).
- ✦ Investment Climate: Stable inflation rates contribute to a predictable economic environment, which is crucial for both domestic and foreign investment. Excessive inflation can discourage long-term investments and hinder economic growth (Chu *et al.*, 2015; Bambe, 2023).
- ✦ International Competitiveness: Inflation rates influence a country's exchange rates and, consequently, its international competitiveness. High inflation can lead to currency depreciation, affecting trade balances and overall economic stability (Shapiro, 1975; Ruiz-Nápoles, 2001; Ghosh, 2013).

Inflation is a complex economic phenomenon. However, it should be considered alongside other economic indicators to gain a comprehensive understanding of an economy's stability and performance as it has some limitations. Firstly, it does not capture all aspects of economic well-being, such as income inequality or environmental sustainability (Coibion, 2017; Prati, 2024). Secondly, different sectors of the economy may experience varying inflation rates, which might not be fully reflected in aggregate measures (Ayyoub and Wörz, 2021). Thirdly, rapid technological changes and improvements in product quality can make it challenging to accurately measure price changes over time (Jaravel, 2019).

Unemployment rate

The unemployment rate belongs to key indicators of macroeconomic stability, providing insights into the overall health and performance of an economy. It measures the percentage of the labour force that is actively seeking employment but unable to find work (Kingdon and Knight, 2006). As a macroeconomic measure, the unemployment rate offers valuable information about the labour market, economic growth, and social well-being (Yfanti et al, 2020).

The unemployment rate is closely linked to the country's economic output. A low unemployment rate generally indicates that economy is operating near its full potential, while a high rate suggests underutilisation of human resources and potential output (Levine, 2012; Labonte, 2014; Mura *et al.*, 2020). Employment is crucial for individual and societal well-being. High unemployment can lead to social issues, reduced consumer spending, and increased government expenditure on social welfare programmes (Sinfield, 2018; Sage, 2019). Policymakers use the unemployment rate to gauge the effectiveness of economic policies and to make decisions about future interventions (Sahnoun and Abdennadher, 2018). Central banks often consider unemployment levels when setting interest rates (Stiglitz, 1998; Pressman, 2019).

The unemployment rate is a lagging indicator of the business cycle. The increase in unemployment during recessions is primarily attributed to cyclical unemployment, driven by depressed aggregate demand, while structural unemployment, caused by mismatches in skills or job locations, contributes to a minority of the rise in the unemployment rate (Shimer, 2005; Hall, 2005; Ferraro, 2023).

Research indicates that more fiscally decentralised countries tend to experience lower unemployment rates, with a greater impact on structural unemployment compared to cyclical unemployment (Akalbeo *et al.*, 2023). Long-term

relationships between unemployment, inflation, and output are explored to understand their interconnectedness and impact on macroeconomic stability (Škare, 2014).

The unemployment rate as a single measure has limitations in capturing the full complexity of macroeconomic stability. It is acknowledged that the unemployment rate alone may not fully represent the health of the labour market and the overall economy. The metaphor of the “iceberg in the labour market” highlights the limitations of focusing solely on the unemployment rate, emphasising the need for a more comprehensive approach to evaluating the health of the labour market (Baerts, 2021).

Fiscal balance (budget balance)

Fiscal balance, often referred to as the budget balance, is a critical measure of macroeconomic stability. It represents the difference between a government’s revenues and expenditures. A fiscal surplus occurs when revenues exceed expenditures, while a fiscal deficit happens when expenditures surpass revenues (Blejer and Cheasty, 1991). A consistent fiscal deficit can lead to an accumulation of public debt, which may become unsustainable over time. High levels of debt can constrain a government’s ability to respond to economic crises and may necessitate austerity measures that can further destabilise the economy (Reinhart and Rogoff, 2010; Rajaguru *et al.*, 2021).

Fiscal deficits can lead to inflation if they are financed by printing money. This can erode purchasing power and create economic instability. Conversely, fiscal surpluses can help to control inflation by reducing the need for monetary expansion (Catao and Terrones, 2005; Dhal, 2015; Bordo and Levy, 2021). However, the impact of fiscal deficits on inflation can vary based on the sources of financing. Domestic borrowing, especially from the central bank, can be inflationary in the long term, while borrowing from external sources may be less inflationary, especially in the short term (Khan *et al.*, 2020).

A balanced fiscal policy can promote sustainable economic growth. Excessive borrowing to finance deficits can lead to higher real interest rates, crowding out private sector access to funds and hindering private investment, while prudent fiscal management can create a stable environment conducive to investment and growth (De, 2012; Bonam and Lukkezen, 2019). Countries with a fiscal deficit below 3% of GDP can implement a sustainable development policy more effectively, promoting competitiveness and avoiding periodic shocks and

budget cuts (Postula and Raczkowski, 2020). A healthy fiscal balance provides the government with the flexibility to implement counter-cyclical policies. During economic downturns, the government can increase spending or cut taxes to stimulate the economy without exacerbating debt levels (Gülşen, 2022; Heimberger, 2023).

Fiscal stability enhances public and investor confidence in the government's ability to manage the economy. The current policy agenda suggests that improving the government balance sheet and reducing public debt can increase confidence in the country's economic prospects, leading to higher investment. The scaling up of public investments can result in higher long-run output and consumption levels, requiring a fiscal stabilisation package to preserve fiscal sustainability. Furthermore, fiscal stability can lead to the lowering of borrowing costs, as evidenced by the impact of government stance on public debt in historical data, where fiscal contractions deteriorated public debt as a percentage of GDP (McCausland and Theodossiou, 2015; Ghilardi and Sola, 2016).

Fiscal rules designed to be unaffected by the current state of the business cycle, such as budget balance rules that set ceilings in cyclically adjusted terms, reduce fiscal volatility, and contribute to macroeconomic stability. Strong, properly designed numerical rules act as an anchor for fiscal policy makers and contribute to more stable discretionary fiscal policy (Reuter *et al.*, 2022). Fiscal rules, particularly those on balanced budgets, can make discretionary policy output-stabilising rather than destabilising, contributing to macroeconomic stability (Sacchi and Salotti, 2015). The interaction between monetary policy and national fiscal policies is crucial, with the primary fiscal balance found to positively depend on the policy rate, allowing the government to devote more resources to pursue the objective of output stability (Papagni and Purificato, 2022).

The budget balance, as the main indicator of fiscal policy, may not adequately evaluate the government's policy and its macroeconomic impact. While balanced budget requirements aim to achieve fiscal sustainability, they can have substantial negative side effects, such as transferring public debt into less controllable budget areas and shifting the balance of power away from the democratically accountable legislature (Heun, 2014). Masten and Gnip (2016) find that the cyclically adjusted budget balance (CABB), used in the European fiscal framework to assess fiscal discipline, frequently fails to identify the true fiscal policy stance and may lead to increased macroeconomic instability.

Public debt

Public debt represents the total amount of money that a government owes to external creditors and domestic lenders. In detail, it encompasses the financial obligations of a government, including central and local government debt. It is a crucial measure of economic and financial sustainability (Barro, 1979; Reinhart and Rogoff, 2009; Mammadli *et al.*, 2021). Public debt is typically measured as a percentage of GDP to provide a relative scale of the debt burden. This ratio helps in comparing debt levels across different countries and time periods (Reinhart *et al.*, 2012). Public debt is often used as a tool for fiscal policy to cover essential expenditures, such as health, education, and infrastructure investment (Cifuentes-Faura and Simionescu, 2024).

Public debt sustainability is a critical concern as doubts about its sustainability can lead to a debt crisis, threatening political and economic stability (Hecker, 2013). The COVID-19 pandemic has led to substantially higher levels of public debt, raising concerns about sustainability, especially with recent increases in interest rates (Papaioannou and Tsetsekos, 2021; Zwalf and Scott, 2022). Excessive long-term debt can increase fixed costs associated with debt payments, potentially reducing the stability of non-debt related expenditures (Denison and Guo, 2015). In a consequence, high and rising borrowing costs can lead to more aggressive fiscal consolidation efforts by governments, especially when interest bill indicators exceed certain thresholds (Debrun and Kinda, 2016).

The relationship between public debt and economic growth is complex, with evidence suggesting that up to a certain threshold, a positive relationship exists; however, beyond that point, increasing debt levels can have a negative impact on average GDP growth (Hu *et al.*, 2021; Pujari and Biradar, 2022; Topuz and Sekmen, 2023). High public debt levels are associated with lower growth as they crowd out capital accumulation and increase resource use, which reduces the rate of growth (Clootens and Magris, 2024). The relationship between public debt and inflation varies, but high inflation is not a lasting remedy for a high public debt ratio. It may only lead to a decline in the government debt ratio under specific conditions and on condition that inflation expectations remain anchored (Aimola and Odhiambo, 2020).

High levels of public debt can undermine investor confidence and economic stability. Conversely, manageable debt levels can enhance confidence in the government's fiscal management and promote economic stability (Ghosh *et al.*, 2013; Morganti, 2023). Public debt can be measured at face value, market value, or amortised cost, each with its own limitations in accurately reflecting the burden

it imposes on the government (Irwin, 2019). Furthermore, public debt is a significant and controversial instrument of public financing, with its increase often attributed to politico-economic factors (Döring and Oehmke, 2019).

Current account balance

The current account balance represents the sum of net exports of goods and services, net primary income, and net secondary income. It is a crucial indicator of a country's economic stability as it reflects the nation's investments, capital flows, and indebtedness (Altayligil and Çetrez, 2020; Ariç *et al.*, 2021; Ekinçi and Özcan, 2022). The current account balance indicates whether a country is a net lender or borrower in the global economy. A surplus suggests such a country is saving more than it is investing, while a deficit indicates it is borrowing from the rest of the world.

Macroeconomic stability, represented by the inflation rate, has been found to reduce current account deficits. Contrary, a rise in the growth rate, real effective exchange rate, fiscal deficit, trade openness, institutional quality, financial market development, and stage of development can lead to larger current account deficits (Altayligil and Çetrez, 2020). A country's current account deficit is significantly affected by domestic demand factors, fiscal-related factors, institutional-related factors, and financial development (Dauti, 2024).

Persistent current account deficit may indicate macroeconomic problems and negatively correspond to private consumption and domestic investment, potentially affecting competitiveness in international markets, and leading to currency depreciation and economic instability (Wajda-Lichy, 2015; Kholopov, 2022).

Persistently large external imbalances contributed to the global financial crisis, emphasising the need for coordination of national policies to achieve a sustained recovery (Bosworth and Kawai, 2015). Reversals of current account imbalances are often pursued as a policy objective, but the actual experience of such reversals does not suggest association with disruptive business cycle episodes or macroeconomic risks (Du Plessis and Freytag, 2014). Moreover, large imbalances in current account balance can necessitate policy interventions. For example, a significant deficit might require measures to boost exports or reduce imports, while a large surplus could lead to pressure for currency appreciation.

The evolution of global external imbalances can be related to structural factors, such as fiscal deficits, oil dependency, and cyclical factors, including changes in output growth, oil prices, and exchange rates (Chueng *et al.*, 2013). Macroeconomic

imbalances, including current-account discrepancies, output gaps, and exchange-rate misalignments, strongly interact through a causal relationship. Positive output-gap shocks and currency overvaluation deepen current-account deficits, while variations in external imbalances mainly result from exchange-rate misalignments in the euro area and are mostly explained by output gaps for non-eurozone members (Gnimassoun and Mignon, 2016). Real exchange rate adjustment is critical for achieving a sustainable current account position and thereby for helping to maintain macroeconomic and financial stability (Gervais *et al.*, 2016).

There is no universally agreed-upon ideal current account balance. Large and persistent surpluses or deficits in major economies can contribute to global economic instability (Plecita *et al.*, 2013; Beirne *et al.*, 2021). Additionally, the current account balance can be affected by temporary factors, such as business cycles or commodity price fluctuations, which may not reflect long-term economic stability (Afonso and Silva, 2017; Baas and Belke, 2023).

Exchange rate

The exchange rate refers to the value of a nation's currency relative to other currencies and plays a significant role in international trade, investment, and overall economic performance. Exchange rates have a direct impact on the country's competitiveness in international markets, influencing the price of imports and exports. Sustainable and stable exchange rate policies are recommended to promote greater exchange rate stability and enhance real exports, while an overvalued currency may harm export competitiveness (Subanti *et al.*, 2019). The choice of exchange rate regime allows policymakers to make their currency a safer investment for international investors, impacting domestic capital accumulation, wages, and the country's share in the world wealth (Hassan *et al.*, 2023).

The relationship between exchange rates and macro fundamentals is perceived to be highly unstable, driven by expectations of structural parameters in the economy (Bacchetta and Van Wincoop, 2013). Exchange rate fluctuations play a vital role in influencing macroeconomic variables, including economic growth, through channels such as net exports and investments (Hussain *et al.*, 2019). De Grauwe and Schnabl (2004) prove that the association of exchange rate stability with higher real growth remains quite robust. Moreover, exchange rate stability is crucial for managing inflation as it is expected to reduce domestic inflation pressures through policy discipline and credibility effects (Mohanty and Bhanumurthy, 2014). Real exchange rate adjustment is critical for achieving a sustainable current

account position and maintaining macroeconomic and financial stability in emerging-market economies (Gervais *et al.*, 2016).

In normal times, exchange rates adjust according to the stance of monetary policies, particularly differences in interest rates set by central banks (Klose, 2017). The impact of monetary policy on exchange rates has been growing significantly in recent years (Ferrari *et al.*, 2021). Central banks in developing countries often aim for exchange rate stability but are reluctant to relinquish monetary policy autonomy. However, the use of multiple policy instruments, such as interest rate and foreign exchange interventions, may not necessarily equip monetary authorities with better tools to achieve their targets (Villamizar-Villegas, 2016).

Factors such as the size of the economy, fiscal policy, foreign capital inflow, and current account deficit also influence the maintenance of stable exchange rates (Jurek, 2013). Government stability may have sizable implications for the interactions between foreign direct investment (FDI) and the exchange rate, with the most prevalent type of symbiosis being a positive effect of FDI on the exchange rate (McCloud *et al.*, 2024).

The exchange rate has some limitations as a measure of country's economic stability. Firstly, excessive exchange rate volatility can be detrimental to economic stability, making it difficult for businesses and policymakers to plan for the future (Morina, 2020). Secondly, exchange rates can be sensitive to external factors, such as global economic conditions, geopolitical events, and commodity price fluctuations (Gevorkyan, 2019). Thirdly, policymakers often face trade-offs between exchange rate stability and other economic objectives, such as maintaining low inflation or stimulating growth (Keefe and Shadmani, 2020).

Interest rates

The central bank's interest rates refer to the rates set by central banks to influence the economy. Central banks, such as the Federal Reserve, Bank of England, European Central Bank, and Central Bank of Poland, set key interest rates as part of their monetary policy tools (Zimmerman, 2014). The setting of interest rates by central banks affects various macroeconomic parameters, such as inflation, exchange rates, and economic growth (Ahmad and Premaratne, 2018).

Interest rates are traditionally viewed as a means to deliver macroeconomic stabilisation goals, such as low, stable inflation and sustainable growth (Cecchetti and Kohler, 2014). Interest rates indirectly affect economic growth and employment (AboElsound *et al.*, 2021; Wielechowski *et al.*, 2023). The Taylor Rule and Fisher

Relation are used to represent interest rate policies and can be included in macroeconomic models to study stability under various interest rate rules (Waters, 2022).

Financial development and interest rate liberalisation can stabilise the economy and alleviate the influence of external shocks, particularly in emerging and developing countries (Yang and Liu, 2016). Central banks use interest rates as a macroprudential instrument to reduce financial imbalances, especially after the global financial crisis. After the global financial crisis, central banks have paid more attention to the phase of the credit cycle when setting interest rates, indicating the use of interest rates as a macroprudential instrument (Kurowski, 2019). Central banks can stimulate real activity by changing the size or composition of their balance sheets, affecting interest rates and stabilising the economy when interest rate policy is ineffective (Hörmann and Schabert, 2015). The integration of monetary policy and macroprudential policy is increasingly important for maintaining monetary and financial system stability, especially in the face of changes in foreign capital flows (Juhro *et al.*, 2022). Effective management of interest rates requires coordination with fiscal policy. The study on macroeconomic stability and optimal policy mix emphasised the need for coordinated fiscal and monetary policies to maintain sustainable economic development (Hanif and Arby, 2003).

Frequent changes in interest rates can create economic uncertainty (Istefi and Mouabbi, 2018). Stability in interest rates is crucial for long-term economic planning and investment.

HDI – Human Development Index

Human Development Index (HDI), calculated by the United Nations Development Programme (UNDP), is a composite indicator used to measure the overall development of countries based on three dimensions: longevity and healthy living, education, and standard of living (Sagar and Najam, 1998; HDR, 2024). These dimensions are measured using sub-indicators to provide a comprehensive view of a country's development (Omrani *et al.*, 2024; Czech *et al.*, 2021). It is used to classify countries as developed, developing, or underdeveloped, and to measure the impact of economic policies on quality of life.

HDI as a quantitative index used for cross-sectional and temporal comparison of socioeconomic performance, is suitable for assessing macroeconomic stability. It comprises indicators of health, knowledge, and standard of living, which are crucial aspects of a country's overall economic stability and development (Türk *et al.*, 2021).

HDI has been compared to GDP as a measure of economic development and well-being. While GDP focuses solely on economic output, HDI incorporates social factors, such as health and education, providing a more comprehensive assessment of the country's development (Monni and Spaventa, 2013; Elistia and Syahzuni, 2018; Roy and Dalei, 2020).

The compensatory effect between the dimensions of HDI has been a major criticism, leading to the proposal of alternative approaches for calculating the index (Pereira and Mota, 2016). HDI has also been criticised for not measuring some relevant variables and for its methodology and index selection (Sagar and Najam, 1998; Urzúa and Vilbert, 2024).

EVI – Economic Vulnerability Index

Economic Vulnerability Index (EVI) is a widely recognised measure used by the United Nations for cross-country comparison purposes, particularly to review the list of Least Developed Countries (LDCs) (Cariolle *et al.*, 2016; Wang, 2013). The components of EVI are calculated as a weighted average of eight variables related to exposure to shocks and the frequency of shocks (Altimari *et al.*, 2019). These variables include indicators related to the domestic economic system, external economic system, and financial system (Li *et al.*, 2022). EVI is also used to assess the risk of a country being harmed by external economic shocks (Briguglio, 2016).

EVI is associated with economic growth sustainability and is important in vulnerability studies (Ren *et al.*, 2018). It is also linked to systemic risk, which is crucial for sustainable macroeconomic growth (Harun and Gunadi, 2022). It can also help to identify countries that may require assistance in building resilience to external economic shocks, thereby contributing to sustainable development goals (Diop *et al.*, 2021; Gnanon, 2019). EVI can inform policy decisions and international development efforts by providing a comprehensive measure of economic vulnerability, allowing policymakers to target interventions and support to the most vulnerable countries. Highly economically vulnerable states can reduce the harmful effects of external economic shocks by adopting policies that lead to resilience building, while countries not highly exposed to external shocks can render themselves economically unstable due to weak economic, social, and environmental governance (Briguglio, 2016).

EVI differs from other measures of macroeconomic stability. Unlike GDP and GNI, which measure economic output and income, EVI specifically focuses on

the structural vulnerability of economies. Furthermore, it has undergone revisions in methodology over time, which impacts its ability to assess changes in vulnerability (Cariolle *et al.*, 2016).

MSP – Macroeconomic Stabilisation Pentagon

The foundation for research into the process of macroeconomic stabilisation is a set of indicators known as the “magic square” or “Kaldor magic square” which corresponds to four stabilisation policy objectives, stimulating economic growth, increasing employment, ensuring internal balance (by reducing the inflation rate), and ensuring external balance (by striving for a balanced balance of payments) (Grynja and Marcinkiewicz, 2017; Masárová *et al.*, 2022). In detail, the magic square, commonly is simply a radar chart à la Von Mayr, with four axes: inflation, unemployment, growth, and current account (Piaser, 2024). The concept of the magic square was introduced by Kaldor in 1971 and further developed by the OECD in the 1970s (Saavedra-Rivano and Teixeira, 2017). Medrano-B and Teixeira (2013) later standardised the “Index of Economic Welfare” to assess macroeconomic performance (Firme and Teixerira, 2014).

Currently, one of the leading methods for assessing macroeconomic stability is the Macroeconomic Stabilisation Pentagon – MSP, referring to the method of assessing the condition of the economy (by A.W. Philips and R. Mundell), developed by Grzegorz W. Kołodko and his team at the Institute of Economic Cycles and Foreign Trade Prices in the early 1990s and then updated several times (Rackowski and Komorowski, 2023).

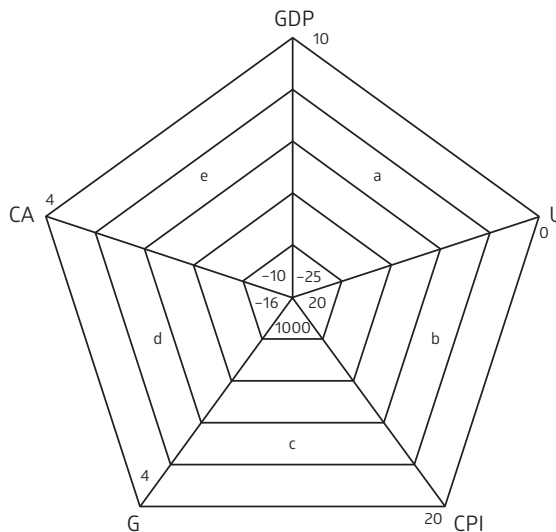
MSP is a conceptual model designed to evaluate and visualise the macroeconomic stability of a country. The concept of the MSP emerged in the early 1990s, during the economic transitions in Central and Eastern Europe. Countries like Poland adopted MSP to monitor and guide their economic reforms. The model helped these transitioning economies to stabilise and grow by providing clear targets and metrics for macroeconomic policies (Kołodko, 1993).

MSP assesses economic performance using five key indicators, each represented as a vertex of a pentagon. These indicators provide a comprehensive view of the economic health and stability of a nation, allowing both internal and external assessments. They include the following:

- ✦ *GDP growth rate*, which measures the overall economic growth and is a crucial indicator of economic health. Higher GDP growth indicates a thriving economy, while lower growth may signal economic stagnation or recession.

- ✦ *Inflation rate* – maintaining low and stable inflation is vital for economic stability as it preserves the purchasing power of the currency and ensures predictability in economic planning.
- ✦ *Unemployment rate*, which reflects the employment situation in the country. Lower unemployment rate signifies a robust job market and economic health.
- ✦ *Budget balance*, which assesses the fiscal health by measuring the difference between government revenues and expenditures. A balanced or surplus budget is preferable as it indicates sustainable fiscal policies.
- ✦ *Current account balance*, which measures the country's international economic position, considering trade balance, net income from abroad, and net current transfers. A positive balance indicates more exports than imports, which is beneficial for economic stability.

These five indicators are plotted on a radar chart, forming a pentagon shape, hence the name (Pera, 2016). Figure below depicts the Macroeconomic Stabilisation Pentagon.



where:

GDP – GDP growth (in %),

U – unemployment rate (in %),

CPI – inflation rate – Consumer Price Index (in %),

G – rate of budget balance to GDP (in %),

CA – rate of current account balance to GDP (in %),

a, b, c, d, e – description is presented below.

Source: Kołodko, 1993.

Macroeconomic Stabilisation Pentagon comprises five triangles. The first, triangle *a*, known as the real sphere triangle, is defined by parameters reflecting the rate of change in real GDP and unemployment. Triangle *b*, termed the short-ageflation (or slumpflation) triangle, is bounded by the unemployment rate and inflation dynamics. Triangle *c*, the budget and inflation triangle, is determined by inflation dynamics and the budget balance. Triangle *d*, referred to as the financial equilibrium triangle, depends on the budget and current account balances. Lastly, triangle *e*, called the external sector triangle, is characterised by the variability of the current account balance and the dynamics of global GDP (Kołodko, 1993).

MSP enables a quick insight into the most important macroeconomic indicators of an economy, providing a comprehensive view of its stability (Żuchowska, 2013). A larger surface area of the pentagon generally indicates better macroeconomic stability, while a smaller area suggests less stability (Ionita, 2015). MSP enables comparison between different countries or time periods for the same country, making it useful for tracking progress or comparing economic performance. While the original model used specific scales (*e.g.*, logarithmic scale for inflation in countries with hyperinflation), it can be adapted for different contexts. For instance, when analysing developed economies with low inflation, linear scales may be more appropriate (Dobrzański and Bobowski, 2020).

Based on the review of the basic concept of the Macroeconomic Stabilisation Pentagon, originally developed by Kołodko, and its applications and modifications effected by Zaman and Drcevic (2009), Hurduzeu and Lazar (2015), Ionita (2015), Liulov *et al.* (2020), among others, it is evident that these concepts take into account the cyclical fluctuations of indicators used to evaluate the macroeconomic stability of a national economy. The main limitation of the MSP model is that it assumes that all five indicators are equally important, which may not always be the case. Additionally, it does not account for factors like unrealised production or non-marketable inventories (Dobrzański and Bobowski, 2020).

MIP – Macroeconomic Imbalance Procedure

The European Union has legally defined macroeconomic stability as stipulated in the Maastricht Treaty, through four criteria and five indicators. These include low and stable inflation, low long-term interest rates, low national debt relative to GDP, low budget deficits, and currency stability (UN, 2024).

Macroeconomic Imbalance Procedure (MIP), introduced in 2011, is a critical element of the European Union's framework for economic governance, aimed

at identifying, preventing, and addressing macroeconomic imbalances that may threaten the stability of individual EU countries, the euro area, or the EU as a whole. It is an essential mechanism aimed at safeguarding economic stability through vigilant monitoring and timely intervention. The procedure operates under a legal framework established by the “Six-Pack” legislation, which includes Regulation (EU) No. 1176/2011 on the prevention and correction of macroeconomic imbalances and Regulation (EU) No. 1174/2011 on enforcement measures for excessive imbalances. These regulations form the basis for MIP and its enforcement mechanisms, particularly for the euro area member countries, under Articles 121 and 136 of the Treaty on the Functioning of the European Union (TFEU). MIP is integrated into the EU’s annual economic policy coordination cycle, known as the European Semester. The cycle begins in November with the publication of the Alert Mechanism Report (AMR) by the European Commission. AMR employs a scoreboard of 14 headline indicators with thresholds and 25 auxiliary indicators without thresholds to assess potential economic imbalances across EU member states. Headline indicators cover three areas: external imbalances and competitiveness, internal imbalances, and employment indicators. The list of headline indicators includes the following (European Commission, 2024):

- ✦ Three-year backward moving average of the current account balance as a percent of GDP (+6% and – 4% thresholds),
- ✦ Net international investment position as a percent of GDP (-35% threshold),
- ✦ Five-year percentage change of export market shares measured in values (-6% threshold),
- ✦ Three-year percentage change in nominal unit labour cost (+9% for euro area and +12% for non-euro area thresholds),
- ✦ Three-year percentage change of the real effective exchange rates (-/+5% for euro area and – /+11% for non-euro area thresholds),
- ✦ Private sector debt (133% of GDP threshold),
- ✦ Private sector credit flow (14% of GDP threshold),
- ✦ Year-on-year changes in house prices (6% threshold),
- ✦ General government sector debt (60% of GDP threshold),
- ✦ Three-year backward moving average of unemployment rate (10% threshold),
- ✦ Year-on-year changes in total financial sector liabilities (16.5% threshold),
- ✦ Three-year change in the activity rate (-0.2% threshold),
- ✦ Three-year change in long-term unemployment rate (+0.5% threshold),
- ✦ Three-year change in youth unemployment rate (+2% threshold).

The supplementary indicators include, among others, labour productivity, residential construction, poverty, deprivation and social exclusion, spending on research and development, foreign direct investment flows and stocks, gross fixed capital formation, and GDP (UN, 2024).

Based on the Alert Mechanism Report (AMR), countries requiring further scrutiny undergo an In-Depth Review (IDR), usually published in February as part of the annual country reports (Economy and Finance). IDR evaluates the nature and severity of identified imbalances and classifies them into categories: no imbalances, imbalances, excessive imbalances, or excessive imbalances requiring corrective action. Countries found to have imbalances or excessive imbalances receive policy recommendations and are subject to specific monitoring to ensure compliance and progress in addressing these issues. Specific monitoring involves intensified dialogue between the European Commission and national authorities, including follow-up missions and progress reports (Economy and Finance). This process ensures that recommended corrective actions are implemented effectively to mitigate identified risks. When a country is identified with excessive imbalances, it enters the Excessive Imbalance Procedure (EIP), an enhanced surveillance mechanism. Under EIP, the European Commission can recommend that the Council of the EU requires the country to submit a corrective action plan. This plan must detail the measures the country will take to address its imbalances and provide a timeline for their implementation. The Council monitors the execution of these plans, and failure to comply can result in sanctions, including fines for the euro area member states (European Commission, 2024).

Conclusions and further research recommendations

The exploration of macroeconomic stability presented in this chapter underscores its crucial role in fostering long-term economic resilience and growth. Macroeconomic stability is not a singular concept but a multifaceted goal that encompasses various dimensions, including price stability, fiscal discipline, and financial system robustness. These elements together create a stable environment that allows economies to function efficiently, minimise vulnerabilities, and sustain progress in the face of internal and external shocks.

The analysis within this chapter highlights how leading economic theories approach the concept of stability. Classical economic thought emphasises the self-regulating nature of markets, suggesting that minimal intervention is required for an economy to achieve its natural equilibrium. This school of thought

emphasises the long-term neutrality of money, positing that monetary policy has little to no effect on real variables, such as output and employment, in the long run. Instead, classical economists argue that the market operates efficiently when left to its own devices, provided that external interventions are minimal. However, this perspective, while foundational, has been challenged by the realities of modern economies, which often face complexities that pure market mechanisms cannot fully address.

On the other hand, Keynesian economics, with its advocacy for active government intervention, provides a contrasting viewpoint that has become increasingly relevant in contemporary economic policy. Keynesians argue that markets are not always self-correcting and that without government intervention, economies can experience prolonged periods of unemployment and underutilisation of resources. This school of thought underscores the importance of using fiscal and monetary policies to stabilise economic fluctuations, achieve full employment, and ensure price stability. The Keynesian approach has been particularly influential in shaping modern macroeconomic policies, especially in times of economic downturns when traditional market mechanisms fail to restore equilibrium.

This chapter has also delved into the practical aspects of maintaining macroeconomic stability. Price stability, fiscal prudence, and financial resilience are not just abstract goals; they are critical factors that influence the daily lives of citizens, the performance of businesses, and the overall trajectory of national economies. Price stability, for instance, ensures that inflation does not erode purchasing power, facilitating predictable economic planning. Fiscal stability enables governments to fund essential services and invest in future growth without incurring unsustainable debt. Financial stability ensures that credit remains available, and that the financial system can absorb shocks without collapsing, thus supporting broader economic stability.

Furthermore, the chapter emphasises the importance of coherent and coordinated policy responses in achieving macroeconomic stability. Monetary and fiscal policies, when aligned, can effectively mitigate economic volatility and support steady growth. The challenges of the past decades, including financial crises or even economic recessions, have demonstrated the necessity of such coordination. Effective policymaking is not just about choosing the right tools but also about timing and implementing them in a way that supports the overall stability of the economy.

The methods for assessing macroeconomic stability, such as monitoring GDP growth, inflation, unemployment, and fiscal balances, are essential for understanding the current state of an economy and identifying potential risks. These indicators

serve as vital benchmarks for policymakers, enabling them to craft responses that are both timely and effective. However, these metrics also require careful interpretation as they can sometimes present an incomplete picture if not considered in the broader context, including global economic conditions and structural factors.

In reflecting on the broader implications of macroeconomic stability, it is clear that this concept is central to the well-being of nations. Stability creates a foundation upon which sustainable growth can be built, allowing economies to innovate, invest, and improve living standards over time. However, achieving and maintaining stability requires constant vigilance, adaptability, and a willingness to engage with both traditional and emerging economic challenges.

As this chapter has demonstrated, the pursuit of macroeconomic stability is both a complex and dynamic endeavour. It requires a balance of theoretical insights and practical policy measures, along with a deep understanding of the global economic environment. By continuing to focus on these elements, policymakers can help to ensure that their economies remain resilient in the face of future challenges, fostering a stable and prosperous future for all.

Factors determining macroeconomic stability

Konrad Raczkowski,
Dariusz Filip,
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Introduction

The aim of this chapter is to define the importance of macroeconomic stability for the economy, together with identifying the factors that determine it. The starting point here, however, will be the reference to the definition of macroeconomic stability in its main areas. Based on a critical-cognitive review of the literature on the subject, potential factors, both internal and external, affecting macroeconomic stability will be identified. Using relevant central statistics or national accounts, it will be possible to assess the economic conditions of individual countries and show the links between individual variables that measurably determine stability. This chapter will also provide an overview of the so-called institutional safety nets, including prudential mechanisms, and the economic policies pursued by individual governments.

This study is devoted to macroeconomic stability, but as balance and predictability are sought in various aspects of the economy, one of its most important areas appears to be the financial system as part of the larger economic system. Many definitions of the financial system can be found in the literature. Their diversity and inconsistency in terminology make it necessary to clearly define the concept at the outset of deliberations and to use the introduced definition consistently in

further reasoning¹. Allen and Gale (2000) formulate a definition, emphasizing the functions of the financial system. In their view, the financial system plays a key role in the allocation of resources; it channels household resources to the corporate sector, facilitates the equalization of investment volumes over time, and enables a wider distribution of risk in the economy. In discussing the structure of the financial system, Pietrzak *et al.* (2004) distinguish between two segments: public and market. The market segment of the financial system consists of:

- ✦ financial instruments,
- ✦ financial markets,
- ✦ financial institutions,
- ✦ the rules under which the above elements operate.
- ✦ The public segment of the financial system, on the other hand, consists of:
 - ✦ fiscal institutions,
 - ✦ fiscal instruments,
 - ✦ public financial instruments,
 - ✦ fiscal institutions.

Due to the multidimensional and complex interrelationships between all elements of the financial system and the economic environment, disruptions originating from any element of the economic system can undermine its overall stability. Thus, defining the issue of stability requires a systems approach. In general, financial stability is a state of dynamic and sustainable equilibrium in interconnected markets (Solarz, 2001). Equilibrium here means limiting and dealing with emerging imbalances before they pose a threat. A similar definition is given in the *Financial System Stability Report*, where financial system stability is characterized as a state in which the financial system performs its functions continuously and efficiently, even in the event of unexpected and adverse disturbances of significant magnitude and low probability of occurrence (NBP, 2024).

¹ Neave (1998) sees the financial system as a meeting ground for the interests of non-financial economic agents and financial organisations. In contrast, the infrastructure of the financial system in this view is built by such elements as markets, intermediaries, and rules of operation. Pietrzak *et al.* (2004), however, points out that the financial system is part of the economic system, with the latter being an element of the social system. The financial system, despite being related to other systems, has its own specificity that distinguishes it from other systems in the economy. The aforementioned authors define the financial system itself as the mechanism through which services are provided that allow the circulation of purchasing power in the economy. An extensive definition of the financial system is also provided by Blake (2000). He states that any developed financial system consists of participants in the financial system, financial instruments, markets, rules of contract, and rules of operation of the system.

In summary, in financial terms, an economic system is characterized by stability if it is able to withstand shocks and prevent the emergence of cumulative processes that adversely affect the allocation of savings to investment and the conduct of payments in the economy (Paddoa-Schioppa, 2002). In contrast, macroeconomic stability, broadly defined, is a state of the economy in which key economic indicators (inflation, unemployment, economic growth, and balance of payments, among others) remain stable, which promotes predictability and sustainability. This means that the economy does not experience sharp fluctuations that could lead to financial or economic crises.

The purpose of this chapter is to determine the importance of macroeconomic stability for the economies of selected countries, together with identifying the factors that determine it. These factors can be divided into internal and external; some of them will be measurable, while others are underpinned by various types of prudential mechanisms, applied by the institutions of the financial safety net, but also by the economic policies pursued by individual governments.

This chapter consists of three parts. In the second part, a description of the measurable factors influencing macroeconomic stability will be made on the basis of the literature review. Using relevant central statistics or national accounts, it will be possible to assess the economic conditions of individual countries and show the links between the individual variables that measurably determine title stability. In the third part, the safety network institutions (the financial safety net) will be described, together with the mechanisms supporting the subject macroeconomic stability, including economic policies. Safety net institutions in the area of financial system stability will be an extremely important – through the mechanisms and regulations used – but will represent a nonquantifiable dimension of the issue at hand. The chapter concludes with a summary and the formulation of conclusions and recommendations related to macroeconomic stability.

2.1 Measurable factors of macroeconomic stability

As mentioned in the introduction, macroeconomic stability translates into, among other things, instruments, markets, economic agents, and the rules under which they operate, leading to predictability and fostering sustainable development. Macroeconomic stability factors can be divided into internal and external. Some of these will be measurable. For example, within internal factors, fiscal policy was distinguished, the assessment of which can be done by analyzing the sustainable budget (*e.g.*, Cuadrado-Ballesteros and Bisogno, 2022; Haubrich, 2020), or even

the efficiency of public spending (*e.g.*, Albassam, 2020; Afonso and Alves, 2023). The literature also states that price stability and inflation control (*e.g.*, Apostolakis, Papadopoulos, 2019; Blot *et al.*, 2015), which are the objectives of central banks' monetary policies, make up the endogenous factors associated with macroeconomic stability. Still other approaches link macroeconomic stability, including resilience to financial crises, to the labour market situation, *i.e.*, unemployment and employment policies (*e.g.*, Sharma and Winkler, 2017; Lei, *et al.*, 2023).

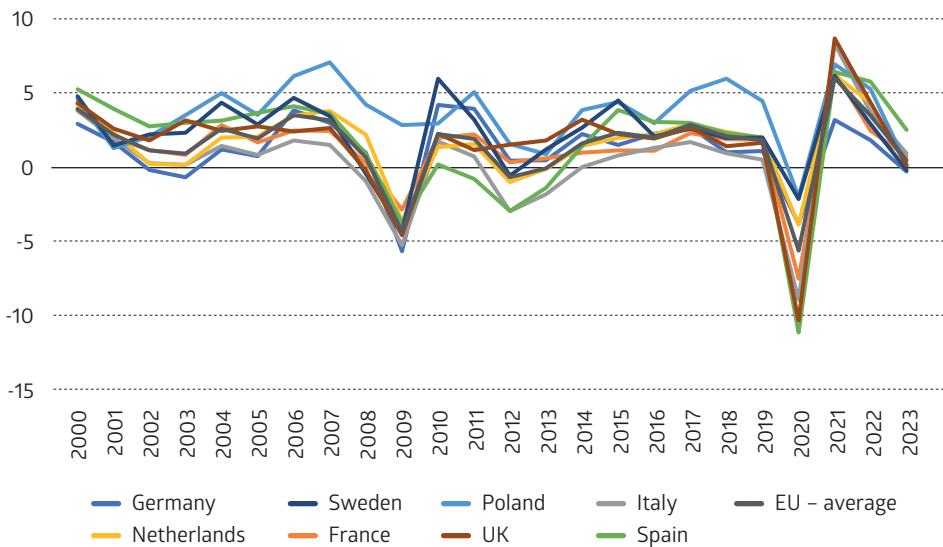
The second type of measurable factors affecting macroeconomic stability can be described as external. Among these are the issues related to globalization and international trade. The link between the current account on the balance of payments and macroeconomic stability is often cited in academic studies (*e.g.*, Kołodko, 1993; Kaminsky and Reinhart, 1996). In contrast, other works assume that such measurable factors of macroeconomic stability include exchange rate fluctuations (*e.g.*, Ghosh *et al.*, 2010; Eichengreen, 1998). A particularly important issue in recent years, in the context of the emergence of contemporary crises, is the link between macroeconomic stability and commodity and energy prices, where the impact of oil and gas prices on the economy can be measurable (*e.g.*, Hoffart *et al.*, 2024; Chang, 2023).

In order to show the links between the various variables that measurably determine macroeconomic stability, it was decided to present the economic determinants of individual countries. This will be done using the relevant statistics, which consist of national accounts. The values of the selected indicators supplement the text, prior to the analysis itself and the creation of the macroeconomic stability model, which will be presented later in the book, and are presented in an illustrative capacity. This study, however, represents a kind of assessment of the mentioned determinants and has an introductory character to the study. For this purpose, eight significant European economies have been selected, whose GDP at current prices represents nearly 94% of the GDP of all EU countries. These include Germany – the economy known for its strong industrial sector and exports; France – with a strong services and agricultural sector; the United Kingdom (despite not currently being a member of the EU) – known for its developed financial sector, especially in London; Italy – with a strong industrial sector, especially in car manufacturing and fashion; Spain – with a strong tourism and agricultural sector; Netherlands – known for its developed commercial and logistics sector; Sweden – known for its innovation and strong technology sector; and Poland, whose economy is known for its dynamic growth, especially in sectors such as automotive, information technology, agriculture (especially food production), and outsourcing services. The values achieved were compared with the EU average and,

where a benchmark value was not available, the average value achieved for the above-mentioned selected eight countries. The statistics that will be referred to in this chapter cover the period of 2000–2023, except for the values of a few indicators that were not yet available for 2023.

As mentioned, in the work devoted to identifying measurable determinants of macroeconomic stability, one of the most frequently cited economic indicators is the economic growth rate. Figure 1 shows the values of economic growth in selected countries for the period of 2000–2023.

FIGURE 1. Changes in the level of GDP growth in selected European countries



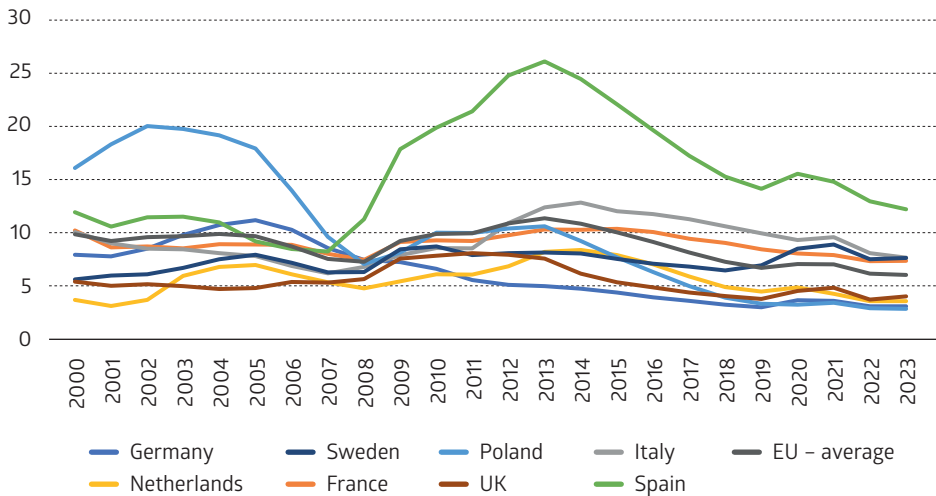
Source: Own compilation based on data of the worldbank.org database.

The dynamics of economic growth vary, depending on the level of development of a country. For example, until recently, Poland was considered a developing country by the World Bank; however, since 2009, it has joined the group of high-income economies². Other countries, whose economic characteristics are presented, were and are treated as developed economies, and their macroeconomic situation is stable, but they are characterised by a lower rate of development. In recent years,

² Poland was recognised as a developed country by FTSE Russell in September 2018. This marked Poland's promotion to the group of the 25 most developed countries in the world according to this classification.

practically all economies of the world have experienced a significant slowdown or even a recession as a result of the COVID-19 pandemic. For practically all countries in the chart (with the exception of Spain), economic growth in 2023 was close to the EU average, *i.e.*, 0,45%. Sustained, but even modest, GDP growth is the basis for the desired macroeconomic stability. At the same time, the analyzed factor is significantly related to the volume of employment. Figure 2 provides information on the unemployment rate in selected countries.

FIGURE 2. Level of unemployment rates in selected European countries

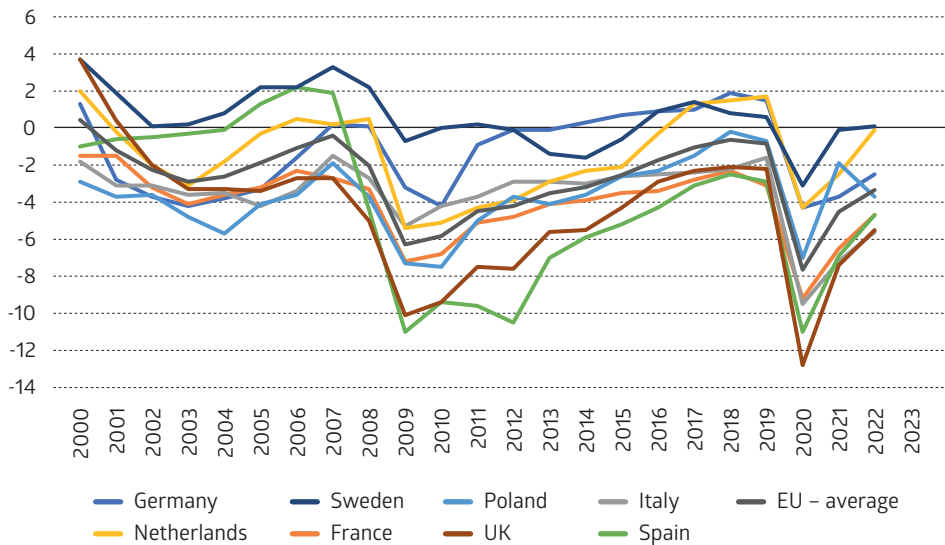


Source: Own compilation based on data of the worldbank.org database.

As mentioned, macroeconomic stability is the resilience of the economy to phenomena resulting from emerging crises, which, in addition to slowing down growth, may have consequences for the labour market. Businesses faced with apparent threats may pursue different employment policies, and this will translate into unemployment levels. As shown in Figure 2, Poland was still facing a double-digit unemployment rate until the financial crisis of 2007–2008; while practically since 2013, there has been a decrease in this unfavorable phenomenon. The situation was slightly different in Southern European countries, such as Spain and Italy. After the Eurozone crisis, these countries had to undertake a series of difficult reforms and austerity measures to stabilize their economies, including reforms to increase the competitiveness of their economies, such as liberalizing the labour

market. The Spanish economy in particular has still not fully recovered, with negative social consequences, such as high unemployment and falling living standards. Spain aside, Italy, Sweden, and France have unemployment rates slightly higher than the EU average (6%). In the United Kingdom, the Netherlands, Germany, and Poland, there has not been much of a problem with involuntary unemployment for a long time, which is also a good sign of these economies. Other aspects that can affect macroeconomic stability include fiscal policy (Figure 3).

FIGURE 3. Level of the fiscal balance as a percentage of GDP in selected European countries



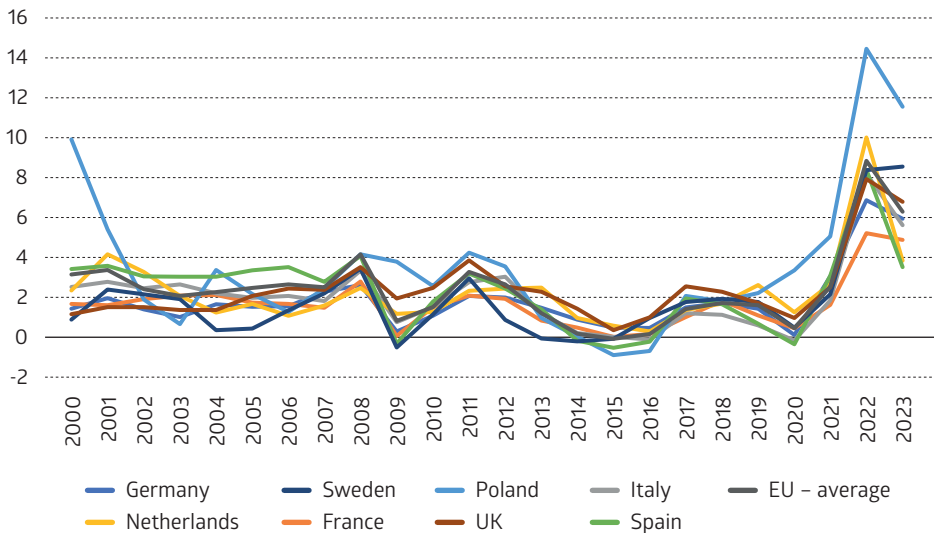
Note: Due to a partial lack of data in the World Bank database, data for 2023 have been omitted.

Source: Own compilation based on the data of the worldbank.org database.

One even intuitive way to identify macroeconomic stability factors is to link changes in the value of an economic indicator to the occurrence of a crisis situation. For example, the analysis of a sustainable budget, expressed in the fiscal balance as a percentage of GDP, can be helpful in assessing this stability. It is natural that developing countries and countries investing in development incur increased budget expenditures. This is also the case of Poland. The analysis of the value of the indicator discussed in Figure 3, in the context of eight selected economies, provided two further conclusions. The aforementioned crisis in the

Eurozone (2009–2012), to which the majority of EU countries belong, resulted from the accumulation of a number of unfavorable phenomena, including the high public debt of some countries, led to the need for deregulation of some sectors of the economy and forced improvements in the efficiency of public administration in the following years. The European Mediterranean countries, for example, were forced to introduce severe austerity measures that included cuts in public spending, tax increases and pension reforms. In addition, an unprecedented epidemiological crisis (2020–2021) led to an economic collapse, which had to be offset again by increased budget deficits as a proportion of GDP. The trend of decreasing budget deficits as a proportion of GDP, despite still being below average, is evident in Italy, the UK, Spain, and France. From this perspective, the best performers are Sweden and the Netherlands, where the value of the indicator in question there has been close to 0 in recent years.

FIGURE 4. Inflation rates in selected European countries

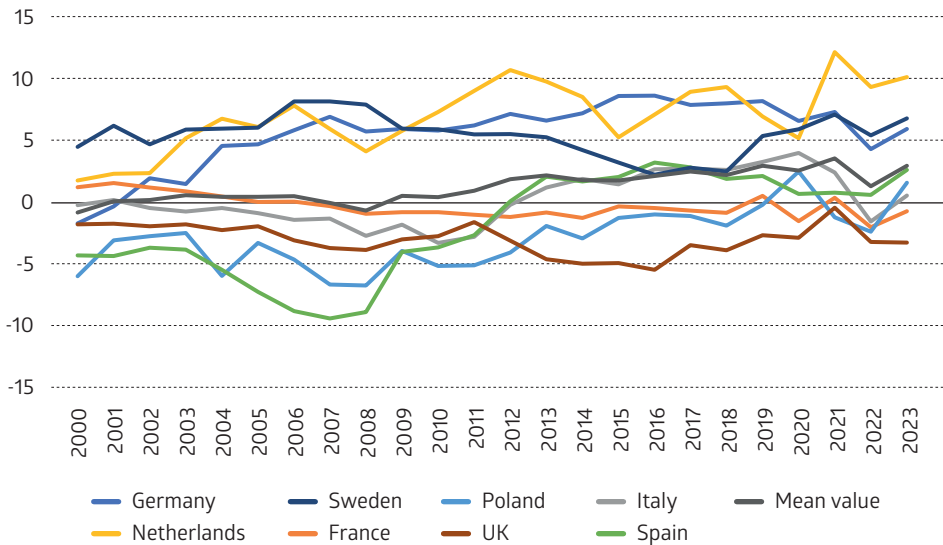


Source: Own compilation based on the data of the worldbank.org database.

Another aspect related to this stability, which belongs to the group of endogenous factors, is inflation control, as it affects price stability. The monetary policy strategy pursued adopted by individual central banks as well as by the governing council of the ECB responds to price destabilization by aiming for an inflation

target over the medium term. This is understandable especially as in both the short and long terms low inflation and stable economic growth are associated with lower income inequality, and improved well-being of the poor (*e.g.*, Ahiadorme, 2022). Poland faced problems of high prices, especially in the early 2000s. However, since the outbreak of the pandemic and after the outbreak of the war in Ukraine, when energy prices (Figure 6) started to be the main inflationary factor, practically all economies faced the effects of inflation. For the time being, it is possible to speak of a halt in inflation and a slight – but reversal – trend associated with rising prices among the analyzed economies. This area was linked to another factor determining macroeconomic stability – the trade balance (Figure 5).

FIGURE 5. Current account balance as a percentage of GDP in selected European countries

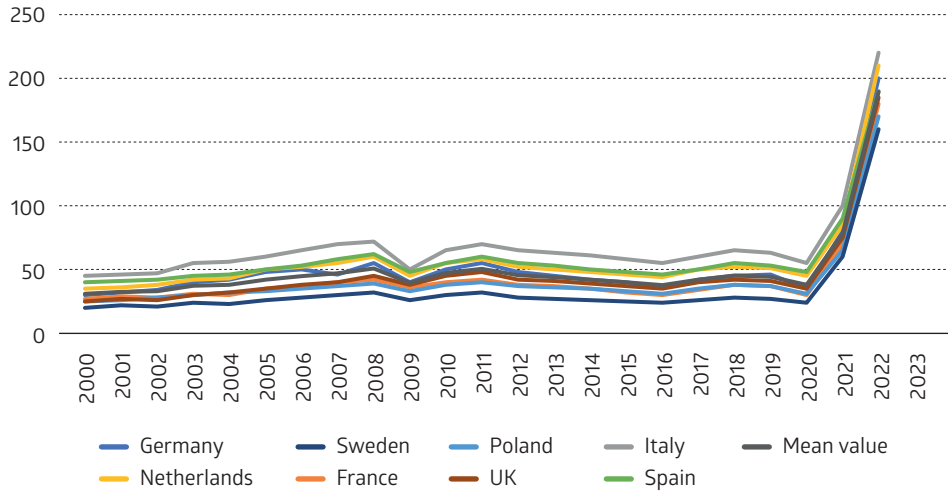


Source: Own compilation based on the data of the worldbank.org database.

An increase in the price of raw materials, labour costs, or even other production elements led to higher prices for final products, and this in turn had an impact on the current account on the balance of payments. Economies with high current account balances relative to GDP include the Netherlands, Germany, and Sweden. On the other hand, at the other extreme, meaning an excess of imports over exports, have been the UK, France, and Poland, among others, in recent years. This may be worrying due to the lack of competitiveness of exports and may further

lead to a depreciation of the national currency, *e.g.*, in the case of Poland. It should also be borne in mind that the COVID-19 pandemic appeared as a game-changer in foreign investment (*cf.* Ayinde *et al.*, 2024).

FIGURE 6. Average prices of energy (in EUR/MWh) in selected European countries



Note: Due to a partial lack of information in the databases, data for 2023 have been omitted.

Source: Own compilation mainly based on wholesale energy prices for day-ahead markets in Europe, according to analyses available at energy-charts.info and ember-climate.org.

The energy price levels in Figure 6 are annualized, which means that they can vary according to seasonal market fluctuations. Nevertheless, between 2021 and 2022, a significant increase in electricity prices was observed in Europe as a result of global energy market developments (*e.g.*, fossil fuel price spikes), gas supply problems, rising carbon certificate prices in the European Union, as well as the impact of the war in Ukraine and other geopolitical factors. Undoubtedly, the ongoing energy transition, but also the lack of independence of some countries in this area, are currently among the most vexing and urgent problems to be solved for modern economies. Energy efficiency interacts with practically all other factors presented earlier, representing at the same time the most incalculable element threatening macroeconomic stability (*cf.* Raczkowski *et al.* 2023; Mac Clay *et al.*, 2023).

2.2 Mechanisms and institutional safety nets as qualitative factors of macroeconomic stability

In this part of the chapter, the focus will be on the institutions belonging to the so-called safety network that are responsible for the economic policy, but also on the mechanisms used by these entities to support macroeconomic stability. As a result of the implementation of certain strategies and policies by such institutions, certain non-quantifiable factors will be discussed, which are qualitative and can also be divided into internal and external.

The discussion of institutions and types of the economic policy in helping to maintain macroeconomic stability can begin with an international perspective. First of all, mention should be made of the International Monetary Fund (IMF)³. This is an international organization within the UN dealing with issues of global economic stability. Its purpose is to coordinate financial policies and provide assistance to member countries related to maintaining currency stability, facilitating international monetary cooperation, and developing multilateral exchange (multilateralism). Currently, the International Monetary Fund fulfils 3 important functions:

- ✦ regulatory – which involves overseeing member countries’ monetary restrictions and compliance with exchange rate rules,
- ✦ lending – the IMF provides financial assistance to indebted member countries, which in return are required to carry out economic reforms and other stabilization measures,
- ✦ consultative – carried out through a range of consultative services and cooperation among member countries.

The literature provides ambiguous assessments of the IMF’s role in preventing economic crises (*e.g.*, Beeson and Broome, 2008; Kern *et al.*, 2023). The IMF’s activities have been subject to criticism from many quarters, including a number of economists. One of the loudest criticisms of the effects of the IMF comes from Stiglitz (2002), the winner of the Nobel Prize in Economics.

Another institution that constitutes the organizational architecture of the global development support system is the World Bank. The activity of the World Bank is to fight poverty by stimulating the economic development of countries.

³ The IMF was established in July 1944 at the United Nations during the Bretton Woods Conference and began its activities in 1947. After the Second World War, a need appeared to offset the changes that had taken place in many war-ravaged countries by, among other things, creating an international organisation to counteract perturbations in the international currency market.

This is effected through the promotion of foreign investment and international trade and through the facilitation of capital investment, which indirectly aims to lift entire populations of developing countries out of poverty. Among the tools used by the World Bank, the following can be mentioned:

- ✦ low-interest loans,
- ✦ interest-free loans,
- ✦ grants to developing countries

used for a variety of purposes, including investments in education, health, public administration, infrastructure, finance and private sector development, agriculture and environmental protection, and natural resource management. The World Bank consists of two institutions: The International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). However, recent surveys show that citizens of the recipient countries are reluctant about the assistance conditionality. Nevertheless, closer alignment of beliefs with the organization's policies is positively associated with greater public confidence (*cf.* Anderson, 2024).

International institutions belonging to the so-called safety network play a special role in maintaining financial stability. At the European level, the main entity designated for this is the European Central Bank (ECB)⁴ with the ESCB Financial Stability Committee. The ECB acts as the central bank for the European Union Member States that have introduced the euro in their countries. Its main task is to define and conduct a common monetary policy in the euro area and to maintain the purchasing power of the currency, thereby ensuring price stability in the euro area. The ECB is responsible for supervising the banking systems in the EU countries, carrying out foreign exchange operations, performing the issuing function for the euro, and collecting the statistical data needed for monetary policy and the functioning of payment systems. In carrying out these tasks, the ECB operates within the framework of the European System of Central Banks (ESCB), which comprises the ECB and the 28 central banks of the European Union countries. The ECB plays a key role in reducing macroeconomic divergences among member states, as exemplified by the ECB's asset purchase programmes discussed in the study by Castañeda and Cendejas (2022).

At this point, the EU's financial stability institutional framework will be presented. While macroprudential decisions are taken by the Governing Council of the ECB, they apply to all banks from all countries covered by the Single

⁴ The ECB was established in 1998 as a result of the transformation of the European Monetary Institute, which was set up after the signing of the Maastricht Treaty on European Union.

Supervisory Mechanism (SSM), *i.e.*, all euro area countries and those other EU countries whose supervisory authorities have concluded a close cooperation agreement with the ECB. The Governing Council and the Supervisory Board of the ECB hold regular meetings for a general exchange of views on the micro-prudential and macroprudential perspectives from across Europe in the so-called Macroprudential Forum. These institutions are supported by the Financial Stability Committee, which comprises representatives of the ECB and national central banks and supervisory authorities. Its task is to jointly assess risks and coordinate ECB and national authorities' policies. Another institution that makes up the safety net is the European Banking Authority (EBA)⁵. It is a European Union body whose objective is to protect the public interest by contributing to the short, medium, and long-term stability and effectiveness of the European Union financial system.

Among the key institutions in supporting European stability are the European Stability Mechanism (ESM)⁶. It is an intergovernmental organization established in 2012 by member states of the euro area. Its mission is to enable the countries of the Euro area to avoid and overcome financial crises and to maintain long-term financial stability and prosperity. Another institution in the framework of maintaining financial stability is the European Systemic Risk Board (ESRB). The ESRB is an independent EU body responsible for the macroprudential oversight of the financial system within the EU. This institution was established in 2010 in response to the financial crisis in the euro area.

In Poland, the financial stability safety net consists of several key institutions that cooperate to ensure the stability of the financial system (*cf.* Komorowski and Filip, 2017). These include the Central Bank of Poland (NBP), which is responsible for monetary policy and macroprudential supervision, the Polish Financial Supervision Authority (PFSA), the Ministry of Finance, which is responsible for fiscal policy and crisis management in the financial system, or even the Bank Guarantee Fund (BFG), which, among other things, is responsible for the protection of bank deposits.

Within the framework of the internal factors of the stability in question, it is again important to mention the skillful conduct of fiscal policy by national governments. The literature is rich in works analyzing public spending in times of threats to destabilize the economy (Darby and Melitz, 2008; Heimberger, 2023),

⁵ The European Banking Authority (EBA) was established by Regulation (EU) No. 1093/2010.

⁶ ESM is the successor to the European Financial Stability Facility (EFSF), a temporary institution created in 2010.

in order to efficiently allocate resources to areas with the highest added value, or even to keep the budget deficit at a level that does not threaten the stability of the economy (*e.g.*, Abbott and Jones, 2012). Also, there are works assessing the link between sustainable public finances and monetary policy and the role of the central bank (Gali and Perotti, 2003), or even responding to monetary risks through an appropriate exchange rate policy (Papaioannou, 2020).

In order to systematize the mechanisms presented and the roles played by the different institutions, Table 1 summarizes selected approaches within the framework of the determinants of macroeconomic stability.

TABLE 1. Selected comparisons of macroeconomic stability determinants by international classifications and research approaches

NO.	CLASSIFICATION APPROACH
1.	<p>International Monetary Fund (IMF)</p> <ul style="list-style-type: none"> » The IMF focuses on monitoring the stability of the global economy and helping countries to maintain sound macroeconomic fundamentals. <p>Fiscal policy</p> <ul style="list-style-type: none"> » Sustainable public finances: Maintaining budget deficits and public debt at levels that do not threaten the stability of the economy. » Efficiency of public spending: Efficient allocation of resources to areas with the highest added value. » Tax system: A fair and efficient tax system that ensures stable government revenues. <p>Monetary policy</p> <ul style="list-style-type: none"> » Inflation control: Maintaining a stable price level to preserve the purchasing power of money. » Exchange rate stability: Preventing excessive fluctuations in the exchange rate of the national currency. » Central bank independence: Ensuring the autonomy of the institution responsible for monetary policy. <p>Stability of the financial sector</p> <ul style="list-style-type: none"> » Financial regulation and supervision: An effective regulatory framework to prevent excessive risks in the financial system. » Bank capitalization: Maintaining adequate levels of capital in financial institutions. » Liquidity of financial markets: Ensuring the smooth functioning of financial markets and the availability of credit. <p>External balance</p> <ul style="list-style-type: none"> » Balance of payments: Maintain a balanced trade and financial balance with foreign countries. » Foreign exchange reserves: Holding adequate reserves to absorb external shocks. » Trade openness: Integrating with international markets in a way that supports economic growth.

NO.	CLASSIFICATION APPROACH
	<p>Labour market</p> <ul style="list-style-type: none"> » Low unemployment: Maintaining high levels of employment that promote social and economic stability. » Labour market flexibility: The ability of the labour market to adapt to changing economic conditions.
2.	<p>The World Bank</p> <ul style="list-style-type: none"> » Focus on poverty reduction and promoting sustainable development <p>Good governance and institutions</p> <ul style="list-style-type: none"> » Rule of law: A stable and predictable legal framework conducive to economic activity. » Efficient public administration: Competent and transparent public institutions. » Anti-corruption: Minimizing corrupt practices to enhance economic efficiency. <p>Investment in human capital</p> <ul style="list-style-type: none"> » Education: A high level of education of the population as a basis for innovation and productivity. » Health care: Access to quality health care to support productivity. » Social inclusion: Ensuring equal opportunities and reducing social inequalities. <p>Infrastructure</p> <ul style="list-style-type: none"> » Transport and logistics: Developed transport infrastructure for efficient movement of goods and services. » Energy: Stable and accessible energy sources to support economic activity. » Information and communication technology: Modern digital infrastructure to foster innovation and efficiency. <p>Environmental sustainability</p> <ul style="list-style-type: none"> » Environmental protection: Managing natural resources in a way that ensures their sustainability. » Climate change adaptation: Strategies to minimize the negative impacts of climate change on the economy. » Renewable energy: Promoting environmentally friendly energy sources.
3.	<ul style="list-style-type: none"> » Perspectives from economists and economic theory <p>Keynesian school</p> <ul style="list-style-type: none"> » Efficient demand: Maintaining adequate levels of aggregate demand through fiscal interventions. » Fiscal policy as a stabilization tool: Using public spending and taxes to smooth business cycles. » Public investment: Stimulating the economy through investment in infrastructure and public services. <p>Monetarist School</p> <ul style="list-style-type: none"> » Money supply control: Regulating the amount of money in circulation as key to controlling inflation. » Stable inflation expectations: Maintaining predictable and low inflation expectations among economic agents. » Central bank independence: Preventing political influence on monetary policy. <p>New Classical Economics</p> <ul style="list-style-type: none"> » Rational expectations: Recognition that economic agents anticipate and respond to economic policies in a rational manner. » Price and wage flexibility: The rapid adjustment of prices and wages to changing market conditions. » Lack of government intervention: Minimizing the role of the state in the economy to avoid market distortions.

NO.	CLASSIFICATION APPROACH
3.	<p data-bbox="215 248 435 271">Institutional Economics</p> <ul style="list-style-type: none"> <li data-bbox="215 271 1028 322">» Quality of institutions: Strong and effective institutions as a foundation for economic stability. <li data-bbox="215 322 1049 373">» Property rights: Clearly defined and protected property rights to foster investment and growth. <li data-bbox="215 373 1072 395">» Economic culture: Social norms and values that support entrepreneurship and innovation.

Source: Own elaboration.

Conclusions and further research recommendations

The aim of this chapter was to determine the importance of macroeconomic stability for the economies of the selected countries, together with identifying the factors that determine it. According to the observations made, basic macroeconomic indicators are able to outline the levels of macroeconomic stability in question. Both internal and external factors, which can be presented in a measurable way, are only part of the answer to the desired stability. The second group of factors that should be taken into account can be described as qualitative as it is characterized by a nonquantifiable dimension.

This chapter presents a classic account of five measures that help to assess macroeconomic stability, *i.e.*, the level of GDP growth, unemployment rate, fiscal balance as a percentage of GDP, inflation rate, and current account balance as a percentage of GDP, which show the *de facto* economic conditions of individual countries. The sixth element, *i.e.*, the energy price level, is also considered in contemporary literature (*cf.* Raczkowski *et al.* 2023; Mac Clay *et al.*, 2023). Nevertheless, a comprehensive assessment of the issue at hand can be carried out in addition with the inclusion of qualitative factors, such as the institutional safety nets, including prudential mechanisms, and the economic policies pursued by individual governments.

Development *versus* stability – a comparative analysis

Janusz Szyrmer

Introduction

The main objective of the conventional macro-fiscal policy is to foster long-term development of a national economy. This complex task involves promoting inclusive/equitable economic growth that contributes to all country residents' welfare, quality of life, human development, and institutional progress. Equally complex is the task of maintaining macroeconomic stability. The question that arises is how these two policy objectives –development and stability – are interconnected. Do they support or reinforce each other or are they mutually competitive? Another question is whether the (in)stability-related indicators are interrelated among one another. And yet another, whether the stabilisation or destabilisation of one component of the economy coincides with and may stabilise or destabilise some other components.

To address these questions, the author experimented with available data covering the most recent decade, *i.e.*, the period between 2014 and 2023. One of the key areas of focus is the complex relationship between macroeconomic stability and growth. While stability is often seen as a prerequisite for growth, it is not sufficient on its own to ensure sustained high rates of economic expansion. Achieving long-term growth requires a multifaceted approach that includes regulatory reforms, improved governance, trade liberalisation, and comprehensive financial sector reforms.

However, the interaction between economic stability and development remains a subject of debate. Some evidence suggests that countries with distortionary policies, such as high inflation, large budget deficits, and misaligned exchange rates, suffer more economic volatility and slower growth. Yet, weak institutional frameworks, such as ineffective property rights enforcement and political instability, often exacerbate these problems, raising questions about the true drivers of economic outcomes.

This analysis delves into the nuanced relationships between stability, growth, and development, highlighting the complexities in determining causal links. Despite strong macroeconomic indicators in some advanced economies, like in the United States, public perception of economic performance often diverges from the underlying data, further complicating these discussions.

For most indicators, the data used in this analysis are ten-year timeseries. For some indicators, only single-year data sets were used. The indicators covered all countries for which the data were available online.

3.1 Development and macro-fiscal indicators: definitions and interactions

Development indicators

Gross Domestic Product (GDP) is the output created by producing goods and services in a country during a specific period. It also quantifies the income earned from that production and the total amount spent on final goods and services (less imports). It is the standard measure of the size of a national economy. It also serves as a denominator for various macro-fiscal indicators expressed in GDP percentage points, such as GDP ratios of fiscal deficit, national savings and investments, and current account balance. The change in GDP (GDP growth rate in constant prices) is a proxy for economic growth, making it a crucial component of our analysis.

GDP-PPP level is the value of gross domestic product converted to international dollars using purchasing power parity (PPP) rates. International dollar has the same purchasing power in every country as the US dollar has in the United States. The level of GDP-PPP *per capita* is frequently used to approximate a country's development level.

GDP values are controversial indicators criticised for their diverse drawbacks. Among other things, they fail to account for the distribution of an increase or decrease in the domestic product, *i.e.*, how different groups of the population benefit or suffer from GDP changes over time. The Gini coefficient (annual) measures the extent to which the distribution of income or consumption among individuals or households within an economy deviates from a perfectly equal distribution. Gini index of 0 represents perfect equality, while the index of 100 implies perfect inequality. In this analysis, a “reversed” Gini coefficient is used, RGini level (annual):

$$\text{RGini LEVEL} = 100 - \text{Gini LEVEL}$$

Thus, this indicator becomes a (positive) proxy for equitable growth/development. The greater it is, the more equitable income distribution takes place.

The World Health Organization (WHO) defines the QLI (Quality-of-Life Index) as an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns. The index (annual) is intended to account for the changes in the people’s overall well-being in a country. It is based on a variety of factors: (i) physical, psychological, and social functioning; (ii) satisfaction with different aspects of life; and (iii) the availability of essential goods (such as food, shelter, clothing, transport, and entertainment), and less tangible goods, such as climate, fresh air, clean water, safe neighbourhoods, and good schools (<https://www.who.int/toolkits/whoqol>).

HDI (Human Development Index) was devised to emphasise that people and their capabilities should be the ultimate criteria for assessing the development of a country, not the economic growth alone. HDI (annual) is a summary measure of average achievement in key dimensions of human development: (i) enjoying a long and healthy life; (ii) being knowledgeable; and (iii) having a decent standard of living. HDI is a geometric mean of normalised indices for each of the three dimensions (<https://hdr.undp.org>).

The World Bank’s Worldwide Governance Indicators (WGIs) are intended to gauge countries’ levels of institutional development. Six indicators are used: (i) Voice and accountability; (ii) Political stability and absence of violence/terrorism; (iii) Government effectiveness; (iv) Regulatory quality; (v) The rule of law; and (vi) Control of corruption. In this study, the averages of these indicators calculated for the ranks of countries at the beginning of the decade (2014) are used: WGI (www.govindicators.org).

Macro-fiscal indicators

In addition to the above-listed development indicators, the following annual macro-fiscal indicators are used: CPI (Consumer Price Index), GDP deflator, national savings, investment, fiscal balance, national debt, unemployment rate, CA balance (current account balance), Xrate (exchange rate appreciation), and official reserves (currency and gold).

“Macroeconomic instability consists of large swings in economic activity, high inflation, unsustainable debt levels, and volatility in exchange rates and financial markets” (<https://www.reutgroup.org/Publications/macro-economic-stability>).

3.2 Macroeconomic instability and the role of INSTAB

Brian Ames *et al.* state that “there is no unique set of thresholds for each macroeconomic variable for stability and instability. Rather, there is a continuum of various combinations of levels of key macroeconomic variables (*e.g.*, growth, inflation, fiscal deficit, current account deficit, international reserves) that could indicate macroeconomic instability. While it may be relatively easy to identify a country in a state of macroeconomic unrest (*e.g.*, large current account deficits financed by short-term borrowing, high and rising levels of public debt, double-digit inflation rates, and stagnant or declining GDP) or stability (*e.g.*, current account and fiscal balances consistent with low and declining debt levels, inflation in the low single digits, and rising *per capita* GDP), there is a substantial ‘grey area’ in between where countries enjoy a degree of stability, but where macroeconomic performance could clearly be improved” (Ames *et al.*, 2001).

In a paper published in the CEPAL Review, its authors used the International Monetary Fund’s World Economic Outlook (IMF WEO) data covering the period between 1980 and 2015 to explore the relationships between sustained GDP growth and macroeconomic volatility. Among other things, they find out that “(i) inflation has a tangible negative impact on growth, (ii) higher inflation is associated with greater nominal and real volatility, (iii) current account volatility contributes significantly to real volatility, (iv) real volatility has a negative impact on trend GDP growth, and (v) macroeconomic volatility does not contribute to growth or well-being” (Le Fort Varela, Gallardo, and Bustamante, 2020).

Several authors maintain that macroeconomic volatility is not bad for socio-economic development as long as it remains relatively low. A UNCTAD document states the following: “Some macroeconomic instability may be desirable to the

extent that development processes involve quantitative and qualitative changes in all economic and social variables and advance at uneven paces. However, high macroeconomic instability is strongly detrimental to economic development and social welfare. Indeed, it inhibits or distorts long-term economic decisions related to productive investment, employment creation, and innovation. In addition, large swings in economic activity, volatility in exchange rates and financial markets, and boom-and-bust episodes entail large economic and social costs” (Global Macroeconomic Stability, 2016)

Delving into the theoretical underpinnings of the relationships between development and (in)stability remains beyond the scope of our current effort. Here, the approach is data-driven. The author utilises available information to mechanically investigate the linkages between development and (in)stability.

In addition to the standard instability measures quoted in the literature, the author uses another marker to gauge the growth volatility over time of all macro-fiscal indicator trends in this analysis, which is INSTAB.

INSTAB indicator

INSTAB is akin to the statistic’s standard deviation. It approximates the average deviation of each indicator’s annual observations, in percentage points, from the corresponding yearly value of a constant-growth-rate trend. This trend is derived from the indicators’ values at the beginning and the end of a period by applying the same growth rate every year. For example, Poland’s GDP level (in constant prices) in 2014 was PLN 1,723 billion. It was PLN 2,379 billion in 2023.⁷ The fixed annual growth rate, g , calculated for Poland’s GDP evolution for 2014–2023 was 3.65% (Table 1 and Figure 1). It was derived from the following formula:

$$g = ((L/F)^{1/(n-1)}) - 1 = 3.65\%$$

where:

$L = 2,379$: last value of the annual GDP timeseries (2023)

$F = 1,723$: first value of the series (2014)

$n = 10$: the number of years in the timeseries

⁷ Own calculations based on International Monetary Fund World Economic Outlook (IMF WEO), April 2024

The instability indicator, INSTAB, for Poland's GDP growth was 1.65%. The values of the GDP fixed-growth trend were the following (PLN billions):

2014: 1,723
 2015: 1,723*1.0365 = 1,786
 2016: 1,786*1.0365 = 1,851
 2017: 1,851*1.0365 = 1,919
 ...
 2023: 2,295*1.0365 = 2,380

The following formula produced the INSTAB indicator for the decade 2014–2023:

$$\text{INSTAB} = (\text{SUM}(\frac{((x_i - x_i^t)^2)}{x_i})^{0.5})/n = 1.65\%$$

where:

x_i = Actual value of the timeseries, $i = 2014, \dots, 2023$

x_i^t = Fixed-rate trend value, $i = 2014, \dots, 2023$ (for Poland, the rate was 3.65%)

$n = 10$: number of years in the timeseries

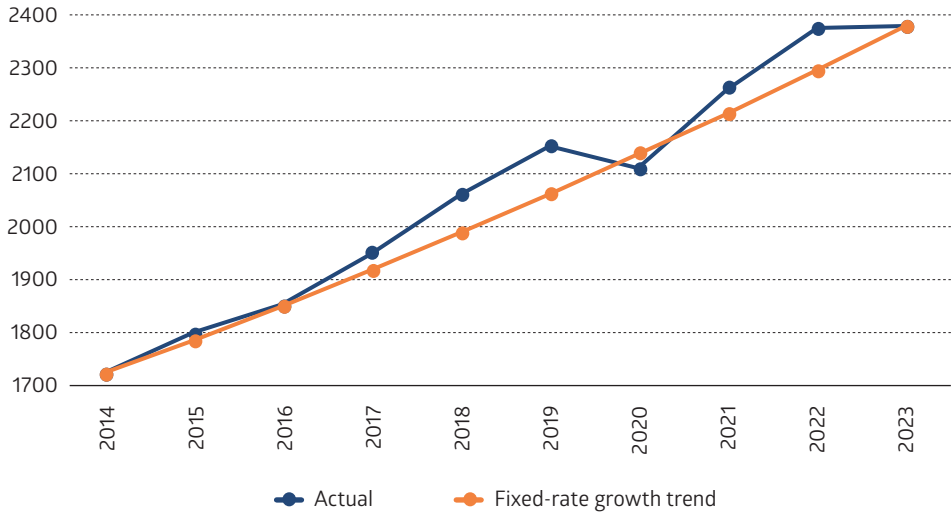
TABLE 1. Derivation of INSTAB for Poland's GDP timeseries, constant prices, 2014–2023

UNIT: PLN BILLION	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Actual timeseries, x_i , $i = 2014, \dots, 2023$	1,723	1,798	1,852	1,947	2,062	2,154	2,111	2,257	2,376	2,380
Fixed-rate growth trend, x_i^t , $g=3.65\%$	1,723	1,786	1,851	1,919	1,989	2,062	2,137	2,215	2,296	2,380
Deviation, $(x_i - x_i^t)/x_i$	0.00%	0.70%	0.02%	1.44%	3.57%	4.31%	1.24%	1.87%	3.37%	0.00%
Deviation, squared $((x_i - x_i^t)/x_i)^2$	0.00%	0.00%	0.00%	0.02%	0.13%	0.19%	0.02%	0.04%	0.11%	0.00%
Deviation, square root $((x_i - x_i^t)/x_i)^{0.5}$	0.00%	0.70%	0.02%	1.44%	3.57%	4.31%	1.24%	1.87%	3.37%	0.00%
INSTAB indicator	1.65%									

Source: International Monetary Fund World Economic Outlook (IMF WEO), April 2024.

For Poland, during the decade 2014–2023, the average deviation from a fixed-rate trend was 2.32%.

FIGURE 1. Poland, GDP growth: actual *versus* trend PLN billion, constant prices



Source: Author's calculations.

3.3 Comparative analysis of country groups: stability *versus* growth

INSTAB values were computed for all timeseries included in our analysis for all countries for which data were available from the IMF and several other sources.

Measures

Our comparative analysis used the following measures of indicators (annual time-series):

- ✦ **LEVEL:** annual value for a particular year.
- ✦ **AVERAGE:** % of GDP, reflecting the average value of an indicator over the decade, 2014–2023.
- ✦ **CHANGE:** %, change between the beginning and the end of the decade, 2014–2023.

- ✦ INSTAB: % deviation, instability indicator, 2014–2023; a higher level of INSTAB denotes a greater instability (see above for its definition).
- ✦ CORRELATION COEFFICIENT (r): its values range from -1 to 1; it is a statistical measure of the strength of a linear relationship between two variables; a coefficient of -1 describes a perfect negative relationship, with values in one series rising as those in the other decline and vice versa; a coefficient of 1 shows a perfect positive correlation; a coefficient of 0 means no linear relationship.

Table 2 provides the list of indicators, their names, and units.

TABLE 2. The variables used in the analysis

VARIABLE/ INDICATOR	SOURCES	NAME	UNIT	LEVEL	AVERAGE	CHANGE	INSTAB
DEVELOPMENT INDICATORS							
GDP PPP/capita	a	PPP	International dollars	2014			
GDP growth	a	GDP	%			2023 vs 2014	2014-2023
RGini	b	RGini	0-100	Most recent			
Quality of life index	c	QLI	0-100	2021			
Human development index	d	HDI	0-1	2022			
WGI, average rank rank	e	WGI	0-100	2014			
MACRO-FISCAL INDICATORS							
CPI index	a	CPI	2014 = 100, %			2023 vs 2014	2014-2023
GDP deflator index	a	Deflator	2014 = 100, %			2023 vs 2014	2014-2023
National savings	a	Savings	Ratio over GDP, %		2014-2023		2014-2023
Investment	a	Investment	Ratio over GDP, %		2014-2023		2014-2023
Fiscal balance	a	Fiscal balance	Ratio over GDP, %		2014-2023		2014-2023

VARIABLE/ INDICATOR	SOURCES	NAME	UNIT	LEVEL	AVERAGE	CHANGE	INSTAB
National debt	a	Debt	Ratio over GDP, %		2014- 2023		2014- 2023
Unemployment rate	a	Unem- ployment	Share of labor force, %		2014- 2023		2014- 2023
Curent account balance	a	CA balance	Ratio over GDP, %		2014- 2023		2014- 2023
Exchange rate appreciation	f	Xrate	Local currency vs USD, % */			2023 vs 2014	2014- 2023
Official reserves	f	Reserves	USD, %			2023 vs 2014	2014- 2023
INSTABILITY INDICATOR							
INSTAB	g	INSTAB	%				2014- 2023

*/ Currency appreciation

Sources:

- a) IMF WEO April 2024
- b) <https://worldpopulationreview.com/country-rankings/gini-coefficient-by-country/>
- c) <https://worldpopulationreview.com/country-rankings/standard-of-living-by-country>
- d) <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>
- e) www.govindicators.org
- f) IMF International Financial Statistics (IFS)
- g) Author's calculations

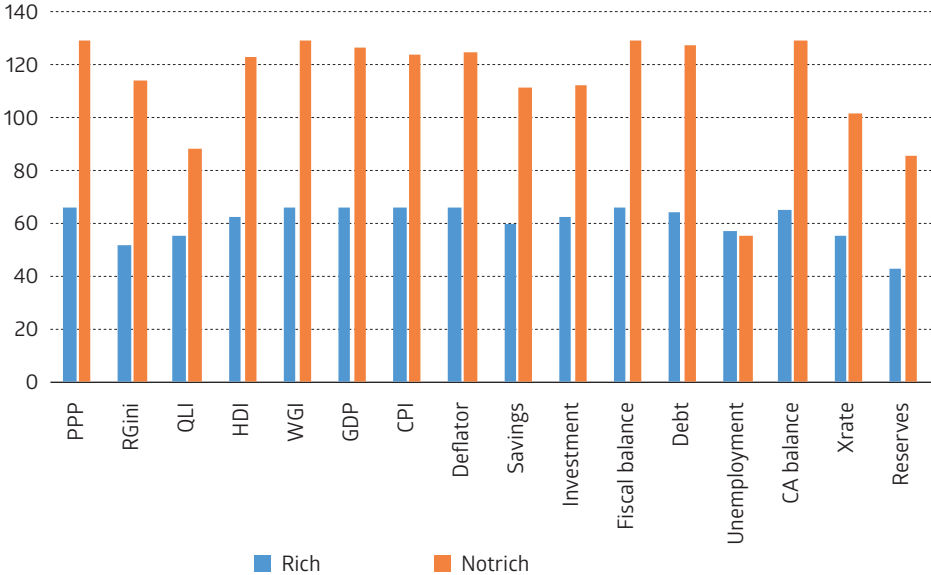
Countries

To quantify the overall relationships between development and macro-fiscal (in) stability, correlation and regression coefficients for three groups of countries were calculated: (i) ALL: all countries for which data is available from the IMF, World Bank, and several other sources (up to 196 countries); (ii) RICH: a subgroup of countries whose GDP-PPP *per capita* was above 20,000 international dollars at the beginning of the decade in this analysis – 2014 (up to 66 countries); and (iii) NOTRICH: a subgroup of countries whose GDP-PPP *per capita* was below 20,000 international dollars at the beginning of the decade (up to 130 countries). For each indicator, the number of countries was lower due to the lack of data for some countries. Furthermore, a few outliers with extreme values of their averages

were excluded from our calculations, *e.g.*, the changes in (increases in) the levels of several indicators, 2023 over 2014, *i.e.*, GDP of Guyana – by 343%; CPI and GDP deflator of Venezuela – by 2,882,831,617,036% and 19,549,530,758,361%; and official reserves: of Rwanda – by 63,214% and of Tajikistan – by 112,592%.

Figure 2 shows the number of observations of each indicator. The largest number of missing values in the RICH countries occurred in RGini and unemployment, which was partly due to the lack of data for several rich Arab countries. The number of observations in reserves was also low for the RICH countries because the Eurozone members were not included in the data set. These countries pursued atypical monetary policies. For instance, over the decade, France’s reserves declined by 98.8% and Germany’s reserves decreased by 99.7%. The lowest number of observations for the NOTRICH countries occurred in unemployment since the national statistics did not publish the unemployment rates in many of these countries. Therefore, the unemployment summary statistics were not reliable.

FIGURE 2. Number of observations in indicators



Source: Author’s calculations.

Examples of stability versus growth cases

It was interesting to notice that in several countries that enjoyed fast GDP growth rates, some macro-fiscal indicators misperformed, challenging the above-mentioned definitions of instability and its influence over GDP growth. For instance, eleven fast-growing African countries enjoyed rapid GDP growth (averaging 52%, twice as fast as the global average) while experiencing very high inflation (CPI increased by 181% over the decade, three times greater than the global average). In nine Asian countries, GDP growth was also solidly above the global average (average at 46% *versus* 26% globally). At the same time, inflation was more than twice the global average (average CPI increase at 146%). In both groups of countries, average GDP deflators were several times greater than global averages. The following are the examples of countries with a high growth rate accompanied by high instabilities.

The Republic of Türkiye (Figure 3) enjoyed rapid growth while coping with remarkably high inflation (515% *versus* 64% globally). The official foreign reserves fell by 93%, while the global average increased by 432%. Its INSTAB measures were a mixture of higher and lower values compared to global averages; however, due to the lack of evidence, it is difficult to decide whether this rapid GDP enlargement happened despite or because of the high inflation and low reserves.

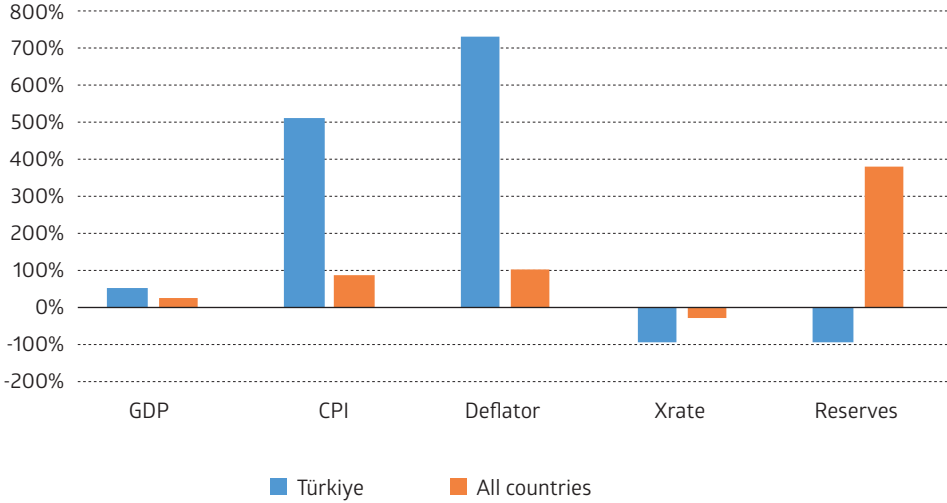
The Maldives' national economy (Figure 4) provided another example of a successful "cohabitation" of high growth and high and low instabilities. Over the last decade, the Maldives' economy grew twice as fast as the global average and was relatively equitable. RGini coefficient was 71 for the Maldives and 62 globally. Inflation indexes were several times lower than global averages. On the other hand, its fiscal and CA deficits were much higher than the averages for all countries. Its debt-to-GDP ratio was bigger than the overall average (and kept growing). Also, some of its INSTAB indicators were significantly greater than global averages. For instance, INSTAB's GDP growth was 10% *versus* 4% globally.

Egypt (Figure 5) was also a fast-growing country (growth at 49% *versus* 26% globally) despite poor performance of almost all macro-fiscal indicators, including high inflation, low savings, low investment, high fiscal deficit, high debt, and low reserves. On the other hand, most of its INSTAB indicators had relatively small values, showing lower volatilities than global averages.

The Gambia (Figure 6) likewise managed to achieve rapid growth, accompanied by high inflation, low savings and investment, and high fiscal and CA deficits. At the same time, similarly to Egypt, most of Gambia's INSTAB rates were lower than global averages.

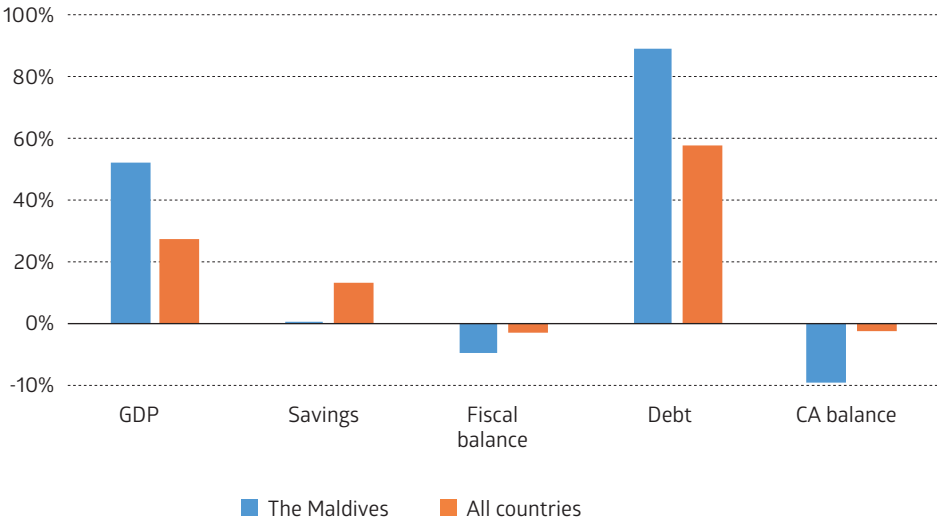
FIGURES 3–6. GDP change: 2023 *versus* 2014, and selected indicators, 2014–2023, annual averages

FIGURE 3. Türkiye



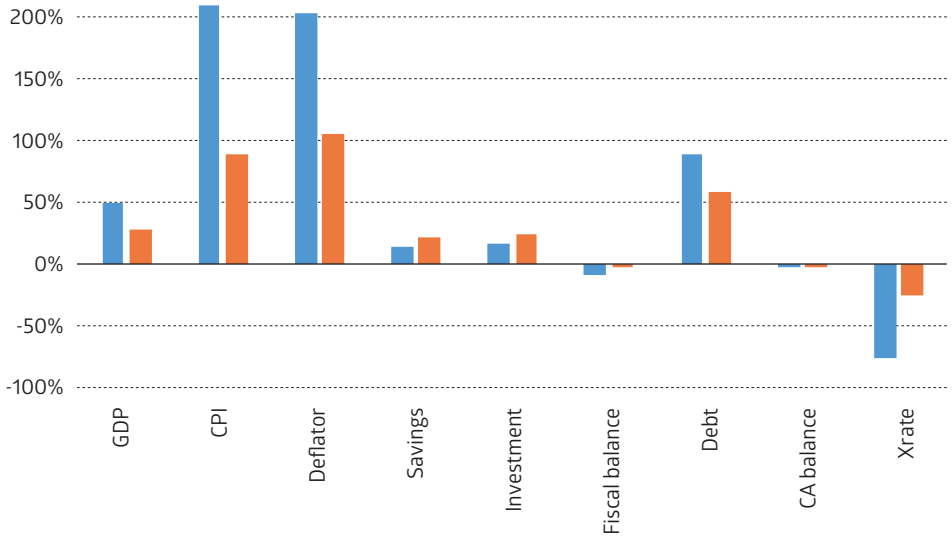
Source: Author's calculations.

FIGURE 4. The Maldives



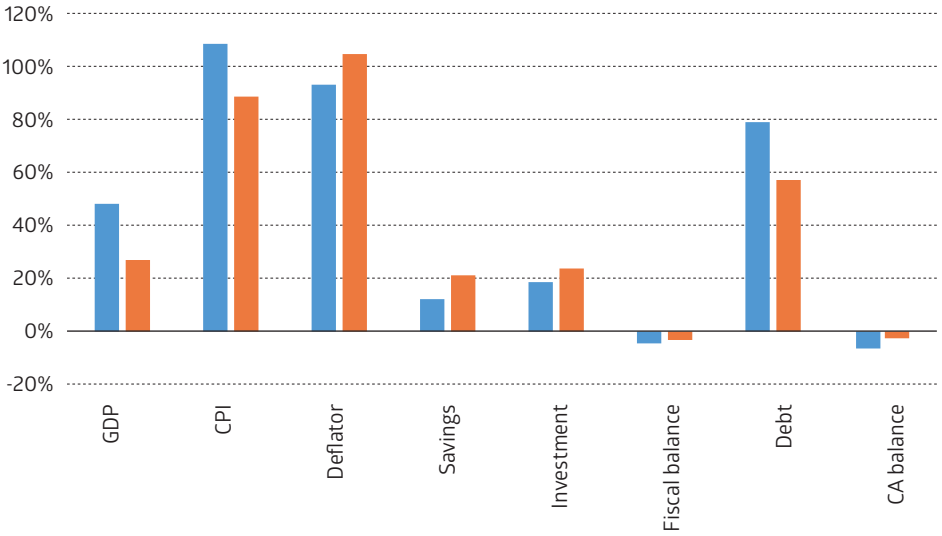
Source: Author's calculations.

FIGURE 5. Egypt



Source: Author's calculations.

FIGURE 6. The Gambia



Source: Author's calculations.

The presented above and many other cases of “challenges” to the instability-*versus*-growth assertions quoted above motivated this study, the results of which are presented herein.

Indicators' averages

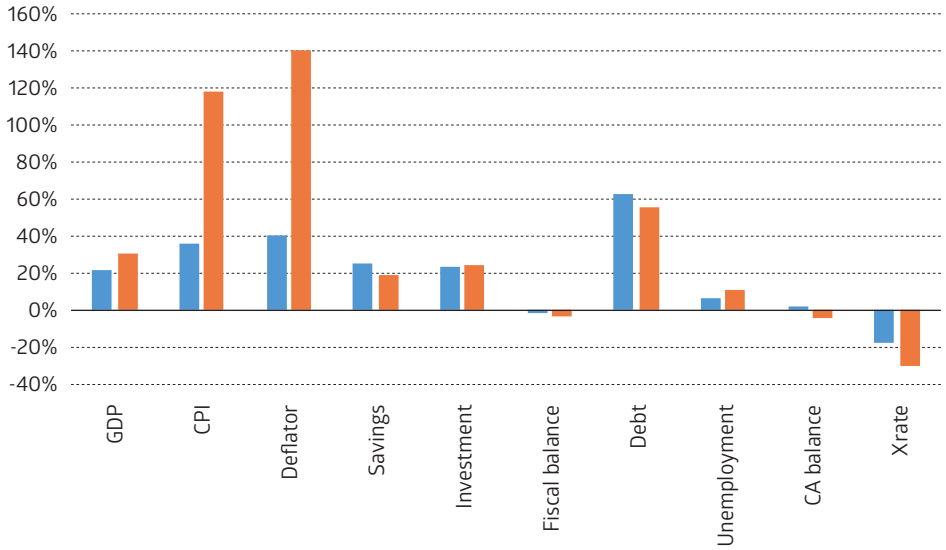
Figure 7 shows averages of macro-fiscal indicators. The NOTRICH countries' economies grew faster than those of the RICH countries. In the former, inflation (CPI and deflator) was several times higher than in the latter. Also, fiscal deficit and unemployment were greater in the NOTRICH countries. However, debt was larger in the RICH countries.

The INSTABs in savings and investment were significantly greater in the NOTRICH countries. Fiscal balances, debt, and CA balances experienced greater trend instabilities in the RICH countries.

Somewhat unexpectedly, over the decade, the average values of the INSTAB indicators of both the RICH countries and the NOTRICH countries were equal to 92% (Figure 8). In the former, the INSTABs were much greater than in the latter in fiscal balances. In the NOTRICH countries, the INSTABs were greater in CA balances. A partial explanation for these differences might be the policy instruments used to cope with the Covid pandemic – domestic fiscal budgets in the RICH countries and foreign assistance in the NOTRICH countries.

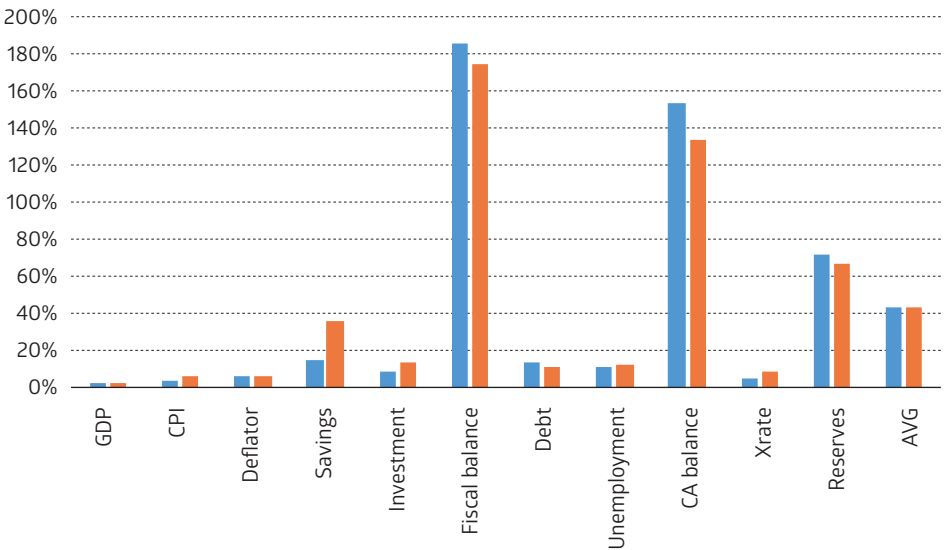
FIGURES 7-8. Averages of macro-fiscal indicators and INSTAB indicators

FIGURE 7. Macro-fiscal indicators, averages



Source: Author's calculations.

FIGURE 8. INSTAB indicators, averages

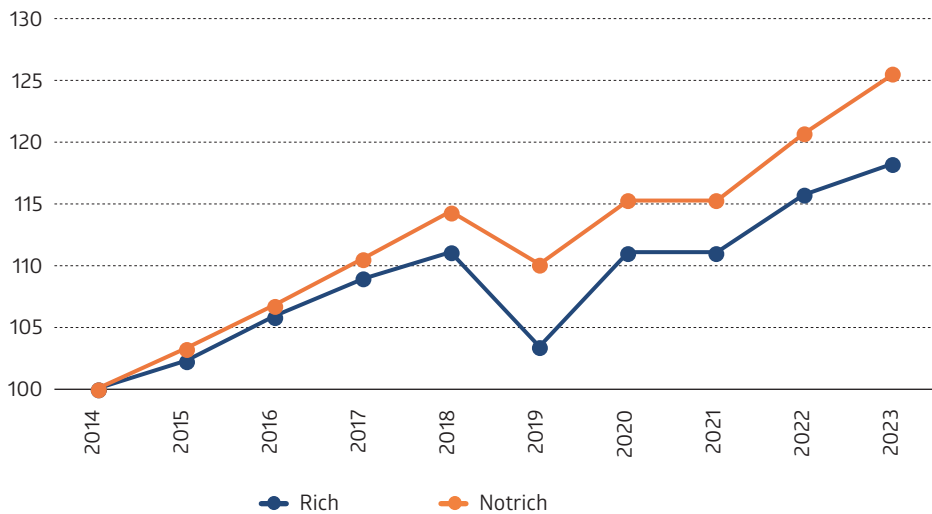


Source: Author's calculations.

Over the decade, the GDP of RICH countries grew by 18%, while it grew by 26% in the NOTRICH countries (Figure 9). At the same time, CPI increased by 118% in the latter countries and 36% in the RICH countries (Figure 10). Figures 11 and 12 show the evolution of CPI, deflator, and GDP growth over time. Among the RICH countries, between 2014 and 2023, only in Türkiye did CPI increase significantly – more than five times – while the Turkish economy rapidly grew (see above). Savings, investment, low fiscal and CA deficits, and currency appreciation supported the rapid growth.

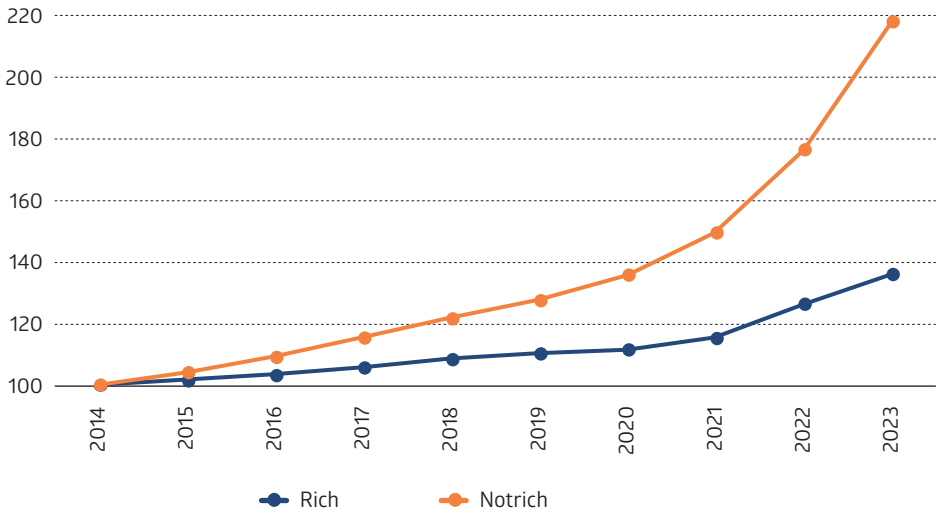
FIGURE 9–12. GDP, CPI, deflator in selected groups of countries in 2014–2023

FIGURE 9. GDP growth, averages, 2014=100



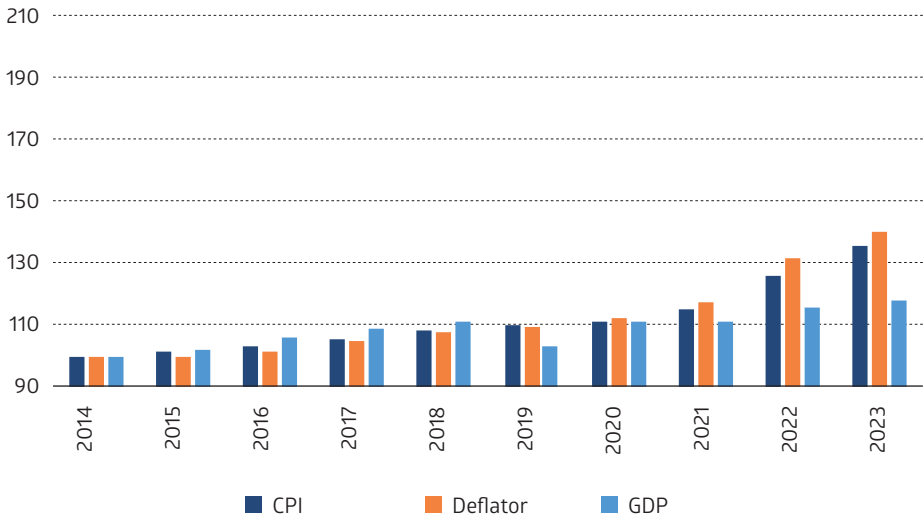
Source: Author's calculations.

FIGURE 10. CPI, averages, 2014=100

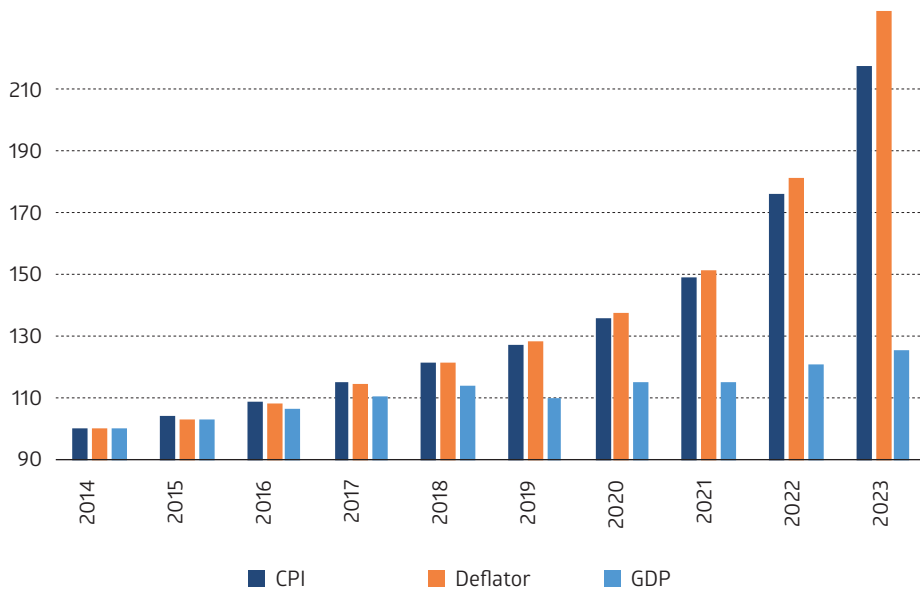


Source: Author's calculations.

FIGURE 11. RICH countries: CPI, Deflator, and GDP 2014=100



Source: Author's calculations.

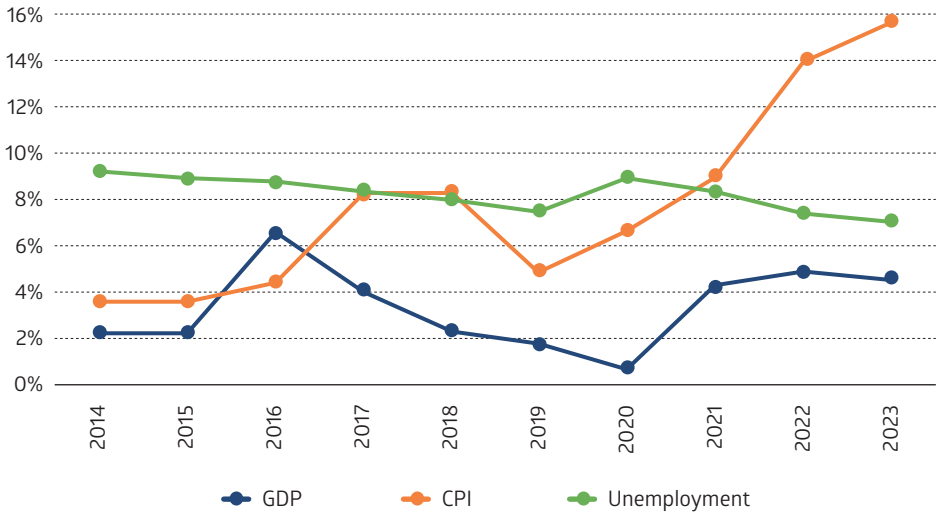
FIGURE 12. NOTRICH countries: CPI, Deflator, and GDP, 2014=100

Source: Author's calculations.

It should be reemphasised that these indicators are only quantitative proxies lacking “qualitative” background information about the management by macro-fiscal policies. As noted above, volatility might be beneficial if its meanders are prompted by deliberate decisions consistent with policy objectives. For instance, many countries granted cash handouts to residents and incurred other fiscal expenditures to mitigate the harmful effects of the Covid pandemic. This way, the shrinkages of GDP were less severe. An outcome of these policies was elevated inflation in the aftermath of the 2020 recession. Average CPI was 4.8% in 2019, 6.5% in 2020, 8.9% in 2021, 14.0% in 2022, and 15.7% in 2023. Unemployment grew from 7.4% in 2019 to 8.9% in 2020 and gradually shrank in the subsequent years (Figure 13). Fiscal and CA deficits rose in 2020 and also diminished after that. Debt jumped from 56.1% in 2019 to 67.7% in 2020 to subside in the subsequent years (Figure 14).

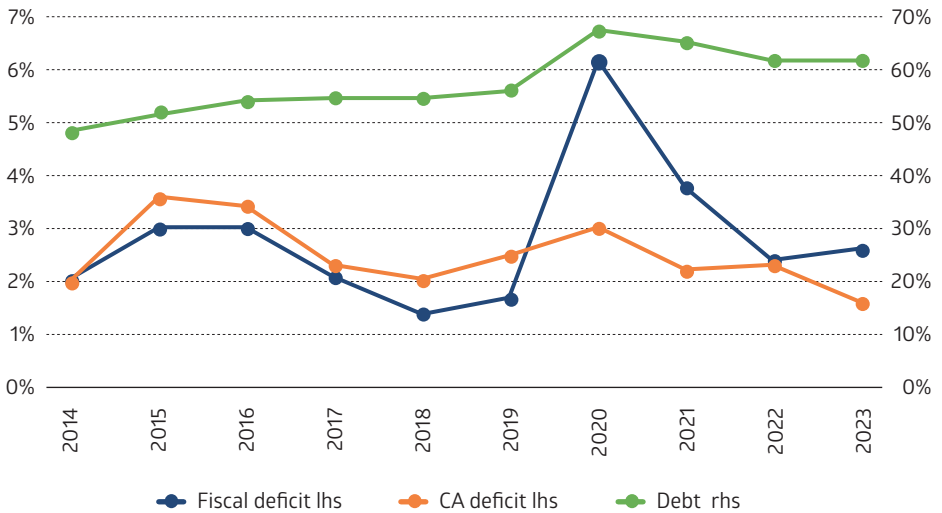
FIGURES 13–14. Selected indicators in 2014–2023

FIGURE 13. Selected indicators. Average values



Source: Author's calculations.

FIGURE 14. Selected indicators. Average values



Source: Author's calculations.

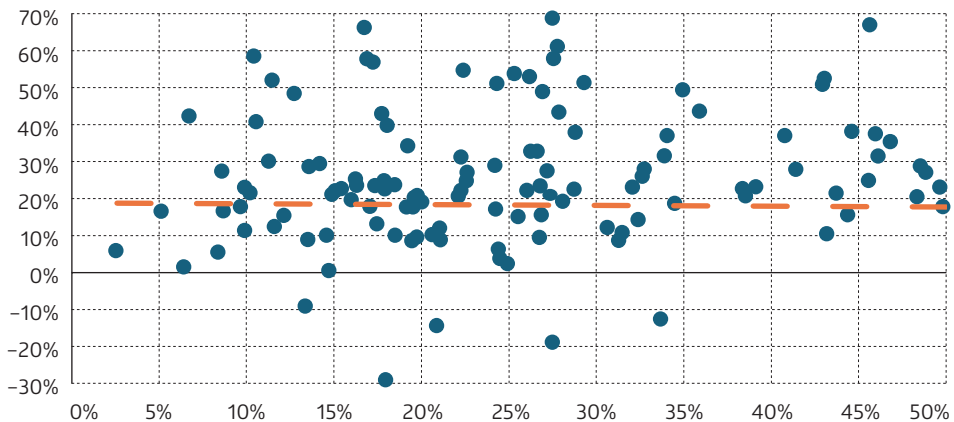
Relationships between GDP growth and macro-fiscal indicators

Figures 15–24 display scatter diagrams of the relationships between GDP growth and ten macro-fiscal indicators. The flat trend lines indicate lack of significant relationships. Upward-sloping lines indicate positive relationships, and downward-sloping lines indicate negative relationships.

All trend lines covering the GDP-growth *versus* instability indicators were relatively flat, showing the lack of significant relationships (correlation coefficients below 0.15).

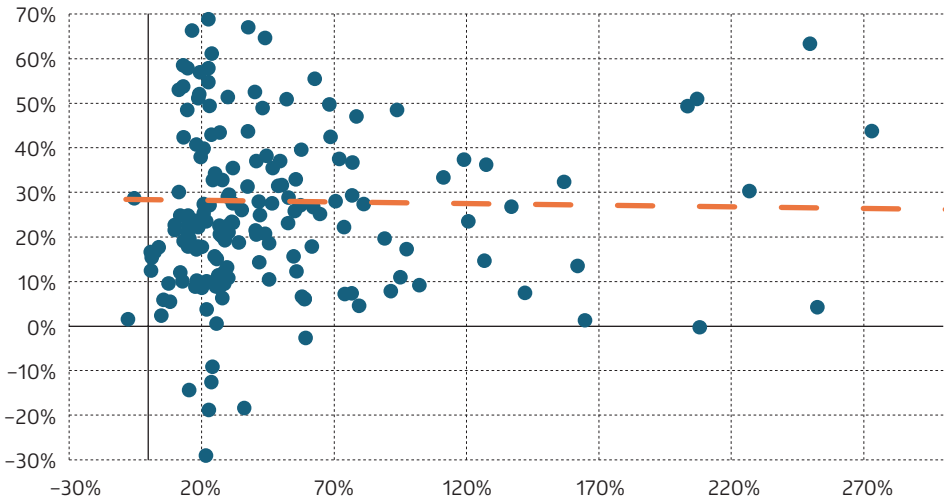
FIGURES 15–24. All countries, relationships (scatter diagrams) between macro-fiscal indicators (horizontal axis) and GDP growth (vertical axis), 2014–2023

FIGURE 15. CPI, % of GDP AVERAGE, 2014-2023



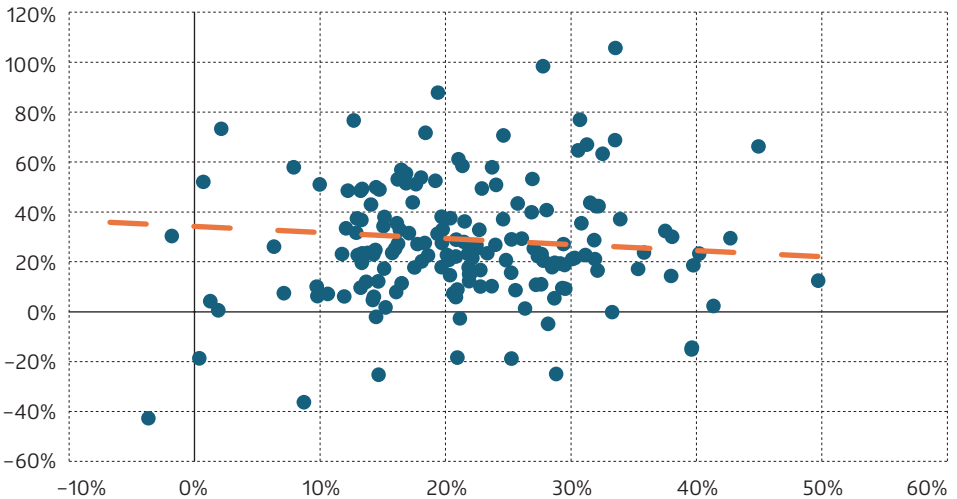
Source: Author's calculations.

FIGURE 16. GDP deflator, % of GDP AVERAGE, 2014-2023



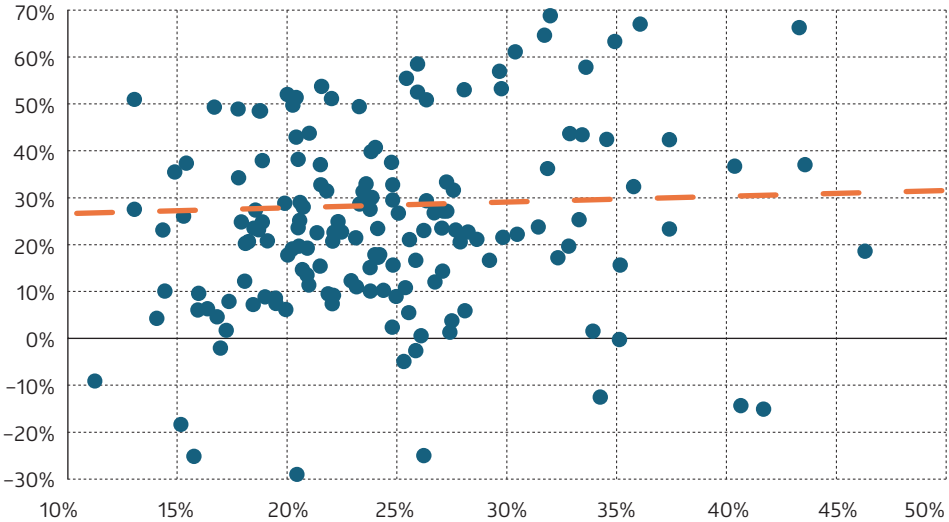
Source: Author's calculations.

FIGURE 17. National savings, % of GDP AVERAGE, 2014-2023



Source: Author's calculations.

FIGURE 18. Investment, % of GDP AVERAGE, 2014-2023



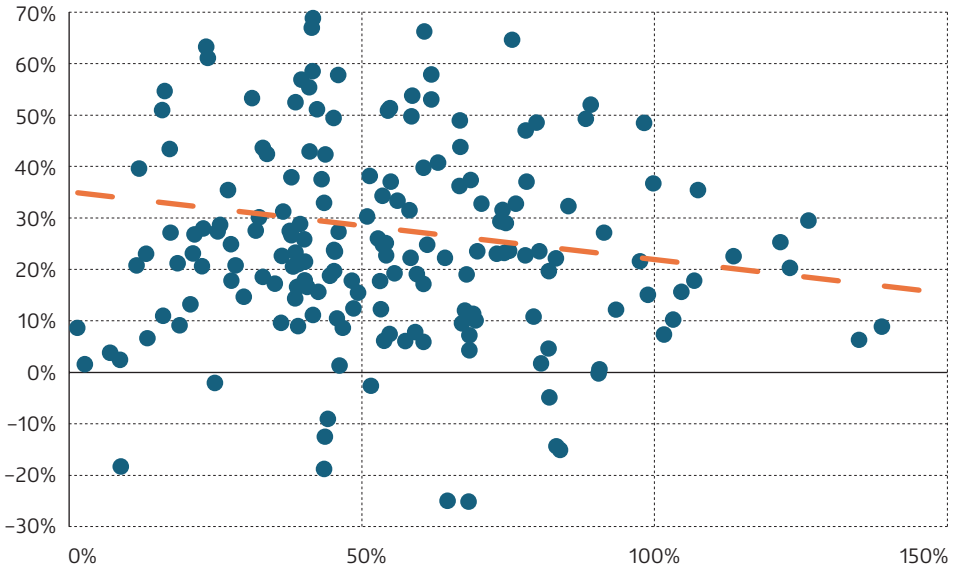
Source: Author's calculations.

FIGURE 19. Fiscal balance, % of GDP AVERAGE, 2014-2023



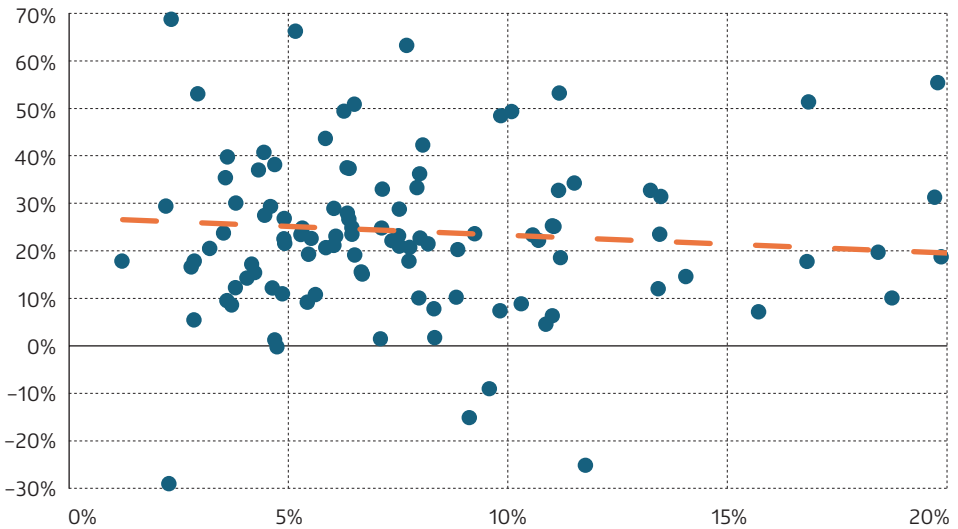
Source: Author's calculations.

FIGURE 20. Public debt, % of GDP AVERAGE, 2014-2023



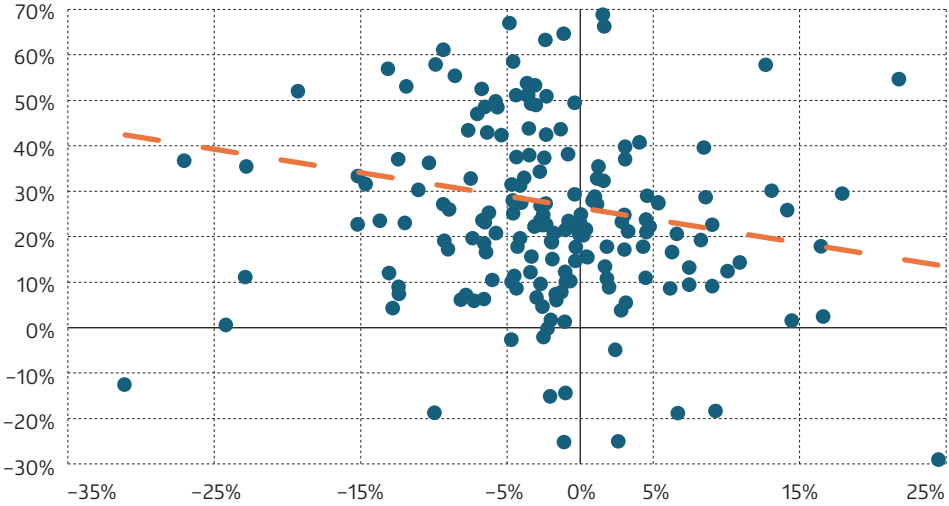
Source: Author's calculations.

FIGURE 21. Unemployment, % of labor force AVERAGE, 2014-2023



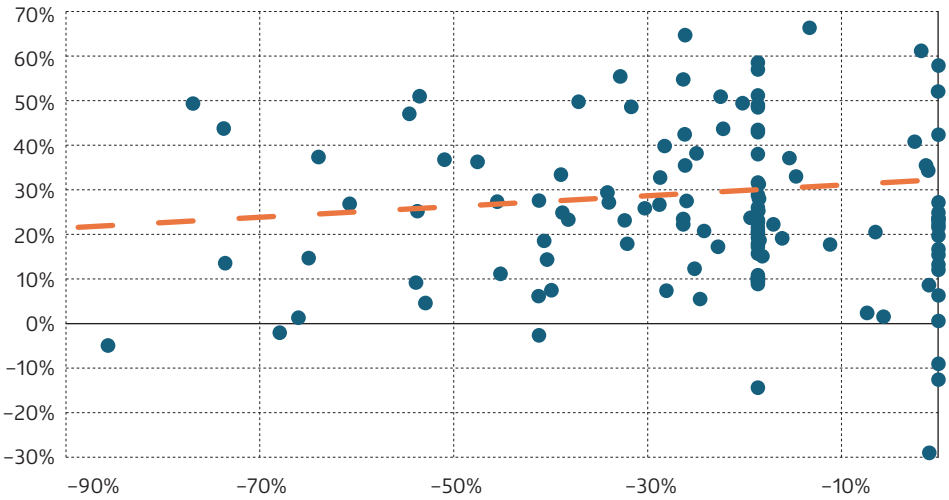
Source: Author's calculations.

FIGURE 22. CA balance, % of GDP AVERAGE, 2014-2023

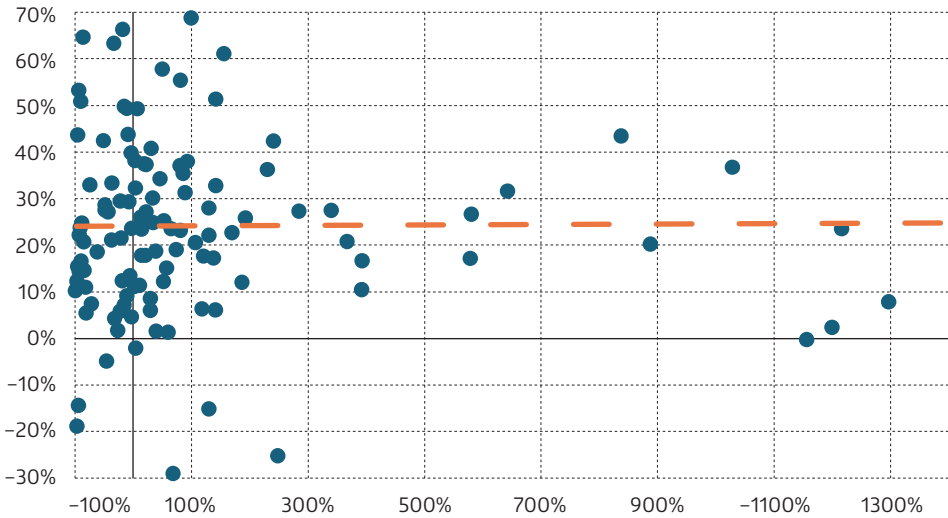


Source: Author's calculations.

FIGURE 23. Xrate, % CHANGE, 2023 vs 2014



Source: Author's calculations.

FIGURE 24. Reserves, % CHANGE, 2023 vs 2014

Source: Author's calculations.

The trend lines inserted into the above scatter diagrams fail to differentiate the directions of these relationships for different subgroups of countries. One way to determine more detailed relationships is to search for the inflection points at which the line changes direction, switching from positive to negative or negative to positive. In such a way, the lines may be broken down into two or more pieces. Thus, the lines were arbitrarily split into two parts (although other ways to find the inflection points are possible). Figures 25–30 display a few examples of the splitting results.

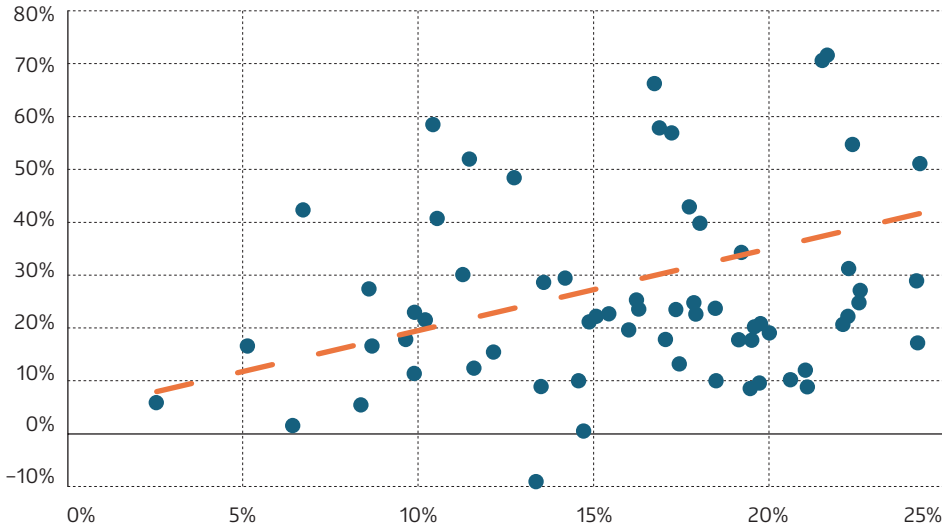
For most countries, inflation negatively interacted with growth. However, inflation positively correlated with growth in the countries where CPI increased by no more than 25% during the decade – although, this is just a far-reaching simplification of what was going on. The picture was, in fact, much more complicated (see below).

The borderline for debt was 50%. In the countries with an average debt-to-GDP below 50%, debt and GDP were positively correlated. One can assert that more consequential is not how much debt a country takes but rather how the debt is spent. There are examples of the misuse of debt (Greece, Sri Lanka, and many others) by allocating borrowed funds to consumption or botched investments. When the funds are well invested, elevated national debt may foster growth.

Only in a minority of countries might a reduction in the current account deficit (increase of CA balance) stimulate growth. For most of them, the greater it was (the lower the CA balance), the faster the GDP increased. In these countries, foreigners might actively contribute to consumption, investments, and/or export growth. Of course, this relationship did not account for the potential longer-term outcomes of foreigners' involvement.

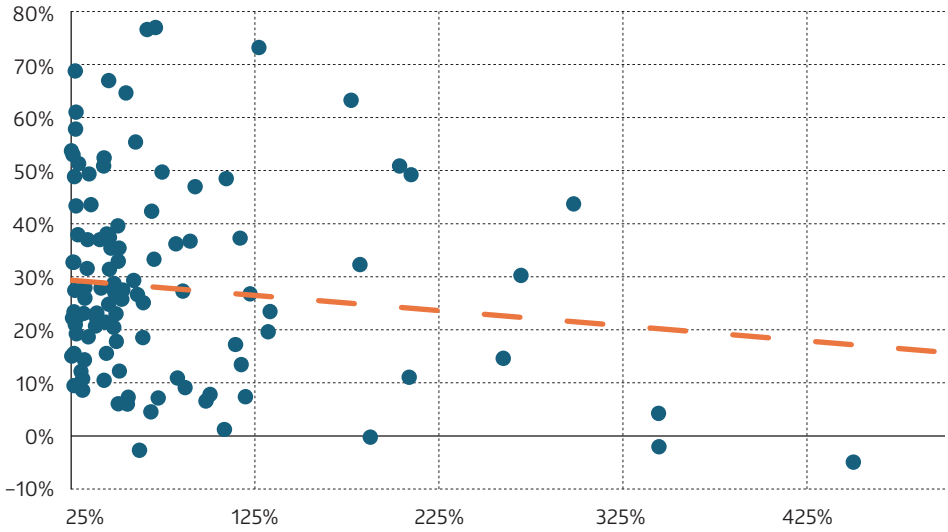
FIGURES 25-30. All countries, relationships (scatter diagrams) between macro-fiscal indicators (horizontal axis) and GDP growth (vertical axis), with splits

FIGURE 25. CPI<25%



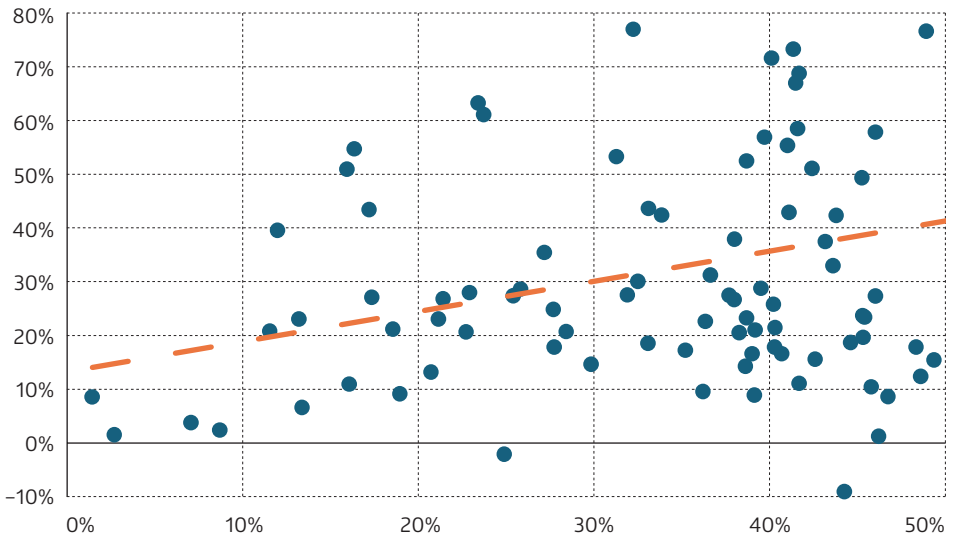
Source: Author's calculations.

FIGURE 26. CPI>25%



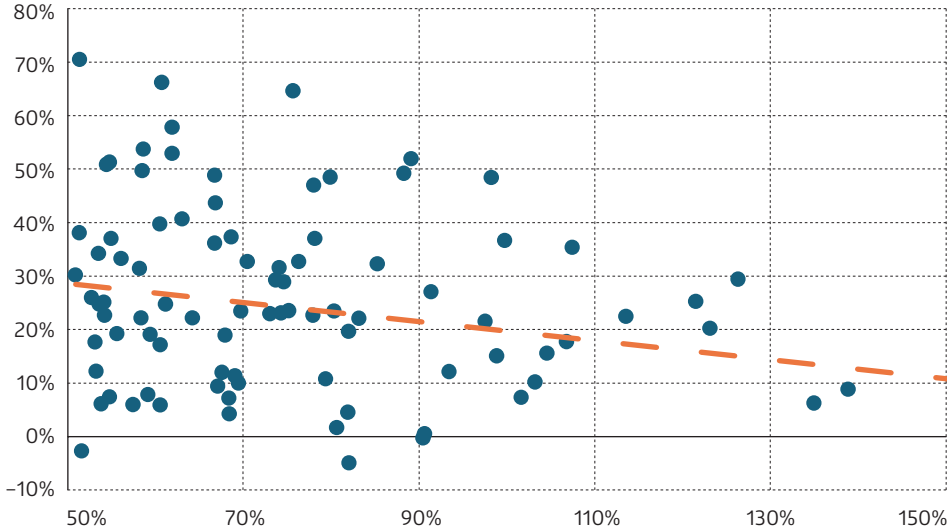
Source: Author's calculations.

FIGURE 27. Debt<50%



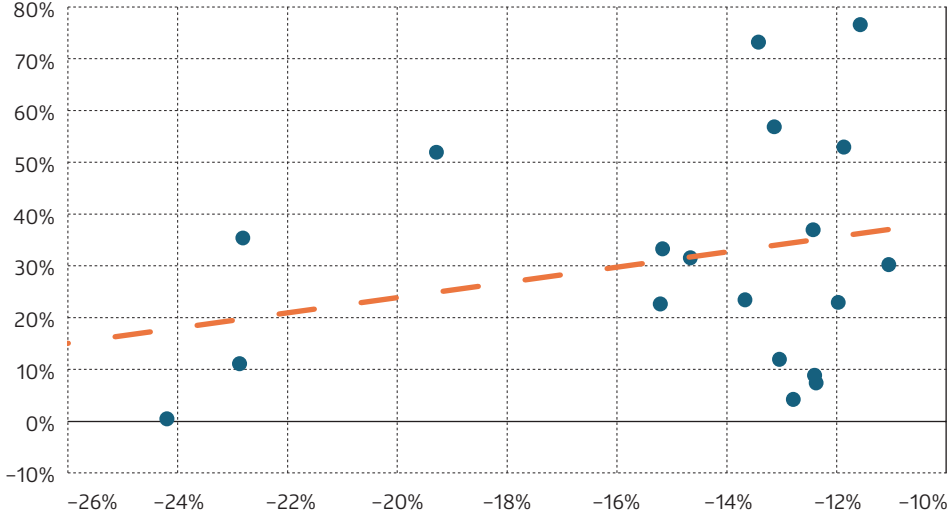
Source: Author's calculations.

FIGURE 28. Debt>50%

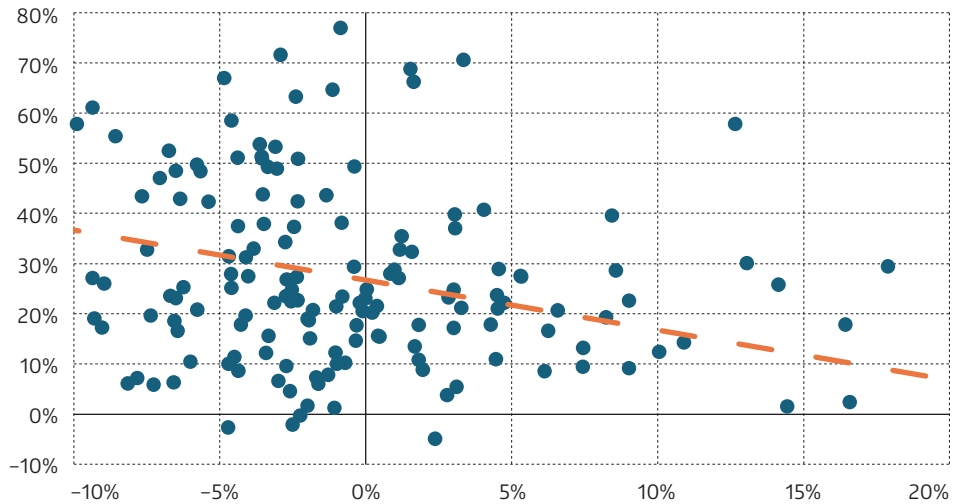


Source: Author's calculations.

FIGURE 29. Current account balance<-10%



Source: Author's calculations.

FIGURE 30. Current account balance > -10%

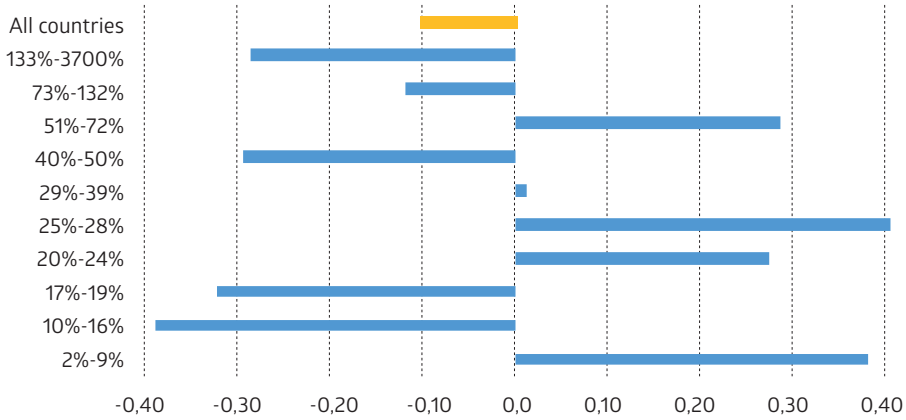
Source: Author's calculations.

3.4 Correlations and implications for policy

Correlations among indicators

We begin this section of our report by examining the relationship between CPI and GDP growth in more detail. The correlation coefficient for all countries was -0.10 . It was $+0.18$ for 69 countries where CPI increase over the decade was less than 25%. It was -0.18 for 118 countries, where this increase was greater. However, when the data set was broken down into ten (up to) twenty-country subgroups, the correlations kept jumping up and down (Figure 31). For some subgroups, they were significantly positive. For some others, they were significantly negative. This seems to corroborate the complexity of this relationship. Inflation is only one of the triggers affecting GDP growth.

FIGURE 31. Correlations between CPI and GDP growth 20-country groups, smallest to highest levels



Source: Author's calculations.

The following tables display correlation coefficients between indicators. Table 3 presents the coefficients used to measure the relations among the five development indicators. Most correlations were positive and statistically significant ($r > 0.14$). In less developed economies, GDP tended to grow faster (partly due to a lower base as of 2014). Hence, it is unsurprising that the correlation coefficients between GDP growth and other development indicators were not significant in most cases. RGini, life quality (QLI), human development (HDI), and governance (WGI) were strongly positively correlated among themselves (except for RGini in the NOTRICH countries).

TABLE 3. Correlation coefficients between development indicators

	HDP CHANGE	RGini LEVEL	QLI LEVEL	HDI LEVEL	WGI LEVEL
CORRELATIONS WITH GDP CHANGE, 2023 VS 2014					
RICH		0,09	-0,10	0,21	0,15
NOTRICH		0,06	-0,02	-0,01	0,00
CORRELATIONS WITH RGINI LEVEL, MOST RECENT					
RICH	0,09		0,19	0,23	0,26
NOTRICH	0,06		0,10	0,06	-0,14
CORRELATIONS WITH QLI LEVEL, 2021					
RICH	-0,10	0,19		0,76	0,66
NOTRICH	-0,02	0,10		0,50	0,23
CORRELATIONS WITH HDI LEVEL, 2022					
RICH	0,21	0,23	0,76		0,84
NOTRICH	-0,01	0,06	0,50		0,59
CORRELATIONS WITH WGI, 2014					
RICH	0,15	0,26	0,66	0,84	
NOTRICH	0,00	-0,14	0,23	0,59	

Legend

r = Correlation coefficient

- Strongly positively correlated, $r > +0.14$
- Weakly positively correlated, $0 < r < +0.15$
- Weakly negatively correlated, $-0.15 < r < 0$
- Strongly negatively correlated $r < -0.14$

Source: Author's calculations.

The set of correlation coefficients between the five development indicators and eleven macro-fiscal indicators is a mixed bag (Table 4). As expected, the correlations between GDP growth and national savings and investment were positive. Greater savings supported investment, which in turn fostered development.

Most correlations between inflation indicators (CPI and deflator) and development indicators were negative, which is what could be expected. “Macroeconomic instability occurs when the price level fluctuates, unemployment increases, and the economy produces less output. Macroeconomic instability comes with a deviation in the economy from its equilibrium level, often causing distortions in the market. These distortions in the market then harm individuals, businesses, multinational companies, etc. Macroeconomic instability is concerned with deviations

in macroeconomic variables such as the aggregate price level, aggregate output, and the level of unemployment” (<https://app.vaia.com/studyset/9655030/summary/61676028>).

According to the ESCWA, “(...) [macro]economic stability is a term used to describe the financial system of a nation that displays only minor fluctuations in output growth and exhibits a consistently low inflation rate” (United Nations Economic and Social Commission for Western Asia, www.escwa.org).

Hence, stable GDP growth and price inflation indexes become the primary stability markers. GDP growth is believed to be fostered by low inflation.

Interestingly, as noted above, a strong confirmation of this relationship could not be found. While CPI and deflator were negatively correlated with GDP growth in the NOTRICH countries, the correlations were significantly positive in the RICH countries. In our search for the inflection points (see above), one-third of countries where CPI increased over the decade by less than 25% showed a significant positive correlation. Also, correlations were positive in several smaller groups of countries (Figure 31). Perhaps in some countries central banks tended to be overly rigorous in mitigating price increases. Damage to growth could have been instigated only by excessive inflation, while moderate inflation might have stimulated growth. Inflation might help to overcome price stickiness by supporting flexibility, allowing prices to adjust quickly to structural changes.

While Table 4 displays the correlations between macro-fiscal and development indicators' average values, Table 5 presents correlation coefficients between the latter and instability indicators (INSTABs). Hence, Table 4 accounts for the levels of indicators, and Table 5 accounts for the instabilities of indicator trends over time. In most cases, the instabilities correlated negatively with the development indicators, or the coefficients were insignificant. Surprisingly, an unstable CPI positively correlated with GDP growth in the RICH countries. An active macro-fiscal policy may explain this relationship. This indicator might appear to be a helpful policy instrument and, as such, may have been undergoing volatility over time.

TABLE 4. Correlation coefficients, development indicators *versus* macro-fiscal indicators

	GDP	CPI	DEFLATOR	SAVINGS	INVESTMENT	FISCAL BALANCE	DEBT	UNEMPLOYMENT	CA BALANCE	XRATE	RESERVES
CORRELATIONS WITH GDP CHANGE, 2023 VS 2014											
RICH		0,17	0,21	0,06	0,33	-0,09	-0,01	-0,05	-0,27	-0,12	0,14
NOT-RICH		-0,18	-0,13	-0,06	-0,02	0,02	-0,19	-0,17	-0,04	0,23	0,00
CORRELATIONS WITH RGINI LEVEL, MOST RECENT											
RICH	0,09	-0,12	-0,14	-0,13	-0,11	0,16	0,13	-0,02	-0,07	-0,13	0,17
NOT-RICH	0,06	0,02	-0,01	0,02	0,18	0,09	-0,07	-0,05	-0,10	0,13	-0,02
CORRELATIONS WITH QLI LEVEL, 2021											
RICH	-0,10	-0,13	-0,09	0,37	0,00	0,18	0,17	0,02	0,50	-0,06	-0,72
NOT-RICH	-0,02	0,03	0,12	0,43	0,29	0,11	-0,04	-0,25	0,22	0,06	0,00
CORRELATIONS WITH HDI LEVEL, 2022											
RICH	0,21	-0,17	-0,13	0,42	0,00	0,25	0,19	-0,21	0,41	0,13	-0,35
NOT-RICH	-0,01	0,03	0,15	0,17	0,14	0,07	0,12	-0,15	-0,01	0,22	0,05
CORRELATIONS WITH WGI, 2014											
RICH	0,15	-0,27	-0,24	0,19	-0,03	0,18	0,15	-0,22	0,25	0,25	-0,25
NOT-RICH	0,00	-0,14	-0,08	0,02	0,17	0,09	0,07	0,00	-0,16	0,40	0,08

Source: Author's calculations.

TABLE 5. Correlation coefficients, development indicators *versus* instability indicators (INSTABs)

	GDP INSTAB	CPI INSTAB	DEFLATOR INSTAB	SAVINGS INSTAB	INVESTMENT INSTAB	FISCAL BALANCE INSTAB	DEBT INSTAB	UNEMPLOYMENT INSTAB	CA BALANCE INSTAB	XRATE INSTAB	RESERVES INSTAB
Correlations with GDP CHANGE, 2023 vs 2014											
RICH	-0,21	0,26	-0,01	-0,16	-0,33	0,06	-0,16	0,05	-0,09	0,19	0,16
NOT-RICH	0,39	-0,14	-0,15	-0,04	-0,03	-0,14	-0,09	-0,25	0,07	-0,21	0,00
Correlations with Rgini LEVEL, most recent											
RICH	-0,05	0,05	-0,16	0,07	0,01	0,34	-0,48	0,02	-0,14	0,18	0,17
NOT-RICH	-0,02	0,11	0,08	0,09	-0,07	-0,07	-0,05	-0,25	0,02	-0,05	-0,02
Correlations with QLI LEVEL, 2021											
RICH	-0,62	-0,02	-0,21	-0,49	-0,44	-0,01	-0,14	0,08	-0,09	-0,22	-0,67
NOT-RICH	-0,28	0,03	0,06	-0,35	-0,31	-0,18	-0,18	-0,24	0,09	-0,16	0,06
Correlations with HDI LEVEL, 2022											
RICH	-0,60	-0,03	-0,31	-0,64	-0,61	0,21	-0,02	-0,12	-0,12	-0,21	-0,34
NOT-RICH	0,07	0,05	0,09	-0,21	-0,17	-0,11	0,01	-0,22	0,11	-0,22	-0,01
Correlations with WGI, 2014											
RICH	-0,21	-0,13	-0,47	-0,52	-0,54	0,12	-0,11	0,01	0,04	-0,31	-0,26
NOT-RICH	-0,04	-0,07	-0,11	-0,26	-0,15	-0,05	-0,23	-0,11	-0,08	-0,36	-0,05

Source: Author's calculations.

As shown in Table 6, no macro-fiscal indicators significantly correlated with GDP growth. This finding seems to challenge the assertions frequently found in the literature. No strong interdependencies between GDP growth and the indicators covering inflation, debt, unemployment, and CA balance occurred. No negative correlation between CPI and investment was corroborated, either. According to the literature, elevated inflation increases risks and discourages investment.

If to follow the prescriptions found in the literature, this should not be going on as “(...) macroeconomic stability focuses on how well an economy manages its inflationary pressure. Specifically, inflation is considered one of the widely used indicators on how well a country can manage its economy. In general, high inflation rates impede efficient resource allocation process and reduce investment rates. Even though some nations wish to have an encouraging inflation rate, there are no opinions for a higher inflation rate. Thus, higher inflation may be inferred as a sign that the concerned government has lost control in managing the economy” (Fischer, 1993; quoted by Siddik, 2023).

TABLE 6. Correlation coefficients between macro-fiscal indicators

	GDP	CPI	DEFLATOR	SAVINGS	INVESTMENT	FISCAL BALANCE	DEBT	UNEMPLOYMENT	CA BALANCE	XRATE	RESERVES
GDP		-0,10	-0,09	-0,07	0,03	-0,02	-0,13	-0,11	-0,13	0,13	0,05
CPI	-0,10		0,99	-0,19	0,09	-0,11	0,27	0,08	-0,22	-0,20	-0,03
Deflator	-0,09	0,99		-0,15	-0,03	-0,10	0,21	0,03	-0,13	-0,33	-0,04
Savings	-0,07	-0,19	-0,15		0,68	0,35	-0,21	-0,46	0,60	0,04	-0,12
Investment	0,03	0,09	-0,03	0,68		0,00	-0,03	-0,16	-0,21	-0,01	-0,02
Fiscal balance	-0,02	-0,11	-0,10	0,35	0,00		-0,22	-0,26	0,31	0,10	0,19
Debt	-0,13	0,27	0,21	-0,21	-0,03	-0,22		0,17	-0,24	-0,04	0,04
Unemployment	-0,11	0,08	0,03	-0,46	-0,16	-0,26	0,17		-0,42	-0,20	0,03
CA balance	-0,13	-0,22	-0,13	0,60	-0,21	0,31	-0,24	-0,42		0,07	-0,15
Xrate	0,13	-0,20	-0,33	0,04	-0,01	0,10	-0,04	-0,20	0,07		-0,02
Reserves	0,05	-0,03	-0,04	-0,12	-0,02	0,19	0,04	0,03	-0,15	-0,02	

Source: Author's calculations.

Many INSTAB indicators were mutually positively interrelated (Table 7). With one exception (reserves and unemployment), no INSTABs are significantly negatively correlated. For all other relationships, the correlations are positive or insignificant. For instance, it could be interpreted that unstable inflation and/or fiscality spills over to GDP, investment, debt, unemployment, and current account.

TABLE 7. Correlation coefficients among INSTAB indicators

	GDP INSTAB	CPI INSTAB	DEFLATOR INSTAB	SAVINGS INSTAB	INVESTMENT INSTAB	FISCAL BALANCE INSTAB	DEBT INSTAB	UNEMPLOYMENT INSTAB	CA BALANCE INSTAB	XRATE INSTAB	RESERVES INSTAB
GDP INSTAB		0,08	0,08	0,41	0,15	-0,01	0,09	0,21	-0,04	0,03	0,02
CPI INSTAB	0,08		0,95	0,03	0,00	-0,06	0,00	0,11	-0,08	0,01	0,00
Deflator INSTAB	0,08	0,95		0,05	0,06	-0,07	0,09	0,08	-0,01	0,08	-0,01
Savings INSTAB	0,41	0,03	0,05		0,30	-0,01	0,06	0,19	-0,05	0,05	-0,04
Investment INSTAB	0,15	0,00	0,06	0,30		0,08	0,09	0,15	0,04	0,06	-0,03
Fiscal balance INSTAB	-0,01	-0,06	-0,07	-0,01	0,08		-0,01	0,00	-0,01	0,31	0,18
Debt INSTAB	0,09	0,00	0,09	0,06	0,09	-0,01		0,10	-0,03	0,04	-0,02
Unemployment INSTAB	0,21	0,11	0,08	0,19	0,15	0,00	0,10		-0,02	0,04	-0,18
CA balance INSTAB	-0,04	-0,08	-0,01	-0,05	0,04	-0,01	-0,03	-0,02		-0,02	0,11
Xrate INSTAB	0,03	0,01	0,08	0,05	0,06	0,31	0,04	0,04	-0,02		0,18
Reserves INSTAB	0,02	0,00	-0,01	-0,04	-0,03	0,18	-0,02	-0,18	0,11	0,18	

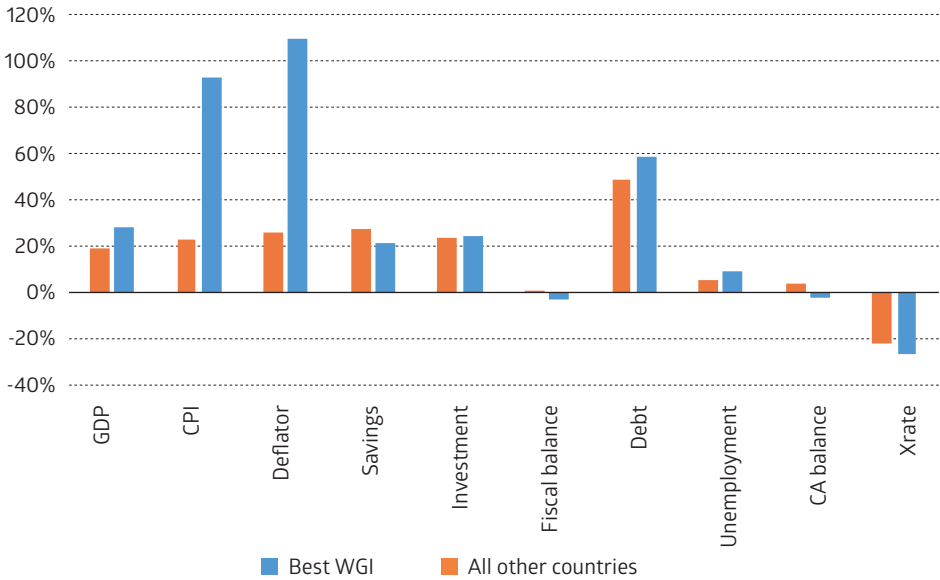
Source: Author's calculations.

Finally, it is interesting to look at the relationships between institutions and growth. To do this, macro-fiscal indicators for the ten best performers in governance (New Zealand, Finland, Switzerland, Norway, Luxembourg, Sweden, Canada, The Netherlands, Denmark, and Australia) against all remaining countries (Figures 32 and 33) were compared. The top governance countries performed better regarding the levels of almost all macro-fiscal indicators (lower inflation, debt, unemployment, fiscal and CA deficits, and higher savings), except GDP growth (19.1% *versus* 27.7%) and investment (23.5% *versus* 24.0%). Fiscal balance was the only INSTAB greater in the top governance performers than in the remaining countries. Institutions matter; however, they not necessarily supported the economic growth. When this analysis was repeated, but the countries were sorted by

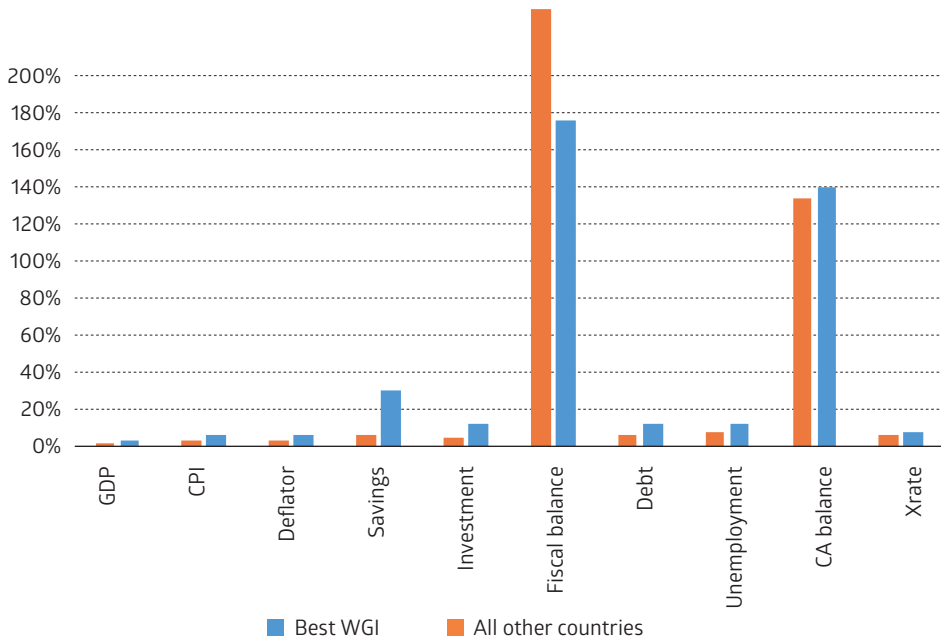
life quality (QLI), the results were similar since most of the best life-quality performers were the same as top governance performers.

FIGURE 32-33. Relationships between institutions and growth

FIGURE 32. Ten best governance countries and all other countries, averages



Source: Author's calculations.

FIGURE 33. Ten best governance countries and all other countries, INSTABs

Source: Author's calculations.

Conclusions and further research recommendations

International comparative analysis provides helpful insights into the experience of countries worldwide. Policymakers can learn about other countries' macro-fiscal relationships and the successes and failures of policymaking.

The results of the subject analysis seem to agree with those authors who underscore a high degree of complexity in the relationships between stability and growth. "(...) macroeconomic stability doesn't mean that the economy will grow at a high rate. To keep growing at a high rate, you'll need to do many things that are a lot of work. This includes regulatory and privatisation changes and things, such as better governance, trade liberalisation, and banking sector reforms" (<https://unacademy.com/content/railway-exam/study-material/general-awareness/a-brief-overview-of-macro-economic-stability/>).

"Countries that have pursued distortionary macroeconomic policies, including high inflation, large budget deficits, and misaligned exchange rates, appear to have suffered more macroeconomic volatility and also grown more slowly during the postwar period. Does this reflect the causal effect of these macroeconomic policies

on economic outcomes? One reason to suspect that the answer may be no is that countries pursuing poor macroeconomic policies also have weak ‘institutions’, including political institutions that do not constrain politicians and political elites, ineffective enforcement of property rights for investors, widespread corruption, and a high degree of political instability” (Acemoglu *et al.*, 2002).

These assertions regarding the influence of volatilities over growth seem to make a lot of sense. However, the growth-*versus*-development relationships might be even more multifaceted than that.

The evidence fails to deliver convincing support for some of these inferences. As shown above, top governance performers were doing much better regarding the levels of macro-fiscal indicators, but their economies grew at lower rates than other economies.

In the entire analysis, direct relationships between different indicators were covered. In most cases, only two subgroups of countries were accounted for: RICH and NOTRICH. However, in the regression models in which the effects of macro-fiscal indicators and their trend instabilities on GDP growth, the level of development was introduced (GDP-PPP *per capita*) as an additional predictor, and almost all regression coefficients became insignificant. No development–stability interdependence could be found. More work is needed to examine these relationships.

Perhaps the incidence of instability may have more significant political effects than economic consequences. Currently, the US economy may be such a case. Economic output, adjusted for inflation, grew by a solid 3% during the most recent 12-month period. The unemployment rate is 3.9%. And the US economy created over 3.5 million jobs in 2023 (The Washington Post, May 23, 2024).

These accomplishments are much better than those of almost all advanced economies worldwide. Despite the US economy’s strong performance, Americans are down on the economy (again), with inflation topping election concerns. “Prices (...) have an outsize impact on people’s perception of the economy” (The Washington Post, May 19, 2024).

It would be interesting to repeat the above data experiments by shifting the focus and changing some of the assumptions and specifications.

- ✦ The source of concern about our study may be the nature of the summary statistics, such as averages and correlation coefficients, in which the sizes of the national economies did not weigh the countries. Both China and the Maldives were on equal footing, contributing one value each to the indexes and coefficients. Introducing weights of countries, such as total GDPs, would make larger economies more significant.

- ✦ Keeping the current analysis format but at least eliminating very small countries, such as those with a population below one million, would reduce their effect on the results, which might be viewed as overweighted here.
- ✦ In this study, several simplifications were made. Four development indicators were covered with only single-year levels. Several macro-fiscal indicators were included in the analysis as averages calculated over the ten years. Accounting for evolution over time would shed more light on the relationships between development and (in)stability.
- ✦ Also, as noted above, GDP growth rate may be affected by the denominator of this indicator. As a result, countries with lower GDP levels can grow much faster, partly due to the low denominator of the rate. In absolute terms, GDP growth of the members of the European Union by 1% may be many times greater than the increase of 20% in many NOTRICH countries. Developing an alternative method for cancelling this low-denominator effect would be interesting.
- ✦ Extending the analysis period from the current ten years to twenty years or more could increase the significance of the results. The data covering the last decade were strongly influenced by the Covid pandemic, which might have diminished the longer-term applicability of our findings.
- ✦ Ten years is a relatively short period. The short-term relationships may be misleading. It would be informative to look at the longer-term consequences of large instabilities. Studying the growth patterns in one ten-year period, say 2014–2023, of countries that experienced high instabilities during a previous decade (*e.g.*, 2004–2013) would shed light on the consequences of instabilities over time and facilitate forecasts.
- ✦ Applying more advanced econometric methods, such as panel regressions, may verify the analysis results more rigorously.
- ✦ Disaggregating the countries into several subgroups and analysing each separately may help to account for a cultural and geopolitical context.
- ✦ Undertaking case studies of selected countries may improve our understanding of the mechanism behind the stability-*versus*-development relationships. An extremely high inflation accompanied the rapid growth of Türkiye's economy. A very low inflation accompanied the rapid growth of the Maldives. More detailed considerations of policies in different countries may shed more light on the relationships between development and stability.

Macroeconomic modelling in behavioural economics

Dariusz Karaś

Introduction:

Classical macroeconomics *versus* behavioural macroeconomics

In mainstream economics, particularly classical economics (Smith, Petty, Ricardo, Malthus), neoclassical economics (Jevons, Edgeworth, Walras, Pareto), and New Keynesian economics (Hicks, Meade, Tobin, Samuelson, Modigliani), people are seen as individuals making informed decisions based on logic. The core idea behind this is the rational expectations hypothesis according to which the rationality of actors in the economy relates not only to their current actions but also to their expectations of changes in the economy and their responses to those changes (Lucas, 1973) and decision-makers rely on proper cost-benefit analysis to maximise expected net benefits (Becker, 1976). With the increasing frequency of economic crises, economists have begun to realise that economic theories based on such factors are an inadequate representation of real-world decision-making processes and the paradigm of economics based on the concept of a perfectly rational human being does not work (Thaler, 2000). Mainstream economics based on formalised models and assuming the existence of complete information failed to predict relevant real-world economic phenomena (Mäki, 2001). A classic example of the failure of a theory describing the causal relationship between variables is the Phillips curve correlating wage inflation with unemployment (Hendry, 2018). Classical macroeconomic models not only failed to predict the significant crises emerging in leading world economies since the 1970s but also failed to explain

them (Akerlof, 2002). As a result, the concept of *homo economicus* began to be questioned (Cartwright, 2011). In particular, economists of the Austrian School (Veblen, Keynes, Simon) criticised it, emphasising bounded rationality, uncertainty in economic decision-making, and no reliance on a rational human being who is fully informed about all circumstances affecting their decisions. Representatives of this strand of economics argued that perfect knowledge never exists, which means that all economic activity involves risk. Some empirical studies confirmed these conclusions, particularly with respect to decisions of investors who showed a tendency to make risk-averse choices in the case of gains and choose risk in the case of losses (Tversky and Kahneman, 1974, 1983).

In contrast to mainstream economics, behavioural economics, currently one of the most interesting and thriving strands of contemporary economics (Makuch, 2012), sees people as irrational and emotional beings who are influenced by biases and experience when making decisions. The appropriate inclusion of behavioural factors in models shows why model concepts based on rational thinking fail. Macroeconomic behavioural models lend realism to simplistic models of traditional economics, such as the Keynesian consumption function (Hosseini, 2011; Katona and Morgan, 1980). Over the past 20 years, macroeconomists have incorporated more and more results from behavioural economics into their models. This has helped to remedy deficiencies in standard approaches to modelling the economy, such as the alternative lack of inertia in the standard New Keynesian model of economic fluctuations (Driscoll and Holden, 2014). The global financial crisis demonstrated the strong importance of psychological factors, which manifested themselves in an unwarranted belief in ever-rising property prices or a sharp decline in confidence in capital markets. The “animal instincts” of human beings, trust, honesty, the propensity for corruption, the illusion of money, and succumbing to legends are treated as additional factors influencing the economy (Akerlof and Shiller, 2009). As a result, behavioural analyses can show how dynamic interactions between markets generate volatility, endogenous cycles, and secular stagnation (Skott, 2023).

This chapter aims to demonstrate the effectiveness of behavioural macroeconomic models in explaining economic phenomena in which classical, neoclassical, or Keynesian models fail. First, it presents the objections raised against the concept of *homo economicus*, which is the starting point for the development of behavioural economics. Next, it discusses the relevance of behavioural modelling for the analysis of decision-making processes. Finally, it presents macroeconomic models incorporating behavioural factors and shows their advantages over mainstream macroeconomics models.

4.1 Questioning the concept of *homo economicus*

The human factor was introduced into economics by Adam Smith who described the influence of individual behaviour and self-interest on achieving economic equilibrium in his 1759 work, “The Theory of Moral Sentiments” (Polowczyk, 2009). The originator of the term *homo economicus* is Jeremy Bentham who pointed out that human beings making rational economic decisions always have self-interest in mind. The term was introduced to economics by John Stuart Mill in his works on political economy (Persky, 1995). However, this did not result in the incorporation of human nature factors into economic models as there was a strong call for the separation of economics and psychology initiated by Vilfredo Pareto. Pareto believed that economic theories should be proven on the basis of well-established empirical facts about observable human choices (Brzeziński *et al.*, 2008). He continued the Lausanne School in economics (Mathematical School) initiated by the French economist Leon Walras (Polowczyk, 2009), creator of the mathematical theory of general economic equilibrium (Blaug, 1987). Milton Friedman, who is considered to be the founder of monetarism, also believed that the psychological motives of an individual’s actions are irrelevant to economic research (Altman, 2004). Friedman (1953) acknowledged that the assumptions of the *homo economicus* theory are unrealistic but argued that they still make it possible to predict human economic behaviour because people behave as if the assumptions of neoclassical economic theory were correct, even if they are not. This means that the effectiveness of a model is determined by the accuracy of its predictions and not by its fit to actual data. As a result, the assumptions made (*e.g.*, rationality) may not be true but are acceptable as long as the predictions formulated on their basis are better than predictions based on different assumptions (Zaleśkiewicz, 2020). This line of thinking was continued by, among others, John Hicks and Paul Samuelson, who eliminated the concept of utility from consumer theory and showed that the theory could be created solely on the basis of axioms concerning the observable choices of individuals (Makuch, 2012; Polowczyk, 2009). The economic theory was based on the concept of perfectly rational decision-making processes and human being, as a subject of the socio-economic system, functions in it as an individual making rational choices (Makuch, 2012). Under this assumption, mainstream macroeconomics created consistent and universal models, which could then be empirically tested using highly developed econometric methods (Brzeziński *et al.*, 2008). Such an approach resulted in the scientific imperialism of economics. However, the closed methodology of mainstream economics did not last and crises in the world’s leading economies that were not predicted by the models caused

economics to eventually turn to other sciences, such as experimental psychology, management, and sociology, for solutions (Brzeziński *et al.*, 2008).

Initially, the mismatch between models and economic reality seemed to be explained by Lucas (1976) who suggested that any attempt at prediction and conclusions about the economy drawn from econometric studies, conducted using only historical data, was ineffective. Proponents of Keynesianism attempted to respond to these objections by modifying the original Keynesian ideas in the 1980s. These attempts were the stirring of a new Keynesian economics. However, it did not reject the assumption of the rationality of the decisions of market participants. Instead, attention was drawn to delayed adjustment of prices to the forces of supply and demand. The situation did not change until Herbert Alexander Simon, who proposed the term “bounded rationality” (Makuch, 2012), pointed out that human beings have a limited capacity to analyse information overload and are limited in their ability to acquire information and that thinking is subject to cognitive and emotional constraints, which means that decisions made seek satisfaction rather than maximum material benefit (Barros, 2010; Simon, 1955). In practice, this leads to a search for a solution that meets the expected requirements, with all available options not analysed when making a choice (Simon, 1956, 1979). However, this still did not explain why the model concepts of classical economics fail in explaining the decisions made by investors who hold on to cheap stocks for too long or entrepreneurs who finalise investments despite rising costs. Only models that attempt to understand market behaviour, taking into account psychological (emotional and personality) factors influencing decision-making, became effective in describing decisions (Shefrin, 2008).

4.2 Origins and development of behavioural economics

Despite crises that started to emerge from the 1970s onwards, which could not be predicted or explained by models of traditional economics, the works that took into account the psychological aspects of decision-making were initially overshadowed by modifications to classical theories. This did not change until the Bank of Sweden’s Alfred Nobel Prizes in Economics in 2001 and 2002 for Akerlof, followed by Kahneman and Smith, brought behavioural economics to prominence. When the reputation of conventional economics suffered through the onset of the 2009 financial crisis, it gained even more publicity.

Behavioural economics is a discipline that combines the achievements of economics and psychology. Daniel Kahneman and Amos Tversky who analysed

factors influencing the decision-making process are generally considered to be the founders of behavioural economics. They did not explicitly reject the assumption of individual rationality but took it as a starting point and studied deviations from it treated as anomalies from the benchmark behaviour (Brzeziński *et al.*, 2008). The criticism of neoclassical economics, as described earlier, resulting from unrealistic assumptions of neoclassical economics and pointing out that the paradigm of rational behaviour ignores the vulnerability and irrationality of human nature and that human decisions do not necessarily lead to the maximisation of one's own profits, marked the stirring of behavioural economics. At the same time, behavioural economics was developing at American universities (Carnegie Institute of Technology and University of Michigan (Hosseini, 2011) and English universities (Oxford University and the University of Sterling (Angner and Loewenstein, 2012) as a separate strand of economics, unnoticed by the economic science world of the time. Nowadays, behavioural economics, despite its short existence as a separate discipline, is divided into the old behavioural economics (Simon, Katona), whose representatives were united by a general dissatisfaction with conventional economics and a desire to develop a more realistic alternative using insights from cognitive psychology, and the new behavioural economics (Kahneman, Tversky, Slavic, Thaler, Smith), represented primarily by the winners of the Bank of Sweden's Alfred Nobel Prize in Economic Sciences, who took the concept of rationality as a starting point for behavioural modelling (Sent, 2004). Behavioural economics has become a fast-growing science due to its focus on describing behaviour treated as deviations from strict rationality and analysing it mainly by means of experiments, which has made it possible to explain crises more precisely as deviations from the general growth trend of the economy.

4.3 A behavioural approach to economic decision-making

Numerous studies have shown that decision-making is influenced by cognitive errors and that individuals make decisions based on their own perceptions of inputs. Therefore, it is the individual's construction of reality rather than objective inputs that can shape the decision-making process and dictate how to behave in a given situation, which means that cognitive errors can lead to distorted perception, inaccurate judgement, illogical interpretation, and irrationality (Kahneman and Tversky, 1972). The economy consists of boundedly rational heterogeneous actors who do not fully understand their complex environment and apply simple decision-making heuristics (Hommes, 2021). Furthermore, allowing for cognitive

errors and heuristics enables faster decision-making, which may be desirable when timeliness is more valuable than accuracy (Tversky and Kahneman, 1974). In particular, it allows analysis of the speed and manner of decision-making in relation to new information obtained by market participants (Gigerenzer and Goldstein, 1996). Cognitive errors occur for a simple reason: individuals have a bounded capacity to process information (Morewedge and Kahneman, 2010). Furthermore, the influx of new information can lead to inaccurate judgements of others and the activation of stereotypes and the conjunction fallacy (Tversky and Kahneman, 1983). The conjunction rule indicates that the probability of a conjunction $P(A \& B)$ cannot exceed the probabilities of its components $P(A)$ and $P(B)$ because the set of possibilities of the conjunction is contained in the extension of its components (Ross, 2010). However, observations suggest that judgements under uncertainty are often based on intuitive mental shortcuts that are not constrained by the conjunction rule (Tentori *et al.*, 2010; Wedell and Moro, 2008) and the representativeness and accessibility heuristics activated in decision-making can make a conjunction appear more likely than one of its components (Tversky and Kahneman, 1983). Humans are not robots quickly analysing all available options, as apparently perceived in traditional economics.

Behavioural economics makes it possible to understand anomalies that occur in market participants' decision-making, unexplained in a normative approach. Research suggests that cognitive biases may cause individuals to require less evidence for claims that confirm their biases (Rodríguez-Ferreiro and Barberia, 2021) or interpret information in a way that confirms their biases and discredit information that does not support the initial opinion (Mahoney, 1977). This can potentially distort perceptions and lead to misjudgements and irrational decisions. Conspiracy theories are an excellent example of this mechanism. Decision-making is also significantly influenced by the tendency to stick with the current situation rather than making a decision leading to an alternative situation to avoid risks and losses (Dean *et al.*, 2017; Kahneman *et al.*, 1991). Prospect theory illustrates how a decision-maker's preferences are shaped by risk propensity and the context of the situation in which the choice is made. Given a choice between a smaller and certain gain and a larger but uncertain gain, people tend to choose the prudent option. In contrast, given a choice between a low but certain loss and a higher but uncertain loss, people will usually choose the latter (risky) option. This model explains the tendency of investors to hold on to cheap stocks for too long and the sunk cost trap, manifested in the irrational desire of entrepreneurs to complete unfinished investments when it is almost certain that they will not make a profit (Thaler, 1988).

Tversky and Kahneman (1974) showed that people's abilities do not allow them to respond adequately to all problems. For example, a known risk, such as a terrorist attack, is considered more likely than another, such as an excessively hot summer. As a result, economic policy decisions will focus on security aspects instead of the environment or agriculture, with consequences in economic stability. The theory is based on the assumption that people solve problems by starting with an initial conjecture or relevant starting point, which is later adjusted to arrive at a final answer. This leads to a situation where the probability of a financial crisis looming or inflation rising may be misestimated and economic policy decisions will be based on these assumptions. An alternative approach based on behavioural economics shows that a macroeconomics model that works with an internal explanation of the business cycle and takes into account the bounded cognitive capacity of decision-makers (De Grauwe, 2013) proves more effective. The inclusion of behavioural factors showing that optimistic expectations can cause growth and pessimistic expectations can cause a slump explains the unfulfilled pursuit of rational market equilibrium – the economy is then unstable and persistent aggregate fluctuations emerge, strongly reinforced by the coordination of trend-following behaviour (Hommes, 2021). Therefore, if the model takes into account the bounded cognitive capacity of decision-makers and the limited ability to process information, which lead to the appearance of cognitive errors (Kahneman and Tversky, 1996; Morewedge and Kahneman, 2010; Tversky and Kahneman, 1974), it is possible to explain economic fluctuations more precisely and forecast with less error than classical macroeconomic models based on econometric modelling. A Bayesian approach to data modelling is useful here as it minimises the effects of data uncertainty and incompleteness in the decision-making process (Vilares and Kording, 2011). Probability models for macroeconomic time series allow the study of the determinants of economic growth, the sources of business cycle fluctuations, the propagation of shocks, and the prediction of the effects of economic policy changes (An and Schorfheide, 2007).

4.4 Behavioural macroeconomic modelling

Macroeconomic data in the form of time series, due to its non-stationarity, rarely corresponds to theoretical concepts, which is why economic policy often produces unexpected results and macroeconomic forecasts fail (Hendry, 2018). With this in mind, behavioural macroeconomics seeks to explain the differences between the real economy and the general equilibrium model in terms of deviations from

rational decisions (Akerlof, 2002). The theoretical literature has long attempted to formalise deviations from rational expectations using a model (Kukacka and Sacht, 2023). One of such approaches is a business cycle model with heuristics and a non-linear switching mechanism (De Grauwe, 2011). However, there are few empirical literature sources in this context as it is often difficult to adequately identify behavioural effects in non-linear macroeconomic models, especially as the volatility of key economic indicators, such as inflation, may depend heavily on bounded rationality in the decision-making process (Kukacka and Sacht, 2023). This section outlines the inadequacies of the models currently used to analyse the economy and illustrates their greater potential to explain states of the economy once behavioural factors are taken into account. The main scopes of behavioural analysis of macroeconomic issues were first defined by G. Akerlof (2002). In the context of these issues, the applicability of the behavioural approach to economic policy and the creation of economic stability is presented.

Behavioural stability models

New Keynesian dynamic stochastic general equilibrium (DSGE) models (Hommes, 2021] used to analyse economic fluctuations and study the effects of macroeconomic and monetary policies constitute the most important class of macro-models commonly used by central banks prior to the 2007–2008 financial crisis. However, their main problem is to match the observed inertia (Milani, 2009). These models are only able to explain business cycle fluctuations as a result of external shocks (De Grauwe, 2013) as business cycles in these models are induced by external shocks combined with slow wage and price adjustments (De Grauwe and Ji, 2020). Empirical results verifying the ability of New Keynesian models to fit the data indicate that the rational expectations hypothesis is primarily responsible for the failure of models such as DSGE to capture the co-transformation between observed macroeconomic expectations and their implementation (Cole and Milani, 2019). Each type of unpredictability has different implications for economic theory and forecasting, with macromodels based on the assumption of predictable behaviour of decision-makers and their expectations (Hendry, 2018):

$$E_{x_t} [x_{t+1} | \tau_t] = \int x_{t+1} (x_{t+1} | \tau_t) dx_{t+1} \quad (1)$$

where E_{x_t} is the expectation operator for the future value of the macroeconomic indicator and τ_t is the information available in the period. Therefore, formula (1) should

not be treated as an unencumbered expectation as it depends on the available information. Moreover, research in the field of behavioural finance shows that the most common cognitive error in formulating forecasts is excessive optimism (Zaleśkiewicz, 2020). As a result, DSGE models are doubly flawed; they are estimated on the basis of incorrect assumptions about the behaviour of decision-makers and lead to incorrect conclusions without taking into account the fact that the indicators describing the economy are generally non-stationary (Boumans and Morgan, 2001; Hendry and Mizon, 2014).

Whether a mismatch in the productive structure or inflationary expectations and adaptive learning by the private sector is the source of inflation persistence is a key implication for the optimal choice of monetary policy (Gaspar *et al.*, 2010). In the rational expectations model, central bank credibility is a binary variable – the bank either has or does not have the ability to commit to future monetary policy actions and influence expectations. Deviations from rational expectations increase the potential to explore volatility in the economy, reinforcing the importance of managing inflation expectations (Svensson and Woodford, 2005). Through adaptive learning, the private sector formulates its expectations based on past inflation behaviour, which means that inflation prospects depend on the central bank's past actions. Therefore, when taking action, the central bank chooses between stabilising output and anchoring future inflation expectations, in addition to the standard mid-term trade-off between current output stabilisation and current inflation (Clarida *et al.*, 1999). Studies covering the euro area suggest that the aggressiveness of monetary policy strongly depends on the perceived degree of maintenance of inflation expectations by the private sector, which means that the European Central Bank should try to respond more aggressively to fluctuations in inflation than would be the case in the same economy with rational expectations and without adaptive learning (Milani, 2009). Heuristic switching models, which have been used in financial economics for more than two decades (Brock and Hommes, 1997), are very well suited for such analyses. However, in macroeconomics, this modelling approach is relatively new (De Grauwe and Ji, 2019; Kukacka and Sacht, 2023). Heuristics represent simple behavioural rules that derive from the fact that the structure of the economy is observable but the interactions between relevant variables, such as output and inflation, are not adequately model-explained and heuristic switching models exhibit a much more complex non-linear structure than linearised DSGE models accounting for bounded rationality (Dyer *et al.*, 2024; Lux and Zwinkels, 2018).

Behavioural relationship between inflation and unemployment

In the case of monetary policy, one of the fundamental concepts supporting central bank decision-making is the Phillips curve. Although originally estimated for the UK (Phillips, 1958), it has subsequently proved its worth for the US (Perry *et al.*, 1970) and many other countries (Flanagan *et al.*, 1983). According to the Phillips curve, when demand is high and unemployment is low, workers can negotiate a higher nominal wage increase than when demand is low, and unemployment is high. In turn, pricing policies of companies translate productivity-adjusted wage inflation into price inflation. Therefore, for economic decision-makers, there is a sustainable trade-off between inflation and unemployment (Akerlof, 2002).

Assuming only full rationality, the short-term curve should be vertical, but empirical studies contradict this and show that the classical Phillips curve is not an adequate description of the relationship between inflation and unemployment. Prices are rigid because decision-makers are wrong as they rely on outdated information, even with rational expectations (Mankiw and Reis, 2002). This results in unpredictable shifts in the synchronicity of changes in factors due to internal stochastic volatility, unexpected outliers and unpredictable external shifts in distributions (Hendry and Mizon, 2014). Similarly, the currently popular New Keynesian Phillips curve (NKPC) is not always able to explain the relationship between inflation on the one hand and output or unit labour costs on the other because the rational expectations hypothesis implies too high a correlation between lagged output and inflation expectations in the future, leading to an estimate of a negative coefficient of output, contrary to what the theory suggests (Adam and Padula, 2011). At the same time, empirical results show that, once potentially irrational expectations are taken into account, rigid price models are able to establish a close link between output dynamics and inflation behaviour (Adam and Padula, 2011). Only then does the New Keynesian Phillips curve become a plausible explanation of inflation dynamics as a function of output dynamics or unit labour costs. The initial equations of the New Keynesian model are as follows (Gali, 2015):

$$y_t = \frac{1}{1+\chi} E_t y_{t+1} + \frac{1}{1+\chi} y_{t-1} - \tau(r_t - E_t \pi_{t+1}) + \varepsilon_t \quad (2)$$

$$\pi_t = \frac{\nu}{1+\alpha\nu} E_t \pi_{t+1} + \frac{\alpha}{1+\alpha\nu} \pi_{t-1} + \kappa y_t + \varepsilon_{\pi,t} \quad (3)$$

$$r_t = \theta_r r_{t-1} + (1-\theta_r) (\theta_\pi \pi_t + \theta_y y_t) + \varepsilon_{r,t} \quad (4)$$

where E is the expectation operator in the New Keynesian approach. The model includes quarterly frequency variables. In equation (2), the dynamic IS curve results from intertemporal optimisation of consumption and savings, leading to consumption smoothing. The parameter β denotes the inverse of the intertemporal elasticity of substitution in consumption behaviour. Equation (3) represents the New Keynesian Phillips curve, where the demand gap acts as a driving force for inflation dynamics derived from monopolistic competition and rigid prices according to the Calvo model (1983). The slope of the New Keynesian Phillips curve is determined by the parameter θ . The parameter δ represents the discount factor. Intrinsic persistence is incorporated into the demand and supply equations using the parameters χ and ρ for habit formation and price indexation, respectively. According to the Taylor rule (4) with a smoothed interest rate, monetary decision-makers respond directly to simultaneous changes in output and inflation. The exogenous driving forces in the model variables are assumed to be subject to idiosyncratic shocks ϵ_t , which are independent and have an identical distribution with mean equal to zero and specified variance (Nehrebecka and Brzozowski, 2016). Although the model successfully explains the response of real variables to monetary policy, it also has a number of shortcomings. One of the key problems is that the model exhibits a lack of inertia (De Grauwe, 2013; Milani, 2009) and shocks only exhibit instantaneous effects (a shock in period t will only have effects in that period; in subsequent periods, the levels of endogenous variables only depend on themselves, current shocks, and expected future shocks). This total lack of model persistence is due to the lack of inclusion of lagged inflation or the demand gap in the IS or AS equations, either directly or indirectly through expectations that may depend on them (Driscoll and Holden, 2014). However, empirical studies show that the real effects of monetary policy shocks are both lagged and long-run (Mankiw, 2001).

The New Keynesian model of monetary policy can be made more realistic by adding a behavioural factor describing expectations about future inflation values. The expectations operator including the three types of heuristics is defined as follows (Anufriev and Hommes, 2012):

$$E^{HD} [x_{t+1}] = \eta x_{t-1} + (1 - \eta) E^{HD} x_t \quad (5)$$

$$E^{HR} [x_{t+1}] = x_{t-1} + \rho (x_{t-1} - x_{t-2}) \quad (6)$$

$$E^{HZ} [x_{t+1}] = (\bar{x}_{t-1} + x_{t-1}) + (x_{t-1} - x_{t-2}) \quad (7)$$

Decision-makers fall into three groups of demand gap and inflation forecasters (Jang and Sacht, 2021) with regard to their respective types of heuristics: availability (HD), representativeness (HR), and anchoring (HZ). In a model based on the availability heuristic (5), future expectations are derived from the weighted sum of the previous implementation and the decision-maker's known past predictions. In the extreme case, the expression implies a static decision formation process. In the model based on the representativeness heuristic (6), the past implementation is taken into account and the forecasting rule follows the direction of the last change in the observed variable with an appropriate level of extrapolation (λ). Finally, in a model based on the anchoring heuristic (7), the last change in the observed variable is further extrapolated through the sum of the average of all observations up to time t , with an appropriate anchoring parameter μ for the last change in the observed variable. The inclusion of behavioural parameters in all heuristics allows for greater flexibility in their application on a macro scale (Kukacka and Sacht, 2023). The next step is to appropriately define the switch between heuristics applied. The switch between groups of heuristics is based on a polynomial logistic model. The general market forecast expression for the demand gap and the inflation rate is expressed by the following formula:

$$E_{i,t}x_{t+1} = \sum_{i=1}^3 \left(\alpha_{x,t}^{k\{i\}} \cdot E_t^{k\{i\}} x_{t+1} \right) \quad (8)$$

where $k\{i\}$ denotes the type of heuristic and the probability represents the stochastic behaviour of decision-makers who adopt a particular heuristic in their predictions. The idea behind the switching mechanism is that decision-makers can verify their expectations given the predicted performance of a particular heuristic based on a polynomial logistic model:

$$\alpha_{x,t}^k = \frac{\exp(\gamma U_t^k)}{\sum_{i=1}^3 \exp(\gamma U_t^{k\{i\}})} \quad (9)$$

where the parameter γ denotes the intensity of the choice and is a key parameter for the stability of the model (Anufriev *et al.*, 2019; Jang and Sacht, 2016). The higher the value of the parameter, the more often decision-makers adjust their decision based on the results of their previous forecasts and switch to a more efficient forecasting strategy (De Grauwe and Ji, 2020). It should also be noted that a negative value for the intensity parameter does not make economic sense as it would imply an irrational shift towards less precise forecasting heuristics (Kukacka and Sacht,

2023). Forecasts created from the model discussed above are more precise than rational expectations models (Hommes *et al.*, 2019).

Conclusions and further research recommendations

In classical economics, the favourable economic climate and crises that are typical of capitalism arise from large external shocks. The combination of these shocks with slow adjustments of wages and prices by rational agents leads to cyclical fluctuations. However, empirical behavioural evidence suggests that the foundations of macroeconomic theory need to be rethought and modified accordingly. The behavioural approach in economics and finance has been ignored for many years. There was no recognition of the fact that the human mind has limited abilities to process information from the external environment and thus humans in the decision-making process may make many mistakes as a result of cognitive and emotional distortions (Radke, 2023). Simplified models based on the assumption of strict rationality should be replaced by behavioural models and the assumption of strict rationality should be treated as a special case (Camerer and Loewenstein, 2004). Attempts to complement the inadequacies of models of traditional Keynesian macroeconomics by theories based on microeconomic fundamentals and intertemporal optimisation, with DSGE models at its centre, are imperfect workarounds for non-functional models (Skott, 2023). The inclusion of behavioural factors can help to solve problems in New Keynesian models. Therefore, economic models should be more closely linked to human behaviour and economists should distinguish more clearly between normative and descriptive theories (Thaler, 2000). Market participants exhibit irrational behaviour in their decision-making because these decisions result from emotional reactions and not deliberate choices. In turn, emotions entail different moods experienced by market participants. Moods differ from emotions in that they are less intense and can last longer whereas emotions are the result of specific reactions to an event or situation and are therefore short-lived and more intense (Radke, 2023). Moods can be shaped by external factors, with traditional media and social media playing a large role in this. Government policy also plays a significant role. Among supporters of those in power, it can contribute to increased levels of conservatism, *i.e.*, an underestimation of the importance of new information due to a strong attachment to opinions already held. The reliance on cognitive inclinations causes even experts to be unable to formulate accurate economic forecasts (Radke, 2023). Decision-makers untrained in economic policy theory are not only over-optimistic about the

quality of their policies but are also unaware of the limitations of their decisions (Kruger and Dunning, 1999) and their incompetence deprives them of the skills needed to recognise their deficits (Ehrlinger *et al.*, 2008).

Behavioural economics has revealed a mechanism of inertia that refers to the tendency of individuals to maintain their current course of action, even in the face of new information or changes in their environment, and at the same time hinders contemporary economic growth. By creating a behavioural model that does not depend on the dominant concept of rationality, it is possible to better explain the fluctuations in economic activity, which are endemic to market economies. As a result, the behavioural approach allows for a better understanding of fluctuations in, among others, national output and inflation (Simon, 1997). Moreover, it turns out that in the behavioural model the central bank has a much greater role and influence in stabilising the economy. In contrast to the rational model, the behavioural model predicts that inflation volatility can be reduced if the central bank responds to the demand gap in addition to inflation, even if price stability is the priority, a goal that is more easily achieved if monetary decision-makers also respond to changes in the demand gap (Hommes *et al.*, 2019). Empirical behavioural models provide clear political implications for central banks, such as the European Central Bank, whose sole objective is to achieve price stability. This insight is important, but at the same time it contradicts standard macroeconomic thinking built on full rationality. This is how insights from behavioural economics lead to advances in macroeconomics.

It is worth noting that decision-making by an individual differs from decision-making by a group. This is particularly relevant in the macroeconomic approach in which economic policy decisions are made on the basis of government consensus rather than the guidance of a single individual. In a group, the same cognitive errors arising from biases and experience lead to differentiated solutions, preventing premature consensus on suboptimal solutions (Boroomand and Smaldino, 2023). As a result, cognitive error, usually perceived as an obstacle, can improve collective decision-making by encouraging a broader exploration of options. Over the past six decades, research in the field of behavioural economics has identified a list of cognitive errors affecting judgement and decision-making (Kahneman and Tversky, 1996). The study of cognitive errors has practical implications for such areas as economic policy, entrepreneurship, finance, and management (Zhang and Cueto, 2015) and research on heuristics and biases has also found applications in medicine (Cho *et al.*, 2017) and political science (Trout, 2005).

Nowadays, moving away from the assumption of fully rational actors has become one of the main issues of macroeconomic modelling. At the same time, it is assumed that economic actors operate within bounded rationality instead of processing all information perfectly using unlimited cognitive capabilities. Expectations about the future value of the modelled indicator of the economy play a key role in modern macroeconomic models. Understanding how people actually behave is important for choosing the right economic and monetary policy. This approach should contribute to a more effective description and prediction of economic processes. In terms of behavioural macroeconomics itself, it is seen as a modern tool in creating a stable economic system.

Modelling macroeconomic stability using machine learning

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Introduction

In recent years, the global economy has faced dynamic and complex challenges that have significantly affected macroeconomic stability. In particular, the outbreak of the COVID-19 pandemic and new conventional wars for global leadership have led to profound changes in economic policies and forced a rethinking of how to assess economic stability in a changing global environment. In this context, traditional methods of economic analysis are becoming insufficient to capture the full dynamics of contemporary macroeconomic change. The aim of this chapter is to show how long-term macroeconomic stability can be effectively analysed and predicted using machine learning tools. The presented analysis makes it possible to formulate economic policies more precisely, taking into account the changing conditions and risks faced by modern economies.

This chapter presents a novel iterative economic stability assessment model based on advanced machine learning techniques, such as cluster analysis and Bayesian inference. The model identifies key factors affecting macroeconomic stability, both before and after the COVID-19 pandemic. To model macroeconomic stability, the following variables were adopted: GDP growth rate, unemployment

rate, inflation rate, budget deficit-to-GDP ratio, current account balance-to-GDP ratio, and overall energy price level. The aim was to obtain a picture of dynamic economic reality, where machine learning methods, in particular cluster analysis, facilitate the identification of non-obvious patterns in macroeconomic data, taking into account complex and multidimensional interactions between variables and increasing precision in predicting economic risks. Bayesian inference makes possible the update of probabilities on the basis of new information, which is invaluable in dynamic situations. As a result, this research approach extends the theoretical limits of economics in considering the economy through the non-linearity and non-obviousness of interactions between variables.

Such an approach is of particular relevance to institutions responsible for formulating and monitoring economic policy. For central banks, they can help to assess inflation risks and price stability and enable better management of monetary policy. For ministries of finance and budgetary institutions, it is better to assess fiscal sustainability, especially in the context of budget deficits and current account balances, as it is crucial for public debt management and sustainability of public finances. International financial institutions could use this research approach to monitor macroeconomic stability at global and regional levels, which is particularly relevant in times of global economic crises.

5.1 Modelling macroeconomic stability

Macroeconomic stability can be seen as a kind of rare good related to the state of the economy, although many sources often change the basic terminology or indicators to show that stability exists, whether it is visible or not. The precise definition of macroeconomic stability is always driven by the adopted point of view, the purpose of the research, and practical applications. Macroeconomic stability is usually associated with the political, social, and demographic situation of a country in combination with a favourable economic environment (Gorynia, Marcinkiewicz, 2017). The COVID-19 pandemic and, later, the war in Ukraine also indicated that energy security is essential for economic sustainability.

However, many economists discuss macroeconomic stability, using different indicators or varying terminology to illustrate apparent or real stability. According to the dominant theory in the literature and practical applications, macroeconomic stability is the vulnerability that accrues in accommodative global financial conditions, especially with regard to fluctuations in external financial conditions interacting with domestic growth and slump cycles (Borio *et al.*, 2022; Raczkowski

et al., 2020, pp. 47–48). In this regard, macroeconomic stability includes inflation control, fiscal stability, exchange rate stability, financial security, and political stability, seeing them as necessary indicators of economic growth. It is necessary to assume that energy security can be a sub-aggregate of financial security or a separate (stand-alone) variable due to its nature. Inflationary stability is assumed to support investment and savings, where stable inflation supports both capital accumulation and consumption decisions (Barro, 1996). Fiscal stability provides confidence in government policy, provides markets with greater certainty and stability, and reduces the risk of sovereign debt crises (Reinhart and Rogoff, 2010). Exchange rate stability promotes trade and foreign investment, where countries with more stable exchange rates have higher levels of international trade and are more attractive to foreign investors, which stimulates economic growth (Frankel, Rose, 2002). Financial stability and the avoidance of financial crises lead to a better allocation of capital, which in turn increases productivity (Levine, 1997). Political stability is a condition for macroeconomic stability, where countries with stable political institutions, efficient governance, and the rule of law have higher and more stable economic growth (Alesina *et al.*, 1996).

In the current reality, with the occurrence of polycrises, and in the context of maintaining macroeconomic stability, many, if not all, economies are experiencing increased financial vulnerability with excessive increases in public and private debt and varying inflation dynamics with an upward bias, changing the economic conditions, property rights, or social and financial status of many households, companies, and states (Raczkowski, Komorowski, 2023).

Conducting appropriate economic policy depends on effective measurement, adequate evaluation, and a thorough understanding of the causes of changes in macroeconomic stability. This is because (Kołodko, 2020, p. 43):

- ✦ it is possible to assess whether past policies have promoted macroeconomic stability;
- ✦ areas that need to be addressed first to improve sustainability are identified;
- ✦ areas that are deteriorating and require an economic policy response can be identified.

For the economy to develop properly, all actors must have a good understanding of macroeconomic stability and the sources of instability that can trigger a crisis. Fiscal authorities are the most important actors as they can counter emerging threats to macroeconomic stability through their actions. International organisations and rating agencies that monitor and assess the economic situation and investment risks in different countries also need this type of information. In

addition, investors and others who analyse risks in the economy as part of their decision-making process need to know about macroeconomic stability. When assessing investment risk, an assessment of macroeconomic stability is essential (Kołodko, 2020).

Determining the macroeconomic stability of the economy has important benefits. This type of information reduces economic uncertainty, makes the country more attractive to investors, and increases the likelihood that economic activity will increase in the future. Moreover, by assessing the sustainability of the macroeconomic equilibrium, it is possible to determine whether it is stable or unstable and how this equilibrium relates to the internal and external equilibrium of the country (Janecki, 2017).

Determining the meaning of macroeconomic stability is a difficult and ambiguous task. It is most commonly accepted that economic growth is determined by the right mix of social, political, economic, demographic, military, natural, and climatic elements. In recent years, energy issues, and in particular the energy transition, should also be added to this. This also suggests that the proper and perfect interactions between these elements, both domestically and globally, need to be identified. To restore both internal and external equilibrium, macroeconomic policy must be seen as a key factor in government intervention in economic processes.

Macroeconomic stability should be viewed both in relation to other economies and in relation to the circumstances of previous periods, especially when the economies being compared have similar levels of economic development and a coordinated business cycle. In particular, this is important in attempting to quantify the state of macroeconomic stability and trying to predict its course in the future.

The future potential state of macroeconomic stability can be predicted using modelling, among others. Modelling is just one of many qualitative and quantitative methods used in a thorough review of economic policy. In a perfect world, tools (*i.e.*, laboratory experiments) would be most effective in their predictive value. However, while they can be used at the micro level in some cases, they are not always feasible at the macro level. Modelling appears to be the best alternative to such experiments (Pollit, 2018).

An economic model is a condensed representation of reality that aims to produce testable hypotheses about economic behaviour. An essential feature of an economic model is its inherently subjective construction as there are no objective measures for assessing economic performance. Economists who perceive reality in different ways will come to different conclusions about what is needed to explain it (Ouliaris, 2011).

The use of modelling can be extremely useful in decision-making processes by reducing the information gap and thus reducing risk (Ohirko, 2016). However, it should be remembered that macroeconomic modelling is a difficult task with several limitations. Models rely on data and assumptions that may be wrong or missing. This means that model results should always be interpreted with caution and in combination with information from other sources. Despite these drawbacks, effective macroeconomic stability modelling can be a very useful tool for governments, central banks, companies, and other stakeholders. The complexity of the event being forecast, the type of model, and the quality of the data can affect the accuracy of macroeconomic models in predicting future events. Short-term trends are generally easier for models to predict than long-term trends.

5.2 The role of modelling to predict the course of the macroeconomic stability state

There is a consensus in the literature that macroeconomic stability is crucial for economic growth. Furthermore, macroeconomic stability, broadly understood, plays a key role in the process of socio-economic development (Stiglitz *et al.*, 2006). Its beneficial impact on microeconomic phenomena, such as the reduction of uncertainty in economic activity or in the investment process, especially in international investment, is also emphasised (Kulbacki, 2021).

Models help to understand possible policy outcomes, assess and quantify different mechanisms that may exist, and consider interactions that may have consequences beyond the intended or immediate effects of economic policy. Long-term economic growth cannot be sustained without macroeconomic stability. To create the conditions for balanced, sustainable growth, governments can use stability models to identify and implement policies that support price stability, energy security, employment, and sustainable public finances. The use of models can also help to identify obstacles to growth, such as poor labour or infrastructure availability.

Lower unemployment, stable prices, and better living standards for the majority of the population are the result of macroeconomic stability. Governments can use models to identify and implement policies that promote sustainable growth and income distribution.

Macroeconomic stability projections serve as the basis for monetary and fiscal policy decisions by central authorities and central banks. The use of models can provide a deeper understanding of the impact of different policies on employment,

inflation, economic growth, and other key indicators. This helps to avoid errors that could lead to recession, excessive inflation, or other undesirable effects.

The economy is constantly changing under the influence of internal and external factors. It is possible to attempt to identify potential threats to economic stability, such as financial crises, polycrises, military crises, sudden changes in commodity prices, and geopolitical changes, and predict them using macroeconomic stability models. Governments and businesses can take preventive or mitigating actions if they are warned in advance of such potential events.

Stability and predictability are essential for investors to make informed investment decisions. The use of macroeconomic stability models has the potential to increase investor confidence in a country's economy, thereby attracting foreign capital inflows and supporting economic expansion.

In view of the above applications of macroeconomic stability modelling, it is extremely important and can contribute to:

- ✦ building sustainable economic growth;
- ✦ improving social welfare;
- ✦ making informed political decisions;
- ✦ reducing risk and uncertainty;
- ✦ increasing investor confidence.

The research involved in identifying macroeconomic stability for an economy reveals the strength of the impact of individual economic indicators and the relationships between them.

Up-to-date and in-depth knowledge of macroeconomic stability as well as knowledge of the factors that lead to it can be used by many economic actors. Knowledge of the time and delay functions of the impact of economic factors is particularly important.

5.3 A broadened perspective for considering macroeconomic stability

As the economy is subject to changes in individual factors all the time, in stability research, this translates into a different composition of the system of economic indicators (depicting individual factors in a specific set of variables). In addition to the so-called classic factors, it is necessary to take into account new factors that have gained in importance in the last two decades, such as energy indicators related to the energy transition, indicators describing climate change, and

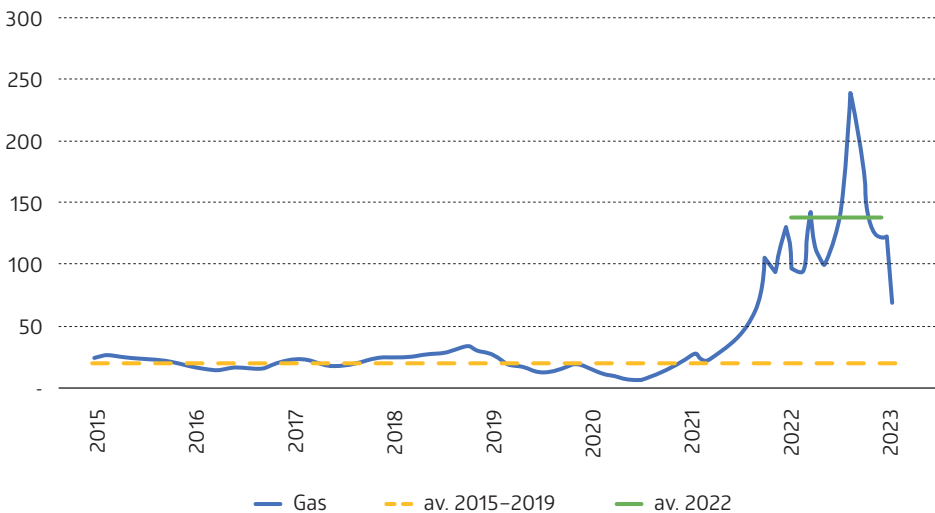
indicators related to the production, distribution, and consumption of individual energy carriers and their emission performance.

Classical approaches to macroeconomic stability have so far ignored issues related to the broader energy transition and climate change, which are directly linked to the whole area of energy security. Outlining the role of these elements in research processes will provide new insights into what happened in the past and what will happen in the future in economic processes. It will also facilitate the preparation of processes that will be used to prepare appropriate macroeconomic stability forecasts and at the same time will contribute to the construction and use of predictive models to achieve the level of macroeconomic stability expected in a given political and economic situation.

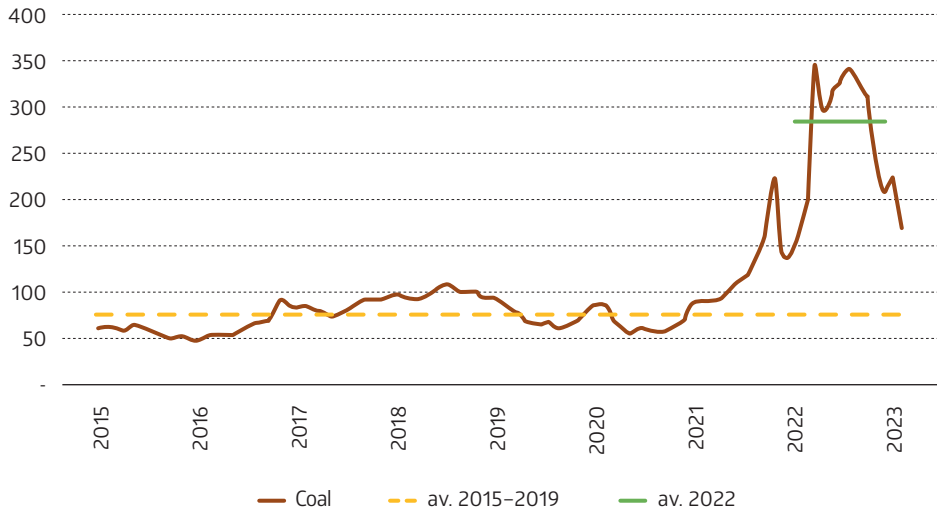
The increase in uncertainty at the global level due to technological, economic, technological, and political changes brings changes at the macro-, meso-, and micro-level. Energy prices and energy carrier prices are susceptible to changes in the geopolitical environment. Fluctuations in the prices of energy carriers are directly linked to changes in the prices of energy offered to the final consumer (especially businesses and households). The dynamics of energy carrier price changes are shown in Diagram 1, which illustrates the development of natural gas, coal, and oil prices from 2015 to 2023.

DIAGRAM 1. Price development of energy carriers (natural gas, oil, and coal) in the period from 2015 to 2023

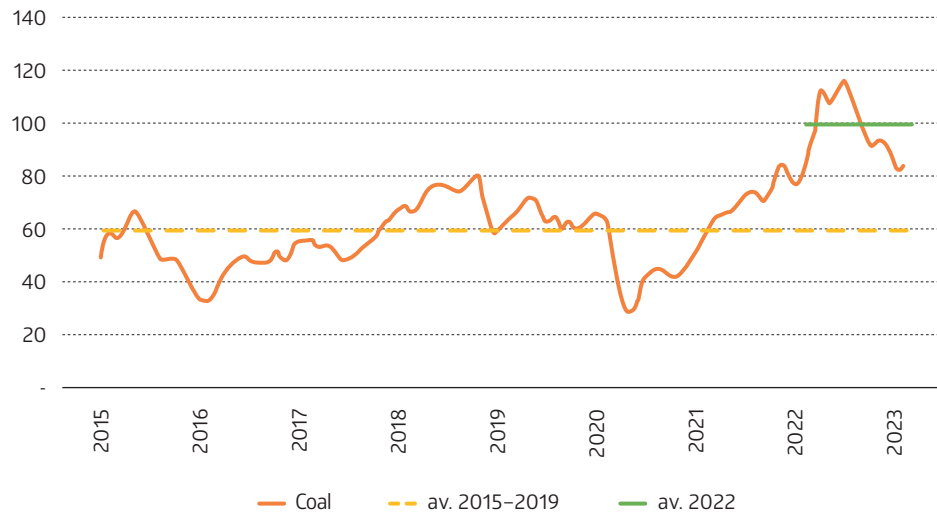
A. Natural gas (TTF, USD/MWh)



B. Coal (ARA, USD/t)



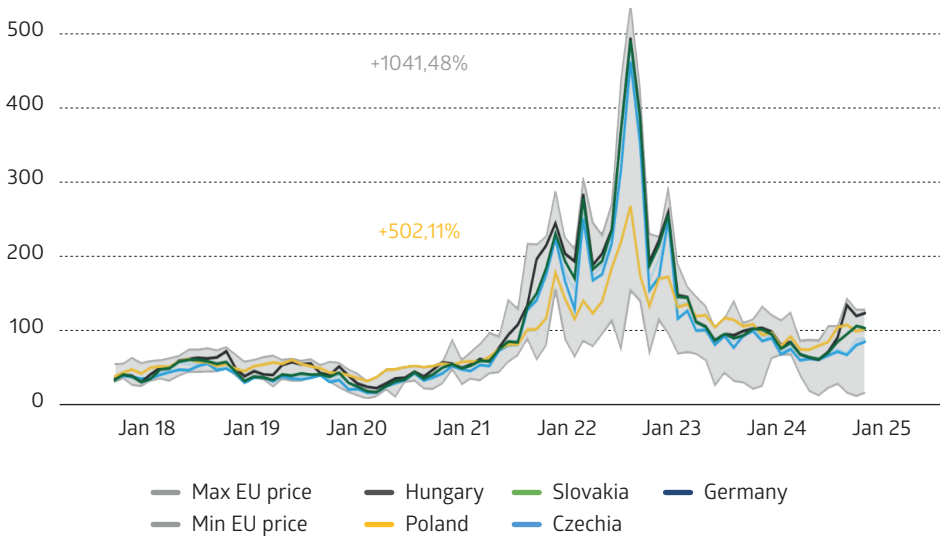
C. Oil (Brent, USD/b)



Source: Gradzewicz M., Jabłoński J., Sasiela M., Żółkiewski Z., The impact of energy price increases on the Polish economy, NBP Working Paper No. 369, NBP, Warszawa 2024, p. 17.

Fluctuations in energy carrier prices translated into changes in electricity prices, as illustrated in Diagram 2, which shows wholesale electricity prices in Europe in the period from January 2018 to September 2024 in Poland and selected EU countries as well as the average maximum and minimum price in the European Union (in EUR/MWh). When comparing the individual years, this correlation and the relationship between changes in energy carrier prices (especially in 2022) and electricity prices are evident.

DIAGRAM 2. Wholesale electricity prices in Europe between January 2018 and September 2024 in Poland and selected countries as well as the average maximum and minimum price in the European Union (in EUR/MWh)



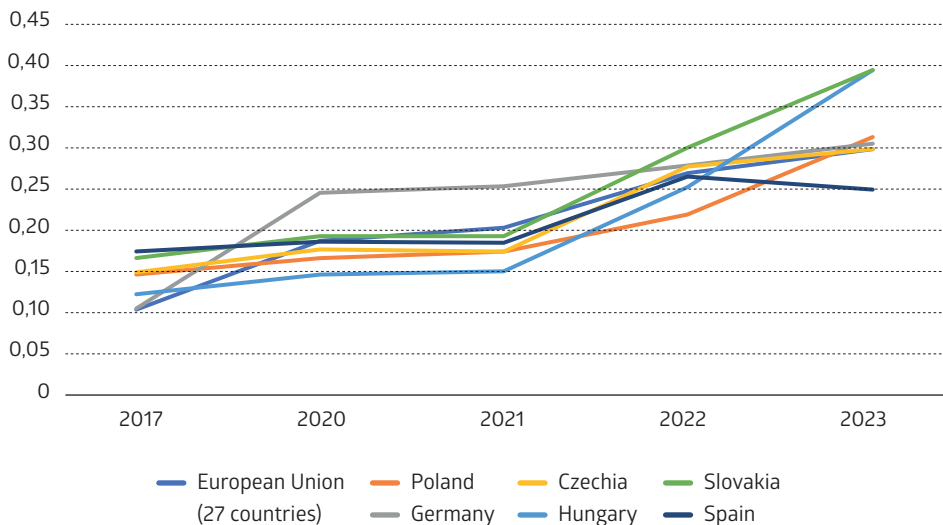
Source: Internal analysis based on EMBER.

When analysing the 1 MWh price change dynamics, the clear increase from 2018 to Q4 2019 is visible. In November 2019, the first case of COVID-19 was recorded. At that time, the price of 1 MWh in Poland was EUR 53.55. Subsequently, during the restrictions on economic and social life that occurred during the pandemic, the price of 1 MWh did not exceed EUR 100. With increasing tensions between Russia and Ukraine, a change in the price of 1 MWh can be observed in 2021. The maximum price was in August 2022. It averaged EUR 268.88, representing 502.11% of the price in November 2019. In the case

of the average maximum price in the EU, the price of 1 MWh of electricity was EUR 52.19 in August, rising to EUR 543.55 per MWh by August 2022, representing 1041.48% of the base price. Such dynamics in the price of electricity have an impact on the cost of final products that are produced by companies and the expenditure incurred by households.

The significant dynamics of the change of electricity prices in the EU and its selected countries are illustrated in Diagram 3, which shows the changes of electricity prices for non-household consumers (annual data in EUR/kWh). The average price per kWh of electricity in 2017 incurred by businesses in the EU was EUR 0.0967. In 2019, during the development of the pandemic and the restrictions and difficulties in obtaining and transporting energy carriers, the price of 1 kWh increased to EUR 0.1770. In 2021, the price of 1 kWh was EUR 0.1959. In the following year, it increased by 34% to EUR 0.2628. In 2023, it rose to EUR 0.2928, an increase of 11%. Over the two years mentioned above, the total increase represents 49%. This significant inflation in electricity prices translates into increased costs in companies' production systems and consequently increases the price of final products.

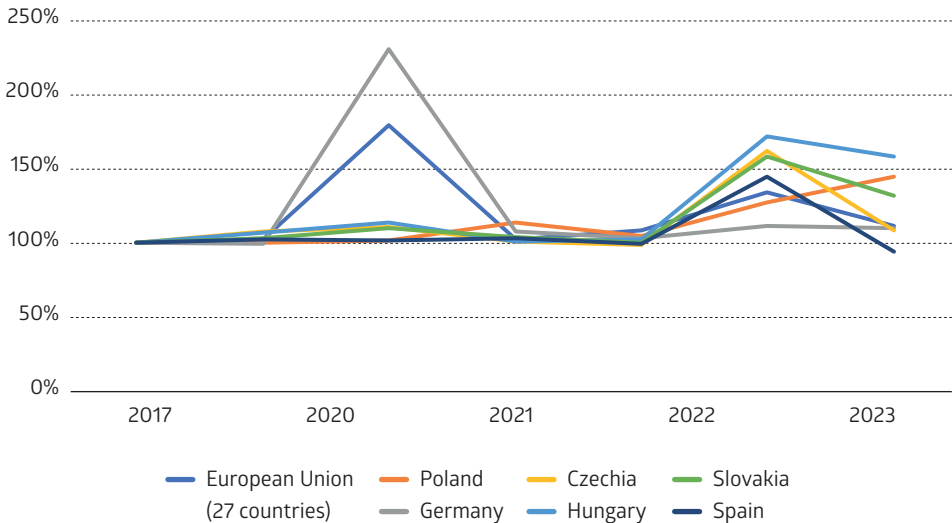
DIAGRAM 3. Electricity prices for non-household consumers in the period from 2017 to 2023, consumption from 20 MWh to 500 MWh (in EUR/kWh)



Source: Internal analysis based on Eurostat data.

The dynamic approach shows the relatively stable level of electricity prices in all EU Member States in 2017 and 2018, as illustrated graphically in Diagram 4, with 2% year-on-year price increase. In 2019, the COVID-19 pandemic began, causing the first disruptions in the procurement and supply processes of the selected energy carriers. These disruptions can be seen in the dynamics of electricity price changes: the year-on-year electricity price between 2018 and 2019 increased by 79% for the EU countries and by 179% for Germany (from EUR 0.0965 to EUR 0.2232). In the case of Germany, there is an overlap of two factors: the constraints on the economy due to the COVID-19 pandemic and the start of the energy transition (the shutdown of nuclear power plants, the increased importance of electricity generation from renewable energy sources, and the lack of diversification of natural gas supplies).

DIAGRAM 4. Electricity price dynamics for non-household consumers in the period from 2017 to 2023, consumption from 20 MWh to 500 MWh (in %, YoY, 2017 base year)



Source: Internal analysis based on Eurostat data.

Ensuring affordable access to energy for businesses and households is crucial for economic growth, a just transition, and building macroeconomic stability.

The impact of the power industry and the related energy transition process have been identified as important factors affecting the stability of the economy and the competitiveness of its operators in domestic and foreign markets.

Therefore, in the context of an extended analysis of the area of economic stability, special attention should also be paid to the functioning of the energy system and the readiness of the economy to actively participate in energy transition processes. An example illustrating the state of the energy system can be found in the Energy Transition Index (ETI)⁸.

The current⁹ framework is based on data that illustrates the performance of countries' energy systems and their readiness for energy transition. The groundwork for building the framework is the energy triangle representing a balanced approach to the three main priority issues: security, equity, and sustainability (Figure 1). Security issues are here defined as an energy system that is reliable, thriving, and operational despite possible disruptions (uninterrupted). Such a system is able to withstand the dynamics of energy demand and supply by responding appropriately (selecting generation sources in such a way that the operation of the entire system is not destabilised, taking into account environmental and economic aspects).

In the energy triangle, sustainability issues are presented as an energy system that is in the process of decarbonisation and at the same time is conscious of the energy it consumes. With such a system, we can have the ambition and hope to pass on a cleaner and less polluted planet to future generations.

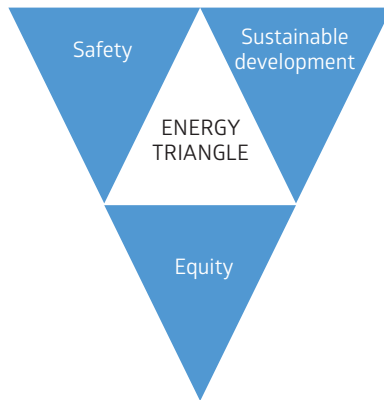
Equity (sometimes called equality) is defined as an energy system within which energy is distributed, accessible, and affordable (inexpensive). It is a system within which initiatives and their sustainability benefits are shared in such a way as to enable the inclusion of as many consumers as possible in equitable economic growth and improved living standards. Energy transition readiness is increasingly shaping

⁸ Energy Transition Index (ETI) is based on an appropriate data architecture and is used to measure and understand the efficiency of energy systems and their readiness for energy transition and to maintain energy security in countries that undertake actions that involve changes in their own energy systems. It is published by the World Economic Forum. ETI provides a benchmark for the ongoing energy transition process. The current shape of the index and its components is the result of many years of work previously associated with the Energy Architecture Performance Index (EAPI) published between 2012 and 2017. Over the years, the main theoretical framework of the study has been modified and the number of components making up the main indicator score has gradually increased, with 18 components in 2017 and 45 components in 2024.

⁹ "In the context of composite indicators, timeliness is particularly important to minimise the need to estimate missing data or revise previously published data. Individual primary data sources determine the optimal trade-off between accuracy and timeliness based on institutional, organisational, and resource constraints, which is why data on different domains are often made available at different times." Handbook on Constructing Composite Indicators: METHODOLOGY AND USER GUIDE; OECD, 2008, p. 47.

countries' competitiveness strategies and influencing their macroeconomic stability. Economies in countries actively implementing the energy transition are incubating new, nascent industries to support future economic growth and development.

FIGURE 1. Components of the energy triangle

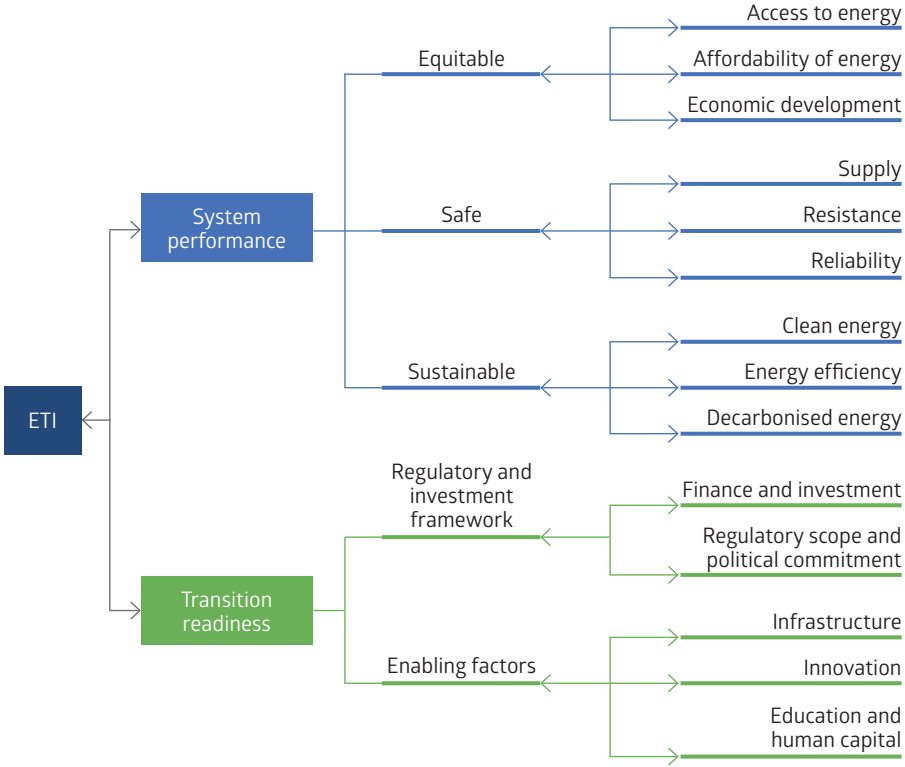


Source: Internal analysis derived from: Securing the Energy Transition – white paper, January 2023, World Economic Forum, Geneva, p. 7.

The ETI framework (system performance and transition readiness) indicates what components are important in identifying and measuring the ongoing energy transition process (Figure 2). In this regard, a group of factors has been identified, of which the following are currently considered to be important: access to energy and its carriers used in households, the affordability of energy (electricity, natural gas, oil, and coal), and economic development, in particular the introduction and use of new low – or zero-carbon technologies enabling energy production.

Security issues relate to the diversification of energy supply and the diversity of energy carriers and sources used in the economy. Other important matters include flexibility of the electricity system, resilience to hydrocarbon supplies, and reliability of transmission and distribution infrastructure. Sustainability issues relate to the energy intensity of an economy, energy consumption *per capita*, the share of clean energy in the consumption profile of economic actors, and greenhouse gas emissions.

FIGURE 2. The groundwork for ETI



Source: Internal analysis.

Further matters considered when analysing the factors influencing the energy transition include the regulatory scope and political commitment as well as finance and investment. Further, consideration is given to factors that enable the transition process, in particular the development of transmission and distribution infrastructure for energy and its carriers (electricity lines and gas and pipeline networks) adapted to renewable energy generation and storage sources. Other important matters include the preparation of the right conditions for the creation and implementation of innovations and the adaptation of the education sector to prepare adequate human resources who will be able to continue the energy transition process with the development of new technologies and to adapt them to changing natural, climatic, social, and economic conditions.

Progress in the energy transition process depends on the extent to which a robust environment, conducive to changes, can be created, particularly with

regard to building macroeconomic stability and conditions for long-term growth. A robust regulatory framework and the ability to attract and deploy capital on a large scale remain essential elements of an enabling environment for the overall transition process and thus for the macroeconomic stability of an economy. In addition to a comprehensive framework of dedicated policies regarding renewable energy, energy efficiency, and energy access, particular attention is needed to ensure that the regulatory framework is aligned with a robust, credible, and ambitious roadmap towards a net-zero emissions state. An appropriate toolbox should be prepared to support the transition through effective carbon pricing. The investment climate, concerning investment not only in the generation infrastructure itself but also in energy storage and transport infrastructure, should be characterised by a low cost of capital, liquidity in domestic markets, and attractiveness for foreign direct investment. In this way, it can be a strong factor enabling the mobilisation of increasing levels of capital for the energy transition process. Energy transition readiness is increasingly shaping countries' competitiveness strategies as they incubate emerging industries to support future economic growth. Factors such as a skilled workforce, innovation, and physical and digital infrastructure are essential to laying the foundations for economic development. All these factors have an impact on the energy transition process, which in turn is an important element in creating macroeconomic stability in the current environment. By contrast, the lack of stability influences increasing economic uncertainty and thus can trigger future socio-economic crises, in particular when combined with the climate changes that are currently taking place. Therefore, energy cannot be ignored when studying macroeconomic stability. As a result, the factor related to diagnosing the state of the energy system should be incorporated into the set of elements considered when modelling macroeconomic stability.

5.4 Predictive macroeconomic stability model

This section presents the assumptions of an iterative model for assessing macroeconomic stability. Six categories of macroeconomic stability were proposed to measure macroeconomic stability in the model: GDP growth rate, unemployment rate, inflation rate, budget deficit-to-GDP ratio, ratio of the current account balance in the balance of payments to GDP, and energy security/general energy price level (Table 1). While the first five factors are commonly used in stability analyses, the price of energy has also become one of the key factors determining the functioning of economic agents due the current macroeconomic situation (Raczkowski, 2023).

The model is based on an iterative optimisation algorithm, taking into account macroeconomic factors affecting the stability of the economy and a logit function describing the state of stability. The functionality of the model was checked against data concerning Poland.

TABLE 1. Indicators determining macroeconomic stability

INDEPENDENT VARIABLE IN THE MODEL	INDICATORS DESCRIBING THE VARIABLE
GDP growth rate	National accounts: Gross domestic product (current prices), in PLN million. National accounts: Gross domestic product (constant prices), corresponding period of the previous year = 100.
Unemployment rate	Staging Cube, Poland, Harmonised unemployment rate (HUR), Total, % of labour force, Monthly. Labour market: Registered unemployment rate (end of period), %.
Inflation rate	Staging Cube, Poland, Inflation (CPI), Total, Annual growth rate (%), Monthly. Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for Poland. Price indices: Consumer price indices, corresponding period of the previous year = 100.
Budget deficit-to-GDP ratio	General government deficit/surplus and debt: General government deficit/surplus, % of GDP. General government deficit/surplus and debt: General government deficit/surplus, PLN million. Budget deficit since 1991. State budget: State budget outturn (balance) (year-to-date), PLN million. State budget outturn (balance) (year-to-date)/Gross domestic product (current prices) [%].
Current account balance-to-GDP ratio	Foreign trade: Total foreign trade goods balance, PLN million. Total foreign trade goods balance/Gross domestic product (current prices) [%].
Overall energy price level	Variable costs of power generation in Poland with the current usw mix [PLN/MWh]. TGeBase, usw rate [PLN/MWh]. MIX POLAND OZE All usw [%]. POLAND HARD COAL PSCMI 1/T usw [PLN/T]. TGEgasDA usw rate [PLN/MWh].

Source: Internal analysis.

Each category of macroeconomic stability factors involves the relevant time series of macroeconomic indicators typical of that category. The following methods were used to formulate a predictive model of macroeconomic stability:

- ✦ Data Mining – analysing large data sets and extracting knowledge by selecting data relevant to the phenomena and processes being analysed.
- ✦ Machine learning (neural networks) – building and optimising the structural parameters of predictive models.

In the first stage of the modelling procedure, data clustering was carried out. Stability indicators were divided into four macroeconomic stability groups assigned to the following categories:

- ✦ Group 1: Very low stability;
- ✦ Group 2: Low stability;
- ✦ Group 3: Medium stability;
- ✦ Group 4: High stability.
- ✦ This stage allows the breakdown of factors influencing overall economic stability. Clustering (cluster analysis), a method of unsupervised statistical classification, groups elements into relatively homogeneous classes. In most algorithms, the basis of clustering is the similarity between elements expressed by a similarity function (similarity metric) (Gordon, 1999). Clustering belongs to unsupervised learning problems, while the k-means method belongs to the optimisation iteration methods of cluster analysis, which involves dividing the entire set of objects according to the general principle of maximising the variance between groups while minimising the variance within study groups (Cox, 1957). The k-means method is one of the popular clustering techniques that divides a dataset into a predefined number of clusters, minimising the sum of the squares of the distances of the points from the centre of the cluster. The starting point is to pre-divide the dataset into k clusters, arbitrarily assigning the analysed objects to these groups. The aim is to assign objects to groups in such a way as to achieve maximum similarity within them while maintaining maximum inter-group differences.
- ✦ The basic procedure of the algorithm consists of the following steps (Everitt *et al.*, 2001):
- ✦ selection of the centres (centroids) of classes (clusters) – preceded by the determination of the number of classes (clusters) – the centroids are selected by, *inter alia*, random selection of k observations, selection of the first k observations from the set, or selection allowing for maximisation of the cluster distance;

- ✦ assigning points to the nearest centroids – each element is assigned to the class (cluster) to whose centroid it is closest (the measure of similarity is the distance between the element and the centroid);
- ✦ calculation of new cluster centres – most often, the new centre of a class (cluster) is the point whose coordinates are the arithmetic mean of the coordinates of the elements belonging to that class;
- ✦ repeating the algorithm until a convergence criterion is reached.

In the model used, the algorithm initialises the centroids randomly and then iteratively assigns each point to the nearest centroid, updating the position of the centroids until convergence is reached or the stop condition is met, *i.e.*, no more shifts of objects from group to group are observed (each element is in the group in which the centroid is closest to it) (Witkowska, 2002).

Prior to clustering, data standardisation was carried out using the z-score method:

$$z = \frac{x - \mu}{\sigma} \quad (1)$$

where: x is the data point value, μ is the population mean, and σ is the population standard deviation.

Clustering of the data was performed using the k-means algorithm with the number of clusters set to 4. The Euclidean distance metric was used as the division criterion function according to the following formula:

$$d_{il}^2 = \sum_{j=1}^m (x_{ij} - \bar{x}_{lj})^2 \quad (i = 1, \dots, n), \quad (2)$$

where: d_{il} is Euclidean distance between the i -th object and the nearest l -th centroid and m is the number of variables (macroeconomic indicators). A set of Euclidean distances is calculated between each element of the set and successive centroids.

Next, a binary classifier was then created for each stability group to distinguish that class from the other classes using Bayesian inference based on conditional probabilities (Schneider, 2015; Wald, 1949). To this end, a logistic regression method was used using the one-*versus*-rest method. The one-*versus*-rest method is a multi-class classification technique that involves training one binary classifier for each class to predict whether an observation belongs to that class or not. The logistic regression model is closely related to the probit model, which is the most appropriate model to use in predicting stability, business cycle, and turning points (Chin *et al.*, 2000; Estrella and Mishkin, 1998).

The logit model has the same basic implications as probit with the advantage of being slightly more intuitive and easier to calculate (Gujarati, 2003). The probability of belonging to a given class c for a given observation x can be expressed by a logistic function as:

$$P(y = c | x) = \frac{1}{1 + e^{-z}}, \quad (3)$$

where z is a linear function defined as:

$$z_c = \beta_0 + \beta_1 x_1 + \dots + \beta_n x_n + \varepsilon_c, \quad (4)$$

where β_i are the regression coefficients and x_i are the features of the observations, *i.e.*, the macroeconomic indicators that characterise stability (for $n = 19$ in this case).

To estimate the parameters, the maximum likelihood method was used (Glantz and Kissell, 2014). Standardised coefficients in logistic regression analysis have the same utility as standardised coefficients in linear regression analysis (Menard, 2011). The class with the highest predicted probability is selected as the assigned class for a given observation. A model explaining the state of macroeconomic stability over a given period can generally be expressed as follows:

$$MSS_t = \max P\left(y_{ct} = c \mid \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + \beta_5 x_{5t} + \beta_6 x_{6t} + \varepsilon_t)}}\right) \text{ for } c \in \{1, 2, 3, 4\}, \quad (5)$$

where MSS_t is the estimated macroeconomic stability state in period t , c is the set of macroeconomic stability states (1 – very low stability, 2 – low stability, 3 – medium stability, 4 – high stability), and y is the logistic regression function determining membership of a given stability state c in period t .

5.5 Assessment and forecast of Poland's macroeconomic stability

Using an iterative model of macroeconomic stability, the assumptions and procedure of which were described in an earlier section, a forecast of Poland's macroeconomic stability was carried out for three different periods:

- ✦ the first period included all available data on the basis of which forecasts were made for 15 months beyond the study period;
- ✦ the second period covered the time before the COVID-19 pandemic, which allowed the identification of key stability factors before the global health crisis;

- ✦ the third period focused on analysing stability during and after the pandemic to assess changes in the dynamics of factors influencing economic stability in the context of the global crisis and possible changes in economic policy.

To select predictors of stability, large datasets were analysed to examine the strength and nature of the relationships between variables and variables associated with the macroeconomic stability factors analysed were extracted. The selection process focused on data that were leading in relation to the macroeconomic indicator to be used to formulate the predictive model. The selection covered more than 100 million time series collected on the ExMetrix platform and produced a set of nineteen time series in the lead relative to the macroeconomic indicator in each category of macroeconomic stability factors considered in the predictive model. The analysis includes a set of nineteen time series collected on the ExMetrix platform, which are in the lead relative to the macroeconomic indicator considered in the predictive model. The data is from 31 March 2003 to 31 December 2023. The data was taken from the databases of Statistics Poland, OECD, and FRED (for the macroeconomic indicators) as well as TGE, Endex, KOBIZE, ENTSO-E, PSE, and ARP S.A. (for the energy price level). The study included two stages. In Stage 1, 40 logistic regression models were estimated in 2023 (Raczkowski, 2023). The models were formulated on a machine learning basis for data from periods with different data ranges covered to test whether the addition of data from subsequent years would have a significant impact on the role of individual criteria in achieving macroeconomic stability. This is especially the case when the focus is on creating conditions for sustainable functioning and reducing economic inequality among the population (Karas, 2020). The results obtained show a very significant increase in the weighting for the energy price level after learning the model and a decrease in the importance of the inflation rate, which may indicate that some of the data that dealt with the inflation rate were classified by the model under the general energy price level, which is justified as changes in the energy price have inflationary or deflationary effects (Raczkowski, 2023).

The first period covered the full range of available data, *i.e.*, from 31 March 2003 to 31 December 2023. Based on formula (4), linear regression models were estimated for individual stability states. The estimation was performed using the Classical Least Squares Method (CLSM), which minimises the difference between the observed values and the values predicted by the model (Maddala, 2006). According to the Gauss-Markov theorem, the CLSM estimator is the linear unbiased estimator with the smallest parameter variance of all regression

estimators, *i.e.*, BLUE – Best Linear Unbiased Estimator (Theil, 1971). The coefficients for each category of stability factors represent the average value of the parameters of the time series of macroeconomic indicators assigned to that category. Below are the estimated model parameters (weights) assigned to the relevant features and stability groups:

TABLE 2. Logistic regression coefficients

FEATURE	GROUP 1	GROUP 2	GROUP 3	GROUP 4
Intercept	-4.320365	-4.419307	-1.500281	-1.980081
GDP growth rate	0.933651	0.773849	0.297749	0.921226
Unemployment rate	0.156864	1.120882	1.396037	1.083191
Inflation rate	0.298403	0.284194	0.781540	0.412207
Budget deficit-to-GDP ratio	1.133138	1.172592	0.875130	0.956788
Current account balance-to-GDP ratio	0.493842	0.187440	0.533029	0.046577
Overall energy price level	0.349675	0.242441	0.377512	0.330030

Source: Own calculations.

Empirical predictive models for each stability group, expressed using a linear function and a logistic function to predict group membership based on specific macroeconomic features, are as follows:

✦ *Group 1 – Very low stability*

$$z_1 = -4.320365 + 0.933651 \cdot (\text{GDP growth rate}) + 0.156864 \cdot (\text{Unemployment rate}) + 0.298403 \cdot (\text{Inflation rate}) + 1.133138 \cdot (\text{Budget deficit to GDP ratio}) + 0.493842 \cdot (\text{Current account balance to GDP ratio}) + 0.349675 \cdot (\text{Overall energy price level}) \quad (6)$$

✦ *Group 2 – Low stability*

$$z_2 = -4.419307 + 0.773849 \cdot (\text{GDP growth rate}) + 1.120882 \cdot (\text{Unemployment rate}) + 0.284194 \cdot (\text{Inflation rate}) + 1.172592 \cdot (\text{Budget deficit-to-GDP ratio}) + 0.187440 \cdot (\text{Current account balance-to-GDP ratio}) + 0.242441 \cdot (\text{Overall energy price level}) \quad (7)$$

✦ *Group 3 – Medium stability*

$$z_3 = -1.500281 + 0.297749 \cdot (\text{GDP growth rate}) + 1.396037 \cdot (\text{Unemployment rate}) + 0.781540 \cdot (\text{Inflation rate}) + 0.875130 \cdot (\text{Budget deficit-to-GDP ratio}) + 0.533029 \cdot (\text{Current account balance-to-GDP ratio}) + 0.377512 \cdot (\text{Overall energy price level}) \quad (8)$$

✦ *Group 4 – High stability*

$$z_4 = -1.980081 + 0.921226 \cdot (\text{GDP growth rate}) + 1.083191 \cdot (\text{Unemployment rate}) + 0.412207 \cdot (\text{Inflation rate}) + 0.956788 \cdot (\text{Budget deficit-to-GDP ratio}) + 0.046577 \cdot (\text{Current account balance-to-GDP ratio}) + 0.330030 \cdot (\text{Overall energy price level}) \quad (9)$$

To obtain predictions of future values in the updated macroeconomic stability model, the values obtained from the partial predictive models for the nineteen factors that had the greatest impact on the economic stability categories were substituted into the resulting model. The predicted state of macroeconomic stability was determined by the highest predicted probability of assignment to a given group derived from the empirical models according to formula (3). The complex formula for the iterative stability model for the analysed period and the selected factors can be expressed as follows:

$$MSS_T = \max_{c \in \{1,2,3,4\}} \left(\frac{1}{1 + e^{-z_c}} \right) = \begin{cases} 1 \Rightarrow \frac{1}{1 + e^{-z_1}} > \frac{1}{1 + e^{-z_2}} \\ 2 \Rightarrow \frac{1}{1 + e^{-z_2}} > \frac{1}{1 + e^{-z_3}} \\ 3 \Rightarrow \frac{1}{1 + e^{-z_3}} > \frac{1}{1 + e^{-z_4}} \\ 4 \Rightarrow \frac{1}{1 + e^{-z_4}} > \frac{1}{1 + e^{-z_1}} \end{cases}, \quad (10)$$

The results of the forecast calculated from formula (10) are included in Table 3.

TABLE 3. Stability prediction for the following months between January 2024 and March 2025

PREDICTION DATE	STABILITY GROUP
2024-01-31	2 – Low stability
2024-02-28	2 – Low stability
2024-03-31	3 – Medium stability
2024-04-30	3 – Medium stability
2024-05-31	2 – Low stability
2024-06-30	2 – Low stability
2024-07-31	4 – High stability
2024-08-31	4 – High stability
2024-09-30	2 – Low stability
2024-10-31	4 – High stability
2024-11-30	4 – High stability
2024-12-31	3 – Medium stability
2025-01-31	3 – Medium stability
2025-02-28	3 – Medium stability
2025-03-31	3 – Medium stability

Source: Own calculations.

Verification of the prediction model was performed on the basis of the following metrics: precision, recall and F1-Score for each of the four groups. Precision measures how many of the predicted cases for a class actually belong to that class. Recall measures how many of the actual cases of a class were correctly identified by the model. The F1-Score is the harmonic mean of precision and recall.

TABLE 4. Predictive model evaluation

STABILITY GROUP	PRECISION	RECALL	F1-SCORE
1	0.90	0.85	0.87
2	0.88	0.92	0.90
3	0.82	0.78	0.80
4	0.89	0.95	0.93

Source: Own calculations.

In the study case, the model achieved an accuracy of 0.88, meaning that 88% of all cases were correctly classified.

Subsequently, to identify key stability factors prior to the global health crisis COVID-19 and to assess changes in the dynamics of factors affecting economic stability as a result of the global crisis, the models were estimated with the research sample split into pre-pandemic and post-pandemic periods.

The pre-pandemic period includes data from 31 March 2003 to 29 February 2020. Below are the model parameters estimated according to formula (3) (weights) for the sample covering the pre-pandemic period data, assigned to the relevant features and stability groups:

TABLE 5. Logistic regression coefficients (pre-pandemic period)

FEATURE	GROUP 1	GROUP 2	GROUP 3	GROUP 4
GDP growth rate	0.745746	0.780348	0.254915	0.296999
Unemployment rate	0.308761	1.213161	1.249288	1.049471
Inflation rate	0.408929	0.570610	0.456306	0.065042
Budget deficit-to-GDP ratio	0.983646	1.051842	1.203099	1.054643
Current account balance-to-GDP ratio	0.183992	0.270108	0.674825	0.173861
Overall energy price level	0.264913	0.297648	0.218556	0.244749

Source: Own calculations.

The values of the estimated parameters indicate that the GDP growth rate and the budget deficit-to-GDP ratio are most important for generating very low stability of the economy, while the unemployment rate mainly influences the maintenance of the state of the economy at a medium level (low and medium stability). High stability of the economy is determined almost equally by the unemployment rate and the budget deficit-to-GDP ratio.

The post-pandemic period includes data from 31 March 2020 to 31 December 2023. Below are the model parameters estimated according to formula (3) (weights) for the sample covering the post-pandemic period data, assigned to the relevant features and stability groups:

TABLE 6. Logistic regression coefficients (post-pandemic period)

FEATURE	GROUP 1	GROUP 2	GROUP 3	GROUP 4
GDP growth rate	0.594879	0.324936	0.191169	0.738249
Unemployment rate	0.805252	0.300219	0.271416	0.593372
Inflation rate	0.377687	0.229089	0.379280	0.364773
Budget deficit-to-GDP ratio	0.431225	0.380409	0.161862	0.649687
Current account balance-to-GDP ratio	0.232588	0.107464	0.501224	0.195247
Overall energy price level	0.169151	0.304918	0.205654	0.431548

Source: Own calculations.

The values of the estimated parameters indicate that, after the health crisis, it is the unemployment rate that is of the greatest importance in steering the economy towards a state of very low stability. The GDP growth rate and the budget deficit-to-GDP ratio are the most important for generating high stability of the economy. It is also worth noting that all factors are of similar importance for maintaining the state of the economy at a medium level (low and medium stability), while significant disturbances in indicators, even in one indicator only, lead to an extreme state.

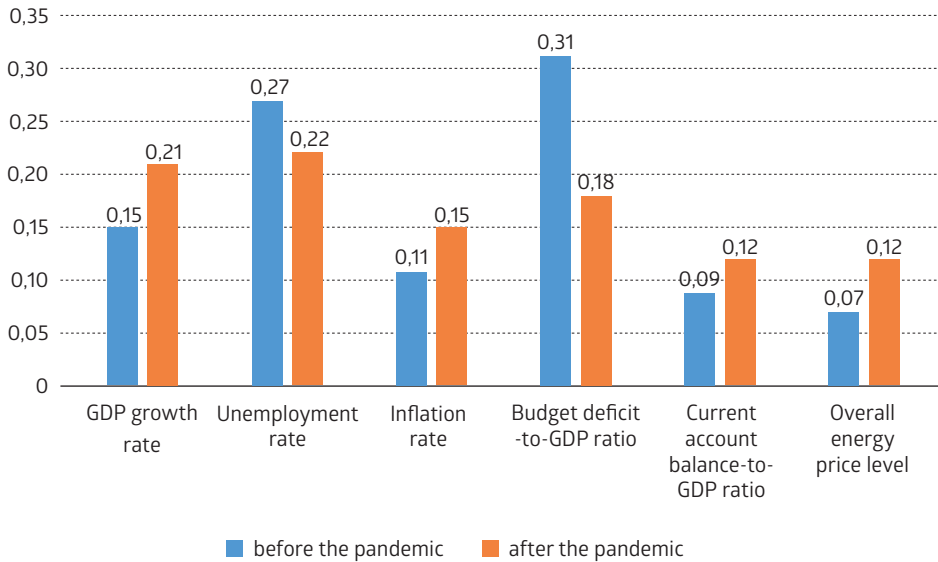
A comparison of the prediction results (Figure 3) for the pre- and post-pandemic periods shows the dynamics of changes in factors affecting economic stability.

The analysis of the research results brings the following conclusions. One group of conclusions seem obvious (even trivial) and the other changes the perception of the main research area (macroeconomic stability modelling).

It should be emphasised that the COVID-19 pandemic and, later, the war in Ukraine have had a significant impact on how macroeconomic stability is perceived, which means that the previously used research tools and methods should be modified. The changes should concern the research area in positive economics and cover the following issues (Badiei *et al.*, 2022):

- ✦ improving the quality of economic policies, including monetary policy;
- ✦ greater precision and accuracy of analyses;
- ✦ a deeper understanding of economic behaviour;
- ✦ identifying new relationships and patterns;
- ✦ the development of new fields of research.

FIGURE 3. Logistic regression coefficients – percentage of share indicators in the pre- and post-pandemic model



Source: Own calculations.

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- ✦ the development of new fields of research.

New canons of macroeconomic stability can form the basis for a paradigm shift in stability analysis by, for example, central banks, affecting household disposable income, investment capacity, and the level of return on corporate equity. There is

also a need to apply a new perspective on the perception of macroeconomic stability in the use of tools used in normative economics. This should cover the following issues (Caplin and Schotter, 2008):

- ✦ identifying new factors influencing the dynamics of economic stability;
- ✦ improvements to the assessment criteria;
- ✦ improving the quality of analyses;
- ✦ development of new tools to assess macroeconomic stability.

The impact of the events referred to above caused the weighting of individual factors affecting macroeconomic stability to change in the study. As a result, due to fundamental changes in the functioning of the economy, some factors became more relevant from the perspective of macroeconomic stability. Additionally, factors such as the unemployment rate and the budget deficit-to-GDP ratio were shown to have lost their importance, as illustrated in Figure 3 (“Logistic regression coefficients – percentage share of indicators in the pre – and post-pandemic model”).

The group of factors that lost importance in the perception of macroeconomic stability after the COVID-19 pandemic comprises the unemployment rate and the budget deficit-to-GDP ratio. The share of the indicator on the unemployment rate changed from 27% (before the pandemic) to 22% (after the pandemic). The percentage share of the indicator on the budget deficit ratio in the stability research changed from 31% (before the pandemic) to 18% after the pandemic.

At the same time, another group of factors became relevant. It included the GDP growth rate, the inflation rate, the current account balance-to-GDP ratio, and the overall energy price level. The indicator on the GDP growth rate was 15% before the pandemic and its relevance increased to 21% in the post-pandemic period. The indicator on the inflation rate changed from 11% (before the pandemic) to 15% (after the pandemic). The current account balance-to-GDP ratio changed from 9% to 12% in the post-pandemic period. The increase in the indicator on the overall energy price level is one of the most dynamic of all the factors that make up the macroeconomic stability modelling study. The indicator on the overall energy price level was 7% before the pandemic and 12% after the pandemic.

As the changes and dynamics of the values of the individual indicators show, the perception of the weighting (and thus relevance) of the individual elements that have so far been considered crucial in the context of macroeconomic stability has changed. In conclusion, given the multidimensional economic and geopolitical

changes as well as the ongoing process of energy transition, it is very likely that the value of the overall energy price level will play an increasingly important role in building macroeconomic stability in the future.

Modern technologies, such as data mining and machine learning, offer previously unavailable opportunities for action in terms of mining the available data to create predictive models and increase the effectiveness of the predictions made. The results of this research coincide with changes in the previous paradigm of research on macroeconomic stability. The socio-economic processes currently taking place (ongoing or just initiated) will cause changes in the perception and use of tools to achieve macroeconomic stability and thus contribute to building conditions for sustainable economic growth.

Conclusions and further research recommendations

There is a consensus in the literature that macroeconomic stability is crucial for sustainable economic growth. Projections of macroeconomic stability serve as the basis for monetary policy decisions taken by central banks and economic policy decisions taken by central authorities. The measurement of macroeconomic stability is closely related to the nature of the proposed methodology, in particular the type of data used to determine whether it is historical, current, or based on macroeconomic forecasts (Raczkowski and Komorowski, 2023). The use of appropriate models will give a deeper understanding of the impact of different policies on employment, inflation, economic growth, and other key indicators including those relating to the current state and the energy system that is subject to transition. This will help to avoid mistakes and dangerous situations that could lead to a destabilising economic situation (*e.g.*, recession, excessive inflation, or other undesirable effects).

The iterative economic stability assessment model proposed in this chapter leads to the identification of key factors that have a significant impact on economic stability. The model is algorithmic and allows a rapid multivariate analysis based on cluster analysis methods and Bayesian inference.

Using the model presented here, the models were estimated with the research sample split into pre-pandemic and post-pandemic periods to identify key stability factors prior to the global health crisis COVID-19 and to assess changes in the dynamics of factors affecting economic stability as a result of the global crisis. The results of the iterative parameters of the models show that maintaining high stability of the economy in the pre-pandemic period required appropriate

policies on unemployment and the budget deficit and the deterioration of GDP growth dynamics steered the economy towards very low stability. The results of the iterative parameters of the models show that maintaining high stability in the economy in the post-pandemic period required appropriate policies for the budget deficit and GDP growth dynamics and, to a lesser but equally important extent, for unemployment and energy prices. The unemployment, mainly rising, steered the economy towards a loss of economic stability.

It should be emphasised that another factor, extending beyond the previous studies and important in the process of moving towards economic (macroeconomic) stability, has also been identified: the change in energy prices the impact of which has increased significantly in the post-pandemic period and may gradually increase in the following years due to the initiated energy transition process. The energy transition process requires changes in energy production, transmission, and distribution technologies, which may play a key role in shaping the economy of the future. Economic actors can be expected to experience changes in the costs of generation, transmission, and distribution and thus changes in the overall level of energy prices. Increased energy prices will increase the operating costs of households and businesses, which in turn will change the level of competitiveness of entire industries, sectors and, consequently, the entire economy and its stability. Therefore, paying special attention to energy transition issues should be a permanent element in the study of macroeconomic stability.

Based on the presented methodology for studying macroeconomic stability, with all its elements described in this chapter, the following conclusions can be drawn:

- A. The novel and unique approach to the dynamic view of macroeconomic stability as a phenomenon dependent on the changing palette of factors influencing it has implications for the use of tools used in the research in both positive and normative economics.
- B. The previous paradigm for perceiving macroeconomic stability is changing. In a post-pandemic situation, the importance of certain factors has increased and thus the so-called classical factors hitherto identified with macroeconomic stability (the unemployment rate and the budget deficit-to-GDP ratio) have lost their importance.
- C. Modelling macroeconomic stability is an evolving process due to technological developments in the use of new AI-based tools that allow the identification of new factors influencing macroeconomic stability.
- D. The importance of the impact of energy prices in maintaining macroeconomic stability is increasing. The energy transition process initiated in the economy is

the element whose importance in the post-pandemic period clearly increases in the context of the perception of macroeconomic stability.

- E. The study of the energy transition process requires knowledge of the energy system and its key components and thus the costs that are and will be incurred in the economy due to changes in energy production systems (from RES and other energy carriers). The role and importance of energy transmission and distribution systems from generation sites to the end user cannot be ignored throughout the research process. Therefore, the palette of tools used so far should be revised, *e.g.*, by adding an analysis of the dynamics of the Energy Transition Index (ETI).
- F. The process of modelling macroeconomic stability should be subject to continuous improvement. As the study concerns the post-pandemic period and the time of political and socio-economic turbulence caused by Russia's invasion of Ukraine and its consequences, the methodology of macroeconomic stability research will be subject to evolution.
- G. As the paradigm and methodology of macroeconomic stability research changes, new research methods will be required, taking into account new AI tools and the increasing capacity and frequency of the collection of the required data.

The implementation of the conclusions may contribute to proposing possible changes in economic policy and building a long-term economic strategy to state authorities and institutions and thus have an impact on maintaining macroeconomic stability.



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