International Monetary Spillovers: The role of inflation

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Dissertation written under the supervision of Professor Diana Bonfim

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Abstract

The recent years have been marked by a profound integration in both trade and financial markets across Europe that contributed to a spread from the Euro Area's monetary policy decisions far beyond its borders. This paper aims to delve into the intricate subject of monetary policy spillovers, focusing on the dynamic relationship between the Euro area's monetary policy and its impact on European nations that have chosen not to adopt the Euro as the common currency. A complex environment has been created where monetary policies set by the European Central Bank (ECB) radiate across borders, influencing economic variables and shaping policy landscapes. By the time of the financial and Eurozone crisis, the expansionary policies implemented by the ECB brought a cascade of effects, prompting policymakers in non-Euro area countries to navigate through challenges and opportunities posed by these spillovers. Small open economies, particularly those in Central and Eastern Europe, began a journey of economic and financial integration with the euro area after they agreed to join the European Union (E.U.). However, the vulnerability of these nations to spillover effects extends beyond eastern and central European countries; even Western and Northern European countries find themselves deeply involved in the Euro area's economic dynamics. Whether through pegged currencies or recent integration into the European Union, the impacts are profound, and inflation is a crucial factor.

Keywords: Monetary Policy, Common Currency, Spillovers, Integration, Inflation.

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Resumo

Os últimos anos foram marcados por uma profunda integração dos mercados comerciais e financeiros em toda a Europa, o que contribuiu para uma propagação das decisões de política monetária da área euro muito para além das suas fronteiras. O presente documento pretende aprofundar o complexo tema das propagações da política monetária, centrando-se na relação dinâmica entre a política monetária da zona euro e o seu impacto nas nações europeias que optaram por não adotar o euro como moeda única. Criou-se um ambiente complexo em que as políticas monetárias definidas pelo Banco Central Europeu irradiam para além das fronteiras, influenciando as variáveis económicas e moldando os cenários políticos. Aquando da crise financeira e da crise da zona euro, as políticas expansionistas aplicadas pelo BCE produziram uma cascata de efeitos, levando os decisores políticos dos países não pertencentes à zona euro a enfrentar os desafios e as oportunidades colocados por estas repercussões. As pequenas economias abertas, como as da Europa Central e Oriental, iniciaram um percurso de integração económica e financeira com a área euro após a sua adesão à União Europeia. No entanto, a vulnerabilidade destes países ao efeito de contágio estende-se para além dos países da Europa Central e Oriental, até os países da Europa Ocidental e do Norte estão profundamente envolvidos na dinâmica económica da área euro. Isto acontece seja através de moedas indexadas, quer através da recente integração na União Europeia, os impactos são profundos e a inflação um fator crucial.

Palavras-chave: Política monetária, Moeda Única, Repercussões, Integração, Inflação.

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1. Introduction

The creation of the Euro Area (E.A.)[1] in 1999 marked a historic milestone in European economic integration, bringing unprecedented cooperation among member states. Designed to enhance economic stability and increase and facilitate trade, the adoption of a single currency finished with exchange rate uncertainties and transaction costs, opening the way to deeper economic ties within the Eurozone. As the E.A. evolved, financial markets became increasingly interconnected; a nexus was created through which monetary policy decisions made within the E.A. had a spillover effect on other European countries that did not join the common currency. This integration resulted from cross-border investments, shared financial institutions, and trade linkages, which amplify the transmission channels of monetary policy decisions beyond the E.A. borders and make the need to analyze the spillover effects of monetary policies essential.

Thus, this thesis delves into the complex subject of monetary policy spillovers within the European Union (E.U.), highlighting the transmission of policies from the E.A. to non-EA member countries. Besides the backdrop of the creation of the E.A. and the increasing integration of the financial markets, this study goes deeper into the critical role of inflation to understand the interconnected dynamics of monetary policy across and beyond the E.U.

Following advanced econometric techniques and rigorous data analysis, this study presents country-specific and cross-country analyses, bringing to light the inherent heterogeneity in the spillover effects. The goal is to discern whether the level of inflation of countries outside the E.A. has led to a convergence or divergence with the decisions made by the European Central Bank, as the responsible entity for the monetary policy of the E.A.

Our analysis uncovers two main dimensions of heterogeneity response to E.A. monetary policy shocks. First, the choice of exchange rate regime plays a pivotal role, revealing that economies with pegged exchange rates witness different responses than those with floating rates. Second, financial integration emerges as a determining factor, with more integrated economies exhibiting heightened sensitivity to changes in interest rates and financial uncertainty.

This study contributes to the nuanced understanding of monetary policy spillovers by unraveling the size and direction of these spillovers. Examining how country characteristics

[1] The Euro became the official currency for electronic transactions and banking in 1999, while banknotes and coins were only introduced in 2002. In 1999, the Euro Area included eleven countries: Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, and Finland.

shape responses provides insights beyond the Trilemma, illumining the intricate interplay between monetary policies, inflation dynamics, and the evolving global financial landscape. While at the same time, taking into consideration the financial sector leverage of non-euro area countries that could provide information on the capital structure, risk exposure, and potential vulnerabilities of financial institutions. This analysis is beyond important since monetary policy decisions can influence changes in these components and, in turn, impact economic and financial conditions, as already mentioned. Thus, by combining monetary policy and corporate finance variables we are providing a more comprehensive view of the factors influencing financial and economic outcomes in non-euro area countries.

Based on Li, J., Meng, X., Zhang, L., & Zhou, T. (2023), we demonstrate that countries have more freedom to follow the ECB's decisions on monetary policy when they are in a low inflation environment (2.5-lemma[2]). By doing so, we aim to contribute to the literature on international monetary spillovers by focusing on the role of inflation while analyzing the correlation between interest rates in E.A. countries and individual countries outside the E.A.

Insights of this research may contribute to ongoing discourse on the economic implications of the E.A.'s creation, and its influence on the broader U.E. By understanding the mechanisms of monetary policy spillovers, policymakers, central banks, and researchers can craft more effective strategies that consider the interdependence of E.U. economies.

This paper is organized as follows: We start by revising the literature and what was already discovered regarding this topic in Section 2. Then, in Section 3, we will start with a preliminary analysis that will cover the period since the creation of the E.A. and will go through the most relevant economic and financial events until 2023 while analyzing specific countries. In Section 4, we will present our model and methodology, which will open the door to Section 5, where we further explore data and the results of our empirical analysis. Section 6 concludes.

[2] Regarding empirical findings, "2.5-lemma," or something between a trilemma and a dilemma, means that without capital controls, a flexible exchange rate regime offers some monetary policy autonomy when the central country tightens its monetary policy. However, it fails to do so when the central country lowers its interest rate.

2. Literature Review

As time passed, financial markets gradually integrated, increasing their correlation with business cycles worldwide. Thus, monetary policy from the single monetary policy in the Euro Area (E.A.) has tended to spill over to other European countries outside the monetary union, testing their capacity to stay isolated.

The small open economies from Eastern Europe that joined the European Union (E.U.) in 2004 and 2007, like the Czech Republic, Hungary, Poland, Romania, and Bulgaria, have since deepened their economic and financial integration with the Euro Area. These countries may be even more exposed to spillover effects from E.A. monetary policy than Northern Europe countries, such as Sweden and Denmark that also decided not to adopt the Euro as official currency. However, all these countries are firmly integrated with the E.A. As an alternative to the common currency, Denmark and Bulgaria maintain fixed currency pegged with the Euro. At the same time, other nations that are highly financially open, like the Czech Republic, Hungary, Poland, Romania, and Sweden, allow their exchange rate to fluctuate against the Euro but keep a strong presence of European Banks.

However, inflation also plays an essential role in this transmission since it drives changes in monetary policy, exchange rates, and, most importantly, economic and financial stability. This led us to a central topic in macro policy, presented by Schoenmaker (2013), the Financial Trilemma, which states that it is impossible to have, at the same time, independent financial policies, integration in the global markets, and financial stability. This incompatibility of coexistence does not affect only big open economies but also small economies that are affected by a global financial cycle (Obstfeld (2015)) since nations that follow flexible exchange rate regimes often enjoy more considerable policy flexibility compared to those with fixed exchange rate regimes, when looking to open capital markets. The Trilemma makes things more complicated for monetary policymakers since they must consider the consequences of their decisions on both financial and macroeconomic stability, introducing challenges in managing the trade-offs between these two vital aspects of economic and financial stability (Rey (2015, 2016)).

After decades of relative price stability, the Global Financial Crisis brought discussions about inflation to the forefront, and at the same time, the increasingly integrated nature of the global financial markets, already mentioned, may have brought a re-thinking of the role of monetary

policy and the trilemma hypothesis, particularly in this post-Global Financial Crisis period. The movements of policy interest rates were found to be more sensitive to global financial shocks around the time of the emerging markets crises in the late 1990s and early 2000s and since the Global Financial Crisis of 2008 (Aizenman et al., (2016)). This period brought to light that the Trilemma Hypothesis still dictates open economies macroeconomic policy and, at the same time, made non-EA countries response patterns change, namely after the U.S. Fed and ECB started the quantitative easing (Q.E.) policy, which was right after the GFC, pushing its policy rate near the zero boundaries.

Thus, policymakers and central banks in countries outside the E.A. found it necessary to respond to the spillover effect caused by the notable expansionary policy implemented by the ECB in the aftermath of the global financial crisis. As part of the E.U., it is assumed that these economies undergo similar economic conditions as the E.A. countries, so symmetric spillovers resulting from the E.A.'s expansionary monetary policy could act as a significant stimulus, during the aftermath of the global financial crisis, aiding in the closure of the output gap within these countries. However, taking into consideration countries outside the monetary union that are already positioned in a phase of the business cycle that does not need additional monetary stimulus, such as Sweden or Denmark, that present much more vigorous and stable economies in comparison with the other Eastern Europe countries in analysis, expansionary spillovers might instead lead to an economic overheating that can result in reduced risk perceptions, increased capital inflows and escalating asset prices (Potjagailo (2017)).

Perhaps if the ability of domestic monetary policy to respond to these spillovers is restricted, such as by an additional policy objective of maintaining exchange rate stability, macroprudential policies may serve as an additional tool (Obstfeld (2015). The challenge has been designing an appropriate domestic policy that, in optimal cases, helps reap the benefits from economic and financial integration with the E.U. and the E.A. while mitigating the associated risks.

According to Potjagailo (2017), economies with exchange rates pegged to the Euro (Bulgaria and Denmark) show more significant spillover effects on production than economies with floating exchange rates (Sweden, Hungary, Poland, Czech Republic, and Romania) due to a combination of more significant foreign demand effects, the absence of expenditure switching effects, and more significant interest rate responses in countries with pegged exchange rates.

Thus, the latter observations are in line with the Trillema Hypothesis, which states that in economies with higher capital market openness, countries with stable exchange rates should face a more robust interest rate transmission of foreign shocks (Klein and Shambaugh (2015)). While, at the same time countries with higher financial integration show more significant effects of interest rates and financial uncertainty in response to the easing in foreign monetary conditions. However, the authors found that floating rate regimes only provide asymmetric or incomplete isolation from E.A. monetary policy. At the same time, capital controls offer protection from leading countries' shocks on monetary policy for individual countries, even if they follow a fixed or flexible exchange rate regime. The same argument was used years later by Dées and Galesi (2021), who found that the differences in responses across exchange rate regimes are not statistically significant since economies with floating exchange rate regimes are not entirely isolated from U.S. monetary policy shocks, even though they appear to be relatively less affected by that type shocks.

However, this analysis will cover more than just economic channels and dynamics. The financial channel is also essential in the transmission of monetary policy. The global banking sector and the cross-border leverage can influence this diffusion. An expansionary monetary policy adoption decreases the costs of loans and increases the demand for credit (Bernankend Gertler (1995)). An increase in the domestic exchange rate, resulting from expanding foreign monetary policies, alleviates the burden of existing loans denominated in foreign currencies. This, in turn, produces positive effects on wealth and enhances the creditworthiness of borrows (Bruno and Shin (2015)) while contributing to an increase in credit supply since foreign-owned banks can obtain funds from their head offices at lower cost (Cetorelli and Goldberg (2012)). Therefore, by improving funding conditions, the monetary policy of foreign nations enhances the growth of domestic credit and the inflow of capital, which will stimulate local investment and coordinate movements in output across countries (Devereux and Yetman (2010)). Nonetheless, this potentially leads to credit booms or substantial increases in capital flows (Rey (2015)).

Overall, introducing the Euro has led to a broad decrease in the impact of monetary shocks. Under the new monetary policy regime, long-term interest rates and consumption, investment, output, and employment show less responsiveness to short-term interest rate shocks. However, trade and the effectiveness of the real exchange rate exhibit a more pronounced reaction.

Although the monetary transmission has become more consistent across the yield curve, the asymmetries persist (Boivin et al. (2009)).

Finally, the non-EA countries with fixed exchange rate regimes should show more substantial spillovers over interest rates compared to countries with flexible exchange rate regimes, in line with the trilemma hypothesis of international monetary policy (Potjagailo (2017)). Therefore, this paper aims to study further if the asymmetric response will still hold if we consider the inflation level of non-EA countries based on Li, J., Meng, X., Zhang, L., & Zhou, T.(2023). Besides, Han and Wei (2018) have already proved that this asymmetry is more likely to hold when the inflation of the non-EA countries is low since a low inflation environment gives more independence to countries to follow the center countries' cut in interest rate, without fearing of an inflated economy. Nevertheless, there is a grey zone in their paper where the asymmetric responses break down, pointed out by Li, J., Meng, X., Zhang, L., & Zhou, T. (2023), when an individual country is already in a high inflationary environment. In this situation, the E.A. cut on interest rates can bring huge inflation costs for the periphery country.

Li, J., Meng, X., Zhang, L., & Zhou, T. (2023) worked along the lines that defended that a flexible exchange rate regime appears to convey monetary policy autonomy to individual countries when the integrated group raises its interest rate but does not do so when it lowers (2.5 lemma). The authors rejected the hypothesis of a Trillema and Dillema and considered the hypothesis of 2.5 lemma literature. Thus, my contribution to the literature comes from exploring the critical role of inflation and the importance of considering it in the trilemma literature. Therefore, this paper aims to interpret the correlation between policy rates from countries that joined the E.U. but not the Monetary Union and the E.A. countries, considering its intention to follow the policy rate adjustment of the ECB.

3. Preliminary Analysis

In the 1960s, the need to consolidate the economic stability in Europe and facilitate cross-border trade brought the idea of creating an economic and monetary union for Europe. Thus, in 1999, eleven countries adopted the Euro as their official currency, giving the European Central Bank (ECB) complete control over their monetary policy with the primary objective of maintaining price stability, setting interest rates for the Euro Area as a whole.

This common currency was only used initially in accounting. However, coins and banknotes were introduced into circulation years later as national currencies were phased out. Thus, in 2002, twelve of the fifteen countries that were part of the E.U. decided to adopt a common currency. Nevertheless, Denmark, Sweden, and the U.K. rejected this option. The fact that Denmark and Sweden had relatively solid and stable economies allowed them to avoid facing the same immediate economic imperatives to adopt the Euro as some countries that joined the Eurozone. At the same time, joining the Eurozone would have required them to cede a degree of control over their domestic monetary policies to the ECB and the expected monetary framework. Referendums to decide on euro adoption took place in both countries, and the results were against joining the Eurozone. The outcome of these referendums reflected concerns and doubts among the citizens about the potential benefits and risks of adopting the common currency, so both countries decided to step away from this point of integration. As the U.K. is no longer part of the E.U., it will not be considered in the analysis. In the case of Denmark, the country chose to retain the Danish Krone with the promise of keeping a fixed exchange rate with the Euro. In contrast, Sweden could do so if the public sentiment or economic conditions change.

3.1. Euro Introduction

The period from 1999Q1 to 2002Q4, with the economic and financial preparation for a common currency, was challenging for Europe, and many countries saw much economic development. The European economy experienced moderate economic growth during this period since many E.U. countries benefited from increased trade and reduced currency exchange costs due to adopting the common currency.

During this period, interest rates steadily increased in Denmark until 2000Q4, reflecting a tightening monetary policy to control inflation above two percent. Sweden's interest rates also

increased over the same period, and inflation rates remained positive throughout the entire period, with some fluctuations. While there were quarters with lower inflation rates, it does not indicate a persistent deflationary trend. As it is possible to see in Figures 1 and 2, from 2001 onwards, the interest rates from Sweden and Denmark started to converge more to the Euro Area values, and consequently, inflation rates began the same trajectory around the target inflation defined by the central banks as optimum (2% inflation).

As stated by the European Commission in 2019, the Euro's first decade was marked by its expansion across the continent. However, the second one was a thought period for Europe, with the beginning of the economic and financial crisis back in 2008.

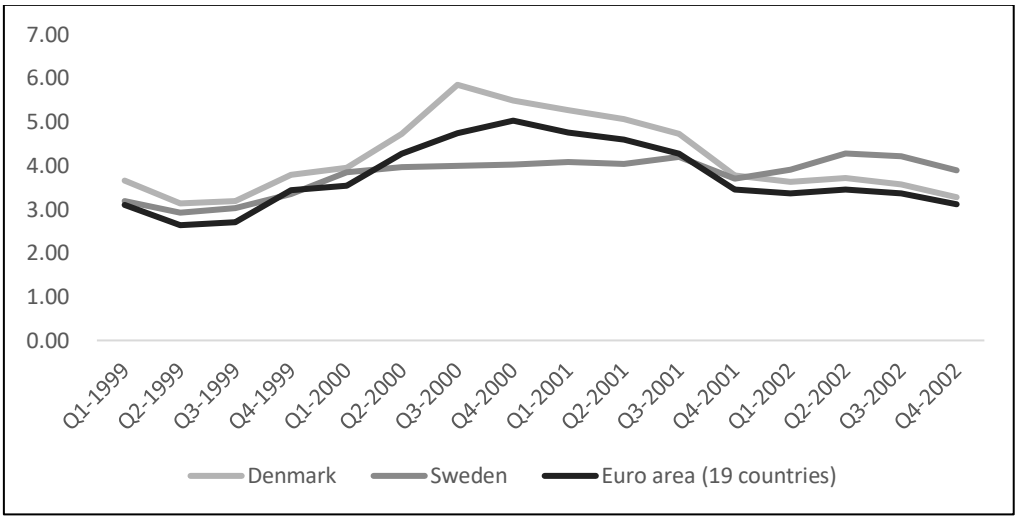

Figure 1- Short-Term Interest Rates per Centum (1999Q1-2002Q4) Source: OECD Stat.

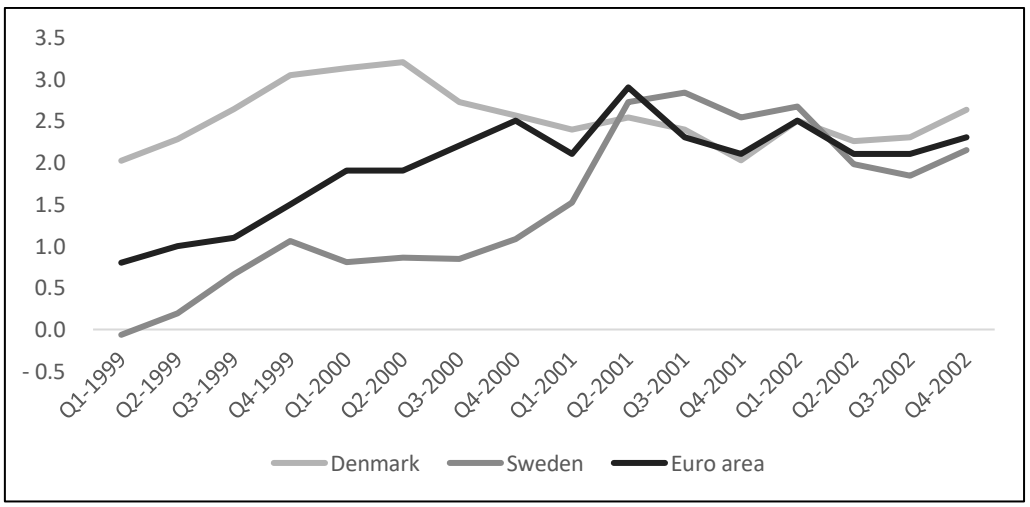

Figure 2- Inflation rates (1999Q1-2002Q4). Source: OECD Stat.

3.2. Global Financial Crisis

After extensive growth and development in most E.U. countries, in 2004 the largest enlargement included ten new member states. At that time, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia joined the E.U., bringing the E.U.'s membership to twenty-five. Of these countries, only one, Slovenia, joined the Eurozone on January 1, 2007. On the same date, the E.U. welcomed more members, Bulgaria and Romania, and in 2009, Cyprus and Malta joined the Euro Area.

From 2007Q1 to 2008Q4, Europe experienced significant economic and financial changes, mainly due to the global financial crisis that originated in the United States and had far-reaching consequences worldwide. European banks started facing liquidity problems, and many countries experienced severe recessions.

By this time, all the countries in the analysis were already part of the European Union, and the concerns about economic stability and inflationary pressures caused, as shown in Figures 3 and 4, the Czech Republic, Denmark, Poland, Sweden, and Bulgaria to increase their interest rates gradually. In contrast, Hungary and Romania experienced a more accentuated increase in interest rates.

During this period, Bulgaria kept super high inflation rates. This crisis opened the way for significant changes in European financial regulations and strengthened monetary policy coordination among E.U. member states, especially in the Eurozone. It also highlighted the interconnectedness of financial markets, their massive contribution to monetary policy spillovers, and the need for coordinated responses among countries to manage economic and financial stability.

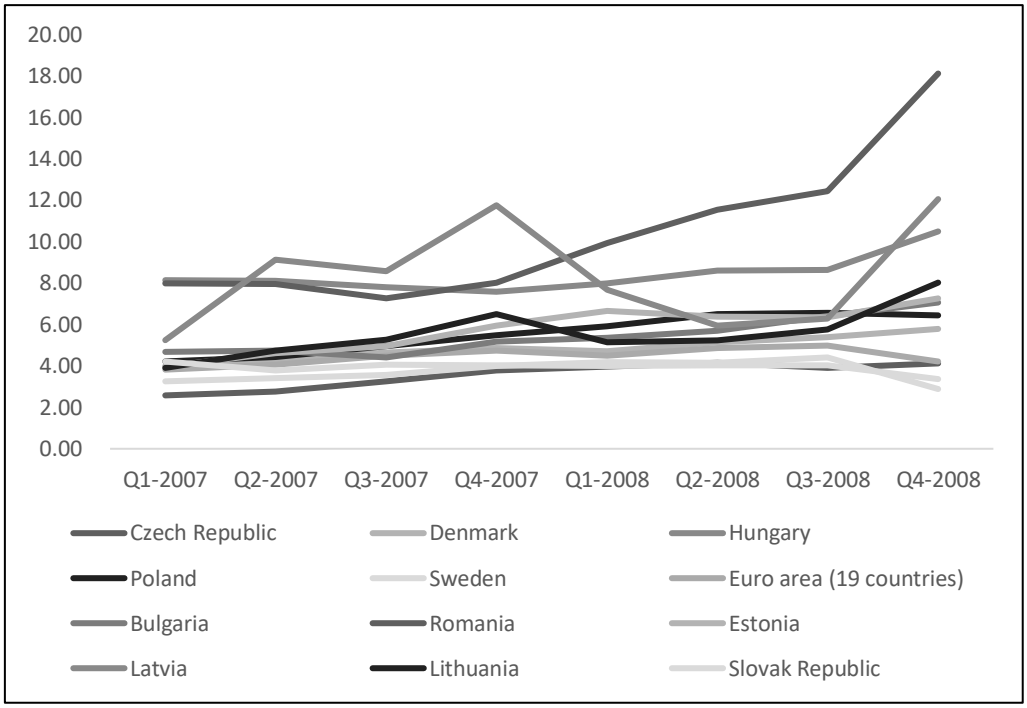

Figure 3- Short-Term Interest Rates per Centum (2007Q1-2008Q4) Source: OECD Stat.

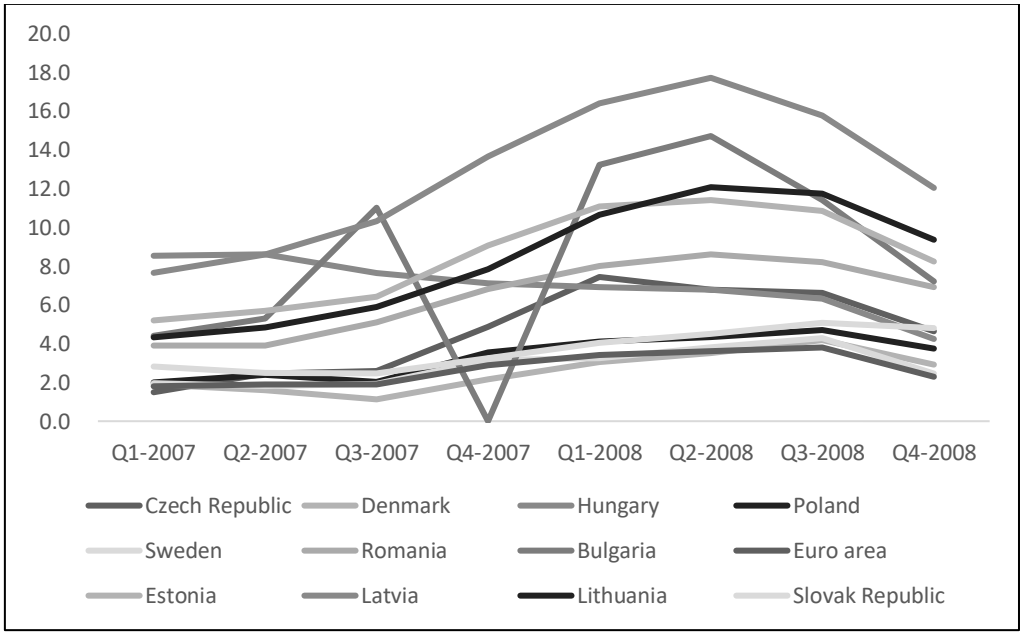

Figure 4 - Inflation Rates (2007Q1-20081Q4). Source: OECD Stat.

3.3. Sovereign Debt Crisis

After the challenging period in the E.U. in 2007-2008, 2010 brought another phase in the Eurozone's challenges. The sovereign debt crisis officially unfolded around 2010, making countries seek financial assistance, implement austerity measures, and face economic contractions. The transition from the global financial crisis to the sovereign debt crisis highlighted how economic shocks and financial instability can have lasting repercussions, especially in an integrated monetary union like the Eurozone.

By that time, the European Union had 27 countries. However, ten of them continued without joining the Euro area; only Slovakia joined the Euro during the end of the global financial crisis and the beginning of the Sovereign Debt Crisis. Find the evolution on interest rates and inflation in figure 5 and 6.

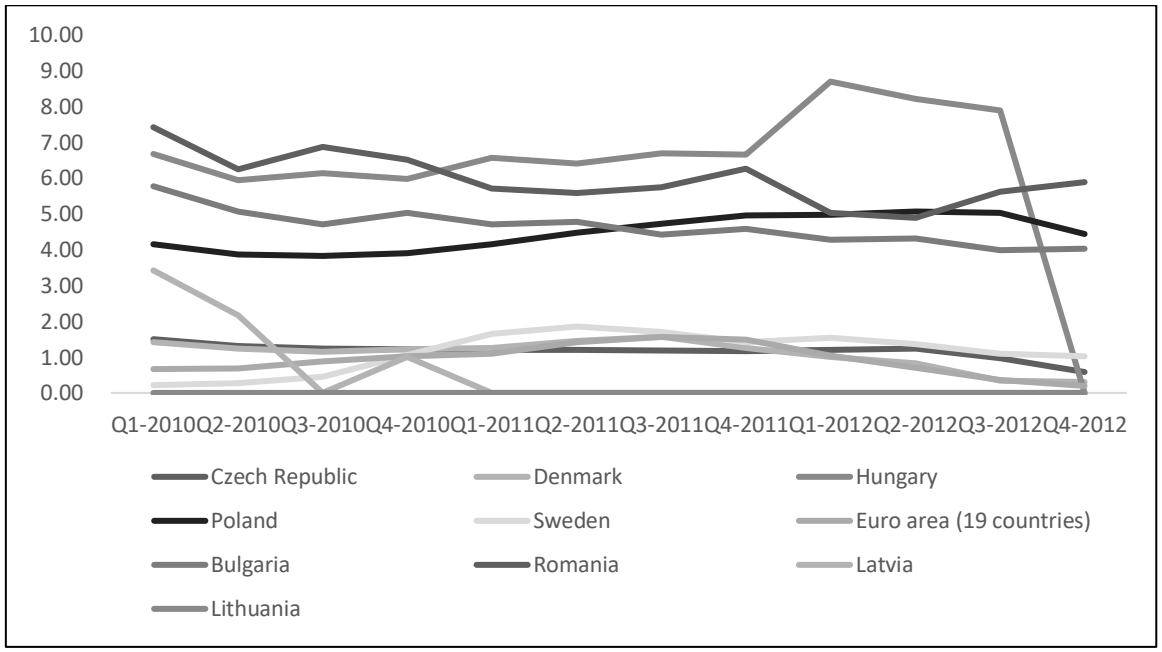

Figure 5- Short-Term Interest Rates per Centum (2010Q1-2012-Q4). Source: OECD Stat.

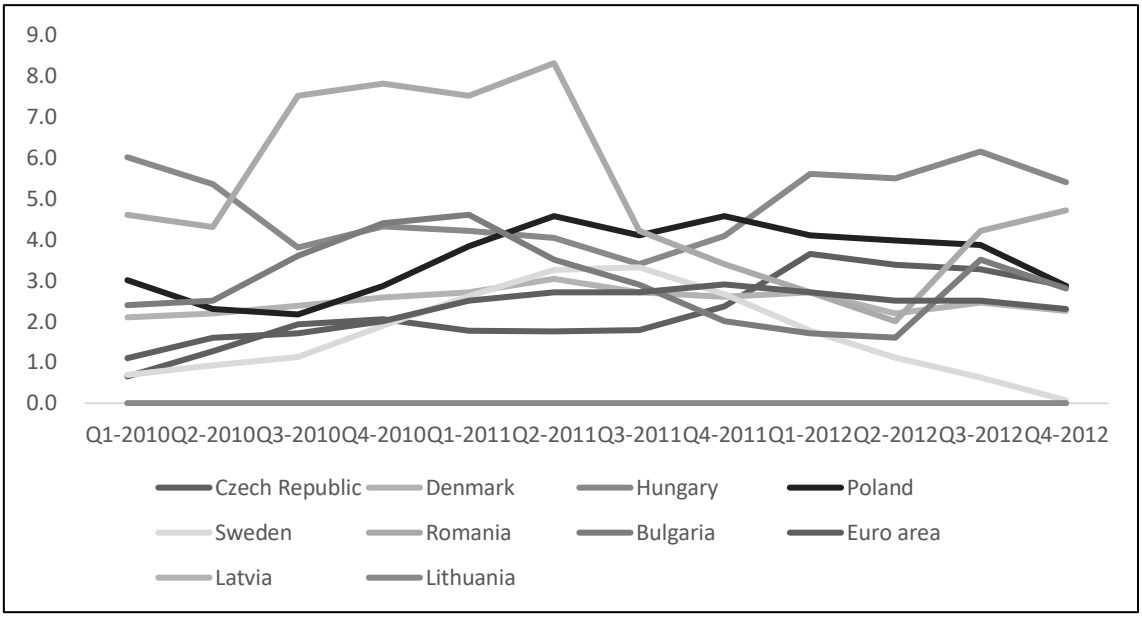

Figure 6- Inflation Rates (2010Q1-2012Q4). Source: OECD Stat.

Regarding inflation rates, the Euro Area displayed a general decreasing trend. At the same time, countries like Hungary experienced fluctuating inflation rates, peaking at 6.1% in 2011Q3, while Sweden maintained consistently low and stable inflation rates with a brief increase in 2011Q1.

As a result, in the Euro Area, interest rates fluctuated, starting at 0.66% in 2010Q1, reaching a peak of 1.56% in 2011Q3, and ultimately declining to 0.20% by 2012Q2. Among individual countries, Hungary experienced high and volatile interest rates, peaking at 8.69% in 2010Q4, while Sweden maintained consistently low rates with a slight increase in the first half of 2011.

Overall, the Euro Area and the E.U. faced challenges during the sovereign debt crisis, reflected in both interest rates and inflation fluctuations. During that time, there was a collective effort in the Euro Area to manage inflation and economic stability, with interest rates decreasing over time.

3.4. Covid Pandemic

After years of economic recovery and low-interest rates due to a long period of recession and global financial crisis, at the beginning of 2020Q1, the COVID-19 pandemic led to a widespread economic disruption globally. The uncertainty behind the situation and possible effects caused the ECB to implement various measures to mitigate the economic impact, including interest rate cuts, asset purchases, and a targeted longer-term refinancing operation.

However, due to the decreased demand, lockdowns, and restrictions, uncertainty, and disruptions in the supply chain, due to the spread of the virus, cause challenges to inflation and overall economic uncertainty. The ECB reacted to stabilize the economy, but inflation dynamics were influenced by the complex and evolving nature of the pandemic's effects on economic activity.

By that time, the Euro Area was made by 20 of the total 27 countries that belong to the E.U. Bulgaria, the Czech Republic, Denmark, Hungary, Poland, Romania, and Sweden stayed outside the common currency, and from now on this will be the seven countries in analyze versus the E.U. as a group highly integrated in Figure 7 and 8.

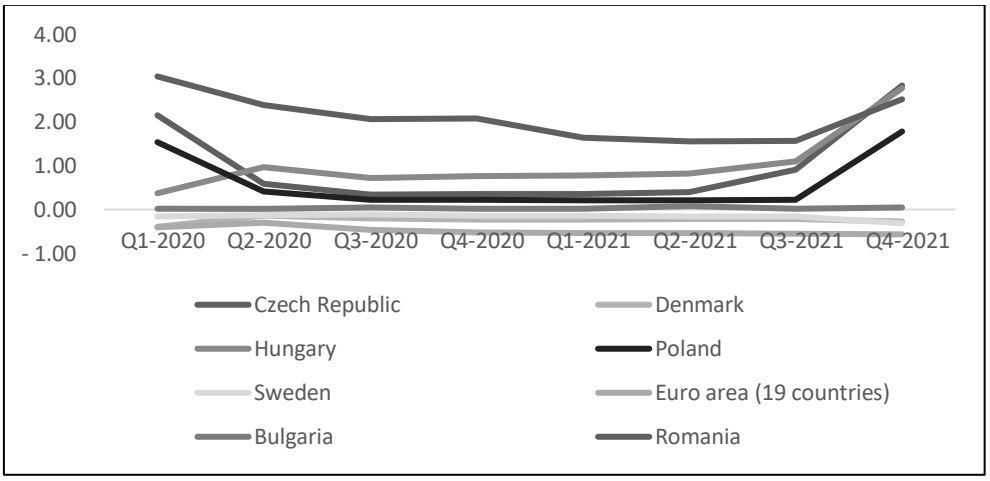

Figure 7- Short-Term Interest Rates per Centum (2020Q1- 2021Q4). Source: OECD Stat.

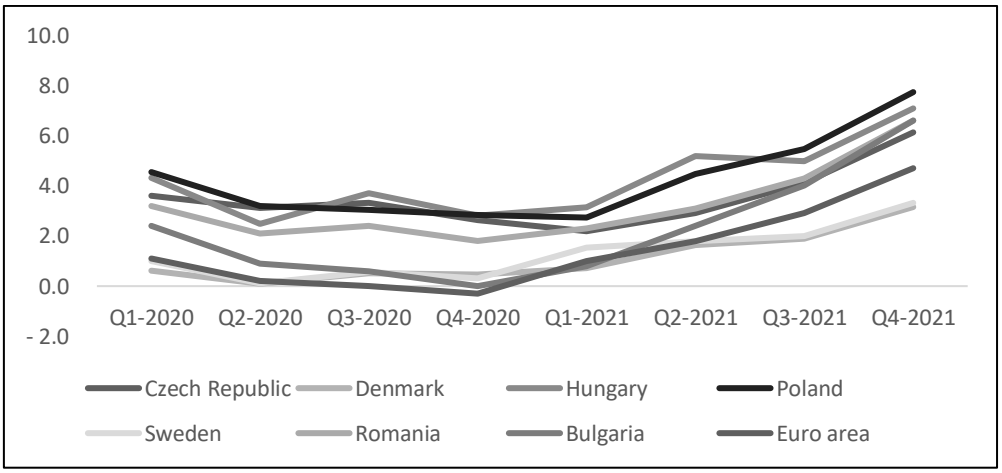

Figure 8- Inflation Rates (2020Q1-2021Q4). Source: OECD Stat.

In the Euro Area, inflation rates varied around zero, experiencing a slight uptick in 2021Q2 (1.8%) and a more significant surge in 2021Q4 (4.7%). Among countries that do not belong to the Euro Area, the Czech Republic had moderate inflation, peaking at 6.1% in 2020Q2, while Denmark maintained low and stable rates, reaching 3.2% in 2021Q4. Hungary also showed inflation fluctuations, peaking at 7.1% in 2021Q4, while Poland assisted a decline, ending at 7.7% in 2022Q4. Besides, Sweden maintained low and stable rates with a brief increase in 2021Q1.

As mentioned, the Euro Area suffered a notable decrease in interest rates due to continued lower inflation, from 2021Q1 to 2021Q3, with a slight increase in 2021Q4. The short-term interest rates in the Czech Republic fluctuated, peaking at 2.83% in 2021Q4, while Denmark maintained consistently negative rates. On the other hand, Hungary saw an increase to 2.77%, Poland experienced a peak at 1.78%, and Sweden maintained negative rates with minor fluctuations.

Thus, there was a general trend of decreasing interest rates in the Euro area because of an accommodative monetary policy. Inflation rates, however, show more fluctuations, with some countries experiencing higher inflation rates in certain quarters. Thus, changes in interest and inflation rates may influence monetary spillovers, affecting economic conditions in neighboring countries and the broader Euro area.

3.5. Russia's Invasion of Ukraine

While the world was still recovering from the recent events and the economy was retaking its pace, Russia's invasion of Ukraine in 2022Q1 brought uncertainties and potential disruptions to this economic recovery. The conflict increased volatility in financial markets, interest rates, and inflation dynamics as stated in Figure 9 and 10.

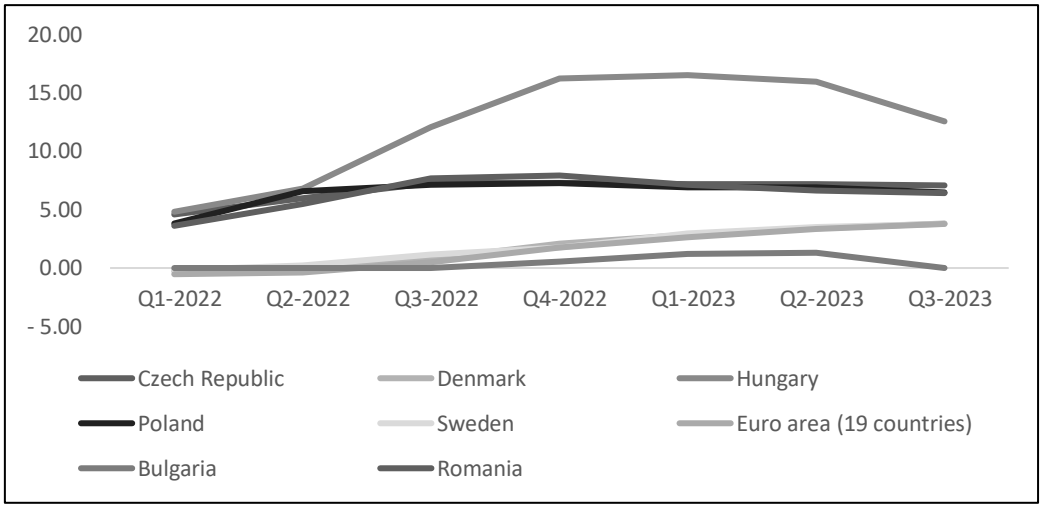

Figure 9- Short-Term Interest Rates per Centum (2022Q1- 2023Q3). Source: OECD Stat.

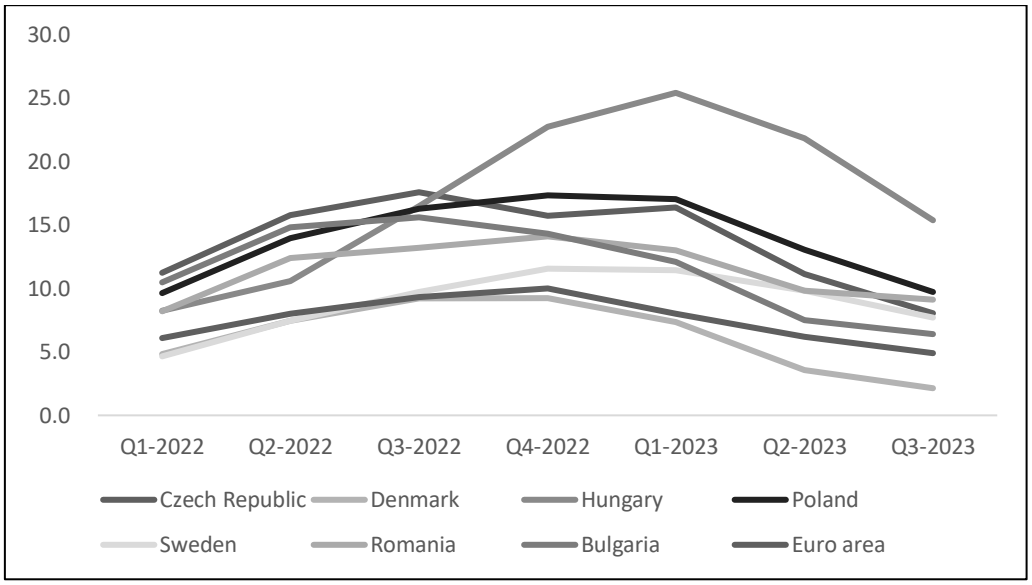

Figure 10- Inflation Rates (2022Q1-2023Q3). Source: OECD Stat.

The change in the geopolitical context, the volatility in the financial markets, and the rising prices for energy created inflationary pressure and brought a steady increase in the Euro Area inflation that reached its peak in 2023Q3 of 4,9%.

Regarding the countries without the Euro, Hungary faced the highest inflation rate, peaking at 25,4% in 2023Q3, while the Czech Republic and Poland had more minor increases but still had a high peak of 17%. In general, all the countries faced a rise in inflation that made them take some measures, namely regarding interest rates. All the countries without the Euro as an official currency had to increase their interest rates to fight inflation. Monitoring the interplay between interest rates and inflation may provide valuable insights into potential monetary spillovers, particularly in the case that we are studying.

3.6. Leverage Ratio

From 2007 onwards, the Euro Area has faced some significant challenges. After the Global Financial crisis, many financial institutions faced increasing scrutiny, which could have affected their leverage ratio. Furthermore, the arrival of the Sovereign Debt Crisis in 2010 led to increased concerns about the stability of financial institutions, especially in the Euro Area. The hard effort to recover the economy with bailouts and financial support programs also had implications for the leverage ratios of domestic credit institutions.

The recuperation from the financial crisis brought to light some global regulatory changes, such as Basel III[3], which introduced new capital requirements and leverage ratio standards for banks to prevent liquidity failures. All these new requirements were based on enhancing the banking sector's resilience and mitigating the risks that caused the spread and effects of the financial crisis.

The prolonged recuperation period of low-interest rates that followed the end of the sovereign debt crisis, initiated by central banks to stimulate economic recovery, has influenced credit institutions' leverage strategies since low-interest rates can impact financial institutions' profitability and risk profile. As mentioned, this period was interrupted by the arrival of the Covid 19 Pandemic, which once again brought challenges to financial institutions: lockdowns, economic disruptions, and government support measures affected the financial health and leverage positions of credit institutions (Figure 11).

[3] Basel III, developed by the Basel Committee on Banking Supervision, represents a comprehensive set of international banking regulations designed to enhance the stability and resilience of the global banking system. It introduces stricter minimum capital requirements, emphasizing Common Equity Tier 1 capital as the most loss-absorbing. Basel III also emphasizes enhanced risk management practices, disclosure requirements, and transparent communication to regulators and the public. The framework has been progressively implemented worldwide, shaping the regulatory landscape for financial institutions.

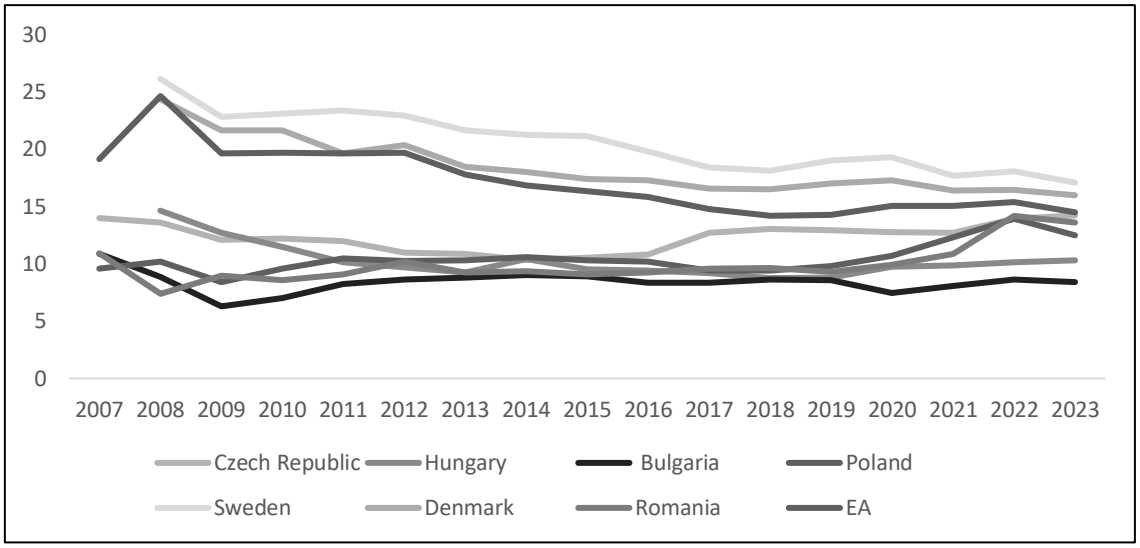

Figure 11- Total assets/ Total equity pure value Source: ECB

Based on domestic credit institutions - Foreign E.U. & non-EU and Foreign EA-controlled subsidiaries and branches' total assets/total equity ratio pure number, the leverage ratio across all countries generally exhibits a decreasing trend over the years. As expected, the global financial crisis influenced the leverage ratio for most countries. However, in the following period, there was a gradual decline in leverage ratios, suggesting a broader move towards financial stability.

Sweden presented the highest leverage ratio during the global financial crisis and the subsequent period. This could have been due to the low-interest rates compared with the E.A. and the other E.U. member countries that did not join the Euro since the traditional cost of borrowing, where low-interest rates can encourage excessive borrowing and lead to high leverage. Czech Republic, Hungary, Bulgaria, Poland, and Romania generally showed a decreasing trend in leverage ratios, aligning with the post-crisis global financial landscape. Despite some common trends, there are still divergent responses among countries; for example, Denmark had relatively high-interest rates but maintained a high leverage ratio, suggesting that local economic conditions and specific factors influenced the country's borrowing behavior.

Looking at monetary spillovers, there is evidence in the data that the global financial crisis led to a synchronized response regarding interest rates among countries. For instance, as interest rates increased globally, some countries experienced a simultaneous rise in their leverage ratios, indicating a possible shared impact of the crisis.

In recent years, interest rates in the Euro Area and several individual countries have experienced fluctuations. Inflation rates increased during this period; Bulgaria and Hungary saw substantial

spikes in inflation during this period. However, there is little event correlation between interest rates, inflation rates, and leverage ratios during this period. While higher inflation is typically associated with higher interest rates and lower leverage ratios, the leverage ratios of domestic credit institutions in various countries remained relatively stable during the recent period. Leverage in the Czech Republic, Denmark, Hungary, Poland, and Sweden showed only moderate changes but with no drastic shifts.

4. Empirical Analysis

The primary empirical focus lies in the correlation between interest rates in monetary policy within the countries that belong to the E.A. and E.U. countries that do not belong to the Euro Area and how this connection relates to the levels of domestic inflation in non-Euro Area countries, following the research of Li et al. (2023).

$$\Delta rp_{i,t} = \rho rp_{i,t-1} + \gamma \Delta r\text{EA}_{i,t} + \delta \Delta \text{ICI}_{i,t} + \tau Control_{i,t} + \Omega \text{ Leverage}_{i,t} + \theta_t + \varepsilon_{i,t}$$

Where $\Delta rp_{i,t}$ represents the changes in the policy interest rate of the European but non-Euro Area countries i in time t. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries i, $rp_{i,t-1}$; the change in the interest rate of the euro area, $\Delta r\text{EA}_{i,t}$; $\Delta\text{ICI}_{i,t}$ (the European Union Industrial Confidence Indicator) which is commonly used to proxy the business and industry confidence for the Europe Union; and the financial sector leverage (debt to equity) of non-euro area countries that provide information on the capital structure, risk exposure, and potential vulnerabilities of financial institutions. Monetary policy decisions can influence changes in these components and, in turn, impact economic and financial conditions. Combining monetary policy and corporate finance variables provides a more comprehensive view of the factors influencing financial and economic outcomes in non-euro area countries. Besides, domestic variables that affect the dependent variable are included in the vector $Control_{i,t}$, with t denoting the time trend. Inflation expectations have been stabilized which resulted in a decreasing tendency on interest rates around the world. We use the time trend, t, to capture this tendency in the regression model and expect a negative coefficient, θ.

To better understand and compare the different coefficients and follow the lines of Han and Wei (2018), Obstfeld et al. (2019), and Li et al. (2023) to find the effect of inflation on the international transmission of interest rates, we will specify γ in the model as the dummy

variable that measures when a country is in a low or high inflation environment and if there was a decrease or increase in the interest rates in the E.A.

$$\gamma = f1D increase,high + f2D increase,low + f3D decrease,high + f4D decrease,low$$

Where $Dincrease$, $high$ =1 if the Euro Area increases interest rate and the Non-Euro Area country's domestic inflation level is high (above the median inflation of two percent), while $Dincrease,high$ =0 otherwise. The remaining three dummies are similarly defined. Thus, when E.A. raise(lower) its policy rate, we will have the following:

$$\Delta r^{p}_{i,t} = \rho rp_{i,t-1} + f1D_{increase,high}\Delta r\mathrm{EU}_{i,t} + f2D_{increase,low}\,\Delta r\mathrm{EU}_{i,t} + \delta\Delta\mathrm{ICI}_{i,t} + \tau Control_{i,t} + \theta_t + \varepsilon_{i,t}$$

$$\Delta r^{p}_{i,t} = \rho rp_{i,t-1} + f1D_{\mathrm{decrease},high}\Delta r\mathrm{EU}_{i,t} + f2D_{\mathrm{decrease},low}\,\Delta r\mathrm{EU}_{i,t} + \delta\Delta\mathrm{ICI}_{i,t} + \tau Control_{i,t} + \theta_t + \varepsilon_{i,t}$$

5. Results

5.1. Data

To complete the analysis, several regressions were run to measure different results and impacts of the different variables in the spread of monetary policy from E.A. Data regarding short- and long-term interest rates was extracted for all countries from OECD Statistics. The variation of the Industrial Confidence Indicator (ICI) that will work as a proxy of the European business cycle was extracted from the Eikon Data Stream. To complete the analysis with a corporate finance variable, data regarding financial corporations' total assets and financial liabilities was extracted from the European Central Bank dataset. The vector control constructed based on equal weights for GDP growth and variation in inflation was built on data extracted from OECD Statistics. Due to the lack of data for all the variables and different countries, the time spans used in the individual regressions are presented in Table 1. A table with the results for all stages of the analysis and regressions is presented. Each table contains the p-values marked with *** p <0,01, **p < 0,05, *p<0,1, and the respective coefficients of each variable in parenthesis.

Country	Period	
CZ	Q12004	Q42022
DN	Q42012	Q42022
HG	Q11999	Q22017
PL	Q12004	Q42022
SW	Q11999	Q42022
BL	Q12007	Q42022
RM	Q12007	Q32022

Table 1- Time spans

The analysis is divided into three different groups[4]. The first analysis is based on seven different regressions, one per each of the current members of the E.U. that do not belong to the E.A. (Poland, Czech Republic, Romania, Bulgaria, Sweden, Denmark, and Hungary) based on short-term interest rates. According to the methodology[4], there is a split when there is an increase or a decrease in the interest rates by the ECB, based on the dummy variable defined that measures when countries were in a low or high inflationary environment to analyze the different effects. Find the results when there was an increase in interest rates in Table 2.

Short-Term	**INCREASE IR**						
	Poland	Czech Republic	Hungary	Sweden	Bulgaria	Romania	Denmark
$\rho rpi, t-1$	0.192	0.084*	0.016**	0.239	0.810	0.371	0.181
	(0.087)	(-0.220)	(-0.071)	(-0.070)	(0.0053)	(-0.068)	(-0.093)
$f1$ **high** Δr**EU** t	0.293	0.170	0.373	0.00***	0.001***	0.935	0.00***
	(0.673)	(0.594)	(0.544)	(1.703)	(1.952)	(0.0071)	(1.094)
$f2low\ \Delta r$**EU** t	0.608	0.665	0.256	0.625	0.016**	0.392	0.001***
	(0.519)	(-0.178)	(-4.136)	(-0.129)	(-13.0256)	(-2.423)	(2.177)
ΔICI*t*	0.188	0.198	0.031**	0.00***	0.016**	0.164	0.594
	(-0.031)	(0.032)	(-0.067)	(-0.069)	(-0.078)	(-0.0505)	(0.006)
$\tau Controli,t$	0.00***	0.424	0.854	0.00***	0.003***	0.015**	0.559
	(0.856)	(-0.018)	(-0.0336)	(0.730)	(0.5738)	(0.3072)	(-0.011)
ΩLeverage i,t	0.247	0.665	0.057*	0.709	0.000***	0.133	0.323
	(0.325)	(-0.007)	(-158.317)	(0.032)	(-0.076)	(1.098)	(-0.025)
Constant	0.001***	0.416	0.039**	0.389	0.992	0.975	0.669
	(-0.677)	(0.054)	(0.808)	(-0.080)	(-0.208)	(0.009)	(-0.012)
Nº obs	76	76	57	96	64	64	41
R-square	0.5783	0.1096	0.1642	0.6677	0.4730	0.1928	0.9331

Table 2- Regression results on the increase in short-term interest rates

*Note: This regressions were run when there was an increase of the IR by the ECB. $\Delta rp\ i,t$ represents the changes in the policy interest rate of the European but non-Euro Area countries i in time t. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries i, $rp\ i,t-1$; the change in the interest rate of the euro area, ΔrEA; $\Delta ICIt$ variation on the European Union Industrial Confidence Indicator ; ΩLeverage i,t and the financial sector leverage (debt to equity) of non-euro area countries. $f1$ high ΔrEU t and $f2low\ \Delta r$EU t represent dummy variables that define when countries were in a high and low inflation environment respectively. In the first line we find the p-values p-values marked with *** p <0,01, **p < 0,05, *p<0,1 and in the second line and in parenthesis we find the coefficients.*

The Euro-Area's interest rate increase when countries were in a high inflation environment positively affected the variation of interest rates in Sweden, Bulgaria, and Denmark. At the

[4] In all stages of the analysis, the regressions ran is based on Li et al. (2023):

- In the case of an increase in interest rates by the E.A. (Increase I.R.): $\Delta r^{p}{}_{i,t} = \rho r^{p}{}_{i,t-1} + f1D_{increase,high}\Delta r^{\mathrm{EU}}{}_{\mathrm{i},t} + {}_{f2Dincrease,low}\ \Delta r^{\mathrm{EU}}{}_{\mathrm{i},t} + \delta\Delta\mathrm{ICI}_{\mathrm{i},t}\ \ \tau Control_{i,t} + \theta t + \varepsilon_{i,\,t}$
- On the other hand, in a decrease of interest rates by the E.A. (Decrease I.R.): $\Delta r^{p}{}_{i,t} = \rho r^{p}{}_{i,t-1} + f1D_{\mathrm{decrease},high}\Delta r^{\mathrm{EU}}{}_{\mathrm{i},t} + {}_{f2D\mathrm{decrease},low}\ \Delta r^{\mathrm{EU}}{}_{\mathrm{i},t} + \delta\Delta\mathrm{ICI}_{\mathrm{i},t}\ \ \tau Control_{i,t} + \theta t + \varepsilon_{i,\,t}$

same time, this increase had a negative effect when Bulgaria was in a low inflation environment and a positive effect in Denmark. The fact that these countries maintain pegged exchange rate regimes gives them less autonomy to keep their interest rates when faced with an increase by the ECB (Li et al., T. (2023)). On the other hand, the effects of the economic cycle proxied by the variation of the ICI negatively affected Hungary, Sweden, and Bulgaria, which may indicate a more significant impact of the business cycle in the decisions about monetary policy. Regarding the variation of inflation and the GDP growth contemplated in the control vector, it is statically significant in four of the seven countries in the analysis, presenting a positive influence in Poland, Sweden, Bulgaria, and Romania's interest rate variation.

Furthermore, taking the analysis to a corporate finance level, the financial corporation's leverage had mixed effects. However, Hungary and Bulgaria's variation in interest rates has been affected since a decrease in the leverage of financial corporations is anticipated to be associated with an increase in interest rates (Devereux and Yetman (2010)). Overall, the variables chosen could explain more than fifty percent of the variation of interest rates in Poland, Sweden, and Denmark.

When proceeding to the case where E.A. increases interest rates, the results present different conclusions as we can see in Table 3.

Short Term	**DECREASE IR**						
	Poland	Czech Republic	Hungary	Sweden	Bulgaria	Romania	Denmark
$\rho rpi, t-1$	0.003***	0.180	0.018**	0.085*	0.455	0.921	0.219
	(0.10)	(-0.212)	(-0.085)	(0.0751)	(0.0191)	(-0.0089)	(0.367)
$f1$ **high** $\Delta rEU\ t$	0.001***	0.002***	0.695	0.007***	0.034**	0.022**	0.090*
	(0.767)	(0.610)	(0.426)	(0.9722)	(-0.8984)	(1.600)	(1.859)
$f2low\ \Delta rEU\ t$	0.773	0.00***	0.002***	0.00***	0.900	0.040**	0.080*
	(-0.0679)	(1.227)	(8.811)	(0.5855)	(-0.1356)	(6.431)	(2.228)
$\Delta ICIt$	0.018**	0.806	0.088*	0.00***	0.007***	0.127	0.121
	(-0.059)	(0.006)	(-0.076)	(-0.071)	(-0.0795)	(-0.050)	(-0.111)
$\tau Controli,t$	0.00***	0.534	0.820	0.00***	0.00***	0.004***	0.155
	(0.694)	(0.0126)	(0.0410)	(0.7303)	(0.787)	(0.232)	(0.1566)
Ω**Leverage** i,t	0.028**	0.423	0.017**	0.001***	0.001***	0.134	0.161
	(0.241)	(-0.015)	(-187.81)	(0.0955)	(-0.073)	(0.999)	(0.254)
Constant	0.001***	(0.010) **	0.011**	0.072*	0.591	0.976	0.323
	(-0.498)	(0.166)	(1.194)	(-0.1523)	(-1.398)	(-0.0105)	(-0.157)
Nº obs	76	76	57	96	64	64	41
R-square	0.5509	0.1985	0.2045	0.6606	0.3940	0.3133	0.3066

Table 3-Regression results on decrease in short-term interest rates.

Note: This regressions were run when there was a decrease of the IR by the ECB. $\Delta rp\ i,t$ represents the changes in the policy interest rate of the European but non-Euro Area countries i in time t. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries i, $rp\ i,t-1$; the change in the interest rate of the euro area, ΔrEA; $\Delta ICIt$

*variation on the European Union Industrial Confidence Indicator ; ΩLeverage i,t and the financial sector leverage (debt to equity) of non-euro area countries. f1 high ΔrEU t and f2low ΔrEU t represent dummy variables that define when countries were in a high and low inflation environment respectively. In the first line we find the p-values marked with *** p <0,01, **p < 0,05, *p<0,1 and in the second line and in parenthesis we find the coefficients.*

Regarding the ECB decrease in interest rates, the lagged policy assumed a more critical role. Despite presenting mixed signals, it is statistically significant for Poland, Hungary, and Sweden, positively affecting Poland and Sweden while negatively impacting Hungary. Besides, the results show that when individual countries live in a high inflation environment, the decrease in interest rates in the E.A. positively affects the variation of the interest rates; the E.A. cut on interest rates can bring huge inflation costs for the individual countries (Li et al., T. (2023)) so it may influence its decision to raise interest rates besides the decision of the ECB. Bulgaria, as a country that presents a pegged exchange rate, which means less independence over its own monetary policy decisions, follows the trend of the E.A., hurting its interest rate variation. It is statistically significant in all countries analyzed except Bulgaria and Hungary. Meanwhile, the same decrease in interest rates by the E.A., when the Czech Republic, Sweden, Romania, Hungary, and Denmark had low inflation, had a positive and statistically significant contribution to its changes in macro policy, as Han and Wei (2018) defended when the inflation of the non-EA countries is low it gives more independence to countries to follow an independent decision without fearing of an inflated economy.

As stated for the increase in interest rates, in this case, the business cycle also negatively affected Poland, Hungary, Sweden, and Bulgaria. In contrast to the rise in interest rates the control vector positively affected Sweden and Romania and positively in Bulgaria. Keeping attention to the effects of corporate finance in this process, the leverage of financial institutions also presented a mixed effect, presenting a positive impact in Poland and Sweden and a negative in Hungary and Bulgaria. As in the previous analysis, the R-Square was fixed above fifty percent for Poland and Sweden.

The analysis of short-term interest rates allows a comprehensive view of more immediate economic impacts. However, long-term interest rates may reflect market expectations such as inflation and economic growth over an extended period. Thus, complementing both may bring a more comprehensive understanding of how monetary policy actions affect different segments of the interest rate spectrum and the economy. This takes the analysis to the next step, studying the same model but considering long-term interest rates. Find the results in Table 4 and 5.

Long Term	**INCREASE IR**						
	Poland	Czech Republic	Hungary	Sweden	Bulgaria	Romania	Denmark
$\rho rpi, t-1$	0,120	0,503	0,240	0,255	0,887	0,473	0,041**
	(-0,0386)	(-0,0208)	(-0,04196)	(-0,011)	(-0,0029)	(-0,05923)	(-0,0663)
$f1$ **high** Δr**EU** t	0,00***	0,363	0,018**	0,00***	0,676	0,196	0,00***
	(1,7421)	(0,2883)	(0,9411)	(1,161)	(0,101)	(0,7815)	(1,246)
$f2low$ Δr**EU** t	0,001***	0,219	0,026**	0,00***	0,092*	0,026**	0,00***
	(1,1015)	(-0,1738)	(1,438)	(1,3668)	(0,321)	(1,3675)	(1,15)
ΔICIt	0,692	0,601	0,004***	0,007***	0,012**	0,091*	0,00***
	(-0,0035)	(0,0067)	(-0,0614)	(0,023)	(-0,0295)	(-0,03177)	(0,02)
$\tau Controli,t$	0,001***	0,881	0,950	0,158	0,098*	0,590	0,003***
	(0,1629)	(0,0023)	(0,0064)	(-0,05846)	(0,0855)	(0,02393)	(-0,0981)
ΩLeverage i,t	0,614	0,009***	0,934	0,072*	0,509	0,845	0,0019***
	(0,049)	(-0,06287)	(-3,5190)	(-0,0351)	(0,0056)	(-0,0374)	(-0,2014)
Constant	0,342	0,149	0,688	0***	0,079*	0,587	0,240
	(-0,1134)	(0,115)	(0,1081)	(-0,1349)	(-0,109)	(0,2246)	(0,12436)
Nº obs	76	76	72	96	64	64	41
R-square	0,6235	0,0899	0,1876	0,6596	0,2496	0,1777	0,7707

Table 4-Regression results on the increase in long-term interest rates.

*Note: This regressions were run when there was a increase of the IR by the ECB, considering long-term interest rates. $\Delta rp\,i,t$ represents the changes in the policy interest rate of the European but non-Euro Area countries i in time t. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries i, $rp\,i,t-1$; the change in the interest rate of the euro area, ΔrEA; ΔICIt variation on the European Union Industrial Confidence Indicator ; ΩLeverage i,t and the financial sector leverage (debt to equity) of non-euro area countries. $f1$ high ΔrEU t and $f2low$ ΔrEU t represent dummy variables that define when countries were in a high and low inflation environment respectively. In the first line we find the p-values marked with *** p <0,01, **p < 0,05, *p<0,1 and in the second line and in parenthesis we find the coefficients.*

In the context of long-term interest rates, the lagged policy negatively affected the variation in Denmark. The increase in monetary policy in the E.A. was particularly significant when countries were in low inflation environments, presenting a positive effect in all countries except the Czech Republic, which is coherent with the results of short-term interest rates. At the same time, when in high inflation environments, the impact was positive, as in the short-term analysis for Hungary, Sweden, Denmark, and Poland.

Furthermore, by what was expected, long-term interest rates may highlight expectations regarding inflation and economic growth. Thus, both ICI variation and the Control vector that reflects the business cycle, inflation variation, and GDP growth had mixed impacts on the changes in macro policy in individual countries. Besides, the variation of the ICI is particularly

significant for Sweden, Bulgaria, Romania, and Denmark, while the vector Control is only for Poland and Denmark.

In contrast with the results of short-term interest rates, the financial corporations' leverage presented a homogeneous signal, with a negative coefficient in the Czech Republic, Sweden, and Denmark. Find the results when a decrease on the interest rate took place in Table 5.

Long Term	**DECREASE IR**						
	Poland	Czech Republic	Hungary	Sweden	Bulgaria	Romania	Denmark
$\rho rpi, t-1$	0,226	0,241	0,028**	0,179	0,935	0,258	0,443
	(-0,0312)	(-0,0315)	(-0,08279)	(-0,01859)	(-0,0017)	(-0,0874)	(0,0441)
$f1$ **high** Δr**EU** t	0,00***	0,256	0,159	0,00***	0,048	0,341	0,159
	(1,1615)	(0,2518)	(0,7641)	(1,541)	(0,7418)	(0,39311)	(0,2049)
$f2low\ \Delta r$**EU** t	0,00***	0,00***	0,00***	0,00***	0,033**	0,00***	0,00***
	(1,4987)	(1,2148)	(1,892)	(0,9752)	(-0,627)	(1,8477)	(-1,158)
ΔICI*t*	0,263	0,974	0,009***	0,458	0,008**	0,09*	0,321
	(-0,01580)	(-0,0004)	(-0,05758)	(0,0089)	(-0,033)	(-0,03518)	(-0,0164)
$\tau Controli,t$	0,007***	0,599	0,902	0,831	0,078*	0,374	0,265
	(0,2008)	(0,0091)	(-0,01261)	(0,0136)	(0,087)	(0,03818)	(0,124)
ΩLeverage i,t	0,958	0,001***	0,823	0,139	0,825	0,943	0,934
	(-0,0047)	(-0,0622)	(-11,8272)	(-0,0456)	(0,0019)	(-0,0108)	(0,01425)
Constant	0,07**	0,016**	0,03**	0,00***	0,613	0,112	0,567
	(0,2098)	(0,2029)	(0,6681)	(0,1669)	(-0,035)	(0,61669)	(0,1031)
Nº obs	76	76	72	96	64	64	41
R-square	0,4136	0,2311	0,2539	0,4162	0,3312	0,2287	0,4500

Table 5-Regression results on decrease in long-term interest rates.

Note: This regressions were run when there was a decrease of the IR by the ECB, considering long-term interest rates. $\Delta rp\ i,t$ *represents the changes in the policy interest rate of the European but non-Euro Area countries* i *in time* t*. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries* i*,* $rp\ i,t-1$*; the change in the interest rate of the euro area,* Δr*EA;* Δ*ICI*t *variation on the European Union Industrial Confidence Indicator ;* Ω*Leverage* i,t *and the financial sector leverage (debt to equity) of non-euro area countries.* $f1$ *high* Δr*EU* t *and* $f2low\ \Delta r$*EU* t *represent dummy variables that define when countries were in a high and low inflation environment respectively. In the first line we find the p-values marked with *** p <0,01, **p < 0,05, *p<0,1 and in the second line and in parenthesis we find the coefficients.*

In the results of a decrease in interest rates by the E.A., it is essential to highlight the significance of a decrease in interest rates when individual countries faced low inflation rates, which positively affected the variation in all of them except Denmark and Bulgaria, which with a pegged exchange rate with the Euro, followed the decision of ECB. The fact that for most of the period analyzed, inflation was above the target, due to the Global Financial Crisis and Sovereign Debt crisis, these results may be a consequence of a reaction from the Central Banks to avoid this tendency. When Poland and Sweden had inflation above the target, the decrease

in interest rates by the ECB positively impacted the variation in its interest rates. As stated in the short-term analysis, and once again, the significance of variables that proxy the business cycle or reflect domestic variables proves the importance of contemplating both short-term and long-term interest rates. The financial corporations' leverage presented once more a negative coefficient in the Czech Republic. The predominant negative coefficient for the leverage variable may be due to a long-term interest rates analysis. The relationship between leverage and long-term interest rates may be influenced by factors that unfold over an extended period, such as changes in the economic environment, market sentiments, or policy expectations.

The second stage of the analysis is based on all seven individual countries as a group. In order to present a more consistent statistical result, seven individual countries were merged into only one group of countries, and the results can be found in Table 6.

	INCREASE IR	**DECREASE IR**
$\rho rpi.t-1$	0.002***	0.003***
	(0.0056)	(0.0056)
$f1$ **high** Δr**EU** t	0.587	0.716
	(0.2330)	(0.079)
$f2low$ Δr**EU** t	0.721	0.636
	(-0.0397)	(0.1083)
ΔICI*t*	0.501	0.480
	(-0.0909)	(0.1831)
$\tau Controli.t$	0.508	0.504
	(0.1746)	(0.1831)
ΩLeverage $i.t$	0.798	0.787
	(-0.0098)	(-0.010)
Constant	0.367	0.435
	(1.798)	(-0.053)
Nº obs	266	266
R-square	0.0396	0.0398

Table 6-Regression results grouped.

*Note: This regressions were run for all countries as a group when there was a increase and a decrease of the IR by the ECB, respectively in the first and second column. $\Delta rp\,i,t$ represents the changes in the policy interest rate of the European but non-Euro Area countries i in time t. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries i, $rp\,i,t-1$; the change in the interest rate of the euro area, ΔrEA; $\Delta ICIt$ variation on the European Union Industrial Confidence Indicator ; ΩLeverage i,t and the financial sector leverage (debt to equity) of non-euro area countries. $f1$ high ΔrEU t and $f2low\,\Delta r$EU t represent dummy variables that define when countries were in a high and low inflation environment respectively. In the first line we find the p-values marked with *** p <0,01, **p < 0,05, *p<0,1 and in the second line and in parenthesis we find the coefficients.*

As well as in the results of the individual regressions, the grouped results show that lagged policy remains significant in the variation of interest rates, contributing positively to its variation. However, the grouped regression presented little significance for the rest of the variables and delivered a very low R-square which represents a limitation of this paper.

The analysis's final stage consists of the split of the seven countries between two groups: Eastern European countries (Poland, Hungary, Romania, Bulgaria, and the Czech Republic) and Northern European countries (Denmark and Sweden).

Many Eastern European countries have undergone significant economic transformations since the end of the Cold War and the dissolution of the Eastern Bloc in 1989. Some of these countries have transitioned to market-oriented economies and have experienced varying degrees of economic growth. Namely, Poland that is known as a success story regarding economic transition. It began implementing economic reforms in the early 1990s, including the liberalization of prices, privatization of state-owned enterprises, and establishing a market-oriented legal framework. Hungary also began economic reforms in the late 1980s and early 1990s, transitioning from a centrally planned economy to a more market-oriented one. After the peaceful dissolution of Czechoslovakia in 1993, the Czech Republic also continued economic reforms on its way to a market economy. Thus, most Eastern European countries have benefited from integration with the broader European economy transitioning from a planned to a market economy.

On the other hand, it represents a big contrast to Northern European countries, Sweden, and Denmark, which are generally considered to have strong and stable economies. These countries rank high on various global economic indicators, including income per capita, innovation, and overall quality of life. These economies are known for their social welfare systems, high levels of education, and innovation-driven economies.

All these contrasts and huge development differences made it relevant to analyze the two groups of countries separately to see how monetary spillovers could affect such different economies. Find the results in Table 7.

	INCREASE IR		DECREASE IR	
	Northern Europe Countries	Eastern Europe Countries	Northern Europe Countries	Eastern Europe Countries
$\rho rpi.\ t-1$	0.210	0.122	0.418	0.066*
	(-0.1186)	(-0.125)	(-0.0878)	(-0.1512)
$f1$ high $\Delta rEU\ t$	0***	0.010**	0.878	0.528
	(-5.7332)	(1.122)	(-0.1356)	(-0.070)
$f2low\ \Delta rEU\ t$	0.066*	0.014**	0.506	0.401
	(0.3298)	(-4.212)	(-0.0813)	(2.8659)
$\Delta ICIt$	0.792	0.071*	0.795	0.404
	(0.0636)	(-1.177)	(-0.0710)	(-0.5414)
$\tau Controli.t$	0.851	0.074*	0.713	0.392
	(-0.0455)	(0.455)	(0.101)	(0.2029)
$\Omega Leverage\ i.t$	0.008*	0.078*	0.017**	0.033**
	(0.1334)	(0.2099)	(0.1527)	(0.2830)
Constant	0.312	0.120*	0.514	0.068**
	(0.1699)	(14.086)	(0.1194)	(16.8796)
Nº obs	38	38	38	38
R-square	0.3901	0.2865	0.2147	0.1778

Table 7-Regression results in Eastern Vs.—northern European countries.

*Note: This regressions were run, based on two different groups of countries, when there was a increae and a decrease of the IR by the ECB, considering the two firat columns for the first scenario and the other two columns for the second scenario $\Delta rp\ i,t$ represents the changes in the policy interest rate of the European but non-Euro Area countries i in time t. We assume that it depends on four main factors: the lagged policy rate of non-euro area countries i, $rp\ i,t-1$; the change in the interest rate of the euro area, ΔrEA; $\Delta ICIt$ variation on the European Union Industrial Confidence Indicator ; $\Omega Leverage\ i,t$ and the financial sector leverage (debt to equity) of non-euro area countries. $f1$ high $\Delta rEU\ t$ and $f2low\ \Delta rEU\ t$ represent dummy variables that define when countries were in a high and low inflation environment respectively. In the first line we find the p-values values marked with *** p <0,01, **p < 0,05, *p<0,1 and in the second line and in parenthesis we find the coefficients.*

The increase in monetary policy from the E.A. is statistically significant in both groups of countries with low and high inflation rates. These results show that in a high inflation environment, with an increase in interest rates, Northern Countries are negatively influenced by the tightening of monetary policy of the ECB compared to the Eastern countries that present a positive influence.

All the economic-related variables and corporate finance are significant for Eastern European countries when there is an increase in interest rates. The business cycle generally hurts interest rates, while financial corporate leverage presents a positive effect, highlighting that in both

Eastern Europe and Northern, a variation in the interest rates, in turn, produces positive effects on wealth and enhances the creditworthiness of borrows (Bruno and Shin (2015)). This variable presents its even higher importance in this regression since it is significant for both groups of countries and in both situations.

In conclusion. the regression results show a considerable difference between the spread of monetary policy from the E.A. in Eastern European countries compared to Northern countries, as could be expected as the two groups of countries represent different economies and financial dynamics.

5.2. Robustness checks

In the initial regression analysis, we identify the high inflation group based on inflation levels surpassing what the central banks consider to be the stable value for inflation of two percent. We perform additional analyses with alternative definitions for high-inflation groups to assess the robustness of our regression results concerning this grouping criterion. Thus, based on Li, J., Meng, X., Zhang, L.,&Zhou, T . (2023), we reclassify high and low-inflation groups based on the inflation level one period earlier, designating high-inflation groups as countries with lagged inflation exceeding two percent. The results of the robustness check can be found in Tables 8,9,10 and 11.

Short Term	**INCREASE IR**						
	Poland	Czech Republic	Hungary	Sweden	Bulgaria	Romania	Denmark
$\rho rpi.\ t-1$	0.131	0.064*	0.017**	0.340	0.413	0.354	0.244
	(0.083)	(-0.237)	(-0.062)	(-0.055)	(0.0213)	(-0.067)	(-0.078)
$f1$ **high** Δr**EU** t	0.614	0.137	0.764	0.00***	0.739	0.739	0.00***
	(0.276)	(0.577)	(-0.215)	(1.572)	(-0.323)	(0.281)	(1.075)
$f2low\ \Delta r$**EU** t	0.019**	0.851	0.094*	0.220	0.316	0.790	0.445
	(-1.914)	(-0.063)	(1.709)	(0.246)	(-7.095)	(-2.075)	(0.642)
ΔICIt	0.098*	0.200	0.046**	0.00***	0.373	0.182	0.213
	(-0.0457)	(0.032)	(-0.063)	(-0.069)	(0.021)	(-0.0477)	(0.014)
$\tau Controli.t$	0.00***	0.508	0.663	0.00***	0.00***	0.017**	0.132
	(0.692)	(-0.015)	(-0.085)	(0.735)	(0.448)	(0.299)	(-0.027)
ΩLeverage $i.t$	0.125	0.673	0.036**	0.586	0.007**	0.145	0.376
	(0.177)	(-0.007)	(-180.92)	(-0.054)	(-0.354)	(1.080)	(-0.027)
Constant	0.002***	0.283	0.035**	0.263	0.428	0.987	0.815
	(-0.459)	(0.066)	(0.892)	(-0.103)	(-2.113)	(-0.005)	(-0.0075)
Nº obs	76	76	57	96	64	64	41
R-square	0.5166	0.1118	0.1618	0.6609	0.5442	0.1949	0.9274

Table 8- Robustness check results: increase in interest rates. Note: robustness check based on the same approach as Table 2.

The robustness check reveals sensitivity to the definition of high and low inflation groups, as is expected. It is impacting the coefficients both in high and low inflation environments. However, the overall fit of the models indicated by R-square values remains consistent across the baseline and robustness check.

Short Term	**DECREASE IR**						
	Poland	Czech Republic	Hungary	Sweden	Bulgaria	Romania	Denmark
$\rho rpi.\ t-1$	0.002***	0.268	0.007***	0.038**	0.422	0.687	0.204
	(0.01000)	(-0.179)	(-0.074)	(0.085)	(0.017)	(-0.033)	(0.379)
$f1$ **high** Δr**EU** t	0.001***	0.003***	0.455	0.00***	0.242	0.030**	0.233
	(0.792)	(0.586)	(0.541)	(0.697)	(0.350)	(1.20)	(0.979)
$f2low\ \Delta r$**EU** t	0.012**	0.053**	0.020**	0.559	0.602	0.119	0.084*
	(1.452)	(0.928)	(5.85)	(-0.183)	(1.448)	(4.665)	(2.747)
ΔICI*t*	0.012**	0.854	0.038**	0.00***	0.405	0.105	0.115
	(-0.062)	(0.005)	(-0.082)	(-0.072)	(0.0166)	(-0.057)	(-0.121)
$\tau Controli.t$	0.00***	0.702	0.817	0.00***	0.00***	0.004***	0.149
	(0.707)	(0.0075)	(0.043)	(0.738)	(0.4199)	(0.251)	(0.166)
ΩLeverage $i.t$	0.066*	0.388	0.037**	0.323	0.026**	0.106	0.188
	(0.156)	(-0.015)	(-160.61)	(0.090)	(-0.036)	(1.104)	(0.208)
Constant	0.00***	(0.035) **	0.023**	0.012**	0.457	0.999	0.360
	(-0.471)	(0.132)	(0.965)	(-0.211)	(-0.0357)	(0.0003)	(-0.130)
Nº obs	76	76	57	96	64	64	41
R-square	0.5619	0.1640	0.1910	0.6581	0.5472	0.2703	0.3131

Table 9- Robustness check results: decrease in interest rates. Note: robustness check based on the same approach as Table 3.

Regarding the robustness check results. When there is a decrease in interest rates, the lagged policy variable consistently shows a positive relationship with the dependent variable in the baseline and robustness checks. In contrast, the effectiveness of the high and low inflation groups in explaining the dependent variable appears limited, with small coefficients and statistical insignificance. Once again, the results are sensitive to the definition of high and low inflation groups, even though the overall fit of the models remains relatively consistent across the baseline and robustness check.

	INCREASE IR	DECREASE IR
$\rho rpi, t-1$	0.683	0.762
	(-0.0080)	(0.0056)
$f1$ high ΔrEU t	0.000***	0.000***
	(0.996)	(0.936)
$f2low$ ΔrEU t	0.276	0.056*
	(0.356)	(0.627)
ΔICIt	0.141	0.001****
	(-0.019)	(-0.045)
$\tau Controli,t$	0.003***	0.00***
	(0.1321)	(0.156)
ΩLeverage i,t	0.398	0.238
	(-0.0269)	(-0.034)
Czech Republic	0.672	0.884
	(-0.044)	(-0.015)
Denmark	0.315	0.358
	(-0.097)	(-0.090)
Poland	0.632	0.741
	(0.058)	(0.040)
Romania	0.372	0.308
	(-0.137)	(-0.1511)
Bulgaria	0.504	0.968
	(1.266)	(-0.072)
Hungary	0.199	0.074*
	(-0.230)	(-0.316)
Constant	0.402	0.055*
	(0.594)	(0.135)
Nº obs	474	474
R-square	0.2072	0.2300

Table 10-Robustness check results: grouped regression.

Note: robustness check based on the same approach as Table 4.

Furthermore, let us look at the grouped regression[5], which includes all seven countries in the analysis, and country-fixed effects, that were included to improve the internal validity of our estimates by isolating the effects of the variables of interest from the potential influence of unobserved country-specific factors. This will make the estimated coefficients more likely to capture the genuine causal relationship. The robustness check introduces changes in coefficients, with some becoming statistically significant, which may indicate some sensitivity

[5] *Country-fixed effects were applied in this regression.*

to the model specification. When inflation is above the target, both the rise and the decrease in interest rates by the ECB positively impact the variation of the countries that did not join the common currency. Besides, when lagged inflation was above two percent, the tightening of monetary policy by the ECB has a positive impact on the variation of the interest rates of non-euro countries. In this situation, the variation of the ICI has a negative impact.

The variable control contributed positively to the rise in interest rates in individual countries when faced with an increase and decrease in the interest rate in E.A.

Besides, following the previous results, the overall fit of the models remains more consistent across the robustness check, which may be due to the introduction of country-fixed effects. The model delivered an R-square of 20,72% and 23% to the case of an increase and decrease, respectively, representing a much higher value than the baseline results. The improved results indicate that the alternative specifications better fit the data as we used different model specifications.

Finally, considering the split between Eastern European and Northern countries, the baseline analysis and robustness check show mixed results with some statistically significant coefficients, as shown in Table 11. The effect of high and low inflation varies between regions and across the two models, probably due to the change in the classification criteria of low and high inflation environments, while lagged policy does not show a statistically significant effect on interest rate changes in both analyses. Regarding corporate finance analysis, the leverage of financial corporations has a significant effect on interest rate changes, especially in the robustness check.

	INCREASE IR		DECREASE IR	
	Northern Europe Countries	Eastern Europe Countries	Northern Europe Countries	Eastern Europe Countries
$\rho rpi, t-1$	0.667	0.138	0.791	0.071*
	(-0.074)	(0.104)	(-0.048)	(0.124)
$f1$ high $\Delta rEU\ t$	0.906	0.192	0.413	0.006***
	(-0.151)	(0.886)	(-0.403)	(0.358)
$f2low\ \Delta rEU\ t$	0.605	0.092*	0.780	0.217
	(-0.391)	(-3.106)	(0.151)	(-2.108)
$\Delta ICIt$	0.774	0.405	0.738	0.019
	(-0.011)	(-0.072)	(-0.09)	(-0.178)
$\tau Controli,t$	0.729	0.053*	0.742	0.007***
	(-0.017)	(0.311)	(0.016)	(0.393)
$\Omega Leverage\ i,t$	0.135	0.374	0,061*	0.595
	(-0.174)	(0.092)	(-0.173)	(0.052)
Constant	0.013	0.102	0.023**	0,053**
	(0.935)	(-13.174)	(-0.173	(-15.308)
Nº obs	38	38	38	38
R-square	0.0308	0.3496	0.038	0.3731

Table 11-Robustness check results: Northern Europe countries Vs. Eastern European countries.

Note: robustness check based on the same approach as Table 5.

Overall, a decrease in R-squared between the baseline analysis and the robustness check could be due to several factors. However, the modification in the model specification with the change in the definition of two variables may be the explanation. Thus, the results are sensitive to the definition of high and low inflation groups, even though the overall fit of the models remains relatively consistent across the baseline and robustness check.

6. Conclusion

As European countries increased their integration by joining the European Union and consequently, some of them decided to adopt a common currency, its decisions regarding monetary policy started to be the responsibility of the European Central Bank. However, as some of the European Union countries decided not to join the common currency, they were exposed to Euro Area monetary spillovers. Extensive literature views the integrated economy monetary policy changes as international monetary spillovers, and individual countries are generally affected, with some buffer provided by flexible exchange regimes.

Han and Wei (2018) document the asymmetric reactions of periphery countries: they react to the center country's policy rate cut but not the policy rate rise. When we transpose this way of reasoning to this paper, we have concluded that individual countries react accordingly to the

Euro Area monetary policy decisions when there is a rise in interest rate but also that they react in a heterogeneous way when there is a cut on interest. Precisely, when the European Central Bank loosens its monetary policy, individual countries generally follow looser monetary policy similarly because of "fear of appreciation." Considering much-discussed literature, we reexamine the heterogeneous transmissions of international monetary spillovers, focusing on the role of countries' inflation levels.

Overall, inflation does play a key role in understanding individual countries' heterogeneous response to monetary spillovers. Countries facing high inflation are more willing to follow the ECB policy rate raise. However, they are more reluctant to follow a cut on interest rates. Moreover, when countries face low inflation, individual countries show that they have more independence to follow their own decisions. Specifically, the countries with flexible exchange rate regimes showed more monetary autonomy: they are more likely to consider domestic inflation when coping with international monetary spillovers.

The tightening of monetary policy by the ECB yields an increase in interest rates in all countries during periods of high inflation. With flexible exchange rate regimes, the Czech Republic, Sweden, Hungary, and Romania demonstrate increased autonomy in adjusting interest rates when responding to ECB-induced increases. In contrast, when faced with low inflation scenarios, the rise in interest rates by the ECB results in a decrease in interest rates, particularly for the countries with flexible exchange rates. Besides, countries like Bulgaria and Denmark, with pegged exchange rate regimes, tend to align with ECB decisions, regardless of inflation levels.

We also observe that countries tend to pay more attention to domestic inflation after the global financial crisis. Thus, our contribution to the related literature comes from the discussion based on the Trilemma hypothesis, by emphasizing countries' fundamentals such as inflation. The concern for domestic inflation may alter individual countries' decisions to follow a central country's monetary policy rate changes. We also empirically confirm our theoretical prior by documenting the heterogeneous responses of the countries that did not join the Euro Area, considering their differential inflation levels.

The heterogeneous responses presented in this paper may have some policy implications. From the Global Financial Crisis and Sovereign Debt Crisis to the COVID-19 pandemic, all have had severe impacts on the global economy, especially for individual countries outside the Euro

Area, impacting their average inflation target and the leverage of financial corporations. However, it has been shown that this transmission channel contributes to increased interest rates.

Finally, domestic factors like inflation become crucial to understanding the heterogeneous transmission of international monetary spillovers. Countries outside the Euro Area may find it optimal to adjust policy rates in the same direction as the ECB and may not do so at other times. Therefore, this paper enriches the perspectives to interpret policy rate correlations, highlighting individual countries' intention to follow the policy rate adjustment of the ECB according to their inflation level.

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