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Heterogeneous Transmission of Monetary Policy to Euro Area Financial Markets

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HETEROGENEOUS TRANSMISSION OF MONETARY POLICY TO EURO AREA FINANCIAL MARKETS

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Abstract

Financial markets play an important role in the transmission of monetary policy in the Euro Area. However, as the Euro Area is composed of several countries with different macroeconomic and financial conditions, the financial markets may react differently to monetary policy decisions.

Therefore, the main goal of this study is to analyze the impact of the European Central Bank´s (ECB) (conventional and unconventional) monetary policy shocks on Euro Area financial markets (stock markets and sovereign bond yields). Specifically, I assess the possibility of heterogeneous responses across the Euro Area financial markets to a monetary policy shock using an IPVAR model with fixed effects and heterogeneous slopes. This approach allows me to access country-specific reactions to the implementation of monetary policy shocks, controlling for macroeconomic and financial fundamentals of financial markets.

The contribution of this study is twofold. First, it contributes to the financial literature by evaluating the effects on financial markets after a monetary policy shock, while considering the macroeconomic dynamics. Second, it contributes to the macroeconomic literature by allowing the dynamic effects between macroeconomic and financial fundamentals, to understand whether they affect the monetary policy transmission.

The results suggest that conventional and unconventional monetary policy shocks may have distinct effects on financial markets. Additionally, sovereign bond yields in peripheral countries exhibit a more pronounced response to an unconventional monetary policy shock than core countries, primarily due to their macroeconomic fundamentals. Regarding the stock returns, the heterogeneity of a conventional monetary policy shock is mainly influenced by the country's financial fundamentals. These results may help to reduce the heterogeneity among Euro Area financial markets through the ECB intervention on some fundamentals and allow Euro Area investors to understand how the market incorporates monetary policy decisions.

JEL codes: E44, E52, G12

Keywords: Stock Returns, Sovereign Bond Yields, Monetary Policy Transmission, Euro Area

Resumo

Os mercados financeiros desempenham um papel importante na transmissão da política monetária na Área Euro. No entanto, como a Área Euro é composta por vários países com diferentes condições macroeconómicas e financeiras, os mercados financeiros podem reagir de diferentes formas às decisões de política monetária.

Assim, o principal objetivo deste estudo é analisar o impacto dos choques de política monetária (convencional e não convencional) do Banco Central Europeu nos mercados financeiros da Área Euro (mercado de ações e obrigações soberanas). Concretamente, eu aplico um modelo *IPVAR* com efeitos fixos e declives heterogéneos que me permite perceber as respostas heterogéneas nos mercados financeiros da Área Euro a um choque de política monetária. Esta abordagem permite-me perceber as reações específicas de cada país face a um choque de política monetária, controlando para os fundamentos macroeconómicos e financeiros dos mercados financeiros.

Em primeiro lugar, esta dissertação contribui para a literatura financeira ao avaliar os impactos nos mercados financeiros, tendo também em conta as dinâmicas macroeconómicas. Em segundo lugar, contribui para a literatura macroeconómica ao permitir a existência de efeitos dinâmicos entre os fundamentos macroeconómicos e financeiros, de forma a perceber se estes afetam a transmissão da política monetária.

Os resultados sugerem que choques de política monetária convencional e não convencional podem originar efeitos distintos nos mercados financeiros. Além disso, as *yields* dos países periféricos têm maiores respostas a um choque não convencional que os países centrais principalmente devido aos seus fundamentos macroeconómicos. A heterogeneidade nos retornos das ações face a um choque convencional é principalmente devido aos fundamentos financeiros do país. Estes resultados podem ajudar a reduzir a heterogeneidade nos mercados financeiros da Área Euro através da intervenção do Banco Central Europeu em alguns fundamentos e permitir aos investidores da Área Euro compreender como as decisões de política monetária afetam o mercado.

Códigos JEL: E44, E52, G12

Palavras-chave: Retornos das Ações, *Yields* das Obrigações Soberanas, Transmissão da Política Monetária, Área Euro

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Abbreviations

APP: Asset Purchases Programs

CMP: Conventional Monetary Policy

ECB: European Central Bank

FG: Forward Guidance

GDP: Gross Domestic Product

IPI: Industrial Production Index

IPVAR: Interacted Panel Vector Autoregressive

QE: Quantitative Easing

UK: United Kingdom

UMP: Unconventional Monetary Policy

US: United States

VAR: Vector Autoregressive

1. Introduction

Financial markets are a well-known channel of monetary policy that enables central banks to influence economic conditions, playing an important role in connecting monetary policy decisions to the real economy (Hildebrand, 2006). Specifically, during the Global Financial Crisis, these markets received special attention due to their malfunction in transmitting monetary policy through conventional mechanisms (Dell'Ariccia et al., 2018). However, with the introduction of unconventional monetary policy (UMP), the European Central Bank (ECB) was able to improve the Euro Area financial market conditions, reducing sovereign bond yields and increasing stock prices (Rogers et al., 2014). Nowadays, with the high inflation rates the ECB had to normalize its monetary policy by raising interest rates and stopping Quantitative Easing (QE). Given the significant impact of UMP on financial markets, policy normalization raises some concerns. These changes in the monetary policy make it particularly interesting to account for all the periods since the beginning of the Euro Area in this study.

However, the ECB faces a significant challenge since its monetary policy decisions are applied to all Euro Area countries, each one with different macroeconomic and financial conditions. For example, considering the macroeconomic conditions, Italy's debt-to-gross domestic product (GDP) at the end of 2022 was 144.4%, whereas the Netherlands was 51%.[1] Likewise, regarding financial conditions, the yield spread at the end of 2022 for Germany was 0.007%, while Austria's was 0.065%, almost ten times as big.[2] Consequently, the heterogeneous values of these variables, which also represent financial market fundamentals, may suggest that monetary policy can affect countries differently due to the influence of the fundamentals (De Santis, 2020; Kinateder and Wagner, 2017). Thus, my research question is: Does the monetary policy affect the Euro Area Financial Markets in a heterogeneous way, and what may underlie these reactions?

So far, the literature has had two main approaches to analyzing the relationship between monetary policy and financial markets, which may be of value to my research question. Firstly, focusing on the financial literature, this literature generally finds that an expansionary monetary policy leads to a higher decrease in sovereign bond yields of peripheral countries

[1] Eurostat. (2023). *Quarterly Government Debt.* https://ec.europa.eu/eurostat/data-browser/view/GOV_10Q_GGDEBT/default/table?lang=en, accessed on 26 Junel 2023
[2] Datastream (2023) and Author´s Calculations

and an increase in stock returns that may be influenced by the market capitalization of these countries (e.g., Fendel and Neugebauer, 2020; Sondermann et al., 2009). Secondly, considering the macroeconomic literature, the evidence regarding the stock market is less clear, but for sovereign bond yields, the authors generally find a decrease among countries with significant heterogeneity (Elbourne et al., 2018; Blot et al., 2020). Despite some studies in the macroeconomic literature that shed some light on these heterogeneous reactions, for example, De Santis (2020) and Hafemann and Tillmann (2020) there is not extensive literature in this regard. In particular, to the best of my knowledge, I have not found a study that analyzes the heterogeneous transmission to the financial markets while attempting to explain these distinct reactions through the underlying fundamentals (macroeconomic and financial) of financial market variables.

Hence, the main objective of this dissertation is to analyze the impact of conventional monetary policy (CMP) and unconventional monetary policy (UMP) transmission on financial markets, specifically stock returns and 10-year sovereign bond yields, within the Euro Area countries and to understand if there is a heterogeneous reaction among them. Additionally, by incorporating the fundamentals that are specific to the country, I also want to shed some light on what may justify the heterogeneous reactions.

This dissertation may contribute to the existing literature in two main ways. First, this study contributes to the financial literature by evaluating the effects of monetary policy on financial market variables while accounting for the macroeconomic dynamics after the monetary policy shock. Second, this study may contribute to the macroeconomic literature by incorporating a comprehensive set of financial and macroeconomic fundamentals of stock returns and sovereign bond yields. This inclusion may allow to understand if the transmission of monetary policy to Euro Area financial markets depends on these variables. While for example, De Santis (2020) has explored this question through the interaction of the Asset Purchases Programs (APP) news and the fundamentals of sovereign bond yields, the evidence regarding stock returns remains scarce. For these contributions, I apply an interacted panel vector autoregressive model (IPVAR), where monetary policy shocks are derived from the decomposition of the shadow rate of De Rezende and Ristiniemi (2023). The interaction terms result from the interaction of the monetary policy and each fundamental of stock returns and sovereign bond yields. These terms may help to understand whether the transmission of

monetary policy across Euro Area countries is affected by these fundamentals. To estimate the model, I apply country-fixed effects with generally heterogeneous slopes.

The results suggest that conventional and unconventional monetary policy shocks may have different effects on financial markets. I find that a contractionary monetary policy shock (conventional or unconventional) generally increases the Euro Area sovereign bond yields. For stock returns, the contractionary CMP shock increases the returns, while the UMP shock decreases the returns. In addition, I only find signals of heterogeneity in sovereign bond yields to an UMP shock, where peripheral countries have higher responses to the UMP shock than core countries. This result can potentially be explained by the macroeconomic conditions of a country, for example, higher unemployment rates and debt-to-GDP ratios lead to greater increases in sovereign bond yields. For the stock returns, I find higher signals of heterogeneity in a CMP shock than in an UMP shock. This heterogeneity in stock returns to a CMP shock may be attributed to financial conditions such as financial depth and dividend yield of the country.

This study may be of relevance to the ECB and investors in the Euro Area. The results may shed some light on the transmission of monetary policy to financial markets, helping to reduce the heterogeneity across Euro Area countries. This reduction may be through the potential ECB intervention in certain fundamentals, such as the debt-to-GDP ratio and financial depth, which explain some of the heterogeneity. Moreover, it may provide some indications to Euro Area investors on how the market generally incorporates the monetary decisions and how they should proceed to take advantage of investment opportunities.

This dissertation is organized into six sections. The following section reviews the related literature. Section 3 is divided into three subsections: the first one considers the monetary policy shock, the following one presents the description of the methodology, and the last one presents the explanation of the exogenous variables. Section 4 contains the information on the selected data. Section 5 consists of three subsections: the analysis of the impulse response functions, the analysis of the heterogeneous reactions across Euro Area financial markets, and the last one considers the effects of the fundamentals. The final section includes the main conclusions of this study.

2. Monetary Policy and Financial Markets

This section is organized into four subsections. The first presents the main definitions related to the subject, the second explains how conventional and unconventional monetary policy may affect financial markets (namely stocks and bonds), and the next reviews the main conclusions from the empirical literature on the relationship between financial markets and monetary policy. The last subsection includes the heterogeneity studies on the Euro Area.

2.1. Main Concepts

This dissertation has two key concepts: Monetary Policy and Financial Markets. On the one hand, Monetary Policy is based on a set of rules by which central banks attempt to influence the macroeconomic conditions of a country or the area in which the policy is applied. Currently, two different monetary policies are known, conventional and unconventional monetary policy. In CMP, the central bank uses the short-term interest rate to target macroeconomic variables (Friedman and Kuttner, 2010). However, with the global financial crisis in 2007, output contracted, and inflation was low, and even when the ECB lowered the policy rate to stimulate the economy, it was no longer effective, since financial markets were not able to transmit the monetary policy actions to the economy. To ensure that financial markets would function again, the ECB began unconventional monetary policies, characterized by QE and forward guidance (FG). QE can be broadly defined as large-scale purchases of long-term assets by the central bank with the expectation of lower long-term yields. The FG intended to provide market participants with information on the future trajectory of policy rates (Dell'Ariccia et al., 2018).

On the other hand, Financial Markets are the intermediaries where investors buy and sell financial assets such as stocks and bonds. Depending on the different assets that are traded, these markets may be classified as the stock market and sovereign bond market (Kidwell et al., 2016). In the stock market, the investors trade securities of companies that represent a share of the company (Teweles and Bradley, 1998). The sovereign bond market represents the debt of governments held by market participants who own the financial instrument, usually long-term debt (Kidwell et al., 2016).

2.2. Transmission Channels of Monetary Policy

This subsection reviews the main transmission channels through which monetary policy affects stocks and bonds. I start by reviewing the transmission channels from CMP to bonds and stocks and then proceed to the channels from UMP.

Before proceeding to the channels of monetary policy, I start by analyzing the main components of bond yields and stock returns to better understand how monetary policy may affect these instruments. Regarding sovereign bond yields, Gagnon et al. (2011) point out that yields have two main components. The first is the average level of short-term, which is associated with the expected return from short-term investments. The second component is the term premium, which represents the additional expected return that results from the risk of bearing long-term investments (Gagnon et al., 2011). Relying on the cash flow model, one of the components of stock returns is the discount rate. The discount rate is related to market interest rates, and these market rates are influenced by the central bank. This rate represents the value at which firms discount future cash flows. The other component is the future cash flows, which may be related to the general level of economic activity (Ioannidis and Kontonikas, 2008). The stock returns also have the equity premium, which relates to the perception of risk from investors (Bernanke and Kuttner, 2005).

Considering the effects of CMP on bond yields, the focus of the literature on these effects is the relationship between short-term and long-term interest rates, i.e., the yield curve. According to the expectations hypothesis of the yield curve, long-term interest rates mainly reflect market participants' expectations about the future values of short-term interest rates plus a term premium (Campbell and Shiller, 1991). Therefore, the transmission from short-term to long-term interest rates is mainly through expectations (Hildebrand, 2006). According to this, the literature identifies three main ways in which monetary policy can affect bond yields (Bomfim, 2003; Evans and Marshall, 1998). First, the increase in the short-term interest rate leads to a flattening of the yield curve, i.e., yields at shorter maturities increase more and the effect dissipates throughout the yield curve because the increase is considered transitory (Bomfim, 2003). Second, monetary policy affects future medium-term monetary policy expectations, i.e., an unexpected increase in the tendency of future central bank actions lead to an increase in yields for all maturities since it is anticipated that short-term interest rates will increase in the future (Rudebusch and Wu, 2008; Bomfim, 2003). However, the two effects mentioned above may occur simultaneously, leading to a higher upward movement

of the yield curve (Bomfim, 2003). Finally, monetary policy affects the term premium (Evans and Marshall, 1998; Hanson and Stein, 2015). In this sense, Hanson and Stein (2015) suggest that when short-term interest rates fall, yield-oriented investors increase their demand for long-term bonds so that their portfolio yields do not decline, causing long-term yields to fall.

Turning to stock returns, the literature has highlighted three ways in which CMP may affect stock returns (Bernanke and Kuttner, 2005; Ioannidis and Kontonikas, 2008). First, relying on the cash flow model, a decline in the short-term interest rate leads to a lower discount rate, which is, an expansionary monetary policy leads to an increase in the stock returns (Ioannidis and Kontonikas, 2008). Second, expansionary monetary policies increase expected future dividends because they increase the general level of economic activity, leading stock investors to expect higher cash flows and consequently higher returns (Ioannidis and Kontonikas, 2008). Finally, expansionary monetary policy can reduce the equity premium because it may reduce investors' perception of risk, which lowers the risk of stocks and leads investors to demand lower equity premiums (Bernanke and Kuttner, 2005).

Now, analyzing the impact of UMP on bond yields, several studies emphasize five channels: the signaling, the portfolio rebalancing effects, the duration channel, the liquidity, and the default risk (Gagnon et al., 2011; Joyce et al., 2010; Krishnamurthy and Vissing-Jorgensen, 2011). Starting with the signaling channel, this channel may be responsible for affecting the first component of yields, i.e., the expected short-term interest rate (Gagnon et al., 2011). This effect on yields may result from the fact that monetary policy actions can signal and transmit a commitment regarding the path of the future short-term interest rates where economic agents incorporate this information into their decisions (D'Amico et al., 2012; Joyce et al., 2010; Woodford, 2012). Second, the portfolio rebalancing channel affects bond yields through the term premium (Gagnon et al., 2011). According to this channel, some investors trade only in their preferred maturities (i.e., investors with preferred habitat), and there are arbitrageurs responsible for exploiting differences in expected returns. Therefore, QE reduces the amount of long-term assets held by investors, which reduces the term premium and the yields of long-term assets by raising their prices. At the same time, since investors face changes in the returns of their portfolios, they may increase the demand for assets with higher returns (D'Amico et al., 2012; Gagnon et al., 2011; Joyce et al., 2010). Third, the duration risk channel is associated with the decrease of long-term assets in the market, which leads to the decrease of the duration risk in the market. Therefore, investors demand a lower

premium to maintain this risk (Gagnon et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011; D'Amico et al., 2012). Fourth, regarding the liquidity channel, through the asset purchases, the central bank may be able to decrease the costs associated with selling assets to investors, which leads to a decrease in the liquidity premium in these assets, thereby improving the market liquidity (Gagnon et al., 2011; Joyce et al., 2010). Lastly, default risk is another channel, but it is not directly related to the implementation of QE but to the impact of these policies on the economy. Economic recovery can lead to a decrease in investors' risk aversion, which leads to a lower default risk premium, lowering the bond yields (Krishnamurthy and Vissing-Jorgensen, 2011).

Turning to stock returns, four channels are considered, three of which are also applied to bond yields, namely the portfolio rebalancing channel, the signaling channel, and the liquidity channel (Krishnamurthy and Vissing-Jorgensen, 2013; Chebbi, 2019; Bowdler and Radia, 2012). First, concerning the portfolio rebalancing channel, Krishnamurthy and Vissing-Jorgensen (2013) refer that the impact of this channel is mainly on the assets where the purchases occur, but it can also affect other assets through spillover effects. In this channel, the yields of purchased assets decrease, so investors decide to change the composition of their portfolios by buying other substitute assets, such as stocks, increasing their prices (Gagnon et al., 2011). Second, the signaling channel leads to a reduction in the yields of long-term assets, which may lead to portfolio adjustments where investors increase their demand for substitute assets, raising the price of stocks. However, this channel may also lead investors to expect that conditions are worse than they preview, so they are encouraged to acquire more safe assets and the demand for stocks will decrease (Chebbi, 2019; Joyce et al., 2010; D'Amico et al., 2012). Third, the liquidity channel also affects the stock market since the QE may increase the liquidity of the market, which may lead to a higher demand for stocks, leading to an increase in their prices (Bowdler and Radia, 2012; Chortareas et al., 2019). Finally, the bank-lending channel is related to the increase in banks' reserves, which increases banks' liquidity. With more liquidity, banks can increase lending, resulting in better financing terms (Joyce and Spaltro, 2014; Rodnyansky and Darmouni, 2017; Matousek et al., 2019). When financing costs decrease, Q-Tobin increases and this reflects an increase in the market value of firms, i.e., stock prices increase (Stefański, 2022).

2.3. The Impact of Monetary Policy on Financial Markets

This subsection is organized into two strands of empirical literature according to the frequency of the applied data. First, I consider the literature that analyzes the relationship between monetary policy and financial markets in high-frequency data, i.e., daily or even smaller windows. Second, I review the lower frequency data literature, which includes monthly or quarterly data studies.

Starting with high-frequency data literature, Krishnamurthy et al. (2018) for the Euro Area and Christensen and Rudebusch (2012) for the United Kingdom (UK) and United States (US) find that an expansionary monetary policy lowers sovereign bond yields. However, the relation seems to decrease throughout the announcements of UMP actions, as suggested by Joyce et al. (2012), where the effects tend to be smaller over time because market participants begin to predict the policy actions. Although the above studies analyze the impact of UMP during periods of greater financial turmoil, Altavilla et al. (2021) examine the impact of the 2015 ECB program of QE when there was less financial turmoil. Altavilla et al. (2021) find that these policies reduced sovereign bond yields. Moreover, the author refers that some channels became more important, such as the duration channel and credit risk, which facilitated spillover effects to other assets, while other channels that were more relevant during periods of greater financial turmoil became less relevant in the transmission (Altavilla et al., 2021).

Considering the stock market, Bernanke and Kuttner (2005) for the US and Haitsma et al. (2016) for the Euro Area suggest a negative relationship between stock returns and a monetary policy shock. However, the relationship is not always clear. According to Bredin et al. (2009), monetary policy changes by the ECB do not seem to affect German stock returns. One possible justification may be related to the fact that capital markets only react if the change is permanent, as they have a more long-term behavior in Germany (Bredin et al., 2009). Moreover, Rogers et al. (2014) find that an expansionary UMP is responsible for increasing stock prices in the Euro Area and the US, however, the same result does not hold for Japan and the UK. This evidence is not in line with Bredin et al. (2009) which finds that a surprise shock in CMP affects the stock returns from the UK. The high-frequency literature is important since it evaluates the immediate effects of the monetary policy on financial market variables, however, it does not allow the development of macroeconomic dynamics.

Turning to the low-frequency literature, one of the strands of literature that accounts for dynamic effects between financial markets and macroeconomic variables is the transmission mechanism literature. Since financial markets are part of the transmission mechanism, some authors incorporate financial market variables, such as sovereign bond yields and stock market indicators, to analyze these channels.[3] This approach allows authors to understand how monetary policy may influence financial market variables (e.g., Boeckx et al., 2014; Hafemann and Tillmann, 2020; Hesse et al., 2018). Regardless, this literature also considers the macroeconomic effects on output and inflation (e.g., Cassola and Morana, 2004; Boeckx et al., 2014; Hesse et al., 2018).

Starting with the macroeconomic effects, Cassola and Morana (2004) find that a temporary or permanent shock seems to influence the macroeconomic variables in a similar way, so the credibility of the central bank has an important role. More recently, Weale and Wieladek (2016) for the US and UK, and Boeckx et al. (2014) for the Euro Area, find that an expansionary monetary policy shock has a positive impact on output and inflation. However, Hesse et al. (2018) find a decrease in the effectiveness of the APP for the US and UK, partly due to the anticipation of the programs, suggesting that monetary policy shocks are more efficient in periods of financial stress than in periods of recovery. In addition, for the Euro Area, Ouerk et al., (2020) find that an expansionary monetary policy shock does not have significant impacts on inflation, since the transmission of monetary policy may be long and uncertain.

Moving now to the effects on financial market variables, more specifically on the sovereign bond yields, the literature finds that an expansionary monetary policy shock decreases the sovereign bond yields (Boeckx et al., 2014; Ouerk et al., 2020; Hesse et al., 2018). Ouerk et al. (2020) and Boeckx et al. (2014) suggest that this occurs due to the decrease in credit risk premium associated with the reduction of yield spreads between the Euro Area and German yields. Moreover, Boeckx et al. (2014) also refer that this result may come from the decrease in term premium which increases liquidity and leads investors to acquire longer-term assets.

Attending now on the stock market, the evidence is not so clear (Hafemann and Tillmann, 2020; Ouerk et al. 2020; Hesse et al., 2018). Hesse et al. (2018) and Cassola and Morana

[3] Some authors consider other financial market variables, for example, Weale and Wieladek (2016) analyze the three-month and one-year interest rates futures one year ahead. However, I only consider the evidence on sovereign bond yields or stock market (prices or returns).

(2004) find that an expansionary monetary policy shock exerts a positive effect on stock prices and Ouerk et al. (2020) associate the increase in stock prices with the portfolio re-balancing channel. However, Hafemann and Tillmann (2020) find no significant reaction, which may be related to the heterogeneity across Euro Area countries. A bigger focus on the stock market is provided by Balatti et al. (2016), who study not only the effects on stock prices but also on stock market volatility and liquidity. The authors find that an expansionary UMP shock leads to an immediate decrease in stock prices, possibly due to the revision of investors' macroeconomic expectations (Balatti et al., 2016). However, in the longer term, Balatti et al. (2016) find that stock prices increase due to the lower interest rates, which decreases borrowing costs and increases the present value of dividends. In addition, the lower returns on bond yields may prompt investors to rebalance their portfolios to riskier assets (Balatti et al., 2016). Furthermore, Balatti et al. (2016) find that volatility increases in both countries, the US, and the UK, as the market incorporates the new information, but the authors only find significant results for the liquidity in the US, where it decreases, possibly due to an increase in uncertainty. Since generally, financial markets are not the focus of these studies, the literature does not focus on explaining the transmission of monetary policy to financial market variables. The exceptions I find are the studies of Balatti et al. (2016) and Hafemann and Tillman (2020). Balatti et al. (2016) go beyond the study of stock prices and analyze stock market volatility and liquidity.

Nevertheless, there is literature exclusively focused on the effects of monetary policy on financial markets with low-frequency data (e.g., Laopodis, 2013; De Santis, 2020; Kinateder and Wagner, 2017). First, considering the sovereign bond yields, in Euro Area Blot et al. (2020) and De Santis (2020) find that the expansionary UMP shock reduced the sovereign bond yields. In addition, De Santis (2020) points out that the effectiveness started some months before the actual implementation of the ECB QE in 2015. This effectiveness suggests that monetary policy is effective even when implemented in periods of lower financial stress (De Santis, 2020). Another important strand is the literature that tries to explain the sovereign bond yield spreads (Kinateder and Wagner, 2017; Gibson et al., 2016). Kinateder and Wagner (2017) find that both conventional and unconventional monetary policies affect the sovereign bond yield spreads of the Euro Area, while Gibson et al. (2016) point out that ECB APP reduced the sovereign bond yield spreads of stressed countries. Furthermore, these authors find that some observed factors (e.g., country-specific liquidity; debt-to-GDP ratio) may explain the yield spreads. Kinateder and Wagner (2017) also find that unobserved

factors that may be related to the risk premium or the country-specific turmoil of some countries can explain the sovereign bond yield spreads.

Second, accounting for the studies on the stock market and monetary policy, the relationship is not clear (Laopodis, 2013; Bjørnland and Leitemo, 2009). On the one hand, Laopodis (2013) studies these two variables in the US during three distinct regimes and does not find a consistent relationship across time. Moreover, Suhaibu et al. (2017) for some African countries find a positive relationship between these two variables. On the other hand, Bjørnland and Leitemo (2009), for the US find that a contractionary CMP shock leads to a fall in real stock returns, which may be explained by the rise in the discount rate and by the reduction of the output that leads to lower expected dividends. The values return to normal as the interest rate falls, the output increases, and consequently the value of discounted dividends increases (Bjørnland and Leitemo, 2009). Furthermore, Lima et al. (2016) study the effect of QE on stock returns of three countries, the UK, the US, and Japan, and this author finds that an expansionary UMP increases stock returns. In addition, an appreciation of the exchange rate for the UK and US, and an increase in industrial production, only for the US, affects positively the stock returns of these countries (Lima et al., 2016). In most of these studies, there is a concern about connecting the economy and stock prices, explicitly using vector autoregressive (VAR) that finds bidirectional connections between stock prices, monetary policy, and economy (e.g., Laopodis, 2013; Suhaibu et al., 2017).

2.4. Heterogeneity in Euro Area Financial Markets

This last subsection accounts for the heterogeneity of the effects of monetary policy on Euro Area financial markets. I start by reviewing the studies on high-frequency literature and then I proceed to the low-frequency studies.

Concerning the insights from the high-frequency literature of sovereign bond yields, Fendel and Neugebauer (2020) and Urbschat and Watzka (2020) find that peripheral countries experience higher responses to an expansionary UMP, i.e., bigger decreases in sovereign bond yields. In addition, Urbschat and Watzka (2020) point out that these results may be due to the reduction of credit risk for peripheral countries. Fendel and Neugebauer (2020) also suggest that these reactions could be related to the higher risk premium of peripheral countries, i.e., countries with lower solvency levels have higher reactions. In the case of the stock market, attending to daily data literature, Angeloni and Ehrmann (2003), Sondermann et al. (2009), and Pacicco et al. (2019) analyze the response of Euro Area stock markets to changes

in monetary policy and find a heterogeneous response across countries in their analysis. However, it is important to note that Angeloni and Ehrmann (2003), suggest a homogeneous response across countries when Portugal and Ireland are excluded from the sample. These heterogeneous reactions may be related to differences in stock market composition across countries, according to Angeloni and Ehrmann (2003), or the differences in stock market capitalization, i.e., countries with higher capitalization have higher significant reactions as suggested by Sondermann et al. (2009). Furthermore, Pacicco et al. (2019) also suggest that CMP affected more the core countries, in opposition to the UMP with higher reactions in the peripheral countries.

Attending to low-frequency data, since the Euro Area is a set of different countries, some studies focus on the heterogeneity of transmission of monetary policy between countries, more specifically on the asymmetrical effects of monetary policy in real variables, i.e., output and inflation (Ciccarelli et al., 2013; Georgiadis, 2015; Burriel and Galesi, 2018). These authors find evidence of heterogeneity among Euro Area countries. However, while Ciccarelli et al. (2013) focus on the banking system, Georgiadis (2015) and Burriel and Galesi (2018) focus on the structural characteristics to explain the heterogeneity. Georgiadis (2015) finds that the output of Finland and Ireland is more affected by monetary policy shocks compared to Portugal, which may be related to the industrial structure that is more sensitive to interest rates and to the more flexibility in the labor market. Moreover, Burriel and Galesi (2018) find that the output of Baltic countries generally reacts more, and the inflation of Estonia and Spain also experiences stronger responses. These authors suggest that less developed countries and countries with more resilient banking systems are more affected by monetary policy in terms of output. Similar results are find for prices, even though the evidence is not clear (Burriel and Galesi, 2018). An additional point is made by Ciccarelli et al. (2013) and Burriel and Galesi (2018) that suggest that heterogeneity has evolved, and the biggest changes occurred during the financial stress period.

Some authors also analyze the heterogeneous transmission of monetary policy to the financial market's variables (Hafemann and Tillmann, 2020; Boivin et al., 2008; Elbourne et al., 2018). Boivin et al. (2008) find that a contractionary monetary policy shock impacts all sovereign bond yields, but the Italian and Spanish yields have the highest increases. Elbourne et al. (2018), Ouerk et al. (2020), and Hafemann and Tillmann (2020) generally find that an expansionary monetary policy shock decreases the sovereign bond yields, but with significant

heterogeneity. More specifically, Portuguese yields are less sensitive to monetary policy and French yields have more persistent results than Spanish or Italian yields (Ouerk et al., 2020). Additionally, Greece's yields do not display significant results (Ouerk et al., 2020; Hafemann and Tillmann, 2020). Moreover, Hafemann and Tillmann (2020) find that German yields decrease more than Portuguese or Spanish yields. For the stock market, there is less evidence. Hafemann and Tillmann (2020) do not find consistent results between countries while Ouerk et al. (2020) find an increase in stock prices except for Spain, which provides some evidence on the portfolio rebalancing channel. Moreover, Hafemann and Tillmann (2020) try to shed some light on what may explain the heterogeneity through the structural characteristics of the countries. The authors suggest that countries with strong fundamentals, current account surpluses, and low debt-to-GDP ratios, i.e., core countries, respond more strongly to monetary policy than countries with weaker fundamentals (Hafemann and Tillmann, 2020).

The literature that explicitly analyzes the effects of monetary policy on financial markets on low-frequency data also presents some evidence. Regarding sovereign bond yields, De Santis (2020) study the heterogeneity across Euro Area countries, interacting its APP news with the fixed effect of each country. The author finds that countries with the more fragile fundamentals have higher responses which may be due to the decrease in risk-free rate or to the default risk of countries (De Santis, 2020). Moreover, Blot et al. (2020) also find that countries with more fragile fundamentals have higher responses to UMP, i.e., Italy and Spain have higher decreases than France's or Germany's sovereign bond yields. Between the peripheral countries, Gibson et al. (2016) find that the impact is greater on Greece than on Portugal's sovereign bond yields.

These studies provide important insights into the heterogeneity of Euro Area financial markets. However, while De Santis (2020) incorporates the fundamentals of sovereign bond yields to explain the heterogeneous reactions, there is scarce evidence regarding the fundamentals of the stock market in low-frequency studies for the Euro Area. The exception I find for the stock market is Hafemann and Tillmann (2020). However, these authors focus on the structural characteristics of the country rather than the fundamentals and do not interact the monetary policy variable with these country-specific variables. Thus, to the best of my knowledge, I do not find evidence that accounts for the macroeconomic dynamics effects after a monetary policy shock on the Euro Area financial markets, while also attempting to explain the heterogeneity through the fundamentals of both financial market variables.

3. Methodology

This section consists of three subsections. The first is related to the explanation of the monetary policy shocks, the second has a description of the applied model and the last one contains the explication of the exogenous variables.

3.1. Monetary Policy Shock

In this subsection, I start by justifying the monetary policy shocks I choose. Then, I proceed to the explanation and how I proceed to determine these shocks.

I apply two shocks, one for CMP and another for UMP, to allow me to understand the differences in transmission in these two policies. To identify my monetary policy shocks, I apply a similar approach that Hafemann and Tillmann (2020) use. This approach consists of applying the monetary policy surprises as defined by event study methodologies (e.g., Bredin et al., 2009; Rogers et al., 2014). These shocks allow me to identify the dynamics of the monetary policy and financial markets without imposing some restrictions, such as signs or zero restrictions. These restrictions are a way to identify the monetary policy shock followed by some authors, for example, Balatti et al. (2016) and Elbourne et al. (2018). However, the effects of UMP in the financial markets are not clear, especially in this new context so these restrictions may limit the behavior of the variables and provide indications that are not the most adequate (Hafemann and Tillmann, 2020). Therefore, I apply some financial insights through these shocks that may be helpful in a better understanding of the relationship between these variables.

Focusing now on the explanation of these shocks, it is important to note that financial markets have different behavior than other macroeconomic variables, such as inflation and output. The financial market variables are unlikely to respond to anticipatory monetary policy actions since they exhibit a forward-looking behavior (Bernanke and Kuttner, 2005; Kuttner, 2001). This behavior is based on the hypothesis of the efficiency of financial markets, which states that financial markets react immediately to any information or to surprise/unanticipated monetary policy actions. The anticipated changes do not seem to affect financial markets since these changes have already been incorporated into the markets (Bredin et al., 2009). Thus, to evaluate the impact of monetary policy on financial markets, the literature usually determines the surprise change in monetary policy (Bernanke and Kuttner, 2005; Kuttner, 2001; Bredin et al., 2009).

Considering first the conventional surprise component that is present in policy actions, the literature applies daily or intraday changes to the futures of the policy rates (e.g., Bernanke and Kuttner, 2005; Bredin et al., 2009). The market's expectations for an interest rate change typically may be represented by the difference between policy rates and their futures. Thus, the daily variation of the futures accounts for changes in market expectations (Bredin et al., 2009). However, since there is no future contract for the ECB policy rate, Bredin et al. (2009) apply the daily change of front contract of the three-month Euribor future according to the following equation:

$$CMP = f_t - f_{t-1} \tag{3.1}$$

where f_t represents the value of Euribor three-month future on a t day, i.e., on a given announcement day. Thus, I follow the same approach to evaluate the CMP surprise. To do that, I start to get the dates of announcements of monetary policy of ECB that may be consulted on Table 8 in Annex 1, next I obtain the values of the front contract of the three-month Euribor and then I proceed to the daily change on the announcements days.[4] In the end, I add up the surprises by month.

Regarding the unconventional surprise component, one of the options used by the literature is the intraday variation in sovereign bond yields around a considered window (e.g., Rogers et al., 2014). However, since there are two types of monetary policies (conventional and unconventional) it becomes important to follow a method that can decompose the conventional and unconventional monetary policy surprise. Thus, I use De Rezende and Ristiniemi's (2023) shadow rate. This shadow rate evaluates the stance of the monetary policy, which is not distinct from other shadow rates in this matter (e.g., Wu and Xia, 2016). However, this rate has some features, i.e., it is available at a daily frequency, allows me to obtain the stance of monetary policy at any period, and may be applied to any term structure model. Moreover, this rate does not need assumptions regarding zero lower bound values (De Rezende and Ristiniemi, 2023).

Considering more specifically this shadow rate, De Rezende and Ristiniemi (2023) apply two steps to obtain the values. The first starts with the determination of a term structure model to evaluate the yield curve, short-term expectations, and short-term interest rates. Attending

[4] The dates of announcements were taken from:
ECB. (2023). Press releases by date. https://www.ecb.europa.eu/press/pr/date/html/index.en.html and from De Rezende and Ristiniemi (2023)

to the conventional period, the shadow rate usually corresponds to the short-term interest rate. However, to obtain the estimation of the shadow rate on UMP periods another step is necessary. In this step, De Rezende and Ristiniemi (2023) follow an event study, i.e., the authors regress the short-rate surprises on short-rate expectations. After that, the authors proceed to an inverse prediction to determine the shadow rate on unconventional periods. In unconventional monetary periods, the shadow rate is a function of the short-rate expectations and the term premium on announcement days (De Rezende and Ristiniemi, 2023).

An important feature of this shadow rate as mentioned above, is that allows the decomposition of the values into CMP surprises and UMP surprises according to the following equation (De Rezende and Ristiniemi, 2023):

$$UMP_t = \Delta S_t - CMP_t \tag{3.2}$$

where ΔS_t is the variation on shadow rate, CMP_t represents the conventional monetary policy surprise as defined above, and UMP_t represents the surprise on UMP. To determine the UMP surprises, I follow this method, applying the difference between the variation of the shadow rate of De Rezende and Ristiniemi (2023) and the CMP surprise, as defined above. Thus, the CMP surprise in Equation 1 and the UMP surprise defined in Equation 2 represent my measures of the monetary policy shocks that I apply in the model of the following subsection.

3.2. The Empirical Model

In this subsection, I justify the methodology I choose and then I explain each one of the components of the model.

Two methodologies are typically used to study the impact of monetary policy on financial markets. The first is the event study, which is a methodology applied with high-frequency data, i.e., daily data or intraday data (Rogers et al., 2014; Bernanke and Kuttner, 2005; Altavilla et al., 2021). This methodology has some advantages, i.e., the focus on short-period controls for the influence of other variables or information that may impact the financial market variables. Moreover, this methodology also decreases the endogeneity problems between monetary policy and financial market variables (Bredin et al., 2009). However, this methodology only allows to determine the impact of monetary policy on financial markets and does not allow evaluate the dynamic and the adjustment effects since the macroeconomic dynamics take time to adjust (Bluwstein and Canova, 2016).

The second methodology is a VAR, which is commonly used with low-frequency data, i.e., monthly, or quarterly data. The VAR model eliminates the endogeneity problem between the financial and macroeconomic variables (Bredin et al., 2009). Moreover, this methodology can ease concerns regarding the timing that financial markets take to respond to monetary policy actions (Balatti et al., 2016). Since I can insert the macroeconomic variables, this methodology allows me to understand the dynamic relationships between the variables. Thus, I opt to follow a methodology based on the VAR model.

In addition to a VAR, I apply an IPVAR model, following the methodology of Amendola et al. (2020). Since I have a common monetary policy for a set of countries (i.e., the Euro Area) to better understand the heterogeneity in the monetary policy transmission, I opt to insert the values for each country, so I introduce the feature of a panel to the model. I also insert the interacted component since I also pretend to understand if the transmission of monetary policy is affected by the exogenous variables that I consider. However, in contrast to Amendola et al. (2020) which have an interacted term between two endogenous variables, I apply an interacted term between monetary policy (endogenous variables) and all exogenous variables.

Now I focus on explaining each one of the components of the model. The model may be represented as follows:

$$Y_{i,t} = \sum_{i=1}^{N} C_i D_{i,j} + \sum_{i=1}^{N}\sum_{k=1}^{L} B_{i,k} D_{i,j} Y_{i,t-k} + F^1 X_{i,t-1} + F^2 X_{i,t-1} \times CMP_{t-1} + F^3 X_{i,t-1} \times UMP_{t-1} + K^1 J_{t-1} + K^2 J_{i,t-1} + u_{i,t} \quad (3.3)$$

where t = 1,…,T is the time dimension, i = 1,…,N is the selected country on the sample and k=1,..,L is the lag structure. The endogenous variables are represented in $Y_{i,t}$ and are the real stock returns, the sovereign bond yields, the conventional and unconventional monetary policy, the industrial production index (IPI), and inflation. These variables are present in some studies on the mechanism of transmission and are important to understand how monetary policy is transmitted (e.g., Wieladek and Pascual, 2016; Balatti et al., 2016; Hafemann and Tillmann, 2020). Thus, excluding these variables would imply disregarding the important mechanisms that may affect stock returns and sovereign bond yields. I take the first differences in the IPI, inflation, real stock returns, and sovereign bond yields due to the non-

stationarity of these endogenous variables. After that, I apply an Augmented Dickey-Fullar test for each country, and each series is stationary.

Attending to the model above, the first component of the equation represents the average of heterogeneity for each country not explained by the variables on the model, in which C_i represents the country-specific intercept of country i and $D_{i,j}$ represents a dummy variable for each country. In the second component, the model allows each country to have its relationship with endogenous variables, in which $B_{i,k}$ represents the autoregressive coefficients of endogenous variables.

The third component represents the addition of exogenous variables to the estimation of the model to control the movements of the stock returns and sovereign bond yields. The fourth and fifth components of the model represent the interaction terms. These components are inserted since the focus of this study is to understand the transmission of monetary policy to financial markets and if it is influenced by the chosen variables. F^1, F^2, F^3 represent the pooled estimated coefficients, $X_{i,t-1}$ is the vector with exogenous variables and $X_{i,t-1} \times CMP_{t-1}$ and $X_{i,t-1} \times UMP_{t-1}$ are the interaction terms. The explanation for each one of these exogenous variables is provided in the next subsection.

The next two components, $K^1 J_{t-1}$ and $K^2 J_{i,t-1}$, represent the addition of the control variables. The first component represents the control variables for the Euro Area, and the second represents the control variables specific to the countries. The last component, $u_{i,t}$, represents the vector of residuals with normal distribution and zero mean.

Generally, I follow an estimation with fixed effects and heterogeneous slopes. However, to allow that heterogeneity comes only from exogenous variables, in the components related to the exogenous variables, I estimate homogenous slopes. Moreover, I choose one lag to keep the estimation process simple, due to the large number of parameters to estimate. The estimation procedures follow the Amendola et al. (2020) procedures.

3.3. Fundamentals of Financial Markets

As mentioned above, in this subsection, I explain each of the exogenous variables and how these variables may affect the financial market variables. These variables are listed in Appendix 1, in Table 7. I only choose variables that explain the stock returns and the sovereign bond yields, i.e., that are fundamentals of these variables, since the focus of the study is the

financial markets. These variables can be categorized into two main groups: macroeconomic and financial fundamentals.

In the first group, I include the macroeconomic fundamentals, the current account, the debt-to-GDP, and the unemployment rate, which are fundamentals frequently applied in the literature (e.g., Kinateder and Wagner, 2017; Blot et al., 2020; Botey-Fullat et al., 2023). Starting with the effects on stock returns, the current account and the debt-to-GDP may impact stock returns as investors often consider the macroeconomic conditions of a country in their decisions (e.g., Ahmed et al., 2017; Assoumou-Ella et al., 2022). The unemployment rate is typically associated with economic activity (Botey-Fullat et al., 2023; Hesse et al., 2018). Thus, this fundamental may affect the stock returns through the future cash flows by the signals that provide related to the economic activity (Ioannidis and Kontonikas, 2008). Moving on to the effects on sovereign bond yields, the current account signalizes the external imbalances of a country and may be associated with macroeconomic risk, impacting the sovereign bond yields (Blot et al., 2020; Afonso and Rault, 2015). The second fundamental is associated with the default risk of a country and its ability to meet its financial obligations, thereby affecting sovereign bond yields (Kinateder and Wagner, 2017; Poghosyan, 2014). The last fundamental is a measure of economic activity as mentioned above, in which higher rates can lead to lower expected fiscal revenues. This reduction in expected revenues can contribute to an increase in sovereign bond yields (Poghosyan, 2014; De Santis, 2020; Botey-Fullat et al., 2023).

In the second group, the financial fundamentals, I include five variables. Since the market is not only affected by macroeconomic conditions, especially the stock market, I choose two ratios that according to the literature have an influence on the market, i.e., the dividend yield and the price on earnings ratio (Ruhani and Junoh, 2023; Shen, 2000). The other three financial fundamentals are frequently applied in some studies (e.g., Eichengreen and Gupta, 2015; Jun et al., 2003; De Santis, 2020). Additionally, among the last three variables, the trading value on market capitalization and the yield spread represents the liquidity in markets, which is also one of the channels of monetary policy (Gagnon et al., 2011). Thus, I start by considering the effects of the two first variables and then I move to the last three variables since the fundamentals may affect the financial markets distinctively.

On the one hand, the dividend yield may affect the stock returns by the discount of future cash flows (including dividends), as outlined in the cash flow model (Ioannidis and Kontonikas, 2008). Thus, this ratio serves as an indicator of the return on dividends on the stock

price (Ruhani and Junoh, 2023). On the other hand, the price on earnings ratio, being a valuation ratio, can impact the stock returns by providing indications regarding the overvaluation of some stocks in the case of higher values. Consequently, a higher price on earnings ratio might be associated with lower future returns (Shen, 2000; Rahman and Shamsuddin, 2019). Attending to the effects on sovereign bond yields, the stock market may affect the economic conditions, and one of the ways is through Tobin-Q. Specifically, the lower/higher returns of the stock market affect the Tobin-Q, which in turn may impact the investments in firms. These impacts on the investments may be reflected in the economic conditions (Suhaibu et al., 2017). Considering the influence of economic conditions on sovereign bond yields as referenced above (Poghosyan, 2014; De Santis, 2020) it can be expected that these ratios may also exert an effect on sovereign bond yields.

Considering now the last three fundamentals, the first one is the market capitalization on GDP and this ratio is a measure of the financial depth of a country (Ahmed et al., 2017; Mishra et al., 2014). On the one hand, this may affect both the markets (stock and bond yields) since the financial depth may increase the resilience of the countries with higher capitalization. On the other hand, with higher capitalization the investors may rebalance their portfolios more easily, and thus the shock leads to higher reactions for those countries (Mishra et al., 2014). The second fundamental is the ratio of trading value on market capitalization which represents the liquidity of the stock market (Eichengreen and Gupta, 2015; Jun et al., 2003). The last fundamental is the yield spread which also represents the liquidity of the bond market (Favero et al., 2010; Kinateder and Wagner, 2017; De Santis, 2020). Both measures affect the returns of the financial market variables since it may be expected that investors demand a higher return for holding assets in markets with higher transaction costs (Favero et al., 2010; Jun et al., 2003).

4. Selected Data

This section contains the description of the sample for this study and the analysis of the statistics descriptives of the variables.

The sample includes the ten initial countries of the Euro Area, Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, and Spain, since 2002M1-2022M12, to be able to analyze the effects of conventional, unconventional, and normalization of monetary policy. The only country excluded is Luxembourg due to a lack of data. The frequency of this study data is monthly data since it allows the insertion of macroeconomic variables which are available at a monthly or quarterly frequency (Balatti et al., 2016).

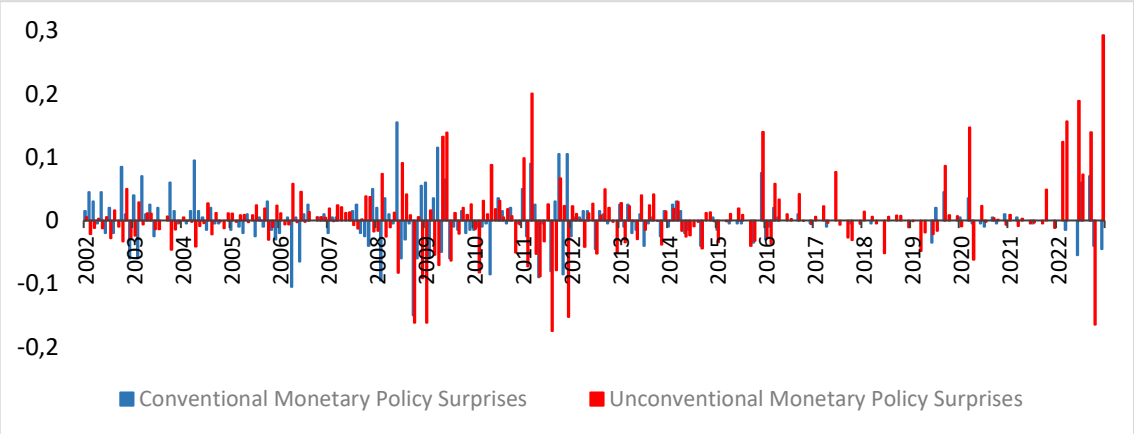
As mentioned above the selected variables are presented in Table 7 in Appendix 1. The selected variables may be grouped into three classifications. The first includes the endogenous variables that are usually present in the transmission mechanism (e.g., Wieladek and Pascual, 2016; Elbourne et al., 2018). These variables include the real stock returns for the main stock index of each country and the benchmark of the 10-year yields for each country.[5] I also include the IPI since it is a proxy of GDP commonly used in literature, is available at a monthly frequency, and does not require any transformations (e.g., Balatti et al., 2016; Laopodis, 2013; Bjørnland and Leitemo, 2009). The other two variables are the Harmonized Index of Consumer Prices-All Items Harmonized and the conventional and unconventional monetary policy. To evaluate the conventional monetary policy, I obtain the values of the front contract of the three-month Euribor future from Datastream. The second group consists of exogenous variables, macroeconomic and financial fundamentals, that according to literature, may explain the sovereign bond yields and stock returns (e.g., Cassola and Morata, 2004; Laopodis, 2013; Blot et al., 2020). Moreover, the last group of variables includes the control variables, which account for expectations since financial market variables tend to be influenced by them (Altavilla et al., 2021; Aristei and Martelli, 2014).

Attending to the values of the monetary policy, Figure 1 presents the evolution of the surprises of CMP (in blue) and the surprises of UMP (in red). As would be expected, the main CMP surprises occurred until 2012, during the years of greater financial turmoil that prompted the beginning of the UMP. In 2022 due to the normalization, it can be seen once

[5] The main stock index is ATX, for Austria, BEL20, for Belgium, OMX Helsinki, for Finland, CAC40, for France, DAX, for Germany, ISEQ, for Ireland, FTSE MIB for Italy, AEX, for Netherlands, PSI20, for Portugal and IBEX, for Spain.

again more pronounced CMP surprises. Attending UMP surprises, the higher values started in 2009, with the beginning of the UMP. During the subsequent years, the values continued to be higher than the CMP surprise, with higher increases in 2022. Considering the rest of the variables, the descriptive statistics are in Table 1. Focusing on the main variables, the average of the sovereign bond yields for the median of the observations is 2,75% and its standard deviation is 1,99%. Regarding the stock returns its average is 0,00 and its standard deviation is 0,06%. However, some exogenous variables have a considerable difference between the values of maximum and minimum, for example, debt-to-GDP with a minimum of 23,60% and a maximum of 154,50%. Thus, it may be interesting to analyze the descriptive statistics for each country in Table 2, to understand the heterogeneity of values across countries.

Figure 1: Conventional and Unconventional Monetary Policy Surprises



Note: This figure provides the surprises of CMP (in blue) and UMP (in red). Data from January 2002 to December 2022.
Source: Datastream, De Rezende and Ristiniemi (2023) and Author´s Calculations

For the macroeconomic variables, I may refer to some indications:

- Considering variables such as debt-to-GDP, current account, and unemployment rate, Portugal, Spain, and Italy seem to indicate the countries with the most fragile macroeconomic indicators;
- Debt-to-GDP represents on average values superior to 100% in Italy (120,18%) and in Portugal (103,34%), compared to Finland with an average of 54,48%;
- The unemployment rate averages 16.05% in Spain and 10.13% in Portugal, compared to 5.47% in Austria.

Considering exogenous financial variables, there is also some information to highlight:

- The dividend yield averages 1,92% in Ireland, almost half of Spain's with 3.97%;
- The price on earnings is 17,21 in Ireland and in Germany 14,64;
- The ratio of market capitalization on GDP has higher averages in Finland, Belgium, and the Netherlands;
- The higher ratios of trading value on market capitalization are observed in France with an average of 10,52% and in Italy with an average of 10,91%, compared to Belgium with only 3,28%;
- The yield spread, with lower values in the Netherlands with an average of 0,01%, while Portugal and Ireland have higher values with 0,10% and 0,08%, respectively.

Overall, it can be highlighted that most of the exogenous variables show some heterogeneous values across countries.

Table 1: Descriptive Statistics of the Sample

Variables	Mean	Maximum	Minimum	Stand. Dev.
10 Year Yield (%)	2,75	13,85	-0,65	1,99
Industrial Production Index	4,60	5,39	3,82	0,20
Inflation (%)	1,84	11,60	-2,50	1,49
Real Stock Returns	-0,001	0,22	-0,34	0,06
Current Account (%)	0,91	19,67	-61,66	5,36
Debt-to-GDP (%)	79,54	154,50	23,60	27,35
Unemployment Rate (%)	8,56	26,40	2,90	3,96
Dividend Yield (%)	3,32	10,19	0,67	1,23
Mar. Cap./GDP (%)	46,14	156,24	6,31	25,78
Price/Earnings	15,85	35,35	4,00	4,61
Trading Value/Mar. Cap. (%)	6,77	26,74	1,73	3,66
Yield Spread (%)	0,03	1,24	-0,73	0,10
Business Confindence Indicator	100,10	104,31	89,15	1,78
Citigroup Economic Index	8,38	176,50	-275,60	65,85
Consumer Confindence Indicator	99,68	103,22	92,91	1,78
Economic Sentiment Index	99,30	123,00	57,10	9,83
Inflation Expectations (%)	1,64	4,80	0,80	0,49
Real GDP Expectations (%)	1,56	12,70	-2,80	1,54
VIX	19,90	59,89	9,51	8,31

Stand. Dev. – Standard Deviation/Mar. Cap. – Market Capitalization
Note: This table provides the summary statistics for all variables except the monetary policy for the median of all countries, from January 2002 to December 2022.
Source: Datastream, Eurostat, OECD, ECB Surveys and Author´s Calculations

Table 2: Statistics of the Endogenous and Exogenous Variables

Variables		Austria	Belgium	Finland	France	Germany	Ireland	Italy	Netherlands	Portugal	Spain	Total
10 Year Yield (%)	Mean	2,35	2,51	2,27	2,38	2,02	3,23	3,42	2,21	4,01	3,12	2,75
	Stand. Dev.	1,72	1,72	1,70	1,64	1,75	2,46	1,46	1,73	2,69	1,70	1,99
Industrial Production Index	Mean	4,56	4,56	4,69	4,64	4,54	4,31	4,69	4,60	4,66	4,70	4,60
	Stand. Dev.	0,14	0,16	0,07	0,07	0,09	0,39	0,11	0,09	0,10	0,12	0,20
Inflation (%)	Mean	2,04	2,11	1,65	1,63	1,72	1,53	1,80	2,04	1,79	2,12	1,84
	Stand. Dev.	1,11	1,58	1,22	0,97	1,23	1,96	1,36	1,71	1,54	1,77	1,49
Real Stock Returns	Mean	0,00	-0,00	-0,00	0,00	0,00	0,00	-0,00	-0,00	-0,00	-0,00	-0,00
	Stand. Dev.	0,07	0,05	0,06	0,05	0,06	0,06	0,06	0,06	0,05	0,06	0,06
Current Account (%)	Mean	2,20	0,84	0,97	-0,37	6,18	-1,24	0,22	6,49	-4,32	-1,90	0,91
	Stand. Dev.	1,21	1,71	3,18	0,91	2,07	10,67	2,28	2,30	4,86	4,16	5,36
Debt-to-GDP (%)	Mean	77,08	89,13	54,48	86,34	69,10	63,02	120,18	55,50	103,34	77,19	79,54
	Stand. Dev.	6,28	4,58	13,20	17,41	6,29	30,86	15,70	7,14	28,40	29,84	27,35
Unem-ployment Rate (%)	Mean	5,47	7,43	8,07	8,93	6,10	8,18	9,35	5,87	10,13	16,05	8,56
	Stand. Dev.	0,73	1,12	0,95	0,91	2,63	3,99	1,93	1,39	3,32	5,47	3,96

(Continues)

Table 2: Statistics of the Endogenous and Exogenous Variables (Continued)

Variables		Austria	Belgium	Finland	France	Germany	Ireland	Italy	Netherlands	Portugal	Spain	Total
Dividend Yield (%)	Mean	2,68	3,43	3,88	3,35	2,89	1,92	3,76	3,38	3,90	3,97	3,32
	Stand. Dev.	0,97	1,32	0,83	0,77	0,63	1,19	1,12	0,99	1,15	1,35	1,23
Market Capitalization/ GDP (%)	Mean	20,51	60,51	88,79	43,07	29,76	30,63	31,66	76,02	29,96	50,51	46,14
	Stand. Dev.	6,75	17,19	23,17	10,79	7,99	9,43	6,57	27,26	6,27	9,53	25,78
Price/Earnings	Mean	14,86	16,40	16,29	15,95	14,64	17,21	15,60	15,53	17,15	14,81	15,85
	Stand. Dev.	4,57	5,36	3,49	4,16	3,93	5,39	4,00	5,26	4,60	4,05	4,61
Trading Value/Market Capitalization (%)	Mean	3,96	3,28	7,38	10,52	6,88	4,53	10,91	8,09	4,57	7,61	6,77
	Stand. Dev.	1,76	0,95	3,29	3,46	2,76	1,54	3,39	2,97	1,70	3,18	3,66
Yield Spread (%)	Mean	0,02	0,02	0,02	0,01	0,02	0,08	0,01	0,01	0,10	0,02	0,03
	Stand. Dev.	0,02	0,03	0,03	0,02	0,08	0,16	0,02	0,01	0,22	0,03	0,10

Stand. Dev. – Standard Deviation

Note: This table provides the mean, and the standard deviation for the exogenous and endogenous variables, except for the monetary policy for all the countries, from January 2002 to December 2022.

Source: Datastream, Eurostat, OECD, and Author´s Calculations

5. Results

This section is organized into three subsections. The first subsection examines the median effects of monetary policy shocks. The second subsection focuses on the reactions observed in the financial markets within the Euro Area. Lastly, the third subsection analyzes what may explain the different reactions to financial market variables.

5.1. Median Effects of Monetary Policy Shocks on Euro Area Financial Markets

Figure 2 presents the impulse response functions following a positive standard deviation for both conventional and unconventional monetary policy, representing a contractionary monetary policy shock. The response function captures the impact on the various endogenous variables, the CMP, the UMP, the real stock returns, the 10-year sovereign bond yields, the IPI, and inflation. The left panel of the figure illustrates the impulse responses after a CMP shock, while the right panel presents the impulse responses after an UMP shock.

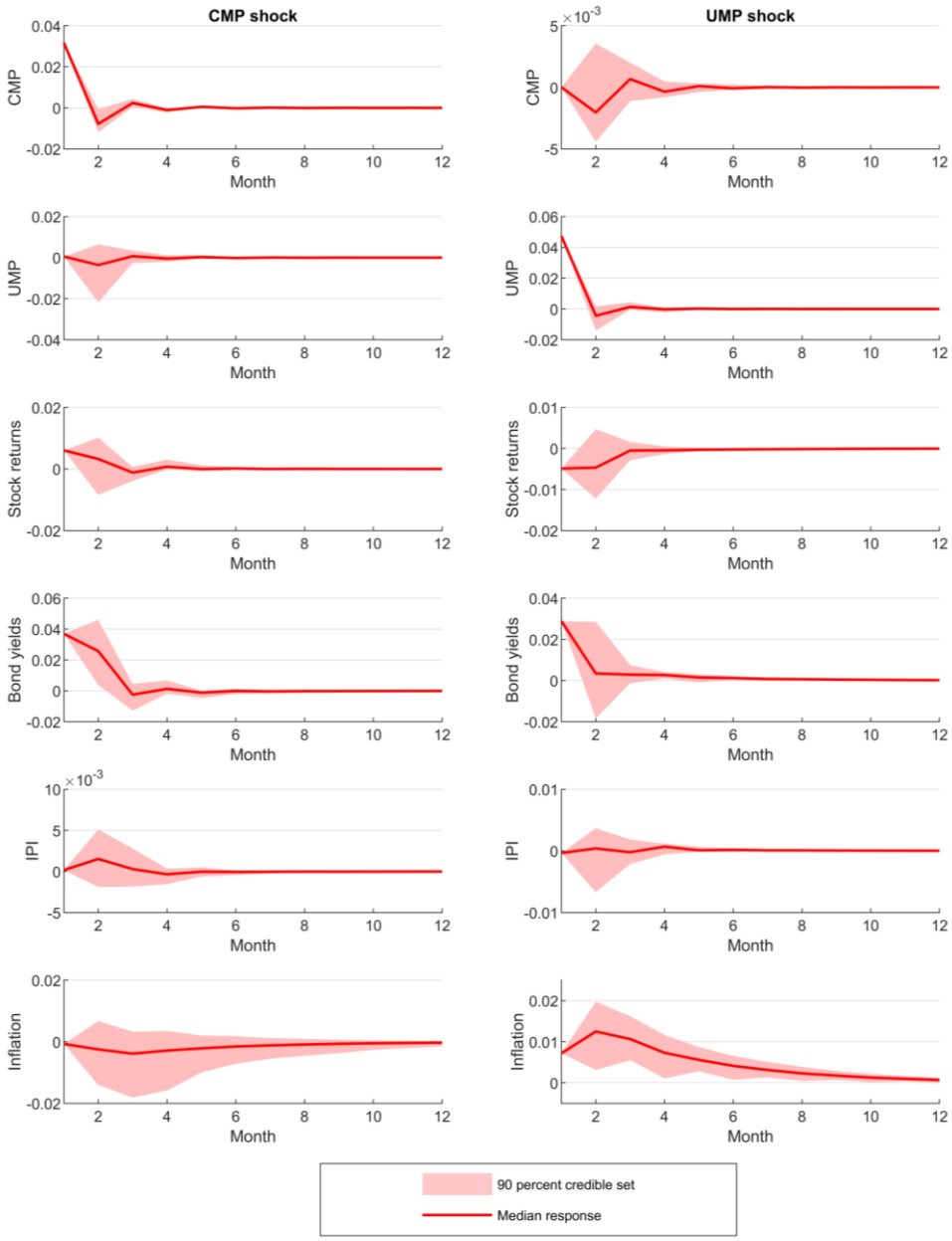
To start, it is important to emphasize that my monetary policy shocks represent surprises in the market. This feature may justify, for example, the lower persistence observed in some of my results compared to certain findings in the literature, as evident in this subsection. Moreover, it is also relevant to interpret the macroeconomic results having this in consideration.

Starting with the left panel, the reaction of CMP shock is not very persistent, as the effects are only significant for two months. The effects on the UMP are represented in the second graph. However, the confidence intervals do not allow to draw any suggestions. Thus, there is no relationship between these variables.

The next variable to highlight is the real stock returns, which show a significant effect for one month. Initially, I find a positive relationship between a CMP shock and the real stock returns. This result may suggest that the contractionary monetary policy shock generally prompts investors to reassess their macroeconomic forecast for the economy. Consequently, investors may perceive that the macroeconomic conditions are better than the preview. This reassessment may lead to a decrease in the perception of the risk, leading investors to require a lower equity premium (Bernanke and Kuttner, 2005; Balatti et al., 2016). After this initial reaction, the real stock returns start to decrease, however, the effect is not significant. This result does not seem in line with most of the literature, even though there is not a clear

relationship. Some authors, such as Cassola and Morana (2004) and Bjørnland and Leitemo (2009) find a negative relationship between the CMP shock and the stock market.

Figure 2: Impulse Response Functions to Monetary Policy Shocks



Note: This figure provides the impulse response functions of the endogenous variables to a monetary policy shock.
Source: Datastream, Eurostat, OECD, ECB Surveys and Author´s Calculations

As for the results of the CMP shock on sovereign bond yields, this evidence aligns with the literature. I find a positive relationship with the CMP shock, even though the monetary policy shock applied by the authors may be different (e.g., Boivin et al., 2008; Hafemann and

Tillmann, 2020). This result may be justified since the monetary policy affects the expectations regarding future monetary policy decisions, i.e., it may be expected that in the future the short-term interest rates also increase (Rudebusch and Wu, 2008; Bomfim, 2003). The effects on sovereign bond yields demonstrate an immediate increase in yields, which decreases over time as the impact of the monetary policy shock dissipates. The effects are only significant for two months. Lastly, concerning macroeconomic impacts, I do not find significant evidence regarding the IPI or inflation.

Turning now to the right panel, it is represented the reaction of the endogenous variables to an UMP shock. The first graph illustrates the effects of this shock on CMP. Similar to the previous shock, the effects are insignificant, indicating no relationship between these two variables, suggesting their interdependence. Furthermore, the effects of UMP shock are only significant for almost two months.

The effects on the real stock returns exhibit an opposite sign compared to the CMP shock. Initially, I observe an immediate decrease in the real stock returns, however, the effect becomes insignificant within two months. This finding aligns with the results of Hesse et al. (2018) and Ouerk et al. (2020), who also find a negative relationship between the stock market and an UMP shock, despite using different monetary policy shocks. In addition, the significance of the reaction for the authors in their studies is more persistent. The result may be justified by the increase in the discount rate and a possible reduction of the output, leading to lower expected cash flows and subsequently lower stock returns (Bjørnland and Leitemo, 2009).

Considering the effects on the sovereign bond yields, an UMP shock also leads to an increase in the sovereign bond yields, similar to the findings for the CMP shock. However, the magnitude of this effect is comparatively lower. Additionally, the persistence of the impact diminishes, and its significance dissipates after two months. This positive relationship between sovereign bond yields with an UMP shock is also according to Boeckx et al. (2014) and Ouerk et al. (2020), even though the authors use different shocks and observe superior persistence in the effects. One suggestion for the result is the decrease in liquidity of the markets, which leads to an increase in the term premium that is reflected in the increase in the sovereign bond yields (Boeckx et al., 2014).

Attending the change of the sign of the reaction of the real stock returns and the increase in the sovereign bond yields, this may suggest that the portfolio rebalancing channel is one of the channels that is working face to an UMP shock. Since the UMP may be associated with a decrease in the liquidity of the market, the term premium increases leading to a higher return from the sovereign bond yields. Consequently, this change in returns on sovereign bond yields may prompt investors to rebalance their portfolios and decrease the demand for riskier assets, such as stocks, decreasing their returns (Gagnon et al., 2011).

Regarding the macroeconomic impacts, the IPI does not exhibit a significant result. However, I find an unexpectedly positive relationship between the unconventional contractionary monetary policy shock and inflation. This relationship is more persistent compared to other variables and dissipates after ten months. This result may be explained by the possibility that the transmission of monetary policy may be long and uncertain as refer by Ouerk et al. (2020). Moreover, Engen et al. (2015) do not find greater effectiveness of the expansionary unconventional monetary policy, and the authors suggest that this could be due to expectations that the economy would increase faster than happened. In this case, the positive relationship may result from expectations of a more pronounced economic downturn.

5.2. Cross-Country Heterogeneous Effects on Euro Area Financial Markets

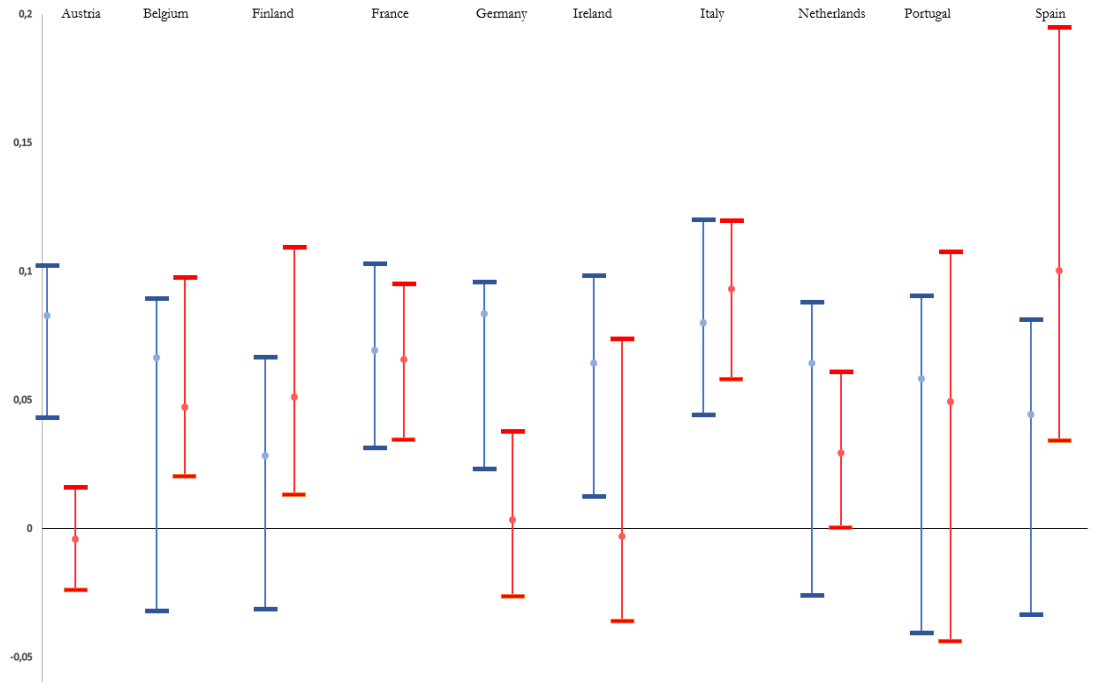
For this subsection, I analyze the reactions across countries regarding sovereign bond yields and stock market returns and verify if there are heterogeneous reactions. To do that, I determine the cumulative sum of the reaction to a conventional/unconventional monetary policy shock for each country and financial market variable. I begin by analyzing the reactions to CMP shock and UMP shock for sovereign bond yields, and then I proceed to the stock returns, following the same order.

Starting with Figure 3, it is presented the impact of the CMP shock in blue and the impact of the UMP shock in red on sovereign bond yields. Concerning the CMP shock, I find a positive median reaction for all Euro Area countries. Additionally, I find five countries with insignificant results, namely Belgium, Finland, Netherlands, Portugal, and Spain. Analyzing the median reactions, Finland, Spain, and Portugal exhibit the lowest median responses, while Italy, Austria, and Germany demonstrate higher median reactions.[6] Even though the monetary policy shock applied by the authors is different, Boivin et al. (2008) also suggest

[6] In this subsection, when referring to the highest or lowest reactions, I consider the absolute value of the reaction in the countries, irrespective of its sign.

that Italian yields demonstrate one of the highest responses to a CMP shock, and in general, the authors find a positive reaction between conventional monetary policy shock and sovereign bond yields. However, it is important to point out that I do not find a heterogeneous response across the countries.

Figure 3: Reaction of Sovereign Bond Yields to Monetary Policy Shock



Note: This figure represents the median reaction for each country, in blue is the reaction to a CMP shock, and in red is the reaction to an UMP shock. This graph plots 90% confidence intervals.
Source: Datastream, Eurostat, OECD, ECB Surveys and Author´s Calculations

For the UMP shock, generally, I find a median positive reaction for the major Euro Area countries I consider, except for Austria and Ireland. Moreover, some countries, namely Austria, Germany, Ireland, and Portugal, do not exhibit a significant reaction to the UMP shock. It is also important to note that despite the different monetary policy shocks applied by the authors, the literature also finds a positive relationship between the UMP shock and sovereign bond yields in most Euro Area countries (e.g., Elbourne et al., 2018; Ouerk et al., 2020). I may highlight the result for Portugal, which may appear unexpected. However, while Elbourne et al. (2018) do not find a positive relationship, Ouerk et al. (2020) find a comparatively lower decrease in sovereign bond yields for Portugal when compared to other countries. Furthermore, considering the median reactions, countries such as Ireland and Austria present the lowest median reaction with a negative sign. The higher median reactions are provided by France followed by Italy and Spain. Regarding the heterogeneous reactions, for

instance, Austrian sovereign bond yields have lower increases than Belgium, France, Italy, and Spain. In addition, the German and Netherlands sovereign bond yields have lower increases than Italy's sovereign bond yields. Blot et al. (2020) also find that the UMP decreases more the Italian yields than the German yields. These findings may suggest that some peripheral countries have higher responses to UMP shocks than the core countries. The high-frequency literature, for example, Fendel and Neugebauer (2020) align with this suggestion. Moreover, low-frequency literature may also suggest that countries with the worst fundamentals typically have higher reactions, which is the case of De Santis (2020).

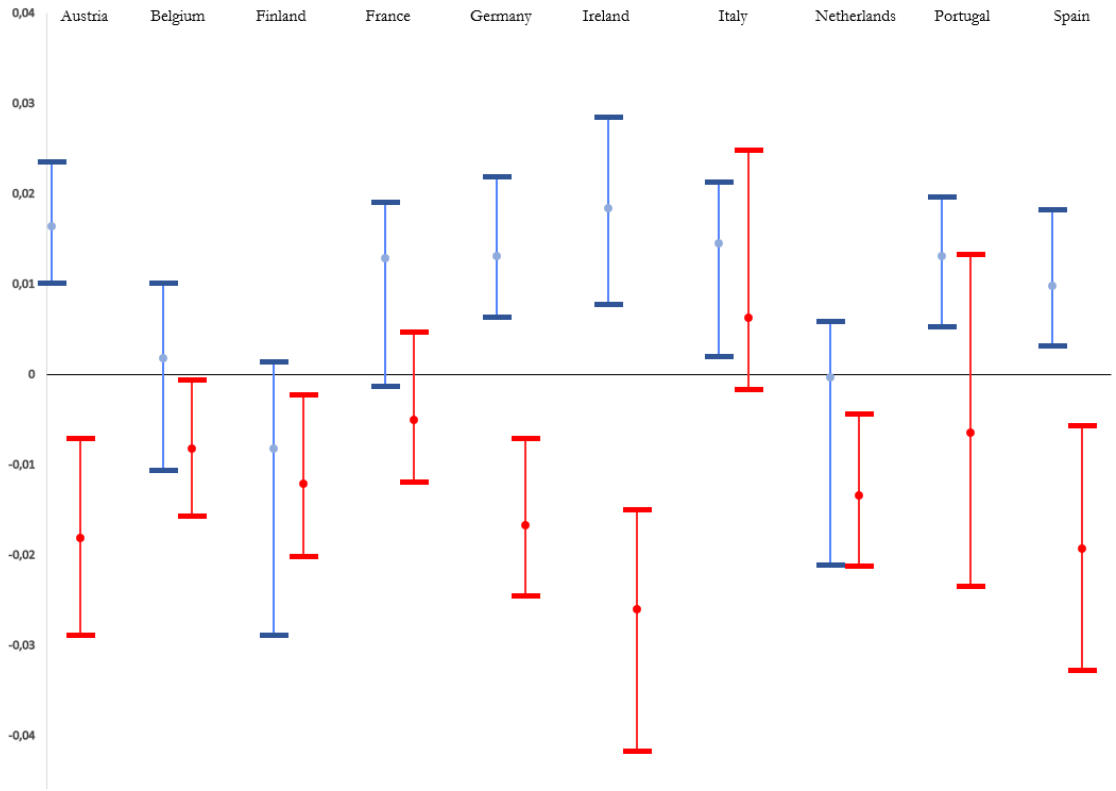
Considering now Figure 4, the CMP shock is presented in blue, while the UMP shock on the stock returns is in red. Attending on CMP shock, I find a median positive reaction for most Euro Area countries, except Finland and the Netherlands. Additionally, I find four countries that do not display significant results, Belgium, Finland, France, and the Netherlands. Attending to the median reactions, Finland, Belgium, and the Netherlands exhibit lower median reactions, with Finland and the Netherlands displaying a negative sign. The higher reactions are provided by Italy, Austria, and Ireland. Moreover, I also find heterogeneity in the reactions, for instance, Belgium has lower increases than Austria. In addition, the Netherlands has lower increases than Austria, Germany, and Ireland. Furthermore, Finland has lower increases than Austria, Germany, Ireland, Spain, and Portugal. These distinct reactions provide evidence of cross-country heterogeneity, as suggested by Hafemann and Tillmann (2020).

Turning to the UMP shock, most Euro Area countries reveal a negative median reaction, except Italy. Moreover, some countries, namely France, Italy, and Portugal, do not demonstrate significant results. This negative relationship between the stock market and UMP shock is also found in most Euro Area countries by Ouerk et al. (2020). Furthermore, when examining the median reactions, countries such as France, Italy (with a positive sign), and Portugal display the lowest reactions. The higher median reactions are observed by Austria, Spain, and Ireland. Regarding the heterogeneous reactions, Ireland has higher decreases than France and Italy. Moreover, Italy has lower decreases than Austria, Finland, Germany, Ireland, Netherlands, and Spain.

Thus, the analysis reveals heterogeneous reactions in sovereign bond yields to an UMP shock, while for stock returns, the higher differences occur with a CMP shock. Although I find some indications, for example, that the UMP shock may have a stronger impact on the

sovereign bond yields of more fragile countries, as suggested by some authors, for example, De Santis (2020), the next subsection analyzes whether the fundamentals explain the heterogeneous reactions to shed some light on this behalf.

Figure 4: Reaction of Real Stock Returns to Monetary Policy Shocks



Note: This figure represents the median reaction for each country, in blue is the reaction to a CMP shock and in red is the reaction to an UMP shock. This graph plots 90% confidence intervals.
Source: Datastream, Eurostat, OECD, ECB Surveys and Author´s Calculations

5.3. Explaining Heterogeneous Reactions in the Euro Area Financial Markets

In the previous subsection, I find heterogeneous reactions in Euro Area financial markets. In this subsection, I assess if the fundamentals impact the transmission of monetary policy. To this end, I evaluate and compare the median reactions (across country) for the observations when each fundamental variable is higher than the third quartile (25% of observations with higher values) to the reactions for the observations when each fundamental variable is below the first quartile (25% of observations with lower values). Thus, the following tables have three columns: (1) reactions for higher value observations, (2) for lower value observations, and (3) the difference between these two columns. By analyzing the values in the third column, it is possible to understand if the fundamentals have a significant impact on the transmission of monetary policy to financial market variables. To begin, I analyze the

fundamentals with higher differences in the sovereign bond yields, starting with the impact of CMP shock and then proceeding to the impact of UMP shock. Afterwards, I turn to the stock returns, following the same order. Given my objective of understanding what is underlying the different reactions on countries, I only analyze the three main fundamentals that contribute to the most substantial (absolute) differences. Thus, each table presents the fundamentals sorted in a descending order in terms of the absolute differences.

Even though I do not find heterogeneous reactions to a CMP shock on sovereign bond yields in the previous subsection, I still analyze the fundamentals with higher differences. The three fundamentals with higher differences are the price on earnings ratio, the financial depth (market capitalization on GDP), and the unemployment rate, as presented in Table 3. Regarding the first fundamental, sovereign bond yields increase more in observations with lower price on earnings ratios (first line). This outcome can be linked to the stock market performance, specifically through the concept of Tobin Q. For the stock returns, a CMP shock leads to a higher increase for observations with higher price on earnings ratios, resulting in a higher overvaluation of these assets. This may seem unexpected since higher price on earnings ratios are typically associated with lower future returns (Shen, 2000). However, as suggested by Balatti et al. (2016), this may be justified by the review of the economic forecast, indicating that economic conditions are better than previously anticipated. As a result, investors adjust their reactions, leading to higher increases in stock returns for higher price on earnings ratios as they begin to consider that returns will not decrease as initially predicted. With the higher increase in stock returns associated with higher price on earnings ratios, the Tobin Q is affected, which may be reflected in higher investments (Suhaibu et al., 2017). This positive variation in investments can contribute to better economic conditions, which, in turn, may impact positively the expected fiscal values and affect the sovereign bond yields with smaller increases (Poghosyan, 2014). The second variable is the financial depth, and I find higher increases for the observations with lower financial depth (second line). Such a result may suggest that the financial depth may increase the resilience of the markets (Mishra et al., 2014). The last fundamental is the unemployment rate, and I find higher increases in sovereign bond yields with lower unemployment rates (third line). This result can also be associated with the review of economic conditions and the association of the unemployment rate to economic conditions (Botey-Fullat et al., 2023). As investors begin to consider that economic conditions are better than previously anticipated, they also start accounting for higher expected fiscal revenues than initially predicted for these observations. Thus,

there is a lower increase in the higher unemployment rate observations to adjust to the investor´s expectations.

Table 3: Reaction of Sovereign Bond Yields to CMP

Conventional Monetary Policy - Sovereign Bond Yields			
Exogenous Variables	High	Low	Difference
P/E Ratio	0,0304**	0,0807**	-0,0503**
Mar. Cap./GDP	0,0366**	0,0704**	-0,0338**
Unemployment Rate	0,0491**	0,0701**	-0,021**
Trading Value/Mar. Cap.	0,0695**	0,0536**	0,0159**
Yield Spread	0,0556**	0,0641**	-0,0085**
Debt to GDP	0,0508**	0,0587**	-0,0079**
Dividend Yield	0,0563**	0,0584**	-0,0021**
Current Account	0,0613	0,0603	0,001

Mar. Cap. - Market Capitalization
Note: This table shows the median reactions for the low and high observations and their respective difference for each fundamental in reaction to a CMP shock.
** Denote statistical significance at the 5% confidence level.
Source: Datastream, Eurostat, OECD, ECB Surveys, and Author's Calculations.

Attending to the UMP shock, the heterogeneous reactions on sovereign bond yields are mainly influenced by the unemployment rate, the debt-to-GDP ratio, and financial depth, as presented in Table 4. For the first fundamental (first line), I observe higher increases in sovereign bond yields with higher unemployment rates. This last result can be justified by the association of higher unemployment rates with lower economic activity (Botey-Fullat et al., 2023). Thus, the increase in sovereign bond yields is more pronounced in these cases due to lower expected fiscal values (Poghosyan, 2014). Regarding the second fundamental, I find that an UMP shock increases more the sovereign bond yields with higher values in the ratio of debt-to-GDP ratio (default risk) (second line). This result may be justified since the UMP shock leads to an increase in the default risk. This result is related to the De Santis (2020) result, which finds that an expansionary UMP decreases the default risk of countries, which may provide evidence that the UMP shock affects the sovereign bond yields through the default risk. Lastly, I find that sovereign bond yields with higher financial depth have higher increases (third line). This may be attributed to the fact that investors may be able to rebalance their portfolios easily, leading to higher reactions in those observations (Mishra et al., 2014).

Table 4: Reaction of Sovereign Bond Yields to UMP

Unconventional Monetary Policy - Sovereign Bond Yields			
Exogenous Variables	High	Low	Difference
Unemployment Rate	0,0731**	0,0083**	0,0648**
Debt-to-GDP	0,0806**	0,0249**	0,0557**
Mar. Cap./GDP	0,0613**	0,0254**	0,0359**
Dividend Yield	0,0569**	0,028**	0,0288**
Price/Earnings	0,0577**	0,0352**	0,0225**
Trading Value/Mar. Cap.	0,0546**	0,0329**	0,0216**
Current Account	0,0283**	0,0466**	-0,0184**
Yield Spread	0,037**	0,0414**	-0,0044**

Mar. Cap. - Market Capitalization
Note: This table shows the median reactions for the low and high observations and their respective difference for each fundamental in reaction to an UMP shock.
** Denote statistical significance at the 5% confidence level.
Source: Datastream, Eurostat, OECD, ECB Surveys, and Author's Calculations.

For the effects on stock returns of CMP shock, the fundamentals with higher differences are the financial depth, the dividend yield, and the debt-to-GDP ratio, as presented in Table 5. Regarding the first fundamental, in the case of observations with high financial depth, this is the only fundamental that leads to a decrease in stock returns with the CMP shock (first line). This suggests that a considerable financial depth may contribute to better transmission of CMP. Moreover, since the increase in stock returns is higher for lower values of financial depth, this may also suggest that the financial depth may increase the resilience of the markets to CMP shocks (Mishra et al., 2014). Moving on to the second fundamental, the dividend yield, I find higher positive reactions on the dividend yields with lower observations (second line). This result may be related to the fact that investors may prefer higher dividend yields as a safer source of income (Hartzmark and Solomon, 2019). However, as the shock leads to a better economic perspective and does not increase the perception of risk, the investors make a higher positive adjustment in the lower dividend yield observations to adjust their initial expectations. The last fundamental is the debt-to-GDP ratio, and I find higher increases in the returns for higher debt-to-GDP observations (third line). This result may also be related to the review of economic perspectives. As a result of this shock, the stock returns increase, especially for observations with higher debt-to-GDP ratios, as investors initially account for a higher default risk in these observations. Thus, there is a positive adjustment

to adjust their initial expectations.

Table 5: Reaction of Real Stock Returns to a CMP

Conventional Monetary Policy - Real Stock Returns			
Exogenous Variables	High	Low	Difference
Mar. Cap./GDP	-0,0022**	0,0162**	-0,0183**
Dividend Yield	0,0062**	0,0132**	-0,0069**
Debt-to-GDP	0,0102**	0,0045**	0,0057**
Unemployment Rate	0,0125**	0,0082**	0,0043**
Yield Spread	0,0104**	0,008**	0,0023**
Current Account	0,0074**	0,0091**	-0,0017**
Trading Value/Mar. Cap.	0,0098**	0,0085**	0,0013**
Price/Earnings	0,0091**	0,008**	0,0011**

Mar. Cap. - Market Capitalization
Note: This table shows the median reactions for the low and high observations and their respective difference for each fundamental in reaction to a CMP shock.
** Denote statistical significance at the 5% confidence level.
Source: Datastream, Eurostat, OECD, ECB Surveys, and Author's Calculations.

Considering now the effects of UMP shock, I highlight the heterogeneous reactions from the dividend yield, the debt-to-GDP ratio, and the liquidity risk (trading value on market capitalization), as presented in Table 6. Attending to the reaction of the dividend yield, I observe higher decreases in the stock returns in cases of lower dividend yield observations (first line). One possible explanation for this result is that investors may perceive dividends as a safer source of income compared to uncertain future gains resulting from price valuations (Hartzmark and Solomon, 2019). Additionally, contractionary monetary policies may increase the perception of risk in the stocks (Bernanke and Kuttner, 2005). Consequently, it may be expected that larger decreases in the returns occur in cases of lower dividend yields, as investors consider these assets to not be as safe as the higher dividend yield observations. Regarding the second fundamental, the debt-to-GDP ratio, I find that stock returns decrease more with lower debt-to-GDP ratios (second line). This result indicates that investors pay attention to macroeconomic fundamentals. However, the higher decrease observed in countries with better debt-to-GDP ratios implies that solid macroeconomic conditions are important for the stock channel to work in the transmission of monetary policy, as suggested by Hafemann and Tillmann (2020). The third fundamental is the liquidity risk, and I find that the decrease is higher in the less liquid markets (third line). This may be related to the fact

that one of the objectives of an expansionary UMP is to provide more liquidity in markets (Dell'Ariccia et al., 2018). Thus, during a contractionary UMP shock, it may be expected that market liquidity decreases, which prompts investors to require a higher liquidity premium (Bowdler and Radia, 2012). This results in a stronger reaction in the less liquid markets.

Table 6: Reaction of Real Stock Returns to UMP

Unconventional Monetary Policy - Real Stock Returns

Exogenous Variables	High	Low	Difference
Dividend Yield	-0,0055**	-0,0197**	0,0142**
Debt-to-GDP	-0,0034**	-0,0168**	-0,0134**
Trading Value/Mar. Cap.	-0,0069**	-0,0141**	0,0072**
Current Account	-0,0149**	-0,0086**	-0,0062**
Price/Earnings	-0,0142**	-0,0081**	-0,0061**
Unemployment Rate	-0,0118**	-0,0157**	0,0039**
Yield Spread	-0,0131**	-0,0107**	-0,0023**
Mar. Cap./GDP	-0,0122	-0,0124	0,00021

Mar. Cap. - Market Capitalization
Note: This table shows the median reactions for the low and high observations and their respective difference for each fundamental in reaction to an UMP shock.
** Denote statistical significance at the 5% confidence level.
Source: Datastream, Eurostat, OECD, ECB Surveys, and Author's Calculations.

Attending to the largest heterogeneous reactions that I find in the previous subsection, I can highlight that for sovereign bond yields on UMP shock, the main differences are due to the macroeconomic fundamentals (debt-to-GDP and unemployment rate). This is a result that is consistent with De Santis (2020) and the high-frequency literature that suggests that peripheral countries, that is, countries more fragile are the most affected (e.g., Urbschat and Watzka, 2020; Fendel and Neugebauer, 2020). For the stock returns on CMP shock, I find that financial indicators are the main determinants of the different reactions (financial depth and dividend yield). Such a result provides some evidence that market capitalization, as suggested by Sondermann et al. (2009), and the composition of the stock market, as referred to by Angeloni and Ehrmann (2003), may play a role in explaining the heterogeneous reactions in Euro Area financial markets, even though these authors find a negative relationship between the conventional monetary policy shock and stock returns. Finally, it is worth noting that the debt-to-GDP variable, the default risk, plays an important role in explaining the

heterogeneity in stock returns and sovereign bonds in response to an UMP shock. This demonstrates that the default risk of countries is a crucial factor to consider.

6. Conclusion

In this study, I apply an IPVAR model to study the transmission of monetary policy decisions to Euro Area financial markets. Specifically, the monetary policy shocks of the model result from the decomposition of De Rezende and Ristiniemi's (2023) shadow rate into conventional and unconventional surprises. Additionally, I incorporate financial market fundamentals to understand whether the transmission is conditioned by these variables and may justify a possible heterogeneity in the transmission.

The results suggest three main findings. Firstly, I find that both a CMP and an UMP shock have a positive relationship with sovereign bond yields, which is generally consistent with previous findings of the literature (e.g., Boivin et al., 2008; Boeckx et al., 2014). However, concerning the stock market, a CMP shock exhibits a positive relationship with stock returns, meaning that a contractionary shock increases stock returns. On the opposite, an UMP shock leads to a decrease in stock returns. The CMP shock result is unexpected, but as mentioned before, this may be attributed to the review of economic perspectives from investors as suggested by Balatti et al. (2016).

Secondly, the study reveals that heterogeneous reactions do not occur with the same intensity for stock returns and sovereign bond yields, nor among the different policy shocks. The analysis shows that the heterogeneous reactions for sovereign bond yields occur in response to an UMP shock, with some peripheral countries having the higher median reactions. This is a result that aligns with the literature that refers that some peripheral countries or countries more vulnerable usually have higher responses (e.g., De Santis, 2020; Fendel and Neugebauer, 2020). Regarding the stock returns the higher differences occur with a CMP shock, where countries such as Austria and Ireland display higher median increases.

Thirdly, the fundamentals may help to understand the heterogeneity across Euro Area countries. Thus, the heterogeneity of sovereign bond yields in response to an UMP shock may be mainly explained by the macroeconomic conditions of a country. Higher debt-to-GDP ratios and higher unemployment rates may lead to greater increases in yields, playing an important role. Regarding stock returns, the financial fundamentals are the main responsible. Financial depth and dividend yield may be important variables in explaining this heterogeneity. However, it is important to note that both macroeconomic and financial fundamentals influence the transmission and are jointly responsible for the heterogeneity I find in financial market variables.

These results may have implications for the ECB and Euro Area investors. Specifically, these results may provide some guidance to the ECB regarding which fundamentals are more relevant for the transmission to financial markets. In particular, the ECB could study the possibility of imposing more strict rules on the debt-to-GDP ratio of Euro Area countries, as this variable is responsible for significant differences in transmission. In addition, the ECB, jointly with financial supervisors, could take some measures to reduce the differences in the financial depth across countries to reduce the asymmetries in the transmission.

Considering Euro Area investors, they may be able to understand how the stock market and the bond market generally incorporate each CMP or UMP shock. In particular, investors may be able to gain some insights into the differences in the returns of assets across Euro Area countries and incorporate this information to make their investment decisions, enabling them to take advantage of opportunities.

Finally, the results of this study should be analyzed with caution due to some potential limitations. On the one hand, some variables used in this study are not available at a monthly frequency, and the interpolation or proxies used may lead to less accurate results. On the other hand, all the fundamentals were regressed on both stock returns and sovereign bond yields, although the original idea was to identify the stock fundamentals and regress them only on the stock market variable and the same for sovereign yields. Thus, future research may address some of these issues. It may develop better this methodology to account for this last problem. Moreover, exploring other monetary policy shocks that do not represent market surprises could provide further insights into different dynamics.

Appendix 1: Selected Variables

Table 7: Selected Variables

Variable Name	Definition	Source	References
Endogenous Variables			
10 Year Yield	10 Year Sovereign Benchmarks Yield (%)	Eurostat	Hesse et al.,2018 Elbourne et al., 2018 Blot et al., 2020
Conventional Monetary Policy Surprise	Daily difference between the front contract of the three-month Euribor Future	Author´s Calculations and Datastream	Bredin et al., 2009 De Rezende and Ristiniemi, 2023
Industrial Production Index	Logarithmic of Industrial Production Index	Author´s Calculations and Eurostat	Balatti et al., 2016 Hesse et al., 2018 Laopodis, 2013
Inflation	Harmonised Index of Consumer Prices - All-Items Harmonised Index of Consumer Prices (%)	Eurostat	Laopodis, 2013 Hesse et al., 2018 Elbourne et al. 2018
Real Stock Returns	Difference between the logarithm of stock returns and the logarithm of the ratio of consumer price index	Author´s Calculations, Datastream and Eurostat	Cassola and Morana, 2004 Laopodis, 2013 Hesse et al., 2018
Unconventional Monetary Policy Surprise	Difference between the shadow rate of De Rezende and Ristiniemi (2023) and conventional monetary policy surprise	Author´s Calculations and De Rezende and Ristiniemi (2023)	De Rezende and Ristiniemi, 2023
Exogenous Variables – Macroeconomic Fundamentals			
Current Account*	Current Account Balance (%GDP)	Author´s Calculations and Main Economic Indicators - Organization for Economic Co-operation and Development	Afonso and Rault, 2015 Hafemann and Tillmann, 2020 Blot et al., 2020

Debt-to-GDP*	GOVERNMENT CONSOLIDATED GROSS DEBT (%GDP)	Author´s Calculations and Eurostat	Afonso and Rault, 2015 Gibson et al., 2016 Kinateder and Wagner, 2017
Unemployment Rate	Harmonised Unemployed - Monthly rates (%)	Main Economic Indicators - Organization for Economic Co-operation and Development	Hafemann and Tillmann, 2020 Hesse et al., 2018 Botey-Fullat et al. 2023
Exogenous Variables - Financial Fundamentals			
Dividend/Stock Price	Ratio between the dividend paid on stock price of the main stock index (%)	Datastream	Hartzmark and Soloman, 2019 Ruhani and Junoh, 2023 Rahman and Serletis, 2023
Market Capitalization/Gross Domestic Product	Ratio of Market Capitalization of the Main Stock Index on Gross Domestic Product (%)	Author´s Calculations and Datastream	Ahmed et al., 2017 Mishra et al., 2014
Price/Earnings	Price on Earnings Ratio of the main stock index	Datastream	Shen, 2000 Rahman and Shamsuddin, 2019 Ruhani and Junoh, 2023
Trading Value/Market Capitalization	Ratio of Trading value on Market Capitalization (%)	Author´s Calculations and Datastream	Eichengreen and Gupta, 2015 Jun et al., 2003
Yield Spread	10-year bid-ask YTM spreads (%)	Author´s Calculations and Datastream	De Santis, 2020 De Santis, 2014 Kinateder and Wagner, 2017
Control Variables			
Business Confidence Indicator	OECD Business Confidence	OECD - Organization for Economic Co-operation and Development	Aristei and Martelli, 2014
Citigroup Economic Index	Citigroup Economic Surprise Index - eurozone	Datastream	Urbschat and Watzka, 2020 Fendel and Neugebauer, 2020

Consumer Confidence Indicator	OECD Consumer Confidence	OECD - Organization for Economic Co-operation and Development	Aristei and Martelli, 2014
Economic Sentiment Indicator	Economic Sentiment Indicator	Eurostat	Aristei and Martelli, 2014 Botey-Fullat et al., 2023
Inflation Expectations*	One Year Ahead - Harmonised Index of Consumer Prices Forecast (%)	Survey of Professional Forecasters - ECB surveys	Blot et al., 2020 De Santis, 2020
Real GDP Expectations*	One Year Ahead - Real GDP Growth Forecast (%)	Survey of Professional Forecasters - ECB surveys	Blot et al., 2020 De Santis, 2020
VIX	CBOE Volatility Index da Chicago Board Options Exchange	Datastream - Chicago Board Options Exchange (CBOE) Volatility Index	Aristei and Martelli, 2014 Kinateder and Wagner, 2017 Urbschat and Watzka, 2020

Note: This table provides information regarding the selected variables in this study. The stars "*" represent the variables that were interpolated to the monthly frequency.
Source: Datastream, Eurostat, De Rezende and Ristiniemi (2023), OECD, ECB Surveys and Author.

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Annex 1: Monetary Policy Announcements

Table 8: Monetary Policy Announcements

Dates of the Announcements of European Central Bank					
03/01/2002	03/03/2005	08/05/2008	05/05/2011	03/07/2014	13/09/2018
07/02/2002	07/04/2005	05/06/2008	09/06/2011	07/08/2014	25/10/2018
07/03/2002	04/05/2005	03/07/2008	07/07/2011	04/09/2014	13/12/2018
04/04/2002	02/06/2005	07/08/2008	04/08/2011	02/10/2014	24/01/2019
02/05/2002	07/07/2005	04/09/2008	08/09/2011	06/11/2014	07/03/2019
06/06/2002	04/08/2005	02/10/2008	06/10/2011	04/12/2014	10/04/2019
04/07/2002	01/09/2005	08/10/2008	03/11/2011	02/01/2015	06/06/2019
01/08/2002	06/10/2005	06/11/2008	08/12/2011	22/01/2015	18/06/2019
12/09/2002	03/11/2005	04/12/2008	12/01/2012	05/03/2015	25/07/2019
10/10/2002	01/12/2005	15/01/2009	09/02/2012	15/04/2015	12/09/2019
07/11/2002	12/01/2006	05/02/2009	08/03/2012	03/06/2015	24/10/2019
05/12/2002	02/02/2006	05/03/2009	04/04/2012	16/07/2015	12/12/2019
09/01/2003	02/03/2006	02/04/2009	03/05/2012	03/09/2015	23/01/2020
06/02/2003	06/04/2006	07/05/2009	06/06/2012	22/10/2015	02/03/2020
06/03/2003	04/05/2006	04/06/2009	05/07/2012	03/12/2015	12/03/2020
03/04/2003	08/06/2006	02/07/2009	02/08/2012	21/01/2016	18/03/2020
08/05/2003	06/07/2006	06/08/2009	06/09/2012	18/02/2016	30/04/2020
05/06/2003	03/08/2006	03/09/2009	04/10/2012	10/03/2016	04/06/2020
10/07/2003	31/08/2006	08/10/2009	08/11/2012	21/04/2016	16/07/2020
31/07/2003	05/10/2006	05/11/2009	06/12/2012	02/06/2016	10/09/2020
04/09/2003	02/11/2006	03/12/2009	10/01/2013	21/07/2016	29/10/2020
02/10/2003	07/12/2006	14/01/2010	07/02/2013	08/09/2016	10/12/2020
06/11/2003	11/01/2007	04/02/2010	07/03/2013	20/10/2016	21/01/2021
04/12/2003	08/02/2007	04/03/2010	04/04/2013	08/12/2016	11/03/2021
08/01/2004	08/03/2007	08/04/2010	02/05/2013	19/01/2017	22/04/2021
05/02/2004	12/04/2007	06/05/2010	06/06/2013	09/03/2017	10/06/2021
04/03/2004	10/05/2007	10/05/2010	04/07/2013	27/04/2017	22/07/2021
01/04/2004	06/06/2007	10/06/2010	01/08/2013	08/06/2017	09/09/2021
06/05/2004	05/07/2007	08/07/2010	05/09/2013	27/06/2017	28/10/2021
03/06/2004	02/08/2007	05/08/2010	02/10/2013	20/07/2017	16/12/2021
01/07/2004	06/09/2007	02/09/2010	07/11/2013	07/09/2017	03/02/2022
05/08/2004	04/10/2007	07/10/2010	05/12/2013	26/10/2017	10/03/2022
02/09/2004	08/11/2007	04/11/2010	09/01/2014	14/12/2017	14/03/2022
07/10/2004	06/12/2007	02/12/2010	06/02/2014	25/01/2018	09/06/2022
04/11/2004	10/01/2008	13/01/2011	06/03/2014	08/03/2018	21/07/2022
02/12/2004	07/02/2008	03/02/2011	03/04/2014	26/04/2018	08/09/2022
13/01/2005	06/03/2008	03/03/2011	08/05/2014	14/06/2018	27/10/2022
03/02/2005	10/04/2008	07/04/2011	05/06/2014	26/07/2018	15/12/2022

Source: ECB. (2023). Press releases by date. https://www.ecb.europa.eu/press/pr/date/html/index.en.html and De Rezende and Ristiniemi (2023)

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