Utrecht University

Proposal for Master Thesis U.S.E

The effect of Monetary policy tools of low-interest rate and Quantitative Easing on Inflation in the last decade in the Eurozone

Aya ElSayed, 5250080
a.ayaaymansamiribrahimelsayed@students.uu.nl

Academic Supervisor
Professor Bilge Karatas

External Supervisor
Harry Geels

Co-reader
Mohamed Kaakeh

June 30, 2023

1 Abstract

The past decade has seen unprecedented consequences due to low-interest rates and unconventional monetary policy tools, such as quantitative easing (QE). In the Eurozone, these policy tools have been accompanied by chronically low inflation. This paper attempts to test the relationship between inflation, low-interest rate, money supply, and core money growth through empirical research. Historical connections proved a positive relationship between money supply and inflation, but contemporary economics has challenged this. Is it the inflation shock from the supply and demand shocks of COVID-19, and the Ukrainian War costing in an Energy Crisis, or the loose monetary policy leading to high inflation and a need for central bankers to use extreme measures to tighten policy? This paper's findings indicate that the Ukraine war and its interaction terms with the monetary policy tools indeed had a positive effect on inflation, unlike COVID-19 and its interaction terms with the monetary policy tools which had a positive effect on inflation. Interest rate variables did partially support the inverse relationship with inflation. However, Money supply proved against the positive hypothesis of this paper and recorded a negative relationship with inflation.

Keywords: Low-Interest Rates, Unconventional Monetary Policy, Quantitative Easing, Eurozone, Money Supply, Inflation, COVID-19, Ukrainian War, Energy Crisis, Long-Term Effects.

Contents

2 Introduction

2.1 Background and Context

The Eurozone is facing a period of crisis, marked by the profound impact of the worst pandemic in recent history - the COVID-19 outbreak - as well as the pressing reality of an inflationary surge from the Ukraine War period and a looming recessionary phase. There is a rising realization of the negative economic effect of the use of a prolonged implementation of two main monetary policy tools - low-interest rates and historically excessive quantitative easing (QE) - which led to a drastic hike in inflation. The effectiveness of these two monetary policy tools as an effective measure in controlling inflation has been a subject of controversy and pressuring fiscal policymakers. Despite its popularity, it is still unclear whether this set of loose monetary policy tools can achieve their desired outcomes.

2.2 Research problem and questions

European Central Bank (ECB) has adopted an accommodative monetary policy approach of combining low-interest rates with historical excessive use of QE to enhance economic output, lower unemployment and stabilize levels of inflation. However, such monetary policies have induced serious implications, such as a lack of ability to respond effectively to further economic shocks due to exceptionally low yields resulting from bond buying activities, and deviation of asset prices from their true values due to the extended periods of low-interest rates. This paper investigates the influence of such a low-interest rate and QE approach on inflation in the Eurozone of the last decade. The primary objective is to gain an accurate understanding of the effectiveness of these monetary policy tools in controlling inflation levels, especially during a time of prolonged economic uncertainty due to shocks such as COVID-19 and the Ukraine War.

Empirical studies have found mixed results on the effectiveness of low-interest rates and QE in controlling inflation. Some studies have suggested that low-interest rates and QE are effective in reducing inflation, while others have found no significant impact on inflation. For example, a study by (Bernanke & Reinhart, 2004) found that QE had a significant impact on reducing long-term interest rates, but its effect on inflation was less clear. Similarly, a study by (Romer & Romer, 2010) found that interest rate changes had little effect on inflation in the short term but may have an impact in the long term.

On the other hand, there is evidence to suggest that low-interest rates and QE may have unintended consequences, such as asset price inflation and financial instability. For example, a study by (Adrian & Shin, 2010) found that QE may lead to increased financial risk-taking and asset price bubbles. Similarly, a study by (Rey, 2015) found that low-interest rates may lead to excessive risk-taking by investors and contribute to financial instability.

Several studies have investigated the relationship between money supply, inflation, and core money growth in the Eurozone. (Diermeier & Goecke, 2016) and (Rua, 2012) argue that there may not be a direct connection between money supply and inflation in Europe. (Gerlach & Svensson, 2003), on the other hand, suggest that monetary indicators could be used to control inflation. (Aßhoff, Belke, & Osowski, 2021) examine the effect of unconventional monetary policy on inflation expectations in the Eurozone. (Allen & Geels, 2021) question the assumption that the relationship between monetary easing and inflation is positive and lacks empirical evidence to support it. These studies have contributed to the debate on the effectiveness of monetary policy in controlling inflation.

In his interview on January 12, 2023, ECB Executive Board member Philip R. Lane[1] emphatically stated that the ultra-loose monetary policy and expansive monetary injection established during the early days of the pandemic did not contribute to an 'unrestrained

[1]Lane, P. R. (2023, January 17). Interview with Philip R. Lane, Member of the Executive Board of the ECB, conducted by Martin Wolf on 12 January 2023. Financial Times.https://www.ecb.europa.eu/press/inter/date/2023/html/ecb.in230117~1ab0df6f3d.en.html

economy'. He acknowledged an abrupt compounding economic spike. For example, the sudden availability of the virus, an unbalanced demand due to sudden openings, and the energy shock were responsible for the current economic condition. On top of that, he highlighted that the Eurozone had already been subjected to low-interest rates for five years before the pandemic, and little to no inflationary pressure. Therefore, the psychology that global economies were creating an inflationary environment is unsupported by the evidence. These projections are backed by numerous studies highlighting that the inflationary pressure in global economies is ultimately instigated by supply chain failures, excessive fiscal policy, and geopolitical distress, rather than monetary policy adjustments.
In consequence, central banks can deploy a wide scope of macroprudential and regulatory plans to counter the foundational causes of inflation without having to apply monetary instruments. A vicious side-effect of the low-interest rates and voluminous QE implementations has been a decrease in encouragement for companies to improve their balance sheets and for governments to push for structural changes. Corroboration shows that enormous purchase plans have incited zombie banks and firms, inhibited the practice of creative destruction, and restrained the capability of economic growth. (Onaran, 2011) However, despite having expansive QE and reduced interest rates, the ECB still did not create an inflationary scenario, as demonstrated by the fact that inflation in the Eurozone continued to persevere at around 1-1.5 per cent, preventing deflation.

Given the mixed evidence on the effectiveness and potential drawbacks of low-interest rates and QE, it is important to examine their impact on inflation in the context of the last decade. This paper aims to contribute to the literature by analyzing the relationship between low-interest rates, QE, and inflation in the last decade.

This academic paper aims to address the following research question: What is the impact of the implementation of loose monetary policy, characterized by low-interest rates and the utilization of the unconventional monetary policy tool- quantitative easing (QE), by central banks in the Eurozone over the past decade on inflation rate? The objective is to examine whether the adoption of loose monetary policy tools such as low-interest rates and the historically excessive use of QE has resulted in a significant positive effect on inflation in the Eurozone during this period.

2.3 Significance of the study

Specifically, this paper will use panel data regression models to analyze the relationship between inflation and interest rate, QE, and gross domestic product (GDP). The data set dated 2010-2022 monthly for 19 countries in the Eurozone. The analysis will also incorporate dummy variables for the Ukraine war and the COVID-19 pandemic, which may have influenced inflation during the end of the last decade. The paper will explore the relationship between money supply, inflation, and monetary indicators in the Eurozone. The literature includes a mix of perspectives, ranging from the monetary perspective of (Kantor, 2022) to the views of (Ascari, Bonomolo, Hoeberichts, & Trezzi, 2023) who explore the Eurozone great inflation surge, to the perspective of (Grauwe & Polan, 2005) who question whether inflation is always and everywhere a monetary phenomenon. The main strategy of this paper is to test how the effect of monetary policy on inflation by exploring the effects of QE on inflation rates, such as the work of (Yue & Leung, 2011), and the changing nature of financial intermediation and the Global Financial Crisis- GFC of 2007-09, as examined by Adrian and Shin (2010). The review also includes studies of the effects of unconventional monetary policy on inflation expectations, as discussed by (Aßhoff et al., 2021). This paper aims to contribute to the ongoing policy debate surrounding the effectiveness of monetary policy tools in managing inflation in the Eurozone.

The paper is ordered as follows: Chapter 3 provides a literature review of the impact of low-interest rates and QE on inflation along with the proposed hypothesis. Chapter 4 discusses the methodology and data used. Chapter 5 presents the results, while Chapter 6 discusses the implications of the findings and provides recommendations for policymakers. Finally, Chapter 7 concludes the paper.

3 Literature

By reviewing the relevant literature, the aim is to provide the theoretical background and motivation for the model described in Section 3.

3.1 Definition and measurement of inflation

Inflation significantly impacts the economy. It is the rate of change in the overall price level of goods and services over time. Inflation is measured with a price index such as the consumer price index (CPI) or the producer price index (PPI). However, these are based on a set basket of goods and services and may not accurately describe changes in consumer preferences with time. ECB utilizes multiple monetary policy tools to control inflation in the Eurozone. The ECB formally adopted an inflation targeting (IT) framework in 1998, to preserve price stability in the Eurozone. According to this framework, it aimed to ensure inflation rates below, but near, 2 per cent over the medium term. The success of similar frameworks in other nations such as the Bank of England and the Reserve Bank of New Zealand, has prompted the significant adoption of the IT framework by the ECB.

As an aftermath of the GFC of 2007-09, central banks have increasingly utilized low rates of interest and QE to stimulate economic activity and curb inflation. Initially, central banks viewed themselves as having full jurisdiction over inflation targets, but there exist other forces that restrain their reign. Conforming to the conventional view, inflation is attributed to economics and thus full control of inflation ought to be vested in an autonomous central bank whose principal purpose is economic stabilization. Subsequently, a few countries followed this behavioural suggestion by authorizing central banks with enormous fiscal autonomy.

Nevertheless, critics have started to challenge this traditional approach; they claim that monetary policy is not adequate to assure price stability and fiscal policy is required to regulate inflation (Łyziak & Mackiewicz-Łyziak, 2020). (Woodford, 2012) later study analyses the relationship between IT and financial stability and argues that an optimally planned IT framework can help promote financial stability. (Vega & Winkelried, 2005) examine the impact of IT on inflation behaviour and find that it has been successful in lowering inflation volatility across many countries.

Notably, low-interest rates and QE were employed for stimulating economic activity and sustaining price balance; nonetheless, the efficacy of these tools in controlling inflation has been met with considerable debate among academics and policymakers.

3.2 Monetary policy tools and their effectiveness

3.2.1 Low-interest rates

The relationship between low-interest rates and inflation is still inconclusive. As (Bernanke & Reinhart, 2004) suggests that while low-interest rates can stimulate economic activity, their impact on inflation is not straightforward and can be influenced by other factors such as the output gap and inflation expectations. The empirical evidence on the connection between low-interest rates and inflation remains unsettled in academic literature. Whereby, studies have shown that a decrease in the real interest rate can lead to an increase in the money supply (Diermeier & Goecke, 2016). Additionally, a decrease in interest rates can stimulate borrowing and spending, which can increase demand (Grauwe & Polan, 2005). And more evidently, the paper by (Sargent, Wallace, et al., 1981) provides evidence that excessive monetary growth can lead to high inflation rates.

Furthermore, in a study of the Eurozone, (Aßhoff et al., 2021) results suggest that the implementation of these unconventional monetary policies such as QE has been effective in increasing inflation expectations, which is in line with the ECB's goal of achieving price stability. The study also highlights the importance of communication and transparency in central bank policy decisions.

However, there are also views that low-interest rates may not necessarily lead to higher inflation. For example, (Allen & Geels, 2021) argue that the assumption that the relationship between monetary easing and inflation is spurious and offered a theoretical framework to support their argument and suggest that policymakers should consider a broader range of factors when making decisions about monetary policy. They suggest that other factors can influence inflation, such as global competition, demographic and technological change.

Also (Cochrane, 2016) upon reviewing the empirical evidence, he found weak support for the standard theoretical view that raising interest rates lowers inflation. The evidence is often influenced by strong prior beliefs or assumptions. As a result, he suggested that a positive reaction of inflation to interest rate changes is a possibility that should be taken seriously by policymakers and central bankers. And in his paper, he attempts to explore alternative approaches to escape this prediction but finds that adding elements such as money, backwards-looking Phillips curves, multiple equilibria, or Taylor rules fails to produce a different outcome.

Lastly, the relationship between low-interest rates and inflation is complex and multi-faceted. While there is evidence to suggest that low-interest rates can lead to higher inflation rates, other factors can also play a role. Policymakers need to consider these various factors when making decisions about monetary policy and managing inflation.

3.2.2 Quantitative easing

Recent studies have examined the effectiveness of unconventional monetary policy tools such as QE in achieving inflation targets. (Aßhoff et al., 2021) investigated the impact of unconventional monetary policy on inflation expectations in the Eurozone and found that it was effective in increasing inflation expectations. (Allen & Geels, 2021) challenged the notion that the relationship between monetary easing and inflation is positive.

Empirical studies have examined the relationship between monetary policy and inflation in the Eurozone, where inflation has persistently remained below the ECB's target rate of 2 per cent. (Diermeier & Goecke, 2016) analyzed the relationship between money supply and inflation in Europe and found that there was no significant connection between the two variables. Similarly, (Rua, 2012) used time-frequency analysis to investigate the relationship between money growth and inflation in the Eurozone and found that the connection was weak.

(Gerlach & Svensson, 2003) argued that monetary indicators such as M3[2], which includes broad money, could be useful in predicting inflation in the Eurozone. In contrast, (Grauwe & Polan, 2005) questioned the monetary view that inflation is always and everywhere a monetary phenomenon. (van Lerven, 2016) evaluates the effectiveness of QE in the Eurozone and finds that it has been successful in stimulating the economy but has not been as effective in raising inflation rates.

3.3 Relationship between the combined effect of low interest rates and historical excessive use of QE and inflation

One of the main debates in the field of monetary policy is the effect of low interest rates and QE on inflation. While some argue that low-interest rates and QE can lead to inflation, others argue that they can prevent deflation and stimulate economic growth. According to (Bernanke et al., 2002), low-interest rates can lead to an increase in borrowing and spending, which in turn can stimulate economic growth. However, if the economy overheats and inflation starts to rise, central banks may increase interest rates to slow down the economy and keep inflation in check. Similarly, QE can also stimulate economic growth by increasing the money supply and lowering borrowing costs. However, as argued by (Mishkin,

[2]Monetary aggregates background as defined by the ECB M1 is the sum of currency in circulation and overnight deposits; M2 is the sum of M1, deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months; and M3 is the sum of M2, repurchase agreements, money market fund shares/units and debt securities with a maturity of up to two years. https://www.ecb.europa.eu/stats/money_credit_banking/monetary_aggregates/html/index.en.html

2006), if the money supply grows too quickly, it can lead to inflation. In the Eurozone, the ECB has been implementing low-interest rates and QE in response to the GFC of 2007-09 and the subsequent economic slowdown. However, the effectiveness of these policies in terms of inflation control is still a matter of debate. Recent research suggests that the relationship between low-interest rates, QE, and inflation may not be straightforward. For example, Cœuré, B. (2019) [3] argues that the effectiveness of low-interest rates and QE in stimulating economic growth depends on the transmission channels through which these policies affect the economy. Overall, the relationship between low-interest rates, historical excessive use of QE, and inflation is complex and depends on a variety of factors. While some studies suggest that these policies can help to prevent deflation and stimulate economic growth, others warn of the potential for inflation if these policies are not implemented carefully. Further research is needed to better understand the effectiveness of these policies in the Eurozone and other economies.

3.4 Explaining the recent shocks

Monetary policy has faced unprecedented pressure in the wake of two tail-risk events: the global pandemic and Russia's invasion of Ukraine. While a timeline of the last economic crisis due to the recent shocks can be found in the note by (Ascari et al., 2023) at the De Nederlandsche Bank n.v., By considering three phases of the pandemic (the COVID-19 shock (Phase I: the COVID-19 shock (roughly Q1 and Q2:2020)), the reopening of the economy (Phase II: the re-opening of the economy (roughly from Q3:2020 to Q3:2021)), and the post-re-opening (Phase III: the post-re-opening (from Q4:2021 onwards))), they conjecture how the contribution of demand and supply-side shocks evolved from one phase to the next. It appears that aggregate demand experienced a negative shock in the first phase, followed by a sequence of positive shocks in the second and third phases. Additionally, aggregate supply experienced a negative shock in the first phase, followed by a positive shock in the second phase and another negative shock in the third. Those pressures have led some to suggest that "running the economy hot" and "looking through" temporary shocks may be necessary, although the risks they pose to price stability must be weighed carefully. With inflation running near double digits, Central Banks across the Eurozone are thus confronted with a unique challenge.

Moreover, a study by (Attinasi, Balatti, Mancini, Metelli, et al., 2022) suggests that the pandemic has resulted in these unprecedented factors, which can potentially influence price dynamics and contribute to inflationary pressures. Therefore, it is hypothesized that the COVID-19 pandemic has had a significant impact on the inflation rate in the Eurozone.

3.5 Previous research on the relationship between monetary policy tools and inflation

3.5.1 Relationships mixed findings

Previous research has reported various findings on the relationship between monetary policy tools and inflation in the Eurozone. Some studies such as (Rua, 2012) and (Gerlach & Svensson, 2003) have shown a strong connection between money growth and inflation in the Eurozone, while others such as (Diermeier & Goecke, 2016) and (Grauwe & Polan, 2005) have questioned the existence of such a relationship. Furthermore, (Kantor, 2022) argues from a monetary perspective that the relationship between monetary easing and inflation is weak and that controlling the money supply should be the primary goal of monetary policy. (Woodford, 2012) emphasizes the importance of balancing IT with maintaining financial stability. In addition, (Vega & Winkelried, 2005) have examined the effectiveness of IT in the Eurozone and found that it has been successful in reducing inflation expectations.

[3] Cœuré, B. (2019). The ECB's monetary policy measures and inflation expectations. Speech at the 34th SURF Colloquium, Brussels, Belgium. Retrieved from.`https://www.ecb.europa.eu/press/key/date/2019/html/ecb.sp190711~6dcaf97c01.en.html`

Other studies have investigated the impact of unconventional monetary policy on inflation. (Aßhoff et al., 2021) find that unconventional monetary policy such as QE has led to a significant increase in inflation expectations in the Eurozone, while (Allen & Geels, 2021) argue that the assumption that the relationship between monetary easing and inflation is spurious. Similarly, (Akinci, Benigno, Del Negro, & Queralto, 2020) have examined the relationship between the real interest rate and financial stability, finding that lower real interest rates can contribute to financial instability. In conclusion, previous research has presented varied findings on the relationship between monetary policy tools and inflation in the Eurozone. While some studies have found a strong connection between money growth and inflation, others have questioned its existence. The impact of unconventional monetary policy on inflation is also a topic of debate, with some studies finding a significant increase in inflation expectations, while others argue that the relationship between monetary easing and inflation is weak.

3.5.2 Need for further research

Based on the academic papers provided earlier, several gaps in the literature could be addressed by testing the regression equation on inflation. These include:

- Limited focus on the impact of unconventional monetary policy as the papers discussed the impact of traditional monetary policy tools such as interest rates on inflation, but there is a lack of research on the impact of unconventional monetary policy tools such as QE. The regression equation includes money supply (M2) as an independent variable, which can help to test the impact of unconventional monetary policy on inflation.

- Need for more recent data as the papers are several years old and do not consider more recent economic developments, such as the COVID-19 pandemic and the Ukraine war. The regression equation includes these variables as independent variables, which can help to test their impact on inflation in a more current context.

By testing the regression equation on inflation, we can help to fill these gaps in the literature and provide a more comprehensive understanding of the factors that impact inflation. This can help policymakers make more informed decisions about monetary policy and ultimately lead to more stable economic growth.

3.6 Hypotheses

Based on the literature review, shows that there is a strong relationship between monetary policy and inflation in the Eurozone, with core money growth, M3 growth, interest rates, and other monetary indicators all being significant factors. Thus, the following hypotheses can be derived:

H_1 : Interest rates and inflation have an inverse relationship, *ceteris paribus*;

Based on the findings of (Gerlach & Svensson, 2003) suggest that monetary indicators, including interest rates, can be useful for predicting inflation in the Eurozone. Therefore, the paper hypothesizes that as interest rates increase, inflation rates will decrease. Under this hypothesis, this paper will create a narrow/specific model of Monetary tools. One main tool is the interest rate can be divided into main two types as they represent different aspects of the interest rate environment, such as the Deposit Interest Rate (DIR) and the Euro Interbank Offered Rate (EURIBOR).

DIR refers to the interest rate that banks pay to individuals and firms on deposits made in their accounts. It is one of the monetary factors that can affect the inflation rate and it is reasonable to be used as one of the explanatory variables in the regression. The Eurozone is complex and depends on various factors such as the level of economic integration, the degree of competition in the banking sector, and the monetary policy regime. There is empirical evidence supporting that the relationship between deposit interest rates and inflation is negative. For example, (Golinelli & Rovelli, 2002) find that higher deposit interest rates are associated with lower inflation in the Eurozone, but this effect is stronger in countries with more developed financial systems.

The EURIBOR is the interest rate at which banks in the Eurozone lend funds to each other in the interbank market. It is one of the key benchmark rates used in financial markets and is closely watched by policymakers as an indicator of the overall level of liquidity in the Eurozone. A higher EURIBOR can indicate a tighter liquidity condition in the Eurozone, which can affect inflation through its impact on borrowing costs for households and businesses.

Several academic studies support the inclusion of EURIBOR in the regression analysis. For example, the study by (Pateiro-Rodríguez, Barros-Campello, Candamio, & Pateiro-López, 2016) found that EURIBOR is a significant predictor of inflation in the Eurozone, with a one percentage point increase in EURIBOR leading to a decrease in inflation by around 0.2 percentage points.

$\mathbf{H_2}$: Money supply and inflation have a positive relationship, *ceteris paribus*;

Both (Gerlach & Svensson, 2003) and (Diermeier & Goecke, 2016) found evidence of a connection between money supply and inflation and finds that interest rates play a role in the transmission of monetary policy. The paper by (Rua, 2012) takes a time-frequency view and finds evidence of a long-run relationship between money growth and inflation in the Eurozone. Therefore, the paper hypothesizes that as the money supply increases, inflation rates will also increase.

$\mathbf{H_3}$: The COVID-19 pandemic is hypothesized to have a significant negative relationship with the inflation rate in the Eurozone, *ceteris paribus*;

According to a study by (Bodnár, Le Roux, Lopez-Garcia, Szörfi, et al., 2020), the COVID-19 pandemic has resulted in a decline in economic activity, reduced consumer spending, and disrupted supply chains in the Eurozone. These factors have led to a decrease in aggregate demand and excess capacity in various sectors of the economy. As a result, businesses are facing downward pressure on prices, and central banks have implemented accommodative monetary policies to stimulate economic recovery. Based on this evidence, it is hypothesized that the COVID-19 pandemic has a negative relationship with the inflation rate in the Eurozone.

Sub-hypothesis under $\mathbf{H_3}$: The interaction between the COVID-19 pandemic and loose monetary policy tools variables are hypothesized to have an amplifying effect on the negative relationship between the pandemic and the inflation rate in the Eurozone, *ceteris paribus.*

According to a study by (Aßhoff et al., 2021), unconventional monetary policy tools, such as quantitative easing and forward guidance, have been widely used by central banks in response to the COVID-19 pandemic. These tools aim to provide additional stimulus to the economy, support financial markets, and prevent a deflationary spiral. The study suggests that the interaction between loose monetary policy and the COVID-19 pandemic can amplify the deflationary pressures caused by the pandemic. The increased liquidity injected into the economy through these measures may further dampen aggregate demand and contribute to downward pressure on prices. Therefore, it is hypothesized that the interaction between the COVID-19 pandemic and loose monetary policy tools has an amplifying effect on the negative relationship between the pandemic and the inflation rate in the Eurozone.

$\mathbf{H_4}$: The Ukraine war has had a positive significant impact on inflation, *ceteris paribus*;

The study conducted by (Caldara, Conlisk, Iacoviello, & Penn, 2022) suggests that the war in Ukraine has had a significant impact on the inflation rate. They argue that conflicts and political instability can lead to disruptions in the supply chain, trade, and increased uncertainty, which can contribute to inflationary pressures. While the specific nature of the impact is not explicitly mentioned, it can be inferred that the impact of the Ukraine war on the inflation rate is expected to be positive and significant.

Sub-hypothesis under $\mathbf{H_4}$: The interaction between the Ukraine war and loose monetary policy tools variables are hypothesized to have an exacerbating effect on the positive impact of the war on inflation, *ceteris paribus.*

Based on the findings of (Ozili, 2022), it can be inferred that the interaction between loose monetary policy and the Ukraine war may exacerbate the inflationary pressures caused by the conflict. Loose monetary policy tools, such as increased liquidity and low-interest rates, can provide support to sectors affected by the war and stimulate economic activity. However, in the context of the Ukraine war, the disruption in the supply chain, trade, and increased uncertainty may create inflationary pressures. The interaction between loose monetary policy and the war may amplify these inflationary pressures, leading to a stronger positive impact of the war on inflation. Therefore, it is hypothesized that the interaction between the Ukraine war and loose monetary policy tools has an exacerbating effect on the positive impact of the war on inflation.

4 Data and Methodology

4.1 Data sources and sample selection

The data set is built in the years 2010-2022 monthly for 19 countries in the Eurozone, namely Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain. The paper will investigate the relationship between the Inflation rate and its key determinant exogenous variables. The data are gathered from Eurostat or the ECB database. The data set is mainly on monthly calculations, however, the GDP variable is published in quarter rate and will be interpolated. The dependent variable is the Inflation Rate, and the independent variables are all the above-mentioned variables. A quantitative panel data analysis will be conducted to examine the relationship between macroeconomic variables and inflation rates across Eurozone countries. The regression equation employed in this study was inspired by previous research in the field. The equation included variables such as the deposit interest rate, EURIBOR, log of money supply (M2), consumer confidence indicator survey, log of GDP growth rate, and two dummy variables related to COVID-19 and the Ukraine war.

The descriptive data table (Tables 4 and 5 in Appendix A) provides an overview of the key variables used in the analysis and calculates summary statistics for the panel data. The summary statistics typically include count, mean, standard deviation, minimum, and maximum values for each variable within each country.

In this study, the logarithmic transformation is applied to two variables namely GDP and Money Supply M2 following established econometric practices. (Campbell & Perron, 1991) study emphasizes the importance of transforming variables to logarithms. They highlight the benefits of taking logarithms when dealing with time series data and unit roots. According to their findings, logarithmic transformations help in linearizing relationships and reducing the impact of extreme values, leading to more reliable and robust regression results. The use of logarithms enhances the reliability and interpretability of the regression results, contributing to a more comprehensive analysis of the relationship between monetary aggregates and other variables of interest. In line with this methodology, the logarithmic million units of national currency are used to present the data, enabling a better understanding of the relative changes in these variables and facilitating the interpretation of coefficients in the regression equation.

To support the validity of the regression equation, several academic papers were referenced. For instance, (Ascari et al., 2023) investigated the inflation surge in the euro area, while (Aßhoff et al., 2021) analyzed the impact of unconventional monetary policy on inflation expectations. Additionally, (Diermeier & Goecke, 2016) explored the relationship between money supply and inflation in Europe. (Łyziak & Mackiewicz-Łyziak, 2020) examined the influence of fiscal stance on inflation expectations, and (Pateiro-Rodríguez et al., 2016) analyzed the behaviour of monetary aggregates in the euro area. By referring to these studies, this regression analysis aimed to provide empirical evidence and insights into the relationship between macroeconomic variables and inflation rates.

- **Inflation Rate**: Harmonised Index of Consumer Prices (HICP) is used to measure consumer price inflation. That means the change over time in the prices of consumer goods and services purchased by euro-area households. The data obtained is a monthly rate of change per country. Source of euro area data: European Central Bank (ECB)
- **Deposit Interest Rate**: The rates used in the data set are the rate per country for Euro-denominated deposits with an agreed maturity of more than one year from euro-area households (percentages per annum, rates on new business) of euro area data: ecb.europa.eu
- **Euro Interbank Offered Rate**: The Euribor rates are based on the interest rates at which a panel of European banks borrows funds from one another. In the calculation, the highest and lowest 15 per cent of all the quotes collected are eliminated. The remaining rates will be averaged and rounded to three decimal places. Euribor is determined and published at about 11:00 am each day, Central European Time. And in the data set, the highest percentage was selected as a unified figure for the EUROZONE countries per month. Source of euro area data: Euribor-rates.eu
- **Gross domestic product (GDP)**: Nominal GDP growth rate at market prices is the result of the production activity of resident producer units. The paper will use Nominal GDP in the regression because real GDP is adjusted for inflation, which can introduce measurement error and obscure the true relationship between the variables of interest and capture the full impact of inflation on the economy (Campbell & Perron, 1991). It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. Data are presented in logarithmic million units of national currency. Unit: the GDP used in the data set was quarterly figures interpolated to a monthly rate per country. Source of euro area data: European Central Bank (ECB)
- **Money Supply M2**: Monetary aggregates comprise monetary liabilities of euro area residents excluding the central government. Data are presented in logarithmic million units of national currency. Unit: Monthly rate as a unified figure for the EUROZONE countries. Source of euro area data: European Central Bank (ECB)
- **Consumer Confidence Indicator Survey (CCI)**: The Consumer Survey - Consumer Confidence Indicator measures consumers' attitudes and opinions about their economic prospects, their financial situation, and their willingness to spend. Consumer Confidence Indicators are used to gauge the overall level of consumer confidence in the economy and are often used by policymakers and analysts as an early indicator of changes in consumer spending behaviour. Unit: Period-to-period per cent -change as a unified percentage published by the ECB for the EUROZONE. Source of euro area data: European Central Bank (ECB)

4.2 Shock variables

- **COVID-19**: dummy variable that takes the value of 1 for the period affected by the COVID-19 pandemic and 0 otherwise.
- **Ukraine War**: a dummy variable that takes the value of 1 for the period affected by the Ukraine war and 0 otherwise.

COVID-19 and Ukraine War are included in the regression as dummy variables to capture the effects of these exogenous shocks on inflation in the Eurozone. The COVID-19 pandemic and the Ukraine war have the potential to affect inflation by disrupting supply chains, causing changes in demand patterns, and leading to changes in expectations about future economic conditions. By including these variables in the regression, the paper aims to control for the potential confounding effects of these external factors and obtain more accurate estimates of the coefficients of interest.

The war in Ukraine as a full-scale invasion by Russian forces began on February 24, 2022, and this start date will be used in the data set as per (Ozili, 2022) which has used the same start date.

The first human cases of COVID-19 were identified in Wuhan, People's Republic of China, in December 2019; accordingly, the data set will consider this date the pandemic variable start date. [4]

4.3 Regression model specification

The structure of the data leads us subsequently to test the relationship between the variables, using a panel regression analysis which will be conducted using the STATA software. The fixed-effects model or Random effect Model will account for country-specific heterogeneity and time-invariant unobserved effects. The Hausman test will be used to choose between the fixed-effects and random-effects models. Fixed Effects will control for all invariant differences between the countries in the data set. The robustness of the results could be tested by conducting various diagnostic tests, such as testing for multicollinearity, heteroskedasticity, and auto-correlation. The significance of the coefficients could be tested using the t-test, and the overall fit of the model could be tested using the F-test. To estimate the relationship between the independent and dependent variables, the following regression models are computed:

To estimate the relationship between the independent and dependent variables, the coefficients in the equation, denoted by β , α , γ and δ with subscripts indicating the country and time represented the effects of these variables on the inflation rate. The following regression models are computed:

4.3.1 Model 1: Monetary factors effect on Inflation rate

$$\begin{aligned} InflationRate_{it} = &\beta_0 + \beta_1 DepositInterestRate_{it} + \beta_2 EURIBOR_{it} \\ &+ \beta_3 \log MoneySupplyM2_{it} + \beta_4 \log GDPgrowthrate_{it} \\ &+ \beta_5 ConsumerConfidenceIndicatorSurvey_{it}, \\ &+ \alpha_6 COVID19_{it} + \alpha_7 UkraineWar_{it} + \alpha_t + \epsilon_{it}, \\ &\forall i \in \{1, 2, \ldots 19\}, \quad \forall t \in \{2011, \ldots 2021\} \end{aligned} \tag{1}$$

[4] World Health Organization. (2020). Statement on the meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV) [Press Release]. `https://www.who.int/news/item/23-01-2020-statement-on-the-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)`

4.3.2 Model 2: Monetary policy effect on Inflation rate with Interaction terms (COVID-19 and Ukraine War)

$$
\begin{aligned}
InflationRateit = {} & \beta_0 + \beta_1 DepositInterestRate_{it} + \beta_2 EURIBOR_{it} \\
& + \beta_3 \log MoneySupplyM2_{it} \\
& + \beta_4 ConsumerConfidenceIndicatorSurvey_{it} \\
& + \beta_5 \log GDPgrowthrate_{it} \\
& + \alpha_6 COVID19_{it} + \alpha_7 UkraineWar_{it} \\
& + \gamma_1 COVID19_{it} \times DepositInterestRate_{it} \\
& + \gamma_2 COVID19_{it} \times EURIBOR_{it} \\
& + \gamma_3 COVID19_{it} \times \log MoneySupplyM2_{it} \\
& + \delta_1 UkraineWar_{it} \times DepositInterestRate_{it} \\
& + \delta_2 UkraineWar_{it} \times EURIBOR_{it} \\
& + \delta_3 UkraineWar_{it} \times \log MoneySupplyM2_{it} \\
& + \alpha_t + \epsilon_{it}, \\
& \forall i \in \{1, 2, \dots 19\}, \quad \forall t \in \{2011, \dots 2021\}
\end{aligned} \tag{2}
$$

5 Results

This section presents the summary of the regression results obtained from five different tests, labelled as Tests (1) to (5) for each Model suggested in the earlier section. The models explore the relationship between various Macroeconomics variables and the inflation rate in EUROZONE. For each model, OLS regression will be conducted, noting that Model 2 will introduce interaction variables with both dummies' variables; followed by fixed effects estimator and random-effects GLS regression. The results indicate that some of the economic factors have a significant impact on inflation, while others do not show statistical significance.

The correlation matrix (Table 1) suggests limited associations between the variables in the model. The correlations, where present, are generally weak, indicating that these variables may not have a strong linear relationship. The inflation rate (IR) demonstrates a slight positive association with euribor, indicating that changes in euribor might influence the inflation rate to some extent. Additionally, the deposit interest rate (dr) shows a weak positive correlation with euribor and a weak negative correlation with the customer surveys (CS), suggesting that as euribor increases, the deposit interest rate might slightly increase. Furthermore, the logarithm of money supply (lM2) exhibits a weak negative correlation with the deposit interest rate, indicating that an increase in money supply might correspond to a decrease in the deposit interest rate.

It is important to note that the two dummy variables, COVID and WAR, show weak correlations with the other variables. COVID-19 demonstrates a positive correlation with euribor, suggesting that changes in euribor might be associated with the impact of the COVID-19 pandemic. Similarly, WAR shows negative correlations with CS and lM2, indicating a potential relationship between the Ukraine War, customer surveys and money supply. However, these correlations are generally weak, implying that the impact of these events on the other variables may be influenced by other factors not considered in the model.

5.1 Interpretation of Model 1 regression results

The first regression model in Table (2) aimed to examine the monetary factors' impact on the inflation rate in the Eurozone. The model included the DIR, the EURIBOR and M2 as explanatory independent variables. Further, the table started including the dummy variables COVID-19 and the Ukraine War to assess their potential influence on the inflation rate with the independent variables.

Regression (1) examines the relationship between the inflation rate and the monetary policy tools represented by the deposit interest rate (dr), Euribor, and the log of money

Table 1: Correlation Matrix Base Model

	IR	dr	CS	euribor	lGDP	lM2	COVID	WAR
IR	1.00							
dr	0.0697	1.00						
CS	-0.1898	-0.3892	1.00					
euribor	0.2404	0.2722	-0.1860	1.00				
lGDP	0.0383	0.0258	0.0136	0.0136	1.00			
lM2	-0.0165	-0.6549	0.1651	-0.0480	0.0778	1.00		
COVID	0.0521	-0.3883	-0.2001	0.1586	0.0577	0.8007	1.00	
WAR	0.1946	-0.1424	-0.4793	0.0861	0.0451	0.4676	0.4594	1.00

supply (lM2). The coefficients for the deposit interest rate and lM2 are not statistically significant. Solely, the coefficient for Euribor is high reading 7.172, and it is statistically significant ($p < 0.01$). These results suggest that the monetary policy tools of the deposit interest rate and lM2 do not have a significant impact on inflation, unlike euribor. The R-squared value for this regression is 0.066, indicating that the variables included in the model explain only a small portion of the variation in the inflation rate.

Regression (2) expands on the monetary policy tools by introducing dummy variables for specific events, namely COVID and WAR. In addition to the monetary policy tools variable, this regression includes the dummy variables for COVID and WAR. The coefficient for the COVID-19 dummy variable is statistically insignificant ($p > 0.05$), suggesting that the COVID-related shocks do not have a significant impact on inflation. However, the coefficient for the WAR dummy variable is statistically significant ($p < 0.001$), indicating that the WAR has a significant positive impact on inflation. The R-squared value for this regression increases to 0.130, indicating that the inclusion of the dummy variables improves the explanatory power of the model.

Regression (3) further extends the model by incorporating additional variables. In addition to the variables from regression (2), this model includes the country, this model incorporated the Consumer Confidence Indicator Survey (CS) as a measure of consumer sentiment and lGDP (log of GDP growth rate) as an indicator of economic activity. The coefficients for both the deposit interest rate and money supply remain negative and statistically insignificant, confirming that higher deposit interest rates are associated with lower inflation. The coefficient for the Euribor variable is steadily positive and statistically significant at conventional levels ($p < 0.001$), suggesting that increases in Euribor are associated with higher inflation. The COVID and WAR dummy variables maintain their insignificance and significance, respectively. The coefficients for the added variables, country, Consumer Surveys-CS, and lGDP are not statistically significant. The R-squared value for this regression is 0.129, indicating that the inclusion of these additional variables slightly improves the model's ability to explain the variation in the inflation rate.

Regression (4) employs fixed effects estimation, incorporating country-fixed effects to account for unobserved heterogeneity across countries. The variables included in this regression are the same as in regression (3). The coefficients for the variables remain largely consistent with those in regression (3), and their statistical significance is preserved. The within R-squared of 0.1218 suggests that the fixed effects model explains approximately 12.18 per cent of the variation in the inflation rate within each country over time. The between R-squared of 0.0081 indicates that approximately 0.81 per cent of the variation in the inflation rate between countries is accounted for by the fixed effects. The overall R-squared of 0.1005 represents the combined effect of within and between variations.

It is important to note that the R-squared values in this regression indicate a moderate level of explanatory power. This suggests that although the fixed effects model captures some of the variations in the inflation rate, there are other factors or unobserved variables that also contribute to the dynamics of inflation and are not accounted for in the model. Regression (5) uses random effects estimation, assuming that the individual-specific effects

VARIABLES	(1) -reg- monetary policy tools	(2) Adding Dummies variables	(3) Adding All variables	(4) Fixed Effects -xtreg-	(5) Random Effects
Deposit int. rate- dr	0.0260	-0.480	-0.551	-0.0316	-0.0606
	(0.201)	(0.952)	(1.023)	(0.271)	(0.656)
Euribor	7.172***	5.976	7.004	6.651***	6.671
	(1.234)	(4.251)	(4.948)	(0.546)	(4.729)
lM2	-0.00285	-0.0970	-0.0550	-0.0370	-0.0378
	(0.0188)	(0.122)	(0.101)	(0.0236)	(0.0883)
COVID		0.00930	-0.00600	-0.00673	-0.00671
		(0.0139)	(0.00593)	(0.00802)	(0.00546)
WAR		0.0876***	0.0806***	0.0797***	0.0798***
		(0.00927)	(0.00843)	(0.0100)	(0.00796)
country		-0.00286	-0.00295		
		(0.00240)	(0.00235)		
Consumer Surveys-CS			-0.00106*	-0.000855*	-0.000866*
			(0.000602)	(0.000439)	(0.000453)
lGDP			-0.000605	0.00346	0.00290
			(0.00355)	(0.00598)	(0.00315)
Constant	0.0443	1.600	0.918	0.550	0.568
	(0.303)	(1.990)	(1.634)	(0.380)	(1.399)
Observations	2,964	2,964	2,926	2,926	2,926
R-squared	0.066	0.130	0.129	0.122	
Country FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Number of country				19	19

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Model 1: Monetary factors effect on Inflation rate

are uncorrelated with the regressors. The variables included in this regression are the same as in regression (3). The coefficients for the variables are like those in regression (3), indicating that the results are robust to different estimation methodologies. The R-squared value for this regression is 0.122.

These findings align with the literature papers provided, which hypothesize that changes in the euribor rate affect inflation positively. However, the lack of significance for the short-term interest rate contradicts the expectations outlined in the hypotheses. The Euribor rate and M2 money supply variables continue to exhibit no statistically significant relationship with the inflation rate in Model 2, consistent with (Diermeier & Goecke, 2016); (Gerlach & Svensson, 2003).

In terms of the R-squared values for this model, they indicate the proportion of the variation in the inflation rate that can be explained by the included variables in each regression. The R-squared values for all regressions are relatively low, ranging from 0.066 to 0.130. This suggests that the variables included in the models explain only a small portion of the variation in the inflation rate, indicating that other factors not considered in the models might significantly contribute to the dynamics of inflation.

Overall, these regressions provide insights into the relationships between various variables and the inflation rate. While the Euribor and the WAR dummy variable show significant associations with inflation, the COVID-19 dummy variable and other variables do not exhibit statistically significant relationships. The inclusion of additional variables and the use of fixed effects estimation support the robustness of the results. However, the relatively low R-squared values suggest that there are other important factors influencing inflation that need to be considered in future analyses.

Hausman test is used to determine whether the random effects model or the fixed effects model is more appropriate for a panel data analysis. If the test statistic is large and the probability (p-value) is small, we reject the null hypothesis, indicating that the FE model is not consistent and efficient, and the RE model should be preferred. Conversely, if the test statistic is small and the p-value is large, we fail to reject the null hypothesis, suggesting that the FE model is consistent and efficient. The Hausman test was conducted to compare the fixed-effects model (4) with the random-effects model (5). The test results indicate that the random-effects model is preferred over the fixed-effects model, as the test statistic (chi2(2) = 1.04, p = 0.5947) does not provide evidence to reject the null hypothesis of no systematic difference in the coefficients between the two models.

5.2 Interpretation of Model 2 regression results

The second regression model in Table (3) aimed to explore the overall impact of monetary policy on the inflation rate. The table presents the results of five regression models examining the relationship between the inflation rate and various variables in the Eurozone, and their potential effects on the inflation rate including interaction terms between monetary policy tools variables and two dummy variables COVID-19 and the Ukraine War.

Interaction terms are introduced in the model to capture the joint effects of two dummy variables (COVID-19 and the Ukraine War) with the monetary policy tools variables. These interaction terms allow for the examination of how the impact of COVID-19 and the Ukraine War may vary depending on the levels of the monetary policy tools. These terms capture the interaction effect of COVID-19 with the deposit interest rate (Deposit Interest Rate), the European Interbank Offered Rate (EURIBOR), and the logarithm of the money supply (log Money Supply M2), denoted as "coviddr", "covideuribor" and "covidlM2" respectively. Similarly, the interaction terms between Ukraine War and each monetary policy tool variable are represented as "wardr", "wareuribor" and "warlM2". These terms account for the interaction effect of Ukraine War with the deposit interest rate, the EURIBOR, and the log MoneySupplyM2, respectively. By including these interaction terms in the model, it becomes possible to assess how the impact of COVID-19 and Ukraine War on the dependent variable is influenced by variations in the monetary policy tools. Moreover, the model also incorporates other variables such as country (to capture country-specific effects) to provide a comprehensive analysis of the factors affecting the

VARIABLES	(1) -reg- All Interaction Variables	(2) Only COVID19 Interaction variables	(3) Only WAR Interaction variables	(4) Fixed Effects- ALL variables	(5) Random Effects- ALL variables
dr	-0.875***	-0.956***	-0.690***	-0.358	-0.383
	(0.220)	(0.217)	(0.205)	(0.766)	(0.783)
euribor	7.353***	7.502***	7.413***	7.025	7.040
	(1.508)	(1.494)	(1.448)	(5.070)	(5.080)
lM2	-0.0907***	-0.0616***	-0.0765***	-0.0705	-0.0716
	(0.0251)	(0.0228)	(0.0170)	(0.0887)	(0.0904)
COVID	-7.231***	-8.654***		-6.961***	-6.970***
	(1.004)	(0.621)		(1.332)	(1.331)
WAR	-0.396		-8.142**	-2.010	-1.936
	(4.410)		(3.852)	(5.447)	(5.492)
coviddr	1.825***	3.168***		1.421	1.423
	(0.392)	(0.422)		(1.459)	(1.448)
covideuribor	-17.26***	-9.269***		-18.60***	-18.54***
	(5.796)	(1.866)		(3.493)	(3.498)
covidlM2	0.445***	0.528***		0.429***	0.430***
	(0.0628)	(0.0381)		(0.0815)	(0.0815)
wardr	2.570***		4.199***	2.229	2.258
	(0.726)		(0.678)	(1.891)	(1.880)
wareuribor	8.395		-8.930***	10.14*	10.06**
	(6.098)		(1.871)	(5.047)	(5.084)
warlM2	0.0227		0.499**	0.120	0.116
	(0.267)		(0.233)	(0.329)	(0.332)
CS	-0.000849*	-0.00181***	-0.000720***	-0.000639	-0.000650
	(0.000448)	(0.000284)	(0.000248)	(0.000542)	(0.000553)
lGDP	-0.000273	-0.000215	-0.000404	0.00216	0.00232
	(0.000459)	(0.000463)	(0.000454)	(0.00385)	(0.00313)
country	-0.00288***	-0.00289***	-0.00290***		
	(0.000450)	(0.000450)	(0.000451)		
Constant	1.494***	1.015***	1.264***	1.109	1.126
	(0.409)	(0.371)	(0.276)	(1.412)	(1.432)
Observations	2,926	2,926	2,926	2,926	2,926
R-squared	0.140	0.137	0.135	0.133	
Country FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Number of country				19	19

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Model 2: Monetary policy effect on Inflation rate with Interaction Variables (COVID-19 and Ukraine War)

dependent variable.

In regression (1), which includes all interaction variables, the coefficients indicate that a decrease in the deposit interest rate and an increase in the euribor rate are associated with a significant decrease and increase in the inflation rate, respectively. The log of money supply (lM2) also shows a significant negative relationship with inflation. All the interaction variables for COVID-19 and Ukraine War were significant ($p < 0.01$), and all of them were positively related to inflation, except for “covidlM2” and “wareuribor” suggesting a negative impact on inflation. The R-squared value of 0.138 indicates that approximately 13.8 per cent of the variation in the inflation rate is explained by the variables included in this model.

Regression (2) focuses on the interaction between monetary policy tools and the COVID-19 dummy variable. The results show similar patterns as in regression (1), with the deposit interest rate and euribor rate exhibiting significant consistent effects on inflation, except for the log of money supply changed to the positive effect on inflation and became insignificant. Interaction variables recorded contradicting results compared to the prior regression. ”coviddr” remained significant and positive; ”covidlM2” interaction variable remained insignificant however its effect on inflation changed to negative. The ”covideuribor” interaction variable remained significant as well, however, changed its effect to negative, an increase in the euribor rate leads to lower inflation. The R-squared value of 0.118 indicates that approximately 11.8 per cent of the variation in inflation is explained by the variables in this model.

In regression (3), the interaction between monetary policy tools and the Ukrainian War dummy variable is examined. The results reveal steady significant relationships between the deposit interest rate and euribor rate. However, the log of money supply with inflation remained significant, it changed effect to negative. The war interaction variables remained consistent and significant as in model (1) and had the same effect on the inflation rate. The R-squared value of 0.135 suggests that around 13.5 per cent of the variation in inflation is accounted for by the variables included in this model.

Regression (4) includes all variables and fixed effects. While the deposit interest rate, euribor rate, and log of money supply show no significant relationship with inflation, The ”wareuribor” and ”warlM2” interaction variables do not have a significant effect on inflation in this model. However, the Ukrainian War dummy variable (wardr) has a positive and significant effect. The R-squared value is 0.130, indicating that approximately 13 per cent of the variation in inflation is explained by the variables and fixed effects in this model.

In regression (5), which incorporates all variables and random effects, the results are similar to regression (4). The R-squared value remains at 0.130, suggesting that approximately 13 per cent of the variation in inflation is captured by the variables and random effects included in this model.

Overall, the R-squared values indicate that the included monetary policy tools variables and interactions variables account for a moderate proportion of the variation in inflation across the models.

Regarding the external factors results suggest that ceteris paribus, the coefficient estimates for COVID-19 were not statistically significant, unlike the Ukraine War which remained a consistently significant effect on the inflation rate in the Eurozone.

To summarize, the regression results indicate a significant relationship between the deposit rate, Euribor rate, CS and war, supporting the literature on the influence of interest rates on inflation backed by (Diermeier & Goecke, 2016); (Gerlach & Svensson, 2003). However, the impact of other variables, such as the M2 money supply, and COVID-19 indicators, is not statistically significant. The inclusion of additional variables, such as GDP growth and consumer survey, provides further insights into the inflation dynamics; however, insignificant. Nevertheless, these models capture only a fraction of the overall variation in the inflation rate, suggesting the presence of other unobserved factors as challenged by (Allen & Geels, 2021).

And based on the Hausman test results, this paper does not have evidence to suggest that one model is superior to the other. Since the test statistic is 1.05, and the corresponding p-value is 0.9836. Since the p-value is greater than the conventional significance level (e.g., 0.05), we do not reject the null hypothesis. This suggests that the difference between the coefficients of the fixed-effects and random-effects models is not statistically significant.

5.3 Findings

Hypothesis 1 suggested that the Interest rate has an inverse effect on the inflation rate. The results in both Model 1 and Model 2 partially support this hypothesis, as the deposit rate shows a statistically insignificant negative coefficient in Model 1 (0.551, $p > 0.05$) and a statistically significant reliable negative coefficient in Model 2 (-0.852, $p < 0.01$) backed by (Golinelli & Rovelli, 2002). Euribor rate was consistently positive and significant in both models. However, when controlling for other variables in Model 1, the significance of the deposit rate diminishes, suggesting that its impact may be influenced by other factors. These findings align with the existing literature on the relationship between interest rates and inflation (Akinci et al., 2020) supporting the inverse relationship between interest rates and inflation.

Hypothesis 2 posited that the M2 money supply would have a significant positive relationship with the inflation rate. However, the results in both models do not support this hypothesis, as the M2 money supply partially exhibited statistically significant coefficients, however, all are negative. These findings are consistent with previous studies suggesting that the connection between money supply and inflation may have weakened over time (Diermeier & Goecke, 2016);(Gerlach & Svensson, 2003).

Hypothesis 3 suggested that the COVID-19 pandemic has a significant negative relationship with the inflation rate in the Eurozone, same with the interaction variables with the monetary policy tools. Even though the COVID-19 dummy partially recorded a negative insignificant effect on the inflation rate, the interaction variables specifically "coviddr" and "covidlM2" both were positive and significant. Only "covideuribor" maintained negative and significant. These findings emphasize the importance of considering the interplay between economic shocks, such as the pandemic, and monetary policy measures when analysing inflation dynamics in the Eurozone. The study by (Bodnár et al., 2020) supports this finding, highlighting the adverse impact of the pandemic on economic activity and the subsequent decrease in inflation. These findings suggest that the COVID-19 pandemic has a significant negative relationship with the inflation rate in the Eurozone.

Hypothesis 4 proposed that the Ukraine war had a positive significant impact on the inflation rate, coupled with the same relation between the interaction variables with the monetary policy tools. In both models, the findings align with the hypothesis, whereby the War variable in model 1 consistently showed a positive and significant effect on the inflation rate (Ozili, 2022). Moreover, the interaction variables steadily recorded positive and significant effects on the inflation rate (Attinasi et al., 2022). However, "wareuribor" and "warlM2" recorded insignificance in regression (1) in model 2 and as (Belsley et al., 2005) it could be for collinearity issues.

6 Discussion and Robustness checks

Further analysis and modelling are necessary to achieve a better understanding of the dynamics and potential causal relationships among these variables.

6.1 Shortfalls and Limitations

Endogeneity: One potential shortcoming of the regression models is the possibility of endogeneity, where the explanatory variables may be influenced by the dependent variable (inflation) or other omitted variables. Endogeneity can bias the coefficient estimates and lead to unreliable results. To address this limitation, instrumental variable techniques or alternative econometric approaches could be considered.

Omitted Variables: The regression models suffered from omitted variable bias if important variables that are not included in the analysis are correlated with both the explanatory variables and the dependent variable. This omission could lead to biased coefficient estimates and an incomplete understanding of the factors affecting inflation. And three variables were omitted Logarithm of ECB Balance of Payment, Unemployment per country, and Producer Price Index.

Model Specification: The choice of variables included in the models may not capture all the relevant factors that drive inflation. Alternative specifications or additional variables, such as fiscal policy indicators or sector-specific variables, could enhance the models' explanatory power.

Cross-sectional dependence: It refers to the interdependence or correlation of the error terms across different cross-sectional units, violating the assumption of independence. Ignoring cross-sectional dependence can lead to biased and inefficient estimates, compromising the validity of the results.

To address this limitation, various tests and approaches have been proposed in the literature. One commonly used test is the Pesaran CD test, which examines the presence of cross-sectional dependence in panel data (Pesaran, 2004). In the context of this paper's analysis, it was beneficial to explore the presence of cross-sectional dependence and consider appropriate modelling techniques to mitigate its potential impact. Future research could employ advanced econometric methods, such as the spatial panel data models proposed by (Baltagi & Baltagi, 2008), which explicitly account for cross-sectional dependence and provide more reliable estimates.

Pesaran's test of cross-sectional independence yields a test statistic of 97.957 with a p-value of 0.0000 (Table 8 in the appendix). This indicates that there is a significant cross-sectional dependence among the panel data, implying that the observations within each country are not independent of each other. In addition, the results suggest the presence of cross-sectional dependence among the panel data; it can be concluded that the Ukraine war has had a significant positive impact on the inflation rate. However, the COVID-19 pandemic, deposit interest rate, Euro interbank interest rate, and money supply do not exhibit a significant relationship with the inflation rate.

6.2 Random Walk, Heteroskedasticity, and Multicollinearity

The presence of a random walk suggests that the current inflation rate is primarily determined by its past values, and the regression models may not adequately capture this dynamic process. The inclusion of lagged variables in Model (6) attempts to address this concern, but the coefficient estimate for the lagged short-term interest rate is not statistically significant. Previous studies have highlighted the challenges of modelling random walks in economic and financial time series (Choi, 1994); (Geweke, 1982). Further research could explore alternative modelling approaches, such as autoregressive integrated moving average (ARIMA) or state-space models, which are better suited for capturing the persistence and dynamics of random walks (Hamilton, 1994).

Heteroskedasticity refers to the presence of unequal variances of the error term across different levels of the independent variables. The regressions' standard errors reported in the table do not indicate any explicit signs of heteroskedasticity. However, conducting additional diagnostic tests, such as White's test or Breusch-Pagan test (Table 6 in Appendix B), would provide more robust evidence regarding the presence of heteroskedasticity (White, 1980); (Breusch & Pagan, 1979). Notably, both models reported a test statistic value of 14943.028, and the associated p-value is 0.0000, indicating strong evidence against the null hypothesis of independence. Therefore, there is evidence of heteroscedasticity in the panel data. Moreover, the correlation matrix of residuals for the panel data was conducted (see Table 7 in Appendix B). The values in the matrix represent the correlation coefficients between different pairs of residuals. For example, the correlation coefficient between $e1$ and $e2$ is -0.7057, between $e1$ and $e3$ is -0.4603, and so on.

Multicollinearity refers to a high correlation among the independent variables, which can lead to imprecise coefficient estimates and difficulty in interpreting the individual variables' effects. The regressions table does not provide explicit information about multicollinearity. However, it is essential to examine the correlation matrix or conduct a variance inflation factor (VIF) analysis to assess the extent of multicollinearity among the included variables (Belsley, Kuh, & Welsch, 2005). In this study, many of the regressions performed yielded VIF values above 1 (Table 9 in Appendix B), suggesting the presence of multicollinearity. To mitigate multicollinearity, potential solutions include excluding highly correlated variables, collecting additional data, or applying dimensionality reduction techniques, such as principal component analysis (PCA) or ridge regression (Hoerl & Kennard, 1970); (Jolliffe, 2002).

7 Conclusion

The implementation of conventional low-interest rates and unconventional quantitative easing (QE) by central banks in the Eurozone over the last decade has been a subject of controversy and debate regarding its effectiveness in controlling inflation. The analysis incorporated panel data regression models using monthly data from 2010 to 2022 for 19 countries in the Eurozone. Moreover, Dummy variables were included to account for the Ukraine war and the COVID-19 pandemic.

In analyzing the relationship between inflation and monetary policy, this paper employed panel data regression models and incorporated dummy variables for the Ukraine war and the COVID-19 pandemic along with creating interaction variables between them and the monetary policy tools variables, which may have influenced inflation during the end of the last decade. The results of the analysis provided insights into the effectiveness of combing conventional and unconventional monetary policy tools in controlling inflation in the Eurozone.

The literature review revealed mixed evidence on the effectiveness of low interest rates and QE in controlling inflation. Studies such as (Aßhoff et al., 2021) found that unconventional monetary policy, including QE, had an impact on inflation expectations in the Eurozone. Conversely, other studies, such as (Bernanke & Reinhart, 2004), found that the effect of QE on inflation was less clear. The research also highlighted potential unintended consequences of these monetary policy tools, including increased financial risk-taking and asset price bubbles (Adrian & Shin, 2010).

This study contributes to the debate by providing empirical evidence regarding the relationships between interest rates, money supply, the COVID-19 pandemic, the Ukraine war, and inflation in the Eurozone and the impact of the implementation is this loose monetary policy. The findings of interest rate variables were conflicting with each other, whereby the deposit interest rate supports an inverse relationship between interest rates and inflation, aligning with existing literature. Unlike, euribor shows a steady positive relationship between interest rates and inflation. However, the connection between money supply and inflation appears to have weakened over time. The COVID-19 pandemic shows a moderately significant negative relationship with inflation when considering the interplay with monetary policy measures. Additionally, the Ukraine war has a positive and significant impact on inflation (Ozili, 2022), along with its interaction variables. These findings contribute to a better understanding of inflation dynamics in the Eurozone and emphasize the importance of considering multiple non-monetary factors in economic analysis.

References

Adrian, T., & Shin, H. S. (2010). The changing nature of financial intermediation and the financial crisis of 2007–2009. *Annu. Rev. Econ.*, *2*(1), 603–618.

Akinci, O., Benigno, G., Del Negro, M., & Queralto, A. (2020). The financial (in) stability real interest rate, r. *FRB of New York Staff Report*(946).

Allen, E. M., & Geels, H. J. (2021). The assumption that the relationship between monetary easing and inflation is positive is spurious. *Available at SSRN 3763499*.

Ascari, G., Bonomolo, P., Hoeberichts, M., & Trezzi, R. (2023). The euro area great inflation surge. *De Nederlandsche Bank*.

Aßhoff, S., Belke, A., & Osowski, T. (2021). Unconventional monetary policy and inflation expectations in the euro area. *Economic Modelling*, *102*, 105564.

Attinasi, M. G., Balatti, M., Mancini, M., Metelli, L., et al. (2022). Supply chain disruptions and the effects on the global economy. *Economic Bulletin Boxes*, *8*.

Baltagi, B. H., & Baltagi, B. H. (2008). *Econometric analysis of panel data* (Vol. 4). Springer.

Belsley, D. A., Kuh, E., & Welsch, R. E. (2005). *Regression diagnostics: Identifying influential data and sources of collinearity.* John Wiley & Sons.

Bernanke, B. S., et al. (2002). Deflation: making sure 'it'doesn't happen here. *Remarks before the National Economists Club, Washington, DC*, *21*.

Bernanke, B. S., & Reinhart, V. R. (2004). Conducting monetary policy at very low short-term interest rates. *American Economic Review*, *94*(2), 85–90.

Bodnár, K., Le Roux, J., Lopez-Garcia, P., Szörfi, B., et al. (2020). The impact of covid-19 on potential output in the euro area. *Economic Bulletin Articles*, *7*.

Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica: Journal of the econometric society*, 1287–1294.

Caldara, D., Conlisk, S., Iacoviello, M., & Penn, M. (2022). The effect of the war in ukraine on global activity and inflation.

Campbell, J. Y., & Perron, P. (1991). Pitfalls and opportunities: what macroeconomists should know about unit roots. *NBER macroeconomics annual*, *6*, 141–201.

Choi, I. (1994). Residual-based tests for the null of stationarity with applications to us macroeconomic time series. *Econometric Theory*, *10*(3-4), 720–746.

Cochrane, J. H. (2016). Do higher interest rates raise or lower inflation? *Unpublished paper, February, https://faculty. chicagobooth. edu/john. cochrane/research/papers/-fisher. pdf*.

Diermeier, M., & Goecke, H. (2016). *Money supply and inflation in europe: is there still a connection?* (Tech. Rep.). IW Policy Paper.

Gerlach, S., & Svensson, L. E. (2003). Money and inflation in the euro area: a case for monetary indicators? *Journal of Monetary Economics*, *50*(8), 1649–1672.

Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. *Journal of the American statistical association*, *77*(378), 304–313.

Golinelli, R., & Rovelli, R. (2002). Painless disinflation? monetary policy rules in hungary, 1991-99. *Economics of Transition*, *10*(1), 55–91.

Grauwe, P. D., & Polan, M. (2005). Is inflation always and everywhere a monetary phenomenon? *Scandinavian Journal of economics*, *107*(2), 239–259.

Hamilton, J. (1994). *Time series econometrics.* Princeton University Press Princeton, NJ.

Hoerl, A. E., & Kennard, R. W. (1970). Ridge regression: Biased estimation for nonorthogonal problems. *Technometrics*, *12*(1), 55–67.

Jolliffe, I. T. (2002). *Principal component analysis for special types of data.* Springer.

Kantor, B. (2022). Recent monetary history: A monetarist perspective. *Journal of Applied Corporate Finance*, *34*(2), 82–99.

Łyziak, T., & Mackiewicz-Łyziak, J. (2020). Does fiscal stance affect inflation expectations? evidence for european economies. *Economic Analysis and Policy*, *68*, 296–310.

Mishkin, F. S. (2006). *Monetary policy strategy: how did we get here?* National Bureau of Economic Research Cambridge, Mass., USA.

Onaran, Y. (2011). *Zombie banks: How broken banks and debtor nations are crippling the global economy* (Vol. 160). John Wiley & Sons.

Ozili, P. K. (2022). Global economic consequence of russian invasion of ukraine. *Available at SSRN*.

Pateiro-Rodríguez, C., Barros-Campello, E., Candamio, L. V., & Pateiro-López, C. (2016). The behavior of the components of m3 in the euro area: 1999-2014. *Open Journal of Business and Management*, *4*(4), 606–620.

Pesaran, M. (2004). *General diagnostic tests for cross section dependence in panels (iza discussion papers no. 1240. bonn: Institute for the study of labor (iza).*

Rey, H. (2015). *Dilemma not trilemma: the global financial cycle and monetary policy independence* (Tech. Rep.). National Bureau of Economic Research.

Romer, C. D., & Romer, D. H. (2010). The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks. *American Economic Review*, *100*(3), 763–801.

Rua, A. (2012). Money growth and inflation in the euro area: A time-frequency view. *Oxford Bulletin of Economics and Statistics*, *74*(6), 875–885.

Sargent, T. J., Wallace, N., et al. (1981). Some unpleasant monetarist arithmetic. *Federal reserve bank of minneapolis quarterly review*, *5*(3), 1–17.

van Lerven, F. (2016). Quantitative easing in the eurozone: A one-year assessment. *Intereconomics*, *51*(4), 237–242.

Vega, M., & Winkelried, D. (2005). Inflation targeting and inflation behavior: a successful story? *International Journal of Central Banking*, *1*(3), 153–175.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica: journal of the Econometric Society*, 817–838.

Woodford, M. (2012). *Inflation targeting and financial stability* (Tech. Rep.). National Bureau of Economic Research.

Yue, H.-Y., & Leung, K.-T. (2011). The effects of quantitative easing on inflation rate: A possible explanation on the phenomenon. *European Journal of Economics, Finance and Administrative Sciences*, *41*(11), 34–40.

A Appendix A: Additional Tables

A.1 Descriptive Data Tables

Variable		Mean	Std. Dev.	Min	Max	Observations	
Inflation Rate	overall	0.0303663	0.0959031	-0.043	1.47	N =	2964
	between		0.0418809	0.0107628	0.2010755	n =	19
	within		0.0868052	-0.1677092	1.299291	T =	156
Deposit Interest Rate	overall	0.0138198	0.0110478	0	0.062	N =	2964
	between		0.0050346	0.0034538	0.0223083	n =	19
	within		0.0099012	-0.0068084	0.0574262	T =	156
euribor	overall	0.0044369	0.0034263	0.00003	0.01913	N =	2964
	between		0	0.0044369	0.0044369	n =	19
	within		0.0034263	0.00003	0.01913	T =	156
Money Supply M2	overall	1.09E+07	2138889	8209452	1.54E+07	N =	2964
	between		0	1.09E+07	1.09E+07	n =	19
	within		2138889	8209452	1.54E+07	T =	156
GDP	overall	141000.2	214852	0	1006810	N =	2964
	between		215264.2	2810.825	768015.4	n =	19
	within		47400.06	-627015.2	737472.9	T =	156
Customer Survey	overall	-11.62372	6.004752	-28.7	0	N =	2964
	between		0	-11.62372	-11.62372	n =	19
	within		6.004752	-28.7	0	T =	156
lGDP	overall	10.72696	1.588184	7.383244	13.8223	N =	2926
	between		1.605572	7.899201	13.52616	n =	19
	within		0.2816209	5.637219	14.56548	T =	154
lM2	overall	16.18608	0.1897637	15.9208	16.55094	N =	2964
	between		0	16.18608	16.18608	n =	19
	within		0.1897637	15.9208	16.55094	T =	156
COVID	overall	0.2371795	0.425425	0	1	N =	2964
	between		0	0.2371795	0.2371795	n =	19
	within		0.425425	0	1	T =	156
WAR	overall	0.0705128	0.2560525	0	1	N =	2964
	between		0	0.0705128	0.0705128	n =	19
	within		0.2560525	0	1	T =	156
country	overall	10	5.47815	1	19	N =	2964
	between		5.627314	1	19	n =	19
	within		0	10	10	T =	156
month	overall	20621.08	1370.935	18263	22980	N =	2964
	between		0	20621.08	20621.08	n =	19
	within		1370.935	18263	22980	T =	156

Table 4: Descriptive Statistics of the panel Data set Variables

-> country = Austria

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.2010755	.357101	.003	1.47	N = 156
	between		.	.2010755	.2010755	n = 1
	within		.357101	.003	1.47	T = 156
dr	overall	.0095019	.0067368	.0027	.0268	N = 156
	between		.	.0095019	.0095019	n = 1
	within		.0067368	.0027	.0268	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	11.58751	.1254518	11.14461	11.89549	N = 154
	between		.	11.58751	11.58751	n = 1
	within		.1254518	11.14461	11.89549	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

-> country = Belgium

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0247756	.0259892	-.009	.131	N = 156
	between		.	.0247756	.0247756	n = 1
	within		.0259892	-.009	.131	T = 156
dr	overall	.0121827	.0080559	.0013	.0304	N = 156
	between		.	.0121827	.0121827	n = 1
	within		.0080559	.0013	.0304	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	9.496096	.3182929	9.065777	11.36858	N = 154
	between		.	9.496096	9.496096	n = 1
	within		.3182929	9.065777	11.36858	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

Descriptive Statistics of the panel Data set Variables by country (1)

-> country = Cyprus

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0136154	.0270403	-.029	.106	N = 156
	between		.	.0136154	.0136154	n = 1
	within		.0270403	-.029	.106	T = 156
dr	overall	.0210282	.0160372	.0004	.0488	N = 156
	between		.	.0210282	.0210282	n = 1
	within		.0160372	.0004	.0488	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	13.52616	.4441925	8.436417	13.8223	N = 154
	between		.	13.52616	13.52616	n = 1
	within		.4441925	8.436417	13.8223	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

-> country = Estonia

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0378654	.0514609	-.018	.252	N = 156
	between		.	.0378654	.0378654	n = 1
	within		.0514609	-.018	.252	T = 156
dr	overall	.0192359	.0069495	.0084	.0406	N = 156
	between		.	.0192359	.0192359	n = 1
	within		.0069495	.0084	.0406	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	10.71458	.2382874	8.103706	10.96167	N = 154
	between		.	10.71458	10.71458	n = 1
	within		.2382874	8.103706	10.96167	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

Descriptive Statistics of the panel Data set Variables by country (2)

-> country = Finland

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0189295	.0191339	-.007	.091	N =	156
	between		.	.0189295	.0189295	n =	1
	within		.0191339	-.007	.091	T =	156
dr	overall	.0102186	.0071661	.0022	.0282	N =	156
	between		.	.0102186	.0102186	n =	1
	within		.0071661	.0022	.0282	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	12.52742	.1857501	10.68561	12.7807	N =	154
	between		.	12.52742	12.52742	n =	1
	within		.1857501	10.68561	12.7807	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

-> country = France

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0164103	.0151674	-.004	.071	N =	156
	between		.	.0164103	.0164103	n =	1
	within		.0151674	-.004	.071	T =	156
dr	overall	.0165103	.0088725	.0053	.032	N =	156
	between		.	.0165103	.0165103	n =	1
	within		.0088725	.0053	.032	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	13.24127	.0801566	13.09752	13.44211	N =	154
	between		.	13.24127	13.24127	n =	1
	within		.0801566	13.09752	13.44211	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

Descriptive Statistics of the panel Data set Variables by country (3)

-> country = Germany

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0203077	.0222628	-.007	.116	N = 156
	between		.	.0203077	.0203077	n = 1
	within		.0222628	-.007	.116	T = 156
dr	overall	.0112282	.0072677	.0026	.0284	N = 156
	between		.	.0112282	.0112282	n = 1
	within		.0072677	.0026	.0284	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	9.493435	.4973173	9.194495	13.33196	N = 154
	between		.	9.493435	9.493435	n = 1
	within		.4973173	9.194495	13.33196	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

-> country = Greece

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0127628	.0306759	-.029	.121	N = 156
	between		.	.0127628	.0127628	n = 1
	within		.0306759	-.029	.121	T = 156
dr	overall	.0034538	.0080147	0	.0443	N = 156
	between		.	.0034538	.0034538	n = 1
	within		.0080147	0	.0443	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	12.93917	.1928695	10.9014	13.15481	N = 154
	between		.	12.93917	12.93917	n = 1
	within		.1928695	10.9014	13.15481	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

Descriptive Statistics of the panel Data set Variables by country (4)

-> country = Ireland

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0107628	.0239163	-.025	.096	N =	156
	between		.	.0107628	.0107628	n =	1
	within		.0239163	-.025	.096	T =	156
dr	overall	.0129051	.0124166	.0004	.0385	N =	156
	between		.	.0129051	.0129051	n =	1
	within		.0124166	.0004	.0385	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	8.814468	.2905833	8.365044	10.63775	N =	154
	between		.	8.814468	8.814468	n =	1
	within		.2905833	8.365044	10.63775	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

-> country = Italy

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0178269	.0242163	-.01	.126	N =	156
	between		.	.0178269	.0178269	n =	1
	within		.0242163	-.01	.126	T =	156
dr	overall	.0140609	.0082132	.0057	.0429	N =	156
	between		.	.0140609	.0140609	n =	1
	within		.0082132	.0057	.0429	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	9.304793	.4934321	8.841405	12.83766	N =	154
	between		.	9.304793	9.304793	n =	1
	within		.4934321	8.841405	12.83766	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

Descriptive Statistics of the panel Data set Variables by country (5)

-> country = Latvia

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0269615	.0482139	-.043	.22	N =	156
	between		.	.0269615	.0269615	n =	1
	within		.0482139	-.043	.22	T =	156
dr	overall	.0183936	.0118463	.0069	.062	N =	156
	between		.	.0183936	.0183936	n =	1
	within		.0118463	.0069	.062	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	9.536166	.2137457	8.311816	9.92543	N =	154
	between		.	9.536166	9.536166	n =	1
	within		.2137457	8.311816	9.92543	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

-> country = Lithuania

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0330064	.0494788	-.015	.225	N =	156
	between		.	.0330064	.0330064	n =	1
	within		.0494788	-.015	.225	T =	156
dr	overall	.0114218	.0073358	.0022	.037	N =	156
	between		.	.0114218	.0114218	n =	1
	within		.0073358	.0022	.037	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	10.30808	.2356625	8.745937	10.7535	N =	154
	between		.	10.30808	10.30808	n =	1
	within		.2356625	8.745937	10.7535	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

Descriptive Statistics of the panel Data set Variables by country (6)

-> country = Luxembourg

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0225641	.0225429	-.016	.103	N =	156
	between		.	.0225641	.0225641	n =	1
	within		.0225429	-.016	.103	T =	156
dr	overall	.0061071	.0051765	0	.0254	N =	156
	between		.	.0061071	.0061071	n =	1
	within		.0051765	0	.0254	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	7.899201	.3230792	7.409379	9.22377	N =	154
	between		.	7.899201	7.899201	n =	1
	within		.3230792	7.409379	9.22377	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

-> country = Malta

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0182244	.0156525	.001	.074	N =	156
	between		.	.0182244	.0182244	n =	1
	within		.0156525	.001	.074	T =	156
dr	overall	.0223083	.0098012	.0093	.0432	N =	156
	between		.	.0223083	.0223083	n =	1
	within		.0098012	.0093	.0432	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	12.07805	.4113248	7.383244	12.41773	N =	154
	between		.	12.07805	12.07805	n =	1
	within		.4113248	7.383244	12.41773	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

Descriptive Statistics of the panel Data set Variables by country (7)

-> country = Netherlands

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0235449	.0302911	-.007	.171	N = 156
	between		.	.0235449	.0235449	n = 1
	within		.0302911	-.007	.171	T = 156
dr	overall	.0191417	.0096179	0	.0386	N = 156
	between		.	.0191417	.0191417	n = 1
	within		.0096179	0	.0386	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	11.40927	.124973	11.20491	11.9532	N = 154
	between		.	11.40927	11.40927	n = 1
	within		.124973	11.20491	11.9532	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

-> country = Portugal

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0161795	.0228712	-.008	.106	N = 156
	between		.	.0161795	.0161795	n = 1
	within		.0228712	-.008	.106	T = 156
dr	overall	.0119051	.0131302	.0004	.0441	N = 156
	between		.	.0119051	.0119051	n = 1
	within		.0131302	.0004	.0441	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	10.77516	.1057069	10.61488	11.04265	N = 154
	between		.	10.77516	10.77516	n = 1
	within		.1057069	10.61488	11.04265	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

Descriptive Statistics of the panel Data set Variables by country (8)

-> country = Slovakia

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0251795	.0323992	-.009	.151	N =	156
	between		.	.0251795	.0251795	n =	1
	within		.0323992	-.009	.151	T =	156
dr	overall	.0169019	.0078612	.0065	.0357	N =	156
	between		.	.0169019	.0169019	n =	1
	within		.0078612	.0065	.0357	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	9.27725	.1567391	9.043943	9.67165	N =	154
	between		.	9.27725	9.27725	n =	1
	within		.1567391	9.043943	9.67165	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

-> country = Slovenia

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0189295	.0256985	-.014	.117	N =	156
	between		.	.0189295	.0189295	n =	1
	within		.0256985	-.014	.117	T =	156
dr	overall	.0159865	.0151817	.0013	.0423	N =	156
	between		.	.0159865	.0159865	n =	1
	within		.0151817	.0013	.0423	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	9.939955	.1668666	9.027283	10.27421	N =	154
	between		.	9.939955	9.939955	n =	1
	within		.1668666	9.027283	10.27421	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

Descriptive Statistics of the panel Data set Variables by country (9)

-> country = Spain

Variable		Mean	Std. Dev.	Min	Max	Observations	
IR	overall	.0180385	.0244759	-.015	.107	N =	156
	between		.	.0180385	.0180385	n =	1
	within		.0244759	-.015	.107	T =	156
dr	overall	.010084	.0107382	.0003	.033	N =	156
	between		.	.010084	.010084	n =	1
	within		.0107382	.0003	.033	T =	156
CS	overall	-11.62372	6.023075	-28.7	0	N =	156
	between		.	-11.62372	-11.62372	n =	1
	within		6.023075	-28.7	0	T =	156
euribor	overall	.0044369	.0034367	.00003	.01913	N =	156
	between		.	.0044369	.0044369	n =	1
	within		.0034367	.00003	.01913	T =	156
lGDP	overall	10.94417	.1942409	10.74272	12.45916	N =	154
	between		.	10.94417	10.94417	n =	1
	within		.1942409	10.74272	12.45916	T =	154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N =	156
	between		.	16.18608	16.18608	n =	1
	within		.1903428	15.9208	16.55094	T =	156
COVID	overall	.2371795	.4267231	0	1	N =	156
	between		.	.2371795	.2371795	n =	1
	within		.4267231	0	1	T =	156
WAR	overall	.0705128	.2568338	0	1	N =	156
	between		.	.0705128	.0705128	n =	1
	within		.2568338	0	1	T =	156

Descriptive Statistics of the panel Data set Variables by country (10)

-> country = Austria

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.2010755	.357101	.003	1.47	N = 156
	between		.	.2010755	.2010755	n = 1
	within		.357101	.003	1.47	T = 156
dr	overall	.0095019	.0067368	.0027	.0268	N = 156
	between		.	.0095019	.0095019	n = 1
	within		.0067368	.0027	.0268	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	11.58751	.1254518	11.14461	11.89549	N = 154
	between		.	11.58751	11.58751	n = 1
	within		.1254518	11.14461	11.89549	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

-> country = Belgium

Variable		Mean	Std. Dev.	Min	Max	Observations
IR	overall	.0247756	.0259892	-.009	.131	N = 156
	between		.	.0247756	.0247756	n = 1
	within		.0259892	-.009	.131	T = 156
dr	overall	.0121827	.0080559	.0013	.0304	N = 156
	between		.	.0121827	.0121827	n = 1
	within		.0080559	.0013	.0304	T = 156
CS	overall	-11.62372	6.023075	-28.7	0	N = 156
	between		.	-11.62372	-11.62372	n = 1
	within		6.023075	-28.7	0	T = 156
euribor	overall	.0044369	.0034367	.00003	.01913	N = 156
	between		.	.0044369	.0044369	n = 1
	within		.0034367	.00003	.01913	T = 156
lGDP	overall	9.496096	.3182929	9.065777	11.36858	N = 154
	between		.	9.496096	9.496096	n = 1
	within		.3182929	9.065777	11.36858	T = 154
lM2	overall	16.18608	.1903428	15.9208	16.55094	N = 156
	between		.	16.18608	16.18608	n = 1
	within		.1903428	15.9208	16.55094	T = 156
COVID	overall	.2371795	.4267231	0	1	N = 156
	between		.	.2371795	.2371795	n = 1
	within		.4267231	0	1	T = 156
WAR	overall	.0705128	.2568338	0	1	N = 156
	between		.	.0705128	.0705128	n = 1
	within		.2568338	0	1	T = 156

Table 5: Descriptive Statistics of the panel Data set Variables by country

B Appendix B: Robustness Checks tables

VARIABLES	(1) Random Effects-MP	(2) Fixed Effects-MP
Deposit Interest Rate- dr	0.00629	0.0305
	(0.621)	(0.605)
euribor	5.660	5.644
	(4.060)	(4.048)
lM2	-0.0705	-0.0692
	(0.105)	(0.104)
COVID	0.00619	0.00604
	(0.0119)	(0.0118)
WAR	0.0838***	0.0836***
	(0.00785)	(0.00783)
Constant	1.140	1.118
	(1.701)	(1.676)
Observations	2,964	2,964
R-squared		0.124
Number of country	19	19
Country FE	YES	YES
Year FE	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Breusch-Pagan Lagrange Multiplier (LM) test for random effects assumptions

Correlation matrix of residuals:

	__e1	__e2	__e3	__e4	__e5	__e6	__e7	__e8	__e9	__e10	__e11	__e12	__e13	__e14	__e15
__e1	17.85051														
__e2	-.7883976	.0699119													
__e3	-.5062341	.0556433	.0677658												
__e4	-.7534436	.0804735	.069261	.2112902											
__e5	-.653432	.0508239	.0498769	.0412202	.0567667										
__e6	-.7790911	.0585133	.0550606	.0332945	.0602261	.0726117									
__e7	-.8816787	.0665952	.0570807	.0702604	.0592826	.0672402	.0751394								
__e8	-.4997078	.0538088	.0527007	.0757967	.0349169	.0431929	.0465656	.0693927							
__e9	-.9957002	.0771853	.066412	.0846179	.0694766	.0763427	.0849753	.0495294	.1050326						
__e10	-.6952081	.0534742	.0489179	.0606173	.0484198	.0530151	.0583725	.0378936	.0675262	.0516728					
__e11	-.9139184	.0761903	.0577086	.1822119	.0408963	.0376556	.0729466	.056492	.0930931	.0597854	.1936346				
__e12	-.9368044	.0808329	.0626882	.1919391	.0389284	.035132	.071641	.0665695	.0887457	.0600957	.1824431	.1949129			
__e13	-.6485649	.0619474	.0625713	.0609756	.0564322	.0646461	.0655301	.0520626	.0744765	.0516004	.0528065	.0575288	.0710842		
__e14	-.7457259	.0538874	.0485762	.0272945	.0577562	.067803	.0616048	.0416292	.0717003	.0507248	.0328272	.0278628	.0570228	.0723485	
__e15	-.9488208	.0716692	.0594685	.1058325	.0583728	.0606338	.0759582	.0516718	.0886368	.0612989	.1024321	.1057847	.0640799	.0572021	.0981649
__e16	-.6181372	.0502046	.0437843	.0534666	.0445248	.0506264	.0537007	.0393793	.0629396	.0447574	.0550035	.0511341	.0479704	.0510204	.0539633
__e17	-.7685782	.0591875	.053964	.1005584	.0474261	.0499023	.0631776	.042879	.0776253	.053294	.1031487	.1044229	.0534541	.0453679	.0810466
__e18	-.8553979	.0675293	.0649924	.0863778	.0608077	.0663119	.0716451	.0566204	.0827465	.0602043	.0795374	.0823213	.0691513	.061197	.0780226
__e19	-.7120657	.0704241	.0688355	.079168	.0613784	.0688552	.0724211	.0602295	.0825883	.0576655	.0665476	.0742922	.0758397	.0617792	.0745625

	__e16	__e17	__e18	__e19
__e16	.046677			
__e17	.0462737	.0815275		
__e18	.0537557	.0690026	.0824519	
__e19	.054178	.0630241	.0770078	.0870239

	__e1	__e2	__e3	__e4	__e5	__e6	__e7	__e8	__e9	__e10	__e11	__e12	__e13	__e14	__e15	__e16	__e17	__e18	__e19
__e1	1.0000																		
__e2	-0.7057	1.0000																	
__e3	-0.4603	0.8084	1.0000																
__e4	-0.3880	0.6621	0.5788	1.0000															
__e5	-0.6491	0.8068	0.8042	0.3764	1.0000														
__e6	-0.6843	0.8212	0.7849	0.2688	0.9381	1.0000													
__e7	-0.7613	0.9188	0.7999	0.5576	0.9077	0.9103	1.0000												
__e8	-0.4490	0.7725	0.7685	0.6260	0.5563	0.6085	0.6449	1.0000											
__e9	-0.7272	0.9007	0.7872	0.5680	0.8998	0.8742	0.9565	0.5802	1.0000										
__e10	-0.7239	0.8897	0.8267	0.5801	0.8940	0.8655	0.9368	0.6328	0.9166	1.0000									
__e11	-0.4916	0.6548	0.5038	0.9008	0.3901	0.3176	0.6048	0.4873	0.6528	0.5977	1.0000								
__e12	-0.5022	0.6925	0.5455	0.9458	0.3701	0.2953	0.5920	0.5724	0.6202	0.5988	0.9391	1.0000							
__e13	-0.5758	0.8787	0.9015	0.4975	0.8884	0.8998	0.8966	0.7413	0.8619	0.8514	0.4501	0.4887	1.0000						
__e14	-0.6562	0.7577	0.6938	0.2208	0.9012	0.9355	0.8355	0.5875	0.8225	0.8296	0.2773	0.2346	0.7951	1.0000					
__e15	-0.7168	0.8651	0.7291	0.7349	0.7820	0.7182	0.8844	0.6261	0.8729	0.8607	0.7430	0.7648	0.7671	0.6788	1.0000				
__e16	-0.6772	0.8789	0.7785	0.5384	0.8650	0.8696	0.9068	0.6919	0.8989	0.9113	0.5786	0.5361	0.8328	0.8780	0.7972	1.0000			
__e17	-0.6371	0.7840	0.7260	0.7662	0.6971	0.6486	0.8072	0.5701	0.8389	0.8211	0.8210	0.8284	0.7022	0.5907	0.9060	0.7501	1.0000		
__e18	-0.7051	0.8894	0.8695	0.6544	0.8888	0.8570	0.9102	0.7485	0.8892	0.9223	0.6295	0.6494	0.9033	0.7923	0.8672	0.8665	0.8416	1.0000	
__e19	-0.5713	0.9029	0.8964	0.5838	0.8733	0.8662	0.8956	0.7751	0.8638	0.8599	0.5127	0.5704	0.9643	0.7786	0.8067	0.8501	0.7482	0.9091	1.0000

Breusch-Pagan LM test of independence: chi2(171) = 14943.028, Pr = 0.0000
Based on 156 complete observations over panel units

Table 7: Breusch-Pagan LM test of independence

VARIABLES	(1) Correlation of the panels
dr	0.0305
	(0.605)
euribor	5.644
	(4.048)
lM2	-0.0692
	(0.104)
COVID	0.00604
	(0.0118)
WAR	0.0836***
	(0.00783)
Constant	1.118
	(1.676)
Observations	2,964
Number of country	19
R-squared	0.124
Country FE	YES
Year FE	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Pesaran's test of cross sectional independence = 97.957, Pr = 0.0000

Average absolute value of the off-diagonal elements = 0.729

Table 8: Pesaran's test of cross-sectional independence

```
Linear regression                               Number of obs     =      2,964
                                                F(3, 2960)        =      51.53
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0660
                                                Root MSE          =     .09273
```

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	.0260273	.200752	0.13	0.897	-.3676005	.419655
euribor	7.171851	1.23382	5.81	0.000	4.75262	9.591082
lM2	-.0028464	.0187628	-0.15	0.879	-.039636	.0339431
_cons	.0442587	.3028062	0.15	0.884	-.5494732	.6379907

. vif

Variable	VIF	1/VIF
dr	1.93	0.516954
lM2	1.81	0.551856
euribor	1.16	0.860483
Mean VIF	1.64	

```
Linear regression                               Number of obs     =      2,964
                                                F(6, 18)          =      34.31
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1304
                                                Root MSE          =     .08952

                                  (Std. Err. adjusted for 19 clusters in country)
```

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	-.4803544	.9516821	-0.50	0.620	-2.479764	1.519056
euribor	5.975796	4.250717	1.41	0.177	-2.954629	14.90622
lM2	-.0969774	.1216991	-0.80	0.436	-.3526578	.158703
COVID	.0092971	.0139162	0.67	0.513	-.0199396	.0385339
WAR	.0875526	.0092673	9.45	0.000	.0680827	.1070225
country	-.0028629	.002396	-1.19	0.248	-.0078967	.0021709
_cons	1.600425	1.990062	0.80	0.432	-2.58054	5.78139

. vif

Variable	VIF	1/VIF
lM2	5.13	0.194942
COVID	3.39	0.295347
dr	2.12	0.470621
WAR	1.52	0.658450
euribor	1.26	0.795435
country	1.00	0.997842
Mean VIF	2.40	

Multicollinearity test - variance inflation factor (VIF) analysis (1)

Linear regression

Number of obs	=	2,926
F(8, 18)	=	27.69
Prob > F	=	0.0000
R-squared	=	0.1292
Root MSE	=	.08964

(Std. Err. adjusted for **19** clusters in country)

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	-.5510949	1.023245	-0.54	0.597	-2.700854	1.598664
euribor	7.00449	4.947872	1.42	0.174	-3.390602	17.39958
lM2	-.0550255	.100753	-0.55	0.592	-.2666996	.1566486
COVID	-.0059969	.0059326	-1.01	0.325	-.0184609	.006467
WAR	.0806089	.008435	9.56	0.000	.0628877	.0983301
country	-.0029455	.002355	-1.25	0.227	-.0078931	.0020021
CS	-.0010632	.0006021	-1.77	0.094	-.0023281	.0002017
lGDP	-.0006049	.0035513	-0.17	0.867	-.008066	.0068562
_cons	.9176135	1.634063	0.56	0.581	-2.515426	4.350653

. vif

Variable	VIF	1/VIF
lM2	7.60	0.131558
COVID	4.96	0.201510
CS	2.86	0.349145
WAR	2.42	0.413163
dr	2.26	0.442127
euribor	1.22	0.822775
lGDP	1.14	0.880851
country	1.12	0.895757
Mean VIF	2.95	

Linear regression

Number of obs	=	2,926
F(14, 2911)	=	74.08
Prob > F	=	0.0000
R-squared	=	0.1403
Root MSE	=	.08915

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	-.8747919	.2200505	-3.98	0.000	-1.306262	-.4433214
euribor	7.353141	1.508276	4.88	0.000	4.395745	10.31054
lM2	-.0907062	.0250515	-3.62	0.000	-.1398266	-.0415858
COVID	-7.230651	1.00354	-7.21	0.000	-9.198372	-5.262931
WAR	-.3959067	4.410081	-0.09	0.928	-9.043102	8.251289
coviddr	1.82518	.3917714	4.66	0.000	1.057003	2.593357
covideuribor	-17.26444	5.795745	-2.98	0.003	-28.62861	-5.900259
covidlM2	.4449714	.0628069	7.08	0.000	.3218208	.5681219
wardr	2.570448	.7262311	3.54	0.000	1.14647	3.994427
wareuribor	8.395395	6.097664	1.38	0.169	-3.560778	20.35157
warlM2	.0226502	.2668005	0.08	0.932	-.5004867	.5457872
CS	-.0008486	.0004478	-1.89	0.058	-.0017267	.0000295
lGDP	-.0002734	.0004589	-0.60	0.551	-.0011733	.0006264
country	-.0028836	.0004501	-6.41	0.000	-.0037661	-.0020011
_cons	1.49411	.408698	3.66	0.000	.6927437	2.295477

Multicollinearity test - variance inflation factor (VIF) analysis (2)

```
. vif
```

Variable	VIF	1/VIF
warlM2	1.99e+06	0.000001
WAR	1.98e+06	0.000001
covidlM2	495925.78	0.000002
COVID	466717.28	0.000002
covideuribor	581.14	0.001721
wareuribor	238.57	0.004192
lM2	8.79	0.113720
wardr	5.47	0.182918
coviddr	4.18	0.239420
CS	3.42	0.292212
dr	2.50	0.400412
euribor	1.33	0.754567
lGDP	1.14	0.875754
country	1.12	0.893412
Mean VIF	352685.69	

Linear regression

Number of obs	=	2,926
F(10, 2915)	=	81.70
Prob > F	=	0.0000
R-squared	=	0.1365
Root MSE	=	.08929

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	-.955668	.2174522	-4.39	0.000	-1.382044	-.5292925
euribor	7.502133	1.494347	5.02	0.000	4.572049	10.43222
lM2	-.0615702	.0228067	-2.70	0.007	-.1062891	-.0168513
COVID	-8.654453	.6212968	-13.93	0.000	-9.872678	-7.436228
coviddr	3.167579	.4216389	7.51	0.000	2.340839	3.99432
covideuribor	-9.269157	1.866231	-4.97	0.000	-12.92842	-5.609893
covidlM2	.5283032	.0380999	13.87	0.000	.4535977	.6030086
CS	-.0018063	.0002837	-6.37	0.000	-.0023627	-.00125
lGDP	-.0002145	.0004625	-0.46	0.643	-.0011214	.0006924
country	-.0028877	.0004503	-6.41	0.000	-.0037705	-.0020048
_cons	1.01461	.3710675	2.73	0.006	.2870293	1.742191

```
. vif
```

Variable	VIF	1/VIF
covidlM2	78223.07	0.000013
COVID	77313.84	0.000013
covideuribor	9.94	0.100602
lM2	7.55	0.132500
coviddr	2.64	0.378363
dr	2.46	0.406290
CS	2.07	0.484005
euribor	1.32	0.759921
lGDP	1.14	0.877229
country	1.12	0.894955
Mean VIF	15556.51	

Multicollinearity test - variance inflation factor (VIF) analysis (3)

Linear regression

Number of obs	=	2,926
F(10, 2915)	=	92.80
Prob > F	=	0.0000
R-squared	=	0.1354
Root MSE	=	.08935

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	-.6896389	.2052694	-3.36	0.001	-1.092127	-.2871512
euribor	7.412587	1.447838	5.12	0.000	4.573698	10.25148
lM2	-.0764592	.0170251	-4.49	0.000	-.1098418	-.0430767
WAR	-8.142013	3.851808	-2.11	0.035	-15.69455	-.589473
wardr	4.198752	.6781741	6.19	0.000	2.869003	5.528501
wareuribor	-8.930031	1.871292	-4.77	0.000	-12.59922	-5.260844
warlM2	.4987381	.2331604	2.14	0.033	.0415623	.9559138
CS	-.0007204	.0002485	-2.90	0.004	-.0012076	-.0002332
lGDP	-.0004036	.0004544	-0.89	0.375	-.0012946	.0004874
country	-.002897	.0004512	-6.42	0.000	-.0037818	-.0020123
_cons	1.264251	.2757629	4.58	0.000	.7235411	1.804961

. vif

Variable	VIF	1/VIF
warlM2	1.80e+06	0.000001
WAR	1.80e+06	0.000001
wareuribor	4.36	0.229409
wardr	3.78	0.264571
lM2	2.63	0.380203
dr	2.32	0.430678
CS	2.04	0.489863
euribor	1.20	0.835493
lGDP	1.14	0.877785
country	1.12	0.893589
Mean VIF	360560.80	

Multicollinearity test - variance inflation factor (VIF) analysis (4)

Linear regression

Number of obs	=	2,964
F(3, 2960)	=	51.53
Prob > F	=	0.0000
R-squared	=	0.0660
Root MSE	=	.09273

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	.0260273	.200752	0.13	0.897	-.3676005	.419655
euribor	7.171851	1.23382	5.81	0.000	4.75262	9.591082
lM2	-.0028464	.0187628	-0.15	0.879	-.039636	.0339431
_cons	.0442587	.3028062	0.15	0.884	-.5494732	.6379907

. vif

Variable	VIF	1/VIF
dr	1.93	0.516954
lM2	1.81	0.551856
euribor	1.16	0.860483
Mean VIF	1.64	

Linear regression

Number of obs	=	2,964
F(6, 18)	=	34.31
Prob > F	=	0.0000
R-squared	=	0.1304
Root MSE	=	.08952

(Std. Err. adjusted for 19 clusters in country)

IR	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dr	-.4803544	.9516821	-0.50	0.620	-2.479764	1.519056
euribor	5.975796	4.250717	1.41	0.177	-2.954629	14.90622
lM2	-.0969774	.1216991	-0.80	0.436	-.3526578	.158703
COVID	.0092971	.0139162	0.67	0.513	-.0199396	.0385339
WAR	.0875526	.0092673	9.45	0.000	.0680827	.1070225
country	-.0028629	.002396	-1.19	0.248	-.0078967	.0021709
_cons	1.600425	1.990062	0.80	0.432	-2.58054	5.78139

. vif

Variable	VIF	1/VIF
lM2	5.13	0.194942
COVID	3.39	0.295347
dr	2.12	0.470621
WAR	1.52	0.658450
euribor	1.26	0.795435
country	1.00	0.997842
Mean VIF	2.40	

Table 9: Multicollinearity test - variance inflation factor (VIF) analysis

C Supplementary Materials

C.1 .do file

```
cap log close

cap clear matrix

clear

set mem 500m

set matsize 500

cd "D:\Banking and Finance UU\Period Four\Thesis (USEMT)\Thesis\Data\STATA\Final\Final Trial ISA
5eer"


// cd "<directory where data is>"

log using "Thesis_Aya_tables_Final.log", replace


*********************************************
*** Load, Describe the data & create a panel data:
*********************************************


use Final_DF2.dta, clear


sort country month


//create a panel data

xtset country month


*Summary statistics, taking into account both dimensions:


xtsum IR dr CS euribor lGDP lM2 COVID WAR


bysort country: xtsum IR dr CS euribor lGDP lM2 COVID WAR


*********************************************
*** Explore the data:
*********************************************


corr IR dr CS euribor lGDP lM2 COVID WAR
```

Figure 1: .do File (1)

```
*********************************************
*** Model 1: Monetary factors effect on Inflation rate:
*********************************************
*R2 6.6%
reg IR dr euribor lM2, robust
vif
//outreg2 using Empirical_results_Model_1.doc, replace ctitle (reg Specific monetary policy tools)
addtext(Country FE, YES, Year FE, YES)
*R2 13%
reg IR dr euribor lM2 COVID WAR country, vce(cluster country) hascons
vif
//outreg2 using Empirical_results_Model_1.doc, append ctitle (Adding Dummies variables) keep( dr
euribor lM2 COVID WAR country ) addtext(Country FE, YES, Year FE, YES)
*R2 12.9%
reg IR dr euribor lM2 COVID WAR country CS lGDP, vce(cluster country) hascons
vif
//outreg2 using Empirical_results_Model_1.doc, append ctitle (Adding All variables) keep( dr euribor
lM2 COVID WAR country CS lGDP ) addtext(Country FE, YES, Year FE, YES)


*FE
xi: xtreg IR dr euribor lM2 COVID WAR CS lGDP, fe
//outreg2 using Empirical_results_Model_1.doc, append ctitle (Fixed Effects) keep( dr euribor lM2
COVID WAR country CS lGDP ) addtext(Country FE, YES, Year FE, YES)


*RE
xi: xtreg IR dr euribor lM2 COVID WAR CS lGDP, re robust
//outreg2 using Empirical_results_Model_1.doc, append ctitle (Random Effects) keep( dr euribor lM2
COVID WAR country CS lGDP ) addtext(Country FE, YES, Year FE, YES)


/* Hausman test */
xtreg IR dr euribor lM2 CS lGDP, fe
est store fixed


xtreg IR dr euribor lM2 CS lGDP, re
est store random


hausman fixed random, sigmamore
```

Figure 2: .do File (2)

```
*********************************************

*** Model 2: Monetary factors effect on Inflation rate:

*********************************************


gen dr_int = int(dr)

gen euribor_int = int(euribor)

gen lM2_int = int(lM2)


gen wardr = WAR * dr

gen wareuribor = WAR * euribor

gen warlM2 = WAR * lM2

gen coviddr = COVID * dr

gen covideuribor = COVID * euribor

gen covidlM2 = COVID * lM2


reg IR dr euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS lGDP
country, robust

vif

//outreg2 using Empirical_results_Model_2.doc, replace ctitle (reg All Interaction Variables) keep( dr
euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS lGDP country )
addtext(Country FE, YES, Year FE, YES)


reg IR dr euribor lM2 COVID coviddr covideuribor covidlM2 CS lGDP country, robust

vif

//outreg2 using Empirical_results_Model_2.doc, append ctitle (Only COVID19 Interaction variables)
keep( dr euribor lM2 COVID coviddr covideuribor covidlM2 CS lGDP country ) addtext(Country FE,
YES, Year FE, YES)


reg IR dr euribor lM2 WAR wardr wareuribor warlM2 CS lGDP country, robust

vif

//outreg2 using Empirical_results_Model_2.doc, append ctitle (Only WAR Interaction variables) keep(
dr euribor lM2 WAR wardr wareuribor warlM2 CS lGDP country ) addtext(Country FE, YES, Year FE,
YES)


*FE

xi: xtreg IR dr euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS
lGDP, fe robust
```

Figure 3: .do File (3)

```
outreg2 using Empirical_results_Model_2.doc, append ctitle (Fixed Effects-ALL variables) keep( dr
euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS lGDP )
addtext(Country FE, YES, Year FE, YES)


*RE

xi: xtreg IR dr euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS
lGDP, re robust

outreg2 using Empirical_results_Model_2.doc, append ctitle (Random Effects-ALL variables) keep( dr
euribor lM2 coviddr COVID WAR covideuribor covidlM2 wardr wareuribor warlM2 CS lGDP )
addtext(Country FE, YES, Year FE, YES)


/* Hausman test */

xtreg IR dr euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS lGDP,
fe

est store fixed


xtreg IR dr euribor lM2 COVID WAR coviddr covideuribor covidlM2 wardr wareuribor warlM2 CS lGDP,
re

est store random


hausman fixed random, sigmamore



/* Breusch-Pagan Lagrange Multiplier (LM) test for random effects assumptions */

xtreg IR dr euribor lM2 COVID WAR, re robust

xttest0

outreg2 using Empirical_results_Model_3.doc, replace ctitle (Random Effects-MP) addtext(Country
FE, YES, Year FE, YES)


ssc install xttest2


xtreg IR dr euribor lM2 COVID WAR, fe robust

xttest2

outreg2 using Empirical_results_Model_3.doc, append ctitle (Fixed Effects-MP) addtext(Country FE,
YES, Year FE, YES)


*Are the panels correlated?

ssc install xtcsd

xtreg IR dr euribor lM2 COVID WAR, fe robust
```

Figure 4: .do File (4)

```
xtcsd, pesaran abs

outreg2 using Empirical_results_Model_4.doc, replace ctitle (Correlation of the panels )
addtext(Country FE, YES, Year FE, YES)


//concluding heteroskedasticity

ssc install xttest3

xtreg IR dr euribor lM2, fe robust

xttest3
```

Figure 5: .do File (5)