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INFLATION MANAGEMENT IN THE EU: DOES THE EUROZONE OUTPERFORM NON-EURO STATES?

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Abstract

This study examines the effectiveness of the monetary policy of the European Central Bank (ECB) in managing inflation in the Euro Area compared to the independent monetary policy of seven European Union Member States outside the Economic and Monetary Union (EMU). It highlights the complexity of applying a centralized one size fits all approach to diverse economies, highlighting the differences between core and peripheral EMU countries and the unique challenges faced by non-Eurozone countries. In addition, the study includes an analysis of the stress indicator, defined as the difference between the ECB's main refinancing rate and the optimal rate of the central bank of non-EMU countries. This indicator reflects whether the ECB's monetary policy has been too loose or too restrictive relative to the needs of non-Euro Area countries. The stress indicator is further analyzed during key economic periods, including past crises, to assess its volatility. Using econometric models, the study assesses the impact of optimal interest rates and macroeconomic indicators on inflation in three groups: the EU as a whole, Euro Area and non-Euro Area countries. This multi-faceted approach provides valuable insights into the varying effectiveness of centralized and independent monetary policies in addressing inflation challenges.

Keywords

Monetary Policy, Central Bank Independence, Inflation Stabilization, EU, EMU

JEL classification: E52, E58, E63, F36

1. Introduction

The Economic and Monetary Union (EMU) was established as a crucial pillar of the European single market, aiming to foster economic integration, stability and convergence across Europe. The creation of a common currency, the Euro, was intended to eliminate the exchange rate volatility among national currencies, thereby facilitating trade and capital flows within the Union (Adamski, 2020). The European Central Bank (ECB), the main institution of the Economic and Monetary Union, is responsible for managing the euro and implementing a unified monetary policy that aims at maintaining price stability across the Eurozone (Geraats, 2008). However, a versatile approach is highly challenging, particularly for the countries belonging to the Eurozone and for those outside of it, given the diversity of economic conditions. The ECB's policies, while designed to stabilize the entire Eurozone, may not align with the specific needs of individual countries, potentially leading to economic disparities or stress (Nechio, 2011). However, achieving the objectives of the EMU is contingent upon member states meeting specific convergence criteria before joining the Eurozone. Failure to adhere to these criteria can have adverse implications for the economic conditions of both – the member state and the Union as a whole.

The convergence criteria, known as the Maastricht criteria, are essential for ensuring that prospective members of the Economic and Monetary Union (EMU) are economically aligned with the stability objectives of the Eurozone. These criteria mandate price stability, fiscal discipline (with budget deficits under 3% of GDP and debt ratios below 60% of GDP), stable long-term interest rates, and participation in the European Exchange Rate Mechanism (ERM II) to demonstrate exchange rate stability (Bukowski, 2006). Despite these rigorous requirements, several countries, including Belgium, Italy, and Greece, were admitted to the EMU despite not fully meeting the criteria, particularly concerning high public debt levels that far exceeded the 60% threshold, reaching respectively – 117%, 115% and 108% (Cahen, 2023). Moreover, reports from the European Commission and the European Monetary Institute indicated that Greece failed to meet any of the Maastricht convergence criteria (Herz, Kotios, 2000). The non-compliance with these criteria had long-term repercussions, culminating in the Greek

financial crisis, which not only severely impacted Greece's economy but also posed significant challenges to the stability of the entire Eurozone (Pagoulatos, 2020). Similarly, Italy has grappled with persistent economic difficulties, such as low growth and fiscal instability, attributed to unresolved structural issues present before its accession to the EMU (Russo, 2006). Croatia's recent entry into the EMU in 2023, following significant fiscal adjustments, also raises concerns about the long-term sustainability of these measures and potential future economic instability, underscoring the ongoing challenges faced by the Eurozone in managing diverse economic conditions among its members.

In addition to the challenges faced by the countries that were accepted into the Eurozone despite not meeting the required convergence criteria, the current economic situation also highlights the limitations of the centralized monetary policy of the ECB. Inflation is currently one of the most important economic problems in Europe, which is further exacerbated by the ongoing economic crises. In recent years, inflation in Europe has reached its highest level in decades. In the Eurozone, in 2023 inflation reached the highest level since the creation of the common currency in 1999, which has once again raised concerns about the long-term stability of the entire EMU and its ability to respond to economic shocks. The member states of the Eurozone, and in particular the peripheral economies, are struggling with significant challenges in managing inflation, which is exacerbated by the ECB's one-size-fits-all approach to monetary policy (Honohan, 2024). Rising inflation has revived the discussion on the effectiveness of the ECB's monetary policy in counteracting inflationary pressures in such diverse economic environments.

The above-mentioned convergence criteria serve to protect the economy of the entire EMU, not individual member states. In the case of such significant differentiation of the economic conditions of countries currently remaining outside the EMU, it is necessary to analyze whether the Euro Area, composed of countries with diverse economic conditions and often facing different inflationary pressures, can effectively face the challenges posed by global economic crises. While the ECB's centralized monetary policy aims to maintain cohesion within the Eurozone, its rigid framework may lack the flexibility needed to address the unique economic conditions of individual member states, particularly during times of crisis. The relevance of this issue has significantly increased in recent times, as inflation continues to challenge economic stability in many European countries. Therefore, this analysis will focus on assessing the effectiveness of the ECB's approach to inflation management, comparing it with the monetary policies of non-Eurozone countries, and investigating whether the flexibility afforded to these nations allows them to manage inflation more effectively.

The primary objective of this research is to compare the effectiveness of inflation management in the Euro Area and non-Euro Area countries. Specifically, it aims to determine whether the centralized and standardized monetary policy of the ECB provides the necessary flexibility to respond to global economic shocks or if the autonomy enjoyed by non-Euro Area countries allows for a more effective response to inflationary pressures. The study also includes a review of existing literature to identify gaps in knowledge and address them, contributing to current understanding. A comparative analysis of monetary policies reveals differences in approaches and national needs. Additionally, the research evaluates a stress indicator for non-Euro Area countries to assess the adequacy of ECB policies. This indicator is further analyzed during past economic crises to determine whether ECB policies were overly restrictive or excessively loose, enhancing insights into inflation management across diverse economic contexts.

The structure of the article is divided into five parts. It begins with a literature review, which serves to determine the current state of research and research gaps in areas such as the ECB's monetary policy inadequacy, recent inflation challenges in the European Union, inflation management in the Eurozone as well as the national autonomy and inflation management in the non-Eurozone countries The next chapter is focused on discussing the research methodology. It includes a discussion of all the research methods and techniques used in order to achieve the research goal. The following chapter discusses the results of the conducted research, divided into their individual stages. The first stage comprises a contrastive qualitative analysis of the monetary policy of the seven EU member states currently outside the EMU, which serves to highlight the differences in the characteristics and needs of these economies. The next stage discusses the results of the quantitative studies conducted using the stress indicator, which analyses the disparity between the ECB's rate of the main refinancing operations and the optimal interest rate of the central banks of individual countries outside the EMU. In addition, the analysis also covers the average stress indicators for the seven EU member states that do not belong to the EMU during periods of significant economic crises, which shed light on the adequacy of the ECB's monetary policy in the periods that particularly threaten domestic economic stability.

A key component of the research involves the development of three econometric models designed to evaluate the impact of optimal interest rates and selected macroeconomic indicators on inflation. The first model encompasses the entire European Union, while the remaining two focus specifically on the Eurozone and non-Eurozone countries. These models aim to highlight the differences in the effectiveness of monetary policy in managing inflation across these regions, providing a nuanced understanding of regional disparities and policy outcomes.

2. Literature Review

2.1 ECB's Monetary Policy Inadequacy

Monetary policy, which aims to stabilize economies by controlling inflation, managing employment, and adjusting interest rates, is often based on a theoretical framework that seek to balance discretion with principles. In particular, Taylor (1993) discusses the advantages of a rules-based approach, such as the Taylor Rule, which aims to ensure predictability and stability to monetary policy. However, the uniform application of such rules by the ECB, focused primarily on the Eurozone, often ignores the diverse economic conditions of non-Eurozone countries, leading to potential shortcomings.

In their seminal work, Clarida, Galí and Gertler (1998) provide empirical evidence on the effectiveness of monetary policy rules in various international contexts. They emphasize that while such rules can be effective in large, integrated economies like the Eurozone, their application may be less appropriate in non-Eurozone countries with different economic structures and policy needs. This suggests that the ECB's rules-based approach may not be flexible enough to accommodate the specific requirements of these external economies.

Urbanowicz (2014) extends this discussion by examining the stabilizing role of monetary policy within a currency union. She argues that the ECB's policies, tailored to the economic conditions of Eurozone countries, often result to discrepancies when applied to non-Eurozone economies, potentially leading to destabilizing effects. In her later research, Urbanowicz (2024) provides an in-depth analysis of Poland's economic experience in the period from 1999 to 2023, illustrating the inconsistency between the ECB's monetary policy and Poland's economic needs. The study highlights how the ECB's one-size-fits-all approach can lead to periods of economic instability in countries like Poland, which, although closely integrated with the Eurozone, have different economic contexts and needs.

Sławiński's (2016) research critically assesses the limits of the effectiveness of the ECB's monetary policy, particularly in the context of global financial integration. He argues that the ECB's policies are too focused on the Eurozone, failing to take into account the broader interconnectedness of global economies, especially those on the Eurozone's periphery. This critique is consistent with the broader literature that calls for a more nuanced approach to monetary policy, one that can be tailored to the diverse needs of both – the Eurozone and non-Eurozone economies.

2.2 Recent inflation challenges in the European Union

Before European economies could fully recover from the economic freeze caused by the COVID-19 pandemic, another shock emerged in the form of Russia's military aggression against Ukraine. Overlapping of the events complicates a clear assessment of how strongly the war has influenced inflation, however, certain factors are undeniable. Firstly, the Eurozone is heavily dependent on energy imports, particularly from Russia, which until recently was its primary supplier. Russia and Ukraine were also critical producers and exporters of fertilizers and food to EU member states. This disruption significantly drove up prices for essential commodities such as cooking oils, flour, and sugar – key inputs in food production. The Eurozone's high economic openness makes it exceptionally vulnerable to global market disruptions and supply chain disturbances (Arce, Koester, Nickel, 2023). Thus, the Russia-Ukraine war has undeniably increased inflationary pressures in the Eurozone. However, as the ECB (2022) notes, the economic shocks triggered by the invasion have had an even more severe impact on European countries outside the eurozone, given their deeper economic ties with Russia and Ukraine. As Mielus (2022) notes, emerging EU economies outside the eurozone, particularly Poland, Hungary, and the Czech Republic, are experiencing the most severe negative effects of the Russo-Ukrainian conflict. For example, the outbreak of the war led to a decline in the Polish złoty and increased inflationary pressure in Poland. Unlike Eurozone countries, Poland cannot rely on improved conditions for securing funds in financial markets through bond issuance, as interest rates rose following Russian aggression. Consequently, for non-Eurozone countries, access to funds from the EU Recovery Fund is becoming increasingly important (Szczepanik, 2022).

The impact of climate change on inflation, often referred to as climateflation, is undeniable. Among the inflationary factors, the increasing frequency of extreme weather events plays a significant role, driving up the prices of certain goods, particularly food and energy. These effects are magnified by disruptions in supply chains and rising insurance premiums. Additionally, rising temperatures and the prevalence of pollution-related illnesses contribute to lower worker productivity and overall economic efficiency. The ECB (2021) emphasizes that effective management of the green transition can mitigate the adverse inflationary effects of these phenomena. However, this mitigation comes at a cost. Key expenses include higher taxes on fossil fuels and increased carbon pricing under the "Fit for 55" initiative within the EU Emissions Trading System. These costs are expected to be partially passed on to consumers and producers, resulting in higher production costs and consumer prices. Moreover, the energy transition involves a surge in demand for alternatives to coal, such as natural gas, and critical minerals like tin, aluminum, copper, nickel, and cobalt. These resources are essential for green technologies, but their limited supply poses challenges, contributing to price increases. In summary, while the green transition is indispensable for long-term sustainability, it is also a contributing factor to inflation. The challenge lies in

balancing the costs of this transition with its potential to minimize the long-term economic impacts of climate change (Bossone et al., 2022).

2.3. Inflation management in the Eurozone

The monetary policy of the Eurozone, managed by the ECB has been extensively analyzed in terms of its effectiveness in stabilizing inflation. The ECB prioritizes price stability, utilizing tools such as the main refinancing rate, quantitative easing, and forward guidance. While research highlights the strengths of this approach, it also underscores its inherent limitations, particularly when applied across the diverse economies within the Eurozone.

Blanchard and Galí (2010) argue that the ECB's monetary policy demonstrates exceptional effectiveness in managing inflation in core economies like Germany and France. These economies benefit from well-developed financial markets and robust labor market institutions, which enhance the responsiveness of inflation to ECB interventions. Their research highlights that the ECB's inflation-targeting framework fosters stability by encouraging predictable policy adjustments and anchoring market expectations. In these environments, monetary policy works as intended, smoothing inflationary pressures and supporting economic stability.

However, critics such as De Grauwe and Ji (2013) emphasize significant disparities between the core and peripheral economies of the Eurozone. Peripheral countries, including Greece, Portugal, and Spain, often struggle with prolonged inflation persistence. These challenges are rooted in structural weaknesses – such as inefficient labor markets and fiscal rigidity – that make these economies less adaptable to external shocks or centralized monetary interventions. De Grauwe and Ji argue that the ECB's one-size-fits-all approach fails to account for these economic asymmetries, exacerbating inflationary or deflationary pressures in less resilient economies. This policy uniformity may inadvertently deepen the economic divide between core and peripheral states, undermining the cohesion of the Eurozone.

Lane (2012) further critiques the ECB's policy framework, noting that while it proves effective during periods of economic stability, it faces significant challenges in times of crisis. In such circumstances, the ECB struggles to deliver responses tailored to the specific needs of individual member states. Lane's findings highlight that during crises – such as the global financial crisis of 2008 – policy delays and a lack of flexibility contributed to disparities in inflation outcomes across the Eurozone. Peripheral economies, in particular, bore the brunt of these inadequacies, facing prolonged economic stagnation and inflation volatility as the ECB's centralized approach failed to address their specific vulnerabilities.

On the other hand, Taylor (1993) argues that that rules-based approaches can enhance stability by providing structured responses to inflationary pressures. For instance, in the Eurozone, inflation is expected to moderate due to coordinated policy efforts, whereas non-Eurozone countries may experience more volatility owing to localized monetary responses.

These critiques collectively point to the limitations of a uniform monetary policy in a region characterized by such deep economic heterogeneity. While the ECB's tools are effective in well-developed core economies, their rigidity and inability to adapt to the unique conditions of peripheral countries remain significant obstacles to achieving inflation stability across the entire Eurozone.

2.4 National autonomy and inflation management in the non-Eurozone countries

Countries outside the Eurozone are not directly dependent on the ECB and its monetary policy decisions. Their control over independent monetary policies allows them to tailor mechanisms to address current inflationary pressures, offering greater flexibility and adaptability to specific domestic economic conditions.

Research highlights that this independence yields measurable benefits, particularly during periods of economic crises. Dąbrowski (2019) notes that non-Eurozone countries, such as Poland and the Czech Republic, utilize interest rate adjustments and monetary policy frameworks that are tailored to their individual needs. This autonomy facilitates countercyclical policy adjustments, which may diverge from the ECB's stance for the Eurozone. For instance, during the global financial crisis of 2008, countries with independent monetary policies responded more swiftly and effectively to domestic inflationary pressures than Eurozone economies, which were subject to the ECB's centralized monetary policy framework.

An analysis of the impact of monetary policy on various sectors of the economy reveals significant sectoral differences. For instance, a policy of currency depreciation aimed at boosting exports might disproportionately benefit the export-oriented industries while simultaneously increasing the cost of imported goods. Such dynamics can lead to higher production costs for import-reliant sectors, such as manufacturing and retail. On the other hand, a strong national currency may stabilize import prices but weaken export competitiveness, thereby affecting the trade balance and overall economic growth (Liu, 2024).

According to Albiński and Polański (2015), beyond conventional interest rate adjustments, non-Eurozone countries often leverage other instruments of monetary and fiscal policy. For example, interventions in the foreign exchange markets can stabilize exchange rate volatility, mitigating risks for sectors heavily dependent on international trade. Additionally, fiscal measures, such as targeted subsidies for strategic industries or adjustments in tax policy, can complement monetary efforts to stabilize inflation and stimulate economic growth. These multi-

faceted strategies enable more nuanced responses to inflationary pressures but also require careful coordination to avoid policy inconsistencies.

It is worth mentioning that, according to Taylor (1993), flexible exchange-rate systems typically outperform fixed-rate systems in managing price volatility. This insight is particularly relevant when contrasting the inflation performance of non-Eurozone countries, which leverage flexible exchange rates, with the Eurozone, where fixed exchange rates and a unified monetary policy framework dominate.

However, non-Eurozone countries face their own set of challenges in managing inflation. As Cihak and Fonteyne (2009) point out, open economies are more vulnerable to external shocks, such as capital outflows or exchange rate volatility, which can destabilize inflation dynamics. Additionally, the financial markets in these countries often suffer from structural inefficiencies, resulting in slower and less effective transmission of monetary policy.

Urbanowicz (2024) observes that non-Eurozone countries exhibit greater inflation volatility compared to Eurozone economies. She argues that while this volatility is a significant drawback, it is partially offset by the flexibility afforded by independent monetary policies, which allows these countries to achieve meaningful stabilization effects, albeit with some delays. The trade-off between monetary policy flexibility and exposure to external shocks remains a key factor in evaluating the effectiveness of their inflation management strategies.

For instance, Poland has employed strategic currency interventions during periods of acute exchange rate volatility, aiming to stabilize its zloty against the euro (Michalczyk, 2010). Similarly, the Czech Republic implemented unconventional monetary tools, such as quantitative easing, to counter deflationary pressures in the post-2008 recovery period. These examples illustrate the diverse approaches available to non-Eurozone countries in leveraging their monetary sovereignty (Lízal, Schwarz, 2013).

This nuanced perspective underscores the benefits and limitations of independent monetary policies. While autonomy enables non-Eurozone countries to respond more dynamically to domestic challenges, their heightened sensitivity to external conditions and structural inefficiencies poses significant barriers to achieving consistent price stability.

Existing literature has extensively discussed the effectiveness of the ECB's monetary policy within the Eurozone and the flexibility offered by independent monetary policies in non-Eurozone countries. However, there remains a lack of in-depth comparative analysis, particularly regarding the ECB's ability to effectively respond to inflationary pressures across diverse economic contexts.

3. Methodology

This research is focused on assessing whether the ECB's one-size-fits-all monetary approach is more effective in managing inflation compared to the independent monetary policies of seven European Union member stats outside the EMU. Moreover, it aims to evaluate the adequacy of the ECB's monetary policy in addressing the economic needs of non-Eurozone countries.

3.1 Qualitative analysis

The initial phase of the research, built on the comparative framework, examines the alignment of non-EMU countries with the Maastricht convergence criteria, highlighting their degree of compliance and its implications for potential EMU accession. It also explores the diverse exchange rate policies adopted by these countries, contrasting fixed regimes, such as those in Denmark and Bulgaria, with the flexible strategies employed by Poland, Hungary, and the Czech Republic. Additionally, the study evaluates the use of monetary policy tools, including interest rate adjustments and currency interventions, to assess their effectiveness in managing inflation and responding to external economic shocks. The analysis incorporates data-driven insights on inflation rates, exchange rate fluctuations, and public debt levels, alongside qualitative case studies that illustrate country-specific strategies. By examining these factors, the study aims to illuminate the trade-offs between independent monetary policies and the ECB's one-size-fits-all approach, offering a glance on how non-EMU countries navigate economic stability within the broader EU framework.

3.2 Quantifying monetary policy misalignment

The subsequent stage of the analysis focuses on calculating of the stress indicator, defined by Clarida, Galí, and Gertler (1998), as the difference between the ECB base rate and the optimal rate for a given country belonging to the single currency area. In the context of the ECB, this optimal rate is represented by the base rate, which also serves as the rate for the main refinancing operations. For the examined non-Eurozone countries, the following rates, usually determined based on the Taylor rule, were considered optimal: Bulgaria – BNB base interest rate; Czechia – CNB (2W) repo rate; Romania – NBR policy rate; Sweden – Riksbank repo rate; Hungary – MNB base rate; Poland – NBP reference rate; Denmark – Nationalbanken lending rate. This research phase also includes an analysis of the stress indicator levels in the seven non-Eurozone countries over six selected periods, corresponding to significant economic events, as well as an evaluation of the adequacy of ECB monetary policy in relation to the

needs of these countries during the respective periods. According to the study's assumptions, the smaller the difference between the ECB base rate and the optimal rate of the individual countries, the better the alignment of the ECB's monetary policy to the economic requirements of these countries. The period under review spans from January 1, 1999, to July 31, 2024. The starting point was chosen to coincide with the date when the euro was introduced for non-cash transactions and when the ECB began implementing the single monetary policy. All data were sourced from the official websites of the respective central banks. However, due to the unavailability of data for Romania from January 1, 1999 to January 7, 2003, this period was excluded from the analysis. The aforementioned lack of data should not significantly distort the results. It is worth noting that, unlike the data representing the Eurozone, the countries outside this area construct a panel data set, where the excluded information for Romania not only largely correlates with series characteristic of the other regions studied, but is also only a fraction of the information relating to Romania itself. The data obtained are of a daily frequency, ensuring a detailed and precise examination of the stress indicator across the period studied.

3.3 Econometric approach

The following stage of the analysis examines how the central bank's optimal interest rate of the seven non-EMU countries, as well as the key macroeconomic indicators such as real GDP and unemployment rate correlate with the level of inflation. The data utilized in this research were sourced from multiple reputable institutions, including the central banks of the respective non-EMU countries, the European Central Bank, and international economic databases such as the International Monetary Fund (IMF), Federal Reserve Bank of St. Louis (FRED) and the World Bank. The dataset covers the period from January 1, 1999 to December 31, 2023. Due to the nature of the indicators used – the central bank's optimal interest rate – annual data were employed by taking into consideration the value of each indicator as of December 31. The data on inflation and unemployment rates were provided in the form of year-over-year (YoY) changes. In the case of the Eurozone, the HICP inflation rate was used, while for countries outside the Eurozone – the CPI. Due to the fact that the CPI reflects the structure of domestic consumption (a basket of consumer goods specific to individual countries), it was assumed that it is a more precise indicator of inflation experienced by households in a given country outside the Eurozone.

The research was further enriched with two econometric analyses. The first analysis aimed to develop a model for the European Union as a whole, while the second focused on creating two separate models: one for Euro Area and another for non-EMU countries. The purpose of the second analysis is comparative, as it aims to highlight the difference in the effectiveness of inflation management between EMU and non-EMU countries.

To effectively analyze inflation management in the examined regions, the econometric models were developed with two key priorities: achieving high predictive accuracy and ensuring substantive correctness of the estimates. Three core exogenous variables were identified and included in the models. These variables were selected based on established economic theories and prior empirical studies, as they significantly influence inflation in a statistically meaningful way:

- interest rate was expected to have a negative effect on inflation. This assumption is supported by the fact that higher interest rates increase borrowing costs, discouraging both consumer spending and investment, which in turn alleviates inflationary pressures. Conversely, lower interest rates stimulate credit availability, boosting demand and driving inflation upwards. However, in certain scenarios, such as when interest rates are raised in response to sharply rising inflation, their short-term effect might paradoxically be positive, reflecting a reactive monetary policy stance;
- real GDP was anticipated to exhibit a positive relationship with inflation. Real GDP, as a measure of economic activity, reflects aggregate demand in the economy. Higher real GDP levels often signal robust economic activity, which can lead to demand-driven inflation as increased demand for goods and services exerts upward pressure on prices. On the other hand, subdued GDP growth typically corresponds with reduced inflationary pressures due to weakened demand;
- unemployment rate was expected to have a negative relationship with inflation. Drawing from traditional macroeconomic models, such as the Phillips Curve, higher unemployment is associated with lower inflationary pressure due to constrained wage growth and limited consumer demand. Conversely, lower unemployment rate often leads to upward pressure on wages and consumer spending, contributing to higher inflation. However, in the long run, this inverse relationship may diminish as inflation expectations adjust and other factors come into play.

During the analysis, almost 200 models with various specifications were constructed. Only those models with statistically significant variables were selected for further consideration. The statistical significance of these variables was assessed using the Student's *t*-test and validated through the F-test for overall model significance. Additionally, the models were evaluated to ensure the absence of excessive multicollinearity, which could undermine the reliability of the estimated coefficients. Additionally, the research aimed on obtaining three separate models with the highest possible coefficient of determination, while ensuring the analysis of the estimated results

was methodologically sound (in line with the theoretical assumptions outlined above and the logical relationships). A 5% significance level (95% confidence level) was used throughout the analysis.

The extended statistical analysis allowed for the selection of three models considered optimal. The model for the European Union was constructed using the WLS method, while the two models – for EMU and non-EMU countries – are based on the OLS method. The WLS model is a derivative of a model estimated using the classical ordinary least squares (OLS) method, that usually takes the form of:

$$Y = X\beta + \epsilon \tag{1}$$

Where:

- Y is the vector of the dependent variable,
- X is the matrix of explanatory variables,
- β is the vector of parameters to estimate,
- ϵ is the error term with non-constant variance.

In order to apply WLS, both sides of the model were multiplied by $W^{-1/2}$, that stands for the inverse square root of the weight matrix:

$$W^{-1/2}Y = W^{-1/2}X\beta + W^{-1/2}\epsilon \tag{2}$$

The above transformation led to the new regression model:

$$Y_* = X_*\beta + \epsilon_* \tag{3}$$

Where:

- $Y_* = W^{-1/2}Y$ (transformed dependent variable),
- $X_* = W^{-1/2}X$ (transformed explanatory variables),
- $\epsilon_* = W^{-1/2}\epsilon$ (transformed error term).

After having the data transformed, the parameter estimates $\hat{\beta}$ was obtained with the usage of standard OLS formulas on the transformed model.

The coefficient of determination R^2 for WLS, known as Kvålseth's coefficient, was calculated as:

$$R^2_{WLS} = 1 - \left[\frac{(Y_* - X_*\hat{\beta}_*)'(Y_* - X_*\widehat{\beta}_*)}{Y_*'Y_* - n\bar{Y}_*^2}\right] \tag{4}$$

Where:

- $\hat{\beta}_*$ represents the WLS estimator of β,
- in the second term, the denominator corresponds to the sum of the squared weighted Y-values to their mean, while the numerator consists of the sum of the squared weighted residuals.

$$\hat{\epsilon}_* = Y_* - X_*\hat{\beta}_* \tag{5}$$

In the equation (5), R^2_{WLS} from the equation (4) acts as the coefficient of determination for the adjusted or transformed dataset. It quantifies the proportion of variability in the weighted Y-values that can be explained by the weighted X-values. This value corresponds to the output R^2 statistic that is commonly generated by statistical software during a Weighted Least Squares regression analysis (Willett, Singer, 1988).

The research utilizes Excel and Gretl for data analysis and modeling.

4. Results and Discussion

4.1. Contrastive analysis of monetary policy in the non-EMU Countries

The inadequacy of the ECB's monetary policy is particularly evident when assessing the extent to which countries aspiring to join the EMU meet the convergence criteria. According to the Maastricht Treaty, these criteria must be fulfilled in order to avoid negative economic consequences (Van Moltke, 2001). However, many of the countries that have already joined the EMU did not fully meet these criteria at the time of their accession. This has led to various economic challenges within the Eurozone, such as the instability seen in countries like Greece and Italy, where public debt and fiscal deficits far exceeded the prescribed limits (De Grauwe, 2009). The failure to enforce

these criteria strictly has contributed to significant imbalances within the Eurozone, undermining the stability and effectiveness of the ECB's monetary policy (Copelovitch, Frieden, Walter, 2016; Frieden, Walter, 2017).

For the seven EU member states remaining outside the EMU, it is therefore important to analyze several fundamental economic conditions that influence their current economic situation and the feasibility and advisability of their potential accession to the EMU. These conditions include the degree of compliance with the convergence criteria, the flexibility of monetary policies, the resilience of economies to external shocks and the sustainability of public finances. Each of these factors plays a key role in determining whether these countries could benefit from joining the EMU or whether remaining outside the Eurozone would better serve their economic interests. A brief analysis of these aspects will shed light on the challenges and opportunities these countries face concerning EMU membership.

When examining the monetary policies of the seven EU member states outside the Economic and Monetary Union (EMU) – Poland, Sweden, Denmark, Hungary, Czech Republic, Bulgaria, and Romania – a number of key criteria reveal how these countries have managed economic stability while remaining independent of the Eurozone. A crucial criterion is the exchange rate policy, which significantly shapes each country's ability to respond to external economic pressures (Dornbusch, 1994). For instance, Denmark and Bulgaria operate under fixed exchange rate regimes, pegging their currencies to the euro. This arrangement provides stability and predictability, particularly beneficial for small, open economies reliant on trade with Eurozone countries (Hadj Fraj, Bouchoucha, Maktouf, 2020). However, this stability comes at the cost of monetary policy autonomy, as both Danmarks Nationalbank and the Bulgarian National Bank must align their interest rates closely with those set by the ECB, limiting their ability to independently address domestic economic conditions. In contrast, countries like Poland, Hungary, and Czechia have leveraged exchange rate flexibility to their advantage. Poland, for instance, allowed the złoty to depreciate during the 2008 financial crisis, which boosted export competitiveness and helped cushion the impact of the global downturn (Drozdowicz-Bieć, 2011). Similarly, the Czech National Bank used currency interventions to keep the koruna weak between 2013 and 2017, thereby preventing deflation and supporting economic growth during a period of low inflation across the Eurozone (Frait, Mora, 2020). Hungary, too, has utilized its floating exchange rate to stabilize the forint in times of economic turbulence, particularly in response to high levels of foreign-currency-denominated debt (Ciżkowicz-Pękała et. al., 2019).

Another critical criterion is the use of interest rates as a monetary policy tool. Sweden's Riksbank stands out for its aggressive use of negative interest rates to combat deflation and stimulate economic activity, a policy that began in 2015 (Lindvall, 2020). While this approach helped prevent deflation and encouraged spending, it also led to rising property prices and increased household debt, illustrating the challenges of such unconventional monetary policies (Turk, 2015). On the other hand, Poland, Hungary, and Romania have utilized interest rate adjustments to manage inflation and maintain economic growth. For example, Hungary’s National Bank raised interest rates sharply in response to rising inflation in 2021-2022, demonstrating the central bank’s responsiveness to economic pressures (EC, 2024a).

Public debt and fiscal policy compatibility with EMU criteria is another significant factor in evaluating these countries' readiness for EMU membership. Bulgaria, under its currency board arrangement, has maintained a conservative fiscal policy, ensuring public debt levels remain low and consistent with the Maastricht criteria (WB, 2023). In contrast, other countries like Hungary (EC, 2023) and Romania (EC, 2024b) have faced challenges with higher public debt levels, which complicates their potential accession to the EMU. Despite these challenges, these countries have made concerted efforts to stabilize their economies, though not always aligning perfectly with the strict convergence criteria required for EMU membership.

The ability to manage external economic shocks also plays a crucial role in shaping monetary policy (Singh, 2023). Poland and the Czech Republic have shown resilience by effectively using their independent monetary policies to navigate global economic crises. Poland’s response to the Eurozone crisis and the COVID-19 pandemic highlights the benefits of having the flexibility to adjust monetary policy without the constraints of EMU membership. Similarly, the Czech Republic’s strategic use of currency intervention during periods of low inflation demonstrates the importance of having a full range of monetary tools at a country’s disposal (Tyniewicki, Kozieł, 2021).

Undeniably, the diverse economic conditions across the seven EU member states outside the EMU – Poland, Sweden, Denmark, Hungary, Czech Republic, Bulgaria, and Romania – demonstrate the complexities and challenges of applying a one-size-fits-all monetary policy approach, such as that of the ECB. Overall, the diverse strategies employed by these seven non-EMU EU member states underscore the importance of independent monetary policy in addressing national economic needs. The ability to tailor monetary policy to specific domestic conditions has allowed these countries to maintain economic stability, manage inflation, and respond effectively to external shocks. However, the trade-offs involved, such as the limitations imposed by fixed exchange rate regimes or the challenges of managing public debt, highlight the complexities of remaining outside the EMU while still being part of the broader European Union framework. This analysis reveals the nuanced economic landscapes of these countries and the critical role that monetary policy plays in their continued stability and growth. Moreover, the experiences of both non-EMU and EMU member states highlight the challenges of finding a balance between

maintaining monetary policy flexibility and adhering to shared economic goals. As the Eurozone continues to evolve, it remains crucial to address these challenges to enhance economic stability and cohesion across the entire European Union.

4.2. Stress indicator as a measure of monetary policy adequacy

The stress indicator, as conceptualized by Clarida, Gali and Gertler, quantifies the difference between the ECB base rate and the optimal interest rate for each respective country. This metric serves as a proxy for the economic tension or misalignment that arises when a nation's monetary policy requirements diverge from those imposed by the ECB. A positive value suggests that the ECB's rates are too high relative to the national optimal rate, potentially constraining economic activity, whereas a negative value indicates that the ECB's rates are too low, possibly leading to overheating or inflationary pressures.

The choice of this definition stems from its ability to capture the inherent tension faced by non-Eurozone countries that interact economically with the Eurozone but retain independent monetary policies. By focusing on the difference between the ECB rate and the estimated national optimal rate, this approach highlights the trade-offs these countries encounter in aligning their domestic policies with external monetary conditions, particularly in periods of economic uncertainty or crises. Moreover, the indicator provides a standardized framework for cross-country comparison, enabling a systematic analysis of how different economies respond to a common monetary policy benchmark.

However, this indicator is not without limitations. First, the estimation of the optimal interest rate for each country relies on specific models and assumptions, which may introduce biases or inaccuracies. Additionally, the indicator does not account for other factors that influence monetary policy, such as fiscal policies, structural reforms, or external shocks, which might exacerbate or mitigate the stress levels. Finally, it assumes that the ECB rate is uniformly relevant across all non-Eurozone countries, potentially overlooking regional economic dynamics or idiosyncratic shocks that could distort the comparison.

Figure 1. presents the stress indicator for seven non-Eurozone countries – specifically: Bulgaria, Czechia, Romania, Sweden, Hungary, Poland, and Denmark – over the period from January 1, 1999, to July 31, 2024. This analysis aims to examine how these countries have coped with the challenges of adjusting their economic conditions with the ECB's monetary policy, with particular focus to key economic events that have influenced these stress indicators.

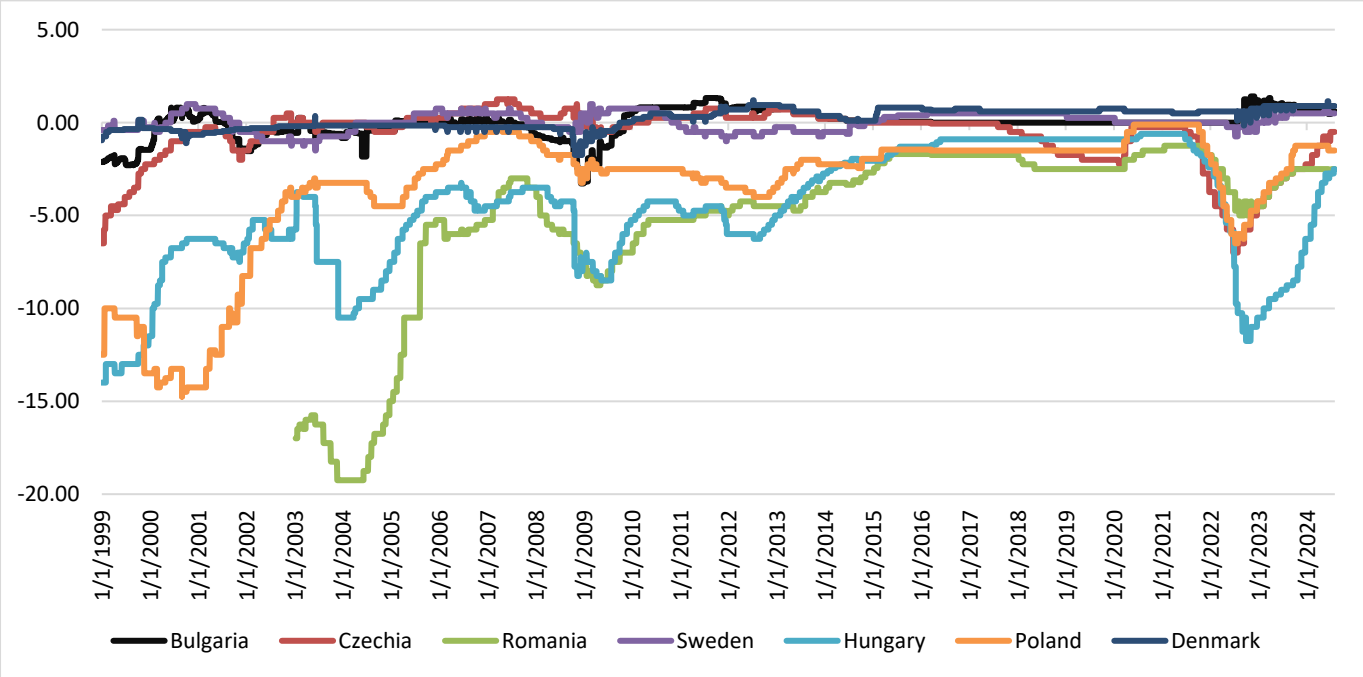

Figure 1: The stress indicator in the non-EMU countries in the period January 1, 1999-July 31, 2024 (in case of Romania January 1, 2003- July 31, 2024)

The key economic events are considered as follows:

- Pre-Eurozone expansion and early 2000s (Jan 1, 1999 – Dec 31, 2003): This period includes the introduction of euro banknotes and coins to circulation (Jan 1, 2002) (Boschker Sieberson, 2007).

Eurozone countries worked to adapt to the new currency, including adopting a common monetary and fiscal policy, and stabilizing their economies (by Dec 31, 2003) (Franks, et al., 2018)

- Pre-global financial crisis (Jan 1, 2004 – Aug 8, 2007): After the first phase of economic stabilization, this period saw economic growth and the intensification of household over-indebtedness, which contributed to the formation of the credit bubble (Merrouche, Nier, 2010);
- Global financial crisis (Aug 9, 2007 – Nov 30, 2009): This period began with BNP Paribas freezing three funds linked to the U.S. subprime market. It includes the collapse of Lehman Brothers (Sept 2008) and the implementation of bailout programs for banks in many countries (Mishkin, 2011). The period ends with the preliminary stabilization of markets (Nov 2009), though it did not mark the end of the excessive debt problems, especially in Greece (BG, 2014);
- European sovereign debt crisis (Dec 1, 2009 – Jun 30, 2014): At the turn of November and December 2009, the Eurozone debt crisis began, when Greece admitted to a significantly higher budget deficit than previously reported. The issue spread to other Eurozone countries (Portugal, Ireland, Spain), and rescue packages (2010-2012) failed to control the situation until mid-2014, when the ECB implemented unconventional monetary policy measures (e.g., quantitative easing). The period ends with the stabilization of public debt markets and the economy (Jun 30, 2014) (Copelovitch, Frieden, Walter, 2016);
- Post-crisis stabilization and economic recovery (Jul 1, 2014 – Dec 31, 2019): After overcoming the worst phase of the Eurozone debt crisis, the economies of the Eurozone countries began to recover and return to the path of economic growth. During this period, the ECB continued a loose monetary policy to support the recovery process, which concluded around Dec 31, 2019 (Hobelsberger, Kok, Mongelli, 2023);
- COVID-19 pandemic and recent developments (Jan 1, 2020 – Dec 31, 2023): With the outbreak of the COVID-19 pandemic, the economies of the world, including the Eurozone, faced another crisis, which was addressed by stimulus programs like NextGenerationEU (Crescenzi, Giua, Sonzogno, 2021) and the Pandemic Emergency Purchase Programme (PEPP) (Böninghausen, et al., 2022). After stabilizing the pandemic crisis in early 2022, the world faced an energy crisis caused by the outbreak of the war in Ukraine (Emiliozzi, Ferriani, Gazzani, 2024).

Changes in the stress indicator over the analyzed periods, in the countries currently outside the Eurozone, are compiled in Table 1.

Country	**Average value of stress indicator [per cent]**						
	Whole timeline (Jan 1, 1999-Jul 31, 2023)	Pre-Eurozone expansion and early 2000s (Jan 1, 1999-Dec 31, 2003)	Pre-global financial crisis (Jan 1, 2004-Aug 8, 2007)	Global financial crisis (Aug 9, 2007-Nov 30, 2009)	European sovereign debt crisis (Dec 1, 2009-Jun 30, 2014)	Post-crisis stabilization and economic recovery (Jul 1, 2014-Dec 31, 2019)	COVID-19 pandemic and recent developments (Jan 1, 2020-Jul 31, 2024)
Bulgaria	-0.04	-0.62	-0.15	-1.07	0.72	0.01	0.37
Czechia	-0.68	-1.28	0.31	0.20	0.35	-0.58	-2.40
Denmark	0.21	-0.35	-0.20	-0.49	0.52	0.61	0.69
Hungary	-4.73	-7.83	-5.86	-5.66	-4.50	-1.15	-4.50
Poland	-3.48	-9.08	-2.41	-1.91	-2.82	-1.57	-1.95
Romania*	-5.17	-17.01	-9.90	-6.18	-4.68	-2.14	-2.54
Sweden	0,05	-0.28	0.27	0.18	-0.26	0.36	0.11

* period from Jan 1, 2003 to Jul 31, 2024

Table 1. The average value of stress indicator in the seven non-Eurozone countries over the selected periods from Jan 1, 1999 to Jul 31, 2024

Based on Table 1, Figure 2 was developed.

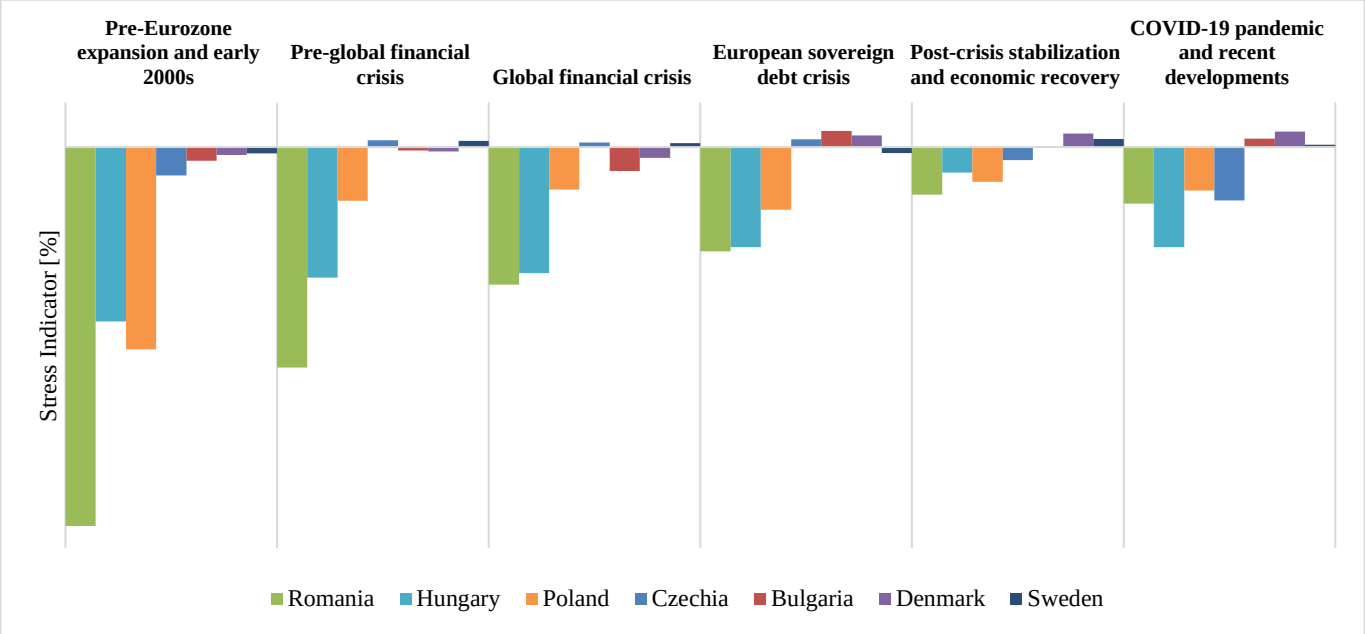

Figure 2. The average value of stress indicator in the seven non-Eurozone countries over the selected periods from Jan 1, 1999 to Jul 31, 2024

During the early 2000s, the stress indicator shows that three non-Eurozone countries, such as Poland, Romania and Hungary, experienced significant negative stress indicators. This period was characterized by the aftermath of the Asian financial crisis (1997) and the dot-com bubble (2000), which influenced global monetary policies. The ECB maintained relatively low-interest rates to support growth within the Eurozone, particularly in response to the economic slowdown caused by these global events. In this period, Romania shows the highest stress indicator at -17.01, indicating that the ECB's monetary policy was far too loose for its economy, which required a much more restrictive stance. Hungary (-7.83) and Poland (-9.08) also required significantly tighter monetary policies, as they were growing faster and their economies needed higher interest rates. Meanwhile, Czechia's stress indicator was closer to zero (-1.28), suggesting that the ECB's policy was relatively well aligned with its needs. Denmark (-0.35) and Sweden (-0.28), being more stable and developed economies, had indicators close to zero, implying a good fit between their needs and the ECB's policy stance. Bulgaria (-0.62) also demonstrated a slightly looser-than-needed monetary policy, but not to the same extent as the other Eastern European nations.

In the years leading up to the global financial crisis, stress indicators across most countries improved, moving closer to zero, reflecting better alignment with the ECB's monetary policy. Romania's and Poland's stress indicators improved to -9.90 and -2.41 respectively, indicating that the ECB's monetary policy was still too loose, but much less so compared to earlier years. Czechia had a positive stress indicator (0.31), suggesting that ECB's policy was becoming slightly too restrictive. This convergence can be attributed to the economic stabilization efforts in the region, particularly in case of Czechia and Poland, as these countries were increasingly integrating into the broader European economy and aligning their monetary policies with the expectations set by the Maastricht criteria for eventual Euro adoption. Hungary's stress level remained relatively high at -5.86, suggesting a need for a more restrictive policy than implemented by the ECB. Meanwhile, Bulgaria (-0.15), Denmark (-0.20), and Sweden (0.27) all had indicators close to zero, implying that the ECB's monetary stance was largely appropriate for these countries.

The global financial crisis of 2008 represents a significant turning point, as evidenced by the sharp movements in the stress indicators for nearly all the countries in the chart. The crisis led to an unprecedented loosening of monetary policy by the ECB, including unconventional monetary measures such as quantitative easing (Schnabel, 2024). While these measures were necessary to stabilize the Eurozone, they were less suitable for some non-EMU countries, especially those not as deeply integrated into the Eurozone's economic framework. Some countries like Romania (-6.18) and Hungary (-5.66) still showed relatively high negative stress indicators, meaning that despite the easing, the ECB's monetary policy was still too loose for their economies, which required even tighter controls. Poland's stress indicator dropped slightly to -1.91, but the ECB's policy was still not tight enough for its needs. Conversely, Czechia (0.20) and Sweden (0.18) had positive indicators, suggesting that the ECB's monetary policy was marginally too restrictive. Denmark (-0.49) and Bulgaria (-1.07) also had negative values of stress indicators, indicating a need for more restrictive monetary policies. In the case of Denmark (-0.49) and Bulgaria (-1.07), a decrease in the stress indicator was also recorded, however it still fluctuated around 0, indicating

a continuing tendency of convergence of the monetary policy of these countries with the monetary policy implemented by the ECB.

The European sovereign debt crisis, which followed the global financial crisis, also had profound effects on the stress indicators. During this period, the ECB's monetary policy became even more accommodative, particularly in response to the financial turmoil in Greece, Italy, Spain, and Portugal. The stress indicators for most non-EMU countries show increased volatility during this period, reflecting the difficulties in managing economic policies in the face of such external pressures. As Europe dealt with the sovereign debt crisis, stress indicators for most countries improved again. Poland (-2.82) and Hungary (-4.50) still required tighter monetary policies, although in case of Hungary the gap was narrowing. Czechia (0.35), Bulgaria (0.72), Denmark (0.52), and Sweden (-0.26) displayed indicators close to zero, reflecting a reasonable alignment between the ECB's stance and their economic conditions. Czechia's indicator was positive again at 0.35, meaning that the ECB's policy was once more slightly too restrictive for its needs. In the case of Romania, the stress indicator decreased to -4.68, yet still remained at the furthest level from 0, which once again indicated that the ECB's monetary policy was too loose for the needs of the Romania's economy.

Following the European Sovereign Debt Crisis, there is a noticeable stabilization in the stress indicators across most countries. During this period, The ECB's policy was focused on maintaining low-interest rates to support the fragile recovery within the Eurozone. For non-EMU countries, this generally meant that their optimal interest rates were more aligned with the ECB's base rate, resulting in stress indicators that hovered around zero. This period of relative calm can be linked to the broader global economic recovery and the stabilization of financial markets. Poland's stress indicator improved to -1.57, and Hungary's to -1.15, showing that the ECB's policies were becoming more suitable for these economies. Bulgaria (0.01) also demonstrated a balance between the ECB's policy and its needs, however in case of Denmark (0.63) and Sweden (0.36) saw their indicators slightly above zero, suggesting that the ECB's policy was a bit too restrictive for these economies. Czechia's stress indicator (-0.58) decreased slightly compared to the previous period, which means that the ECB's monetary policy is excessively loose in relation to the needs of the local economy. What's interesting, Romania recorded a relatively low stress index for the first time (-2.14), which indicates a decreasing divergence and increasing adequacy of the ECB's monetary policy in relation to Romania's needs.

The onset of the COVID-19 pandemic in early 2020 marks another period of significant stress across the non-EMU countries. The ECB, once again, adopted aggressive monetary easing measures, including rate cuts and extensive asset purchase programs, to mitigate the economic fallout from the pandemic. Hungary (-4.50) and Romania (-2.54) showed significant negative stress indicators, indicating that their economies required more restrictive policies than what the ECB was offering. Poland's stress level fell slightly, yet remained relatively stable at -1.95, while Czechia saw a larger gap with a stress indicator of -2.56. In contrast, Bulgaria (0.37), Denmark (0.69), and Sweden (0.11) had indicators close to zero, suggesting that the ECB's policies during the pandemic were well-aligned with their economic conditions.

The stress indicator data illustrates the diverse needs of the countries represented in the analysis, particularly those outside of the Eurozone. Romania, Hungary, and Poland frequently required tighter monetary policies than the ECB was providing, especially in earlier periods, as they dealt with higher growth rates and inflation pressures. Conversely, countries like Denmark, Sweden and Bulgaria generally showed stress indicators close to zero, reflecting a better alignment with the ECB's monetary policy. Czechia's fluctuating stress indicator highlights the varying appropriateness of the ECB's policies over time, as its economy evolved in different phases. This analysis underscores the challenge the ECB faces in setting a one-size-fits-all policy for a diverse group of economies, particularly those outside the Eurozone that are influenced by the Eurozone's monetary conditions.

4.3. WLS model for European Union

The dependent variable in the model is inflation, which was not transformed in any way, while the explanatory variables include:

- interest rate (current value and lagged by 4 periods),
- trend (linear),
- real GDP (only lagged values for periods 2, 5, 6, and 8),
- unemployment rate (for the current period and lagged by 9 periods),
- inflation index (lagged endogenous variable for lags of 1, 3, 4, 8, and 10 periods).

As mentioned before, in the WLS model the weights are the inverse of the squared residuals from the original model. This procedure eliminated the problem of heteroscedasticity and resulted in estimators with lower variance, better interpretability of parameters, and more reliable statistical test results. By using the inverse of the squared residuals as weights, greater importance is given to observations with smaller dispersion (lower error variance), and less weight is assigned to those with larger residuals. In this way, the model adjusts for heteroscedasticity by correcting the inequality in variance and improving the efficiency of the estimation.

In addition to achieving the highest level of the coefficient of determination (explaining 99.55% of the variability in inflation), the model also features the lowest Akaike information criterion (AIC) value among the entire group of models constructed. Due to the applied approach, only one diagnostic test was conducted – an assessment of the normality of the residual distribution. The results are presented in the histogram and the test output below.

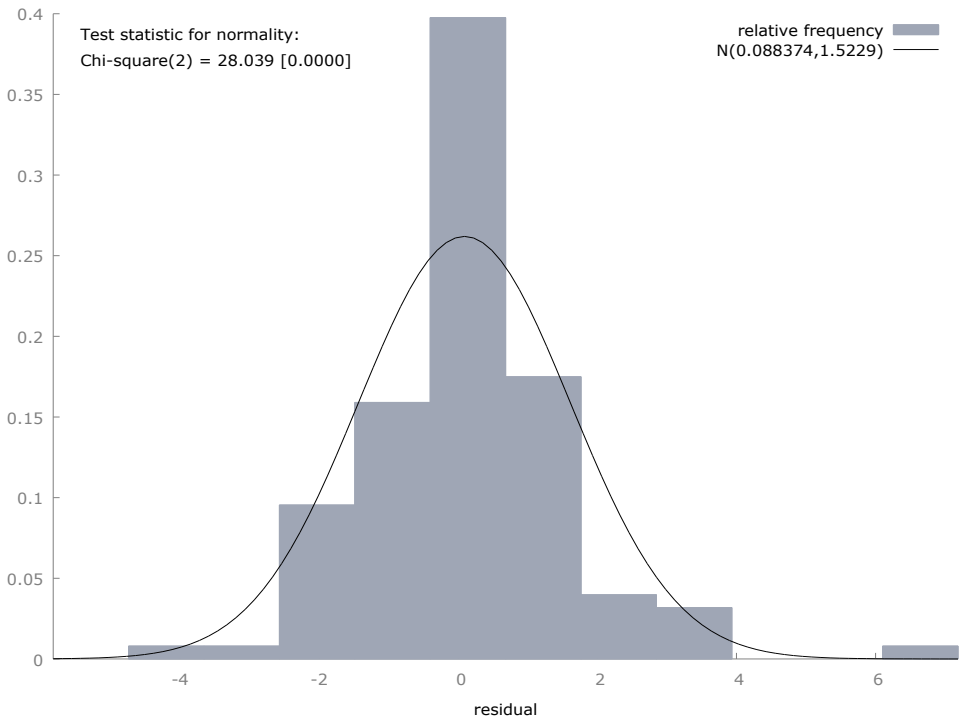

Figure 3. Test statistic for normality

Frequency distribution for residual, obs 1-200
number of bins = 11, mean = 0.0883736, sd = 1.5229

interval			midpt	frequency	rel.	cum.	
	<	-3.6561	-4.1982	1	0.86%	0.86%	
-3.6561	-	-2.5720	-3.1141	1	0.86%	1.72%	
-2.5720	-	-1.4878	-2.0299	12	10.34%	12.07%	***
-1.4878	-	-0.40364	-0. 94572	20	17.24%	29.31%	******
-0.40364	-	0.68053	0.13844	50	43.10%	72.41%	**********
0.68053	-	1.7647	1.2226	22	18.97%	91.38%	******
1.7647	-	2.8489	2.3068	5	4.31%	95.69%	*
2.8489	-	3.9330	3.3910	4	3.45%	99.14%	*
3.9330	-	5.0172	4.4751	0	0.00%	99.14%	
5.0172	-	6.1014	5.5593	0	0.00%	99.14%	
	>=	6.1014	6.6435	1	0.86%	100.00%	

Missing observations = 84 (42.00%)
Test for null hypothesis of normal distribution: Chi-square(2) = 28.039 with p-value 0.00000

Table 2. Test statistic for normality

At the adopted 5% significance level, the null hypothesis must be rejected, indicating that the residuals in the model do not follow a normal distribution. However, this does not imply a flaw in the model, as the weighted least squares (WLS) method does not formally require the residuals to exhibit a normal distribution. The lack of normality does not result in inconsistent parameter estimators, but it is relevant for statistical inference regarding the significance of parameters (t-tests and F-tests). Furthermore, the presence of non-normality largely mitigates the risk of outliers.

The estimation results are presented below.

WLS, using 116 observations

Dependent variable: (Y): Inflation

Variable used as weight: o_usq43_aaa

	coefficient	*std. error*	*t-ratio*	*p-value*	
const	−1,27428	0,219085	−5,816	<0,0001	***
Interestrate	0,560682	0,0415755	13,49	<0,0001	***
Interestrate_4	−0,140061	0,0267446	−5,237	<0,0001	***
time	0,196157	0,00841036	23,32	<0,0001	***
realGDP_2	−0,379152	0,0160875	−23,57	<0,0001	***
realGDP_5	0,199964	0,0100698	19,86	<0,0001	***
realGDP_6	0,0762886	0,0108217	7,050	<0,0001	***
realGDP_8	−0,124993	0,00724145	−17,26	<0,0001	***
Unemploymentrate	−0,198218	0,0126233	−15,70	<0,0001	***
Unemploymentrate_9	0,0928779	0,0100410	9,250	<0,0001	***
Inflation_1	0,369694	0,0156444	23,63	<0,0001	***
Inflation _3	−0,156925	0,0255832	−6,134	<0,0001	***
Inflation _4	0,182979	0,0192166	9,522	<0,0001	***
Inflation _8	−0,199157	0,0143033	−13,92	<0,0001	***
Inflation _10	0,121336	0,0167079	7,262	<0,0001	***

Statistics based on the weighted data:

Sum squared resid	100,6734	S.E. of regression	0,998382
R-squared	0,995525	Adjusted R-squared	0,994905
F(14, 101)	1605,081	P-value(F)	7,7e-112
Log-likelihood	−156,3778	Akaike criterion	342,7555
Schwarz criterion	384,0594	Hannan-Quinn	359,5225

Statistics based on the original data:

Mean dependent var	3,055591	S.D. dependent var	3,747676
Sum squared resid	235,1481	S.E. of regression	1,525844

Table 3. WLS model for European Union

The developed model indicates that, under the assumption that all other variables are held at zero, the inflation rate would decrease by approximately 1.27 percentage points. Over time, inflation displays an upward trend, increasing on average by 0.196 percentage points per unit of time. This suggests a persistent growth in inflation throughout the analyzed period.

A 1 percentage point increase in the current interest rate leads to a 0.56 percentage point rise in inflation, highlighting a positive short-term relationship between interest rates and inflation. However, this relationship changes over time: after 4 periods, a similar increase in interest rates causes a 0.14 percentage point reduction in inflation. This delayed anti-inflationary effect aligns with the predictions of monetary theory, where higher interest rates eventually suppress inflationary pressures.

In case of real GDP, its impact on inflation depends on the time horizon. An increase in real GDP by 1 percentage point reduces inflation by 0.38 percentage points and 0.12 percentage points after 2 and 8 periods, respectively. These findings point to a negative relationship between economic growth and inflation in the medium-term and long-term. In contrast, a 1 percentage point increase in GDP after 5 and 6 periods results in inflation rising by 0.20 percentage points and 0.08 percentage points, respectively. This shift suggests that sustained economic growth may eventually contribute to inflationary pressures.

The unemployment rate, on the other hand, exhibits a mixed relationship with inflation. A 1 percentage point rise in unemployment initially leads to a 0.20 percentage point decline in inflation, which is consistent with the Phillips curve theory. Interestingly, after 9 periods, the effect reverses, as a similar increase in unemployment causes inflation to rise by 0.09 percentage points. This delayed upward impact might reflect lagged adjustments in the economy.

High R^2 values and low values of information criteria, such as AIC, indicate a good fit of the models to historical data. However, there is concern about overfitting. It is important to note that in the WLS model, the use of the inverse squares of the residuals from the original model as weights helped reduce heteroscedasticity, and the potential lack of distortion in the estimates results from the good fit of the original model. Additionally, the use of lagged variables and their number may lead to issues with model identifiability and interpretability, especially in the context of dynamic relationships between variables.

In summary, the analysis highlights the complex dynamics between inflation and key macroeconomic

indicators in the European Union. While a short-term increase in interest rates appears to raise inflation, this effect turns anti-inflationary over time, particularly after four periods. Real GDP exerts mixed effects, reducing inflation in the medium term but contributing to inflationary pressures in subsequent years. Similarly, unemployment generally has a disinflationary effect initially, though delayed responses may push inflation upward. Finally, strong autoregressive effects underscore that inflation's current level is heavily influenced by its previous values.

4.4. OLS models for EMU and non-EMU countries

In order to compare countries outside the Euro Area with those within the Eurozone, similar models were constructed using the OLS approach.

The model presented below, without applying a heteroscedasticity correction, is constructed without accounting for the trend component, meaning it does not include time series decomposition. The estimation for non-Eurozone countries is presented below, using a panel Ordinary Least Squares (OLS) approach.

Pooled OLS, using 150 observations
Included 7 cross-sectional units
Time-series length: minimum 18, maximum 22
Dependent variable: Inflation

	coefficient	*std. error*	*t-ratio*	*p-value*	
const	1,09148	0,284713	3,834	0,0002	***
Interestrate	0,851985	0,0849266	10,03	<0,0001	***
Interestrate_2	−0,557699	0,0641118	−8,699	<0,0001	***
realGDP_2	−0,139831	0,0572909	−2,441	0,0159	**
realGDP_3	0,130561	0,0542879	2,405	0,0174	**
Inflation _1	0,522793	0,0677770	7,713	<0,0001	***

Mean dependent var	3,403202	S.D. dependent var	3,521353
Sum squared resid	544,6634	S.E. of regression	1,944835
R-squared	0,705203	Adjusted R-squared	0,694967
F(5, 144)	68,89439	P-value(F)	1,80e-36
Log-likelihood	−309,5557	Akaike criterion	631,1115
Schwarz criterion	649,1753	Hannan-Quinn	638,4502
rho	−0,089878	Durbin-Watson	2,021038

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 31.2668
with p-value = 1.62369e-07

White's test for heteroscedasticity -
Null hypothesis: heteroscedasticity not present
Test statistic: LM = 42.0443
with p-value = P(Chi-square(20) > 42.0443) = 0.00272905

Wooldridge test for autocorrelation in panel data -
Null hypothesis: No first-order autocorrelation (rho = 0)
Test statistic: t(6) = -2.34228
with p-value = P(|t| > 2.34228) = 0.0576639

Chow test for structural break at observation 4:13 –
Null hypothesis: no structural break
Test statistic: F(6, 138) = 0.870036
with p-value = P(F(6, 138) > 0.870036) = 0.518733

RESET test for specification -
Null hypothesis: specification is adequate
Test statistic: F(2, 142) = 0.502693
with p-value = P(F(2, 142) > 0.502693) = 0.605972

Non-linearity test (squares) -
Null hypothesis: relationship is linear
Test statistic: LM = 26.2412
with p-value = P(Chi-square(5) > 26.2412) = 8.01188e-05

The model demonstrates a satisfactory effectiveness of 70.52%, with all parameters in the specification being statistically significant. The only nuances include the lack of residual normality and the presence of heteroscedasticity. However, the residuals do not exhibit autocorrelation, and the RESET test confirms the correctness of the specification, despite a potential issue with nonlinearity in the squared terms of variables. Additionally, the stability of the estimates is verified through the Chow test. Applying a heteroscedasticity correction reduces the precision of the estimates and diminishes the model's explanatory value, as presented below.

Table 5. Heteroscedasticity correction for OLS model for non-Euro Area countries

Heteroscedasticity-corrected, using 150 observations
Dependent variable: Inflation

	coefficient	*std. error*	*t-ratio*	*p-value*	
const	1,13904	0,229964	4,953	<0,0001	***
Interestrate_2	−0,156456	0,0525137	−2,979	0,0034	***
Inflation_1	0,846327	0,0849411	9,964	<0,0001	***

Statistics based on the weighted data:

Sum squared resid	681,6085	S.E. of regression	2,153321
R-squared	0,419682	Adjusted R-squared	0,411787
F(14, 101)	53,15474	P-value(F)	4,26e-18
Log-likelihood	−326,3773	Akaike criterion	658,7546
Schwarz criterion	667,7865	Hannan-Quinn	662,4240

Statistics based on the original data:

Mean dependent var	3,403202	S.D. dependent var	3,521353
Sum squared resid	1039,862	S.E. of regression	2,659679

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 41.0329
with p-value = 1.22978e-09

Considering the results presented above, the original version of the model appears to be optimal. A similar model for the Eurozone is presented below.

Table 6. OLS model for Euro Area

OLS, using observations 2002-2023 (T = 22)
Dependent variable: Inflation

	coefficient	*std. error*	*t-ratio*	*p-value*	
const	9,95597	1,57642	6,316	<0,0001	***
Interestrate_1	0,791435	0,209187	3,783	0,0016	***
realGDP_2	−0,682145	0,106399	−6,411	<0,0001	***
realGDP_3	−0,295753	0,0905061	−3,268	0,0048	***
Unemploymentrate_2	−0,596829	0,160492	−3,719	0,0019	***
Inflation _3	−1,29379	0,301585	−4,290	0,0006	***

Mean dependent var	2,127273	S.D. dependent var	1,844214
Sum squared resid	12,55845	S.E. of regression	0,885948
R-squared	0,824170	Adjusted R-squared	0,769223
F(5, 144)	14,99935	P-value(F)	0,000015
Log-likelihood	−25,04951	Akaike criterion	62,09902
Schwarz criterion	68,64528	Hannan-Quinn	63,64112
rho	0,179155	Durbin-Watson	1,600783

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 1.06308
with p-value = 0.587699

White's test for heteroscedasticity -
Null hypothesis: heteroscedasticity not present
Test statistic: LM = 21.4046
with p-value = P(Chi-square(20) > 21.4046) = 0.373671

LM test for autocorrelation up to order 1 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.516749
with p-value = P(F(1, 15) > 0.516749) = 0.483281

Chow test for structural break at observation 2012 -
Null hypothesis: no structural break
Test statistic: F(6, 10) = 1.48904
with p-value = P(F(6, 10) > 1.48904) = 0.275279

RESET test for specification -
Null hypothesis: specification is adequate
Test statistic: F(2, 14) = 4.33144
with p-value = P(F(2, 14) > 4.33144) = 0.0343313

Non-linearity test (squares) -
Null hypothesis: relationship is linear
Test statistic: LM = 9.70182
with p-value = P(Chi-square(5) > 9.70182) = 0.0841385

Non-linearity test (logs) -
Null hypothesis: relationship is linear
Test statistic: LM = 3.12043
with p-value = P(Chi-square(2) > 3.12043) = 0.210091

Table 6. OLS model for non-Euro Area countries

In this case, the coefficient of determination is even more precise, at 82.42%, with all predictors remaining fully significant. Model analysis indicates that the residuals follow a normal distribution and are homoscedastic, with no issues of autocorrelation. The estimates are stable, and the choice of a linear relationship as the appropriate specification has been confirmed at the 5% significance level. The only nuance is a negative result from the RESET test concerning specification, which may suggest the omission of a relevant variable. The table below compares both models.

Non-Euro Area countries			Euro Area		
coefficient			*coefficient*		
const	1,09148	***	const	9,95597	***
Interestrate	0,851985	***	Interestrate_1	0,791435	***
Interestrate_2	−0,557699	***	realGDP_2	−0,682145	***
realGDP_2	−0,139831	**	realGDP_3	−0,295753	***
realGDP_3	0,130561	**	Unemploymentrate_2	−0,596829	***
Inflation_1	0,522793	***	Inflation_3	−1,29379	***
Adjusted R-squared	0,705203		Adjusted R-squared	0,82417	
Akaike criterion	631,1115		Akaike criterion	62,09902	
Normality: Chi-square(2) = 31,2668; p = 1,62369e-007			Normality: Chi-square(2) = 1,06308; p = 0,587699		
Heteroscedasticity: LM = 42,0443; p = 0,00272905			Heteroscedasticity: LM = 21,4046; p = 0,373671		
Autocorrelation: t(6) = -2,34228; p = 0,0576639			Autocorrelation: LMF = 0,516749; p = 0,483281		
Structural break: F(6, 138) = 0,870036; p = 0,518733			Structural break: F(6, 10) = 1,48904; p = 0,275279		
Specification: F(2, 142) = 0,502693; p = 0,605972			Specification: F(2, 14) = 4,33144; p = 0,0343313		
Linearity (squares): LM = 26,2412; p = 8,01188e-005			Linearity (squares): LM = 9,70182; p = 0,0841385		
Linearity (logs): N/D			Linearity (logs): LM = 3,12043; p = 0,210091		

Eliminating the trend decomposition factor allowed for an alternative approach to the model, yielding intriguing statistical insights. First and foremost, the Eurozone model emerges as highly stable. Within the sample structure, no variance differentiation is observed, the residuals are uncorrelated and exhibit normality. This reflects the economic homogeneity of the Eurozone, where inflation is driven by lagged returns, the growth dynamics of

real GDP lagged by two and three years – consistent with the natural economic cycle – lagged unemployment rates, and inflation itself, which also exerts a delayed impact of up to three years. This highlights the absence of shock effects or significant market fears in these developed and mature economies.

In contrast, the non-Eurozone areas display a high degree of heterogeneity, which is expected given the mix of mature and emerging economies within this group. While the factors influencing inflation are similar, the key insights lie in the differences and their implications. Notably, inflation in these regions is influenced by a lag of only one year, signaling greater market uncertainty and a faster onset of market panic. The immediate impact of current returns further underscores a heightened responsiveness to changes in macroeconomic indicators.

The real GDP dynamics, on the other hand, exhibit a comparable influence in both regions, with a lagged effect of two and three years. However, it is noteworthy that in non-Eurozone countries, the impact of real GDP growth is weaker, contributing less to inflationary pressures.

These findings emphasize the economic divergence between the two regions, with the Eurozone's stability contrasting sharply with the volatility and variability of non-Eurozone markets. This distinction underscores the varying challenges and responses to inflationary dynamics across these economic landscapes.

In the OLS models for countries outside the Eurozone, despite a lower R^2 and the possibility of generalizing the results to other periods or countries, a potential limitation is the failure to account for heteroscedasticity. Failing to adjust for heteroscedasticity may lead to erroneous conclusions regarding parameter significance, which, in turn, can affect the theoretically high prediction accuracy.

5. Conslusion

The research aimed to evaluate the effectiveness of inflation management in the Euro Area compared to non-Euro Area countries. Specifically, the study was intended to determine whether the centralized monetary policy of the European Central Bank (ECB) enables sufficient flexibility to address global economic shocks or whether the autonomy of non-Euro Area countries provides a more effective framework for responding to inflationary pressures. The research objectives also included identifying knowledge gaps in the existing literature and contributing to a deeper understanding of inflation management within the European Union. Through a comparative analysis of monetary policies and the evaluation of a stress indicator for non-Euro Area countries, this study successfully addressed its goals and provided insights into this critical economic issue.

The analysis revealed key differences in inflation management between the Eurozone and non-Euro Area countries. Eurozone nations benefit from a standardized monetary policy, which promotes economic cohesion and stability across member states. However, this centralized approach often lacks the flexibility to address the specific needs of individual economies. For example, during the European sovereign debt crisis, ECB policies were challenged by the need to support struggling economies like Greece while also preventing inflationary pressures in stronger economies like Germany. This balancing act highlighted the limitations of a one-size-fits-all approach, which may not be sufficiently tailored to address divergent economic conditions within the Eurozone. In contrast, non-Euro Area countries such as Poland and Hungary demonstrated the ability to use independent monetary tools, including flexible exchange rates and interest rate adjustments, to effectively counter inflationary pressures during global economic disruptions. This finding underscores the advantages of monetary autonomy in addressing diverse economic conditions, fulfilling the study's aim of highlighting the strengths and weaknesses of both approaches.

The evaluation of the stress indicator provided critical insights into the alignment of ECB's monetary policy with the needs of non-Euro Area countries. This metric, which measures the difference between the ECB's base rate and the optimal rate for individual economies, revealed significant mismatches, particularly during periods of economic crisis. For instance, the stress indicator showed that countries such as Romania and Hungary frequently required tighter monetary policies than those implemented by the ECB. While these countries were not directly subject to ECB policies due to their independent monetary frameworks, the stress indicator illustrates the challenges they might face if they adopted the euro and relinquished monetary autonomy. Conversely, countries like Denmark and Bulgaria, which operate under fixed exchange rate regimes aligned with the euro, demonstrated stress indicators closer to zero, suggesting that ECB policies were more closely aligned with their economic conditions. These findings addressed the research objective of assessing the adequacy of ECB policies during past economic crises and contributed to understanding of inflation management across the EU.

Additionally, while some countries currently outside the Eurozone, such as Bulgaria and Denmark, have already demonstrated strong alignment with the ECB's monetary stance, they still retain monetary policy autonomy. This suggests that other non-Euro Area countries, after undergoing the ERM II mechanism and meeting convergence criteria, could potentially adapt effectively to the economic demands of the Eurozone. However, the implications of integrating non-Euro Area countries into the Eurozone without fully meeting convergence criteria require careful consideration. Historical experience suggests that countries admitted into the Eurozone with significant economic imbalances, such as Greece, posed challenges for the stability of the entire monetary union. Should non-Euro Area countries like Hungary or Romania join without addressing disparities in inflation rates, fiscal deficits, or public debt levels, this could exacerbate existing imbalances within the Eurozone. Such an

expansion could reduce the effectiveness of ECB policies, as the central bank would need to account for even greater economic heterogeneity among its member states. Conversely, the relatively strong economic performance of the Eurozone as a whole suggests that, with sufficient pre-accession adjustments, these countries could potentially strengthen the union's overall economic stability. This underscores the importance of phased integration and strict adherence to convergence criteria to mitigate risks while capitalizing on potential benefits. Moreover, The econometric analysis further reinforced the contrasting dynamics between the two groups. In the Eurozone, inflation dynamics were characterized by stability and predictability, with lagged variables such as real GDP and unemployment exerting significant but consistent impacts on inflation. This reflects the structural advantages of a coordinated monetary policy framework. In non-Euro Area countries, however, the analysis revealed greater volatility and responsiveness to short-term shocks, as evidenced by stronger and more immediate impacts of variables such as interest rates. This divergence highlights the trade-off between stability and flexibility, a core focus of the research objectives.

By fulfilling the research objectives, the study provided a comprehensive comparison of inflation management strategies and evaluated their effectiveness in responding to global and regional economic challenges. The findings underscored the need for tailored approaches to monetary policy, particularly in diverse economic contexts like the European Union. While the centralized ECB framework offers clear benefits for economic stability, it often falls short in addressing the unique inflationary pressures faced by individual member states. Meanwhile, the autonomy of non-Euro Area countries allows for greater responsiveness to inflationary shocks, albeit at the cost of reduced policy coordination.

In conclusion, this research successfully fulfilled its objectives by providing a detailed comparison of inflation management in the Eurozone and non-Euro Area countries, evaluating the adequacy of ECB policies, and contributing to the broader understanding of monetary policy effectiveness. The findings emphasize the critical balance between stability and flexibility in inflation management, offering valuable insights for policymakers seeking to optimize monetary frameworks across the European Union.

6. Implications for further studies

The analysis of the existing literature shows that the topic addressed in this paper – namely, the effectiveness of the ECB's monetary policy compared to that of non-Euro Area countries in managing inflationary pressures – is widely discussed. However, there is a slight gap in research that goes beyond theoretical and narrative discussions to include robust comparative econometric assessments. Such research is necessary to determine, with greater precision and solid methodological foundation, which monetary policy framework – the centralized approach of the ECB or the independent policies of non-Euro Area countries – provides better results in managing inflationary challenges.

This research, by achieving its objectives, partially fills this knowledge gap. By employing both qualitative and econometric methods, it offers valuable insights into the effectiveness of monetary policy in managing inflation across different European contexts. Nonetheless, further studies are needed to expand on these findings. Future research should incorporate a broader range of macroeconomic indicators and explore additional methodological approaches to deepen our understanding of how diverse monetary policy frameworks impact inflation management, especially in the face of global economic challenges.

References

Adamski, D. (2020). Objectives of The EMU. In F. Amtenbrink, Ch. Herrmann, R, Repasi (Eds.), *The EU Law of Economic and Monetary Union* (pp. 214-258). Oxford Academic. https://doi.org/10.1093/oso/9780198793748.003.0012

Albiński, P., Polański, Z. (Eds.). (2015). *Dylematy polityki makroekonomicznej w warunkach kryzysu zadłużeniowego w Unii Europejskiej*. Oficyna Wydawnicza SGH.

Arce, O., Koester, G., Nickel, Ch. (2023, February 24). One year since Russia's invasion of Ukraine – the effects on euro area inflation. *The ECB Blog*. https://www.ecb.europa.eu/press/blog/date/2023/html/ecb.blog20230224~3b75362af3.en.html?

Bank of Greece. (2014). The chronicle of the Great Crisis. The Bank of Greece 2008-2013. Public interventions and institutional actions to safeguard financial stability and overcome the crisis. The Bank of Greece, Greece.

Blanchard, O., Galí, J. (2010). Labor Markets and Monetary Policy: A New Keynesian Model with Unemployment. *American Economic Journal Macroeconomics, 2*(2), 1–30. https://doi.org/10.1257/mac.2.2.1

Böninghausen, B., Fernández Brennan, L., McCabe, L., Schumacher, J. (2022). The pandemic emergency purchase programme – an initial review. *ECB Economic Bulletin, 8*, 93-116.

Boschker, K., Sieberson, E. (2007). The Euro: money changes everything. The European Union Center of Excellence/University of Washington, USA.

Bossane, M. et al. (2022, September 15). Inflation and the ecological transition: A European perspective. *World Bank Blogs.* https://blogs.worldbank.org/en/allaboutfinance/inflation-and-ecological-transition-european-perspective#_ftn1

Bukowski, S. (2006). The Maastricht convergence criteria and economic growth in the EMU. *Quaderni del Dipartimento di Economia, Finanza e Statistica*, *24*, 1-19.

Cahen, D. (2023). *Addressing sovereign debt challenges in the European Union*, (Regulatory Update April 2023). Eurofi.

Cihak, M., Fonteyne, W. (2009). Five Years After: European Union Membership and Macro-Financial Stability in the New Member States. (Working Paper, No. 2009/068). International Monetary Fund.

Ciżkowicz-Pękała, M., Grostal, W., Niedźwiedzińska, J., Skrzeszewska-Paczek, E., Stawasz-Grabowska, E., Wedołowski, G., Żuk, P. (2019). *Three decades of inflation targeting*, (NBP Working Paper No. 134). National Bank of Poland.

Clarida, R., Galı, J., Gertler, M. (1998). Monetary policy rules in practice. *European Economic Review*, *42*(6), 1033–1067. https://doi.org/10.1016/s0014-2921(98)00016-6

Copelovitch, M., Frieden, J., Walter, S. (2016). The Political Economy of the Euro Crisis. *Comparative Political Studies*, *49*(7), 811–840. https://doi.org/10.1177/0010414016633227

Crescenzi, R., Giua, M., & Sonzogno, G. V. (2021). Mind the Covid-19 crisis: An evidence-based implementation of Next Generation EU. *Journal of Policy Modeling*, *43*(2), 278–297. https://doi.org/10.1016/j.jpolmod.2021.03.002

Dabrowski, M. (2019). The Economic and Monetary Union: Past, present and future. (Report, No 0497). CASE-Center for Social and Economic Research.

De Grauwe, P. (2009, April 15). The politics of the Maastricht convergence criteria. VoxEU.org. https://cepr.org/voxeu/columns/politics-maastricht-convergence-criteria

De Grauwe, P., Ji, Y. (2013). Self-fulfilling Crises in the Eurozone: An Empirical Test. *Journal of International Money and Finance, 34*, 15-36. https://doi.org/10.1016/j.jimonfin.2012.11.003

Dornbusch, R. (1994). Exchange Rate Policies in Economies in Transition 10. In P. van der Haegen, Ch. Thimann (Eds.), *Approaches to Exchange Rate Policy* (pp. 161-184). International Monetary Fund. https://doi.org/10.5089/9781557753649.071.ch012

Drozdowicz-Bieć, M. (2011). Reasons Why Poland Avoided the 2007-2009 Recession. *Prace i Materiały Instytutu Rozwoju Gospodarczego SGH, 86*, 39-66.

Emiliozzi, S., Ferriani, F., Gazzani, A. (2024, January 11). The European energy crisis and the consequences for the global natural gas market. VoxEU.org. https://cepr.org/voxeu/columns/european-energy-crisis-and-consequences-global-natural-gas-market

European Central Bank. (2021). Climate Change and Monetary Policy in the Euro Area, (ECB Strategy Review, Occasional Paper Series 271, September 2021). European Central Bank.

European Central Bank. (2022). Economic, financial and monetary developments, (Economic Bulletin 4/2022). European Central Bank.

European Commission. (2023). Hungary. 2023 Country Report, (Commission Staff Working Document SWD (2023) 617 final). European Commission.

European Commission. (2024a). In-Depth Review 2024. Hungary, (Institutional Paper 284, April 2024). European Commission.

European Commission. (2024b). Romania. 2023 Country Report, (Commission Staff Working Document SWD (2024) 623 final). European Commission.

Frait, J., Mora, M. (2020). From float to currency floor and back to float: the Czech National Bank's temporary exchange rate commitment. In Bank for International Settlements (Ed.), *Financial market development, monetary policy and financial stability in emerging market economies* (pp. 121-131). Bank for International Settlements.

Franks, J., Barkbu, B., Blavy, R., Oman, W., Schoelermann, H. (2018). Economic Convergence in the Euro Area: Coming Together or Drifting Apart?, (Working Paper, WP/18/10). International Monetary Fund.

Frieden, J., Walter, S. (2017). Understanding the Political Economy of the Eurozone Crisis. *Annual Review of Political Science*, *20*(1), 371–390. https://doi.org/10.1146/annurev-polisci-051215-023101

Geraats, P. M. (2008). ECB Credibility and Transparency, (Paper No. 330). European Commission, Directorate-General for Economic and Financial Affairs.

Hadj Fraj, S., Bouchoucha, N., Maktouf, S. (2020). Political stability and economic growth: the role of exchange rate regime. (MPRA Paper No. 104586.)

Herz, B., Kotios, A. (2000). Coming Home to Europe: Greece and the Euro. *Intereconomics*, *35*(4), 170-176.

Hobelsberger, K., Kok, Ch., Mongelli, F. P. (2023). A tale of three crises: synergies between ECB tasks. *Kok, ECB Occasional* Paper, *305.* https://doi.org/10.2139/ssrn.4219400

Honohan, P. (2024). The inflation surge in Europe. *SSRN Electronic Journal*.
https://doi.org/10.2139/ssrn.4875072

Lane, P. R. (2012). The European Sovereign Debt crisis. *The Journal of Economic Perspectives*, *26*(3), 49–68. https://doi.org/10.1257/jep.26.3.49

Lindvall, J. (2020). Sweden's Riksbank: Guardian of Monetary Integrity. In A. Boin, L.A. Fahy, P. t'Hart (Eds.), *Guardians of Public Value. How Public Organisations Become and Remain Institutions* (pp. 1-35). Palgrave Macmillan. https://doi.org/10.1007/978-3-030-51701-4_1

Liu, S. (2024). Impact of Exchange Rate Fluctuation on Import and Export Enterprises in China and Japan and Countermeasures. *Highlights in Business, Economics and Management, 24*, 322-330. https://doi.org/10.54097/4mmr4q90

Lízal, L., Schwarz, J. (2013). Foreign exchange interventions as an (un)conventional monetary policy tool. *BIS Papers*, *73*, 127-143. https://econpapers.repec.org/bookchap/bisbisbpc/73-09.htm

Merrouche, O., Nier, E. (2010). What Caused the Global Financial Crisis? – Evidence on the Drivers of Financial Imbalances 1999–2007, (Working paper, WP/10/265). International Monetary Fund.

Michalczyk, W. (2010). Rola interwencji walutowych na polskiej drodze do Euro. *Folia Oeconomica*, *238*, 121-133.

Mielus, P. (2022). Reakcja rynku finansowego na wybuch wojny rosyjsko-ukraińskiej w porównaniu do reakcji na wybuch pandemii COVID-19 w Europie. *Bezpieczny Bank*, *1*(86), 80-99. https://doi.org/10.26354/bb.5.1.86.2022

Mishkin, F. S. (2011). Over the Cliff: From the Subprime to the Global Financial Crisis. *Journal of Economic Perspectives*, *25*(1), 49–70.

Nechio, F. (2011). *Monetary policy when one size does not fit all*, (Economic Letter No. 2011-18). Federal Reserve Bank of San Francisco.

Pagoulatos, G. (2020). EMU and the Greek crisis: testing the extreme limits of an asymmetric union. *Journal of European Integration*, *42*(3), 363–379. https://doi.org/10.1080/07036337.2020.1730352

Russo, M. (2006). The Challenge of Economic and Monetary Union: Lessons from Italy's Experience. *Bank i Kredyt*, *7*, 3-13.

Schnabel, I. (2024). The benefits and costs of asset purchases [Speech transcript]. European Central Bank. https://www.ecb.europa.eu/press/key/date/2024/html/ecb.sp240528~a4f151497d.en.html

Singh, A. (2023). The Role of Central Banks in Managing Monetary Policy and its Effects on the Economy: An Empirical Analysis of Policy Tools, Economic Indicators, and Implications. *Journal of Student Research*, *12*(4). https://doi.org/10.47611/jsrhs.v12i4.5327

Sławiński, A. (2016). The limits to monetary policy effectiveness. *FINANSE Czasopismo Komitetu Nauk o Finansach PAN*, *1*(9), 9-20.

Szczepanik, M. (2022). Wpływ rosyjskiej agresji na Ukrainę na sytuację gospodarczą UE. *Biuletyn PISM, 40*(2459). https://pism.pl/webroot/upload/files/Biuletyn/Biuletyn%20PISM%20nr%2040%20(2459)%2010%20marca%202022%20r.pdf

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, *39*, 195–214. https://doi.org/10.1016/0167-2231(93)90009-l

Turk, R. A. (2015). *Housing Price and Household Debt Interactions in Sweden*, (Working Paper). International Monetary Fund.

Tyniewicki, M., Kozieł, M. (2021). Current Problems of Financial Law in Poland and in the Czech Republic Including Effects of the COVID-19 Pandemic. *Bialystok Legal Studies*, *26*(4), 53-71.

Urbanowicz, Z. (2014). Stabilizacyjna rola polityki pieniężnej w warunkach unii walutowej. *Ruch Prawniczy, Ekonomiczny i Socjologiczny*, *76*(4), 249–259. https://doi.org/10.14746/rpeis.2014.76.4.17

Urbanowicz, Z. (2024). (Nie)adekwatność polityki pieniężnej EBC w gospodarce spoza strefy euro na przykładzie Polski w latach 1999-2023. *UR Journal of Humanities and Social Sciences*, *30*(1), 145–160. https://doi.org/10.15584/johass.2024.1.9

Van Moltke, K. (2001). The Maastricht Treaty and the Winnipeg Principles on Trade and Sustainable Development. IISD. Canada.

Willett, J.B., Singer, J.D. (1988) Another Cautionary Note About R^2: Its Use in Weighted Least-Squares Regression Analysis. *The American Statistician*, *42*(3), 236-238.

World Bank Group. (2023). Bulgaria. Public Finance Review 2023. International Bank for Reconstruction and Development / The World Bank.