Hacettepe University Graduate School of Social Sciences

Department of Economics

MONETARY TRANSMISSION MECHANISM AND BANKING SECTOR: THE CASE OF TURKEY

Abdullah KÜÇÜKÖNDER

Ph.D. Dissertation

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ACCEPTANCE AND APPROVAL

The jury finds that Abdullah Küçükönder has on the date of 10/01/2023 successfully passed the defense examination and approves his Ph.D. Dissertation titled "Monetary Transmission Mechanism and Banking Sector: The Case of Turkey".

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Abdullah KÜÇÜKÖNDER

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ABSTRACT

KÜÇÜKÖNDER, Abdullah. *Monetary Transmission Mechanism and Banking Sector: The Case of Turkey*, Ph.D. Dissertation, Ankara, 2023.

Changes in the financial and economic structure have put banks, particularly credit, at the center of economic policies in Türkiye over the last two decades. This dissertation examines the linkage between monetary transmission and the banking sector for the Turkish economy, covering the period between 2003 and 2021. The first chapter investigates the money-output and credit-output relationships using the time-varying Granger causality framework. The research finds a causal link between money and output with temporal variations. Accordingly, it suggests that money has a predictive content for output in the pre-global financial crisis period (GFC). However, the causal relationship between money and output disappears after 2015. On the other hand, while the results do not indicate any causality from the credit to output in the pre-GFC period, they identify several causal episodes in the post-GFC period. The study also clarifies that the credit-output linkage in the Turkish economy has weakened after 2015. The such result points out the importance of selective credit policies. The findings also suggest that money has no predictive power for output during economic downturns, while credit is somewhat predictive, except for the GFC. The second chapter analyzes the interest rate pass-through to the deposit and lending rates using a time-varying parameter VAR methodology. The results reveal that the pass-through is incomplete and time-varying. Furthermore, the changes in policy rates are mostly transmitted to the bank rates within one month. The empirical evidence also shows a more robust and stable pass-through for the deposit rates than the lending rates. However, the responses of lending rates to the policy rate appear to be more volatile between 2014 and 2021. Finally, the results suggest heterogeneity across loan rate responses. Accordingly, pass-through is found to be the fastest and highest for commercial loans and the slowest and weakest for housing loans.

Keywords: Money Supply, Banking, Credit, Time-Varying Causality, Interest Rate Pass-through, Time-Varying VAR

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ABBREVIATIONS

AIC	: Akaike Information Criteria
BAT	: The Banks Association of Türkiye
BRSA	: Banking Regulation and Supervision of Agency
CBRT	: The Central Bank of the Republic of Türkiye
ECB	: European Central Bank
Fed	: Federal Reserve
FX	: Foreign Exchange
GDP	: Gross Domestic Product
GFC	: Global Financial Crisis
IMF	: International Monetary Fund
LA-VAR	: Lag Augmented Vector Autoregression
NPL	: Non-performing Loans
TL	: Turkish Lira
TURKSTAT	: Turkish Statistical Institute
OECD	: The Organization for Economic Co-operation and Development
TVGC	: Time Varying Granger Causality
TVP-VAR	: Time-varying Vector Autoregressions with Stochastic Volatility
VAR	: Vector Autoregression
USD	: United States Dollar
WB	: World Bank
WEO	: World Economic Outlook

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INTRODUCTION

Short-term interest rates have increasingly been used as the main policy instrument by central banks since the adoption of inflation targeting in the 1990s. Most central banks set interest rates to achieve their targets, such as inflation, output, employment, and financial stability. However, due to the changing economic and financial landscape, there has been debate about the importance of other financial indicators such as money, credit, and exchange rates in policy making. In fact, for decades, economists and policymakers have tried to answer the question of which financial variable has a stronger link to economic indicators such as inflation and output. In this respect, during the 1970s and 1980s, monetary targets were used as nominal anchors in many advanced countries after Friedman and Schwartz (1963) re-emphasized the role of money on income. However, technological developments, regulations (Blinder and Stiglitz, 1983; Hammond, 2012), and the diminishing role of reserve requirements (Drechsler et al., 2018) weakened the money-income and money-inflation relations. As a result, inflation targeting replaced monetary targets at the beginning of the 1990s. In both frameworks, the role of banks was limited.

However, the banking sector and credit markets have received increasing attention from academics over time (Stiglitz and Weiss, 1981; Gertler and Gilchrist, 1993; Kashyap and Stein, 1994; Bernanke and Gertler, 1995). The global financial crisis (GFC) in 2008 emphasized the importance of the banking sector and credit markets for the economy as a whole (Schularick and Taylor, 2012). After the global crisis, as short-term interest rates reached the zero lower bound, countries introduced many measures, including unconventional tools[1](Bernanke, 2020). These measures aimed to improve financing costs and lending activity by providing liquidity to markets (Dell'Ariccia et al., 2018; Kuttner,

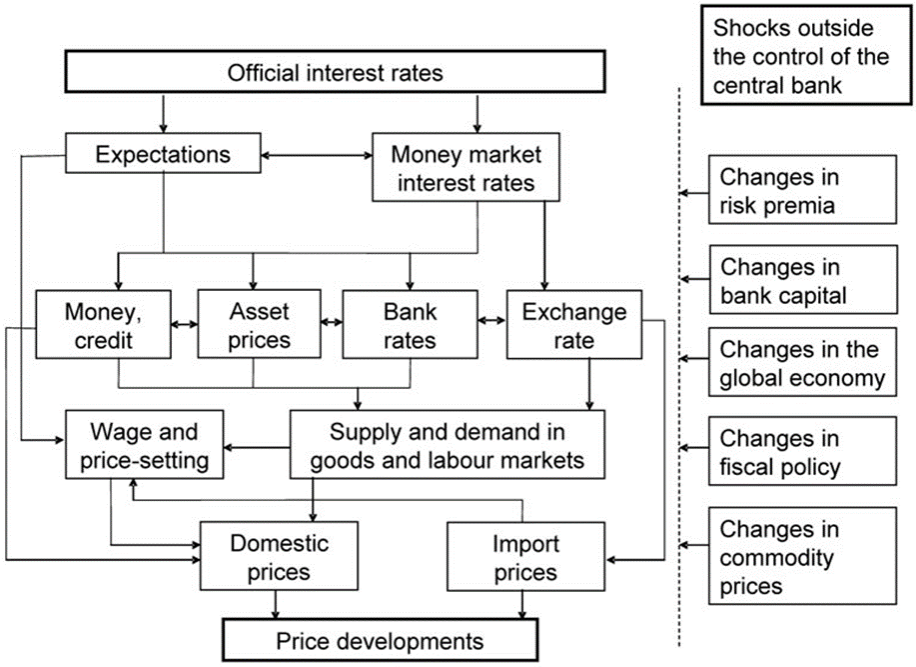
[1] Asset purchasing programs and forward guidance were implemented to support economic activity through the financial markets, especially credit markets.

2018). In addition to monetary policy, many countries have introduced public guarantees and subsidies to support credit growth (OECD, 2010, 2013).

Nevertheless, the unconventional policies in advanced economies posed challenges to emerging economies, such as a surge in capital inflows, currency appreciation, excessive credit growth, and worsening external balances (Tillmann, 2016; Bhattarai et al., 2021). In response, emerging economies used macro-prudential instruments (e.g., required reserves, general provisions, loan-to-value ratio, differentiation in the risk weights of loans and debt-to-income ratio) to contain the risks arising from capital inflows[2]. Moreover, these unconventional policies operate mainly throughout the banking sector, further complicating the monetary transmission mechanism.

The monetary transmission mechanism, in simplest terms, explains how monetary policy influences macroeconomic indicators (Taylor, 1995). The financial sector, the banking sector in particular, has long played a vital role directly or indirectly in all steps of monetary policy transmission due to its size and linkages with the rest of the economy. Monetary policy changes influence the banking sector, e.g., the asset and liability composition, liquidity position, cost of funding, risk-taking behavior, pricing mechanism, profitability, and maturities of assets and liabilities which in turn have implications for the real economy. The interaction between monetary policy and the banking sector is crucial for the level and speed of transmission of monetary changes to the real economy. In other words, the banking sector has the potential to absorb or accelerate the shocks, posing a risk to the effectiveness of the monetary policy. For example, rapid loan growth may lead to undesirable outcomes, such as inflation, financial instability, resource misallocation, and even financial crisis (Mendoza and Terrones, 2008; Dell'Ariccia et al., 2012; Mian and Sufi, 2018; Mian et al., 2020; Sufi and Taylor, 2022).

[2] For details of unconventional monetary policies, see IMF (2013), Kara (2016), Cerutti et al. (2017), Bruno et al. (2017), Akıncı and Olmstead-Rumsey (2018).



Source: ECB

Figure 1. The Monetary Transmission Mechanism[3]

The past two decades have witnessed significant evolutions in Turkish monetary policy. The structural transformation in the banking sector, technological progress, integration into the global economy, capital inflows, and global and domestic shocks have profoundly influenced the monetary policy formulation, implementation, and effectiveness.

Since the transition to the inflation-targeting regime in 2002, short-term interest rates have been at the center of monetary policy. While the monetary aggregates were monitored in the first years, credit indicators gained more importance in the following period. Depending on the period, the economic policies have focused more on credit for various purposes, such as stimulating economic growth, reducing the current account deficit, improving financial stability, and changing the composition of the growth. Such policies have affected the interaction of the main financial variables among themselves and with economic indicators.

[3] Retrieved from https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html

Therefore, exploring the linkages between the banking sector, monetary policy, and the real economy is vital for policymakers and economists[4].

Despite the extensive literature on the monetary transmission mechanism for advanced countries, this process, once described as a black box (Bernanke and Gertler, 1995), still has many unknowns. In particular, the number of studies examining Türkiye as an emerging economy is limited. Given the possible shifts and breaks in the link between economic and financial variables over time, there is a significant gap in modeling the time-varying nature of the relationships. This study aims to fill this gap by identifying linkages between banks, the central bank, and the real sector in Türkiye for the 2003-2021 period with a time-varying approach. Having witnessed a variety of events over the last two decades, including structural transformation in the banking sector, changes in the monetary policy framework and practices, unconventional economic policies, and global and domestic shocks, the case of Turkey can serve as a valuable case study with important implications for both advanced and emerging economies.

The study aims to answer the following questions. First, how linked are bank loans and output? Second, how does the credit-output relationship change over time? Third, does money or credit predict output better? Finally, how do the responses of bank rates to policy rate vary over time?

This dissertation focuses on the three strands of the literature[5]. The first chapter analyzes the causality from money to output and credit to output separately, applying the time-varying Granger-causality test developed by Shi et al. (2018, 2020)[6]. The Granger-causality test also shows the predictive power of money supply and bank loans for economic activity. The

[4] Bernanke (2020) argues that promoting bank loans is more important for countries where banks have a greater role in lending. The share of the banking sector in the financial sector varies across calculations. However, it is 82 percent as of September 2021 (The Banks Association of Türkiye, 2022).
[5] This study focuses on the causality relationship running from credit to output rather than the bank lending channel. In recent years, monetary, fiscal, and financial policies have affected both credit supply and demand.
[6] This study uses credit and bank loans, and output and income interchangeably.

results reveal the causality between financial variables and output changes over time. In this context, I find several causal episodes from money supply to output and credit to output. Moreover, the duration of causal episodes is found to be longer for bank loans than for money supply. The findings also suggest that contrary to the findings for advanced economies (Psaradakis et al., 2005), the predictive power of monetary aggregates for output is weak during recessions. I also find the causal link between credit and output solid and stable for 2011-2015 but poor and volatile for the period after 2015.

The first chapter contributes to the literature on the credit-output nexus for Türkiye. To the best of my knowledge, this is the first study to investigate the causal relationship between credit and output in Türkiye using a time-varying method. Another contribution of the study is that it employs more recent data covering a larger period. Finally, elucidating the factors underlying the changing pattern of causal relationships can provide a basis for further research. The main characteristics of the causal periods may serve as a good starting point.

The second chapter focuses on the pass-through from policy rate to bank rates. Official interest rates are the main instrument in the traditional transmission mechanism. The ability of the policy rate to influence other interest rates is crucial for the effectiveness of the monetary policy (Aristei and Gallo, 2014; Hristov et al., 2014). Given the dynamic structure of the banking sector and the dramatic changes in the monetary policy implementation, time-varying methods appear appropriate in examining the interest rate pass-through in Türkiye. However, the time-varying nature of relationships and the changes in the volatility of shocks have been mostly ignored in previous studies. To address these issues, I analyze the response of bank rates to policy rates for 2003-2021 using the time-varying VAR methodology with stochastic volatility (Primiceri, 2005; Nakajima, 2011).

The findings suggest that deposit rates respond more robustly to the policy rate than loan rates, but pass-through is incomplete for all deposit and lending rates. Also, a significant portion of the pass-through realizes in the short term (one month after the shock). The pass-

through from policy rate to deposit rates exhibits fluctuations and generally tends to decrease across the sample.

The results also show a decline in the response of lending rates to the policy rate in the pre-2007 period, in which the policy rate has a downward trend. However, the pass-through coefficients are found to be higher during the GFC. The link between lending rates and policy rate appears relatively stable in the 2011-2014 period than in the pre-GFC period. This period coincides with the capital inflow surges and the implementation of policy-mix adopted by the CBRT and other authorities. However, the responses of lending rates to policy rate have a volatile pattern in the 2014-2021 period. For example, the results indicate a sharp fall in banks' reaction to policy rates in the 2017-2020 period, with pass-through coefficients reaching their lowest level in the first quarter of 2020. This is followed by a strong rebound in bank responses in the period 2020-2021. Finally, the results show that the housing rate has the weakest link to the policy rate while the policy rate changes are transmitted to commercial loans quickly and at a high rate.

CHAPTER 1: MONEY VERSUS CREDIT: WHAT PREDICTS OUTPUT?

1.1. INTRODUCTION

The interaction between the financial sector and economic activity has been a central topic of debate for economists and policy makers for more than a century[7]. Despite the different theories and mixed empirical evidence, there is a consensus that the financial sector and the real economy are somehow closely linked. This relationship has been analyzed in various dimensions, such as the proxy variables, econometric methodology, and the direction of causality. As a proxy for the financial sector, monetary aggregates, credit indicators, interest rates, spreads, exchange rates, and stock market indicators are the most selected variables in empirical studies. Among these, the study uses the money supply and bank loans.

The money-output relationship has the most extensive literature among these variables. The link between money and output has attracted significant attention with the famous work of Friedman and Schwartz (1963). They demonstrate the role of money supply contraction in the Great Depression and argue that money impacts output. Therefore, policy makers can mitigate output fluctuations by controlling the money supply. Lucas (1972) provides another explanation for why money can be non-neutral. Economic agents with less than complete information cannot identify the types of shocks, and therefore, the monetary fluctuations may have real effects. However, economic agents with sufficient information about the monetary policy and prices adjust themselves correctly. As a result, expected monetary shocks do not impact the real variables. Sticky prices and wages (Mankiw, 1985; Blanchard and Kiyotaki, 1985) and heterogeneities in the liquidity position of economic agents (Lucas, 1990; Fuerst,

[7] See Schumpeter (1912) and Fisher (1933)

1992; Christiano and Eichenbaum, 1992, 1995) are the other factors contributing to the non-neutrality of money, at least in the short-run.

On the other hand, King and Plosser (1984) claim that money and output move together because economic activity determines money; in other words, causality runs from output to money. They see money as a product and an input for other sectors. As economic transactions increase, economic agents demand more money.

On the monetary policy implementation side, in the 1970s and 1980s, advanced countries such as USA and UK implemented monetary targeting to reduce inflation. However, these two countries experienced severe recessions in the first half of the 1980s. Moreover, the imbalances between money and economic activity during this period raised concerns about monetary targeting. As more countries targeted inflation in the 1990s, interest rates were increasingly chosen as the main policy instrument[8]. However, many developing countries continued monetary targeting until the early 2000s (IMF, 2014a).[9]

Despite several financial crises in emerging economies, the global economy enjoyed high growth rates, expanded world trade, capital inflows, and low inflation in the 1990s and 2000s, apart from the dot-com bubble. As a result, central bankers and regulators around the world thought they were performing well. This situation lasted until the GFC in 2008. The excessive growth of the financial sector and the lack of regulation and supervision were the main reasons for the GFC. Moreover, policymakers and their economic models failed to anticipate the crisis (Christiano et al., 2018). Thus, the econometric models, policy instruments, and variable sets of central banks were severely debated.

The GFC was a turning point for economic policymaking and academic studies. Since then, many studies have investigated the role of credit on financial stability and economic activity

[8] See Mishkin (2001) and Hammond (2012) for further details.
[9] https://www.imf.org/external/np/pp/eng/2014/030514b.pdf

(Borio and Drehmann, 2009; Gourinchas and Obstfeld, 2012; Schularick and Taylor, 2012; Dell'Ariccia et al., 2016; Baron and Xiong, 2017). These studies have laid a strong foundation for introducing new regulations on the financial sector at both global and national levels. As a result of these works, authorities closely monitor both credit growth and credit composition.

The credit-output relationship, similar to the money-output nexus, is explained by two main approaches in the causality context. The first is the "demand-following approach," which argues that output affects credit. Banks provide financial services and products, such as loans, which are inputs for other sectors (King and Plosser, 1984). Output growth boosts demand for financial services, and banks react to output changes (Robinson, 1952). The second approach is the "supply-led framework," in which causality runs from finance to output. The financial sector can boost investment, innovation, and economic growth (Schumpeter, 1912). Banks have a leading role in accumulating savings and efficiently allocating funds to more productive areas. Thus, banks stimulate economic activity through capital accumulation and efficiency gains (King and Levine, 1993).

Another critical dimension of credit is the credit growth-financial stability relation. This area has been studied extensively since the GFC, and empirical evidence reveals that credit booms most probably damage economic activity. Mendoza and Terrones (2008) and Dell'Ariccia et al. (2012) show that excessive and rapid credit growth may lead to crisis and output losses. Bluwstein et al. (2021) find that excessive credit expansion can signal the accumulation of vulnerabilities and forecast financial crises.

The banking sector and bank lending have been increasingly crucial for the Turkish economy. The banking sector has undergone significant changes over the last two decades. Technological developments, capital flows, financial liberalization, economic transformation, institutional developments, and global and domestic shocks have significantly influenced its size, structure, and way of doing business. After the 2001 crisis,

the Turkish banking sector was restructured. In this context, the efficiency of state-owned banks was enhanced, and the risk management capacity of the banking sector was improved (BRSA, 2010). Furthermore, the structure of the banking sector changed with bank mergers and acquisitions by foreigners.

The improvement in the public finances provided room for loans and contributed to the banks to fulfill their primary duty of lending more effectively. Also, the decline in the inflation rate and risk premium significantly reduced the interest rate, pushing the loan demand up. As a result of substantial credit growth in this period, the credit-to-GDP ratio reached 68 percent, and the banking sector's total assets to GDP ratio was 127 percent of GDP.

After 2010, ample global liquidity and Türkiye's strong economic performance led to large capital inflows, including direct and portfolio investments. As a result, the real exchange rate appreciated, credit growth accelerated, and the current account balance deteriorated significantly. Policymakers, therefore, paid more attention to understanding the relationship between capital inflows, credit growth, financial stability, and output. Thus, credit indicators have started to be included in monetary policy documents since 2010.

The financial sector and the central bank have dynamically reacted to global developments and trends as the Turkish economy integrated into the global economy and attracted significant capital flows. Accordingly, the toolset of the CBRT, CBRT's funding composition, the banking sector's liability structure, and asset composition have changed throughout the sample period. Therefore, the relationship between variables may vary throughout the sample period.

While the literature on the money-income relationship in Türkiye has been growing, the number of studies analyzing the causality between credit and output is very limited. Moreover, studies that use credit indicators generally focus on financial development. Therefore, considering the potential changes in causal relationships over the sample, this

chapter analyzes the money-income and credit-income relations using the time-varying framework introduced by Shi et al. (2020).

The findings have the potential to provide information for both developed and developing countries as the Turkish case contains various events such as structural transformation, unorthodox policies, and global and domestic shocks over the last two decades. Moreover, to the best of our knowledge, this is the first study to examine the causal link between credit and output for Türkiye using a time-varying method. Therefore, the empirical findings and the characteristics of the causal periods are expected to encourage new studies.

We have two objectives. The first is to investigate whether money and credit aggregates provide information about future changes in output and which one is superior to the other. The second is to test whether causal links between variables vary over time. The results indicate temporal variations in the money-income and credit-income nexus. The findings show that money Granger caused income in the pre-GFC period, while credit did not. On the other hand, in the post-GFC period, the credit-output link became more evident than the money-output link. The results also show that in the post-2015 period, the credit-output relationship weakened, and even the money-output relationship disappeared.

The rest of the chapter is organized as follows. Section 1.2 discusses the theoretical background and literature on the relationship between financial variables and output. Section 1.3 reviews the Turkish economy and the evolution of central banking and the banking sector since 2002. Section 1.4 covers information about the empirical methodology and data. Section 1.5 presents and discusses the findings. Section 1.6 contains the conclusion.

1.2. THEORETICAL BACKGROUND AND LITERATURE SURVEY

The causal link between financial variables and output has been widely studied theoretically and empirically along different dimensions. The first dimension is the choice of the financial variable. In the literature, money supply, exchange rate, interest rate, and credit indicators are widely used as financial variables. In this chapter, we focus on money-output and credit-output linkages.

Money and credit reflect the two sides of a bank balance sheet. Money supply represents bank liabilities, while credit is associated with bank assets. However, for a long time, most policymakers and economists ignored credit and focused only on monetary aggregates because money was considered a good proxy for the financial system. Accordingly, models such as the standard IS-LM models give a special role to money which has an impact on real activity (Bernanke and Blinder, 1988).

On the other hand, new theoretical explanations considering asymmetric information (Stiglitz and Weiss, 1981; Blinder and Stiglitz, 1983) and financial frictions (Bernanke and Gertler, 1995) provide a strong background for credit. In addition, Bernanke and Blinder (1988) integrate bank loans into their models by assuming that bank loans and bonds are not perfect substitutes. Moreover, Friedman (1981, 1983), Bernanke (1983) and Bernanke and Blinder (1988) empirically support the role of credit on output. As a result, credit was invented as a new channel of monetary transmission and has received considerable attention from researchers. However, although the banking sector's and credit markets' importance have been theoretically accepted, credit has been mainly overlooked by policymakers until the GFC. Thus, policymakers and technical experts underestimated the depth of the crisis (Bernanke, 2018). Since the GFC, policymakers and researchers have accelerated their efforts to incorporate credit-related indicators into their models and analysis, which have a major role in economic policymaking.

The second dimension of the money-output relationship is the direction of causality. In other words, does causality run from financial variables to output or vice versa? Both directions of causality have strong theoretical backgrounds and are supported by empirical evidence.

1.2.1. Money-Income Nexus

The debate about money and output relation goes back centuries ago, but it received little attention from researchers and policy makers until the 1960s. With Friedman and Schwartz's "A Monetary History of the United States, 1867-1960" (1963), money began to receive attention. They argue that the money supply affects output in the short run. For example, a rise in the money supply leads to surplus of supply in the money market. Economic agents spend this excess money, and output increases as a result. Friedman and Schwartz (1963) also argued that the shrinkage in the money supply deepened the crisis during the Great Depression. Monetarists assume that the money-ouput link is stable and that targeting monetary variables is the optimal strategy to conduct monetary policy.

Lucas (1972, 1973) developed alternative explanations for how money can affect output. Lucas argues that imperfect information prevents economic agents from adjusting their prices correctly. However, expected monetary shocks have no impact on economic activity because economic agents with rational expectations can swiftly adapt to changes in monetary policy. According to Lucas, only unexpected shocks can affect real variables.

The New Keynesian school is the other proponent of the view that money determines income for several reasons. The first is sticky prices and wages (Mankiw, 1985; Blanchard and Kiyotaki, 1985; Ball and Mankiw, 1994). Since prices respond to a change in the money stock gradually, a central bank can influence the real money balances and aggregate demand in the short run. In addition, Akerlof and Yellen (1985a) argue that even expected money supply shocks can influence economic activity if some economic actors have “near-rational” behaviors with minor costs. Another channel that breaks money neutrality is liquidity (Lucas, 1990; Fuerst, 1992; Christiano (1991); Christiano and Eichenbaum, 1992, 1995). In this

framework, since the nominal money stock of some agents cannot move quickly, a price level change causes a shift in real money balances, employment, and output. The main factor is that monetary changes have uneven effects on agents, and economic agents respond disproportionally to the shocks.

On the other side of the causality, the business cycle theory claims that money has no power to explain output fluctuations. Instead, the correlation between money and output is a natural consequence of reverse causality. King and Plosser (1984) consider inside money as an intermediate good whose price and quantity are determined by economic activity. They argue that output is correlated with inside money, a product of the banking sector. For example, a productivity shock will increase the demand for money, and the banking system will create more money by providing credit. Bank lending is, therefore, an integral part of the money-income debate in addition to its close link with output.

The empirical studies find a causal link between money and output in Türkiye. Bozoklu (2013) concludes a two-way causality between the supply of money and income for the period 1987-2011 by using leveraged bootstrapped simulation technique. Kocaaslan (2014) applies a Markov switching framework that takes into account the subsample instability and finds that the M2 growth rate Granger causes output for the period 1987q4-2012q1. Her results also show that money has predictive power during the late 1980s and 2002-2005 implicit inflation targeting period, while the causal link softens in the recessions. Finally, Arin and Gür (2009) compare the monetary and exchange rate targeting for the 1986-2000 period and conclude that targeting the money supply is a better policy for the Turkish economy.

1.2.2. Credit-Output Nexus

Similar to the money-output relationship, there are different explanations for the direction of causality in the credit-output relationship. The first is the "demand-following" approach, which argues that economic activity determines credit. Accordingly, banks provide financial

services and products, such as loans, which are inputs for other sectors (King and Plosser, 1984). As the economy grows, demand for financial services goes up. Therefore, banks react to output growth (Robinson, 1952). Moreover, economic agents in developed countries demand more sophisticated financial products, leading to more developed financial markets. In contrast, less developed countries have an underdeveloped financial sector due to a lack of demand for financial products.

The second approach is the "supply-leading" framework in which causality runs from finance to output. Schumpeter (1912) argues that the financial sector is crucial in stimulating investment, innovation, and economic growth. Financial intermediaries promote savings and efficiently allocate funds to more productive areas. Thus, banks bolster economic growth through capital accumulation and efficiency gains (King and Levine, 1993).

There is also an alternative framework that is a combination of two approaches. Patrick (1966) claims that the direction of causality depends on the level of development. While finance leads to real activity in the early stages of development, the direction of causality reverses as the economy develops.

Another critical dimension is the non-linearity of the credit-output relation. The impact of credit on output can be affected by the credit growth level. Credit expansion stimulates economic growth to a certain point, but beyond that level, credit growth worsens the economic acitivity. Mendoza and Terrones (2008) and Dell'Ariccia et al. (2012) find evidence of the potential adverse effects of excessive and rapid credit growth on economic activity. Furthermore, Mian et al. (2020) find that credit growth, favoring the non-tradable sector more than the tradable sector, results in deeper output contractions. The main reasons behind these findings are the high indebtedness of economic agents, especially households, and the misallocation of resources to unproductive areas through credit. Therefore, credit growth's size and composition are vital for economic growth and financial stability.

Several additional reasons make the credit-output relationship more complex and incomplete than the money-output relationship. First and foremost, the banking sector both collects deposits and makes loans. They can create money through lending. Second, banks have alternative wholesale funding sources, such as bonds and syndicated loans, and alternative assets, such as securities.

Third, banks' ability and willingness to borrow and lend can cause fluctuations in economic activity beyond the effects of monetary and real shocks. There is an increasing interest and growing literature on what affects banks' capacity and willingness to lend and how banks can generate idiosyncratic shocks. Asymmetric information between borrower and lender underlies these mechanisms. The lender incurs costs such as screening, assessment, and follow-up after the lending in order to obtain more detailed information about the borrower. Along with the cost of these activities, the borrower's riskiness affects the risk premium and the lender's appetite for lending. Since the banks obtain most of their resources through borrowing, the risk premium is also relevant for the banking sector. As the risk premium increases, the cost of lending rises, and the amount of loans decreases. As a result, investment and consumption expenditures will fall, and ultimately economic activity will suffer.

Asymmetric information between banks and their customers can lead to imperfections in credit and deposit markets. Adverse selection and moral hazard problems can distort the financial markets. Banks need to have complete information about borrowers' riskiness and repayment ability. Accordingly, banks apply higher lending rates to high-risk borrowers. However, the interest rate level may affect the riskiness of loans (Stiglitz and Weiss, 1981, 1992). Borrowers willing to pay higher interest rates have high-risk projects and a higher probability of default, and borrowers with safer projects withdraw from the loan market as interest rates rise. Banks face a "lemons" problem. Moreover, higher interest rates may cause the borrower to seek higher returns, which makes the borrower riskier.

Finally, banks respond differently to monetary or real shocks due to heterogeneity in their structure and risk-taking behavior. Heterogeneities among banks also lead to new transmission channels such as deposits (Drechsler et al., 2017), risk-taking (Borio and Zhu, 2012), capital, and liquidity. These issues are beyond the scope of the study. The credit-output relationship is a multidimensional and broad topic. However, this study focuses on the predictive power of credit for the real economy.

1.3. TURKISH ECONOMY AND FINANCIAL SECTOR

Over the last 40 years, the banking sector and central banks worldwide have undergone significant changes due to international capital flows, liberalization, technological developments, and financial crises. In addition, the evolution of the Turkish economy and financial sector became evident after the 2001 financial crisis. This section presents the developments and structural transformation in the economy, the banking sector, and the central bank for the 2002-2021 period. I obtained data on the banking sector's balance sheet from the BRSA, the policy, loan, and deposit rates from the CBRT, inflation, industrial production, and gross national product data from TURKSTAT. The ratios are calculated by the author unless otherwise stated.

1.3.1. Macroeconomic Developments

Turkish economy had fundamental problems and an unstable outlook during the 1990s. Even though Türkiye had a good growth performance on average, the volatility of growth was too high. Growth periods were often interrupted by recessions. Inflation was very high and volatile. The budget deficit was large, and public finance worsened further. Thus, interest rates were significantly high. The banking sector financed the public deficits rather than the real sector, and the credit-to-GDP ratio was meager. The inadequate regulatory and supervisory framework and the sector's low-risk management capacity elevated the banking system's risks in the late 1990s (BRSA, 2010). As a result, the Turkish economy experienced financial crises in the last quarter of 2000 and in February 2001. The 2001 crisis led to a severe contraction in economic activity and employment.

The Turkish economy recorded uninterrupted and high average growth until 2009, thanks to structural reforms, political stability, and a favorable global environment. Fiscal discipline reduced budget deficits and led to a substantial fall in the public debt-to-GDP ratio. In addition to tight fiscal policy, prudent monetary policy succeeded in anchoring inflation expectations, bringing the inflation rate down to single digits. Interest rates also fell

significantly, aided by the decline in the risk premium. Türkiye received substantial capital inflows during this period, including FDI and portfolio investments. External debt increased as access to international capital markets improved. As a result, the Turkish lira was appreciated, and the external deficit remained high.

The GFC hit the economy in 2008 and 2009. As a result, the economy contracted in 2009 for the first time after 2001. Bank loans narrowed, and public borrowing went up as well. Thanks to its prudent banking sector, sound public finance, dynamic structure, and ample global liquidity, the Turkish economy quickly overcame the adverse effects of the GFC. High growth rates, relatively low inflation, low budget deficit, and persistent external deficit continued until 2018. In the 2018-2020 period, due to the currency shock in August 2018 and the COVID-19 pandemic, the average growth rate slowed to 1.9 percent, the average inflation raised to 15.6 percent, and the current account deficit to GDP ratio fell to 1.8 percent on average according to TurkStat. However, in 2021, the growth rate was 11.4 percent, and consumer inflation rose to 36.1 percent.

1.3.2. Monetary Policy Framework

Central banks have played essential and different roles throughout history. The main objectives of central banks have been to finance the public deficit in times of crisis, such as wars, disasters, and epidemics, to ensure price stability, to support economic activity and employment, and to maintain financial stability[10]. However, the balance between these objectives varies over time and across countries.

The CBRT's monetary policy framework, objectives, and instruments have significantly changed since the 2001 crisis. First, the floating exchange rate regime was introduced. Second, with the amendments made to the Central Bank Law in 2001, achieving and

[10] For further details, see Goodhart, C. (2011).

maintaining price stability became the main objective of the CBRT. Third, treasury financing was abolished. Last, the Monetary Policy Committee (MPC) was then established.

1.3.2.1. Inflation Targeting Period (2002-2008)

In 2002, the Central Bank changed the primary objective of monetary policy to price stability under the inflation-targeting regime. Until 2005, the implicit inflation targeting regime was implemented. The CBRT also set monetary targets in line with the inflation targets. The market had a liquidity surplus during this period, and the CBRT withdrew the surplus from the system. Thus, the policy rate was the overnight borrowing rate.

With the macroeconomic stabilization and disinflation process between 2002 and 2005, the CBRT switched to an explicit inflation-targeting regime in 2006. Until the GFC, the CBRT continued withdrawing excess liquidity from the system and accumulating foreign exchange reserves. During this period, the CBRT significantly enhanced its credibility.

1.3.2.2. Monetary Policy After the Global Crisis (2010-2016 Period)

The GFC triggered significant changes in the monetary policy framework and central banking in both advanced and emerging economies. Central banks in advanced countries introduced unconventional policies due to zero lower bounds, pushing capital inflows to emerging economies (IMF, 2013). However, the global liquidity glut resulting from advanced economies' monetary policies threatened emerging economies by triggering rapid credit expansion, currency appreciation, and widening external deficits. As a result, the financial stability objective became increasingly important, and central banks of emerging economies had to expand their toolkit to manage the capital inflows.

In this regard, the CBRT implemented a policy mix including a wider interest rate corridor and macro-prudential tools in the post-crisis period. The central bank raised the volatility in the market rates by widening the interest rate corridor to discourage short-term capital

inflows and simultaneously increase the required reserve ratios to restrain credit growth (Kara, 2013, 2016). In addition, the central bank strengthened its FX reserves through buying auctions, increasing required reserves in FX liabilities, and the reserve option mechanism[11].

Between 2010 and 2016, the CBRT continued to use the asymmetric and wide interest rate corridor, multiple policy rates, required reserves, and the reserve option mechanism. In this period, the liquidity deficit of the banking sector rose, and the CBRT pursued an active liquidity policy. Moreover, the average CBRT funding rate and money market rates were allowed to fluctuate within a wide range (Binici et al., 2019). In this period, BRSA also implemented various macro-prudential instruments, including loan-to-value ratio, debt-to-income ratio for credit cards, limiting maturities of vehicle loans and general purpose loans, capping the installments for credit cards, differentiating the provisions and risk weights among loans.

1.3.2.3. 2016-2021 Period

In 2016, the CBRT simplified the monetary policy framework. As a result, the fluctuations in the daily CBRT funding rate declined significantly, and the predictability of the monetary policy improved. However, the central bank continued to use the reserve requirements actively. Moreover, the CBRT and other authorities implemented many regulations to support loan growth[12]. In addition, the central bank expanded credit facilities such as rediscount credits provided to exporters. On the other hand, the amount of central bank funding increased significantly as banks' swap transactions were shifted from abroad to the central bank, and the FX facility for TL reserve requirements was removed. Moreover, the

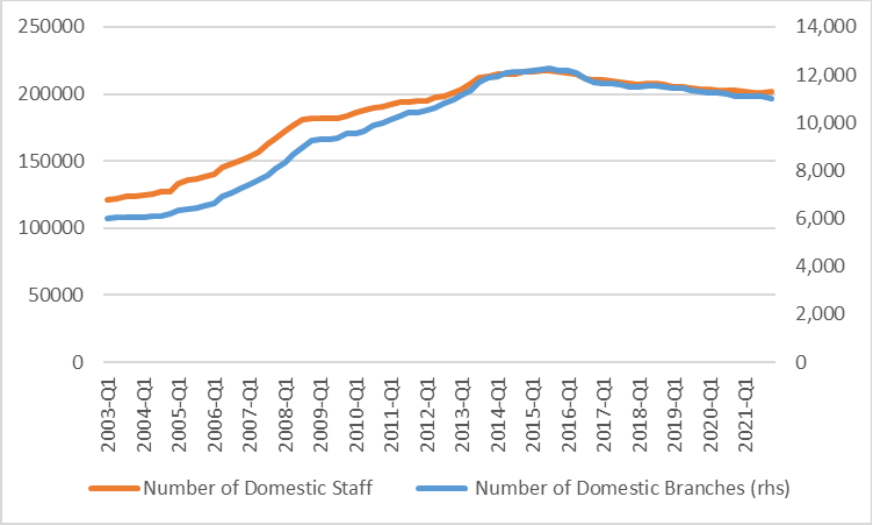
[11] This facility allows banks to hold a certain proportion of TL required reserves in FX and gold. For further details, see Alper et al. (2013) and Aslaner et al. (2015).
[12] These are active ratio, differentiation of TL reserve requirement ratios and remuneration rates according to real credit growth, and loan programs for the real sector below the market rates.

central bank became more active in the foreign exchange market as exchange rate volatility significantly soared.

1.3.3. Banking Sector

The banking sector was restructured after the 2001 crisis. As a result, regulatory and supervisory capacity was enhanced. In the 2003-2021 period, the banking sector made significant progress in asset growth, asset quality, capital structure, risk management capacity, profitability, and efficiency.

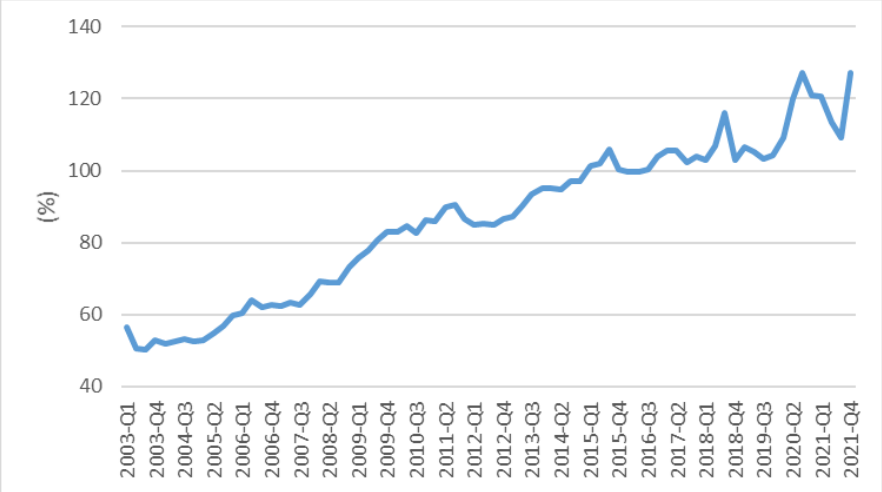
As of 2021, the sector has 32 deposit banks, 6 participation banks, and 15 development and investment banks. Due to growing banking sector activities, the number of branches and personnel almost doubled by the end of 2015. However, despite the ongoing financial development, banks only needed to open new branches thanks to increasing digitalization. Thus, the number of branches and staff slightly declined after 2015.



Source: BRSA

Figure 2. Number of Staff and Branches

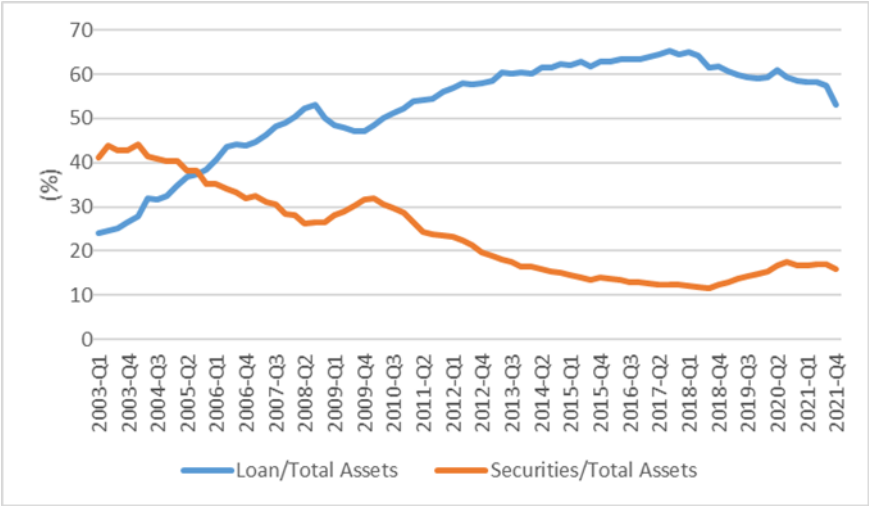
The asset size of the banking sector exceeded TL 4.9 trillion in 2021. As a result, the ratio of asset size to GDP increased to 127.1% from 58.7% in 2002 (Figure 3).



Source: BRSA

Figure 3. Banking Sector Asset Size as of GDP

The asset and liability composition of the banks also changed drastically. On the asset side, due to the high borrowing requirement of the public sector and the high bond rates in the 1990-2002 period, banks mainly invested in public debt securities. With the fiscal discipline after 2002, the borrowing requirement of the public sector decreased significantly, and thus the share of securities in banks' assets declined. During this period, the share of loans also increased steadily. Similarly, while the ratio of loans to assets rose to 53.2 percent from 23 percent in 2002, the share of securities declined from 40.5 percent to 16 percent in the same period (Figure 4). As a reflection of these developments, the ratio of loans to deposits increased.



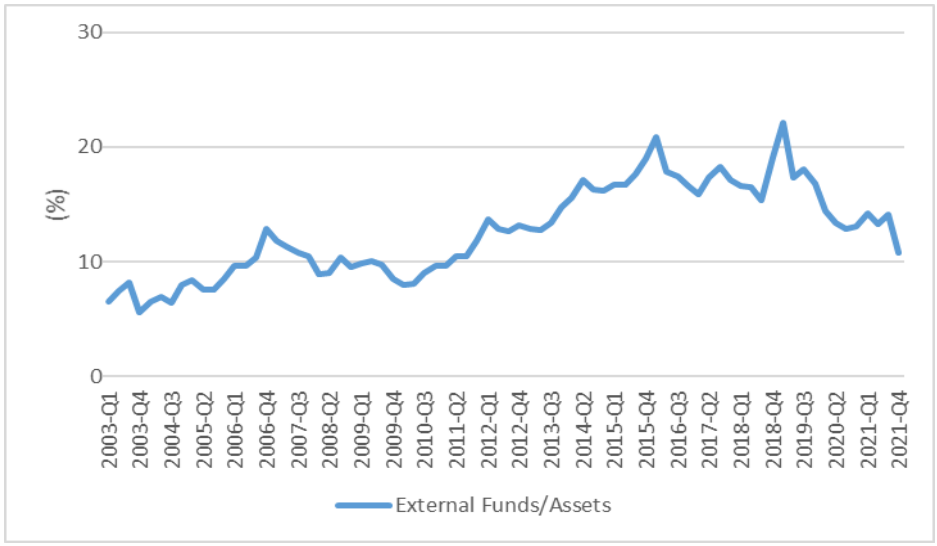
Source: BRSA

Figure 4. Distribution of Assets

On the liability side, deposits continued to be the primary funding source of the banking sector but had a lower share in the balance sheet (Figure 5). As banks' access to global financial markets improved, the resources obtained abroad became a significant funding item (Figure 6). Another growing source for banks was repo funding (after 2008, a large part of the repo item consisted of funds obtained from the central bank). Between 2002 and 2021, the share of repo in total liabilities increased from 2.9 percent to 6.4 percent. Finally, TL-denominated bonds and bills became an alternative source with the introduction in 2009, and their share in the balance sheet reached 3.4 percent in this period.

Source: BRSA

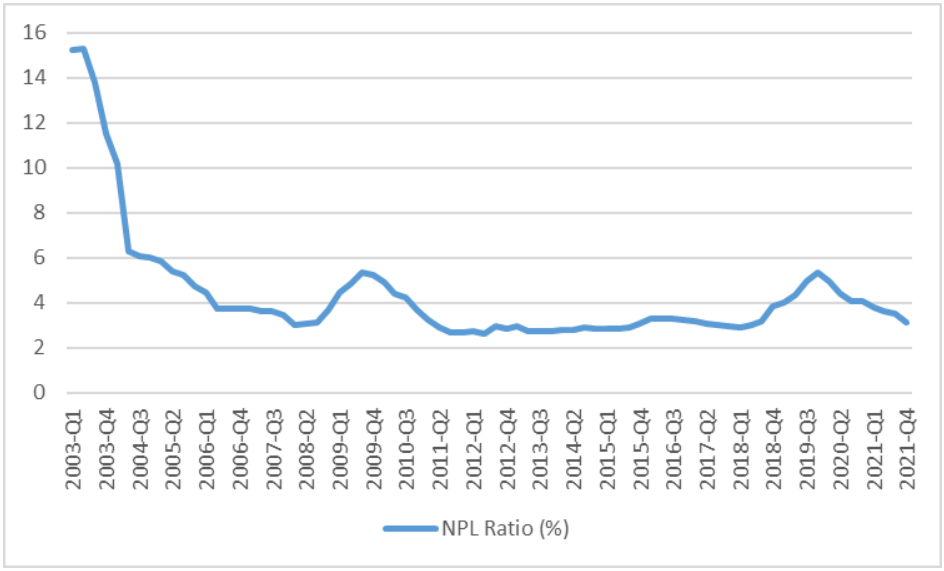
Figure 5. Share of Deposits in the Balance Sheet



Source: BRSA

Figure 6. Share of Funds Provided from Abroad in the Balance Sheet

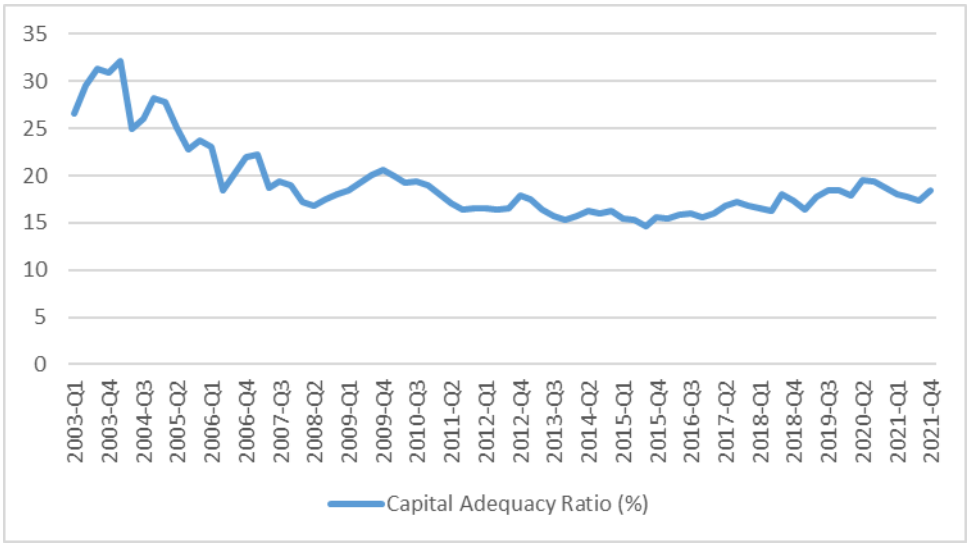
The asset quality also considerably improved. The ratio of non-performing loans (NPL) to total loans decreased significantly and remained relatively low in international comparisons (Figure 7).



Source: BRSA

Figure 7. Non-Performing Loan Ratio

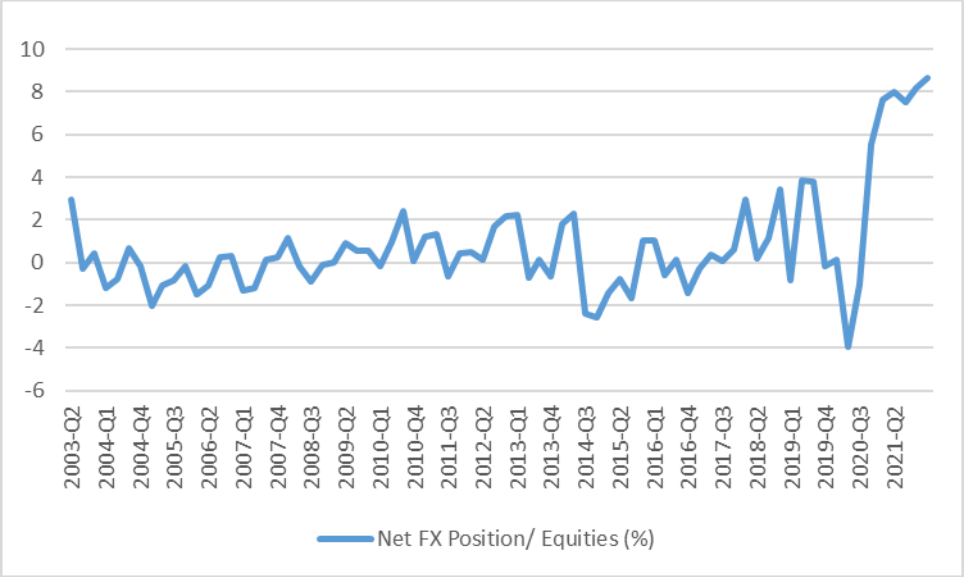
The banking sector maintained its strong capital structure throughout the period. As a result, the Turkish banking sector operated with a high capital adequacy ratio (CAR), which was well above international standards in this period (Figure 8).



Source: BRSA

Figure 8. Capital Adequacy Ratio

The net foreign currency position of the banking sector, which shows the currency risk, indicates that the sector is in a balanced position and manages the currency risk well (Figure 9). The legal limit for net FX position was 20 percent of equities. The Net FX position as a share of equities fluctuated in a limited interval until 2019. However, the banking sector had a long FX position in the last two years. Despite various external and internal shocks, the sector's profits have always been positive during this period.

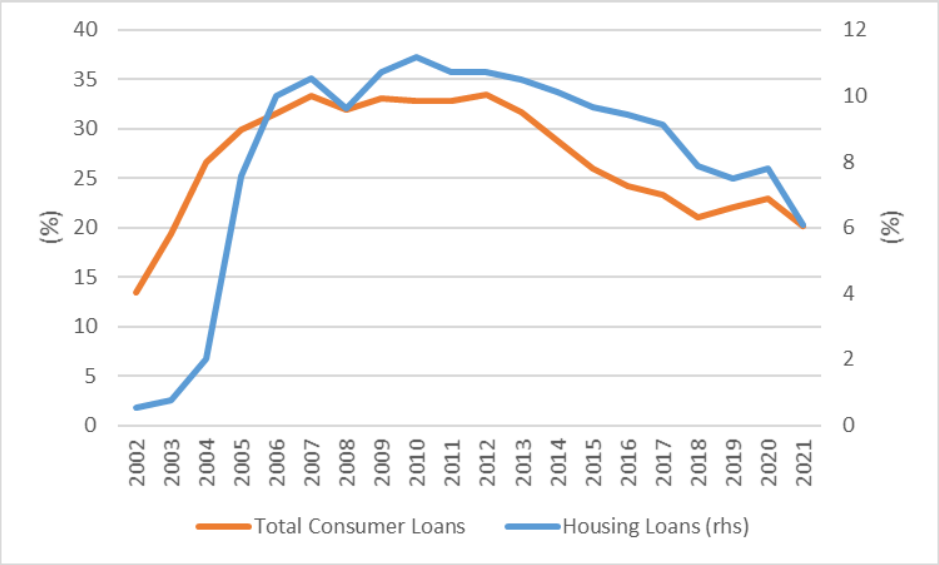


Source: BRSA

Figure 9. Net Foreign Exchange Position as of Equities

The credit market has witnessed remarkable changes since 2001. Economic stability, a low-interest rate environment, and ample funds made consumer loans more attractive for both banks and households. Credit cards and consumer loans started to be widely used in commercial life instead of checks, bills, and other borrowing instruments. The mortgage system was introduced in 2007, and housing loans had a significant share in the loan portfolio. Housing loans' share in total loans exceeded 11 percent in 2010, and it realized around 6 percent in 2021 (Figure 10). The share of consumer loans followed a similar course, with consumer loans accounting for one-third of total loans in the 2007-2013 period. This share has been around 20 percent in recent years, with the remaining (80 percent) being

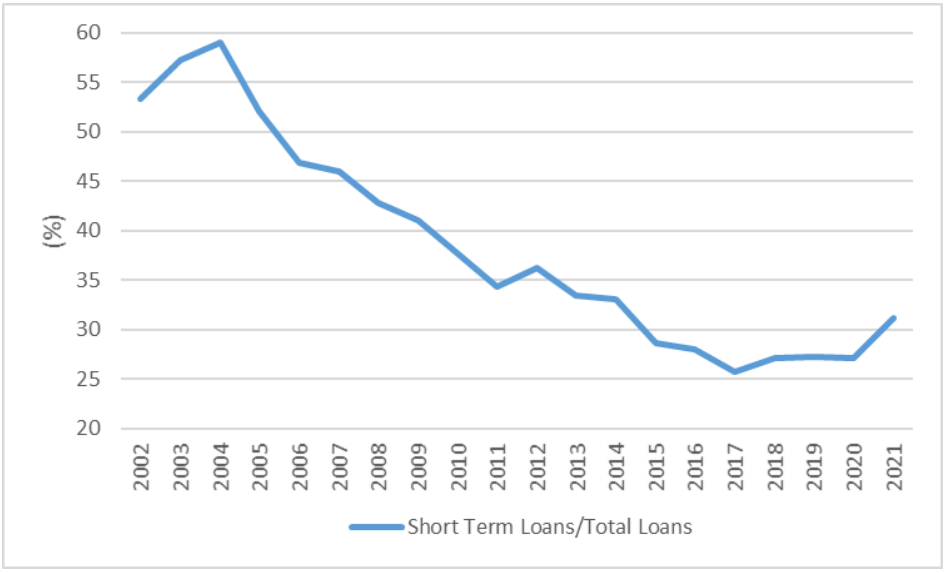
commercial loans. One of the factors behind the increase in the share of commercial loans is the expansion of the Credit Guarantee Fund (CGF) in 2017. The size of the program reached TL 250 billion in 2017. Loans provided under the CGF program have longer maturities and lower interest rates (Akçiğit et al., 2021). Another factor is the depreciation of the Turkish lira. While almost all consumer loans are denominated in TL, commercial loans include a significant amount of FX loans. A depreciation in TL inflates the total loan balances because the TL value of FX loans increases. Therefore, FX-adjusted figures imply higher shares for consumer loans.



Source: BRSA

Figure 10. Share of Consumer Loans and Housing Loans in Loan Portfolio

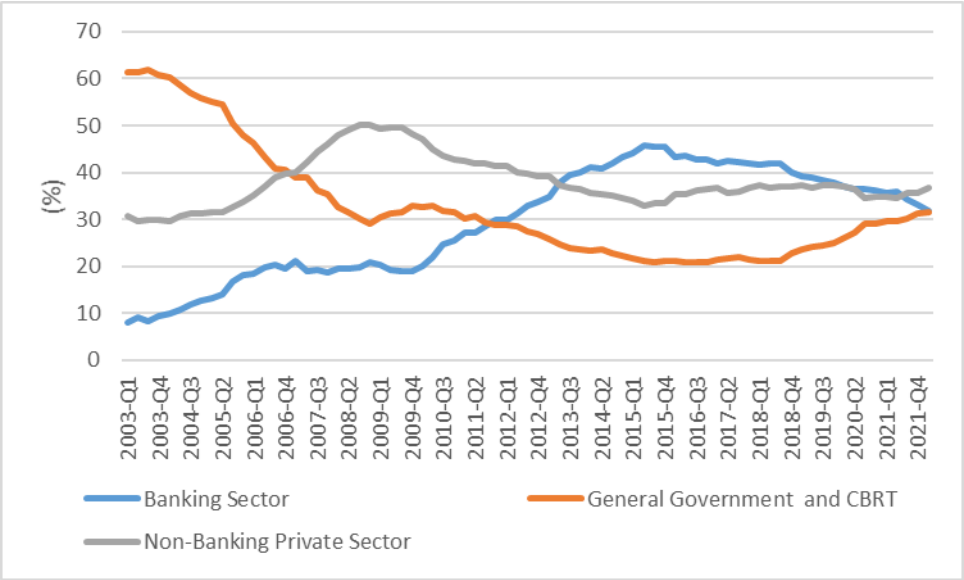
Another improvement was the extension of the maturity of loans. The economic stability and increasing access to international financial markets enabled banks to provide longer-term loans. As a result, the share of short-term loans decreased to 25 percent in 2017 from 60 percent in 2004. However, it has tended to rise for the last couple of years (Figure 11).



Source: BRSA

Figure 11. Share of Short-term Loans

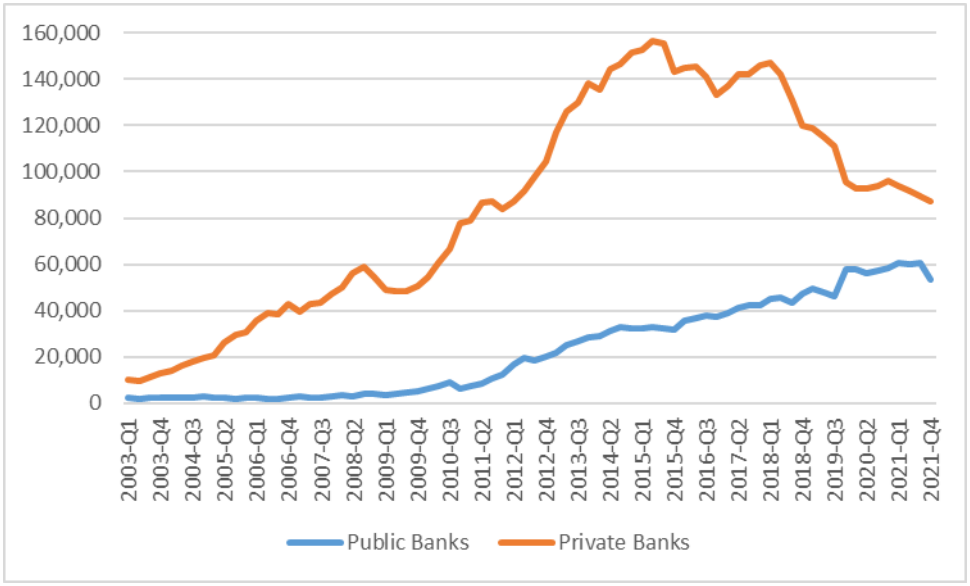
Türkiye grew more than 5 percent on average in the 2003-2021 period with a hefty current account deficit. In other words, domestic savings were insufficient to finance economic growth, and Türkiye needed foreign savings in this period. External borrowing is one way to use foreign savings. Borrowing from abroad also provided cheaper and long-term finance for the private sector in this period. Figure 12 shows the distribution of external debt in the 2003-2021 period.



Source: Ministry of Treasury and Finance

Figure 12. Distribution of External Debt by Sectors

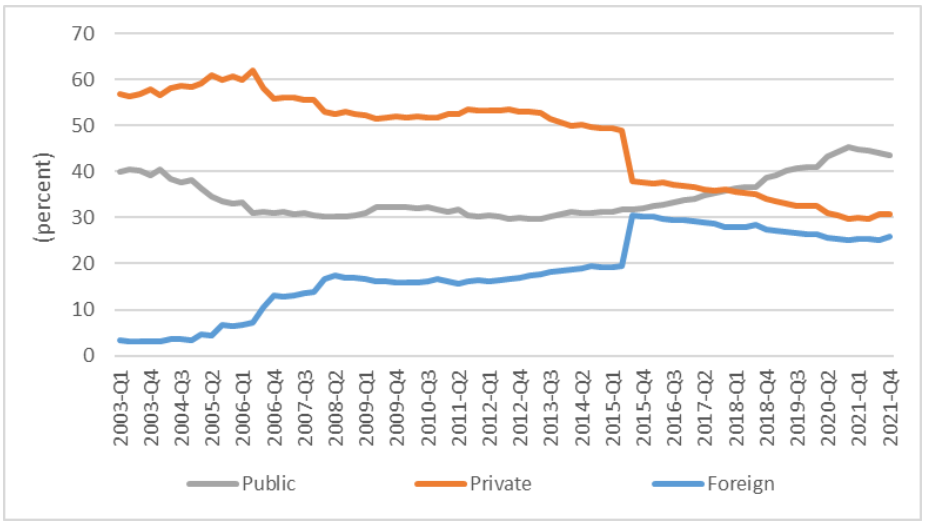
Between 2002 and 2008, the non-banking private and banking sectors increased their share in the country's external debt while the share of the public sector decreased dramatically. After the GFC, the banking sector became the leading actor in external borrowing with its robust structure and credibility. As a result, the Turkish banking sector significantly raised its borrowing from international markets, and its share in the external debt stock reached 46 percent in 2015. In the 2009-2015 period, the non-financial private sector seems to use domestic banks' credits instead of direct external credit. However, after 2015, external debt shifted to the public sector from the banking sector. Therefore, the latest data showed a more balanced distribution of external debt among borrowers. However, within the banking sector, borrowing has shifted from private to public (Figure 13).



Source: Ministry of Treasury and Finance

Figure 13. External Borrowing of Banking Sector (million USD)

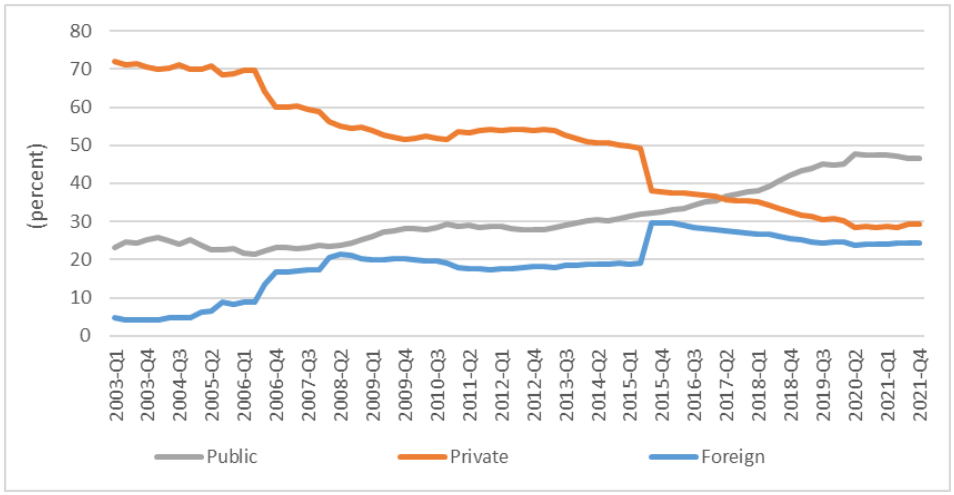
The ownership structure in the banking sector has significant implications for the banking and real sectors. Banks are classified into three groups according to ownership: public (state-owned), private and foreign. The asset shares of the groups showed variation in this period. In 2002, state-owned banks and domestic private banks were the dominant actors in the sector, while foreign banks accounted for only 3 percent of assets. However, thanks to banking reform, high economic growth rates, improved EU accession process, and favorable global conditions, Turkey has attracted over USD 40 billion of foreign direct investment in the banking sector since 2002. As a result, the share of foreign banks in the banking sector increased significantly to 26 percent in 2021, while the share of state-owned banks gradually declined until 2012 (Figure 14). However, after 2015, state-owned banks pursued a more aggressive growth policy and became dominant in the sector.



Source: BRSA

Figure 14. Distribution of Assets by Ownership

We see a similar picture in the loan market. After 2015, public banks became very active in commercial and consumer loans, and their share reached 43 percent in 2021 (Figure 15).



Source: BRSA

Figure 15. Distribution of Loans by Ownership

There are behavioral differences between foreign, public, and domestic private banks. Foreign banks can benefit the national economy and banking sector (Claessens et al., 2001; Levine, 1996). Foreign banks can bring new financial services to the sector with new methods and technologies. Also, competition in the sector is positively affected by foreign entry Sander and Kleimeier (2004). Increasing foreign ownership enhances the institutional capacity of individual banks and the banking sector and improves the country's access to international funds. On the other hand, foreign banks have a shock-transmitting role for global shocks (Cetorelli and Goldberg, 2011). During the GFC, foreign banks cut loans more than local banks (De Haas and Van Lelyveld, 2014).

There has been a divergence in the performance of public, foreign, and private banks in the Turkish banking system. Foreign banks have higher interest rate margins, higher return on equity, and higher non-performing loan ratios compared to public and domestic private banks. On the other hand, public banks operate with lower capital adequacy ratios, NPL ratios, and profitability rates. New entries into the sector, mergers and acquisitions, and differences in the growth performance of banks influenced concentration levels in the sector. The concentration ratios vary across deposit and loan markets but also show fluctuations. The sector became less concentrated until 2017; however, the picture reversed with the increasing share of state-owned banks.

1.4. EMPIRICAL METHODOLOGY AND DATA

1.4.1. Time-Varying Granger Causality Methodology

Granger-causality tests investigate whether lagged values of one variable contribute to forecasting another variable (Stock and Watson, 2001). Vector Autoregressive (VAR) models have been the most widely used methodology in the Granger-causality analysis with the paper of Sims (1980). Causality analysis has continuously evolved from the bivariate framework with new variables, trends, and the transformed data series. Changes in the economic and financial structure and the nature of the shocks raise questions about the stability of the relationships between variables. Various empirical approaches have been developed to capture the changing patterns of relationships.

The first method is to shorten or extend the samples and compare the results from different samples. For example, Stock and Watson (1989) conclude that the money-income linkage is weaker in the shorter sample that excludes the data after September 1979. However, Friedman and Kuttner (1993) have the opposite findings that money has no predictive content for real activity when extending the sample through 1990.

The second way is the forward-expanding window approach developed by Thoma (1994). In this algorithm, the minimum window size is determined at first, and the window size extends by one through the end of the sample. The Wald test statistics are generated for each window.

The third one is the rolling window method (Swanson, 1998; Arora and Shi, 2016), in which window size is fixed, and each test statistic is produced from subsamples with the same size. Fourth, Psaradakis et al. (2005) use a Markov Switching VAR model, finding that the empirical findings are sensitive to the selected sample.

The most recent one is the recursive evolving window methodology introduced by Shi et al. (2018, 2020). This new methodology covers both forward-expanding window and rolling window approaches. Simulation results show that the recursive evolving algorithm has higher power than forward expanding and rolling window methods and produces more robust results (Shi et al., 2020).[13]

Moreover, the new framework works with non-stationary and trending time series and computes heteroskedastic-consistent test results. Considering the structural changes in the Turkish economy and financial system over the past two decades, we expect the money-output and credit-output relations to have a time-varying pattern. Thus, I apply the recursive evolving framework in this study.

I estimate an LA-VAR model (k+d) where k is the lag length on the baseline VAR model and d is the additional lags, the highest integration order of the variables[14]. In addition, a time trend and constant term are added to the models.

The LA-VAR model for a vector of y_t with n-dimensions is given below (Shi et al., 2020, pp. 162-163).

$$y_{1t} = \gamma_0 + \gamma_1 t + \sum_{i=1}^{k} J_i y_{t-i} + \sum_{j=k+1}^{k+d} J_j y_{t-j} + \varepsilon_t \quad (1)$$

where $J_{k+1} = \cdots = J_{k+d} = 0$, t is time trend and ε_t denotes the error term. The equation could be restated as:

$$y_t = \Gamma\tau_t + \Phi x_t + \Psi z_t + \varepsilon_t \quad (2)$$

[13] See Shi et al. (2020) for further details.
[14] See Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996)

where $\Gamma = (\gamma_0, \gamma_1)_{n\times(q+1)}$, $\tau_t = (1, t)'_{2\times1}$, $x_t = \left(y'_{t-1}, \dots, y'_{t-k}\right)'_{nk\times1}$,

$z_t = \left(y'_{t-k-1}, \dots, y'_{t-k-d}\right)'_{nd\times1}$, $\Phi = (J_1, \dots, J_k)_{n\times nk}$, and $\Psi = (J_{k+1}, \dots, J_{k+d})_{n\times nd}$.

The null hypothesis that there is no causality is written as

$$H_0 : R_\phi = 0 \tag{3}$$

Here R is a $m \times n^2k$ matrix and $\phi = vec(\Phi)$ using row vectorization. As the entries of the coefficient matrix of d lagged vectors, Ψ, are assigned to zero, the Ψ matrix is not included in the restrictions.

Therefore, equation 1 is reformulated as

$$Y = \tau\Gamma' + X\Phi' + Z\Psi' + \varepsilon_t$$

where $Y = (y_1, y_2, \dots, y_T)'_{T\times n}$, $\tau = (\tau_1, \dots, \tau_T)'_{T\times 2}$, $X = (x_1, \dots, x_T)'_{T\times nk}$,
$Z = (z_1, \dots, z_T)'_{T\times nd}$ $\varepsilon_t = (\varepsilon_1, \varepsilon_2, \dots, \varepsilon_T)'_{T\times n}$

The OLS estimator is $\hat{\Phi} = Y'QX(X'QX)^{-1}$ where $Q = Q_\tau - Q_\tau Z(Z'Q_\tau Z)^{-1}Z'Q_\tau$,
$Q\tau = I_T - \tau(\tau'\tau)^{-1}\tau'$

The Wald statistic W of the null hypothesis with homoscedastic errors is written as

$$W = \left(R\hat{\phi}\right)'\left[R\left\{\hat{\Sigma}_\varepsilon \otimes (X'QX)^{-1}\right\}R'\right]^{-1}R\hat{\phi} \tag{4}$$

where $\widehat{\Phi}$ = the OLS estimator, $\hat{\phi} = vec(\widehat{\Phi})$, $\otimes$ = Kronecker product, and $\hat{\Sigma}_{\varepsilon} = \frac{1}{T}\hat{\varepsilon}'\hat{\varepsilon}$.

The Wald statistic in Equation 4 follows the asymptotic distribution of χ^2_m with m restrictions (Toda and Yamamoto, 1995; Dolado and Lütkepohl, 1996).

Assume that f_0, f_1 and f_2 are the (proportion in the sample) minimum window size, beginning and final points of the sub-sample, respectively. This method allows changes in window sizes and the beginning point of regression for subsamples. Window size $\tau_w = [f_w T] = f_2 - f_1 \geq f_0$ where T is the full sample size. Keeping the ending point fixed, a set of recursive Wald statistics is computed by expanding windows backward in each sub-sample. Thus, all options for each sub-sample are examined to get the highest test statistics. denoted $\{W_{f_1,f_2}\}_{f_2=f}^{f_1\in[0,f_2-f_0]}$ is the Wald statistics sequence for each observation. Then, the sup Wald statistics is given below.

$$SW_f(f_0) = \sup_{f_2=f,\, f_1\in[0,f_2-f_0]} \{W_{f_1,f_2}\}$$

Shi et al. (2020) also construct the heteroskedastic-consistent Wald test statistic which is written as

$$\mathcal{W}^*_{f_1,f_2} = T_w(\mathbf{R}\hat{\phi}_{f1,f2})' \left[R\{\hat{V}^{-1}_{f1,f2} \hat{\sum}_{f1,f2} \hat{V}^{-1}_{f1,f2}\} R'\right]^{-1} (\mathbf{R}\hat{\phi}_{f1,f2}), \quad (5)$$

$\hat{\phi} = vec(\widehat{\Phi}_{f_1 f_2})$

$\hat{V}_{f_1 f_2} = I_n \otimes \hat{Q}_{f_1,f_2}$ and $\hat{Q}_{f_1,f_2} = \frac{1}{T_w} \sum_{\lfloor Tf_1 \rfloor}^{\lfloor Tf_2 \rfloor} x_t x_t'$

$\hat{\sum}_{f_1 f_2} = \frac{1}{T_w} \sum_{t=\lfloor Tf_1 \rfloor}^{\lfloor Tf_2 \rfloor} \hat{\xi}_t \hat{\xi}_t'$ and $\hat{\xi}t = \widehat{\varepsilon_t} \otimes x_t$

The sup Wald statistic consistent with heteroscedasticity is

$$SW_f^*(f_0) = \sup_{f_2=f,\ f_1\in[0,f_2-f_0]} \{W^*_{f_1,f_2}\}$$

The recursive time-varying Granger causality analysis produces test statistics for each sub-sample separately. The number of hypotheses tested is T-$\lfloor Tf_0 \rfloor$ +1. This high number of testing may cause the multiplicity problem and increases the probability of making a Type 1 error. Shi et al. (2020) offer a bootstrap method as a solution to multiplicity problem[15].

1.4.2. Data

The empirical analysis uses the monthly data from 2003-1 to 2021-12 and includes 228 observations. Although empirical studies differ on the number of variables, papers investigating the money-income nexus usually use four variables; money, output, interest rate, and price level. I add the exchange rate variable into the models, which impacts monetary policy, monetary aggregates, credit, and output. The exchange rate is also considered a proxy for global shocks, risks, and expectations (Binici et al., 2019; Küçük et al., 2022) and domestic risks and uncertainties.

M1 is obtained from the CBRT database[16], the industrial production index and the consumer price index (CPI) are taken from TURKSTAT, and the credit stock is obtained from the BRSA database. The exchange rate represents the monthly average of daily USD/TL rates and retrieved from the CBRT database[17].

[15] For further details about the bootstrap procedure, see Shi et al. (pp.165-166, 2020).
[16] The money supply series is available from December 2005 in the CBRT database. The author produced the data between January 2003 and November 2005 using the deposit data.
[17] Nominal and real exchange rates carry essential information, both used in the literature. However, the study prefers the nominal exchange rate because it better reflects the risks and economic agents' expectations. Also, some studies use the average exchange rate calculated using different weights for the USD and the euro.

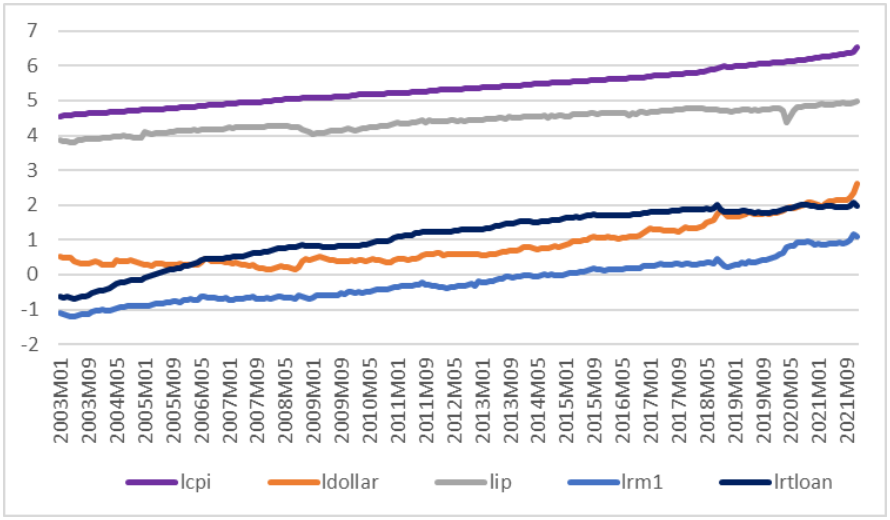
During the sample period, the central bank provided funds to banks via different policy rates. Thus, we have constructed a series for the policy rate[18] using different policy rates. First, we take the overnight borrowing rate for the period before May 2010 since the banking system had a liquidity surplus before the GFC. Between May 2010 and January 2011, funding was provided mainly through the one-week repo; thus, this rate is used for this period. Finally, the CBRT provided funds to the banking system at multiple rates starting in 2011. Therefore, we use the weighted average cost of funding released by the CBRT for the period 2011-2021.

We deflate the nominal money supply and nominal credit stock by CPI to obtain real M1 stock and real credit stock. M1, credit stock, industrial production, and CPI are seasonally adjusted. All data are logged except for the policy rate. The VAR model comprises the logarithm of the real money supply (m1) or the logarithm of the real bank loans (bl), the policy rate, the logarithm of the exchange rate (er), the logarithm of the price level (p), and the logarithm of the industrial production index (ip).

Table 1. Descriptive Statistics

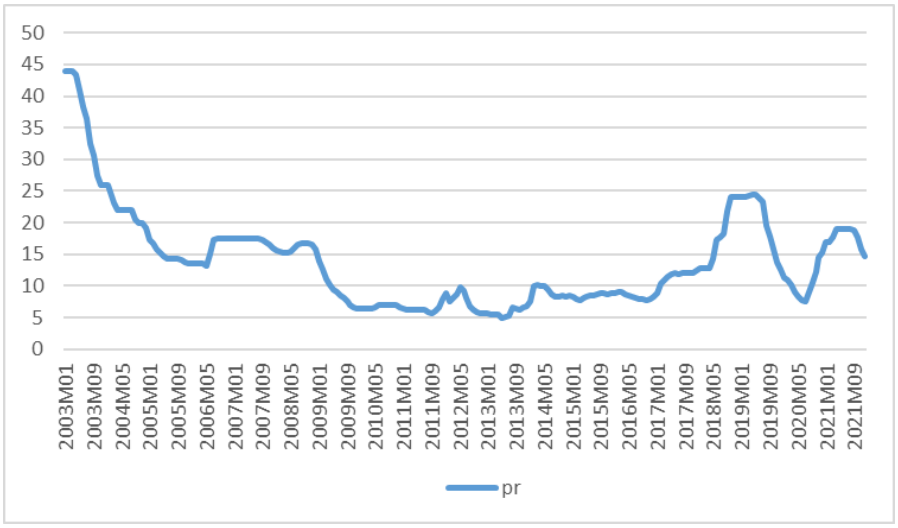
	Real M1 Stock	Real Credit Stock	Consumer Price Index (2003=100)	Industrial Production Index (2015=100)	Exchange Rate (USD/TL)	Policy Rate (%)
Mean	1.0	3.8	243.1	86.1	2.87	13.8
Median	0.7	3.6	205.7	83.7	1.79	12.1
Maximum	3.1	7.9	686.4	144.4	13.53	44.0
Minimum	0.3	0.5	94.5	45.3	1.17	4.8
Std. Dev.	0.6	2.2	127.8	25.0	2.18	7.6
Skewness	1.4	0.1	1.1	0.3	1.78	1.7
Kurtosis	4.5	1.6	3.4	2.0	5.98	6.6
Jarque-Bera	94.4	18.5	46.2	11.8	205.3	230.2
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Sum	222	866	55436	19635	655	3136
Sum Sq. Dev.	85	1079	3706246	141785	1080	13282
Observations	228	228	228	228	228	228

[18] For the period after 2010, there are different approaches to choosing the policy rate. For example, some studies use the CBRT average funding cost, while others prefer BIST overnight rate. Also, some papers take the average of these two.



Source: Author's calculation based on the data from BRSA, CBRT, TURKSTAT

Figure 16. Time series of the logarithm of CPI, exchange rate, industrial production index, real M1, and real total loans



Source: Author's calculation based on the CBRT data

Figure 17. Policy Rate (%)

Before making an econometric analysis, we plot the graphs of variables. Figure 15 and Figure 16 imply that the five variables m1, bl, er, p, and ip are non-stationary. Although this methodology does not need to eliminate unit roots, unit root tests are necessary to determine the maximum order of integration. Therefore, I test for the integration order of the series by

applying the augmented Dickey-Fuller (ADF) test. Furthermore, considering the possible breaks in the series, we employ the unit root test with a structural break[19]. Breaks can be in the form of either an Innovational Outlier (IO) or an Additive Outlier (AO). Table 2 demonstrates the unit-root test results. The results indicate that the maximum order of integration (d) is 1. The lag length of VAR k=2 is selected using BIC with a maximum lag order of 12. The minimum window size is set as 36 months[20]. 5% bootstrapped critical values are calculated based on 499 repetitions, controlling for 1-year period.

Table 2. Unit Root Test Results

	ADF			ADF with break	
	Intercept	Intercept and Trend	None	IO	AO
pr	-4.42	-4.07	-2.98	-5.35	-5.16
m1	0.74	-2.03	-0.63	-4.74	-4.78
br	4.59	-1.40	1.57	-3.07	-2.97
ip	-0.92	-4.07	1.93	-6.32	-4.53
er	3.03	-0.51	4.04	-1.90	-1.90
p	3.03	3.74	4.12	0.61	-0.44
Δm1	-17.61	17.66	-16.60	-17.01	-17.12
Δbr	-12.86	-13.62	-12.21	-13.43	-13.54
Δip	-6.85	-7.11	-6.774	-17.76	-17.86
Δer	-9.35	-10.22	-8.83	-11.95	-12.13
Δp	-4.22	-4.80	-0.35	-11.14	-10.86
Test Critical Values					
1% level	-3.46	-4.00	-2.58	-5.35	-5.35
5% level	-2.87	-3.43	-1.94	-4.86	-4.86
10% level	-2.57	-3.14	-1.62	-4.61	-4.61

The lag lengths are selected based on the SIC criteria with a maximum lag of 14. The break dates are estimated endogenously.

[19] Perron (1989) pointed out that unit root tests produce biased results under a structural break and introduced new methodologies to solve the problem. The break date is assumed to be fixed and known in Perron (1989). Later, Zivot and Andrews (1992), Banerjee et al. (1992), and Vogelsang and Perron (1998) developed approaches that estimate the break dates endogenously from the data.

[20] There are no formulas or specific criteria for the minimum window size. For example, Shi et al. (2020) set the minimum window size to 72 observations for a sample with 664 observations. The three-year window size in this study is almost 16 percent of the total sample size and is considered large enough. The results of the robustness check with a 42-month minimum window size do not indicate a significant difference.

1.5. RESULTS

The two VAR models with five variables are estimated. The test results are presented in Figure 18 and Figure 19. The line and the dashed line in the figures show the heteroskedastic consistent test statistic sequence and 5 % critical value sequence, respectively. If the test statistic value is greater than the critical value (CV), money Granger causes to income.

1.5.1. Money-Output Nexus

The results indicate that the money-output relation is unstable over the sample. The causal relationship is detected only in a very short period of the sample. There are three causal episodes[21]. The first is between the second quarter of 2006 and the third quarter of 2008. During the implicit inflation targeting regime, the CBRT also targeted monetary aggregates (Kara, 2008). The results confirm that money had information about economic activity and was crucial for monetary policy until the GFC when money lost its predictive power for output. The second one starts in the third quarter of 2011 and continues until the first quarter of 2012. The third causal period begins in mid-2014 and lasts almost one year. I find no evidence of a causal link between money and output for the period following July 2015.

Moreover, the findings show no causal episodes during the GFC, the second half of 2018 (currency shock), and the first half of 2020 (COVID-19). These results support the findings of Kocaaslan (2014)[22] that money loses its forecasting power during recessions in Türkiye. While, Psaradakis, Ravn, and Sola (2005) find that the forecasting power of monetary aggregates for output is higher during recessions than during expansions for the US.

[21] The periods with causality links lasting at least six months are defined as causal episodes.
[22] This finding is valid for the 1994, 2000 and 2001 crises. She also finds that M2 has predictive content during the GFC.

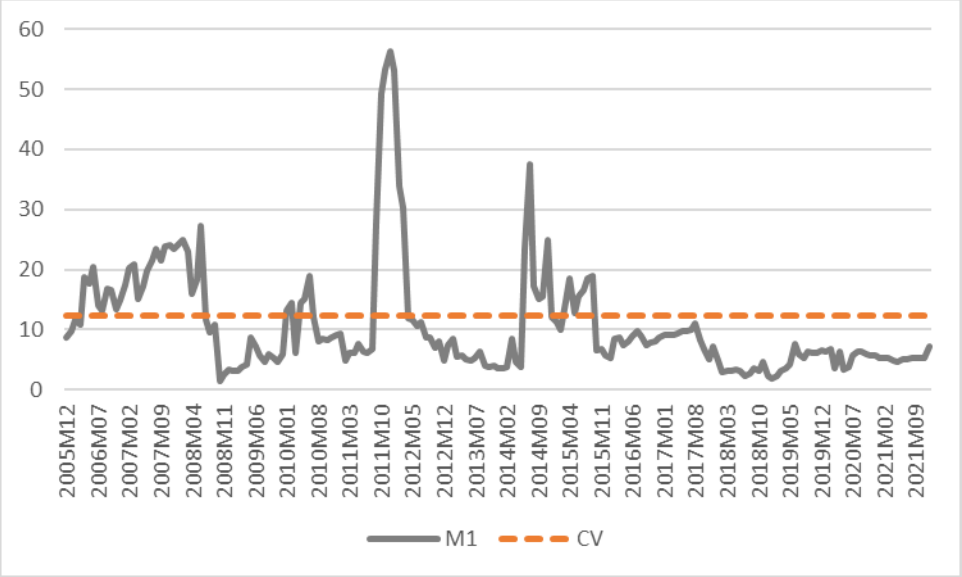


Figure 18. Time Varying Granger Causality Test Results from Money to Output

1.5.2. Credit-Output Nexus

Figure 18 indicates that the causal relation between credit and output is time-varying. The test detects no causality from credit to income before the third quarter of 2011. However, the results point to the first and largest episode starting in July 2011 and lasting until February 2015, i.e., 44 months. The second causal episode is identified between August 2015 and January 2016, lasting six months. The results indicate the third causal episode started in May 2017 and continued for six months. Finally, the findings imply the last casual episode between June 2020 and May 2021.

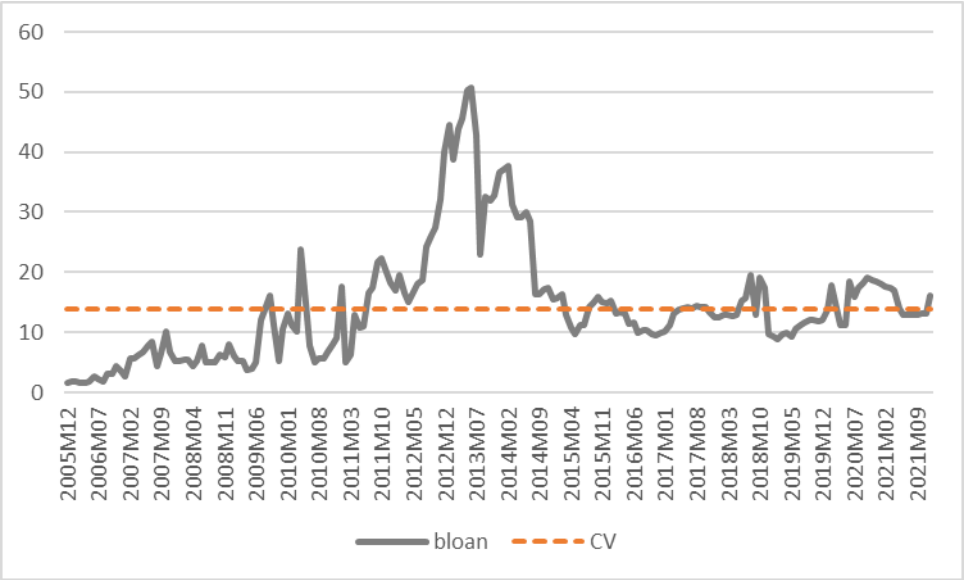


Figure 19. Time Varying Granger Causality Test Results from Credit to Output

The characteristics of causal episodes can give us clues about the driving forces of causality. The first and third periods coincide with positive growth rates, capital inflows, relatively stable exchange rates, and low inflation. The third episode was also a period of expansion of the credit guarantee mechanism, which accelerated credit growth. On the other hand, during the second causal period, capital inflows significantly slowed down, the exchange rate was relatively volatile, and credit growth was low. However, the last causal episode has different characteristics from other causal periods. First, a significantly strong fiscal and monetary stimulus was implemented to overcome the adverse effects of COVID-19. As a result, credit growth reached historic highs over the last 15 years. Second, the pandemic hit the services sector worse than the industry, resulting in a decoupling between the industry and services sector. Third, currency depreciation and inflation were more pronounced than the sample averages.

Figure 18 also exhibits that the test statistics reduced considerably after June 2013 but remained statistically significant until the first quarter of 2015. Since then, the credit-output relation has shown a weaker and more volatile pattern. Also, the duration of causal episodes is shorter in the post-2015 period.

Various factors might be at play in the periods when causality is absent or poor. The non-casual period before the third quarter of 2011 is very long and includes various global and local events. Also, this period bears some similarities with the causal episodes. However, the main difference between this period and the rest of the sample is the divergence between loan and economic growth rates. After the 2001 crisis, demand and supply factors stimulated credit growth. The growth rate of credit (more than 500%) was much higher than the growth rate of industrial production (around 70%) between 2003 and the mid of 2011, suggesting that credit growth was only partially related to economic growth in this period. In other words, these figures imply that part of the credit growth was driven by a shift of financing activities from the non-banking sector to the banking system. As Kara (2013) argues, as the financial sector deepens, the effects of credit on economic activity are likely to become stronger. However, this finding does not support that finance drives output in the early stages of development.

Capital inflows influence both credit growth and economic activity. Therefore, the causal relationship between credit and output appears to be sensitive to capital flows. Moreover, since the exchange rate is important for inflation, investor sentiment, and consumer confidence, capital inflows also affect economic indicators through the exchange rate. The decline in test statistics starting in mid-2013 coincides with FED's signals to taper quantitative easing and the volatility in domestic financial markets. After 2014, capital flows followed a volatile course, mainly due to the normalization of US monetary policy.

Moreover, the public sector increased its influence in the credit market during this period. In this regard, the share of public banks has had an upward trend since 2015, and their share is now more than 40 percent. In addition, Figure 12 and Figure 13 show that the banking sector reduced their external borrowing, and there was a shift from the private banks to government, state-owned banks, and the CBRT. However, the empirical evidence on public banks is mixed. On the one hand, some studies have found negative effects of public banks on productivity and growth (La Porta et al., 2002). On the other hand, depending on the level of financial development (Körner and Schnabel, 2011) and institutional quality (Körner and

Schnabel, 2011; Andrianova et al., 2012; Önder and Özyıldırım, 2013), there may be a positive relationship between public banks and output growth.

Another important finding is that the predictive power of credit varies across recessions. For example, we do not detect any causality during the GFC. However, the results point out a short period of causality in the second half of 2018 and a relatively long period in 2020. One possible factor distorting causality during recessions is that credit has a countercyclical component. Authorities often loosen policies to stimulate credit growth when they see signs of a slowdown. In addition, firms' demand for credit increases for working capital needs rather than for investment. On the other hand, one potential explanation for the causality detected in the last two economic slowdowns is that the industrial production index may underrepresent all economic activity due to the divergence between the services sector and industry after the 2018 currency shock, especially during the pandemic. In such periods, the contraction in the services sector is deeper than in industry.

1.5.3. Robustness Check

As a robustness check, we set the minimum window size to 42 months and the control size to 24 months. Figure 20 and Figure 21 show similar causal episodes with Figure 17 and Figure 18 with slight differences. Therefore, test results appear robust to window and control size changes.

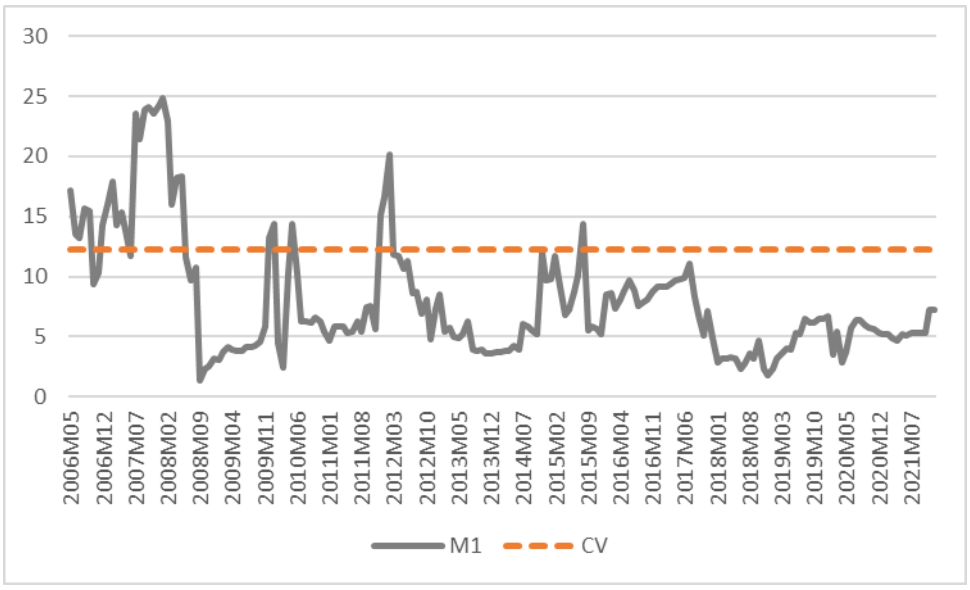
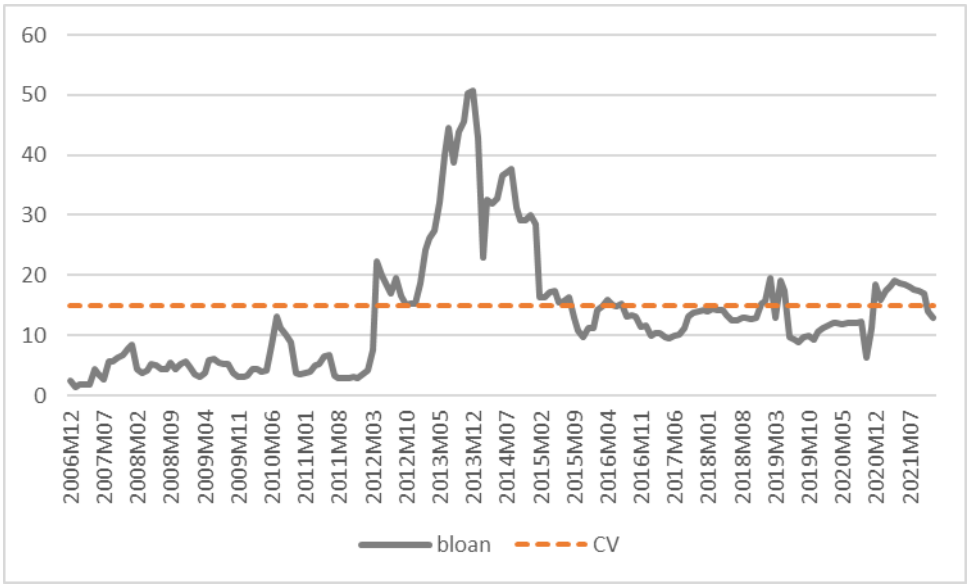


Figure 20. TVGC Test Results from Money to Output for Robustness Check



Window size is 42 and control size is 2 years.

Figure 21. TVGC Test Results from Credit to Output for Robustness Check

1.6. CONCLUSION

This section analyzes the causality relationship between financial variables—money and credit—and output within a time-varying framework. Money (deposits) and credit are the two essential components of banks' liabilities and assets. However, despite the high correlation between money and credit, there is a great deal of theoretical debate and empirical study to answer the question of which is a better indicator for economic objectives such as output.

Researchers and policymakers initially focused on monetary aggregates. Over the last 40 years, however, the credit-income link has received increasing attention. The significance of bank lending is evident in the Turkish economy, where the banking sector dominates the financial system. In other words, firms' high dependence on bank financing boosts the capacity of banks to influence economic activity. With the GFC, the importance of credit indicators was better understood, and since then, policymakers have closely monitored and analyzed the financial sector and credit indicators.

Causality analysis is a widely used method to understand the relationship between variables. The Granger-causality tests allow us to figure out whether money and credit forecast output. Considering the significant changes in the Turkish economy, the banking system, and the monetary policy over the last two decades, we use a time-varying framework. Moreover, the time-varying Granger-causality analysis shows the predictive power of financial variables for output over time.

The results show that the money-output and credit-output relationship vary over time. Money has predictive content for output in the pre-GFC period. However, the GFC interrupts the causal link between money and output, contrary to findings of Psaradakis et al. (2005) for the US economy. As the effects of the crisis eased, money regained its predictive power partially. As a result, several causal episodes are detected between 2009 and 2015. However,

after mid-2015, the forecasting power of money for output disappeared. The results also indicate that money has no predictive power for output during recessions.

Unlike money, the empirical evidence indicates that credit has no predictive content for output before 2011. The low level of financial development at the beginning of the sample, measured by credit to GDP ratio, and the vast differences between the growth rates of credit and economic activity are the possible factors that preclude the causal link between credit and output period in this period. The results indicate several causal episodes in the post-GFC period. The first causal episode is between July 2011 and February 2015. In addition, two short-lived causal episodes are identified in the period from the beginning of 2015 to the second half of 2020. Finally, the findings indicate a relatively longer casual episode between June 2020 and May 2021.

After 2015, in addition to global factors like capital inflows, domestic factors are likely to affect the credit-output relation. In this period, credit guarantees, subsidized loan programs, regulations, and an increasing share of central bank funding in the system strengthened the role of public authority. Moreover, public banks have a leading role in the system with an asset share above 40 percent. In addition, the share of private banks in external borrowing tended to decline while public banks increased their shares. However, in an environment of slowing capital inflows, credit expansion, mainly generated by public banks, is likely to have a weak and short-lived link to output growth. On the contrary, it may push up the exchange rates, inflation, and asset prices.

Moreover, my findings indicate that the credit-output relation differs across the recessions. For example, there is no causal link from credit to output during the GFC, while a short causal episode in the second half of 2018 and a larger episode in 2020 are identified. The countercyclical part of the credit may dampen the causality relationship in economic downturns. During or shortly before recessions, public authorities and public banks support credit growth, and real sector demands more credit for working capital. Another possible

reason is that some portion of the credit provided during recessions is invested in financial instruments instead of being spent on the real activities. On the other hand, the underrepresentation of industrial production for the whole economy can explain the existence of causal relations in the last two economic slowdowns. The depreciation of the local currency boosted exports, particularly of industrial goods, while dampening domestic demand with a significant services component.

CHAPTER 2: HOW BANK RATES RESPOND TO POLICY RATE

2.1. INTRODUCTION

Interest rates have evolved into the main policy instrument of central banks since the introduction of inflation targeting in the 1990s. Central bankers use short-term interest rates to achieve various objectives such as inflation, output, employment, and financial stability. Changes in policy rate influence economic agents' investment, consumption, saving, and borrowing decisions through different channels. The transmission starts by changing the money market and bank interest rates, and the rest of the process depends on the first steps. Therefore, the ability of policy rates to influence other interest rates in the economy is essential to the effectiveness of monetary policy (Aristei and Gallo, 2014; Hristov et al., 2014). In Turkey, the interest rate channel has become increasingly critical as the banking sector dominates the financial system and the weight of loans in the economy has increased over the last two decades.

Under perfect competition with perfect information and in the absence of market failures, changes in policy rates are expected to be fully reflected in bank rates. However, markets are far from this perfect world.

Empirical studies show that interest rate pass-through is incomplete and slow, at least in the short run (Cottarelli and Kourelis, 1994; Egert et al., 2007; Karagiannis et al., 2010; Kwapil and Scharler, 2010; Rocha, 2012; Aristei and Gallo, 2014; Gambacorta et al., 2015). It can be asymmetric (Payne, 2006; Sander and Kleimeier, 2004), heterogeneous, and sometimes even more than complete. Empirical results are sensitive to sample period, cross-country differences, methodologies, and selected instrument types.

The size and pace of interest rate pass-through are affected by rigidities, asymmetric information, maturity mismatch, banks’ behaviors, balance sheet constraints, financial

structure, macroeconomic variables, and monetary policy framework. This list can be extended further.

In addition, the interest rate pass-through also depends on how the interest rate channel interacts with other channels, such as credit and exchange rate channels. For example, a policy rate hike may deteriorate a firm's balance sheet by increasing interest expenditures and reducing collateral values and expected cash flows. As a result, the firm's external risk premium increases, which finally leads to a higher spread and lending rate. Furthermore, changes in exchange rates stemming from policy rate innovations may affect the external risk premiums of firms and lending rates.

The past two decades have witnessed dramatic changes in the Turkish economy, financial markets and monetary policy. After the 2001 crisis, Türkiye restructured its banking sector, improved its public finance, and reduced inflation to single digits by adopting macro reforms. In addition, country risk premiums and interest rates significantly declined. As a result, the Turkish economy became more integrated into the global economy and capital markets. However, the risk premiums and macroeconomic indicators such as growth rate and inflation showed a volatile pattern after 2016.

Moreover, the asset and liability composition of the banking sector has changed over the last two decades. Banks have diversified their liabilities and extended their maturities by increasing their access to international markets. Furthermore, thanks to reduced public borrowing, the banking sector has focused more on intermediation activities, and as a result, the ratio of credit to GDP has increased significantly. However, capital markets are still underdeveloped and unable to provide reliable alternative products not only for firms but also for households. As a result, deposits have long been the dominant instrument in household balance sheets. Hence, interest rate pass-through is critical for countries with a bank-dominated financial sector.

The monetary policy framework and its implementation have evolved in response to both global and domestic developments. Monetary policies in advanced economies influence local monetary policies depending on their global integration (Rey, 2015). For example, after the 2008 GFC, advanced economies implemented additional tools to boost credit growth, such as asset purchasing programs, forward guidance, negative deposit facility rates, and relaxation of collateral standards. However, the expansionary monetary policies of major central banks accelerated capital inflows to emerging economies. Many emerging economies used macroprudential measures to mitigate financial risks arising from capital inflows, credit growth, and asset prices[23].

Before 2010, the CBRT pursued a more traditional policy to achieve its price stability target. However, after 2010, the CBRT added financial stability to its objectives and adopted a policy mix including macroprudential tools (Kara, 2013). Due to often changing global and local conditions, the CBRT has frequently changed the composition and cost of central bank funding and the macroprudential policy framework over the last decade. In addition, in 2020-2021, the central bank introduced new mechanisms affecting credit growth and lending rates.

Changes in the financial structure and the conduct of monetary policy influence the transmission channels of monetary policy (Boivin et al., 2010). As a result, the ability of central bank to influence financial markets and real economic activity is likely to change over time. More concretely, the speed and level of pass-through may fluctuate over time. Hence, developments in financial markets and changes in monetary policy in Turkey over the last two decades suggest using models that consider time-varying patterns and changes in the volatility of shocks.

The literature on interest rate pass-through in Türkiye is growing. However, the studies usually have shorter sample periods and do not adequately consider the volatility of shocks,

[23] For details of unconventional monetary policies, see IMF (2013), Kara (2013, 2016), Cerutti et al. (2017), Bruno et al. (2017), Akıncı and Olmstead-Rumsey (2018).

breaks in the series, and shifts in their interrelationships. This study aims to fill this gap using a more extended dataset covering recent data and a time-varying framework with stochastic volatility.

This study investigates how bank rates respond to the policy rate changes for 2003-2021, employing the time-varying VAR model developed by Nakajima (2011). This model helps us to fix the endogeneity problem and to detect structural changes in the economy in a resilient way. Unlike conventional VAR models, TVP-VAR models compute impulse responses for each month in the sample. Then, the pass-through coefficients are calculated from the cumulative impulse responses for one-month and twelve-month horizons.

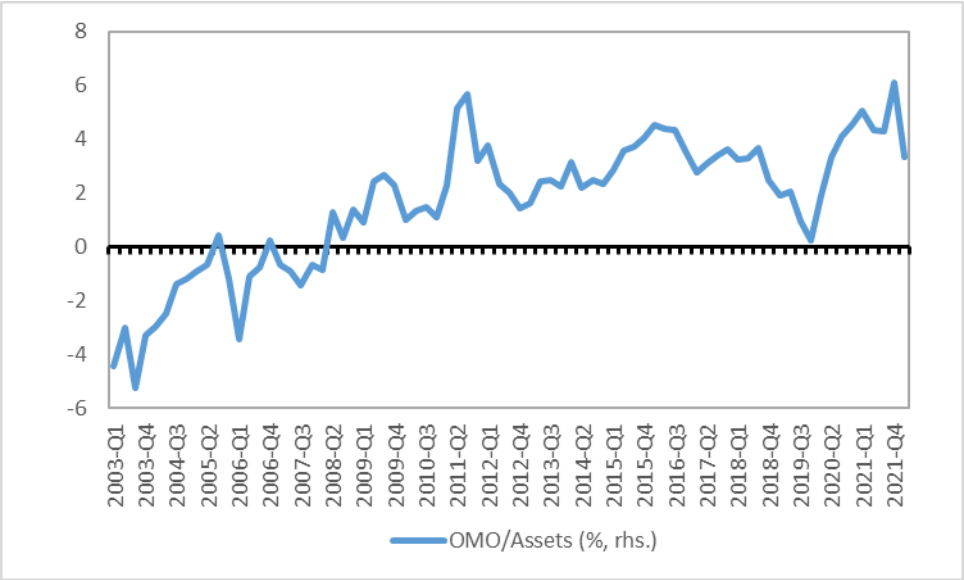
The empirical results show an incomplete pass-through for all bank rates, but deposit rates' responses are more potent than those of lending rates. The results also show that the pass-through coefficients of all deposit and lending rates change over time. In addition, the lending rate for housing is found to have the weakest link with the policy rate. Finally, the results imply that most of the pass-through from the policy rate to the deposit and lending rates occurs one month after the policy rate changes.

The rest of the study is organized as follows. Section 2.2 reviews the Turkish economy and the evolution of central banking and the banking sector since 2002. Section 2.3 discusses the theoretical explanations and empirical literature on the relationship between policy rates and bank rates. Section 2.4 describes the data and methodology. Section 2.5 presents the empirical findings. Finally, section 2.6 concludes.

2.2. BANKING SECTOR DEVELOPMENTS

The banking sector has changed significantly over the last two decades due to capital flows, financial liberalization, technological developments, and financial crises. Following the crisis in 2001, the Turkish banking sector was restructured. In this context, the efficiency of state-owned banks was enhanced, and the risk management capacity of the banking sector was improved (BRSA, 2010). In addition, mergers and foreign accusations altered the structure of the banking sector.

Following the 2001 financial crisis, budget discipline was sustained, and public borrowing decreased significantly. Improvement in public finance reduced the risk premium and helped bring high inflation to single digits. In addition, the declined public borrowing enabled banks to provide more credit to the private sector. Respectively, the asset structure of the banking sector changed in favor of loans. The funding composition also altered with the rise in the shares of foreign funding and bond issues. In addition, central bank funding has risen significantly over time (Figure 22). Before 2010, the system had excess liquidity; thus, the overnight borrowing rate was the reference rate. In the post-2010 period, the banking system had a liquidity deficit, and banks' dependence on central bank funding rose. The share of central bank funding had expanded further through swaps since 2019. However, despite liability diversification, deposits remained the largest and most stable funding source over the sample.



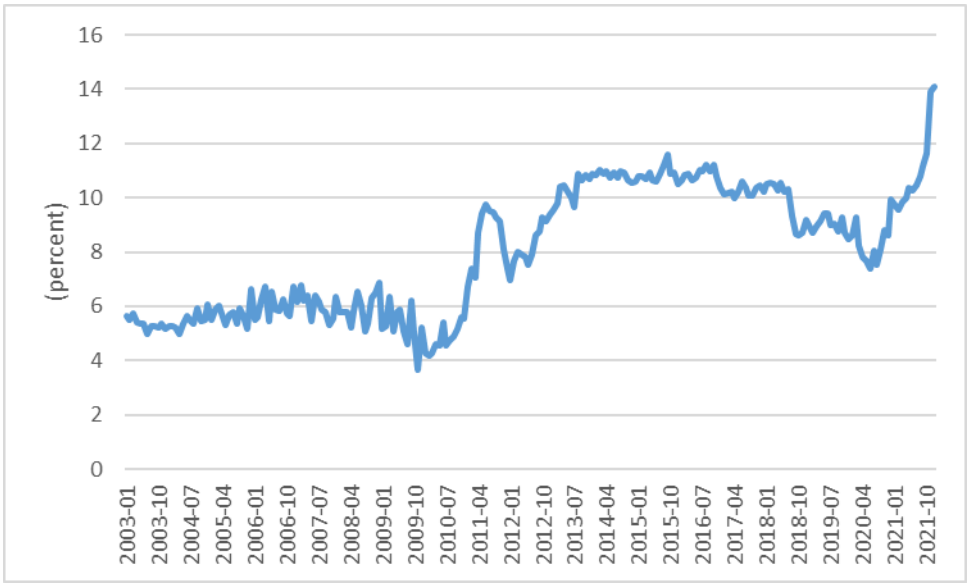
Source: Author's Calculation based on CBRT and BRSA data

Figure 22. Share of Open Market Operations

On the monetary policy side, the CBRT has implemented inflation targeting with a floating exchange rate regime. The short-term policy rate has been the main instrument for almost two decades. However, the GFC and unconventional policies in the post-GFC period changed Turkish monetary policy. There was a global liquidity glut, and Türkiye attracted significant capital inflows. Capital inflows triggered currency appreciation and excessive credit growth, posing financial stability risks. As a result, the CBRT added financial stability to its objectives and adopted an unconventional policy mix starting in late 2010 (Başçı and Kara, 2011). Since then, the policy toolkit has displayed a dynamic structure.

Under this new framework, the central bank kept interest rates highly volatile until 2016 to discourage short-term capital inflows. In addition, the central bank and other regulatory bodies used macro-prudential tools to curb credit growth. The policy covered a wide range

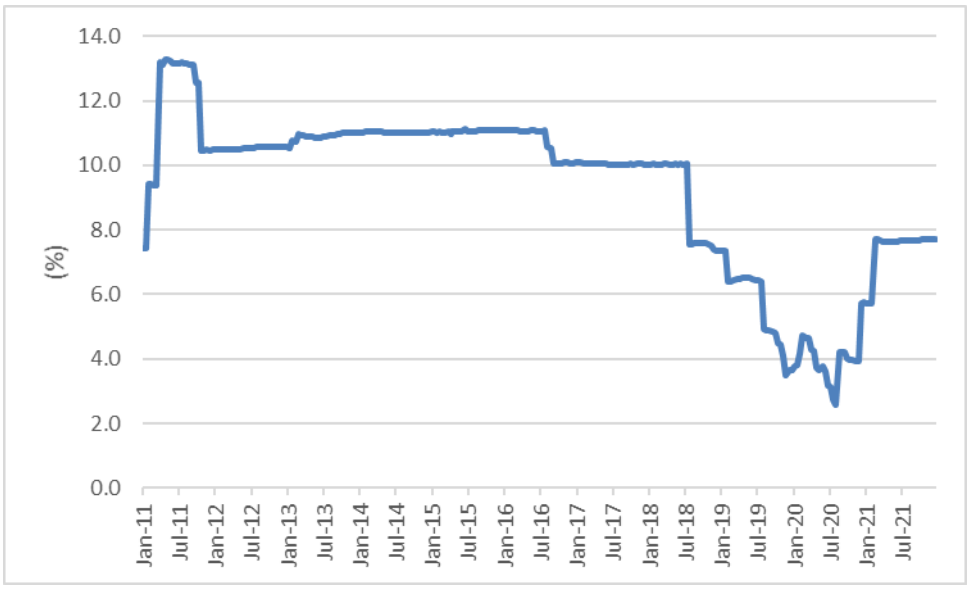
of instruments[24]. In this period, while the policy rate was low, the macro-prudential measures reduced the market liquidity (Figure 23) and imposed additional costs on the banking sector.



Source: Author's Calculation based on the data from CBRT and BRSA

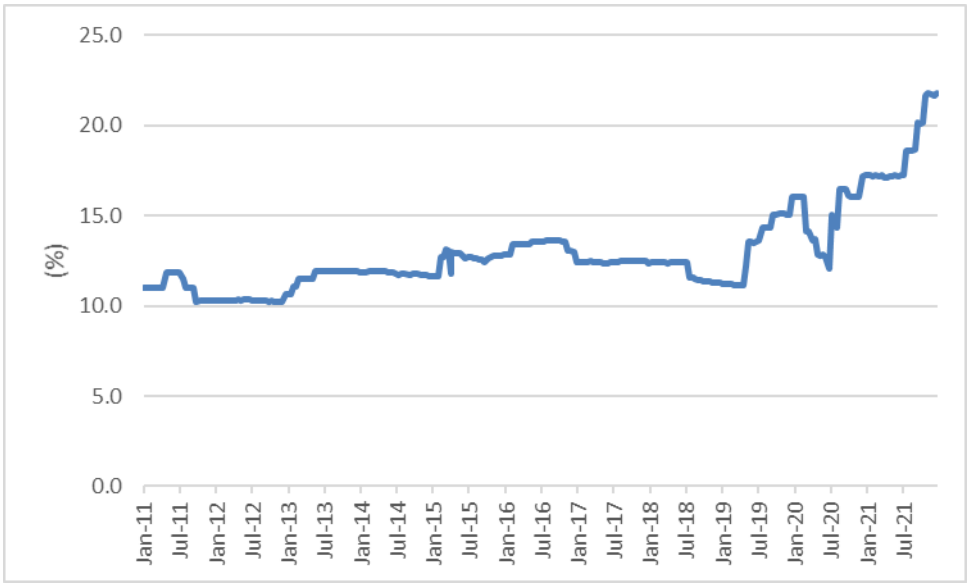
Figure 23. Share of Receivables from the CBRT in Total Assets of Banking Sector

[24] The tool set includes required reserves, general provisions, minimum payments for credit cards, the loan-to-value ratio for housing and vehicle loans, debt-to-income, differentiation in the risk weights of loans, installment limits on credit card and maturity restriction for consumer loans other than housing loans.



Source: CBRT

Figure 24. TL Weighted Average RR Ratio



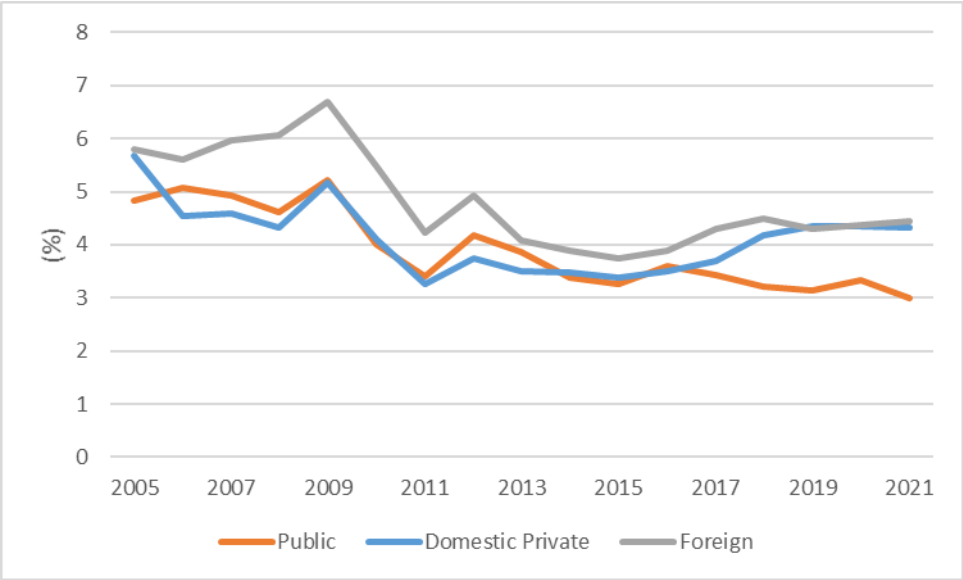
Source: CBRT

Figure 25. FX Weighted Average RR Ratio

After 2016, the policy rate was simplified, market rate volatility decreased, and predictability increased, although the one-week repo rate had not always been the main policy instrument. In addition, the Credit Guarantee Fund (CGF) program was expanded starting at the end of 2016. The program reduces the external finance premium for SMEs with insufficient collateral, which in turn lowers the lending rate for these SMEs. Therefore, this program improved small and medium-sized enterprises (SMEs)' access to bank finance.

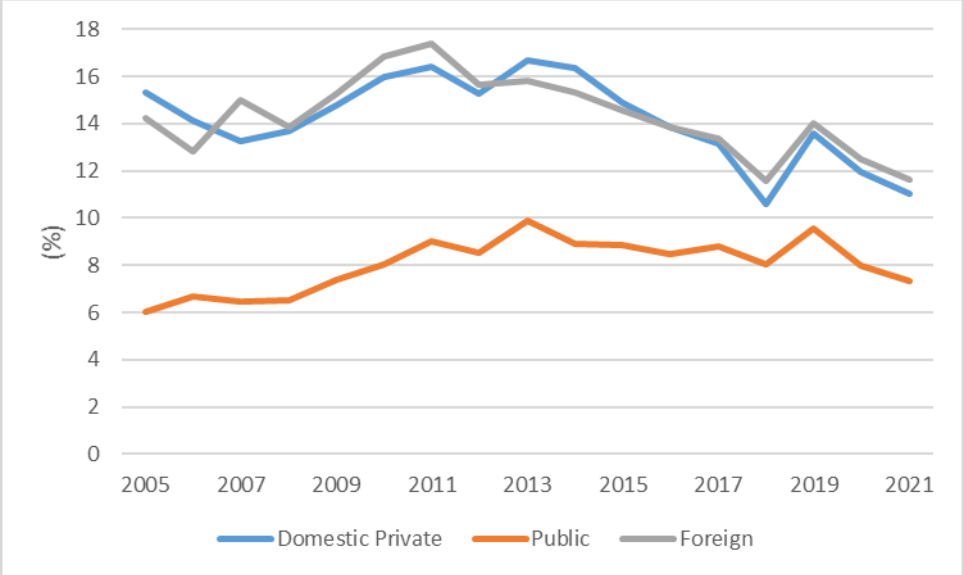
In the last part of the sample, between 2018 and 2021, two major events influenced the Turkish economy and financial sector. The first one was the currency shock in 2018. Both global factors, such as declining capital inflows due to the normalization in monetary policies of advanced economies and trade tensions, and domestic developments, such as rising inflation, increased external imbalances and growing tensions in international relations, led to a sharp depreciation in the TL. As a result, uncertainty significantly increased, and interest rates remained volatile for a while. As a result, loan and deposit rates reached their highest values since 2004. Due to deteriorating risk perception, the loan-deposit interest rate spread widened to historically high levels. Second, the COVID-19 pandemic, which started in the first quarter of 2020, significantly influenced economic and social life globally. Türkiye implemented a fiscal, monetary, and financial policy mix to fight against the economic impacts of the pandemic. As a result, Türkiye experienced a rapid credit expansion in 2020. Also, state banks played a very active role in credit markets (Kara, 2021).

Figure 26 shows the ratio of net interest income to total assets. Until 2016, public banks and private banks had similar interest margins, whereas since then, public banks and private banks have diverged. In addition, Figure 27 displays the share of fees, commission, and banking services revenues in total income. Again, state-owned banks lagged behind other banks throughout the entire sample.



Source: BRSA

Figure 26. Net Interest Revenues / Average Total Assets



Source: BRSA

Figure 27. Fees, Commission and Banking Services Revenues / Total Revenues

2.3. LITERATURE REVIEW

Short-term interest rates are the main monetary policy tool under the inflation-targeting regime. Accordingly, the interest rate channel has been increasingly studied since the 1990s. Since the economic and financial structure and monetary policy frameworks change frequently, the field remains topical, and the literature is expanding with new findings. For instance, since the GFC, the empirical focus has shifted to the euro area.

Under perfect competition without information asymmetry, policy rate changes are expected to be transmitted entirely to other interest rates. However, empirical evidence suggests incomplete pass-through, at least in the short run (Cottarelli and Kourelis, 1994; Egert et al., 2007; Rocha, 2012; Aristei and Gallo,2014; Gambacorta et al., 2015). Several factors affect the level and speed of the banks' response to changes in policy rates.

The most well-known factor is the maturity mismatch between assets and liabilities. This view is well-established and dates back to Samuelson (1945). Shorter-term instruments are expected to respond more quickly to changes in the policy rate. Mojon (2000) finds that the pass-through is higher for short-term loan rates than for long-term loans. In addition, the presence of floating rate contracts accelerates the effects of the policy rate. However, some studies have found the opposite. De Graeve et al. (2007) conclude that interest rates on demand and savings deposits are sticky. Sorensen and Werner (2006) find that mortgage rates adjust faster than short-term consumer loans.

Moreover, according to Weth (2002), banks move more slowly to be less affected by interest rate increases. Empirical evidence also highlights asymmetries and heterogeneities. For example, Hannan and Berger (1991) find that deposit rates move more slowly upward in the United States. Belke et al. (2013) investigate the pass-through of interest rates for 12-euro area countries covering the period 2003-2011. They find that loan interest rate responses to EONIA are incomplete and vary across countries, loan types, and maturities.

Asymmetric information between borrowers and lenders is another critical factor shaping financial markets. Borrowers have more information about their financial situation than banks. As a result, banks incur screening, examination, and monitoring costs to close this information gap. Moreover, the uncertainty that cannot be eliminated leads to an increase in the risk premium and, thus, higher interest rates. Furthermore, high asymmetric information rises borrowers' dependence on banks because banks know borrowers better than other lenders.

Asymmetric information leads to two critical problems. The first is adverse selection. In an environment of rising interest rates, low-risk and low-return projects withdraw from the market because they cannot afford higher interest rates. Conversely, those willing to pay higher interest rates are usually riskier customers.

The second problem is moral hazard. It happens when borrowers receiving high-interest loans invest in risky areas When banks are unable to fully monitor customer activity, the risk of default increases due to borrowers' risky actions, which hurts banks' profits. As a result, banks that are unwilling to take risks due to these two problems may opt for credit rationing instead of raising interest rates (Stiglitz and Weiss, 1992). Credit rationing may lead to an upward rigidity in loan rates. In this case, interest rates would not rise much, but lending would decline. However, some banks may want to be in the risky and high-yielding segment and may prefer to widen the interest rate spread instead of cutting lending. In this case, we may see more than a complete pass-through (de Bond, 2005).

Another factor determining pass-through is the current stance and expectations regarding the policy rate. If banks think the change is temporary, they slowly reflect it in their rates. They want to avoid frequent price changes due to the menu and switching costs. Mojon (2000) and Sander and Kleimeier (2004) state that if the volatility in the market rates increases, banks do not want to change their rates frequently, and thus the responses soften. Similarly, Cottarelli and Kourelis (1994) find that increased volatility in the money market decreases

pass-through. Türkiye experienced high volatility in the market rates in the post-GFC period. In addition to volatility in the market rates, the distance from the equilibrium rate determines the movement of bank rates. As the distance from the equilibrium interest increases, the speed of adjustment will be higher (De Graeve et al., 2007).

Empirical studies reveal that pass-through varies across countries. The macroeconomic situation, financial structure, and institutional capacity of countries are considered the main determinants. Cottarelli and Kourelis (1994) suggest that the pass-through rate differs across countries due to the characteristics of their financial systems. Kwapil and Sharler (2010) analyze the US and the Eurozone. They conclude that incomplete pass-through may occur in the Eurozone in the long run due to the bank-dominated financial system. In other words, bank dependence reduces banks' responsiveness to policy rate changes.

The dollarization of both assets and liabilities hurts the effectiveness of the monetary policy. Moreover, foreign currency-denominated liabilities increase the firm's sensitivity to exchange rate fluctuations, leading to a higher risk premium. Saborowski and Weber (2013) find that credit dollarization reduces pass-through.

The competition[25] in the banking sector bolsters the interest rate pass-through (Cottarelli and Kourelis, 1994; Mojon, 2000; Sorensen and Werner, 2006; Leuvensteijn et al., 2008). Different level of competition in the deposit and loan market enables banks to spread the cost among segments. For example, Leuvensteijn et al. (2008) find it easier for banks in the euro area to lower deposit rates than to raise loan rates because deposit markets are less competitive than loan markets. Similarly, De Graeve et al. (2007) argue that competition in corporate loan markets is more intense than in consumer loan markets.

[25] Different competition indicators, such as concentration ratios, the Lerner index, the private bank ownership ratio, and the foreign bank ownership ratio, are used in the studies.

The banking sector's ownership structure also significantly influences the pricing mechanism through efficiency, competition, and international credit channels. While pass-through is higher for private banks, public banks weakly respond to policy rates (Cottarelli and Kourelis, 1994). However, public banks' high alignment with the central bank can increase the pass-through. Furthermore, Sander and Kleimeier (2004) argue that the presence of foreign banks also boosts competition and pass-through. However, the ability of foreign banks to raise funds from international markets, including their home markets, makes them less sensitive to monetary tightening. Moreover, foreign banks can transmit global shocks to national economies, especially during global turmoil. This global shock transmission could undermine interest rate pass-through and monetary policy's effectiveness.

Banks face competition pressure from non-banking financial institutions and capital markets. The existence of alternatives to the banking sector intensifies the competition and strengthens the interest rate pass-through (Mojon, 2000). Since domestic capital markets are not well-developed in Türkiye, firms have better access to bank loans than capital markets. Moreover, borrowing from abroad can be an alternative to bank loans. Nevertheless, banks' share in the external debt stock rose while the share of the non-banking sector declined until 2015. This trend in external borrowing increases borrowers' dependence on banks. However, since banks' access to international finance is generally cheaper, the whole economy can realize an efficiency gain.

Financial structure and how banks do business also impact how fast a bank responds to policy changes. Capital, liquidity, asset quality, and cost and revenue structure determine banks' average funding cost and markup. For example, as the share of deposits in total liabilities increases, banks become less dependent on the market or wholesale funding, and thus loan rates respond sluggishly to market rates (Sorensen and Werner, 2006). On the other hand, deposit-dependent banks may reflect interest rate increases more quickly in deposits rates in order to hold their depositors.

The banking sector has diversified its services and non-interest income items. Banks' dependence on interest income decreases as the proportion of non-interest revenue increases. Sorensen and Werner (2006) conclude that the higher the non-interest income, the faster the pass-through for short-term loans. The faster pass-through may be the case for interest rate cuts. However, there might be an asymmetry again. For instance, if the policy rate goes up, banks with higher non-interest income may raise lending rates more slowly, at least in the short run, as they are less dependent on interest income.

Moreover, when banks have an opportunity to compensate for the loss in interest rates through other fees on loans, they prefer to expand the volume of loans rather than raise the loan rate. In this case, pass-through can be low. Mojon (2000) shows that high operating costs lead to poor pass-through.

Macroeconomic developments have also influenced the pass-through. For example, inflation is found to be positively related to the interest rate pass-through (Cottarelli and Kourelis, 1994; Mojon, 2000; Sorensen and Werner, 2006). The main factor behind such a finding is that banks make frequent price changes and shorten maturities during high inflation periods. Furthermore, Sorensen and Werner (2006) provide evidence that GDP growth reduces the speed of adjustment because loan demand and deposit supply are positively affected by economic activity.

Finally, the pass-through coefficient may vary over time due to significant economic and financial system changes. For example, some studies find that pass-through declined in many countries during the GFC (Hristov et al., 2014; Gambacorta et al., 2015)

Although the studies investigating interest rate pass-through for Turkey are limited, they are increasing. For example, Aydın (2007) examines the pass-through from the money market rates to bank lending rates for corporate, housing, vehicle, and general-purpose loans for the period between June 2001 and September 2005. He uses bank-level data and finds incomplete

pass-through in the long run for corporate loans due to switching costs and less-developed financial markets. His findings suggest that the consumer lending rate responds faster than corporate loans as competition is higher in the consumer loan market. In addition, interest rates on cash and vehicle loans move along with money market rates during the rapid loan growth episode.

Özdemir (2009), using a symmetric and asymmetric error correction model for the period 2001-2006, finds full pass-through for deposit and loan markets in the long run. His findings also show that the downward rigidity of deposit and loan rates is higher than the upward rigidity.

Yüksel and Özcan (2013) investigate the December 2001-April 2011 period, employing the threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR). Their findings suggest that lending rates react more rapidly to the policy rate than deposit rates. Moreover, their results do not detect any significant change in the interest rate pass-through during the GFC.

Yıldırım (2014) analyzes the period between November 2002 and October 2011, applying the TAR and MTAR models. The results show that loan interest rates show a rapid response to increases in money market rates, while their adjustment to decreases in money market rates is poor. Moreover, the level of downward stickiness of lending rates varies across credit markets. Accordingly, due to the firms' heavy dependence on bank loans in Turkey, commercial loans give the weakest response to the policy rate.

Binici et al. (2019) examine the interest rate pass-through between June 2010 and December 2014. The main features of this period are the uncertainty of the central bank funding cost and the high volatility in money market rates. The study provides evidence that overnight interbank rates became more important than the official rate for lending and deposit rates. In addition, the average funding rate of the central bank has some impact on the lending and

deposit rates. They also underline an asymmetry that loan rates respond faster to monetary tightening than easing.

Şahin and Çicek (2018) use a nonlinear autoregression distributed lag (NARDL) model covering the period between 2011 and 2017. Their results reveal that pass-through is larger for commercial credits than consumer credits and deposits. They also find an almost complete pass-through value for the long run. Finally, their findings prove that banks react more strongly to policy rate cuts than increases.

2.4. EMPIRICAL METHODOLOGY AND DATA

2.4.1. Time-Varying Paramater VAR Methodology

VAR models are extensively used to investigate how monetary policy influences economic and financial variables. VAR models have evolved to capture the time-varying pattern of the relationship by allowing intercept and coefficients to change. In addition, the variance of the structural shocks in the economy varies over time. Therefore, time-varying models with constant volatility may produce biased coefficients (Nakajima, 2011)[26]. Thus, we apply the time-varying vector parameter autoregression framework developed by Primiceri (2005) and Nakajima (2011), which allows intercept, coefficients, variance, and covariance to vary over time.

The TVP-VAR model is based on a structural VAR model.

$$Ay_t = F_1 y_{t-1} + \ldots + F_s y_{t-s} + u_t \qquad , t = s+1, \ldots, n , \qquad (6)$$

where y_t represents a $k \times 1$ vector of variables, and $A, F_1, \ldots, F_s$ denote the $k \times k$ matrices of coefficients. The disturbance vector u_t is a $k \times 1$ structural shock with normal distribution of the form $u_t \sim N(0, \sum\sum)$ where

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_k \end{pmatrix}$$

To determine the simultaneous effects of the structural shock through recursive identification, matrix A gets a lower-triangular form as follows:

[26] For the details of the methodology, see Nakajima, J. (2011).

$$A=\begin{pmatrix} 1 & 0 & \cdots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k1} & \cdots & a_{k,k-1} & 1 \end{pmatrix}.$$

Reduced form specification:

$$y_t=B_1y_{t-1}+\ldots+B_sy_{t-s}+A^{-1}\sum\varepsilon_t \quad \varepsilon_t \sim N(0,I_k), \tag{7}$$

where $B_i=A^{-1}F_i$ for $i=1,\ldots,s.$ $X_t=I_k\otimes(y'_{t-1},\ldots,y'_{t-s})$ where $\otimes$ represents the Kronecker product, then the equation 7 converted as follows

$$y_t=X_t\beta+A^{-1}\sum\varepsilon_t \tag{8}$$

In specification 8, none of the parameters changes over time. If the parameters are allowed to vary, then the model becomes

$$y_t=X_t\beta_t+A_t^{-1}\Sigma_t\varepsilon_t \quad t=s+1,\ldots,n, \tag{9}$$

where the coefficients β_t, and the parameters A_t and Σ_t change over time.

Defining $a_t=(a_{21},\ a_{31},\ a_{32},\ a_{41},\ \ldots,\ a_{k,k-1})'$ is the stacked vector of the lower-triangular elements in A_t and $h_t=(h_{1t},\ldots,h_{kt})'$ with $h_{jt}=\log\sigma_{jt}^2$ for $j=1,\ldots,k$, $t=s+1,\ldots,n$. Assuming the parameters have random walk process as below

$$\beta_{t+1}=\beta_t+u_{\beta t},\quad a_{t+1}=a_t+u_{at},\quad h_{t+1}=h_t+u_{ht}$$

$$\begin{pmatrix} \varepsilon_t \\ u_{\beta t} \\ u_{at} \\ u_{\mathrm{ht}} \end{pmatrix} \sim N\left(0,\begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \sum_{\beta} & 0 & 0 \\ 0 & 0 & \sum_{a} & 0 \\ 0 & 0 & 0 & \sum_{\mathrm{h}} \end{pmatrix}\right)$$

for $t=s+1,\ldots,n$, where $\beta_{s+1}\sim N\left(\mu_{\beta_0},\Sigma_{\beta_0}\right)$, $a_{s+1}\sim N\left(\mu_{a_0},\Sigma_{a_0}\right)$ and $h_{s+1}\sim N\left(\mu_{h_0},\Sigma_{h_0}\right)$.

For simplicity, $\sum_{\mathrm{h}}$ is assumed to be a diagonal matrix. The TVP-VAR model uses the Markov chain Monte Carlo (MCMC) method in the context of the Bayesian framework. We need to

specify priors for the initial states due the random walk assumption. This study set flat priors for the initial states due to having insufficient information related to the initial state[27].

2.4.2. Data

This section investigates the responses of deposit rates with different maturities (one-month, three-month, and six-month) and three lending rates (cash loans, housing loans, and commercial loans) to changes in the policy rate.[28] The empirical studies differ in the choice and number of variables. In VAR models, primarily lending or deposit rates, policy rates, output growth and inflation are used. The annual growth rate of the industrial production index is used to represent economic activity in the model. The inflation rate has been added to the models as it affects monetary policy, saving-investment and consumption decisions. Moreover, the study adds the exchange rate to the VAR models for several reasons. First, it captures global factors such as global risk perception and capital inflows (Binici et al., 2019; Küçük et al., 2022) and domestic developments such as risk premium and uncertainty. The exchange rate also impacts current inflation, inflation expectations, external finance premium, interest rates, and output growth. Therefore, the model includes five variables: the policy rate, bank rate, exchange rate, output growth and inflation[29].

Monthly data covering the period 2003-2021 are used. Deposit and lending rates are the average of weekly flow interest rates in the respective month. All deposits and lending rates are obtained from the CBRT database. The policy rate[30] is the same as the series constructed in the first chapter since the central bank provided funds to banks via different policy rates during the sample period. Also, the exchange rate is the monthly average of USD/TRY parity.

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[27] Priors can also be computed from the pre-sample data. See Koop and Korobilis (2010) and Nakajima (pp.125-129, 2011) for details.

[28] According to CBRT, deposits have very short maturities on average. Deposits with three-month maturity constitute about half of total TL deposits, followed by deposits with one-month maturity with a share of around 20 percent. We exclude the vehicle loans since the share of vehicle loans in bank balance sheets is meager. Financing companies play an active role in the vehicle loans market.

[29] Filardo and Nakajima (2018) use the same five variables and add exchange rates are used to control the interest rate differentials between countries.

[30] See page 34 for details about the generation of the policy rate series.

CPI and industrial production index are seasonally adjusted and are obtained from TURKSTAT.

In the TVP-VAR methodology, the series has to be stationary. For this reason, the ADF test is performed first. Then, considering the possible breaks in the series, the unit root test allowing for structural breaks is also used for both types of breaks, Innovative Outlier (IO) or an Additive Outlier (AO)[31]. Table 3 exhibits the unit-root test results. The ADF test results indicate that policy rate, lending and deposit rates, and the annual growth rate of industrial production are used at their levels, while using the first difference of logged CPI and logged exchange rate.

Table 3. Unit Root Test Results

	ADF			ADF with break	
	Intercept	Intercept and Trend	None	IO	AO
pr	-4.42	-4.07	-2.98	-6.26	-6.21
dr1	-5.58	-4.89	-3.47	-7.99	-7.90
dr3	-5.38	-4.73	-3.23	-6.63	-6.59
dr6	-5.28	-4.63	-3.37	-6.82	-6.74
cash	-3.55	-3.13	-1.69	-5.41	-6.28
housing	-4.55	-4.02	-2.73	-6.06	-6.04
commercial	-3.71	-3.27	-1.89	-4.90	-4.98
ip-growth	-3.42	-3.42	-1.78	-6.24	-5.41
er	3.03	-0.51	4.04	0.88	0.55
p	3.03	3.74	4.12	0.70	0.16
Δer	-9.35	-10.22	-8.83	-11.27	-11.48
Δp	-4.22	-4.80	-0.35	-10.66	-10.22
Test Critical Values					
1% level	-3.46	-4.00	-2.58	-4.95	-4.95
5% level	-2.87	-3.43	-1.94	-4.44	-4.44
10% level	-2.57	-3.14	-1.62	-4.19	-4.19

The lag lengths are selected based on the SIC criteria with a maximum lag of 14. The break dates are estimated endogenously.

[31] Perron (1989) highlighted that unit root tests generate biased results under structural break and proposed alternative methodologies to address the problem. While Perron (1989) assumes that the break date is fixed and known, Zivot and Andrews (1992), Banerjee et al. (1992), and Vogelsang and Perron (1998) estimate break dates endogenously from the data.

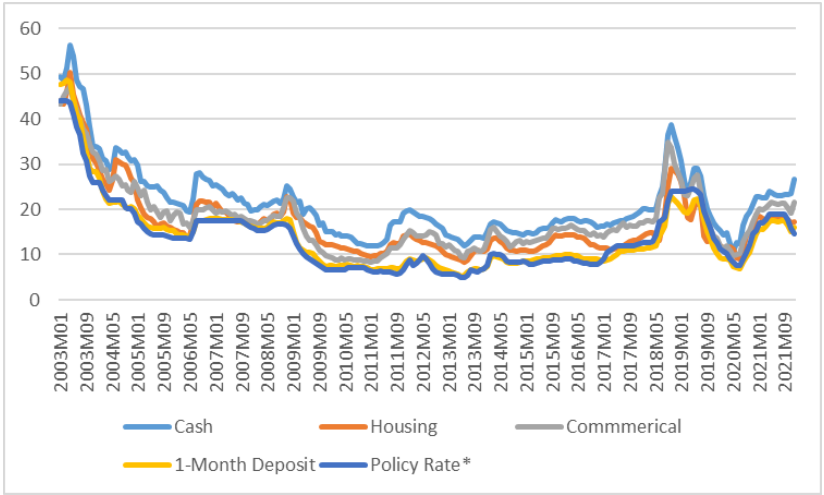
The lag length of the VAR model is chosen as two according to AIC, SIC, and H-Q information criteria, and there is no autocorrelation problem in the models.

Table 4. Descriptive Statistics

	Lending Rates (%)			Deposit Rates (%)			Policy Rate (%)	Consumer Price Index (2003=100)	Industrial Production Index (2015=100)	Exchange Rate (USD/TL)
	Cash	Commercial	Housing	One-month maturity	Three-month maturity	Six-month maturity				
Mean	21.35	17.88	16.77	13.87	15.18	15.13	13.8	243.1	86.1	2.87
Median	19.5	16.3	14.3	11.1	12.9	13.0	12.1	206.0	83.7	1.79
Maximum	56.2	47.0	50.3	48.4	48.3	51.1	44.0	687.0	144.4	13.53
Minimum	10.6	8.4	8.3	5.3	6.5	6.8	4.8	94.8	45.3	1.17
Std. Dev.	8.1	7.5	7.5	7.9	7.4	7.7	7.6	127.8	25.0	2.18
Skewness	1.8	1.6	2.1	2.2	2.1	2.3	1.7	1.1	0.3	1.78
Kurtosis	7.0	6.1	7.7	9.2	8.7	9.9	6.6	3.4	2.0	5.98
Jarque-Bera	273.6	189.7	371.1	542.4	474.2	658.2	230.2	46.2	11.8	205.31
Probability	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Observations	228.0	228.0	228.0	228.0	228.0	228.0	228.0	228.0	228.0	228

Source: Author's calculations

Figure 5 shows that the interest rate series move together but diverge in some periods. Moreover, for most of the sample, the policy rate remains below other interest rates, but sometimes the one-month deposit and mortgage rates fall below the policy rate. The cash loan rate moves above other interest rates due to low collateral value and high credit risk.



*Source: CBRT * Author's calculations*

Figure 28. Policy Rate, Deposit Rates and Lending Rates (%)

2.5. RESULTS

The TVP-VAR model provides several analyses. First, it produces time-varying impulse responses of selected horizons, i.e., one-month, twelve-month. Second, it presents impulse responses at all months in the sample for different horizons. This allows us to analyze a specific time or event and compare the impulse responses during different events. Finally, VAR models provide researchers with a pass-through analysis for selected horizons. The coefficients of interest rate pass-through can be calculated by using the methodology of Leigh and Rossi (2002)[32].

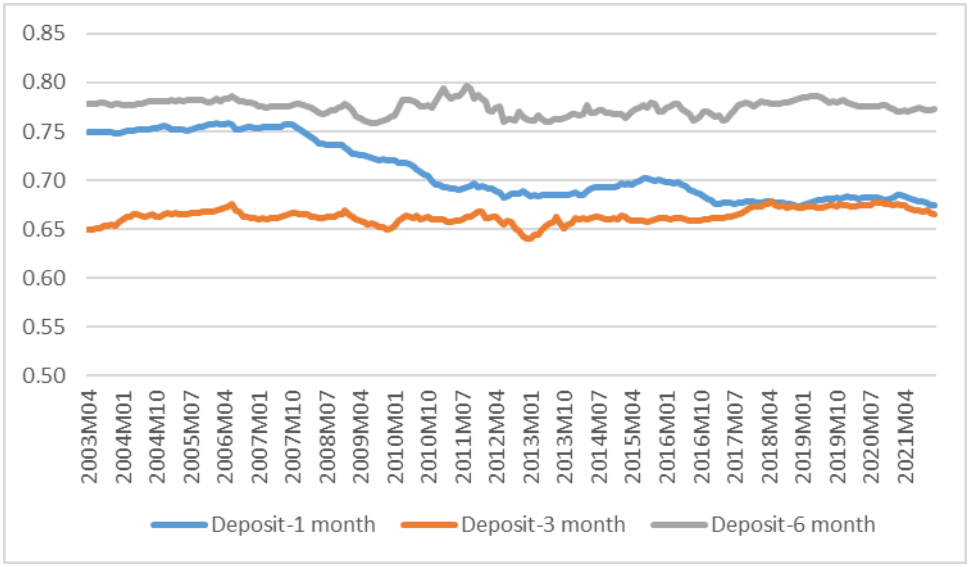
$$PT_{t,t+i} = PR_{t,t+i}/BR_{t,t+i}$$

$PT_{t,t+i}$ is the pass-through after i months, $PR_{t,t+i}$ is the cumulative response of the policy rate to the policy rate change after i months and $BR_{t,t+i}$ is the cumulative response of the bank rates (deposit or lending) to the change in policy rate after i months. The pass-through coefficients are computed for the one-month horizon as the short run and the twelve-month horizon as the long run[33]. The pass-through coefficients show the impact of a one percentage point shock in the policy rate on a bank rate.

2.5.1. Deposit Rates

Figure 29 exhibits the responses of deposit rates in the short run. The pass-through coefficients for three-month and six-month maturity deposits have shown a stable pattern over the sample. However, test results indicate a slight decline in the short-run reaction of the one-month deposit rate after the last quarter of 2007.

[32] Leigh and Rossi (2002) calculated the exchange rate pass-through for Türkiye.
[33] The one-month and twelve-month periods are considered short-run and long-run, respectively.



Source: Author's calculations

Figure 29. Short-run Pass-through from Policy Rate to Deposit Rates

Table 5 displays that the average long-run pass-through coefficients over the sample are very close to each other for all deposit rates. In addition, most of the pass-through occurs in the first month. These findings suggest a fast pass-through.

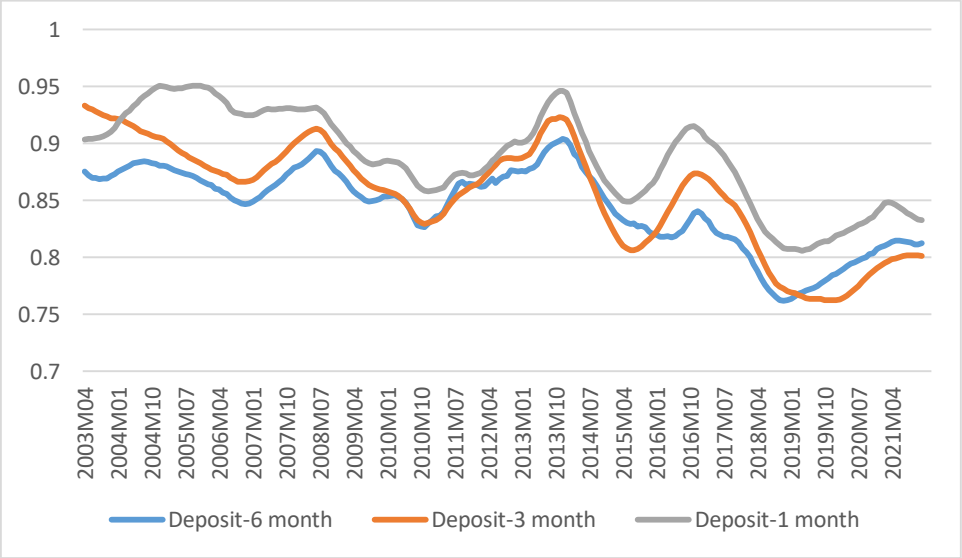
Table 5. Summary Statistics of Impulse-Responses of Deposit Rates

	1-Month Maturity		3-Month Maturity		6-Month Maturity	
	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run
Average	0.71	0.89	0.66	0.86	0.77	0.84
Maximum	0.76	0.95	0.68	0.93	0.80	0.90
Minimum	0.67	0.81	0.64	0.76	0.76	0.76
S. Deviation	0.03	0.04	0.01	0.05	0.01	0.04

Source: Author's calculations[34]

[34] The average size of the response in the TVP-VAR framework is partly related to the impulse response pattern in the time-invariant VAR model (Nakajima, 2011).

The results on long-term pass-through (Figure 30) suggest that the responses of deposit rates to changes in the policy rate have a time-varying pattern over the sample period. The pass-through to deposit rates is less than complete and has a declining trend over the sample.



Source: Author's calculations

Figure 30. Long-run Pass-through from Policy Rate to Deposit Rates

The results indicate a higher and more stable pass-through in the pre-GFC period, in which the Turkish economy experienced high capital inflows, currency appreciation, and falling interest rates. This result aligns with the literature (Hannan and Berger, 1991; De Graeve et al., 2007; Leuvensteijn et al., 2008; Şahin and Çicek, 2018) that deposit rates respond more robustly to policy rate changes during monetary expansion.

We see a decline in the pass-through between the last quarter of 2008 and the last quarter of 2010. This period coincides with the GFC and further policy rate cuts. The relationship between the policy and deposit rates is expected to enhance in a falling interest rate environment. However, the synchronization between deposit and policy rates may be lower

due to relatively higher volatility in the market rates[35] and significant interest rate cuts during this period[36]. Moreover, capital outflows, weakening demand for deposits (Hristov et al., 2014), and currency depreciation may lead to a lower pass-through to deposit rates during the GFC.

Test results indicate an improvement in the sensitivity of deposit rates to the policy rate in the 2010-2014 period. A relatively stable policy rate, a global low-interest environment, capital inflows, and real appreciation in TL may bolster the link between deposit rates and the policy rate.

However, the findings show that the responses of deposit rates softened in the 2014-2019 period. This period witnessed high volatility in capital flows and exchange rates. In addition, macro-prudential tools, expansion of credit guarantees, subsidized loan programs, and increasing share of public banks may reduce the interest rate pass-through to deposit rates in this period.

The results identify a rebound in pass-through coefficients in 2020, but they are still well below initial levels. The recent recovery may be related to the share of central bank funding in the banking sector's balance sheet[37]. The increase in dependence on central bank funding intensifies the sensitivity of deposit rates to the policy rate. Moreover, the pass-through of the policy rate to deposit rates is found to be reduced during periods of substantial policy rate changes, such as the last quarter of 2008, the first quarter of 2014, and September 2018.

[35] See Cottarelli and Kourelis (1994), Mojon (2000), and Sander and Kleimeier (2004) for the effects of volatility on pass-through.
[36] The overnight borrowing rate fell from 16.75 percent in October 2008 to 6.5 percent in November 2009.
[37] The option to hold foreign currency and gold for TL required reserves was reduced gradually and removed ultimately in 2021 (Financial Stability Report-November 2021).

2.5.2. Lending Rates

Figure 31 exhibits the size of the interest rate pass-through for lending rates within twelve months. The pass-through is incomplete and changes over time for all three loan types. Although the responses of lending rates differ in the short run (Figure 32), they follow a similar pattern in the long run.

The average short-run and long-run pass-through coefficients are lower and more volatile than those for the deposit rates (Table 5).

Table 6. Summary Statistics of Impulse-Responses of Lending Rates

	Cash		Housing		Commercial	
	Short-run	**Long-run**	**Short-run**	**Long-run**	**Short-run**	**Long-run**
Average	0.57	0.75	0.50	0.69	0.69	0.74
Maximum	0.59	0.87	0.55	0.87	0.73	0.91
Minimum	0.55	0.63	0.43	0.45	0.65	0.54
S. Deviation	0.01	0.06	0.02	0.08	0.02	0.09

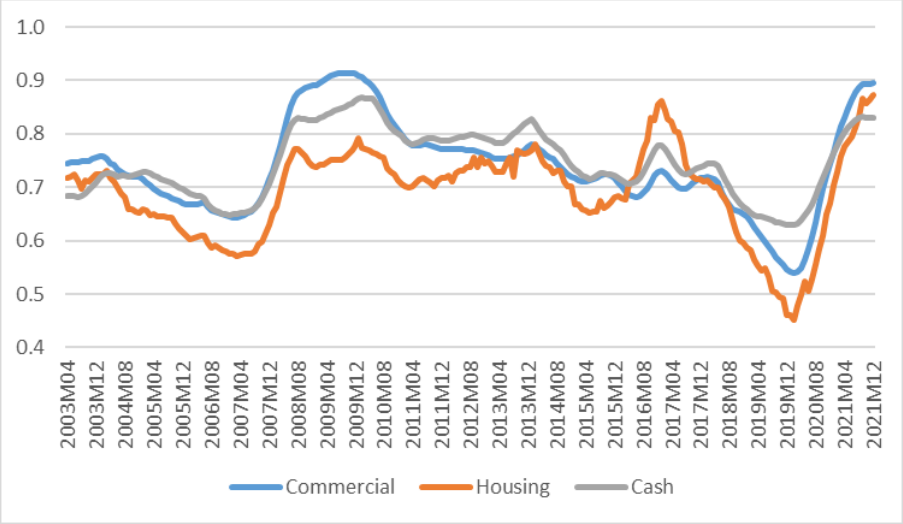
Source: Author's Calculations

The results indicate a downward trended pass-through in the pre-2007 period. This period was characterized by falling interest rates, high economic growth, capital inflows and strong credit growth. Several developments may lead to such a result. First, the lending rates may respond weaker to policy rate cuts (Binici et al., 2019)[38]. Second, high economic growth rates further dampen banks' reactions to policy rate cuts due to strong loan demand (Sorensen and Werner, 2006). Third, low-interest rates and extended maturities boosted the credit demand, which might have made the lending rate sticky downward in this period. Finally, the improved access to international financial markets increased the share of non-deposit funds

[38] Şahin and Çicek (2018) find the opposite results.

in the liabilities. As a result, the policy rate could directly affect a smaller portion of banks' liabilities.

The results imply a strengthening in the responses of lending rates to policy rate accelerating with the GFC in the 2007-2009 period. However, several factors can influence the pass-through working in opposite directions during recessions. On the one hand, the slowing loan demand due to subdued economic activity, worsening access to international finances, and the increased dependence on central bank funding may boost the pass-through to lending rates. On the other hand, elevating credit risks during a recession may dampen the response of loan rates to interest rate cuts.



Source: Author's Calculations

Figure 31. Long-run Pass-through from Policy Rate to Lending Rates

The responses of loan rates display a relatively stable stance in the 2011-2016 period. The first half of this period overlaps economic growth, capital inflows, relatively stable exchange rates, low inflation, and the CBRT's unconventional monetary policy. Favorable global conditions can make the lending rates rigid upwards, and the banks can continue to make loans by external borrowing even if the central bank tightens the policy. In response, the

CBRT used additional tools to break the link between capital inflows and credit which also influence lending rates. As a result, the central bank's actions in this period had mixed effects on the pass-through.

On the one hand, the policy mix boosted the response of lending rates to policy rate by discouraging capital inflows and weakening the link between capital inflows and credit. On the other hand, the instruments other than interest rates affecting lending rates and increased volatility undermined the sensitivity of lending rates to policy rates. For example, Mojon (2000) and Sander and Kleimeier (2004) state that if the volatility in the market rates increases, banks do not want to change their rates frequently, and thus the reaction becomes smaller. Similarly, Cottarelli and Kourelis (1994) find that excessive volatility in the money market can undermine the functioning of the transmission mechanism.

Test results show that the coefficients increased in 2014. The significant interest rate hike at the beginning of 2014 likely contributed to this finding. On the other hand, the volatility in capital flows that started in mid-2013 may have slightly attenuated the link between the policy rate and loan rates in 2014 and mid-2016.

The results suggest a recovery in the responsiveness of loan rates between the second half of 2016 and 2017. The simplification of monetary policy and relatively lower volatility in the money market rates in this period could improve the pass-through levels. In addition, after the end of 2016, the expansion of the Credit Guarantee Fund reduced the riskiness of SMEs for the banking system and influenced banks' credit policy and pricing behaviors. Therefore, the lower credit risk may support better functioning of the interest rate channel.

In the first three quarters of 2018, we observe a weakening link between the policy and lending rates. The interest rate differentials between the central bank and the commercial banks were evident in this period. Due to the rising pressure on financial markets and exchange rates, the banks increased loan rates faster than policy rates starting from the second

quarter of 2018. In addition, the Turkish economy experienced a currency shock in August 2018. As a result, the interest rate spreads reached a historically high level due to increased uncertainty and risks. In response to the currency shock in August 2018, the CBRT significantly raised its policy rate and remained unchanged for almost a year. However, banks started to cut interest rates earlier than the CBRT. However, in the second quarter of 2019, increasing financial market volatility led to a rise in loan rates while policy rates remained stable.

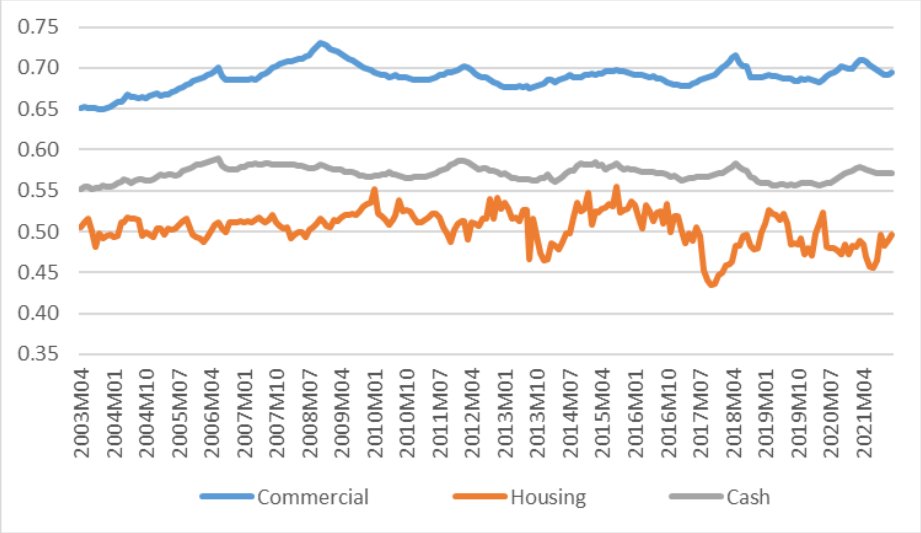
When the COVID-19 pandemic triggered a global economic crisis in 2020, loan rates became more sensitive to the policy rate, similar to GFC. However, unlike in 2008, significant credit growth was recorded in 2020. Despite the declining credit growth in the following period, the pass-through improved further, reaching historic highs in 2021. Several factors may strengthen the relationship between bank rates and policy rate in the 2020-2021 period. First, banks reduced their external borrowing due to mainly declining FX loan demand. Second, the banks' swap funding shifted to the central bank from international markets. Third, the option of holding FX for TL required reserves was gradually decreased and eventually abolished. These three factors increased the banks' dependence on central bank funding.[39] Fourth, the regulations of CBRT and BRSA intensified the regulatory power over the credit markets. Fifth, public banks dominated the credit markets in recent years, and the alignment of the lending rate with the policy rate may be higher for public banks than private banks during policy rate cuts. Finally, the average maturity of loans shortened, especially in consumer loans[40].

Moreover, the responses to the policy rate differ across lending rates. Commercial loans are generally with low maturities and therefore expected to respond quickly to policy rates. In

[39] The maturity of central bank funding is shorter than the average maturity of the deposits. Therefore, it increases interest rate risk.

[40] Data on the average maturity of loans are not published. However, the Financial Stability Report-May 2022 indicates that the average maturity of fixed-rate loans is declining and is around 21 months at the end of 2021. The maturity limits on consumer loans and credit card installments were lowered in the second half of 2021 (CBRT Financial Stability Report-November 2021). Moreover, banks are expected to be reluctant to provide longer-term loans during periods of low interest rates to limit the interest rate risk.

line with this expectation, the results show that the short-term response of commercial loans is significantly higher than other loans (Figure 32). This finding is consistent with Şahin and Çicek (2018) but does not support Aydın (2007).



Source: Author's Calculations

Figure 32. Short-run Pass-through to Lending Rates

Cash loans are mostly unsecured, have lower upper limits on the loan amount, and have a maximum maturity of three years. Since cash loans are considered riskier, the interest rate is set above other loans. The average of the pass-through coefficients from policy rates to cash loans is 0.75 over a 12-month horizon. The pass-through for housing loans is the lowest among all lending rates. The literature provides mixed evidence. This finding supports Mojon (2000) but contradicts Sorensen and Werner (2006), who find that mortgage rates respond faster than short-term consumer loans. There are possible explanations for weak responses of housing loan rates to policy rates. First, housing loans have longer maturities. Second, housing loan customers have higher incomes than other consumer loan users (BAT[41]) because they can provide additional revenues for banks through other channels. Third, due to the longer maturity of housing loans, banks do not consider short-term TL funds a reliable

[41] For details, see the "Consumer Loans and Housing Loans" Report released quarterly by the BAT.

source for financing housing loans. Thus, banks mainly fund housing loans with long-term external resources[42]. Another possible factor behind this outcome is that state banks have provided housing loans with lower rates than market rates for the last few years.

[42] The banks borrow abroad mostly in foreign currency. The banks then convert long-term FX resources into TL through swaps.

2.6. CONCLUSION

This chapter examines the pass-through from policy rate changes to deposit and lending rates in Turkiye for the 2003-2021 period. Considering the changes in the relationship between interest rates in the last two decades, the study employs a time-varying VAR methodology. First, the model produces time-varying impulse responses for selected horizons at all months in the sample. Then, I estimate the pass-through coefficients using the cumulative impulse responses of policy rate and bank rates to a policy rate shock for one-month and twelve-month horizons.

The results indicate that deposit rates respond more solidly to the policy rate than loan rates, but pass-through is incomplete for all deposit and lending rates. Also, a significant portion of the pass-through occurs in the short term (one month after the shock).

The results show that the pass-through coefficients for deposit rates vary over time and have a decreasing trend. The sensitivity of deposit rates to the policy rate remains relatively high and stable in the pre-GFC period when the policy rate is on the downside. This finding is consistent with the literature that deposit rates respond more quickly to policy rate cuts. However, the pass-through coefficients for all deposit types decline during the GFC. Although this finding seems unexpected in an environment of falling interest rates, the size and speed of the rate cuts compared to the previous period may have led to such a result. The pass-through to deposit rates strengthens between late 2010 and early 2014, coinciding with high capital inflows, a relatively stable currency, low-interest rates, low inflation, and high growth rates. However, the deposit rates' responses to policy rates have weakened since the beginning of 2014. In the period after 2019, the coefficient has a relatively stable outlook. However, the level of pass-through in this period is below the initial values.

In contrast to deposit rates, the long-run responses of lending rates to the policy rate vary throughout the sample, while short-run pass-through coefficients of lending rates have a relatively stable pattern. The results indicate a decline in the response of all lending rates to

the policy rate in the pre-GFC period. This finding supports the evidence that lending rates respond less to policy rates during monetary easing. Another possible explanation is that low-interest rates and longer maturities may increase loan demand and limit the downward movement of lending rates.

However, with the GFC, the ability of the policy rate to change the lending rates becomes more pronounced. However, various factors in opposite directions may affect the interest rate pass-through during recessions. On the one hand, increased volatility in financial markets and elevated risks in the real sector undermine the link between the policy rate and loan rates. On the other hand, reduced loan demand and the increased dependence on central bank funding due to the tightened liquidity conditions in financial markets and the difficult access to global capital markets raise the sensitivity of loan rates to the policy rate.

The pass-through coefficients exhibit a relatively stable behavior between 2011 and 2016. The global liquidity glut, capital inflows, and the central bank's policy response are probably the main determinants of pass-through during this period. On the one hand, capital inflows can distort the effects of the monetary policy, affecting the financial conditions and interest rates in the local markets. On the other hand, the CBRT's new policy mix has various effects on lending rates in both directions. But, the relative stability of the pass-through coefficients suggests that the new policy framework may prevent further weakening of lending rate responses.

The findings also suggest a recovery in the pass-through coefficients for the 2016-2017 period. The simplification of monetary policy, relatively lower volatility in the interest rates, reduced risk premiums of SMEs, and a higher risk appetite of banks thanks to CGF could have contributed to the better functioning of the interest rate channel.

The results indicate a significant decline in the link between the policy rate and lending rates in the 2018-2019 period. The policy rate and banks' rate started to diverge in the second

quarter of 2018. Moreover, the depreciation of the local currency and increased credit risks in the corporate sector pushed the loan-deposit spread to historically high levels. Following the currency shock, the CBRT hiked the policy rate and held it almost unchanged at high levels between September 2018 and July 2019 to enhance its credibility and manage expectations. However, lending rates fluctuated during this period. The banks cut rates in the last quarter of 2018 and raised them in the second quarter of 2019. Furthermore, the housing loan packages reduced the housing loan rates independent of the policy rate.

In the first quarter of 2020, as risks to the global economy elevated due to the pandemic, the results indicate a synchronization between the official rate and lending rates, as in the GFC. Moreover, the response of loan rates to the policy rate strengthened further in 2021, approaching historically high levels. Several possible factors may contribute to the recent rebound in the pass-through to loan rates. First, borrowing from the CBRT picked up due to reduced external funding, the shift of international swap transactions to the CBRT, and the removal of the reserve option mechanism. Second, the regulations made by the CBRT and BRSA affected the quantity and price of loans. Third, the share of state-owned banks in the sector increased, and their alignment with the CBRT was likely higher. Finally, macro-prudential measures and the banks' willingness to contain rising interest rate risks shortened the maturity of loans.

Finally, the findings show that there are heterogeneities among loan rates. Among the three loan types, commercial loans have the highest coefficient in the short run, while housing loans have the lowest coefficient. Moreover, in the long run, the relationship between mortgage loan rates and the policy rate is weaker than other loan types. The longer maturities, the higher share of external resources in financing housing loans, and the additional advantages provided by housing loans may cause banks to change housing lending rates more slowly. On the other hand, commercial loan interest rates reflect the changes in the policy rate faster and at a higher level than other loan types due to mainly their short maturity.

CONCLUDING REMARKS

This dissertation analyzes the role of the banking sector in the monetary transmission mechanism in Türkiye, covering 2003 and 2021. The study mainly focuses on the causality relationship between financial variables and output and the pass-through from policy rate to bank rates. The study aims to answer the following questions: How are bank lending and output linked? How does the credit-output relationship change over time? What predicts the output better, money or credit? How does the interest rate pass-through vary over time?

Despite the vast body of literature on monetary transmission, few studies focus on Turkey. Moreover, most of the literature on Turkey has ignored the changing nature of relationships over time and variations in the volatility of shocks. This dissertation, therefore, uses time-varying approaches to shed new light on the evolving linkages between the monetary authority, commercial banks, and the real sector in Türkiye. The study results also provide valuable and practical implications for other countries since the period analyzed includes important events such as the structural transformation after the 2001 crisis, global and domestic shocks, and various monetary policy implementations.

The first chapter examines the causality relationship between the financial variables (money and credit) and output within a time-varying framework. The results indicate that the money-income and credit-income links vary over time. For example, while money had predictive content for output in the pre-GFC period, it lost its forecasting power for output after mid-2015. Furthermore, over the last two decades, money has had no forecasting power for economic activity during economic downturns.

On the other hand, the results do not identify a causal relationship between credit and output before 2011. The main reasons behind the finding may be the low degree of financial development and the substantial difference between the growth rates of bank loans and output. However, the causal link between credit and output is detected in the post-GFC

period, and the causal episode lasts almost four years. I also identify two short causal episodes from the beginning of 2015 to the second half of 2020.

The period after 2015 has witnessed fluctuations in capital inflows, increased influence of the public sector in the credit markets, and the growing role of state-owned banks in many economic areas, from credit markets to external borrowing. However, the impact of the increased role of public banks on economic activity may be limited; rather, it may put pressure on the exchange rate and inflation outlook, especially in periods of slowing capital inflows. Therefore, the allocation of loans comes to the fore in this respect. The weakening link between credit and output highlights the significance of a selective credit approach.

The overall assessment suggests that a certain level of financial depth is necessary for a causal relationship between credit and output. Once this is achieved, the credit-output linkage is firmer and longer lasting when global conditions and capital flows are favorable and private banks' credit appetite is high. Conversely, the findings suggest that when capital flows slow down, and private banks are reluctant in the credit markets, the effect of credit growth generated by public banks and regulations on economic activity is likely to be limited and short-lived.

The second chapter investigates the responses of deposit and loan rates to the policy rate using the time-varying VAR methodology that considers stochastic volatility. The findings suggest that deposit rates respond more solidly to the policy rate than loan rates, but pass-through is incomplete for all deposit and lending rates. In addition, a large part of the pass-through occurs within one month after the shock in general.

The results suggest that the transmission of the policy rate to deposit and lending rates vary over time. Accordingly, the responses of deposit rates tend to decline over the sample while the responses of lending rates fluctuate. For example, the pass-through to lending rates weakened in 2003-2007, strengthened in 2007-2010, remained relatively stable in 2011-

2014, and was on a roller coaster in 2015-2021. The responses of lending rates to policy rate were at their highest levels in the last part of the sample period. The increased role of public banks, regulations, and subsidized lending programs may contribute to such a result.

The findings also reveal that the pass-through coefficients vary across lending rates. Accordingly, commercial loans have the fastest and highest interest rate pass-through, while housing loans have the lowest pass-through.

Even though interest rate pass-through analysis provides important information about the interest rate channel, more is needed to get a complete view of the effectiveness of the monetary policy. This is because, in some periods, more than one policy instrument is used, and the transmission channels interact in a complex way. Therefore, it is important to note that a weaker response of bank rates to the policy rate does not necessarily imply a decline in monetary policy's effectiveness. Instead, a comprehensive analysis considering all policy instruments, such as required reserves and transmission channels like liquidity and exchange rate channels, would be more appropriate.

Although this dissertation contributes to the literature with its large and up-to-date sample and time-varying methods, it has some limitations. First, since lending rates include a premium for default risk and maturity risk, changes in the risk profile of borrowers and the maturity of loans affect lending rates. Therefore, the analysis could be advanced using data on these items. In this context, working with microdata would be more helpful. Second, industrial production cannot fully represent the overall economy, especially the services sector. This inadequacy became more evident after 2018 due to the divergence between services and industry.

Future research could focus on the effects of capital flows on the link between credit and output. Moreover, global and domestic factors affecting the credit-output link can be better understood through a cross-country analysis. For the interest rate pass-through, assessing the

impact of other policy tools in addition to the policy rate and their interactions with each other could provide a better picture of how the monetary policy works. Finally, research on international spillovers and the banking sector's ownership structure may help better understand the banking sector's pricing behavior.

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APPENDIX 1. ETHICS COMMISSION FORM

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GRADUATE SCHOOL OF SOCIAL SCIENCES
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Thesis Title: Monetary Transmission Mechanism and Banking Sector: The Case of Turkey

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Name Surname:	Abdullah Küçükönder
Student No:	N11240500
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Status:	☐ MA ☒ Ph.D. ☐ Combined MA/ Ph.D.

ADVISER COMMENTS AND APPROVAL

Prof. Dr. Timur Han Gür

APPENDIX 2. THESIS ORIGINALITY REPORT

HACETTEPE UNIVERSITY
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Ph.D. DISSERTATION ORIGINALITY REPORT

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Department:	Department of Economics
Program:	Doctor of Philosophy in Economics - Ph.D.
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ADVISOR APPROVAL

APPROVED.

Prof. Dr. Timur Han Gür

APPENDIX 3. THE EXCHANGE RATE-OUTPUT AND INTEREST RATE-OUTPUT LINK

Although this paper focuses mainly on the money-output and credit-output linkages, it also examines the causal link from the exchange rate and the policy interest rate to output. The results show that the exchange rate has more predictive power for output than money, credit, and interest rate and has the most stable causal relationship with output. Our results differ from the findings of Arin and Gür (2009). They investigated the 1986-2000 period and found that targeting the money supply is a better policy than targeting the exchange rate. The difference in our results stems from the sample periods. Trade and financial openness are higher in the 2003-2021 period than in the pre-2000 period, and thus, the exchange rate is more likely to be more critical for Turkish economy.

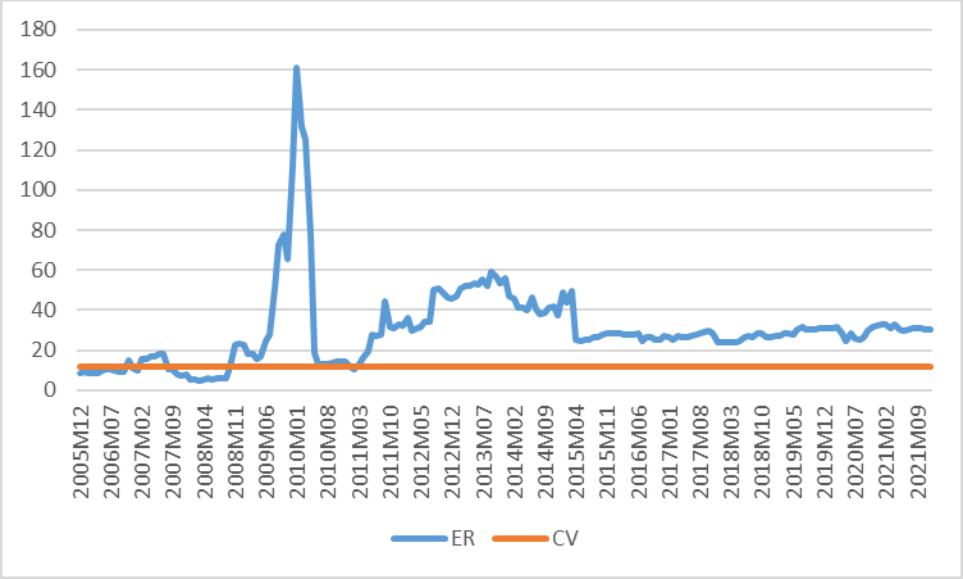


Figure 33. Time Varying Granger Causality Test Results from Exchange Rate to Output

We also find that the policy rate had no predictive power for output before the GFC. After the crisis, we find causality from the policy rate to output for a short period. However, the test results suggest that after the second quarter of 2010, the policy rate again lost its predictive power for output. During the period, between the second half of 2014 and the first half of 2019, we find a causal relationship between the interest rate and output, albeit interrupted at short intervals. Finally, no causality from the interest rate to output is detected for the period after the first half of 2019.

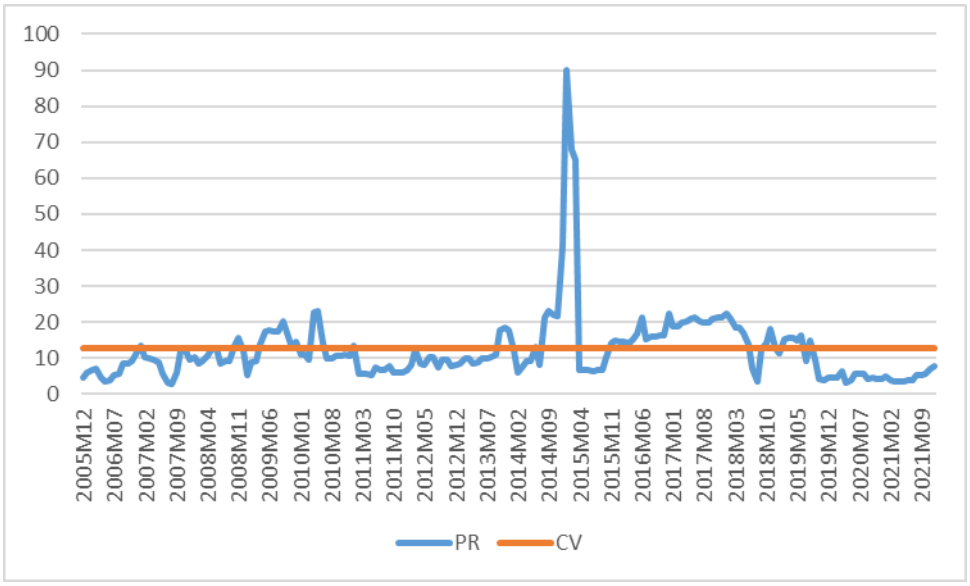
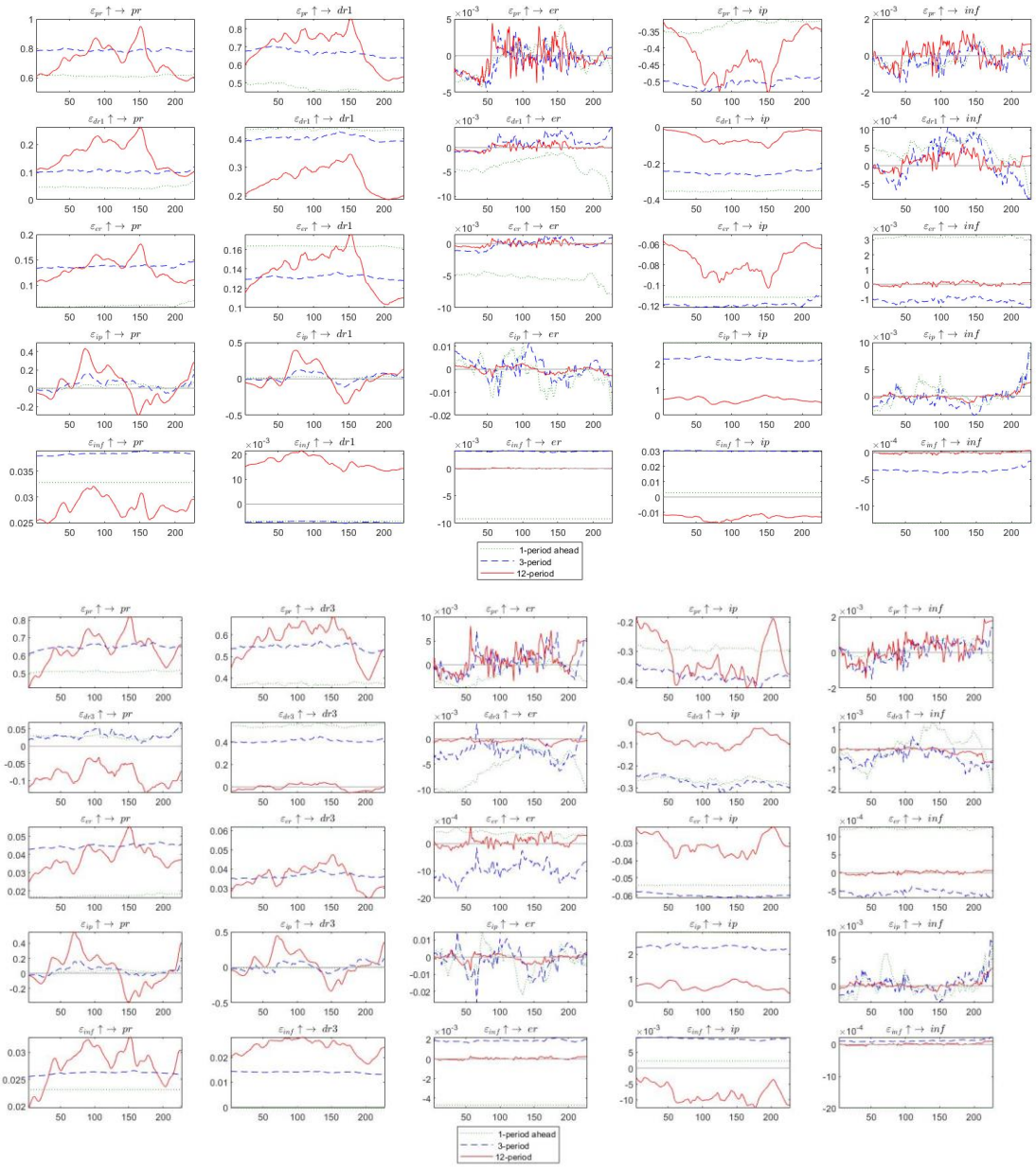


Figure 34. Time Varying Granger Causality Test Results from Policy Rate to Output

APPENDIX 4. FIGURES



*One-month (green dotted line), three-month (blue dashed line) and twelve-moth (red solid line) horizons for the TVP-VAR model

Figure 35. Time-Varying Responses for Selected Horizons for the TVP-VAR model

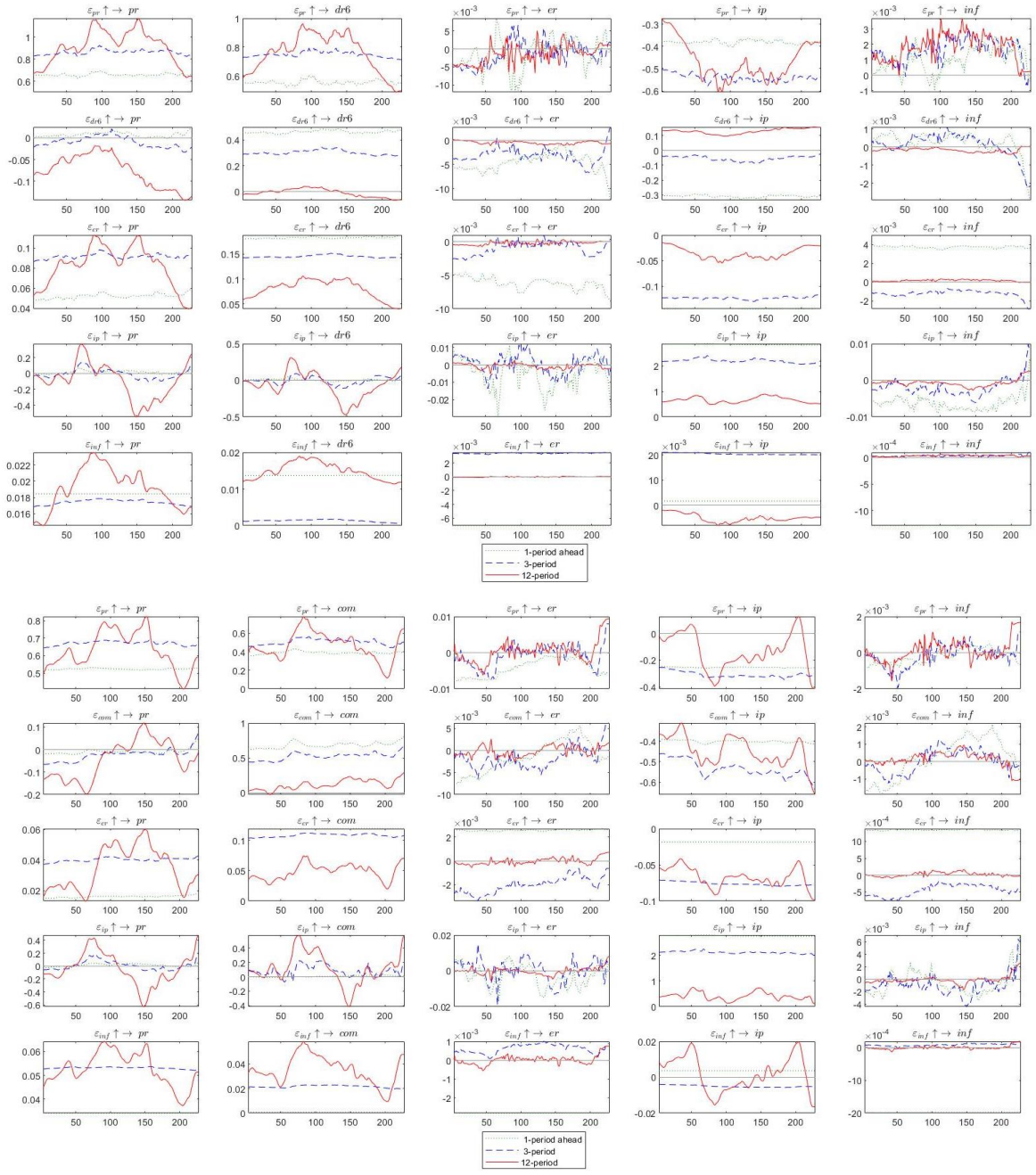


Figure 35. Time-varying responses for one-month (green dotted line), three-month (blue dashed line) and twelve-moth (red solid line) horizons for the TVP-VAR model (continued)

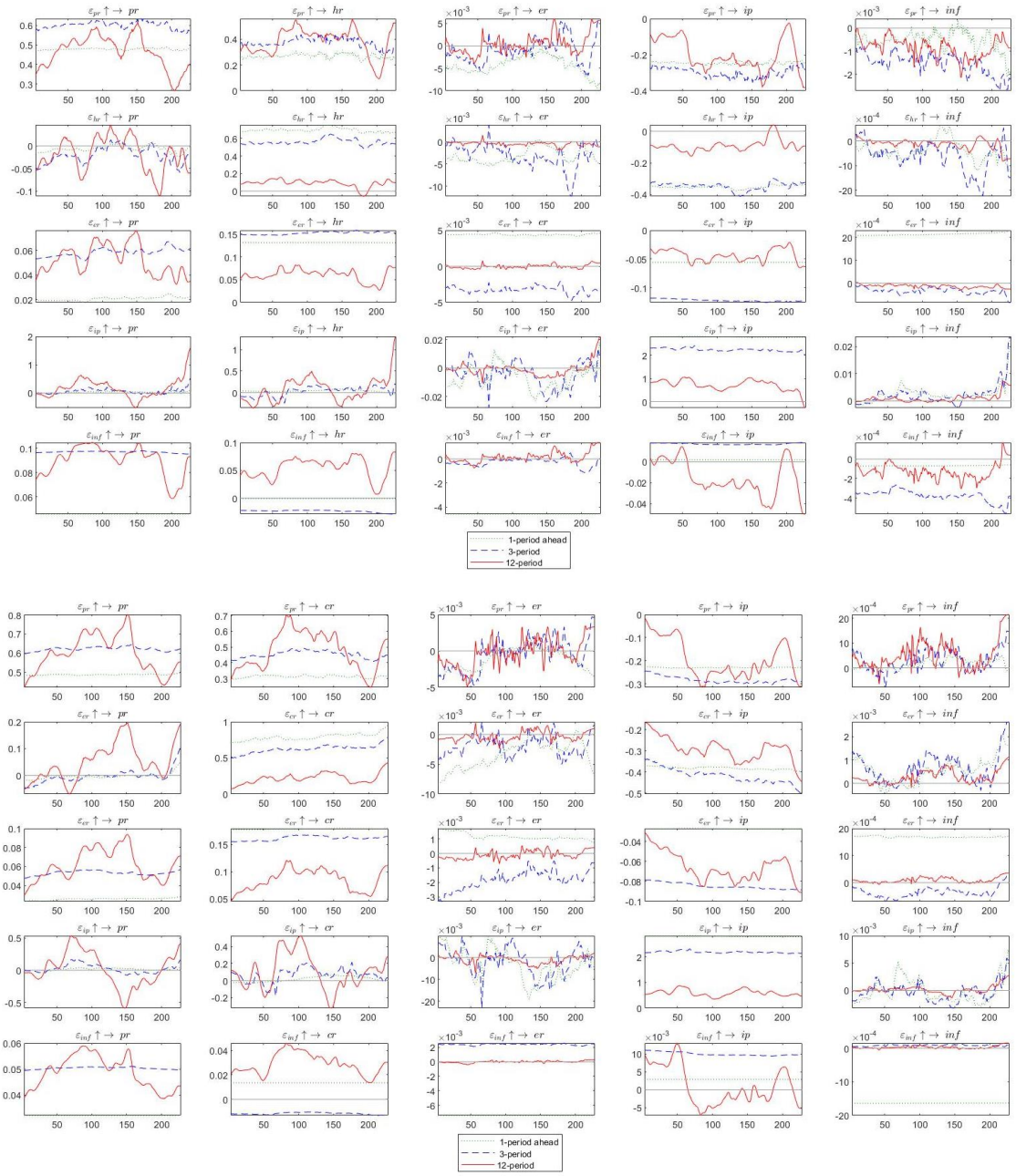


Figure 35. Time-varying responses for one-month (green dotted line), three-month (blue dashed line) and twelve-moth (red solid line) horizons for the TVP-VAR model (continued)

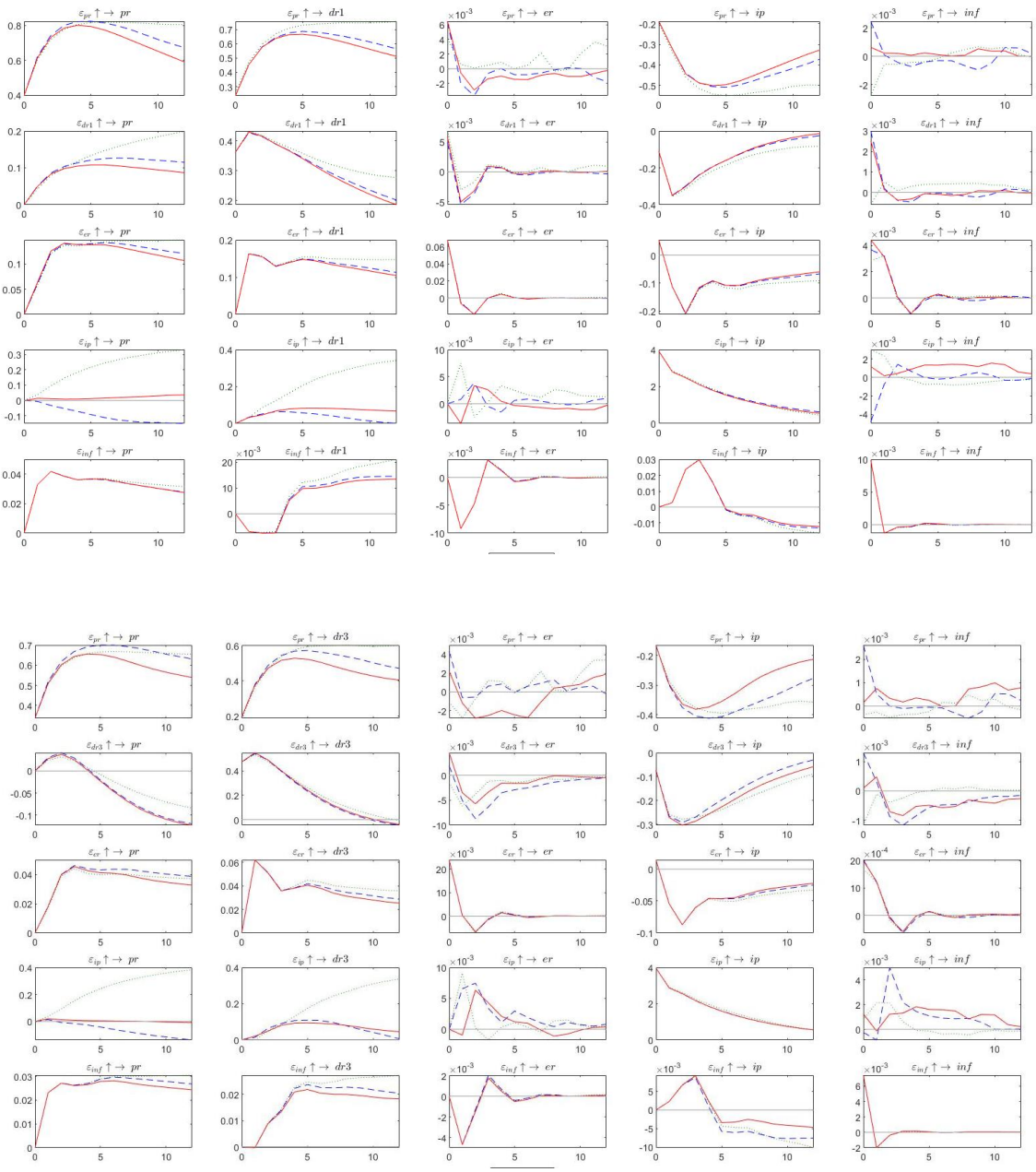


Figure 36. Time-Varying Responses for Selected Episodes

**2009 M08 (green dotted line), 2018 M08 (blue dashed line) and 2020 M03 (red solid line) for the TVP-VAR model*

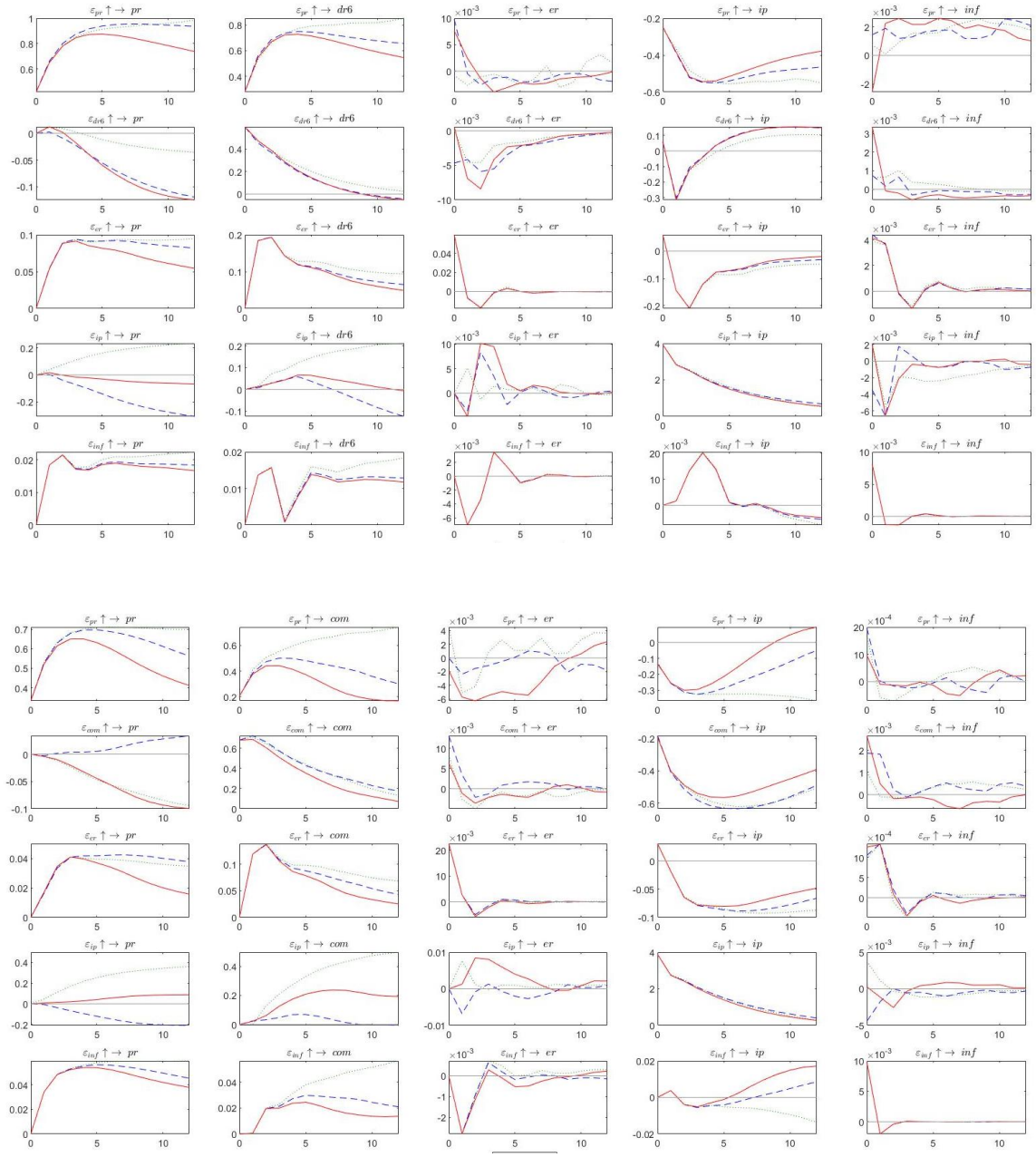


Figure 36. Time-varying responses for 2009 M08 (green dotted line), 2018 M08 (blue dashed line) and 2020 M03 (red solid line) for the TVP-VAR model (continued)

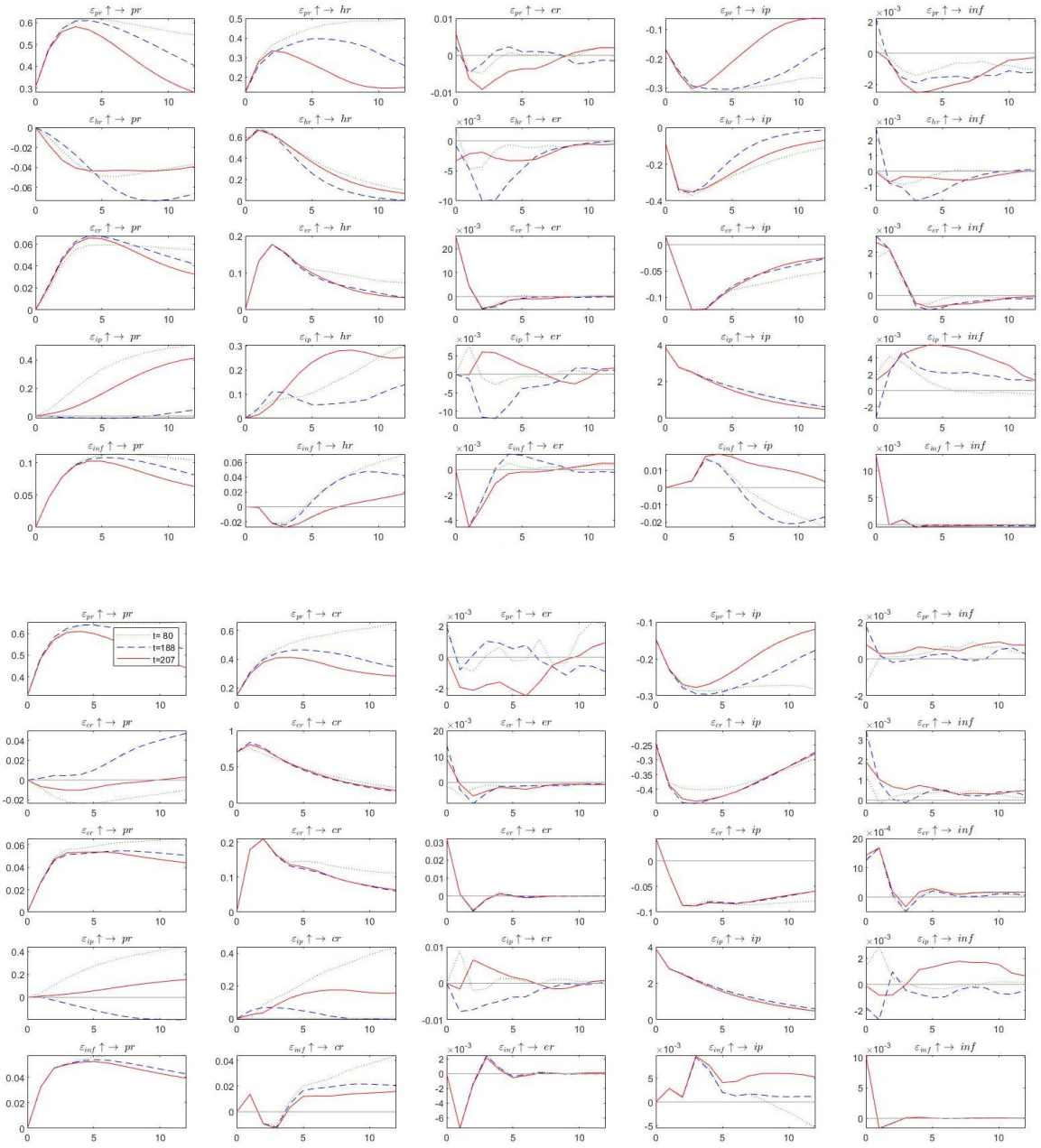


Figure 36. Time-varying responses for 2009 M08 (green dotted line), 2018 M08 (blue dashed line) and 2020 M03 (red solid line) for the TVP-VAR model (continued)