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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

BEYOND DEVELOPED AND EMERGING: UNPACKING POLICY-LENDING RATE DISCONNECTIONS AND INFLATION IN TURKIYE WITH A DIVERSE GLOBAL CAST

GELİŞMİŞ VE GELİŞENİN ÖTESİNDE: TÜRKİYE VE FARKLI KÜRESEL OYUNCULARDA POLİTİKA FAİZİ VE ENFLASYON İLİŞKİ KOPUŞUNU ANLAMAK

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Abstract

This study explores the gap between central bank policy rates and commercial lending rates across developed and emerging economies (Türkiye, UK, US, Italy, Spain, Germany, France). It focuses on the period 2003-2023, highlighting Türkiye's persistent divergence and its link to currency depreciation. The research emphasizes the role of past inflation experiences (adaptive expectations) in shaping current borrowing costs and inflation expectations. This dynamic is particularly relevant in economies with volatile currencies, where lenders demand higher rates to compensate for inflation risks. By understanding these complex interactions, policymakers can develop more effective tools to manage inflation and promote financial stability.

Keywords: Policy-lending rate divergence, adaptive expectations, monetary policy transmission mechanism, SVAR

JEL Classifications: C3, E44, E43, E5

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Öz

Bu çalışma, gelişmiş ve gelişmekte olan ekonomilerde (Türkiye, İngiltere, ABD, İtalya, İspanya, Almanya, Fransa) merkez bankaları politika faizleri ile kredi faizleri arasındaki ayrışmayı incelemektedir. Makale, 2003-2023 dönemine odaklanarak, Türkiye'deki sürekli farklılaşmaya ve bunun döviz kuru değer kaybı ile bağlantısına dikkat çekmekte ve geçmiş enflasyon deneyimlerinin (adaptif beklentiler) mevcut borçlanma maliyetlerini ve enflasyon beklentilerini şekillendirmede oynadığı role vurgu yapmaktadır. Bu durum, tasarruf sahiplerinin enflasyon risklerini telafi etmek için daha yüksek faiz oranları talep ettiği, kuru oynak ekonomilerde özellikle önemlidir. Bu karmaşık etkileşimleri anlayarak, politika yapıcılar enflasyonu yönetmek ve finansal istikrarı sağlamak için daha etkili araçlar geliştirebilecektir.

Anahtar Kelimeler: Politika faizi-kredi faizi ayrışması, adaptif beklentiler, para politikası, aktarım süreçleri, SVAR

JEL Sınıflandırmaları: C3, E44, E43, E5

1. Introduction

During crisis times, it is common for central banks to implement monetary policy measures to stimulate the economy and stabilize financial markets. One of the key tools used by central banks is adjusting the policy interest rates, which can influence borrowing and lending rates in the economy.

Central banks play a vital role in managing a country's economy. One of the primary tools they use to influence economic activity is the policy rate. The policy rate, also known as the key interest rate, is the rate at which the central bank lends money to commercial banks. When the central bank lowers the policy rate, commercial banks can borrow funds at a lower cost, which can encourage them to lend more to consumers and businesses. This can lead to an increase in the money supply and potentially stimulate economic growth. On the other hand, when the central bank raises the policy rate, borrowing becomes more expensive for commercial banks, which can lead to a decrease in lending activity and a tightening of credit conditions. This can lead to a decrease in the money supply and potentially slow down economic activity.

However, the impact of the policy rate on money lending can also be influenced by other factors such as inflation expectations, exchange rate movements, and global economic conditions. In addition, the behaviour of lenders and borrowers can also play a role in how the policy rate affects money lending. For example, if lenders are hesitant to lend due to concerns about borrower creditworthiness or economic uncertainty, then even a lower policy rate may not lead to a significant increase in lending activity.

In some cases, the interest rates charged by banks to borrowers may diverge from the policy rates set by the central bank. There are several factors that can contribute to this divergence. One of the main reasons is that during a crisis, banks may face increased risks and uncertainty, which can make them more cautious in lending. This can lead to an increase in the risk premium charged by banks, which can cause lending rates to be higher than the policy rates set by the central bank.

Another factor that can contribute to the divergence is the availability of funding for banks. During a crisis, funding markets may become disrupted, which can make it more expensive for banks to borrow money. This can lead to an increase in the cost of funding for banks, which can be reflected in higher lending rates.

Additionally, some banks may have a limited ability to pass on the policy rate cuts to their customers due to structural issues such as the high cost of deposits, rigid loan pricing, and limited competition. The nexus between central bank policy rates and commercial bank lending rates, though seemingly straightforward harbours intricate complexities. This article ventures into this enigmatic space, focusing on the intriguing divergence observed in countries like Türkiye, the United Kingdom, the United States, Italy, Spain, Germany, and France. While Türkiye takes centre stage, its supporting cast is carefully chosen – not based on simplistic developed-emerging market distinctions, but rather on their status as homes to preeminent central banks like the Federal Reserve, the European Central Bank, and the Bank of England. This comparative lens allows us to unravel the tapestry of policy transmission mechanisms across diverse economic landscapes.

Further enriching the tapestry is the acknowledgment of heterogeneity within the European Union. Including both manufacturing giants like Germany and France alongside service-driven economies like Italy and Spain sheds light on the interplay between economic structure and policy effectiveness. By weaving in threads of economic diversity, we aim to unveil how varying models might influence the choreography of policy and lending rates.

However, Türkiye will be our focus. By dedicating specific attention to its unique steps and rhythms, we aspire to unlock the intricate factors driving its particular divergence experience. Yet, Türkiye, though mesmerizing, does not exist in a vacuum. The broader comparative framework serves as a vital stage, showcasing how its story resonates within the global harmony of monetary policy dynamics.

To truly appreciate the complexities of this exercise, several key elements merit closer examination. Firstly, anchoring the analysis in a robust theoretical framework, be it monetary policy transmission, bank lending channels, or exchange rate effects, strengthens the foundation of our inquiry. Next, transparency regarding data sources and methodological steps is crucial, allowing others to witness the intricate footwork employed. Furthermore, delving deeper beyond broad economic characterizations and into the specificities of each country's dance moves – domestic economic conditions, financial market structures, and political considerations – reveals the nuanced choreography shaping their divergence.

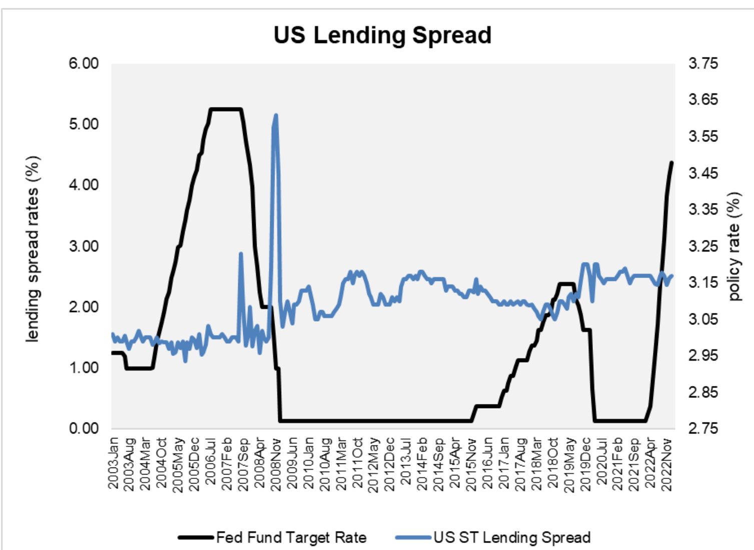
The relationship between major central banks and smaller-market counterparts like the Central Bank of Türkiye (CBT) presents a captivating dynamic. While conventional wisdom suggests that emerging market central banks, facing higher inflation and financial volatility, should closely observe the decisions of their established counterparts, the reality for the CBT in recent years has been far more nuanced. This paper delves into the complex interplay between external influences and domestic imperatives in shaping the CBT's policy rate decisions, with particular focus on the unorthodox policy choices of the past two years and their inflationary consequences.

While it is undeniable that the CBT monitors the actions of prominent players like the Federal Reserve and the European Central Bank, attributing its policy decisions solely to their lead would be an oversimplification. Distinct economic realities dictate divergent paths. Türkiye, grappling with significantly higher inflation than developed economies, necessitates policy tools geared specifically towards its domestic challenges. Furthermore, a history of political interventions has occasionally steered the CBT's course away from strict synchronization with global trends. Finally, the need to manage the Turkish Lira's exchange rate adds another layer of complexity, potentially pushing the CBT to deviate from the monetary policy symphony conducted by larger central banks.

Examining the recent past provides compelling evidence of the CBT's ability to chart its own course. Despite interest rate cuts initiated by the Fed and ECB in 2023, the CBT has remained steadfast in its policy of rate hikes, prioritizing the containment of Türkiye's rampant inflation. This divergence from its Western counterparts underscores the CBT's commitment to addressing its unique economic landscape.

However, the past two years have also witnessed a period of unorthodox policy that stands in stark contrast to this conventional image. From 2021 to 2023, the CBT embarked on a series of aggressive rate cuts, defying market expectations and contradicting established economic principles. This decision, heavily influenced by political pressure from the Turkish government, aimed to boost economic growth and prop up flagging exports. Unfortunately, the consequences were dire. The rate cuts fuelled inflationary pressures, sending Türkiye's consumer price index soaring well above 60% by November 2023[1].

Figure 1: Lending Rates and Policy Rate Walk for US



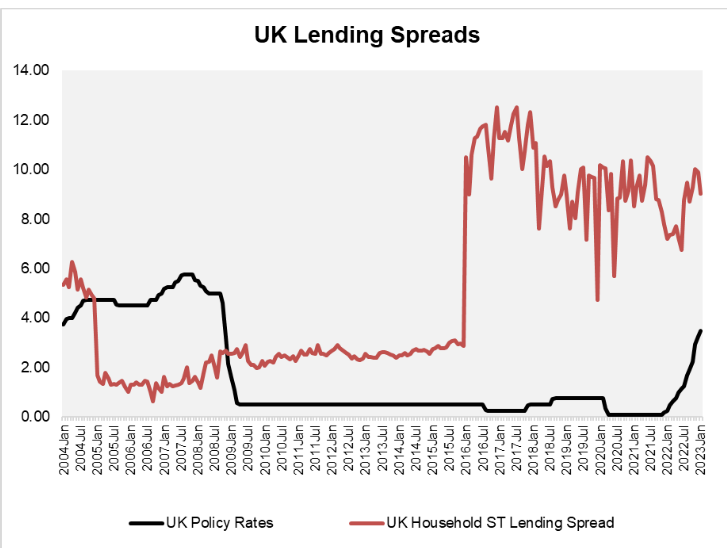
1 TURKSTAT

The divergence of bank lending rates from policy rates has been observed in United States[2] during crisis times. In Figure 1 we plot the spread between shot term lending rates and the overnight interbank rates together with the policy rate of Fed. Spreads drifted away in global financial crisis period and diverged significantly from policy rates and jumped in the aftermath of the Lehman bankruptcy but narrowed afterwards. During the global financial crisis in 2008-2009, the Federal Reserve lowered its policy interest rates to near zero to stimulate economic activity and stabilize financial markets. However, many banks in the United States faced higher funding costs due to increased risk aversion among investors. This led to an increase in the spread between their lending rates and the policy rates set by the Federal Reserve.

In the mid-2000s, the United States experienced a housing market crisis, which led to a tightening of credit conditions and a decline in economic activity. During this time, some banks tightened their lending standards and charged higher interest rates to compensate for increased risk.

Moreover, during the COVID-19 pandemic, the Federal Reserve again lowered its policy interest rates to near zero and implemented a range of measures to support the economy, such as providing liquidity support to banks and purchasing large quantities of government bonds. However, some businesses and individuals in the United States continued to face higher borrowing costs due to the economic uncertainty caused by the pandemic. This led to a divergence between the lending rates charged by some banks and the policy rates set by the Federal Reserve.

Figure 2: Lending Rates and Policy Rate Walk for UK



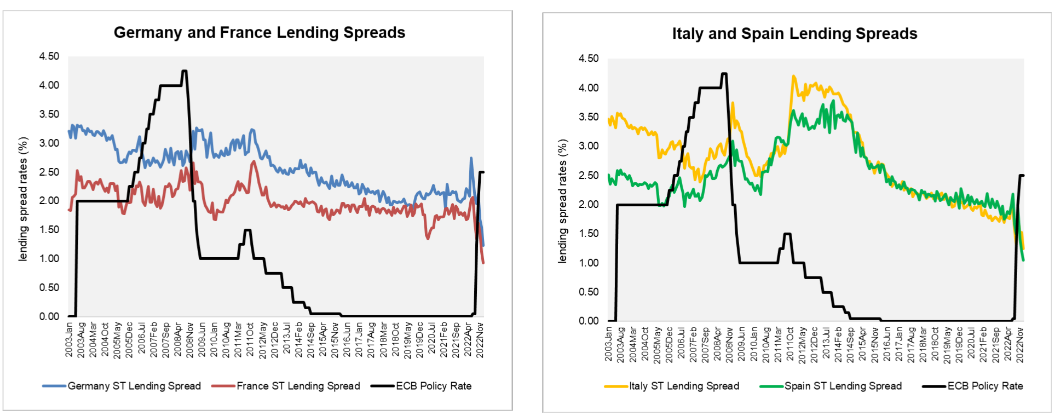
2 The Federal Reserve System, also known as the Fed, is the central bank of the United States. The Fed has used a target range for the federal funds rate as its key policy rate since 2008. The federal funds rate is the interest rate that banks charge each other for overnight loans. In 2021, the Fed's target range for the federal funds rate was 0.00-0.25%. The Fed has kept rates low to stimulate economic activity in response to the COVID-19 pandemic.

In United Kingdom (UK), by contrast with US spreads increased right after Lehman bankruptcy followed by the euro area sovereign debt crisis accordingly. In Figure 1 we plot the spread between shot term lending rates and the overnight interbank rates together with the policy rate of Bank of England. Following the global financial crisis of 2008, the Bank of England also lowered its policy rate to historic lows in order to stimulate lending and economic growth. But many banks did not pass on these rate cuts to their customers in the form of lower lending rates. Instead, they increased the margins they charged on loans, leading to a significant divergence between policy rates and lending rates. Likely, during COVID-19 pandemic the Bank of England has again lowered its policy rate in response to the economic disruption, but some banks have been slow to lower their lending rates in line with the policy rate cuts which has led to concerns that the benefits of the policy rate cuts may not be fully passed on to borrowers, particularly those in more vulnerable economic circumstances (Figure 2).

European countries have also faced the divergence of bank lending rates from policy rates has during crisis times. In Figure 3 we plot the spread between shot term lending rates and the overnight interbank rates of Germany, France, Italy and Spain together with the policy rate of ECB.

In Eurozone crisis between 2011 and 2012, many countries in the region, such as Greece, Portugal, and Spain, faced high borrowing costs as investors became concerned about their ability to repay their debts. As a result, banks in these countries faced higher funding costs, which led to an increase in the spread between their lending rates and the policy rates set by the European Central Bank (ECB)[3]. Consequently, Italy faced a banking crisis in 2016-2017, with a high level of non-performing loans and weak profitability in the banking sector. Finally, Italian banks faced higher funding costs, which led to an increase in the spread between their lending rates and the policy rates set by the ECB.

Figure 3: Lending Rates and Policy Rate Walk for Germany, France, Italy and Spain



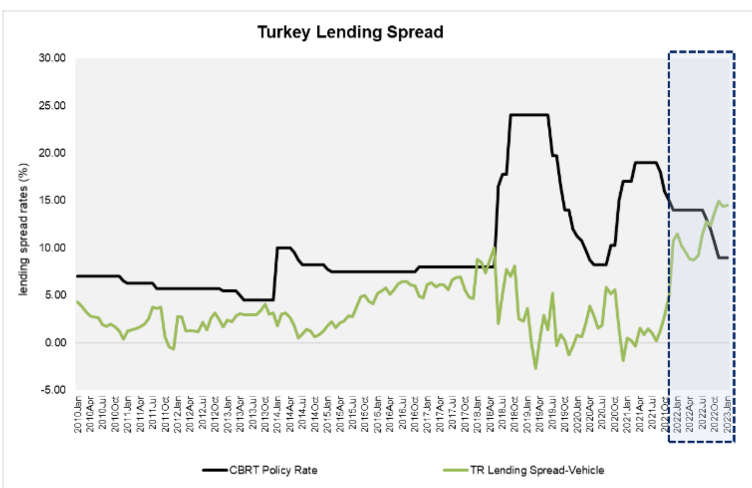
3 The European Central Bank (ECB) holds the responsibility for managing the monetary policy in the Eurozone, which encompasses 19 European Union (EU) member states that have embraced the euro as their currency. To determine its key policy rate, the ECB relies on the interest rate applied to its primary refinancing operations. Throughout 2021, the ECB's main refinancing rate remained at 0.00%. Additionally, the ECB has maintained low interest rates to aid the economic recovery from the pandemic.

Finally, COVID-19 pandemic also had a significant impact on European banking sector. The ECB introduced a range of measures to support the economy, including lowering policy interest rates and providing liquidity support to banks. But some European countries, such as Italy and Spain, continued to face higher borrowing costs due to concerns about their fiscal sustainability. As a result, banks in these countries faced higher funding costs, which led to a divergence between their lending rates and the policy rates set by the ECB.

While developed economies such as US, UK, Germany, France, Italy, and Spain reacted major crisis like global financial, Eurozone crisis, banking crisis and COVID-19 pandemic, Türkiye employed unorthodox approaches. In Figure 4 we plot the spread between shot term lending rates and the overnight interbank rates of Türkiye together with the policy rate of CBRT. While personal finance, vehicle and house lending rate spreads continue to increase after 2022, only commercial lending rate spreads narrow down.

Especially, in recent years, the Central Bank of the Republic of Türkiye has implemented a series of policy rate cuts to stimulate lending and economic growth. However, many banks have not passed on these rate cuts to their customers in the form of lower lending rates. Instead, they have increased their profit margins, leading to a significant divergence between policy rates and lending rates. Moreover, political instability and economic uncertainty in Türkiye have also contributed to the divergence of bank lending rates from policy rates. Due to unorthodox Turkish economic experiment, banks become more cautious about lending and require higher interest rates to compensate for perceived risks. This has led to a widening gap between policy rates and lending rates, as banks seek to maintain their profit margins and manage their risks. Finally, the structure of the banking sector in Türkiye is also another important point. A relatively small number of banks dominate the market, which can limit competition and give banks more pricing power.

Figure 4: Lending Rates and Policy Rate Walk for Türkiye



In addition, low interest rates have contributed to higher inflation in Türkiye in recent years, although the relationship between the two variables is complex and dependent on various factors. The Central Bank of the Republic of Türkiye (CBRT) has pursued a policy of low interest rates in recent years in order to stimulate economic growth and support employment. However, this has also led to higher inflation, which has been a major concern for the government and the public. According to data from the Turkish Statistical Institute (TUIK), inflation in Türkiye reached a peak of 36.1% in October 2018, but has since jumped to 64.27 % in 2022. Despite this improvement, inflation major challenge for the Turkish economy, as it erodes the purchasing power of consumers. As of February 2023, inflation rate stood at 55.18 percent. In this period Türkiye's policy rate essentially remained idle.

By meticulously addressing these points and enriching the analysis with relevant data, theoretical frameworks, and empirical tools, this article aspires to become a valuable contribution to the ongoing scholarly conversation on policy and lending rate divergences. Ultimately, we aim to not only shed light on this complex phenomenon in the specific case of Türkiye but also to contribute to the understanding of its global choreography, ensuring that monetary policy continues to serve as a harmonious melody guiding economic prosperity.

The CBT's recent policy missteps serve as a cautionary tale, highlighting the dangers of prioritizing political expediency over sound economic fundamentals. Blindly mimicking major central banks can be equally perilous, ignoring the specific needs and realities of the domestic economy. Therefore, the optimal strategy for the CBT lies in navigating a delicate middle ground, carefully considering both external influences and internal imperatives to formulate policy decisions that effectively promote both economic stability and sustainable growth.

Moving forward, the CBT must strive to regain its credibility and establish itself as an independent institution guided by data and economic principles. This will require not only resisting political pressures but also demonstrating a clear commitment to transparency and accountability in its policy decisions. Only through such measures can the CBT effectively steer Türkiye's economy toward a future of stable prices and balanced growth.

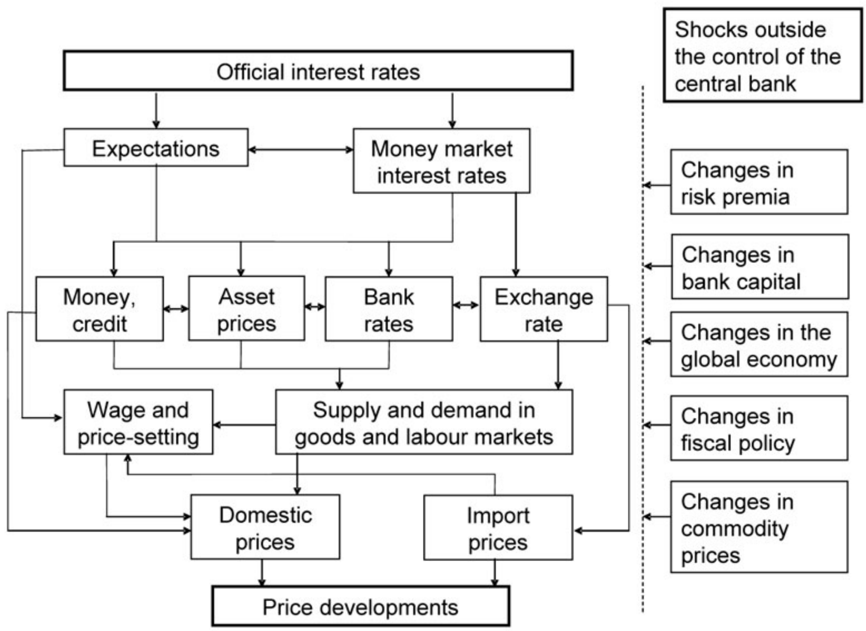
2. Literature

This part is composed of three major relationship duals, policy rates lending rates, lending rates and inflation, adaptive expectations theory and inflation[4]. This study builds upon the frameworks of Bernie (2012) and Illes and Lombardi (2013) to decompose lending spread movements into three key components, thereby illuminating the primary drivers for select countries. Through Figures 6, 7, and 8, we will delve into the dynamic interplay between these components and examine how pivotal events such as the 2008 global financial crisis, the 2011 European banking crisis, Brexit, and Türkiye's unorthodox monetary policies have reshaped the primary drivers of lending rate spreads. This analysis sheds light on a crucial element within the transmission mechanism of monetary policy.

4 Endogeneity of inflation and adaptive expectation is theoretically covered in Appendix A and accepted as given in the main text.

Having said that Figure 5 describes how the economy overall and, specifically, the price level is influenced by decisions related to monetary policy. The transmission mechanism is marked by extended, fluctuating, and unpredictable time delays. Consequently, accurately forecasting the specific impact of monetary policy measures on the economy and price level is challenging. The diagram below offers a visual representation of the primary transmission channels associated with monetary policy decisions.

Figure 5: Transmission mechanism of monetary policy



Source: European Central Bank

In the realm of monetary policy, the central bank assumes the role of providing funds to the banking system with the imposition of interest rates. Given its exclusive authority in money issuance, the central bank exercises full control over determining these interest rates. Anticipations of forthcoming adjustments in the official interest rates contribute to the shaping of medium and long-term interest rates. Graboswki and Stawasz-Grabowska (2021) concluded that the European Central Bank's monetary policy also affected they equity markets of the Czechi Hungary and Poland while Han and Kim (2022) investigate the effect of monetary policies in three countries on the Korean stock market.

Specifically, projections of future short-term rates play a crucial role in influencing longer-term interest rates. Monetary policy extends its impact beyond mere interest rates, guiding the expectations of economic agents regarding future inflation, thereby shaping the trajectory of price developments. The credibility of a central bank plays a pivotal role in firmly anchoring expectations of price stability among economic agents. In instances where a central bank commands high credibility, economic agents are relieved from the necessity of adjusting their prices in response to the fear of escalating inflation or deflationary pressures. Moreover, alterations in policy rates can differentially affect the marginal cost of obtaining external finance for banks, contingent on their individual resources or capital levels. This dynamic becomes particularly salient in challenging times, such as during a financial crisis, when capital becomes scarce, and banks encounter heightened difficulties in capital acquisition.

In tandem with the conventional bank lending channel, which primarily concerns the quantity of loans supplied, a risk-taking channel may also be in play, influencing banks' propensity to bear risks associated with loan provision. The risk-taking channel operates through two principal mechanisms. Firstly, low interest rates contribute to the augmentation of asset and collateral values. This, coupled with the perception of the sustainability of the increase in asset values, induces both borrowers and banks to embrace higher risks. Secondly, the allure of riskier assets intensifies as low interest rates prompt agents to seek higher yields. For banks, these twin effects commonly manifest in a relaxation of credit standards, potentially leading to an unwarranted surge in loan supply.

In this context, inflation is a significant economic challenge that impacts various aspects of an economy, including interest rates, exchange rates, and fiscal policies. Soft currency economies that experience high inflation rates tend to face significant challenges in maintaining policy rates and lending rates at similar levels. This literature review aims to explore the divergence of policy rates and lending rates in soft currency economies that experience high inflation rates. The divergence of policy rates and lending rates has been a persistent problem in developing countries that experience high inflation rates. This issue was first highlighted in the 1980s when countries like Mexico and Argentina experienced significant macroeconomic imbalances due to high inflation rates. The central banks in these countries struggled to maintain interest rates that were commensurate with the high inflation rates, leading to significant divergence between policy rates and lending rates. An essential question revolves around the possibility of a structural shift occurring in the relationship between lending rates and the policy rates established by central banks. According to Hristov et al. (2014), prior to the financial crisis, the interest rate pass-through demonstrated a generally complete impact. However, after the crisis, this impact became significantly distorted, limiting the effectiveness of monetary policy.

Ornek (2009) investigates the effectiveness of different monetary policy channels in influencing output and prices in Türkiye by using a VAR model and data from 1990-2006. The study shows that traditional interest rate and exchange rate channels appear to be effective in transmitting monetary policy shocks. However, evidence for equity price and bank credit channels is not statistically significant. In essence, raising interest rates and/or appreciating the Turkish Lira can effectively cool the economy and reduce inflation, while other channels seem less impactful. Peker and Canbazoglu (2011) found the bank lending channel works effectively, particularly when influenced by controlling money supply (rather than overnight interest rates) by using a VAR model and data from 1990-2006, which means the Turkish Central Bank can effectively manage output and inflation by controlling money supply. On the other hand, Von Borstel et al. (2016) argue that the transmission of conventional monetary policy to bank lending rates remained unchanged despite the global financial crisis. Nevertheless, they observed a change in the composition of the pass-through. Their research emphasizes the importance of reintroducing competition in the banking sector and concludes that unconventional monetary policy is not the appropriate tool to reduce margins during crisis periods. Holton and Rodriguez d'Acri (2015) discovered that in financially stressed countries, increases in sovereign bond yields have a considerable impact on the cost of financing for firms. Moreover, during the crisis period, adjustments in policy rates only partially transmit to firms' lending rates. Furthermore, they found that smaller loans experience a lower overall pass-through of policy rate cuts. Consequently, small and medium-sized enterprises (SMEs) bear a greater negative impact due to the fragmented transmission of monetary policy. According to Albertazzi et al. (2014), fluctuations in the BTP-Bund spread significantly influence the interest rates on term deposits and newly issued bonds. This indicates that investors exhibit greater sensitivity to perceived risk when committing to longer-term investments. On the other hand, the spread has a negligible effect on overnight deposits, which are considered short-term and less risky in nature.

Aysan et al. (2014) delves into the realm of unconventional monetary policy in Türkiye, highlighting two novel tools introduced within the new framework: the asymmetric interest rate corridor and the reserve option mechanism (ROM). From a capital flows perspective, the corridor mitigates fluctuations in foreign fund supply, while the ROM serves to dampen movements in demand for these funds. Both tools have witnessed extensive application by the Central Bank of the Republic of Türkiye (CBRT) and are seemingly effective in curbing financial stability risks associated with excessively volatile capital flows.The CBRT has, through its internal research team, fostered a substantial body of literature dedicated to this novel policy framework. Key contributions include works by Başcı and Kara (2011), Kılıç et al. (2012), Akçelik et al. (2013a, 2013b), and Alper et al. (2013). While Aysan et al. (2013) and Binici et al. (2013a) provide overall empirical assessments, other studies focus on specific tools. Binici et al. (2013b) shed light on the interest rate corridor, Oduncu et al. (2014) delve into additional tightening measures, and Alper et al. (2012), Kucuksarac and Özel (2012), Degerli and Fendoglu (2013a, 2013b), and Oduncu et al. (2013) dissect the ROM in detail. Furthermore, Avcı and Yücel (2017) employ an interacted vector autoregressive (IVAR) approach to investigate the effectiveness of monetary policy in Türkiye through the lens of interest rate pass-through. Their findings indicate complete transmission of policy-induced rate changes to deposit and credit rates within eight months. Additional factors affecting pass-through include banking sector competition, liquidity, and profitability, dollarization, exchange rate flexibility, inflation, and term structure, which exert positive influences. Conversely, regulatory quality, GDP growth, monetary growth, industrial growth, and capital inflows exhibit negative impacts. This study breaks new ground by establishing a direct linkage between monetary policy and inflation. Moreover, it offers a novel analytical approach by decomposing the spread between lending rates and policy rates to gain deeper insights into the dynamics of this relationship.

The policy interest rate is often considered endogenous because it can be influenced by various economic factors, including the current level of inflation, economic growth, and financial market conditions. Similarly, the inflation rate is also considered an endogenous variable when it is influenced by the internal workings of the economy, such as changes in output, unemployment, or wages. For example, if an increase in output leads to a rise in demand for labor, then wages may increase, leading to higher production costs and ultimately to higher prices and inflation. But we shall also consider that the inflation rate can also be considered exogenous when it is influenced by factors outside the economy, such as changes in the international price of oil or the value of the exchange rate.

Gilchrist and Zakrajsek's (2012) discuss the relationship between financial stress and economic activity. According to their findings, financial stocks can cause a widening of credit spreads, a slowdown in economic activity, a decline in short-term interest rates, and persistent disinflation. Hence, a spread-augmented policy rule that adapts to changes in financial conditions via credit spreads can mitigate these negative effects on the real economy. By using credit spreads as an indicator of changes in financial conditions, monetary policy can be adjusted to reduce the impact of financial shocks on the economy. The relationship between interest rates and inflation is a fundamental concept in economics. The origin of the interest rate-inflation nexus studies are Wicksell (1907, 1936 [1898]). Decades later, in 1930, Fisher asserted that the nominal interest rate equals the real interest rate plus the anticipated rate of inflation. According to Fisher's hypothesis, an upsurge in the expected rate of inflation results in a corresponding increase in the nominal interest rate. This principle forms the fundamental regulatory equation for central banks, stemming from Fisher's theory (1930) that identifies inflation as the primary determinant of interest rates, with a one percent increase in inflation leading to a proportional rise in interest rates. Subsequently, Fama (1975) and Fama and Schwert (1977) conducted tests on the Fisher effect in the US and found supportive evidence for constant real interest rates as suggested by the hypothesis. Mishkin (1992) further confirmed Fisher's original theory concerning the relationship between interest rates and expected inflation. Similarly, Kim et al. (2018) employed a panel smooth transition regression model and arrived at the same conclusions as Mishkin (1992).

In their study, Tsong and Hachicha (2014) examined the Fisher effect's validity in four developing countries: Indonesia, Malaysia, Russia, and South Africa. They found compelling evidence supporting a long-term relationship between inflation and interest rates in these nations. However, it is essential to consider the distinction between soft and hard currency economies, as demonstrated by the example of Türkiye. Here, foreign exchange rates pose a significant challenge for managing inflation in developing countries.

According to the research of Barro and Gordon (1983), Giavazzi and Giovannini (1989), and Dornbusch (2001), adopting a fixed or stable exchange rate policy can enhance the credibility of the monetary authority. This enhanced credibility, in turn, may facilitate the task of reducing inflation effectively. A stable exchange rate regime is one of the major requirements for an efficient monetary policy and price stability as well. Şen et. al (2020) employ data for Brazil, India, Indonesia, South Africa, and Türkiye concluding that exchange rates and actual rates of inflation tend to co-move in the long – term. According to their results currency depreciation creates an inflationary impact on domestics' prices via raising the prices of imported goods.

Another important point is inflation inertia. Inflation inertia refers to the tendency of inflation to persist at its current level or rate of change, even after the factors that initially caused it to have changed or been removed. In other words, inflation can become "sticky" or resistant to change, which can make it difficult for policymakers to bring it back to their desired target levels. One reason for inflation inertia is the presence of "price stickiness" in the economy, where businesses and individuals are slow to adjust prices in response to changes in demand or supply. This can create a situation where inflation remains elevated even if the underlying factors driving it have abated. Fisher equation, as criticized by Sargent (1973), falls short in fully explaining the relationship between inflation and interest rates. However, Sargent proposed an alternative perspective, highlighting a bidirectional Granger-causality between interest rates and expected rates of inflation. In his view, the crucial aspect lies in understanding how price expectations are formed. He posited that actual inflation influences expected inflation, and in turn, exerts pressure on nominal interest rates. Furthermore, Summers (1983) rejected Fisher's hypothesis, particularly for the pre-1990 period. Empirical tests considered the potential nonstationary and cointegration of the relevant time series, leading Summers to dismiss Fisher's proposition.

In this context, adaptive expectations theory is another important issue which suggests that people form their expectations about future inflation based on their experience. They adapt their expectations based on their perception of past inflation rates. With regards to the relationship between policy rates and inflation rate, the adaptive expectations theory suggests that changes in policy rates will have an impact on inflation in the short run, but in the long run, the effect of changes in policy rates on inflation will diminish. The impact of changes in policy rates on inflation is not permanent. If the central bank consistently raises policy rates to fight inflation, people will adjust their expectations of future inflation downwards, and this will limit the effectiveness of policy rate changes in reducing inflation. Similarly, if the central bank consistently reduces policy rates to stimulate the economy, people will adjust their expectations of future inflation upwards, and this will limit the effectiveness of policy rate changes in stimulating the economy[5].

Moreover, inflation inertia leads central banks to inefficient policy rate approaches. The use of monetary policy tools poorly suits to the task of controlling inflation or fails to have the desired impact. Inefficient policy rate approaches can exacerbate inflation inertia by creating a situation where policymakers are unable to effectively manage inflation using the tools at their disposal. This can lead to a loss of credibility and trust in the central bank's ability to control inflation, which can further exacerbate inflation expectations and lead to higher inflation over the long term.

Consequently, inflation inertia and adaptive expectations can reinforce each other, leading to a self-perpetuating cycle of high inflation. This can make it difficult for policymakers to bring inflation back to their desired target levels, as they must not only address the underlying factors driving inflation but also manage expectations and change long-held beliefs about future inflation.

5 See Appendix A: Driving the endogeneity of inflation based on adaptive expectations for mathematical interpretations

3. Methodology and Data

Collecting data was challenging and problematic since the reporting frequency and segments differ across countries and the definitions of central banks are not homogenous[6]. We collected data on interest rates and inflation for United States, United Kingdom, France, Germany, Italy, Spain, and Türkiye. Data set covers between January 2003 and January 2023 for Germany, France, Italy, Spain, US and Türkiye to analyze lending rates and policy rates. For UK the dataset is available from January 2004 to January 2023. The data frequency is monthly basis and main sources are Fed, ECB, Federal Reserve Economic Data (FRED) and CBRT. In Table 1 all the variables are defined.

For the United States, data are obtained from Fed and FRED. The Overnight interbank rates correspond to the effective federal funds rates for US and bank prime loan[7] is adopted for short term lending rates. Prime is one of several base rates used by banks to price short-term business loans. For long term lending rates, we adopted 24 months personal loan, Fed fund target rate for policy rate. Policy rates is calculated as the average of upper target and lower target after December 2008. Inflation data are obtained from Fed.

Data for the United Kingdom is sourced from both the Bank of England and FRED. The information includes the monthly average of sterling weighted average interest rates for UK resident monetary financial institutions, excluding the Central Bank, specifically pertaining to other loans, new advances, and initial fixation with a maturity lower than 1 year is used for UK household short term lending rates while same rate with the maturity longer than 5 years is used for UK household long term lending rates. Monthly average of official Bank Rate is adopted for overnight rates to calculate lending margins and these rates are obtained from Bank of England. UK policy rates is obtained from FRED. Inflation data are obtained from FRED.

For the Eurozone, all lending rate, policy rate and overnight rate data are obtained from ECB Monetary Financial Institutions (MFIs) data warehouse[8]. For Germany, France, Italy, and Spain shot term lending rates are obtained for rates with maturity lower than 1 year and for households and non-financial corporations while long term lending are rates are with maturity longer than 1 year.

And finally for Türkiye, all data are obtained from The Central Bank of the Republic of Türkiye. To calculate lending margins personal finance rates are used and other rates and inflation are clearly provided by CBRT. Consequently, for Türkiye we will focus on two periods such as October

6 As an example, we considered including Argentina to the analysis as well however the data accuracy with our main data set was quite low.

7 The prime rate represents the interest rate imposed by most the country's top 25 domestic commercial banks. A noteworthy aspect is that this prime rate usually remains consistent across all banks, unlike the deposit interest rates they offer, which can significantly differ from bank to bank based on funding requirements and portfolio considerations. Although individual banks have the flexibility to adjust their prime rate according to market conditions, it generally aligns closely with prevailing market interest rates.

8 The composite cost-of-borrowing indicators utilize MFI (Monetary Financial Institutions) interest rate statistics. This metric is used to accurately assess borrowing costs for non-financial corporations and households, as well as to enhance comparability between various countries. Lending rates in each country are divided into four primary groups, encompassing short-term and long-term rates for both non-financial corporations and households.

2010-January 2023 and September 2016-January 2023 since monetary policy of Türkiye begin to ruffle after September 2016. Based on these periods by shocks to lending rates, inflation, overnight rates, policy rates and government bonds we provide impulse responses and variance decompositions to understand the impact of conventional monetary policy.

Table 1: Definitions of variables

Variable	Definition
ECB_ON	ECB Overnight Interbank rates
ECB_POLICY_RATE	ECB Policy Rate
FRANCE_ANNUAL_INFLATION	FRANCE Annual Inflation
FRANCE_GOVERNMENT_BOND_1_YEAR	FRANCE Government Bond 1_Year
FRANCE_ST_LENDING_RATE	FRANCE St Lending Rate
GERMANY_ANNUAL_INFLATION	GERMANY Annual Inflation
GERMANY_GOVERNMENT_BOND_1_YEAR	GERMANY Government Bond 1_Year
GERMANY_ST_LENDING_RATE	GERMANY St Lending Rate
ITALY_ANNUAL_INFLATION	ITALY Annual Inflation
ITALY_GOVERNMENT_BOND_1_YEAR	ITALY Government Bond 1_Year
ITALY_ST_LENDING_RATE	ITALY St Lending Rate
SPAIN_ANNUAL_INFLATION	SPAIN Annual Inflation
SPAIN_GOVERNMENT_BOND_1_YEAR	SPAIN Government Bond 1_Year
SPAIN_ST_LENDING_RATE	SPAIN St Lending Rate
TR_ANNUAL_INFLATION	TR Annual Inflation
TR_GOVERNMENT_BOND_1_YEAR	TR Government Bond 1_Year
TR_LENDING_ST_PERSONAL_FINANCE	TR Lending St Personal Finance
TR_ON	TR Overnight Interbank rates
TR_POLICY_RATE	TR Policy Rate
UK_ANNUAL_INFLATION	UK Annual Inflation
UK_GOVERNMENT_BOND_1_YEAR	UK Government Bond 1_Year
UK_ON	UK Overnight Interbank rates
UK_POLICY_RATE	UK Policy Rate
UK_ST_LENDING_RATE	UK St Lending Rate
US_ANNUAL_INFLATION	US Annual Inflation
US_GOVERNMENT_BOND_1_YEAR	US Government Bond 1_Year
US_POLICY_RATE	US Policy Rate
US_ST_LENDING_RATE	US St Lending Rate
US_ON	US Overnight Interbank rates

3.1. Decomposing lending rates

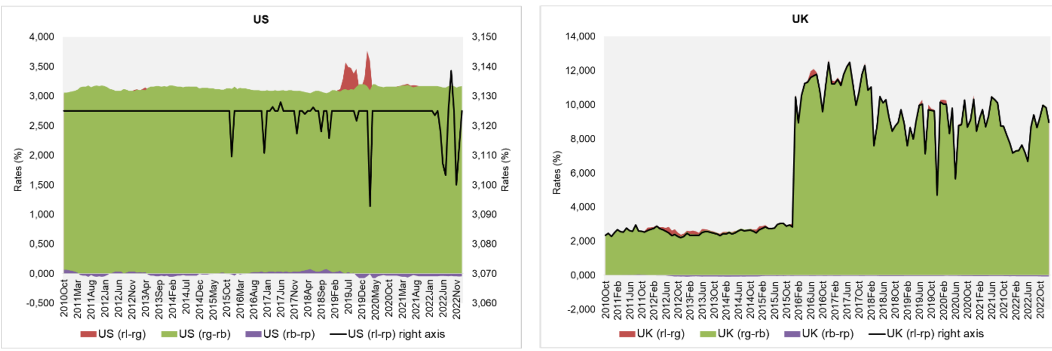
Beirne (2012) employs Euro Overnight Index Average (EOINA) while Illes and Lombardi (2013) use spread rates by decomposing lending rates in to three components such as spread between overnight and interbank rates, spread between government bonds and overnight rates and spread between overnight rates and policy rate. In our study, since the lending spread changes do not directly affect credit markets due to pass-through dynamics, we will adopt decomposition approach as well. The novelty of our paper is Illes and Lombardi (2013) covers only one important recession while our paper covers Italy banking crisis and COVID-19. For Türkiye our data also covers foreign exchange crisis and high inflation period which is the essence of this study.

Mainly, lending spread is a function of business cycles and other micro and macro factors via transmission mechanism. In this context, three components of lending spread are as formulated below:

$$r_l - r_p = (r_l - r_g) + (r_g - r_b) + (r_b - r_p)$$

where is the spread between lending rate and policy rate, is the spread between lending rate and one year government bond, is the spread between one year government bond and overnight interbank rate, and is the spread between overnight interbank rate and policy rate.

Figure 6: Decomposition of the lending spread for US and UK

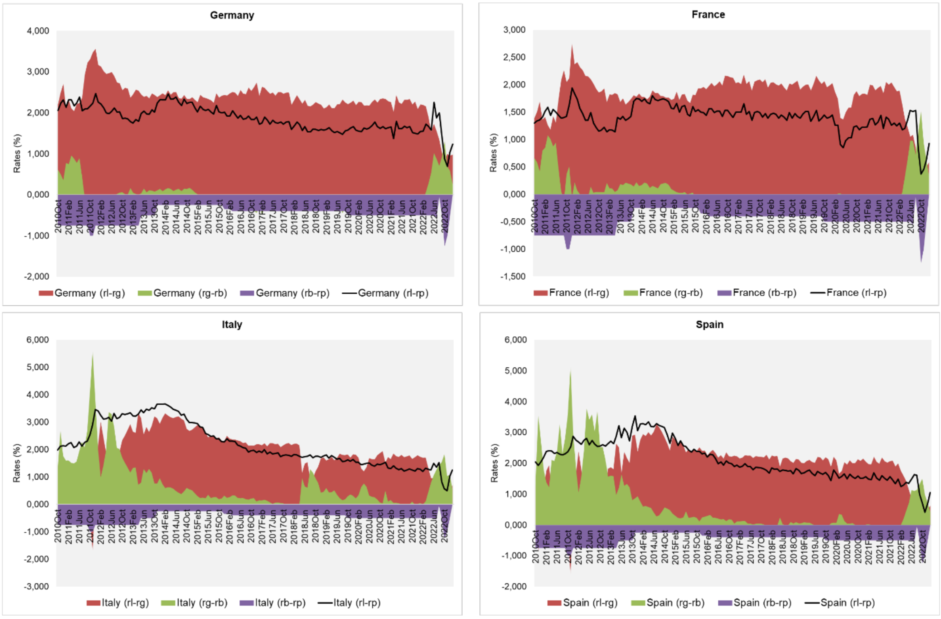


In Figure 6, we show the evolution of lending spread components for US and UK. Firstly, in Figure 1, 2 and 3 during global financial crisis period the spread between lending rates and overnight rates has widened. In contradiction with lending rates, due to central banks' monetary policy, policy rates have dropped. Likewise, during Covid-19 period spread between lending rates and policy rate drops drastically however, right after pandemic global inflation risk has taken over the markets and Fed increased policy rates gradually to control inflation.

For UK the fluctuation is more frequent because of Brexit[9]. Brexit led to increased uncertainty and volatility in the UK economy, which put upward pressure on lending rates as lenders demand higher returns to compensate for increased risk. However, the BoE supported the economy by cutting interest rates or implementing other monetary policy measures, which helped keeping lending rates low till Covid-19. Risk on government bonds (green area), played a significant role in the widening of lending spreads in UK after Brexit.

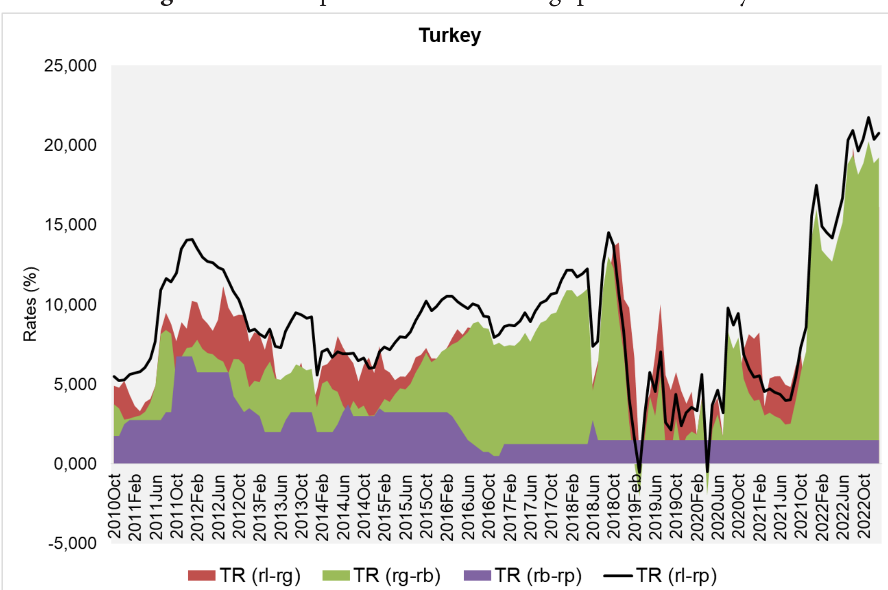
9 The Brexit referendum was initiated by the former Prime Minister of the United Kingdom, David Cameron, who pledged to hold a referendum on EU membership during his 2015 re-election campaign. The referendum asked voters whether the UK should leave the EU or remain a member. On June 23, 2016, the UK made the decision to exit the EU, with 51.9% of the votes in favour and 48.1% against. The outcome of the referendum came as a surprise to numerous individuals, given that the UK had been an EU member since 1973 and had actively influenced EU policy during that period. The process of leaving was finalized on January 31, 2020, officially marking the UK's departure from the EU.

Figure 7: Decomposition of the lending spread for Germany, Italy, France and Spain



In Figure 7, we show the evolution of lending spread components for Germany, France, Italy, and Spain. Government bond yields (red area) clearly plays a significant role in the widening or narrowing of lending spreads in Germany and France. In Italy and Spain, risk on government bonds (green area) also have an important impact on lending spread along with government bond yields.

Figure 8: Decomposition of the lending spread for Türkiye



In Figure 8, we show the evolution of lending spread components for Türkiye. Risk on government bonds (green area) clearly plays a significant role in the widening or narrowing of lending spreads in Türkiye after 2016. Between 2010 and 2016 government bond yields (red area) and spread between the overnight interbank rate and the policy rate explains the bulk of the lending spread due to the interest rate corridor[10] applications of CBRT. Under the interest rate corridor system, the central bank sets two interest rates: the overnight lending rate and the overnight borrowing rate. These rates form a corridor around the policy rate, which is the main interest rate set by the central bank to guide monetary policy.

The CBRT uses this system to influence short-term interest rates in the economy. By adjusting the overnight lending and borrowing rates, the central bank can influence the supply of and demand for money in the economy, and thereby influence short-term interest rates. Since the implementation of the interest rate corridor system, the CBRT has adjusted its policy rates and the corridor width numerous times to achieve its monetary policy objectives, such as maintaining price stability and supporting economic growth. However, in 2018, the CBRT introduced a simplified framework for its interest rate corridor, which involved setting a single policy rate and using overnight borrowing and lending rates as operational tools.

3.2. Structural VARs

There are many econometric models that can be used to study the relationship between policy rates and lending rates divergence. Some examples of econometric models that have been used in empirical studies are Vector Autoregression (VAR) Model, Structural Vector Autoregression (SVAR) Model, Error Correction Model (ECM) and Granger Causality Model. Hence, there are various studies that employ different econometric models and datasets to explore the relationship between policy rates and lending rates divergence in different countries and regions which provide insights into the factors that affect this divergence, as well as its implications for monetary policy and financial stability.

In this study, Structural Vector Autoregression, is chosen to analyze the relationship between policy rates and lending rates due to its ability to identify structural shocks and capture dynamic effects over time. By allowing for the simultaneous modeling of the relationships between variables, SVAR helps address endogeneity concerns, especially in the context of policy rates and lending rates, which are likely to be mutually influenced. This methodology proves valuable in understanding the causal links between changes in policy rates and their impacts on lending rates. Furthermore, SVAR enables the simulation of policy interventions, providing insights into potential outcomes and assisting policymakers in assessing the effects of different actions. Its capacity to model complex interactions

10 The interest rate corridor is a monetary policy tool used by central banks to manage short-term interest rates in the economy. The Central Bank of Turkey (CBRT) also employs this tool to achieve its monetary policy objectives. The Central Bank of Turkey (CBRT) has been using the interest rate corridor tool since January 2010. Prior to that, the CBRT had used a different monetary policy framework, known as the "monetary targeting" framework, which was based on targeting a specific level of money supply growth. However, the CBRT switched to the interest rate corridor system in order to improve its ability to manage short-term interest rates and respond to changing economic conditions.

in economic systems makes SVAR a versatile tool for researchers exploring the intricate dynamics between policy rates and lending rates.

In this section we will briefly explain the relationship between VARs and structural models. Assume that we would like to estimate inflation rate according to certain interest rates in the market and previous period's inflation level. The following specification will represent price level changes:

$$P_t - P_{t-1} = \beta_0 + \beta_1 r_g + \beta_2 r_l + \beta_3 r_p + \beta_4 r_b + \beta_5 (P_{t-1} - P_{t-2}) + v_t^D \quad [1]$$

where $v_t^D = \rho v_{t-1}^D + u_t^D$ and u_t^D is white noise. We can write the equation again such as $(1-\rho L) v_t^D = u_t^D$ and multiply both sides of [1] by $(1-\rho L)$:

$$P_t - P_{t-1} = (1-\rho)\beta_0 + \beta_1 r_g + \beta_1 \rho r_{g_{t-1}} + \beta_2 r_l + \beta_2 \rho r_{l_{t-1}} + \beta_3 r_p + \beta_3 \rho r_{p_{t-1}} + \beta_4 r_b + \beta_4 \rho r_{b_{t-1}} + \beta_5 (P_{t-1} - P_{t-2}) + \beta_5 \rho (P_{t-1} - P_{t-2}) + u_t^D \quad [2]$$

Here is price level changes at date t, r_g *is* 1 year government bond yield, r_l is lending rates, r_p is policy rates, r_b is overnight interbank rates. The parameters $\beta_1, \beta_2, \beta_3$ *and* β_4 represent the effect of various interest rates on the level of prices while β_5 stands for to understand inflation inertia impact. The disturbance v_t^D represents factors other than interest rates and lags of inflation that influence current price levels. To keep this section more compact and simpler we will take specification [1] and [2] to explain dynamic structural VAR models. Before relying on results of [1] and [2], as discussed in Hamilton (1994) we will test that model against a more general specification such as:

$$P_t = k_1 + \beta_{12}^{(0)} P_{t-1} + \beta_{13}^{(0)} r_g + \beta_{14}^{(0)} r_l + \beta_{15}^{(0)} r_p + \beta_{16}^{(0)} r_b + \beta_{11}^{(1)} (P_{t-1} - P_{t-2}) + \beta_{12}^{(1)} r_{g_{t-1}} + \beta_{13}^{(1)} r_{l_{t-1}} + \beta_{14}^{(1)} r_{p_{t-1}} + \beta_{15}^{(1)} r_{b_{t-1}} + \beta_{11}^{(2)} (P_{t-2} - P_{t-3}) + \beta_{12}^{(2)} r_{g_{t-2}} + \beta_{13}^{(2)} r_{l_{t-2}} + \beta_{14}^{(2)} r_{p_{t-2}} + \beta_{15}^{(2)} r_{b_{t-2}} + \cdots \beta_{11}^{(p)} (P_{t-p} - P_{t-(p+1)}) + \beta_{12}^{(p)} r_{g_{t-p}} + \beta_{13}^{(p)} r_{l_{t-p}} + \beta_{14}^{(p)} r_{p_{t-p}} + \beta_{15}^{(p)} r_{b_{t-p}} + u_t^D \quad [3]$$

Like equation [1], the specification in [3] is regarded as a structural price change equation; $\beta_{13}^{(0)}, \beta_{14}^{(0)}, \beta_{15}^{(0)}$ and $\beta_{16}^{(0)}$ are interpreted as the effects of interest rates on price changes u_t^D and represents factors influencing price changes other than interest rates and lags of inflation. In comparison to [1], the setup in [3] broadens how we understand the movements of the error term v_t^D , the partial adjustment process, and how interest rates affect price changes. However, we still can't use regular least squares (OLS) to figure out [3] because of a problem called simultaneous equations bias. If we use OLS for [3], it mixes up the connections among inflation, lending rates, overnight rates, policy rates, government bond rates, and past inflation. The link between interest rates and how inflation keeps going is one reason for this mix-up, but it's not the only one. Every so often, the central bank might change the policy rate, r_p, to match its goals or due to financial issues like a banking crisis. This decision often depends on what inflation and other interest rates are doing now and what they've been doing recently.

$$r_{p_t} = k_4 + \beta_{41}^{(0)} r_{g_t} + \beta_{42}^{(0)} r_{l_t} + \beta_{43}^{(0)} r_{b_t} + \beta_{44}^{(0)} (P_t - P_{t-1}) + \beta_{41}^{(1)} r_{g_{t-1}} + \beta_{42}^{(1)} r_{l_{t-1}} + \beta_{43}^{(1)} r_{b_{t-1}} + \beta_{44}^{(1)} (P_{t-1} - P_{t-2}) + \beta_{45}^{(1)} r_{p_{t-1}} + \beta_{41}^{(2)} r_{g_{t-2}} + \beta_{42}^{(2)} r_{l_{t-2}} + \beta_{43}^{(2)} r_{b_{t-2}} + \beta_{44}^{(2)} (P_{t-2} - P_{t-3}) + \beta_{45}^{(2)} r_{p_{t-2}} + \cdots \ \beta_{42}^{(p)} r_{l_{t-p}} + \beta_{43}^{(p)} r_{b_{t-p}} + \beta_{44}^{(p)} (P_{t-p} - P_{t-(p+1)}) + \beta_{45}^{(p)} r_{p_{t-p}} + u_t^C \quad [4]$$

To illustrate, let's take $\beta_{44}^{(0)}$ which signifies the influence of price changes on the interest rates targeted by the central bank. The disturbance term u_t^C represents policy shifts not explained by current and lagged inflation or other interest rates. If the disturbance u_t^D is exceptionally large, it leads to a similarly substantial $P_t - P_{t-1}$.

In instances where $\beta_{44}^{(0)} > 0$, this would result in an unusually high r_{pt}, creating a positive correlation between u_t^D and the explanatory variable in equation [3]. Consequently, attempting to estimate [3] through ordinary least squares (OLS) becomes problematic. Simultaneous equation bias is a concern not just due to central bank policy and the endogeneity of r_{pt}, but also because inflation disturbances and changes in central bank policy affect lending rates, overnight rates, and government bond yields. For instance, lending rates may be influenced by a relationship connecting them to inflation and various interest rates, including policy rates.

$$r_{l_t} = k_3 + \beta_{41}^{(0)} r_{g_t} + \beta_{42}^{(0)} r_{l_t} + \beta_{43}^{(0)} r_{b_t} + \beta_{44}^{(0)} (P_t - P_{t-1}) + \beta_{41}^{(1)} r_{l_{t-1}} + \beta_{42}^{(1)} r_{p_{t-1}} + \beta_{43}^{(1)} r_{b_{t-1}} + \beta_{44}^{(1)} (P_{t-1} - P_{t-2}) + \beta_{45}^{(1)} r_{p_{t-1}} + \beta_{41}^{(2)} r_{l_{t-2}} + \beta_{42}^{(2)} r_{g_{t-2}} + \beta_{43}^{(2)} r_{b_{t-2}} + \beta_{44}^{(2)} (P_{t-2} - P_{t-3}) + \beta_{45}^{(2)} r_{p_{t-2}} + \cdots \ \beta_{42}^{(p)} r_{l_{t-p}} + \beta_{43}^{(p)} r_{b_{t-p}} + \beta_{44}^{(p)} (P_{t-p} - P_{t-(p+1)}) + \beta_{45}^{(p)} r_{p_{t-p}} + u_t^A, \quad [5]$$

with u_t^A representing other factors influencing lending rates. Thinking this through, the clear result is that all the factors we use to explain things at time *t* in [3] should be seen as dependent on each other. We can group and express the set of equations [3] through [5] together in a simpler way using vectors.

$$B_0 P_t = k + B_1 P_{t-1} + B_2 P_{t-2} + \cdots + B_p P_{t-p} + u_t \quad [6]$$

where

$$P_t - P_{t-1} = (r_p, r_l, r_g, r_b, P_{t-2})'$$

$$u_t = (u_t^D, u_t^S, u_t^A, u_t^C)'$$

$$B_0 = \begin{bmatrix} 1 & -\beta_{12}^{(0)} & -\beta_{13}^{(0)} & -\beta_{14}^{(0)} \\ -\beta_{21}^{(0)} & 1 & -\beta_{23}^{(0)} & -\beta_{24}^{(0)} \\ -\beta_{31}^{(0)} & -\beta_{32}^{(0)} & 1 & -\beta_{34}^{(0)} \\ -\beta_{41}^{(0)} & -\beta_{42}^{(0)} & -\beta_{43}^{(0)} & 1 \end{bmatrix}$$

$$k = (k_1, k_2, k_3, k_4)'$$

and B_s is a (4 X 4) matrix whose row i, column j element is given by $\beta_{ij}^{(s)}$ for s=1, 2, . . ., p. A large class of structural models for an (*n* x 1) vector $P_t - P_{t-1}$ can be written in the form of [6].

Generalizing the argument in [2], it is assumed that enough lags of p are included in the matrices B_s are defined so that u_t is vector white noise. If instead, say u_t followed an rth-order VAR, with

$$u_t = F_1 u_{t-1} + F_2 u_{t-2} + \cdots + F_r u_{t-r} + e_t,$$

then we could premultiply [6] by $\left(r_{I_n} - F_1 L^1 - F_2 L^2 - \cdots - F_r L^r\right)$ to arrive at a system of the same basic form as [6] with p replaced by *(p+r)* and with u_t replaced by the white noise disturbance e_t,

If each side of [6] is premultiplied by B_0^{-1}, the result is

$$P_t - P_{t-1} = \pi_t = \Phi_1 \pi_{t-1} + \Phi_2 \pi_{t-2} + \cdots \Phi_p \pi_{t-p} + \varepsilon_t, \quad [7]$$

where

$$c = B_0^{-1} k \quad [8]$$

$$\Phi_s = B_0^{-1} B_s \text{ for } \quad s=1, 2, \ldots, p \quad [9]$$

$$\varepsilon_t = B_0^{-1} u_t, \quad [10]$$

If we assume that [6] is characterized well enough and u_t is a set of random values, then ε_t will also be a set of random values. In this scenario, [7] can be understood as the vector autoregressive representation of the dynamic structural system described in [6]. Thus, a VAR can be viewed as the reduced form of a general dynamic structural model[11].

In the next session, based on the SVAR models the impulse-response analysis will be provided as well as the variance decomposition graphs.

4. Empirical Findings

Impulse Response Functions (IRFs) play a crucial role in Structural Vector Autoregression (SVAR) models, offering a means to analyze how shocks impact a system of variables over time. Once the SVAR model is estimated, the IRFs are obtained by applying the estimated impulse response matrix to identified shocks, revealing the short-term and long-term effects on each variable while keeping others constant.The computation of confidence intervals for IRFs is integral to understanding the uncertainty associated with these responses. One common method involves bootstrapping, where the data is resampled with replacement, and the SVAR model is re-estimated for each iteration. The distribution of simulated IRFs is then used to construct confidence intervals[12]. The interpretation of confidence intervals is crucial for assessing the reliability of estimated IRFs. Wider intervals indicate greater uncertainty in the response of variables to shocks, while narrower intervals signify greater confidence in the estimated dynamic effects. Overall, this process enables researchers to draw robust

11 For Turkey, we exchange rate (USDTRY) variable can also be embedded in [2].

12 In some cases, researchers may use the asymptotic variance-covariance matrix of the estimated parameters to compute standard errors for IRFs, from which confidence intervals are constructed.

conclusions about the impact of shocks on a system of variables and understand the associated uncertainty in their findings[13].

Figure 9: Impulse responses generated from SVAR with 2 lags for US

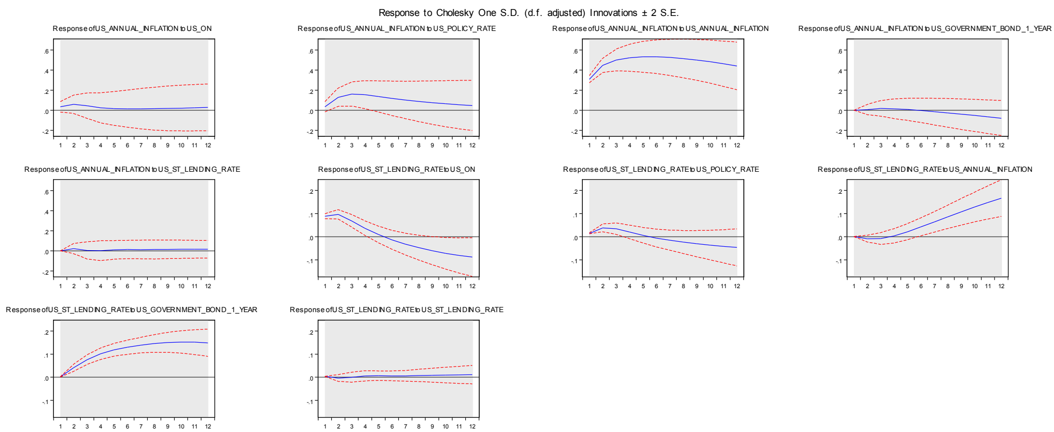


Figure 9's impulse response analysis paints a nuanced picture of the Federal Reserve's inflation targeting strategy through policy rate adjustments. While a lag exists between policy adjustments and their impact on inflation, our findings reveal a crucial temporal dynamic. In the short run, changes in policy rates exhibit a dampening effect on inflation, albeit modest. However, their true efficacy lies in shaping long-term expectations and behaviors. Simulating one standard deviation shocks to interbank rates and lending rates demonstrates minimal immediate impact on inflation. Government bond shocks elicit similarly tepid and lagged responses. Notably, however, inflation exhibits significant inertia, with its own lagged effects increasing from 2% to 4% over time. This highlights the crucial role of past inflation in shaping future inflationary dynamics.

Turning to lending rates, a one-standard deviation shock to policy rates reveals a transient stability, followed by a gradual decline from 1% to – 1% over the observed period. The response of lending rates to policy shocks exhibits moderation over time, culminating in a – 1% level. Interestingly, the response of lending rates to their own lags remains relatively muted.

Importantly, we acknowledge that the effectiveness of policy rate adjustments in tempering inflation is contingent upon the prevailing economic landscape and external factors, such as global economic conditions and fiscal policy.

Figure 10 reveals the nuanced dynamics of the Bank of England's (BoE) policy rate adjustments in influencing inflation. While the initial impact appears sluggish, a gradual dampening effect

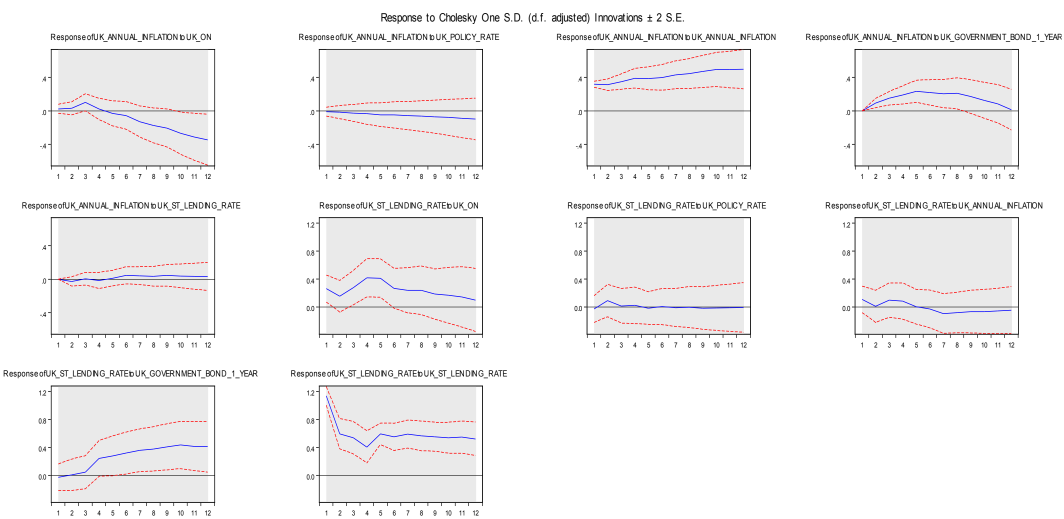
13 Eviews is utilized to run this process

emerges over time. A one-standard deviation shock to overnight interbank rates lead to a transient stability in inflation, followed by a moderate and sustained downward trajectory. Interestingly, inflation exhibits a slight, albeit positive, response to lending rate shocks. Government bond shocks elicit initially positive inflationary responses, which subsequently fade within 12 periods. Notably, inflation demonstrates its own lagged effects, exhibiting moderate and persistent positive dynamics.

Compared to the UK, the US economy has historically proven more responsive to policy rate changes. This disparity can be attributed, in part, to the differing structures of their financial markets. The US market, characterized by its diversity and competitiveness, facilitates the efficient and swift transmission of rate adjustments across various economic sectors. Conversely, the UK's more concentrated financial landscape, dominated by a handful of major banks, can impede the rapid and seamless propagation of policy changes.

In response to a one-standard deviation shock to overnight rates, US lending rates exhibit temporary fluctuations within the first four periods, followed by a gradual decline. Notably, they display relative non-responsiveness to policy rate adjustments. Their reaction to inflation shocks appears more moderate compared to overnight rate changes. Interestingly, lending rates reveal significant negative lagged effects, which stabilize after four periods.

Figure 10: Impulse responses generated from SVAR with 4 lags for UK

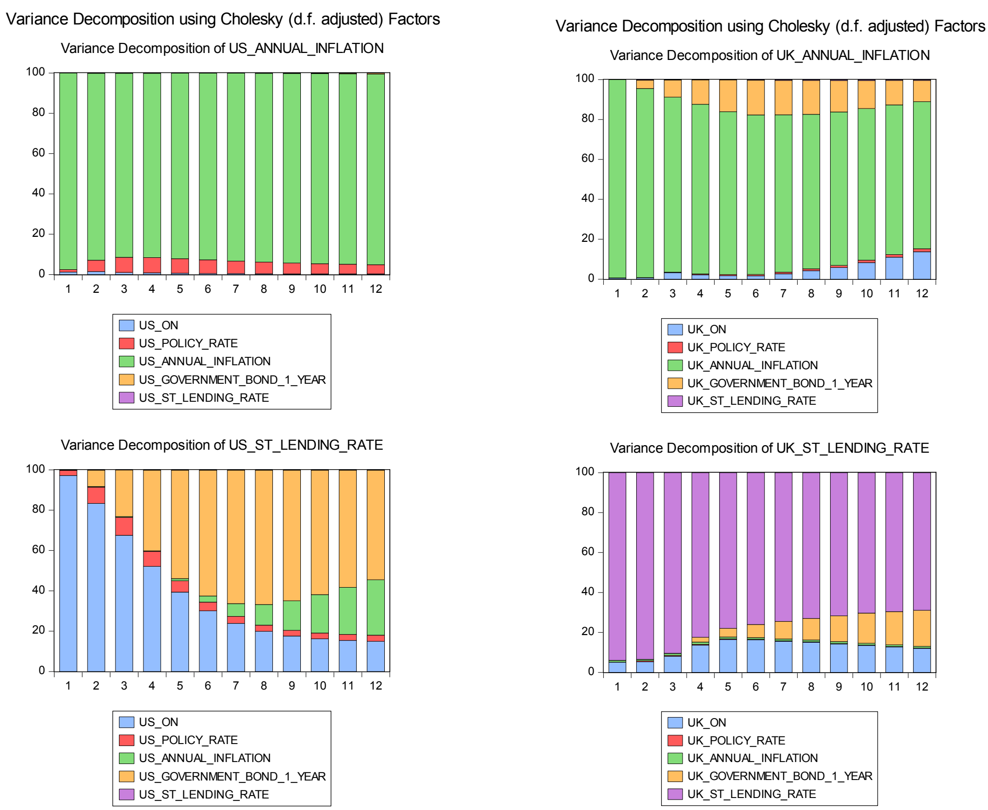


Moreover, in Figure 11 variance decomposition graphs gives us details about the inflation structure of US (left side of the figure) and UK (right side of the figure). Our analysis reveals inflation inertia as a significant challenge for the United States, emerging as the primary driver of inflation in recent years. While policy rates also exert a notable influence, their impact remains secondary.

Contrastingly, the U.K. presents a distinct picture. Here, government bond rates and overnight rates have emerged as increasingly active factors, explaining a larger portion of the variance in inflation. Response of US inflation to lending rates is seems quite low which is also supported by Figure 9.

The lower panel of the graph delves into the decomposed dynamics of lending rates for both the US and UK. Notably, government bond rates and inflation have emerged as increasingly influential factors for US lending rates in recent periods. This stands in stark contrast to the UK, where the level of lending rates remains the primary driver of variance, followed by overnight rates. This suggests that inflationary pressures do not exert a significant direct impact on UK lending rates in the current context.

Figure 11: Variance Decomposition for Inflation and lending rates of US and UK



The European Central Bank (ECB) uses policy rates, such as the refinancing rate and deposit facility rate, to control inflation by influencing the cost of borrowing money for banks and consumers. However, compared to the US and UK economies, the ECB's use of policy rates to control inflation may be less efficient due to the unique structure of the European Union (EU) and the Eurozone. One of the main reasons is the diversity of economic structures and fiscal policies among the EU member states, which can lead to significant divergences in inflation rates and economic growth rates. Therefore, policy rate changes do not have a uniform effect on the Eurozone as a whole. In Figures 12-16, impulse response analysis of the ECB's use of policy rates to control inflation shows that responses of Germany-France and Italy-Spain pairs significantly differ from each other.

Figure 12: Impulse responses generated from SVAR with 5 lags for France

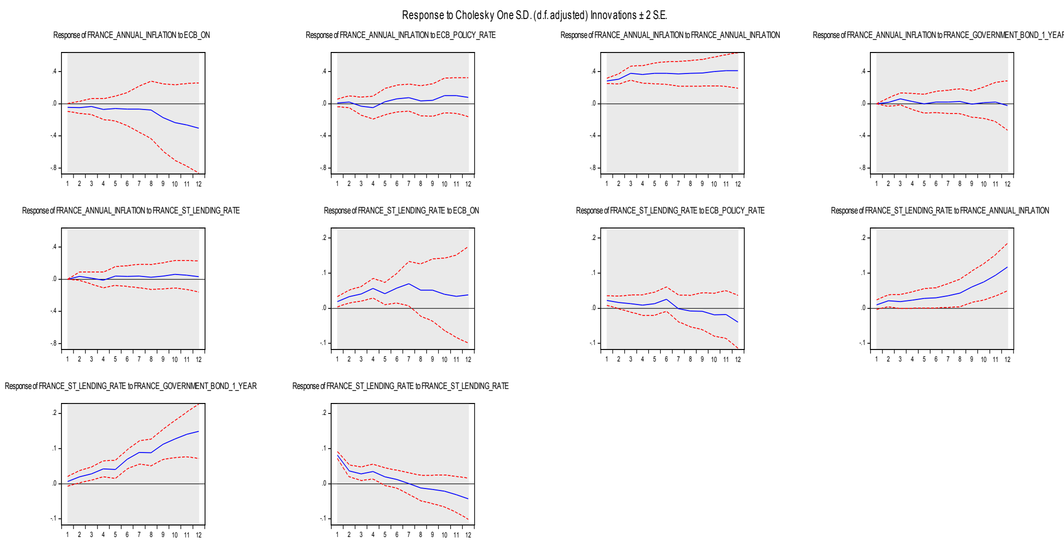
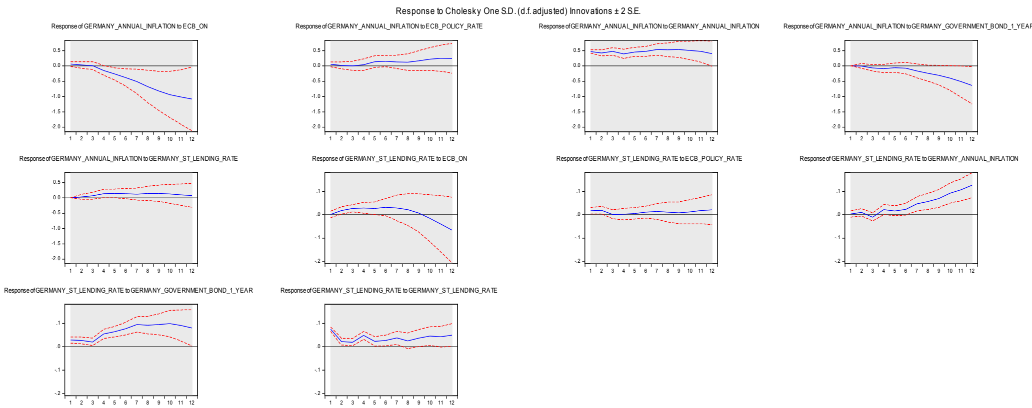


Figure 12 unveils the nuanced dynamics of the European Central Bank's (ECB) policy rate adjustments in influencing French inflation. While an initial stability prevails, a gradual dampening effect emerges over time. Following a one-standard deviation shock to overnight interbank rates, inflation exhibits a transient stability before responding with a slight, albeit sustained, upward trajectory. Lending rate shocks elicit minimal and largely stable inflationary responses, as do government bond shocks. However, a distinct picture emerges when considering policy rate shocks. Initially, inflation exhibits a positive response that intensifies in subsequent periods. This suggests a potentially delayed yet amplified influence of policy adjustments on French inflation. Notably, the impact of inflation on lending rates in France appears pronounced, highlighting a strong intertemporal relationship between these variables.

Figure 13: Impulse responses generated from SVAR with 4 lags for Germany

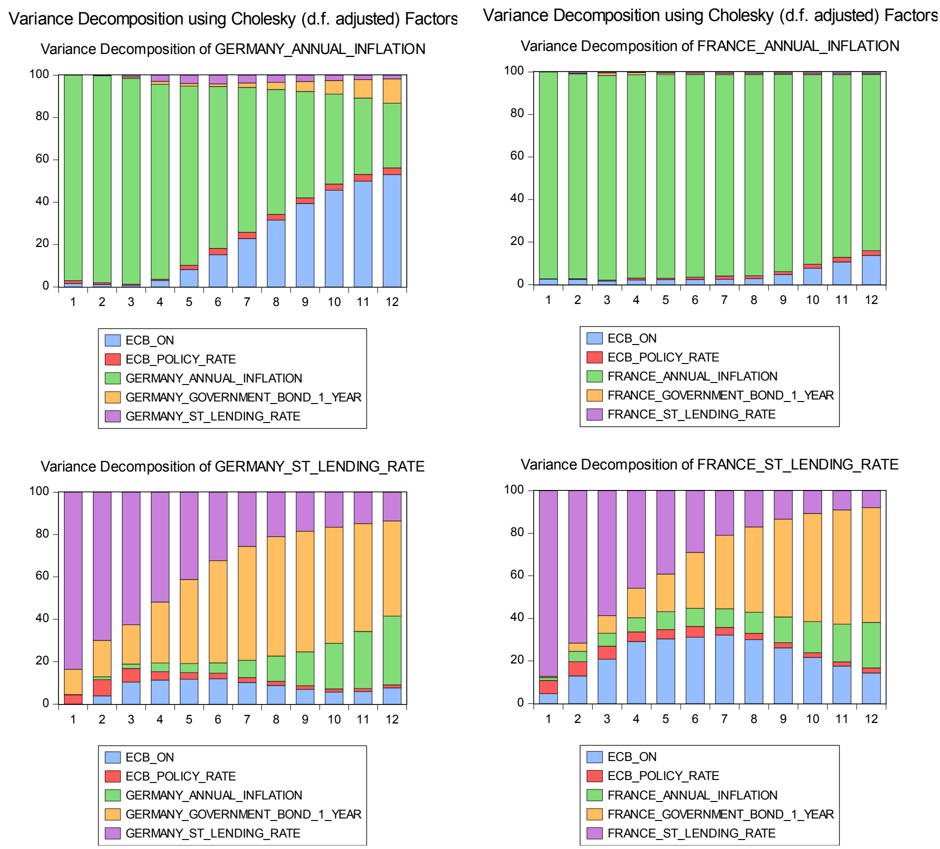


Mirroring the findings for France, a one-standard deviation shock to ECB overnight interbank rates induces a gradual downward trajectory in German inflation. Interestingly, while lending rate shocks elicit a negligible initial upward blip in inflation, it subsequently stabilizes, contrasting with the sustained positive response observed in France. Similarly, government bond shocks generate a gradual decline in inflation for both countries. However, a key disparity emerges when considering policy rate shocks. As witnessed in France, German inflation initially exhibits a muted stability before steadily ascending in subsequent periods. This suggests a potentially similar, albeit less pronounced, delayed amplification effect of policy adjustments on inflation in Germany compared to France. Notably, the pronounced intertemporal relationship between inflation and lending rates also holds true for Germany, echoing the strong dynamic observed in France.

Germany and France are relatively more developed economies compared to Italy and Spain, with more diversified industries and more advanced financial markets. Moreover, the fiscal policies and economic structures of these countries also differ significantly, which can further affect the impact of policy rate changes on inflation. Higher interest rates can also have a more immediate and pronounced effect on inflation, as these countries have more developed and diversified economies, with a relatively high degree of price competition among businesses. Consequently, higher interest rates can also increase the cost of financing for businesses, leading to higher prices for goods and services as businesses try to maintain their profit margins.

In Figure 14 variance decomposition graphs gives us details about the inflation structure of Garmany (left side of the figure) and France (right side of the figure). Our analysis reveals inflation inertia as a significant challenge for France, emerging as the primary driver of inflation in recent years. While policy ECB ON rates also exert a notable influence, their impact remains secondary. Contrastingly, the Germany presents a distinct picture. Here, government bond rates and ECB overnight rates have emerged as increasingly active factors, explaining a larger portion of the variance in inflation in the recent periods. The lower panel of the graph delves into the decomposed dynamics of lending rates for both the Germany and France. Notably, government bond rates and inflation have emerged as increasingly influential factors for Germany lending rates in recent periods which quite the same for France.

Figure 14: Variance Decomposition for Inflation and lending rates of Germany and France



Italy and Spain have traditionally been more reliant on domestic demand, with higher levels of household debt and lower savings rates, while Germany has a larger export-oriented economy and a culture of savings. Consequently, changes in policy rates may have a different impact on consumption and investment behaviour in these countries, and therefore, a different effect on inflation.

Spain and Italy have experienced different levels of inflation volatility in response to changes in policy rates. In Spain, inflation volatility has generally been higher than in Italy. This means that changes in policy rates have had a greater impact on inflation in Spain compared to Italy. Nevertheless, it is crucial to acknowledge that the connection between interest rates and inflation is intricate, and the effects of interest rate adjustments on inflation can fluctuate over time, influenced by other factors like the economic condition and exchange rate.

Additionally, political, and social elements can also influence the transmission of policy rate changes by the ECB to the actual economy in various Eurozone countries. For instance, differences in labour market regulation, tax policies, and social welfare systems can affect the level of wage and price rigidity in different countries, which can in turn affect the responsiveness of inflation to policy rate changes.

Figure 15 reveals a unique trajectory for Italian inflation in response to a one-standard deviation shock to ECB overnight interbank rates. Unlike the gradual declines observed in Germany and France, Italian inflation exhibits a volcanic pattern, initially surging, then retreating, before experiencing a second ascent and ultimately settling back to stability. This oscillatory behavior highlights the distinct sensitivities of Italian inflation to monetary policy adjustments. Lending rate shocks elicit mild and transient upward blips in Italian inflation, again contrasting with the sustained positive response in France. Government bond shocks, similar to the other countries, generate a gradual downward path for Italian inflation. Interestingly, policy rate shocks induce yet another idiosyncratic response in Italy. Mirroring the pattern observed for overnight rate shocks, inflation undergoes a series of ups and downs before stabilizing. This dynamic suggests a potentially complex interplay between policy adjustments and inflationary forces in the Italian context. Moreover, the pronounced intertemporal relationship between inflation and lending rates remains evident in Italy, as in Germany and France, underlining the strong interconnectedness of these variables.

Figure 15: Impulse responses generated from SVAR with 8 lags for Italy

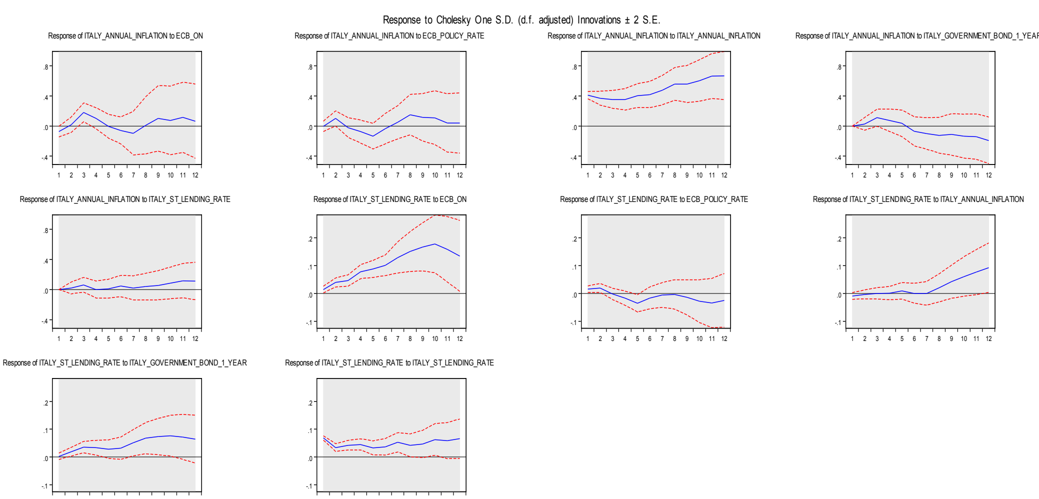
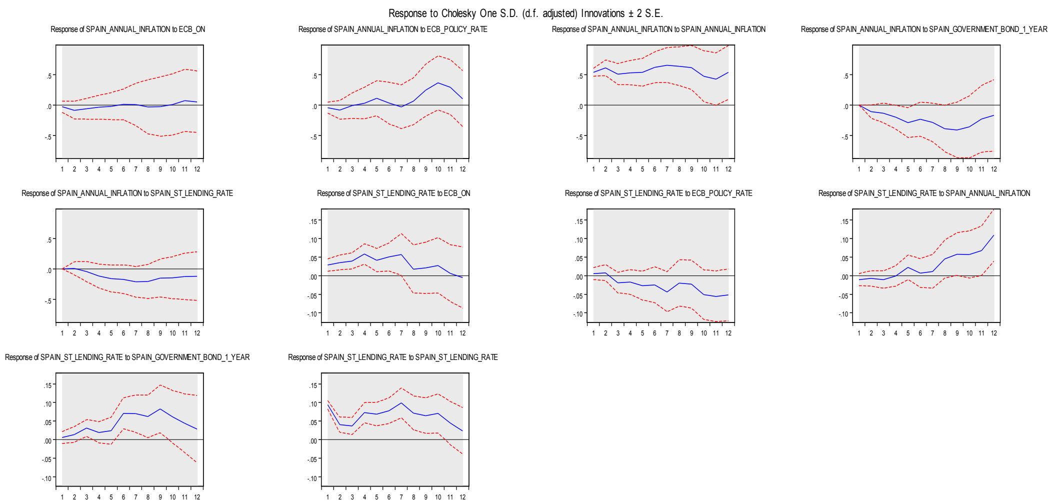


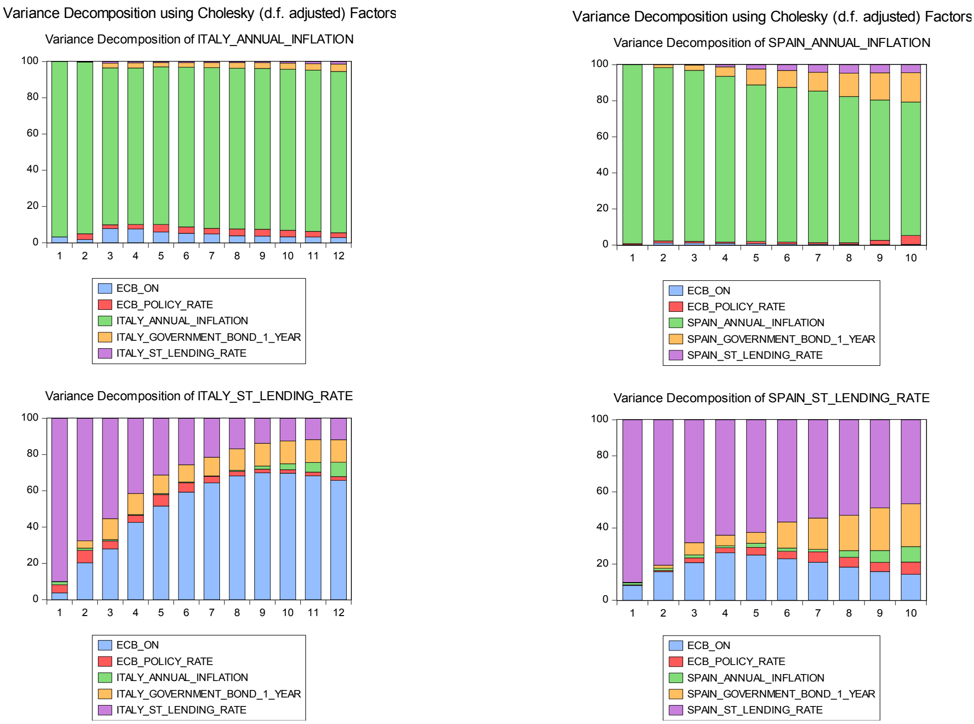
Figure 16 paints a contrasting picture for Spanish inflation compared to the other Eurozone economies. A one-standard deviation shock to ECB overnight interbank rates elicits a meagre and ephemeral impact on inflation, swiftly dissipating in subsequent periods. Government bond shocks generate a gradual downward trajectory for Spanish inflation, aligning with the general trend observed in other countries. However, policy rate shocks induce a unique oscillatory pattern unlike any witnessed elsewhere. Similar to Italy, Spanish inflation undergoes a series of upward and downward fluctuations before ultimately stabilizing. This dynamic suggests a distinctive sensitivity of Spanish inflation to changes in policy rates, potentially reflecting a complex interplay of structural and financial factors. Notably, the strong intertemporal relationship between inflation and lending rates persists in Spain, mirroring the observations in Germany, France, and Italy.

Figure 16: Impulse responses generated from SVAR with 8 lags for Spain



Moreover, in Figure 17 variance decomposition graphs gives us details about the inflation structure of Italy (left side of the figure) and Spain (right side of the figure). Our analysis reveals inflation inertia as a significant challenge for Italy, emerging as the primary driver of inflation in recent years while policy ECB ON rates also exert a notable influence, their impact remains secondary. Contrastingly, the Spain presents a little distinct picture. Again, inflation inertia as a significant challenge for Spain. However, government bond rates and policy rates have emerged as increasingly active factors, explaining a larger portion of the variance in inflation in the recent periods. The lower panel of the graph delves into the decomposed dynamics of lending rates for both the Italy and Spain. Notably, ECB ON rates and lending rates itself have emerged as increasingly influential factors for Italy lending rates in recent periods. Government bond rates also have a stable portion of impact higher than inflation. This stands in contrast to Spain, where the level of lending rates remains the primary driver of variance, followed by government bonds. This suggests that inflationary pressures do not exert a significant direct impact on UK lending rates in the current context.

Figure 17: Variance Decomposition for Inflation and lending rates of Spain and Italy



Finally, in Figures 18-23 we will cover the case of Türkiye which is more complex compared to the hard currency economies above.

Figure 18 paints a contrasting picture for Turkish inflation in response to policy rate adjustments compared to other economies. A one-standard deviation shock to the policy rate elicits a meagre and ephemeral impact on inflation (blue circled graph), rapidly dissipating in subsequent periods. This stands in stark contrast to the more pronounced and sustained responses observed in the US, Germany, France, Italy, and Spain. Interestingly, Türkiye shares a shared characteristic with the UK in this regard, exhibiting a muted sensitivity of inflation to policy rate changes.

Furthermore, government bond shocks induce a divergent trajectory in Turkish inflation. Unlike the observed downward trends in other countries, inflation exhibits a gradual upward ascent in response (blue circled graph). This highlights the distinct dynamics at play in the Turkish economy, potentially reflecting factors such as high structural inflation and reliance on foreign currency-denominated debt. Interestingly, overnight interbank rate shocks elicit the opposite response, triggering a gradual decline in inflation (blue circled graph). This divergence suggests a complex interplay between monetary policy instruments and inflation in the Turkish context.

Turning to lending rates, their reactivity also appears relatively subdued. The impact of inflation on lending rates is fleeting, diminishing within a few periods (red dotted circle). Conversely, overnight rate shocks induce a transient upswing in lending rates before they gradually recede (red dotted circle). These observations underscore the intricate dynamics of the Turkish financial system and its interplay with both inflation and monetary policy

Figure 18: Impulse responses generated from SVAR with 5 lags for Türkiye

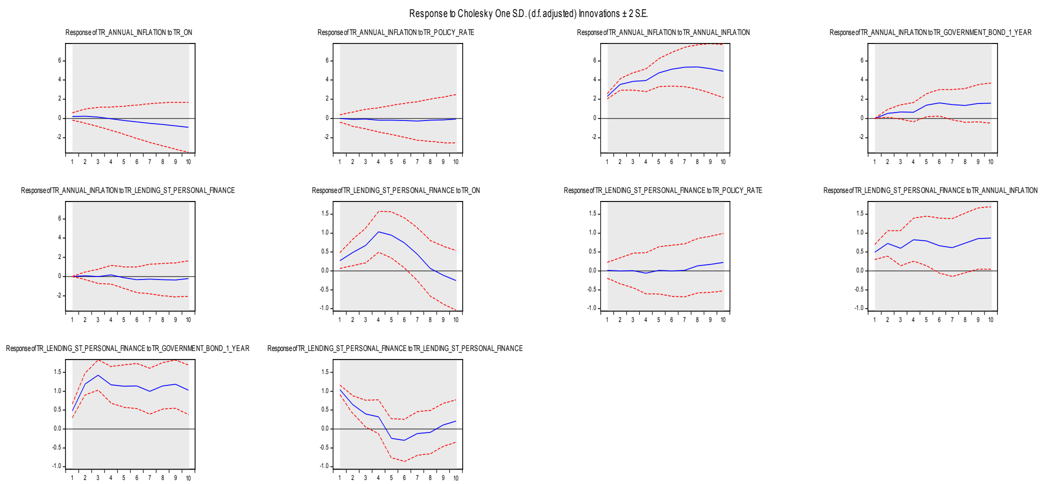
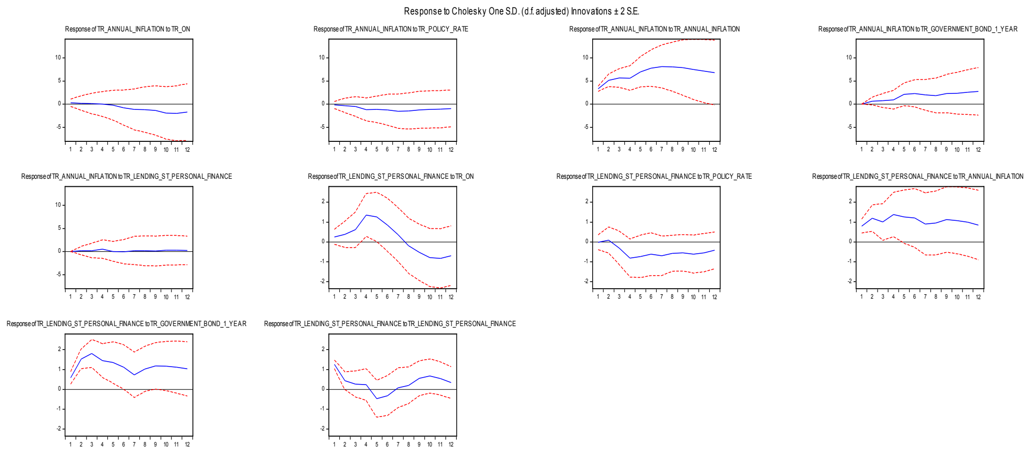


Figure 19 presents a contrasting picture compared to Figure 18, revealing a significantly broader and enduring impact of policy rate shocks on Turkish inflation (blue circled graph). Unlike the fleeting response observed in Figure 18, the inflationary effects persist throughout the analysed period. This divergence suggests a potential shift in the dynamics of monetary policy transmission in Türkiye, possibly reflecting structural changes or policy interventions.

Furthermore, government bond shocks continue to elicit a divergent trajectory in inflation, with a gradual upward ascent mirroring the pattern observed in Figure 18 (blue circled graph). This sustained response reinforces the notion of distinct inflationary pressures at play in the Turkish economy.

Interestingly, a one-standard deviation shock to overnight interbank rates still induce a gradual, albeit muted, decline in inflation (blue circled graph). This pattern, while consistent with Figure 18, highlights the complex interplay between different monetary policy instruments and their varying effects on inflation. The heightened persistence of inflationary dynamics is further underscored by the red dotted graph in Figure 19, which vividly showcases the pronounced level of inflation inertia compared to Figure 18. This observation aligns with concerns regarding the potential distortions introduced into Turkish monetary policy since 2016, particularly the implementation of artificial policy rate cuts driven by political considerations. The amplified variance magnitudes displayed in Figure 19 further point towards this possibility.

Figure 19: Impulse responses generated from SVAR with 5 lags for Türkiye (2016-2023)



The impact of inflation on a hard currency economy is generally less severe than on a soft currency economy. This is because in a hard currency economy, the currency is widely accepted and has a high level of confidence among investors and consumers. Therefore, inflation is less likely to cause a rapid depreciation in the value of the currency or to trigger a panic among investors. Likewise, inflation can have a much more severe impact on a soft currency economy. In such an economy, inflation can quickly erode the purchasing power of the currency, leading to a rapid rise in prices of goods and services. This can cause a domino effect, leading to a decrease in consumer spending, increased costs for businesses, and ultimately, a decline in economic growth.

A soft currency economy may also face challenges in attracting foreign investment, as investors may be reluctant to hold assets denominated in a volatile currency. This can further exacerbate the impact of inflation, as the economy may struggle to attract the foreign capital it needs to fund investment and growth. In this context we include USDTRY variable to identify the impact of foreign exchange impact to both inflation and lending rates of Türkiye (Figure 20 and 21 and 23).

In contrast, in a hard currency economy, where the currency is stable and has a low inflation rate, lending rates tend to be lower compared to a soft currency economy, where the currency is volatile and has a high inflation rate. In a soft currency economy, lenders face higher risks due to the volatility of the currency and the higher inflation rate which leads to higher lending rates as lenders attempt to compensate for the additional risk.

Lowering policy rates in a soft currency economy during a high inflationary period can have mixed effects on inflation. Lower policy rates can encourage borrowing and investment, which can stimulate economic growth and potentially help reduce inflation however, in a soft currency economy with high inflation, lowering policy rates may not have a significant impact on borrowing and investment, as lenders may still be reluctant to lend due to the high level of risk associated with the currency.

This will limit the effectiveness of lower policy rates to stimulate reducing inflation. Moreover, lower policy rates may increase the supply of money in the economy, which can further fuel inflation if the root causes of inflation, such as increasing production costs and wages or government deficits, are not addressed.

Government bond yields also influence lending rates, as they provide a benchmark for the cost of borrowing in the economy. When government bond yields rise, this can increase the cost of funding for banks, which may be reflected in higher lending rates for businesses and consumers. Similarly, when government bond yields fall, this can help to reduce lending rates in the economy.

Figure 20: Impulse responses generated from SVAR with 5 lags for Türkiye including foreign exchange rate (USDTRY)

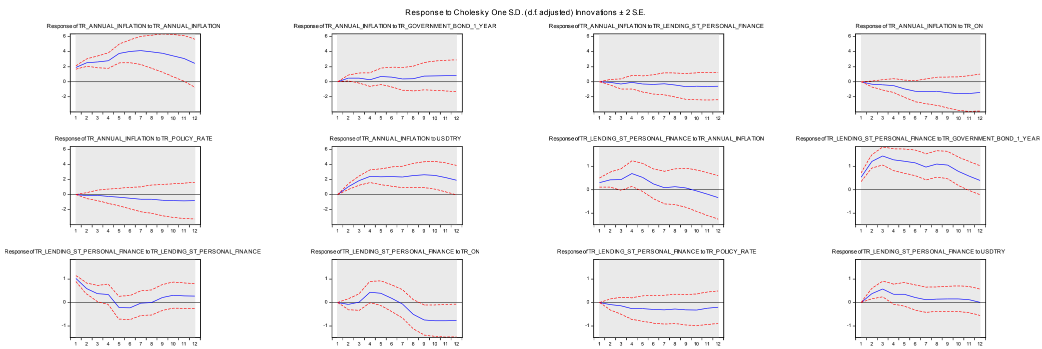
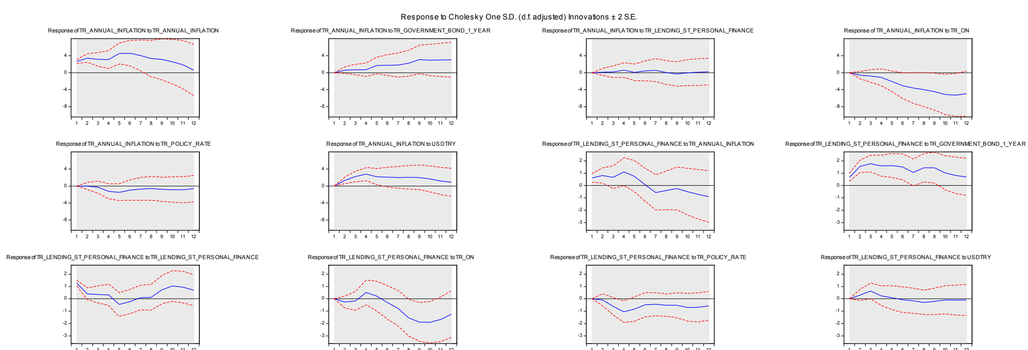


Figure 21: Impulse responses generated from SVAR with 5 lags for Türkiye including foreign exchange rate (USDTRY) (2016-2023)



Figures 22 and 23 delve into the decomposed dynamics of inflation and lending rate variances in Türkiye, illuminating the role of inflation inertia and other pertinent factors. In soft currency economies characterized by volatility, the demand for government bonds can surge, offering a perceived safe haven amidst uncertainty. This heightened demand can exert upward pressure on government bond yields, potentially amplifying their influence on lending rates compared to policy rates (Figure 22). This phenomenon can be attributed to the perceived relative safety and stability of government bonds as an investment option in such contexts.

Furthermore, currency depreciation plays a significant role in shaping lending rates in Türkiye (Figure 23). As the Turkish lira weakens against other currencies, investor appetite for lira-denominated debt, including government and corporate bonds, diminishes. This contraction in demand drives up borrowing costs for both businesses and the government. Additionally, currency depreciation amplifies the risk of defaults on foreign-currency denominated debt, such as loans or bonds issued by the government. This elevated risk translates to higher borrowing costs across the economy, as lenders demand a premium to compensate for the increased likelihood of default.

Figure 22: Variance Decomposition for Inflation and lending rates of Türkiye

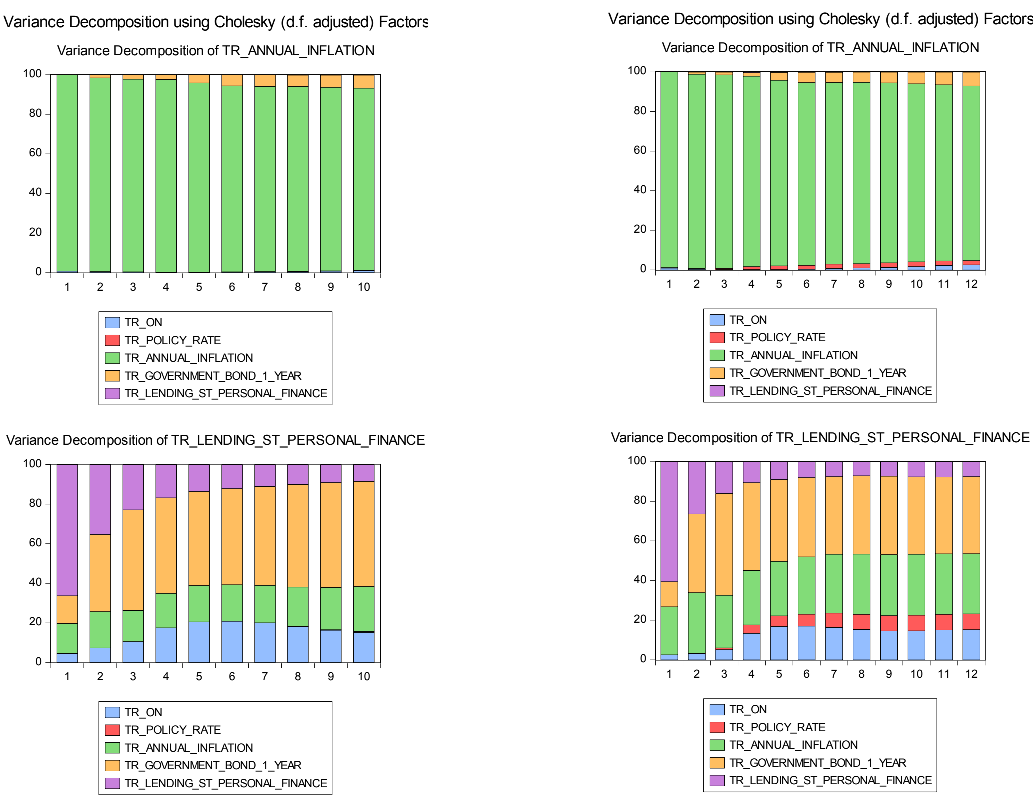
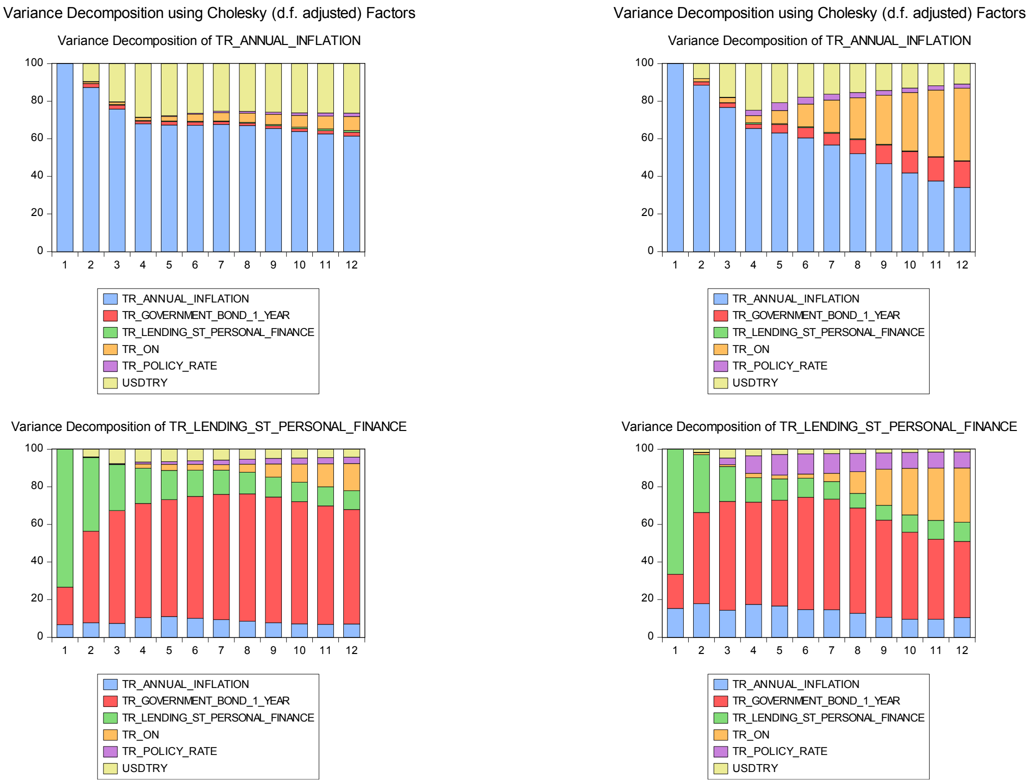


Figure 23: Variance Decomposition for Inflation and lending rates of Türkiye w/FX model



5. Conclusion

This article navigates the enigmatic terrain of policy transmission divergence, venturing into the cases of Türkiye, the United Kingdom, the United States, Italy, Spain, Germany, and France. While Türkiye serves as the focal point, the supporting cast is meticulously chosen. Gone are simplistic classifications of developed versus emerging markets; instead, the selection revolves around these economies harboring preeminent central banks like the Federal Reserve, the European Central Bank, and the Bank of England. This comparative lens unveils the intricate tapestry of policy transmission mechanisms woven across diverse economic landscapes. Enriching the tapestry further is the acknowledgment of intra-EU heterogeneity. Juxtaposing manufacturing powerhouses like Germany and France with service-driven economies like Italy and Spain illuminates the interplay between economic structure and policy effectiveness. By interweaving these threads of economic diversity, we aim to unravel how varying models orchestrate the intricate dance between policy and lending rates.

Monetary policy transmission is characterized by protracted, fluctuating, and unpredictable time lags, posing a significant challenge for accurately forecasting the precise impact of policy measures on the economy and price level. The diagram below provides a visual representation of the key transmission channels through which monetary policy decisions exert their influence.

At the heart of this system lies the central bank, acting as the primary provider of funds to the banking system through the setting of official interest rates. This exclusive control over money issuance empowers the central bank to modulate the cost of credit across the economy. Anticipations of future adjustments in these official rates, particularly concerning the trajectory of short-term rates, play a crucial role in shaping medium – and long-term interest rate expectations. Moreover, monetary policy extends its influence beyond mere interest rate adjustments, impacting economic agents' expectations regarding future inflation and thereby shaping the evolution of price developments.

In general, the short-term policy interest rate set by a central bank, such as the federal funds rate in the United States, is considered to have a greater impact on inflation in the short term than other interest rates, such as long-term bond yields or lending rates. However, the impact of interest rates on inflation is not always straightforward, and there can be lags in the transmission of monetary policy to the real economy. Additionally, other factors, such as changes in commodity prices or shifts in global economic conditions, can also influence inflation. Therefore, central banks must carefully consider a range of factors when setting monetary policy and may adjust interest rates gradually and cautiously in response to changing economic conditions. Reducing interest rates can also led to higher inflation, particularly since the economy has already experienced supply-side pressures such as rising energy and food prices. This created a difficult trade-off for policymakers, who has to balance the competing goals of promoting growth and managing inflation.

In a soft currency economy, the central bank may have less control over interest rates due to factors such as currency fluctuations, political instability, and weak institutions. This can make it difficult for the central bank to use policy rates as a reliable tool for influencing lending rates. In this context, The Central Bank of the Republic of Türkiye (CBRT) has faced criticism for not increasing policy rates in the face of high inflation in recent years. CBRT has implemented several unconventional monetary policy approaches in recent years, despite the country's high inflation rate. One such approach is the use of interest rate corridors, where the CBRT sets a lower and upper bound for its policy rate and uses open market operations to keep the overnight borrowing and lending rates within this corridor. The CBRT has also used direct market interventions, such as selling foreign currency reserves or providing liquidity to the banking sector, to influence exchange rates and maintain financial stability. Despite these unconventional policy approaches, Türkiye has continued to experience high inflation rates, with inflation reaching double-digit levels in recent years.

The Turkish government has expressed a preference for lower interest rates, arguing that high interest rates can hinder economic growth and investment. This has put pressure on the CBRT to maintain a loose monetary policy stance, even in the face of high inflation rates. In this context, Türkiye's decision to lower interest rates despite high inflation is political pressure. However, it is important to note that the use of unconventional monetary policy measures is not unique to Türkiye, and central banks in other countries have also implemented similar policies in response to challenging economic conditions.

In conclusion, the divergence between policy rates and lending rates can have a significant impact on inflation in both developed and developing economies. The adaptive expectations theory suggests that inflation expectations play a crucial role in determining the effectiveness of monetary policy. When lending rates do not reflect changes in policy rates, it can lead to inflationary pressures, particularly in developing economies where market inefficiencies and information asymmetries are more prevalent.

In developed economies, a wider divergence between policy rates and lending rates can lead to increased borrowing costs for households and businesses, which can slow down economic growth. In contrast, in developing economies, the impact of policy rate and lending rate divergence on inflation can be more severe due to the high reliance on bank lending for financing investment and consumption.

Therefore, policymakers in both developed and developing economies must closely monitor lending rates to ensure that they reflect changes in policy rates to avoid inflationary pressures. Furthermore, policymakers should also consider the role of inflation expectations in determining the effectiveness of monetary policy and take measures to anchor them to promote stability and predictability in the economy.

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Appendix A: Driving the endogeneity of inflation based on adaptive expectations

In the classical model, the theory of interest is macroeconomics. Our first assumption is that expectations of inflation are formed "adaptively" where π is driven by the differential equation

$$\delta\pi = \beta\left(\frac{Dp}{p} - \pi\right), \;\; \beta > 0$$

δ is the right-hand time derivative operator. The solution of the above differential equation is

$$\pi(t) = \pi(t_0)e^{-\beta(t-t_0)} + \beta\int_{t_0}^{t} e^{-\beta(t-s)\frac{\dot{p}}{p}(s)\delta s}$$

so that $\pi(t)$ is formed as a geometric **distributed lag** of past actual rates of inflation.

The other assumption under which the model the model will be analysed is that of perfect foresight, so that $\pi(t)$=$\frac{Dp}{p}$. Although changing the first assumption to the second converts the Keynesian model to Classical model the structure of the mathematical model equation is still valid and remain with the same form. Referring to Sargent (1975) we complete classical model by specifying that expectations of inflation employs the adaptive scheme as:

$$\pi(t) = \pi(t_0)e^{-\beta(t-t_0)} + \beta\int_{t_0}^{t} e^{-\beta(t-s)\frac{Dp(\dot{s})}{p(s)}\delta s}$$

where complete model is:

1) $y = f(\lambda)$ which is the intense form of production function.

2) $\frac{w}{p} = f'(\lambda) = \left(\frac{\partial}{\partial N}Kf\left(\frac{N}{K}\right)\right) = \frac{\partial}{\partial N}F(K,N)$ which is marginal product condition for employment. ***K*** is the stock of capital employed and ***N*** is the total labour supply and $\boldsymbol{\frac{w}{p}}$ is the marginal product of labour to the wage.

3) $i = I\big(f(y) - f'(y) - (r + \delta - \pi)\big) = \frac{\dot{K}}{K}$ which is the Keynesian investment schedule where *r*+δ-π is the real cost of capital.

4) $c = z(y - t - \delta)$ which is the consumption function in its capital intensive form where $t = \frac{T}{K}$ and ***z*** is the marginal propensity to consume. The government collects taxes net of transfers at the real rate ***T***.

5) $y = c + i + g + \delta$ which is the national income identity where $g = \frac{G}{K}$ and $c = \frac{C}{K}$. The government makes expenditures at the real rate G.

6) $\frac{M}{p^K}$ = *m(r,y)* which is the portfolio equilibrium condition . The demand for money *m(r,y)* is assumed to be homogenous of degree one in output.

7) $\frac{Dw}{w} = h\left(\frac{\lambda K}{N^S}\right) + \pi$ which is the money wage where $\boldsymbol{N^S}$ is the labour supply. Given , equation (7) refers to the trade-off between the rate of wage inflation and the rate of employment relative to the labour supply as governed by the Phillips curve.

8) $N^s(t) = N^s(t_0)e^{n(t-t_0)}$ which is the labour supply. It is exogenous and ***n*** is the proportionate rate of growth of labour supply.

Finally the model is completed by assumption that inflation depends on adaptive expectations scheme

9) $\pi(t) = \pi(t_0)e^{-\beta(t-t_0)} + \beta\int_{t_0}^{t} e^{-\beta(t-s)\frac{D\dot{p}(s)}{p(s)}\delta s}$

Given the initial conditions $w\ (t_0)$ *and* $\pi\ (t_0)$ given the time paths for exogenous variables M, g and t for $t \geq t_0$, the model will generate the paths of the endogenous variables y, λ, K, c, w, p, r and π. Even tough w, π, and K are exogenous at a point in time, they are inherited from the past according to (3), (7), and (9). In this context, the monetary equilibrium can be driven by solving equations (1)-(6) to form IS and LM curves.

The monetary equilibrium is determined at the point where IS and LM curves intersect each other. The interest rate, real wage, and the capital-labour ratio changes make this equilibrium non-stationary over time but the system will approach a steady state level for fixed values of g, t, and $\frac{\dot{M}}{M}$ where the interest rate, real wage and employment-capital ratio are fixed and prices and wages change at a rate equal to $\frac{\dot{M}}{M} - n$.

At this point we assume that in the steady state level ***y*** is independent of the interest rate. If the firms are to be content to increase the capital stock at the steady-state rate ***n***, so that ***i-n*** equals to zero, we will have

10) $I\left(y - \frac{\lambda(y)}{\lambda'(y)} - (r + \delta - \pi) - n\right) = 0$ which tells us what (*r*+δ-π) must be if the system is to be in a steady-state equilibrium at a given ***y***.

If we take the total differential of the above equation and rearrange we obtain $\frac{\partial(r+\delta-\pi)}{\partial y} = \frac{\lambda''}{\lambda'^2} > 0$. Hence, we will call equation (10) capital market equilibrium curve and label it KE. Consequently, in the steady-state, the price level must adjust so that the LM curves passes through the intersection of the IS and KE curves.

If we continue by assuming that perfect foresight or rationality exists and $\pi = \frac{D(t)}{p(t)}$ by modifying equation (9) such as:

$(9') = \pi(t) = \frac{Dp(t)}{p(t)}$, where the dynamics of the model in response to shocks is much different when (9) is replaced with . If we embed in to (7) we obtain (11) which is;

11) $\frac{Dw}{w} = h\left(\frac{\lambda K}{N^S}\right) + \frac{Dp(t)}{p(t)}$. When we differentiate (2) logarithmically with respect to tine we obtain

12) $\frac{Dw}{w} = \frac{f''(\lambda)}{f'(\lambda)} + D\lambda + \frac{Dp}{p}$.

Equating (11) and (12) gives

13) $h\left(\frac{\lambda K}{N^S}\right) = \frac{f''(\lambda)}{f'(\lambda)} + D\lambda$, where $\frac{f''(\lambda)}{f'(\lambda)} < 0$, where where the employment rate ratio is λ. We can solve (13) for λ in the terms of past values of $\boldsymbol{K}$ and $\boldsymbol{N^S}$. In order to iterate the model let's assume that *f(λ)* follows a Cobb-Douglas production form so that

$$y = f(\lambda) = A\,\lambda^{(1-\alpha)}$$

$$f'(\lambda) = A\,\lambda^{(1-\alpha)\lambda^{-\alpha}}$$

$$f''(\lambda) = -\alpha\,(1-\alpha)A\lambda^{-\alpha-1}$$

$$\frac{f''(\lambda)}{f'(\lambda)} = \frac{-\alpha}{\lambda}$$

Here $h\left(\frac{\lambda K}{N^S}\right)$ takes the form $h\left(\frac{\lambda K}{N^S}\right) = \gamma log\frac{N}{N^s} = \gamma logN - \gamma logN^s$ where log refers to natural logarithm. Then (13) becomes

14) $$\gamma logN - \gamma logN^s = -\alpha\frac{\lambda}{\lambda} = -\alpha DlogN + \alpha DlogK$$

where we can rearrange as $(\gamma + \alpha D)logN = \gamma logN^s + \alpha DlogK$. If we divide both sides with $\boldsymbol{\alpha}$ then we have $\left(\frac{\gamma}{\alpha} + D\right) logN = \frac{\gamma}{\alpha} logN^s + DlogK$. If we divide both side with $\frac{\gamma}{\alpha} + D$ we have

$logN = \frac{1}{D+\frac{\gamma}{\alpha}}\left[\frac{\gamma}{\alpha} logN^s + DlogK\right]$. Notice that $\frac{1}{D+\frac{\gamma}{\alpha}} = \frac{e^{(s-t)\left(\frac{\gamma}{\alpha}+D\right)}}{\frac{\gamma}{\alpha}+D}\Big|_{s=-\infty}^{t}$
$= \int_{-\infty}^{t} e^{(s-t)\left(\frac{\gamma}{\alpha}+D\right)} ds = \int_{-\infty}^{t} e^{(s-t)\left(\frac{\gamma}{\alpha}\right)(s-t)D} ds$.

Let us take the Taylor's expansion of $e^{(s-t)D}$ about $(s-t)D = 0$ and we have

$$e^{(s-t)D} = 1 + (s-t)D + \frac{(s-t)^2 D^2}{2!} + \cdots \qquad \cdots$$

And we have

$$e^{(s-t)D}x(t) = x(t) + (s-t)Dx(t) + (s-t)^2 D^2 x(t) = x(t+s-t) = x(s).$$

In this context, we have

$$logN(t) = \int_{-\infty}^{t} e^{(s-t)\frac{\gamma}{\alpha e}(s-t)D}\left[\frac{\gamma}{\alpha} logN^s(t) + DlogK\right] ds$$

15) $logN(t) = \frac{\gamma}{\alpha}\int_{-\infty}^{t} e^{(s-t)\frac{\gamma}{\alpha LogN^{S}}(s)ds + \int_{-\infty}^{t} s^{(s-t)}\frac{\gamma DK(s)}{\alpha\ K(s)}ds}$. All real variables are now determined and we only have to determine the value of $\boldsymbol{p}$ and $\frac{Dp}{p}$ at instant t.

16) $\frac{M}{p^K} = e^{\beta r}y, \beta < 0$. In this equation we know that r is determined by (5) which we express by modifying (3) and obtain

$r = f(y) - f'(y) - r + \pi + \varepsilon(i), \varepsilon' < 0$. If we embed this in to (16) we obtain

$\frac{M}{p^K} = y\ e^{\beta f(y) - f'(y) - r + \pi + \varepsilon(i)}$ such that

$$logM - logp - logK = logy + \beta[f(y) - \lambda f'(y) - \delta + \pi + \varepsilon(i)].$$

If we change π with $\frac{Dp}{p}$ it gives us

$\left[\frac{1}{\beta} + D\right] logp = \frac{1}{\beta}\left[logM - logK - logy - \beta[f(y) - \lambda f'(y) - \delta + \pi + \varepsilon(i)]\right]$. Finally we obtain

17) $$\log_e p(t) = -\frac{1}{\beta}\int_{t}^{\infty} e^{\frac{(s-t)}{\beta}}\left[logM(s) - logK(s) - logy(s) - \beta\left[f\left(\lambda(y)\right) - \lambda(s)f'\left(\lambda(s)\right) - \delta + \varepsilon\left(i(s)\right)\right]\right] ds$$

Equation (17) states that the current price level as a function of entire future paths of money supply, the capital stock, the employment-capital ratio λ and the rate of investment