STUDYING THE FACTORS THAT DETERMINE THE INTEREST RATES OF GERMANY, FRANCE AND ITALY

Lappeenranta–Lahti University of Technology LUT

Bachelor's Programme in Business Administration, Bachelor's thesis

2023

Onni Vilmunen

Examiner: Post-doctoral Researcher Mahinda Mailagaha Kumbure

ABSTRACT

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LUT Business School

Business Administration

Onni Vilmunen

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50 pages, 4 appendices, 1 chart, 3 figures and 11 tables

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Keywords: interest rates, macroeconomic indicators, central banks, major crises

Interest rates are usually determined by the law of supply and demand. This means that when the supply of money exceeds the demand, the price will fall and vice versa. The price in this case is of course the interest rate. Naturally, important background factors influencing supply and demand for money and, hence, the determination of interest rates. One major factor is the central bank which controls the supply money, or, and perhaps mor so, the interest rate on central bank funds. Macroeconomic factors that reflect the state of the economy as well as expectations of its future development are important for the behaviour of interest rate. External shocks such as normal business cycle shocks, but also large global shocks following the financial crisis of 2008-09, COVID-19, and the Russian Invasion of Ukraine are relevant and, during the post financial crisis of 2008-09, even critical for the determination of interest rates.

The purpose of this bachelor's thesis to study the factors that determine the long-term bond rates of Germany, France, and Italy. The factors selected for this study are macroeconomic indicators such as GDP growth, inflation rate and ECB's bank rate (ECB's major policy rate). Data for the analysis

was collected from public databases and the empirical analysis were conducted utilizing standard econometric, principally OLS methods.

The results suggest that the ECB's monetary policy instrument stands out as the strongest factor affecting long-term interest rates. Conventional macroeconomic indicators, such are GDP growth rate and inflation do not seem have statistically significant effects on the evolution of long-term interest rates.

TIIVISTELMÄ

Lappeenrannan-Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu

Kauppatieteet

Onni Vilmunen

Saksan, Ranskan ja Italian korkotasojen määrittävien tekijöiden tutkiminen

Kauppatieteiden kandidaatintutkielma

2023

50 sivua, 4 liitettä, 1 kaavio, 3 kuvaa, 11 taulukkoa

Tarkastaja: Tutkijatohtori Mahinda Mailagaha Kumbure

Avainsanat: korkotasot, makrotaloudelliset mittarit, keskuspankit, suuret kriisit

Korkotasot yleisesti määritetään kysynnän ja tarjonnan lain mukaan. Periaatteessa tämä tarkoittaa sitä, että kun rahan tarjonta ylittää rahan kysynnän, hinta tippuu ja päinvastoin. Hinnalla viitataan tässä tapauksessa luonnollisesti korkotasoon. Rahan tarjonnan ja kysynnän taustalla on tietysti olemassa tietenkin tekijöitä, jotka vaikuttavat korkotason määräytymiseen. Yksi merkittävä tekijä on keskuspankki, joka kontrolloi rahan tarjontaa ja ehkä enemmän keskuspankin korkopäätösten vaikutusten kautta rahan kysyntään. Kokonaistaloudelliset tekijät ja näihin liittyvät makrotaloudelliset mittarit, jotka heijastavat taloudellista tilannetta määrätyllä aikajaksolla luonnollisesti vaikuttavat talouden korkokehitykseen. Ulkoiset shokit, joista aivan erityisesti suuret globaalit shokit, kuten finanssikriisi vuonna 2008–2009, COVID-19 ja Venäjän hyökkäys Ukrainaan vaikuttavat suuresti korkotasojen määräytymiseen.

Tämän kandidaatintutkielman tarkoituksena on tutkia tekijöitä, jotka selittävät Saksan, Ranskan ja Italian valtion pitkäaikaisen velan korkokehitystä eli pitkien bondien korkoja. Tekijät, jotka tähän tutkimukseen on valittu koostuvat keskeisistä makrotaloudellisista muuttujista kuten BKT:n kasvu ja inflaatio. Näiden lisäksi EKP:n ohjauskorko on lähtökohtaisesti keskeisessä asemassa tarkasteltavien maiden pitkien korkojen kannalta. Empiiristä analyysia varten kanditutkielman havaintoaineisto on kerätty julkisista tietokannoista ja varsinainen empiirinen analyysi EKP:n ohjauskoron makrotaloudellisten muuttujien eli BKT:n kasvun ja inflaation vaikutuksesta pitkiin

korkoihin on suoritettu hyödyntäen tavanomaisia ekonometrisiä, pääsään lineaariseen regressioanalyysiin perustuvia menetelmiä.

Tulokset osoittavat, että EKP:n ohjauskorko on tilastollisesti keskeisin pitkiin korkoihin vaikuttava tekijä. Valittujen makrotaloudellisten muuttujien vaikutukset pitkiin korkoihin eivät estimoituneet tilastollisesti merkitseviksi.

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Abbreviations

GDP = Gross Domestic Product

ECB = European Central Bank

OLS = Ordinary Least Squares

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1. Introduction

To start this study, the introduction section has been divided into four sections. Section 1.1 will describe the background of interest rate determination coupled with observations concerning possible special effects related to aforementioned major crises during the observation period. Section 1.2 is where research questions and objectives will be set. Section 1.3 will focus on methods and limitations. Lastly, section 1.4 will describe the structure of the thesis.

1.1 Background

It is known that the behaviour of market interest rates is mostly affected by demand for and supply of money. The demand for money and interest rates have a direct relationship meaning there is a positive correlation between them. On the other hand, there is an inverse relationship between the supply of money and interest rates meaning when the supply of money increases interest rates tend to go down. Usually, when the economy is evolving along the business cycle upswing or closing into one, the demand for money increases, which puts pressure on the interest rates to increase as well. Symmetrically, when the economy is cooling and heading towards a recession the demand for money tends to fall resulting in decreasing interest rates (Moneycontrol, 2019). However, this is a simplified take on interest rates since there are many factors behind interest rates that drive their behaviour. Interest rates are also affected by both micro- and macroeconomic factors. In this study, we are interested in the latter. Macroeconomic factors or indicators by definition are factors or "Statistics or data readings that reflect the economic circumstances of a particular country, region or sector. They are used by analysts and governments to assess the current and future health of the economy and financial markets" (IG, 2023). This study will be using three of these macroeconomic indicators to examine their impact on interest rates. The indicators chosen are GDP, inflation and central bank monetary policy.

Above central bank monetary policy is mentioned as one of the macroeconomic factors that drive interest rates. Changes in monetary policy is potentially a powerful force that affects the behaviour of other interest rates. Since this thesis focuses on the Euro area, we will be looking at the European Central Bank's strategies and actions regarding monetary policy. One of the main monetary tools that the ECB and also many other central banks use is the central bank rate also called as discount or steering rate. The discount rate refers to the price of central bank funds and it is charged to those institutions that are borrowing funds, usually against eligible collateral, from the central bank. Discount rates are used to affect economic activity in an area that is relevant to the central bank. For example, ECB announces a fall in the discount rate with the aim to increase economic activity in the Euro area and vice versa in the case of an increase in the discount rate.

The relationship between ECB's policy rate and market interest rates has been studied quite considerably. For example, the study by Rai, Seth and Mohanty (2007) suggests that short-term interest rates are more responsive to discount rates compared to long(er)-term interest rates. Although this research was conducted by using data before the introduction of the euro and creation of the ECB, this result between the discount rate and short-term market rates presumably continues to hold also with more recent data. For example, a study by Shaw, Murphy and O'brien (2016) investigated the relationship between ECB monetary policy announcements about the discount rate and jumps in 3-month Euribor interest rate and found evidence of a significant relationship between them. On the other hand, Gambacorta (2008) studied the relationship between the policy rate and interbank rates finding a statistically significant relationship between them.

Events during the sample period covered in this thesis may pose challenges to the interpretation of the results suggested later. To be more specific, for the last few years, the economic world has experienced major increases in uncertainty. In the span of the last four years (2019-2023) the two major global events that occurred had considerable effects on the economies around the globe. The COVID-19 pandemic that emerged late in 2019 - early 2020 had disruptive effects on production lines and supply chains as governments began to shut down specific sectors and provinces in order to stop the infection from spreading (Bachman, 2021). As a result, international trade dropped

alongside with global GDP that drove the global economy into a recession (Bachman, 2021). The second major crisis that in early 2022 was the Russian invasion of Ukraine. The invasion and the continuing war have had an immense disruptive effect on the economic activity in the euro area and the globe (The World Bank, 2022). Disruptions in trade, food and fuel price shocks alongside surging energy prices started to contribute to high inflation rates not seen in decades in euro area (The World Bank, 2022). Although these shocks have no direct impact on interest rates in the euro area, they do have effects on the factors that determine interest rate behaviour. Carnazza and Liberati (2021) investigated sovereign bond interest rates in the euro area during the Covid-19 pandemic and found out that when the ECB Pandemic Emergency Purchase Programme (PEPP) was announced, the countries with a higher level of debt to GDP ratio in the time period before Covid-19, saw their interest rates jump up. Macroeconomic projection done by European Central Bank (2022) proved largely corrected, as inflation rates remained (and continue to remain) above the two percent price stability objective. This means that the ECB needed to adjust its bank rate in response to increasing inflation resulting in higher market interest rates.

Although there exists research on interest rate determination and the underlying factors, new data covering especially the time period of Covid-19 pandemic and the Russian invasion of Ukraine allows us to re-examine the issue in this study.

1.2 Research questions and objectives

The purpose of this study is to examine the determinants of interest rate behaviour in the Euro area in the time span of 2000 - 2023. From the econometric point of view this period is probably somewhat challenging, because it includes big global shocks that can have important interest rate effects and can affect estimation of the relation between the bank rate and long-term interest rates and the interpretation of the results, which is the main focus of this study. The most recent global shocks – the Covid-19 pandemic and The Russian invasion of Ukraine have had big economic effects globally and the Euroarea in particular have been affected by key economic policy decisions that have been taken in response to these shocks. Similar thoughts apply to the financial crisis of 2008, although more time has allowed researcher to study its effects more extensively. The main objective

is to study the behaviour of interest rates through the effects of key macroeconomic indicators on them. As mentioned before the indicators this study will use are GDP, inflation and monetary policy. In addition, the effects of previously mentioned shocks on interest rates will be discussed more closely in the context of interpreting the estimation results. Based on these objectives the research questions will be formed as follows:

The main research question is:

- *How does the macroeconomic indicators GDP, inflation and monetary policy affect the interest rates in Germany, France and Italy?*

The main question will be accompanied by the following sub question:

- *Did the big global shocks – Financial crisis of 2008, COVID-19 pandemic and Russian Invasion of Ukraine have any particular effects on interest rates in Germany, France and Italy?*

1.3 Methods and limitations

The geographical area of interest that this study will be investigating is Europe and more specifically the Euro area. Since the Euro area is fairly large (consisting of 20 different countries), a little bit of narrowing needs to be done given the limited resources of this study and given the fact the three biggest Euro area economies account for most of the size of the Euroarea economy. From the list of countries that form the Euro area – Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Portugal, Slovakia, Slovenia, and Spain this study will be focusing on Germany, France and Italy (European Central Bank, 2023a). Regarding the interest rate data, this study will be using country specific 10-year long-term government bond interest rate of Germany, France and Italy in the analysis. The

empirical method that will be used in the analysis is the static ordinary least squares (OLS) method. OLS can also be applied in more general econometric models that allow for autoregressive structure for the variables. Since the data will be time series data the possibility of non-stationarity is an issue which will be discussed and shortly checked in the empirical analysis. Since interest rates in particular are bounded variables, non-linearities may actually explain why relevant econometric tests do not rule out non-stationarities.

1.4 Structure of the thesis

The structure of this thesis consists of six chapters which are organized as follows: Chapter 1 includes the introduction of the topic, the background of the research done regarding the topic, research questions and objectives and also the methods of research, data and limitations. Chapter 2 and 3 will provide a more in-depth discussion of the theoretical background and literature review about interest rate behaviour in the Euro area. Chapter 4 includes the empirical part of the study together with a description of the methodology and data used in the analysis. Main findings and results of the study will be presented and discussed in chapter 5. Finally, chapter 6 concludes the thesis by summarizing the main findings of the study.

2. Theory

2.1 The role of European Central Bank in determining Euro area interest rates

The European Central Bank (ECB) is the central bank that operates in the Euro area and is responsible for conducting the common monetary policy of the area. In general, a central bank is an institution that manages the currency and controls the supply of money, often also monitoring and administrating the overall stability of the financial system in a certain geographical area (European Central Bank, 2015). Central banks have several tools for conducting monetary policy. One of the main tools is nowadays the key monetary policy interest rate, often called the discount, steering or bank rate. Central banks make decisions on the discount rate which basically is the price at which banks and financial institutions can borrow money – central bank funds or liquidity - from central banks. This was briefly discussed in section 1.1. Back in time central banks have used different tools in conducting monetary policy, but nowadays decisions over the discount rate are normally the main monetary policy decisions in their attempts to manage the economy. However, having said this, the financial crisis of 2008-2009 and the events therefrom forced ECB to innovate and enlarge its monetary toolbox to effectively manage the effects of the crisis.

Before the financial crisis of 2008-2009, the European Central Bank mainly conducted monetary policy by setting its key interest rates. After the crisis ECB decided to expand its set of monetary policy tools in order to ensure stability and adaptation to difficult times. In the post crisis period ECB started to offer different types of loans to the financial institutions at fixed interest rates and against collateral. Second, ECB decided to set negative interest rates on banks' deposits at the central bank to encourage banks more strongly to extend business loans at low rates. The main purpose was to support monetary policy transmission, which, ultimately is critical for ECB to be able to support economic activity in the Euro area. In addition, ECB started to use "forward guidance" as a policy tool to communicate its intentions about future monetary policy, thus the aim being to affect policy expectations of the private sector (European Central Bank, 2023b).

ECB among other central banks has monopoly power to issue euros in the Euro area. ECB has independence in setting its interest rates it applies when issuing central bank funds. ECB as well as many other central banks (also) engage in open market operations to steer the short-term interest rate and also (exchange rates and) longer-term interest rates. Open market operations mean actions that central banks buy and sell assets using central bank money with the purpose of trying to affect interest rates. More often than not, government bonds are used in open market operations. carry out in an open market such as the purchase and sale of assets. Open market operations are used to impact short-term rates, long-term rates as well as exchange rates. Changes in targeted interest rates will then affect relevant economic factors such as unemployment, output and the price level. Monetary policy can be either expansionary or contractionary: If the goal is to boost economic activity ECB will reduce its policy rate expecting it to support economic activity, Banks hopefully are encouraged to extent loans lend to households and businesses. On the contrary if the ECB's goal is to slow economic activity in the Euro area, it will increase its policy rate with the ultimate aim to encourage households and firms to reduce expenditure and save more. This then leads to upward drift to interest rates which then decreases borrowing and demand. Hence, ECB and central banks simply tend to adapt to different economic situations by using their monetary policy tools. During difficult times such as recessions ECB tends to practise expansionary policy in order to boost the economic activity and revitalize growth. Contractionary policy works to the opposite direction. The idea is to restrain economic activity to prevent excessive booms that will for example feed financial bubbles The complex process of ECB's interest rate setting and the transmission of its effects is highlighted in Chart 1. (European Central Bank, 2023c; Investopedia, 2023)

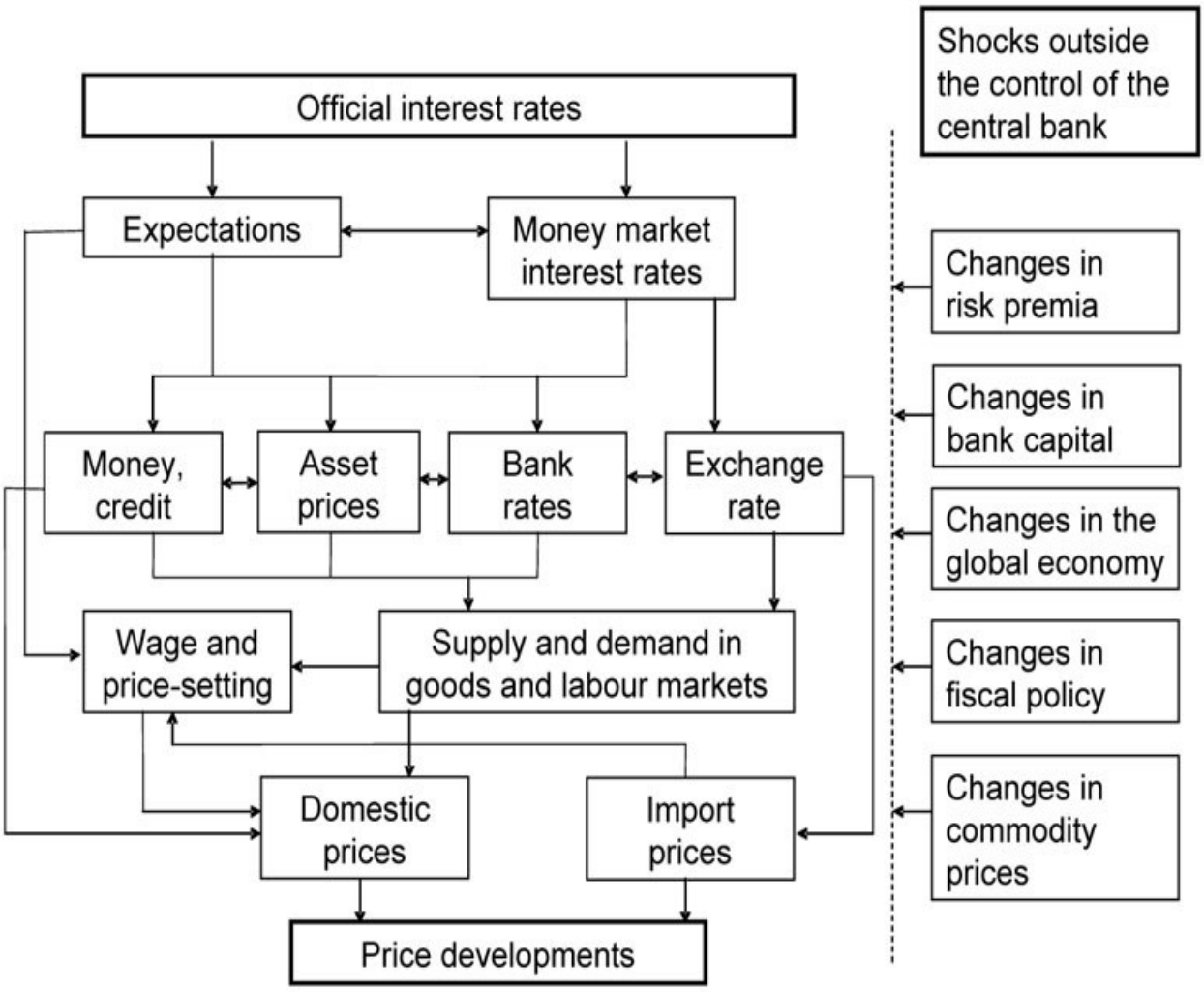

Chart 1. Transmission mechanism of monetary policy (European Central Bank, 2023)

As can be seen from Chart 1, there are several channels through which the policy rate can affect the Euro area economy, most notably the price level or inflation, which is the prime target of the ECB. An important factor affecting the transmission of the ECB's interest rate is associated with external shocks that are outside the control of the central bank but anyway interact with changes in the policy rate decided by the ECB. Moreover, ECB is not the only central bank that have responded strongly to some of the large shocks facing the global economy during the last fifteen years or so. The financial crisis of 2008-2009, COVID-19 pandemic and the Russian invasion of Ukraine are well known examples of those shocks. They are discussed more closely in the next section 2.2.

2.2 Economic effects of the three big shocks – Financial crisis, COVID-19 and the Russian Invasion of Ukraine on interest rates

As can be seen from Chart 1, external shocks that are out of the control of central banks, influence the price stability in Euro area. This section will discuss the reasons behind the large global shocks and how they have influenced interest rates in the Euro area. Each of these three shocks will be covered separately for the sake of clarity.

2.2.1 Financial crisis of 2008-2009

The twenty year period prior to the financial crisis is often called the Great Moderation, because of the apparent macroeconomic and financial stability observed in (at least) major developed economies. Heading closer to 2008 economic growth was accelerating and inflation was picking up and many central banks saw inflation deviating from the target inflation rate, mostly around 2 percent. Asset prices increased rapidly and signals started to emerge indicating that financial instabilities had started to accumulate in the global financial system. Bursting housing price bubbles reversed the trend in the global financial cycle. The financial collapse that followed led to a global economic recession. Central banks, including ECB, responded by cutting interest rates in a number of successive interest rate decisions, bringing the key policy rates practically to zero in the decade following the onset of the financial crisis. Simultaneously, governments took decisions over fiscal policy measures to support economic activity. There seems to be some agreement among economists at least that one factor contributing to the build up of the financial bubble was the low interest rate policy in the US after the 9/11 shock, which increased perceived (macroeconomic) uncertainty, which, in turn, explains why the Fed decided to keep interest rates very low for an extended period of time. In the Euro area interest rates also remained relatively low roughly over the same period after the 9/11 shock. Although arguably central banks kept policy rates too low for too long, one cannot ignore other factors, such as excessive lending by banks to households and firms, that contributed to rapidly increasing debt levels which increased the vulnerability of households and firms and exposed them to destabilizing shocks.

As the economy began to recover, interest rates started to react. Signs of overheating began to emerge as early as 2004 and the United States' central bank FED had to raise rates. Already in 2006 increases in house prices began level off and even fall which alongside rising interest rates made it more difficult for household to service their debt and spelled major trouble in their ability to pay. During the year of 2007 over 25 subprime lenders filed for bankruptcy and as time went on these events started to spread around the globe and the fall of Lehman Brothers in 2008 sealed the fate of the global financial markets pushing the global economy into a deep recession. (Manoj Singh, 2023)

The impact of the Financial Crisis on Euro area short-term interest rates shown will be in Figure 1 below.

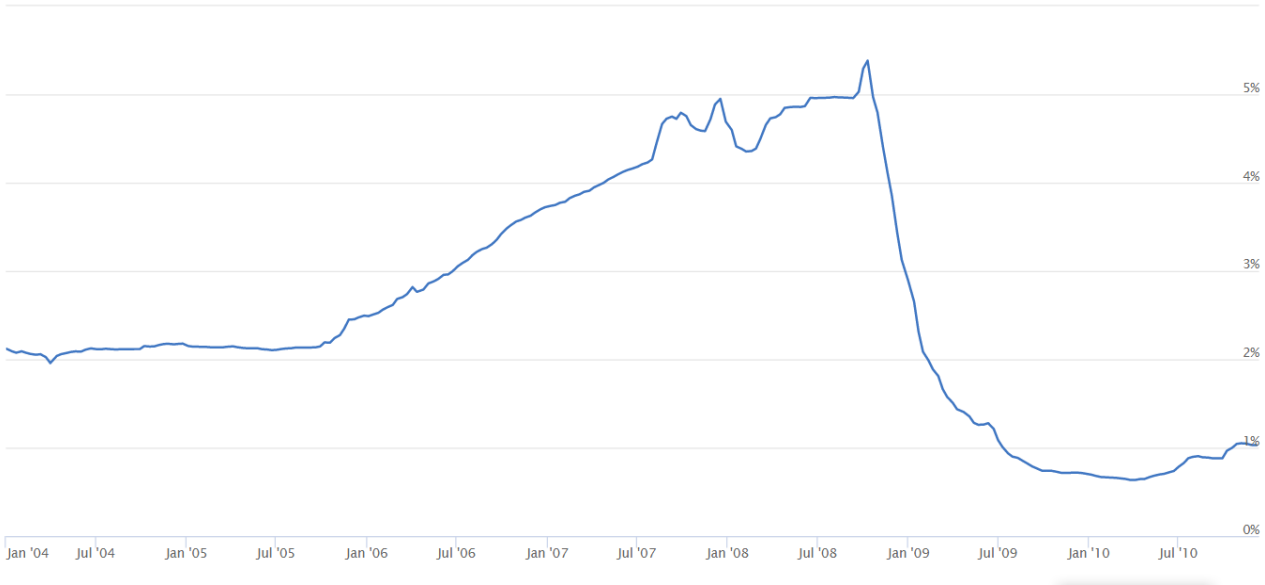

Figure 1. Euribor 3-month 2004-2010. Interest rate level on Y-axis in percentage, time on X-axis in years (Euribor rates, 2023)

As can be seen from Figure 1, the looming troubles can be seen from the year 2005 onwards when interest rates started to rise fairly quickly, starting from a level around two percent in 2005 and peaking higher than five percent just before the collapse of the Lehman Brothers in 2008 and ultimately falling well below two percent in early 2009. The Financial Crisis thus had an immense impact on Euro area interest rates as can be seen from the figure and interest rates followed a similar pattern to the one of the United States.

The crisis sparked and required a reaction from the European Central Bank. The ECB needed to act quickly as financial tensions in the market began to occur. One of ECB's main goal during these tensions was to restore the trust of consumers and (non-financial) firms towards the lending institutions such as banks. During 2007 ECB succeeded to temporarily restore the trust in banks by completing market operations where the ECB provided liquidity to banks with the intention to encourage banks to keep providing credit. When the Lehman Brothers collapsed in 2008, it started the global financial crisis. The resulting major decrease in financial activity increased overall uncertainty and the disruptions in the money market caused short term interest rates to spike up. Once again actions were needed from ECB, and it responded fairly quickly to the situation. ECB began to lower interest rates and after peaking well above ECB's target of two percent inflationary pressures started to ease. In an attempt to support and stabilize financial markets and thereby protecting the transmission mechanism of monetary policy, ECB started to announce in 2009 a series of financial market programmes. (European Central Bank, 2010)

2.2.2 COVID-19 Crisis of 2020 – 2022

The world was hit with a big shock during the early months of 2020 when the Covid-19 pandemic struck. The virus spread quicky across the globe and started to disrupt everyday lives of people and caused severe problems to the economic world. The pandemic had particularly big adverse effects on the production lines and supply chains of companies leading to large and prolonged increases unemployment and a fall in global economic activity. Even though Covid-19 technically is still with us affecting economies worldwide in different ways, this study focuses on the time frame of 2020 to the 2022 to learn how the COVID-19 pandemic affected (short-term) interest rate developments in the Euro area and how ECB reacted to the crisis. Figure 2 below clearly shows the dramatic changes in interest rates around the time when the potentially large and persistent effects of the COVID-19 on uncertainty and, ultimately, on economies were first felt.

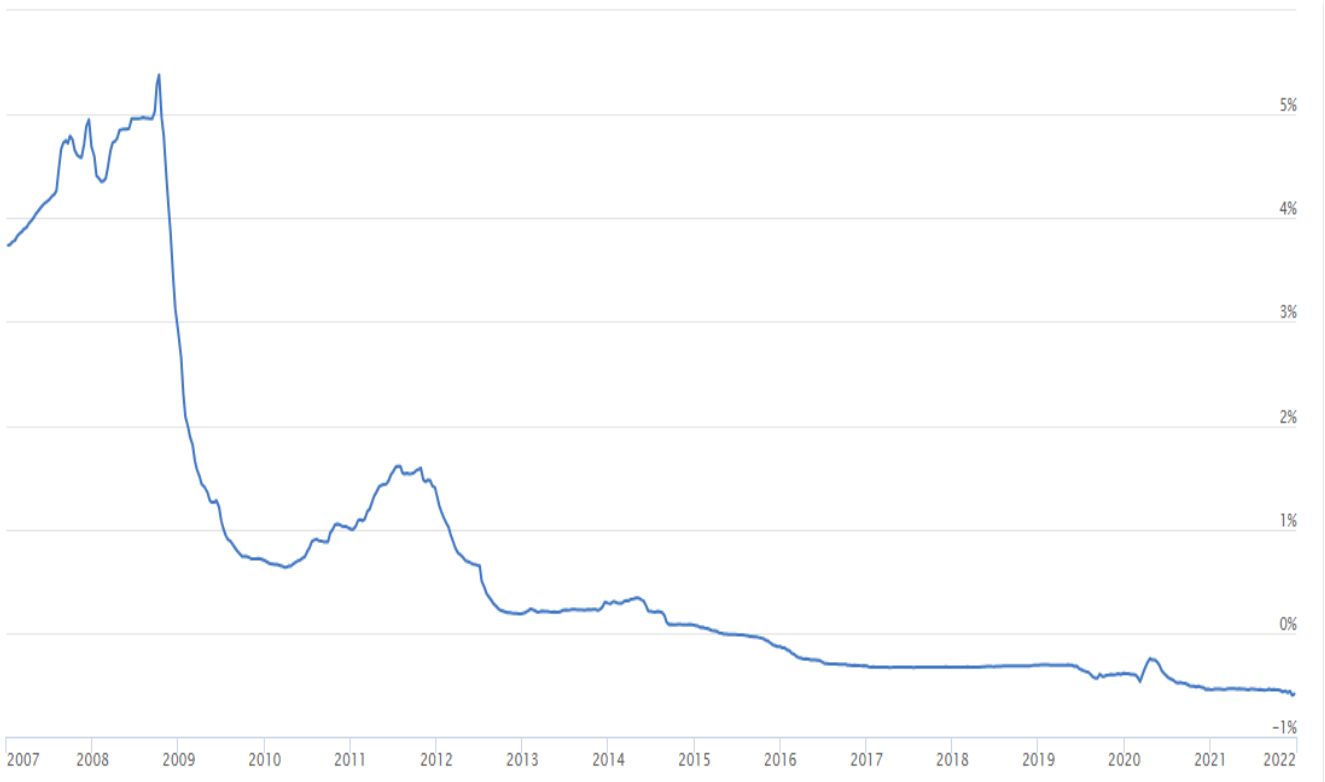

Figure 2. Euribor 3-month 2007-2022. Interest rate level on Y-axis in percentage, time on X-axis in years (Euribor rates, 2023)

When inspecting Figure 2, we can clearly see the large drop in the short-term interest rate from the peak of more than five percent before the collapse of the Lehman Brothers to a low below one percent in early 2020. After a temporary recovery, the 3-month Euribor practically fell down to zero in late 2012 – early 2013 and actually continued to fall below zero in late 2015 and remaining below zero thereafter. Falling and low policy rates provided ample room for (short-term) interest rates to fall. The idea behind low and falling interest rates was to support economic activity and revive economic growth. Fears about the disruptive effects on the transmission of monetary policy also explains ECB's active role in its attempts to stabilize Euro area financial markets during the COVID-19 period. The increase in the 3-month Euribor and, in the background, longer-term interest rates from 2010 to 2012 reflects the Euro area sovereign debt crisis, which ended in the famous 2012 speech by the then ECB's chairman Mario Draghi declaring 'whatever it takes' (to protect monetary policy transmission in the Euro area).

During the post financial crisis period, inflation had already started to fall in the Euro area. Inflation continued to fall below ECB's target of (below but close to) two percent and by the mid of the decade

after the financial crisis there were genuine fears of deflation in the Euro area. Because ECB's policy rate had already hit zero (with deposit rates below zero by ECB's decisions), ECB had to introduce new policy tools to implement monetary policy and communicate its intention to the public. These new tools took the forms of various financial market programmes as well as forward guidance, where the latter focused on factors that would help in lifting interest rates from the floor of zero.

Since zero and even negative interest rates were not sufficiently effective in restoring stability and reviving the Euro area economy, ECB continued to respond to the COVID-19 pandemic by constructing financial market purchase programmes. The programmes' main purpose was to help governments, businesses, and citizens to get access to funds by lowering borrowing costs. With these programmes ECB wanted to ensure that the financial system stabilized and that the banks could keep lending money. As of early 2020 ECB listed three main objectives regarding the situation of Euro area: One was to try to stabilize the markets, two to protect the credit supply and finally objective three was to neutralize the (deflationary) risks to inflation. After the introduction of the PEPP aka the pandemic emergency purchase programme, ECB began to update their approach regarding their policies. The changes were based on the current situation which was determined by relevant new data. New policy approaches focused on the current situation related to unemployment rate, crisis support for healthcare and looming inflationary pressures, which were observed late in summer of 2021 when economic growth seemed to pick up suggesting increasing inflationary pressure. For example, in December 2020 the PEPP was expanded from 750 billion euros which was the size of the package in March of 2020 to 1,850 billion euros. (Hobelsberger, Kok and Mongelli, 2022; European Central Bank, 2023d)

2.2.3 Russian invasion of Ukraine 2022 – Still ongoing event

While still recovering from the COVID-19 pandemic, the world was destined to face yet another crisis. In February 2022 the world was in shock when Russia initiated its invasion in Ukraine. First and foremost, the invasion is a human tragedy but in addition, the war had and still has dramatic economic effects. The effects of the war were felt globally but Europe was hit particularly hard. The war caused an energy crisis mainly because many European countries were heavily dependent on

Russian energy imports. Also, European markets relied on food imports from both Ukraine and Russia and the invasion had a major disruptive effect on the relevant supply chains as well. The resulting large increases in food and energy prices caused inflation increase rapidly to levels not seen in Europe for decades. In 2020 inflation was hovering around 0.3 percent, it had increased to 8.4 percent in 2022. As of January 2023, food prices had increased by 14.1 percent compared to the previous year. Rising prices on food and energy caused major problems for consumers and firms since they had severe negative impacts on real incomes and thereby everyday lives. Especially low-income households faced major difficulties because of rising food and energy prices, since these account for the bulk of the expenditure of low-income households. The situation called for actions from governments and the ECB. In the paragraph we will use Figure on the 3-month Euribor rate chart to discuss the effects of actions taken by the ECB. (Arce, Koester and Nickel, 2023)

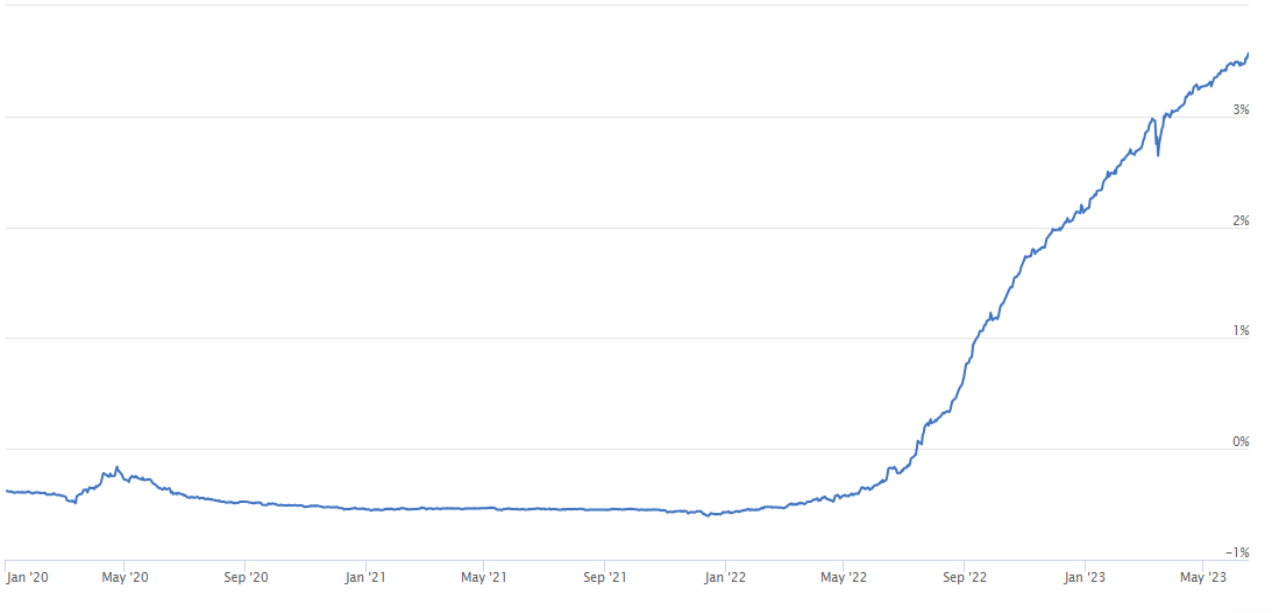

Figure 3. Euribor 3-month 2020-2023. Interest rate level on Y-axis in percentage, time on X-axis in years (Euribor rates, 2023)

We can see from Figure 3 that short-term interest rates remained negative till early 2022. A few months after Russia's invasion in Ukraine begun in February 2022, we can see that the interest rate begins to rise at a rapid pace. The rise in interest rates is a direct response to the increase in inflation that started already in late 2021. ECB decided to raise key interest rates at a rapid rate in response

to rapidly increasing inflation. As we can see from the figure, interest rates steadily increased since around May 2022. As mentioned in ECB press release (2023), inflation is expected to level off and start to decline. Average Inflation is expected to be on 5.4 percent in 2023, 3.0 percent in 2024 and 2.2 percent in 2025. ECB continues to monitor inflationary developments in the Euro and aims to restore price stability and bring inflation back to its medium-term target of two percent.

ECB's one of the most important tools used for fighting inflation caused by the war was definitely using the key policy interest rates. As of June 2023, inflation is still above two percent, but towards the fall of 2023 measures of inflation have fallen further closer to the ECB target. Asset market programmes have recently gained less attention as part of ECB's strategy. So far, it is hard to say what exactly will be the evolution of inflation and interest rates in the Euro area, but according to the macroeconomic projections inflationary pressures should, in the absence of major shocks, wire down during the near futurey. (Arce, Koester and Nickel, 2023; European Central Bank, 2023e). This is consistent with markets expecting a fall in key policy rates in the springtime of 2024.

3. Literature review

Section 2 covered some of the theory and factors behind the determination of interest rates in the Euro area. The role and operations of the ECB were discussed, and it is clear that ECB holds an important role in the determination of interest rates in the Euro area. There are a lot of studies on monetary policy, and they vary in focus and scope. This thesis, however, focuses on interest rates, and it will follow academic research that studies interest rates and their relationship to key macroeconomic factors or indicators and major shocks.

3.1 Macroeconomic indicators and interest rates

Caporale and Pittis (1997) studied how domestic and external factors impact interest rate determination in the United States, Japan, Germany, France and Switzerland. The results of their study finds that Germany has a major impact on the interest rates of both United States and Japan. In addition, the results show that of the domestic conditions, inflation is a major factor influencing interest rates. Gambacorta (2008) studied banks and how they set interest rates. The study analysed how different micro and macroeconomic factors impact the way Italian banks set interest rates. Studying the effects of demand, monetary policy, real GDP and inflation it turned out that real GDP and inflation influence interest rate setting. Maitra (2021) studied the impact of fiscal, monetary policies and trade openness on interest rates in India. The results based on the estimated distributed lag model suggest that especially the openness of trade lowers the interest rates, which may turn out to be an important finding from the point of view of efficient macroeconomic policy. Herrala and Tötterman (2023) studied how the European Central Bank can control interest rates in the future and found out that in addition to interest rate control, the clarity and operational efficiency of the monetary policy framework have to be taken into consideration.

3.2 Major crises and interest rates

Hristov, Hülsewig and Wollmershäuser (2014) studied interest rate pass-through in the Euro area during the financial crisis of 2007-2009. The study, which estimated panel vector autoregression models widely used in multiple time series data, found out that the estimated fall in the interest rate pass-through can be related to structural changes caused by external shocks during the financial crisis.

Carnazza and Liberati (2021) studied the effects of the COVID-19 pandemic on Euro area sovereign bonds interest rates. The study focused on bond markets of eight Euro area countries (France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain) and analysed the role of ECB's policy rates and ECB's announcement of the Pandemic Purchase Programme (PEPP), level of debt to GDP ratio on longer-term interest rates. The results suggest that the countries that had a higher debt to GDP ratio before the pandemic struck, saw their interest rates jump up.

Golitsis, Khudoykulov and Palanov (2022) studied the determinants of non-performing loans in North Macedonia. Non-performing loans are bank loans which are unlikely to be repaid by the borrowers (European Comission, 2023). The study covered major crises like the financial crisis, the Euro crisis, COVID-19 pandemic and the Russian invasion of Ukraine. The study results suggest that the strongest impact to non-performing loans come from unemployment, the GDP and interest rates.

There is not very much research on exactly what determines interest rate dynamics in the Euro area and what are the major shocks that affect them. However, what is perhaps of independent interest is that methodologically many if not most of the relevant studies related to interest rates use simple OLS and autoregressive models which is what this study aims to do.

4. Methodology and data

This section describes the research methods and the data collected for this study use. The main idea is to collect data from long-term government bond interest rates from Germany, France and Italy, and see how their behaviour and evolution can be explained by inflation, GDP growth and ECB's monetary policy in the form of changes in the key policy rate, the bank or discount rate.

The empirical method which was used in this study applies a simple and straightforward econometric method, OLS or ordinary least squares, where the variable y is (linearly) regressed on a vector of explanatory variables X

$$y = \alpha + \beta^T X + \varepsilon$$

β is a $k \times 1$ parameter vector α is constant, and X is a $k \times 1$ vector of explanatory variables. $^{\mathsf{T}}$ denotes transpose. The expected value of the random variable ε is zero and its variance is constant. The so-called ideal conditions assumes that the distribution of ε is the standard normal distribution.

Linear OLS has been applied in many empirical studies using numerical data and at least if certainly a good place to start exploring empirical relationships. Moreover, OLS produces simple summary statistics and makes it possible to illustrate the results using graphical tools (Saunders, 2015). The data analysis was carried out using the statistical program Stata. Before estimating the linear relationship between bond rates and the explanatory variables GDP growth, inflation and ECB bank rate, the variables will be tested for nonstationary by using the Dickey-Fuller test.

The data collection method was simple. Multiple databases were searched and checked through in search for the relevant data on the selected indicators. Data for long term bond interest rates, inflation and GDP was collected from Federal Reserve Bank's Economic Database (FRED, manage by the St Louis Bank) and the data for the ECB bank rate was gathered from two sources: Federal

Reserve Economic Data and from the database of ECB. The ECB data from Federal Reserve Economic Data was in need of some completion. The data did not show anything from the middle of 2000 to the end of 2007 since the bank rates were presented as fixed rates. The ECB did not use fixed rates (in ECB's liquidity auctions) as bank rates in that time period. Instead ECB calculated and used minimum bid rates from its liquity tenders available in ECB's databank. So, these bid rates were inserted into the data from Federal Reserve Bank's Economic data. The raw data collected from these databases were first organized into an Excel file to be available for the main empirical analysis using Stata.

The bond interest rate, inflation rate, GDP growth and the ECB bank rates for Germany, France and Italy are graphically presented in appendix 1, 2, 3 and 4. Average Euro area inflation and GDP growth rate were easily obtained from calculation performed in Excel. GDP growth rates were calculated as quarterly changes in GDP relative lagged level of GDP. The following Table 1 summarizes the collected data in terms of averages for Germany, France and Italy.

	Germany	France	Italy
Bond interest rate (Average)	2,28	2,62	3,6
Quarterly inflation rate (Average)	0,46	0,4	0,48
Quarterly GDP growth (Average)	0,72	0,71	0,57
ECB bank rate (Average)	1,51	1,51	1,51

Table 1. Germany's, France's and Italy's average bond interest rate, inflation rate, quarterly GDP growth and ECB bank rate on a time period of 2000-2023

As can be seen from Table 1, the macroeconomic indicators for Germany and France indicate close similarity. This may be explained by the close economic relations between Germany and France. Italy, on the other hand, is clearly from Germany and France. Slow average growth relative to its neighbors and high public debt relative to GDP could explain Italy's poorer average macroeconomic indicators.

Table 1 however, presents only preliminary data for these countries. The next step applies regression analysis to estimate the relationship between long-term interest rates and the macroeconomic indicators including the policy rate as represented by the bank rate.

5. Estimation results

This section will be summarizing the main findings and results that were discovered during the regression analysis. The regression analysis and other relevant procedures were conducted with StataSE 17, a software that enables users to analyze statistical data and illustrate the results with help of eg. graphical methods. As the analysis will be conducted for all the three countries, this section will be divided into three sub-sections each representing one country. Germany will be covered in sub-section 5.1. Then, France will be covered in sub-section 5.2. Lastly, Italy will be covered in sub-section 5.3.

5.1 Germany

The data for long-term interest rates and inflation in particular suggest there may exist non-stationarities in the data. Consequently, as a first step it may be reasonable to run unit root tests to test for the presence of unit roots in the data. Starting from a simple autoregressive AR(1) model $y_t = \rho y_{t-1} + \varepsilon_t$ where ε_t is a so called white noise process with mean zero and constant variance. A unit root corresponds to value ρ=1. The well-known standard Dickey-Fuller (DF) test uses the following test equation to test the null hypothesis of a unit root in the in a single time series for variable y:

$$\Delta y_t = \alpha + \beta t + (\rho - 1) y_{t-1} + u_t$$

Augmented Dickey-Fuller (ADF) test adds lags of Δy_t to the right hand side of the above equation. According to the DF test a time series may be trend-stationary (ρ<1, nonzero α and/or β) or difference stationary (ρ<1), Hence, difference stationarity can allow for nonzero constant and trend coefficient in the above equation. (Dickey and Fuller, 1979)

When inspecting the data Germany in Appendix 1, it can be seen that the bond rate has a downward linear trend so indicating a deterministic (linear) trend in the bond interest rate series. GDP growth rate, on the other, looks stationary with volatility increasing towards the end of the sample. When inspecting the graph from Appendix 1, the data seems to be moving around zero.

However, from Table 1 can be seen that the average growth rate is positive, not zero, indicating that the level of GDP is trending upwards. For most of the time, quarterly inflation seems vary around a constant, while both its volatility and mean increases towards the end of the sample. There seems to be major nonlinearities in the ECB bank rate series which may explain why the DF test, presented later, suggests a unit root in the bank rate. Nonlinearities rather than a unit root is more likely in the case of the bank rate and the bond rate as well, since these variables are bounded by zero and one (or zero and 100%), while a unit root process can wander around without bounds.

5.1.1 Dickey-Fuller-tests

	Dickey-Fuller-test Germany		
	Bond rate	GDP growth	Inflation rate
MacKinnon approximate p-value for Z(t)	0,9691	0,0019	0,8796

Table 2. Dickey-Fuller-test Germany

Table 2 shows the results for the Dickey-Fuller-test. The null hypothesis for this test is ρ=1 in the above DF test equation, while the MacKinnon p-values show approximate probability values for rejecting the correct null hypothesis of a unit root. As the values are high relative to the standard significance value of 0.05 or five percent, the test does not reject the null hypothesis with high probability. On the other hand, the DF test strongly suggests that GDP growth is stationary. successfully managed to get a result under the risk level leading to the abandonment of null hypothesis. Finally, German inflation appears to evolve as a unit root process. However, nonlinearities once again may be at least part of the story, because inflation starts to pick up rapidly towards the end of the sample together with increasing volatility. However, either nonlinearities or unit roots, these results invite caution in making strong conclusion from the analysis.

	Dickey-Fuller ECB bank rates
MacKinnon approximate p-value for Z(t)	0,8186

Table 3. Dickey-Fuller-test ECB bank rates

Table 3 suggests similar interpretation from the DF test as the one for the bond rate. In this case however, nonlinearities in the form of eg. regime changes (from high to low bank rates) is perhaps a more plausible explanations for the DF test result suggesting a unit root in the bank rate.

5.1.2 Regression results

Model Statistics	
Number of obs	92
R-squared	0.828
Adj R-squared	0.8227

OLS			
	SS	df	MS
Model	259.410	3	86.470
Residual	53.675	88	.609
Total	313.086	91	3.440

Bond rate	Coefficient	Std.Error	t	P > |t|	Lower 95%	Upper 95%
GDP growth	-0.0047	.055	-0.09	0.932	-.11418	.104
Inflation rate	-0.160	.0137	-1.17	0.247	-.43314	.112
Bank rate	1.119	.0546	20.48	0.000	1,01	1.227
_cons	.06736	.137	4,91	0.000	.400	.946

Table 4. Regression analysis results Germany

From Table 4 we can see first of all that only the coefficient on the bank rate enters the OLS regression in a statistically significant way. Secondly, the R-squared is high at 0.828 which suggests the model captures the bulk of the variation in the bond rate. High SS of the model (Sum of Squares of the model) and mean sum of squares (MS) indicate the same. that the coefficient of determination of this model is excellent. However, high t-value for the coefficient on the bank rate as well as the high R-squared should caution against taking the results at face value. The results may be an indication of the so-called 'spurious regression' where two apparently nonstationary time series show high correlation while they are independent. But it is intuitive and plausible that the bank rate should be an important factor explaining movements in long-term interest rates. Statistically it is perhaps not surprising that GDP growth and inflation does not come out as significant factors: GDP growth (rate) is stationary, while inflation does not conform well with the trend in the long-term bond rate.

We could inspect how would the model behave if we remove the two explanatory variables, GDP growth and inflation that are not statistically significant. We will conduct a simple regression model that contains the German bond rate and the ECB bank rate and see will the model improve. Next, we will see how the model looks like if the choose the only statistically significant explanatory variable, the ECB bank rate.

Model Statistics	
Number of obs	93
R-squared	0.8264
Adj R-squared	0.8245

OLS			
	SS	df	MS
Model	267.190	1	86.470
Residual	56.134	91	.609
Total	323.324	92	3.440

Bond rate	Coefficient	Std.Error	t	P > |t|	Lower 95%	Upper 95%
Bank rate	1.128	.0542	20.81	0.000	1,02	1,23
_cons	.5957	.114	5,19	0.000	.367	.823

Table 5. Simple regression model Germany bond rate and ECB bank rate

As can be seen from Table 5 the results didn't drastically change. ECB bank rates coefficient slightly increased among other slight changes such as standard errors decrease. The simple regression model suggests that the ECB bank rate has the highest coefficient.

5.2 France

Same set of steps is followed with the French data as in Germany's case. First Dickey-Fuller-tests and then the regression itself. Graphical presentation of the French data can be found in Appendix 2. Same idea as in Germany's case. DF test results are shown in Table 5 and regression results in Table 6 below.

5.2.1 Dickey-Fuller-tests

	Dickey-Fuller-test France		
	Bond rate	GDP growth	Inflation rate
MacKinnon approximate p-value for Z(t)	0,9594	0	0,4262

Table 6. Dickey-Fuller-test France

When inspecting Table 6, we can see that the discussion and interpretations in the context of Germany apply well for France. Only GDP growth seems to be a stationary variable, while the bond rate and inflation suggest unit roots. We will not repeat the main points of the earlier discussion for Germany, just to re-emphasize the strongly role of the bank rate as a factor behind the bond rate.

5.2.2 Regression analysis

Model Statistics	
Number of obs	92
R-squared	0.799
Adj R-squared	0.7924

OLS			
	SS	df	MS
Model	218.065	3	72.688
Residual	54.788	88	.622
Total	272.85	91	2.998

Bond rate	Coefficient	Std.Error	t	P > |t|	Lower 95%	Upper 95%
GDP growth	-.014	.043	-0.34	0.735	-.1018	.0721
Inflation rate	0.59	.166	0.36	0.723	-.2711	.3892
Bank rate	1.026	.055	18.66	0.000	.9170	1.135
_cons	1.066	.132	8,11	0.000	.0805	1.328

Table 7. Regression analysis results France

When inspecting Table 7, much what was said about the regression results for Germany, applies well for France: High (raw and adjusted) R-squared is 0,79, high t-value on the coefficient for the bank rate apparently speak for high explanatory power of the model and highly significant bank rate, but again, because of the possible 'spurious regression', these caution against taking these results at face value. One curiosity here is that inflation enters positively, although not in a statistically significant way, in the estimated bond rate model.

Next, we will inspect the simple regression model as we did with Germany. The only explanatory variable will be the ECB bank rate in France's case as well.

Model Statistics	
Number of obs	93
R-squared	0.799
Adj R-squared	0.7977

OLS			
	SS	df	MS
Model	225.296	1	225.296
Residual	56.346	91	.619
Total	281.643	92	3.061

Bond rate	Coefficient	Std.Error	t	P > |t|	Lower 95%	Upper 95%
Bank rate	1.036	.054	19,08	0.000	.928	1.144
_cons	1.077	.114	9,37	0.000	.849	1.305

Table 8. Simple Regression France Bond rate and ECB bank rate

We can see from Table 8 that the simple regression model did not change the results drastically as was the case in Germany. Models R-squared did not change at all and the bank rates coefficient improved slightly.

5.3 Italy

Same necessary procedures will be followed as in Germany's and France's case. First Dickey-Fuller-tests and then the regression itself. Data related to Italy's indicators can be found from Appendix 3. Same idea as in Germany's and France's case: Test equation 3 will be used on bond rate and test equation number two will be used on inflation rate and GDP growth.

5.3.1 Dickey-Fuller-tests

	Dickey-Fuller-test Italy		
	Bond rate	GDP growth	Inflation rate
MacKinnon approximate p-value for Z(t)	0,5255	0	0,8075

Table 9. Dickey-Fuller-test Italy

As expected, GDP growth remains the only stationary variable. At the risk level of five percent GDP growth is the only variable to successful in abandoning the null hypothesis of a unit root. Unit roots seem to remain in the bond rate and inflation. However, earlier notes on the test results for the bond rate and bank rate also apply here for Italy, perhaps also for inflation.

5.3.2 Regression analysis

Model Statistics	
Number of obs	92
R-squared	0.5309
Adj R-squared	0.5149

OLS			
	SS	df	MS
Model	106.644	3	35.548
Residual	94.220	88	1.070
Total	200.864	91	2.207

Bond rate	Coefficient	Std.Error	t	P > |t|	Lower 95%	Upper 95%
GDP growth	-.073	.521	-1.42	0.160	-.177	.029
Inflation rate	.185	.155	1,20	0.234	-.122	.494
Bank rate	.706	.072	9,75	0.000	.562	.849
_cons	2.486	.164	15,08	0.000	2,16	2.813

Table 10. Regression analysis results Italy

When looking at Table 10, we can see that the coefficient of determination is 0,53 indicating that the model explains less of the variation of the long-term interest compared to Germany and France. Bank rate enters significantly and remains the most important explanatory variable with a coefficient of 0,706 which, interestingly is less than one. GDP growth and inflation do not enter significantly. Also bank rate remains the only explanatory variable that is statistically significant. Overall, the results are qualitatively similar to Germany and France.

The simple linear model test will be done for Italy as it was done in previous cases for Germany and France. The selected explanatory variable will once again be ECB bank rate.

Model Statistics	
Number of obs	93
R-squared	0.5213
Adj R-squared	0.5161

OLS			
	SS	df	MS
Model	107.012	1	107.012
Residual	98.256	91	1.079
Total	205.268	92	2.231

Bond rate	Coefficient	Std.Error	t	P > |t|	Lower 95%	Upper 95%
Bank rate	0.714	.717	9,96	0.000	.571	0.856
_cons	2.532	.151	16,68	0.000	2.230	2.833

Table 11. Simple Regression Italy Bond rate and ECB bank rate

Also, in case Italy we can see from Table 11 that the model did not drastically change the results. Some minor changes can be seen such as the models R-squared is slightly decreased and the ECB bank rates coefficient is increased.

6. Conclusions

This will be the last section of this thesis; thus, this section summarized the main findings of this study. This section will be divided into subsections. Subsection 6.1 will give a brief discussion about the goals of this study. Subsection 6.2 will focus on summarizing the main findings and proposing answers to the research questions. And finally, subsection 6.3 discusses some of the limitations of the study and suggestions for future research.

6.1 Summary

The relationship between (long-term) interest rates and economic indicators have interested researchers for a long time. The role of central banks lies in the center of this relationship and, in particular, how the effects of external shocks should be managed. There seems to be a general agreement among researchers and policy makers that of the key macroeconomic factors GDP and inflation should contribute significantly to the determination of (long-term) interest rates. Central bank policy rates and expectation of their future development also play an important role. The reason why this study was conducted was to revisit the question concerning the relationship between long-term interest rates and macroeconomic factors including the central bank policy rate using new and fresh data. The selected time period of 2000-2023 contains special economically significant events, mainly the Covid-19 Pandemic and the Russian Invasion of Ukraine, in order to discuss their observed effects on long-term interest rates.

The data was analyzed using standard econometric methods. The data this study utilized was collected from public sources, from Federal Reserve Bank's Economic database FRED. The data consist of time series on inflation, GDP growth and long-term bond rate for Germany, France and Italy together with the bank rate representing ECB's monetary policy rate. This data is presented graphically in appendices 1 to 4. The econometric analysis was conducted using simple OLS regressions and running Dickey-Fuller-tests to test for unit roots in the time series. To summarize the main results this study found that the ECB bank rate appears to be the only statistically

significant economic indicator capturing movements in the long-term interest rates in Germany, France and Italy. GDP growth and Inflation do not seem to provide additional explanatory power. The main findings will be covered in more detail in the next section.

6.2 Main findings

As mentioned before, this subsection will focus on answering research questions that were first presented back in section 1.2. The main research question was as follows:

How does the macroeconomic indicators GDP growth, inflation and monetary policy affect the interest rates in Germany, France and Italy?

Which was coupled with up the sub question:

Did the big global shocks – Financial crisis of 2008, COVID-19 pandemic and Russian Invasion of Ukraine have any particular effects on interest rates in Germany, France and Italy?

The previous existing literature suggested that when studying the relationship between interest rates and macroeconomic factors, it is usually GDP and inflation (on top of the bank rate) that have major effects on interest rate behaviour. However, this study did not find statistically significant effects from GDP growth and inflation on long-term interest rates in Germany, France and Italy. One possible reason could be the global events alluded to above together with the zero lower bound monetary policy that the ECB implemented for an extended period of time after the financial crisis during the 2010-2020 period. Or perhaps the regression model could somehow be improved to obtain more definite results. More on that thought later in subsection 6.3. On the other hand, this study found out that the bank rate is a statistically significant explanatory variable for long-term interest rates in Germany, France and Italy. Possible econometric problems notwithstanding, this result accords well with intuition and one's prior expectations.

When answering the research sub-question, the graphical evidence suggests that no long-term effects or relatively small and short-lived effects on long-term interest rates from the financial crisis

or COVID-19 pandemic. In the case of inflation, the jury is still out there, but very recent evidence seems to suggest that inflation is coming back towards ECB's target of two percent. Then again, ECB reacted strongly and swiftly to the burst of inflation in the latter half of 2021. The macroeconomic factors also reacted to these global events, but the effects did not seem the transmit further to major changes in long-term interest rates.

6.3 Limitations and suggestions for future research

This section focuses on limitations and suggestions for future research. This study had a few limitations, which could be corrected to achieve better, more reliable results. First, a bigger sample size would have served this study better. This study used quarterly time series data which resulted in 92 observations. Using e.g. monthly data would have increased the sample size, but would in this case have required finding good monthly indicators for the GDP. When studying economic anomalies such as external shocks, a bigger sample size would benefit the study as it provides more information and potentially sharper coefficient estimates with smaller standards errors of deviations. For example, more countries could be included in the data. Higher data frequencies were already noted above. In addition, more or alternative explanatory variables could be selected. Additionally, this study utilised a timeframe of 2000-2023 which includes events, eg. Russia's invasion of Ukraine, whose total and final effects have not yet realized. Naturally using longer time series is (almost) always possible. An important suggestion is to use different econometric methods in conducting empirical analyses. This study utilised Dickey-Fuller-tests for testing for unit roots in the sample and simple OLS regression to estimate models for long-term interest rates. Experimenting with alternative methods could give important complementing information for evaluating the performance of these methods.

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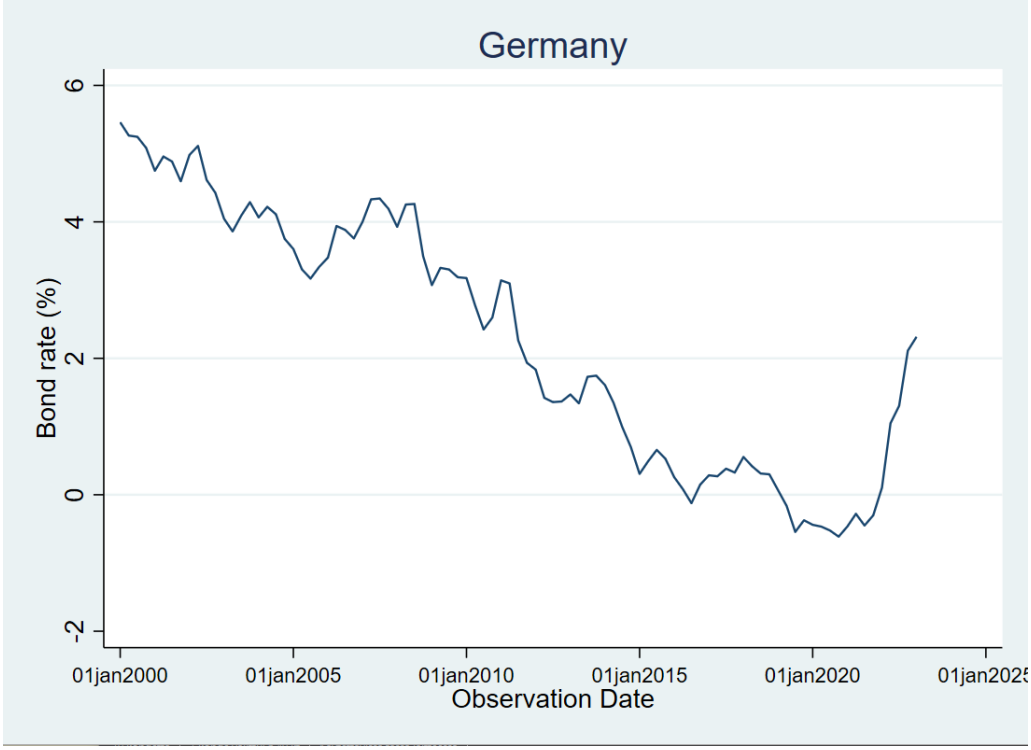
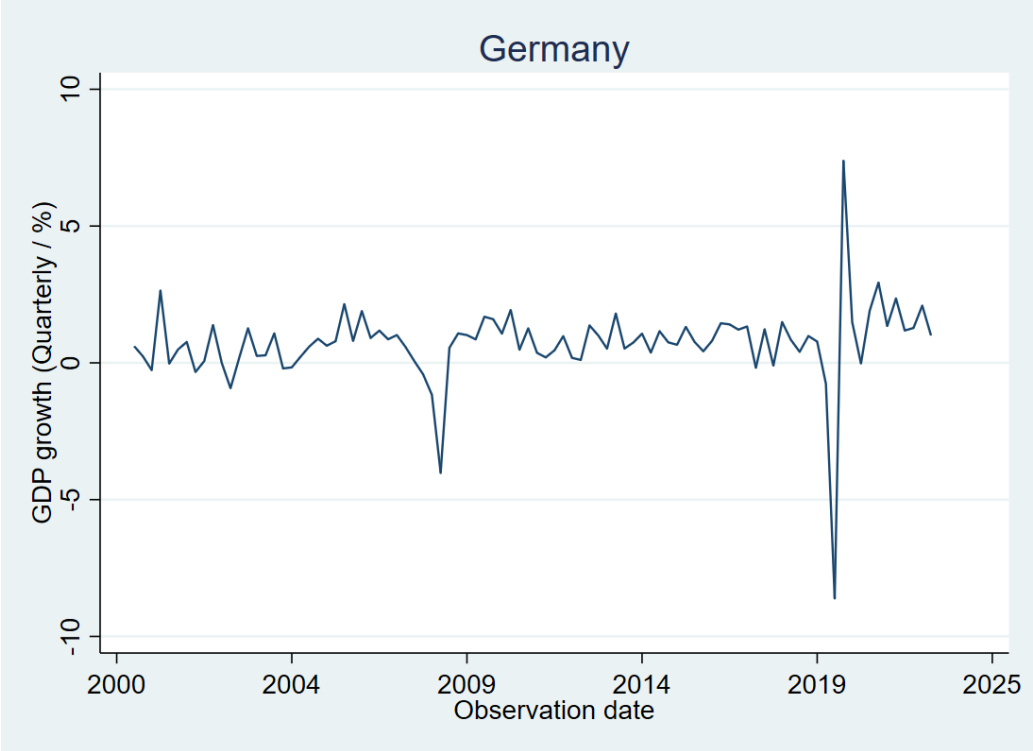
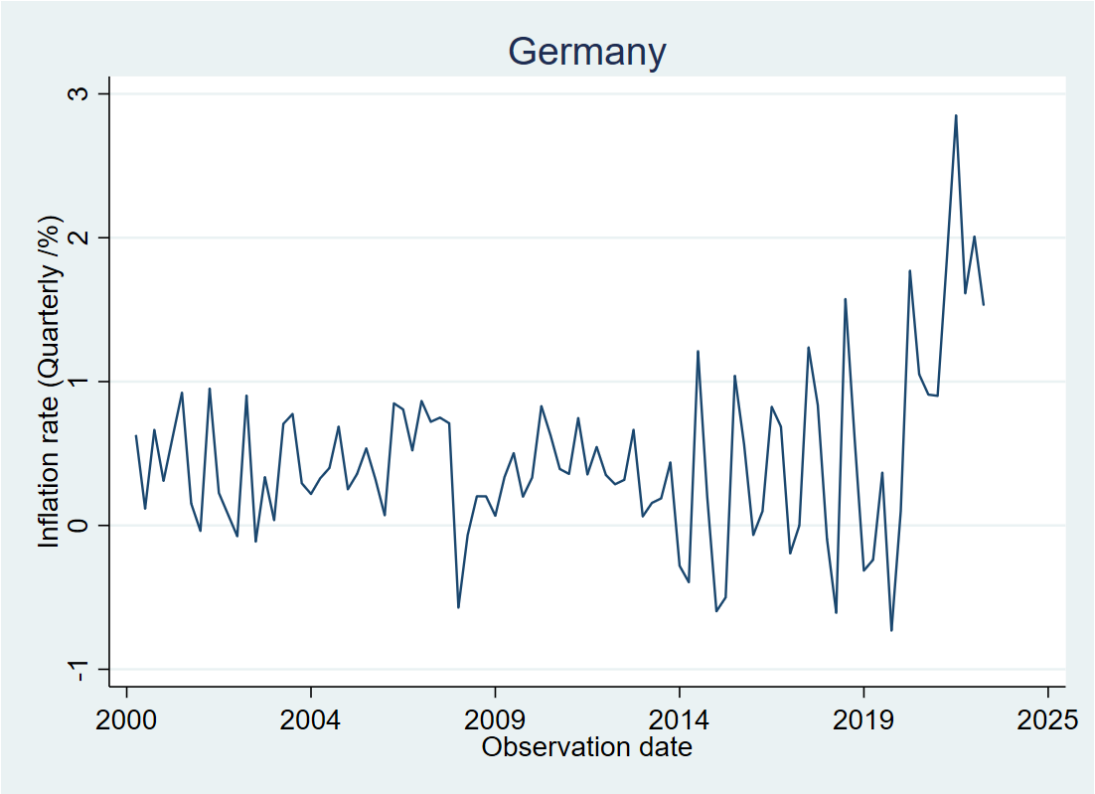
Appendices

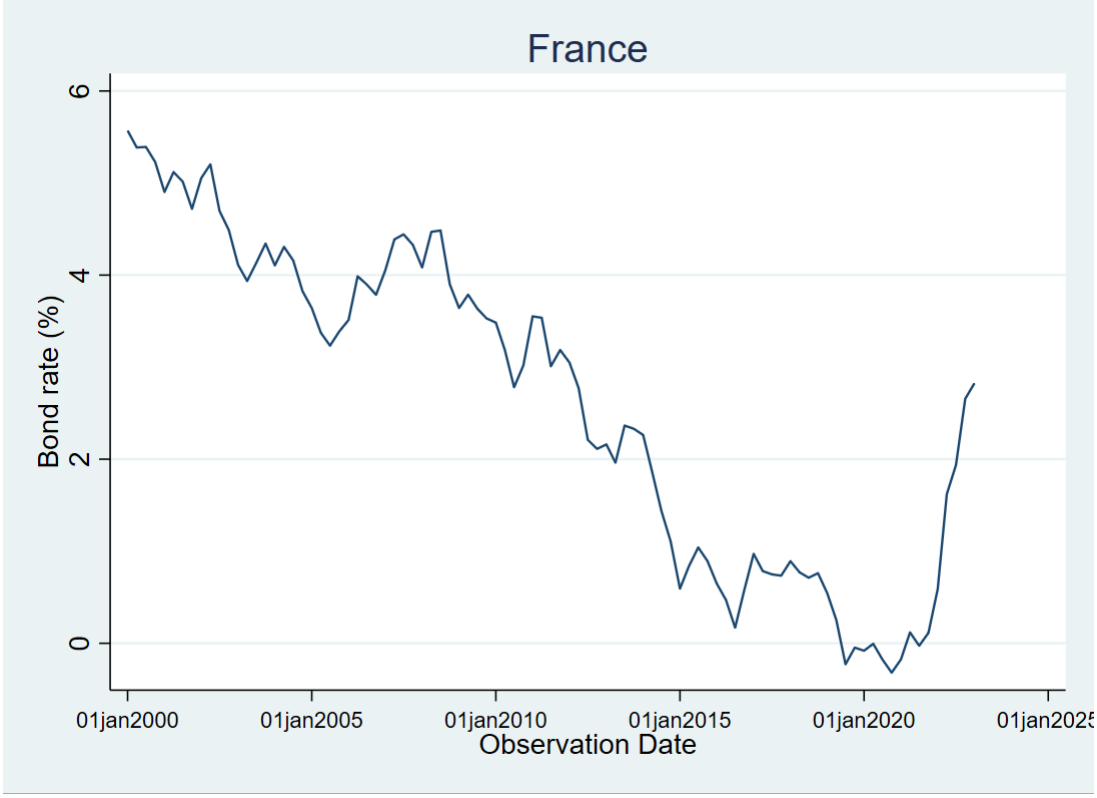
Appendix 1. Graphs of bond rate, GDP growth and inflation rate of Germany

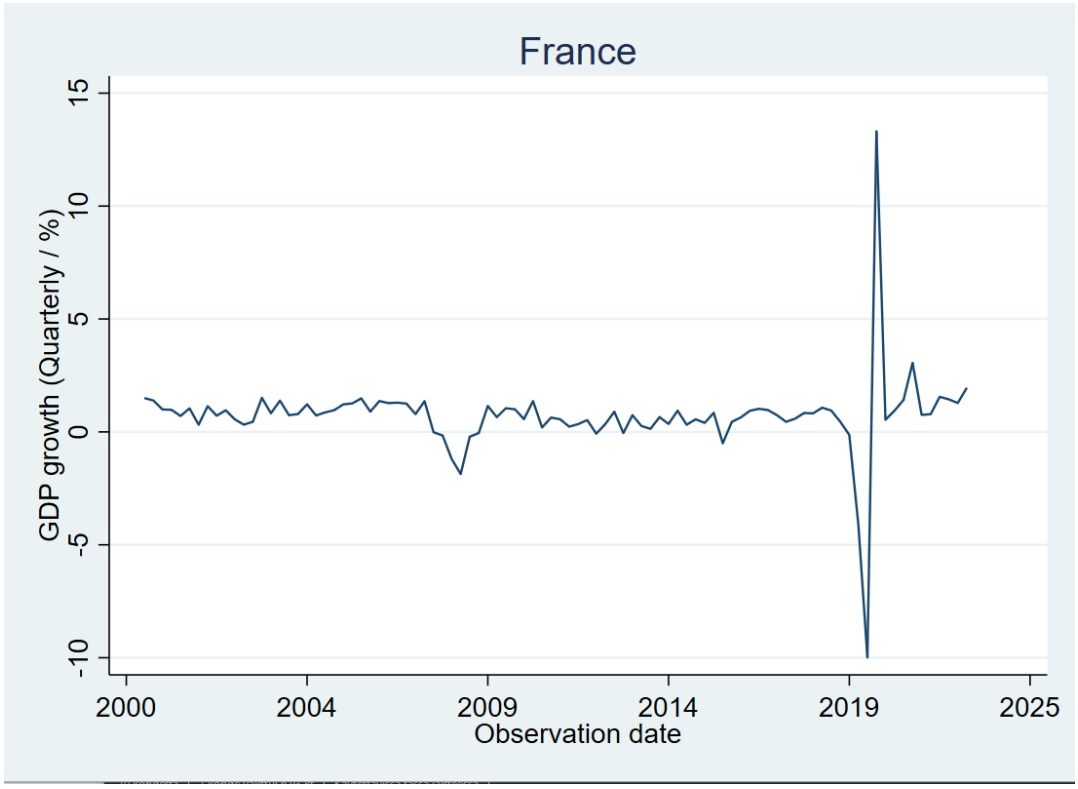


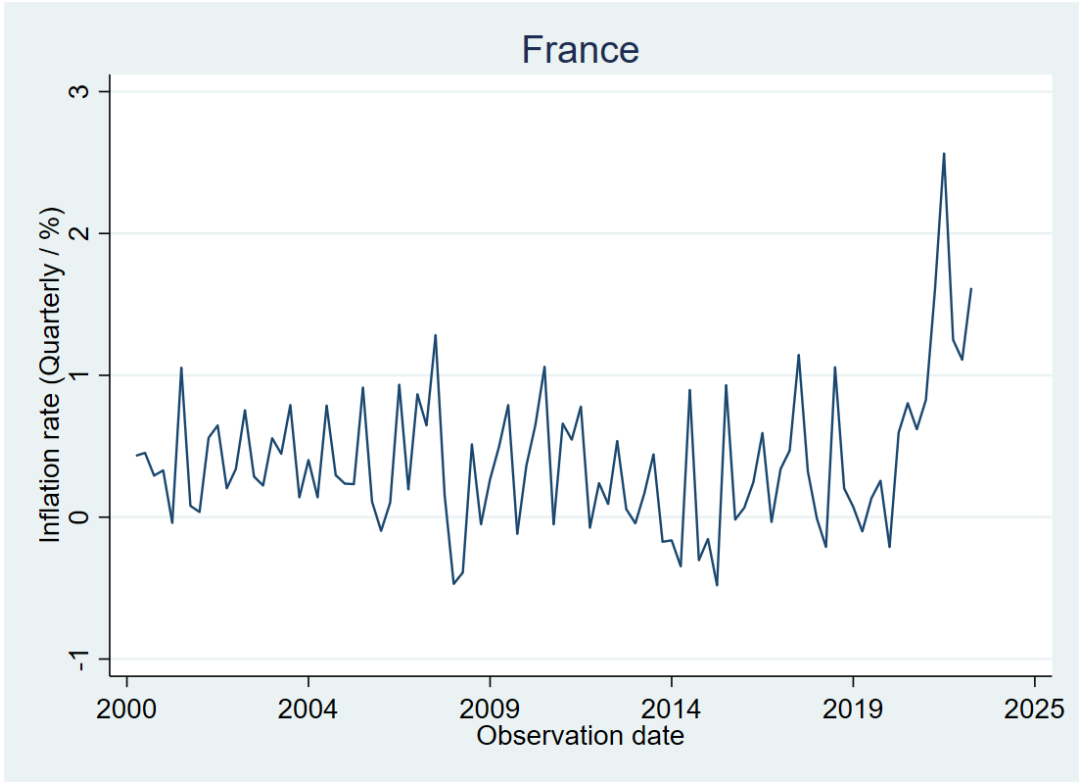




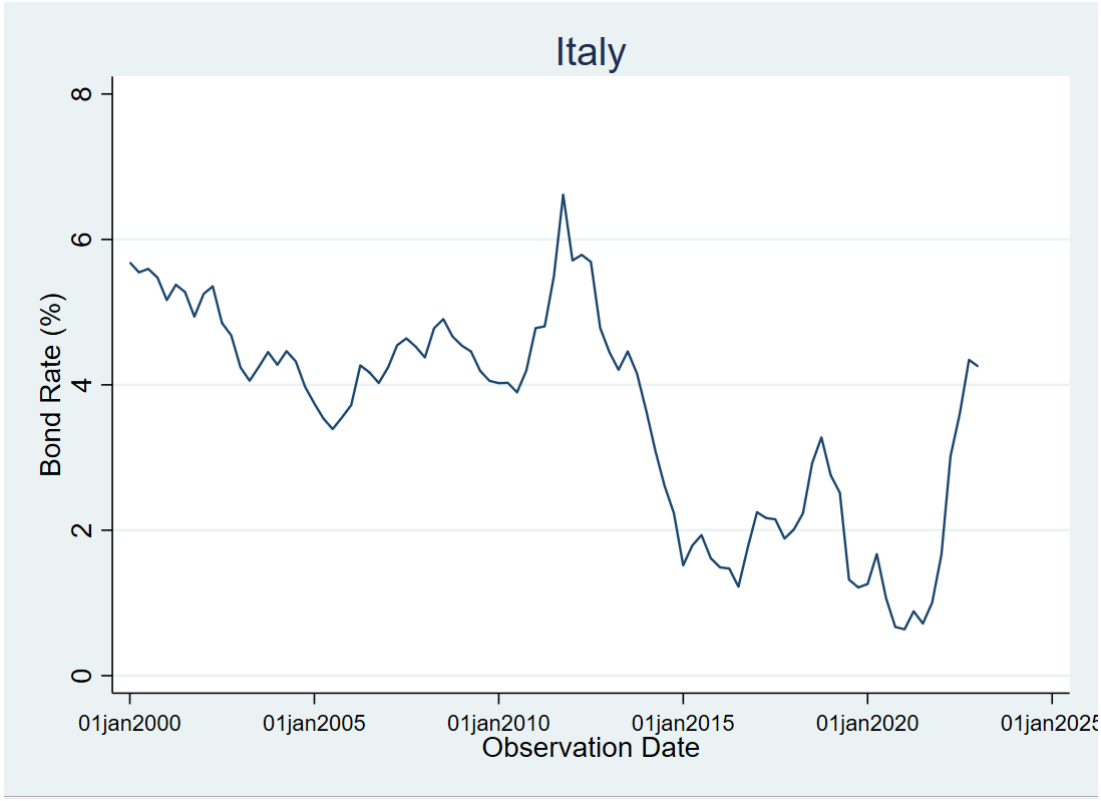
Appendix 2. Graphs of bond rate, GDP growth and inflation rate of France

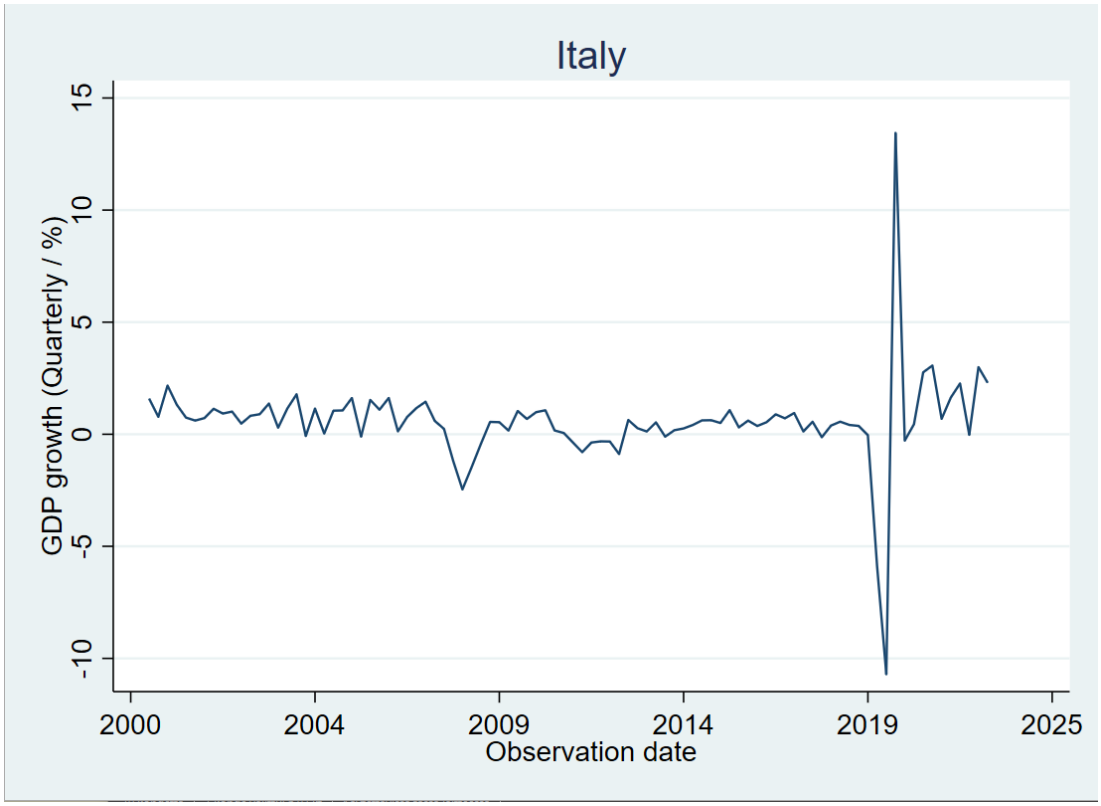


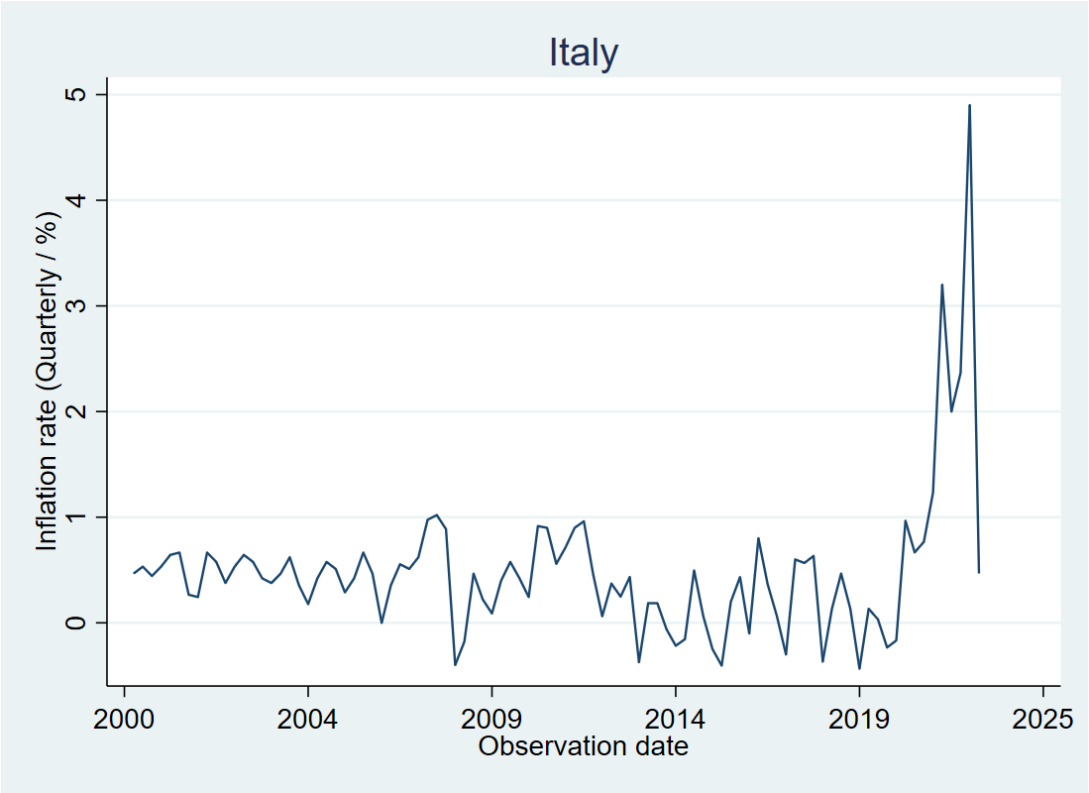

France
GDP growth (Quarterly / %)
15
10
5
0
-5
-10
2000
2004
2009
2014
2019
2025
Observation date


France
Inflation rate (Quarterly / %)
3
2
1
0
-1
2000
2004
2009
2014
2019
2025
Observation date

Appendix 3. Graphs of bond rate, GDP growth and inflation rate of Italy







Appendix 4. Graph of ECB bank rates