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MASTER THESIS

**MONETARY POLICY TRANSMISSION MECHANISMS AND INFLATION:
THE CASE OF TURKEY**

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ÖZ

PARA POLİTİKASI AKTARIM MEKANİZMALARI VE ENFLASYON: TÜRKİYE ÖRNEĞİ

YAHIA MABROUK DEKHILI

Bu sektörel çalışmanın amacı, Türkiye'de para politikası aktarım mekanizmaları ile sektörel enflasyon arasındaki ilişkiyi test etmektir. Bu çalışmanın ekonomik sektörleri, NACE REV2'nin üst düzey toplulaştırmasına (A10) göre tanımlanmıştır. Bu çalışma, 2008 ve 2021 yılları arasındaki üç aylık zaman serisi verilerini kullanarak hem kısa hem de uzun vadeli ilişkileri incelemektedir. Bu amaçla, söz konusu ilişkilerin kısa ve uzun vadeli dinamiklerini analiz etmeye yardımcı olacak bir ECM modeli geliştirmek için ARDL eşbütünleşme yaklaşımı uygulanmıştır. Elde edilen ampirik sonuçlar, döviz kuru mekanizmasının, enflasyon üzerinde hem kısa hem de uzun vadede en güçlü etkiye sahip olduğunu göstermiştir; bunu kredi mekanizması ve faiz oranı mekanizması izlemektedir. Döviz kurunun enflasyon üzerinde hem kısa hem de uzun vadede olumsuz etkisi olurken, kredi kanalının uzun vadede (bazı sektörlerde olumlu, diğerlerinde olumsuz) karışık ve kısa vadede olumsuz bir etkisi vardır. Bulgularımıza göre, faiz oranı mekanizması enflasyonu uzun vadede etkilemezken, kısa vadede olumlu yönde etkilemektedir. Ayrıca, kısa vadeli şoklar, bazı sektörlerde uzun bir süre (32 çeyreğe kadar) devam ederken; diğer sektörlerde ise geçici bir etki (4 çeyrek sonra dengeye dönüş) yapmaktadır.

Anahtar Kelimeler : Para Politikası, Aktarım Mekanizmaları, Enflasyon, ARDL Bounds Test, ECM.

ABSTRACT

MONETARY POLICY TRANSMISSION MECHANISMS AND INFLATION: THE CASE OF TURKEY

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The aim of this study is to test the relationship between the monetary policy transmission mechanisms and the sectoral inflation in Turkey. The economic sectors of this study were defined according to the high-level aggregation (A10) of the NACE REV2. This study has examined both short and long terms relationships using quarterly time series data of the period between 2008 and 2021. The study applied the ARDL cointegration approach to develop an ECM model that will help analysing the short and long run dynamics of such relationships. The empirical results suggest that the exchange rate channel has the strongest effect on inflation in both short and long terms; whereas the credit and the interest rate channels were found to have a moderate and weak effects, respectively. The exchange rate has a negative effect on inflation in both short and long term, while the credit channel has a mixed effect in the long term (positive in some sectors and negative in others) and a negative one in the short term. The interest rate channel was found to be ineffective in the long term and to have a positive effect in the short term. Moreover, short term shocks are found to persist for long periods (up to 32 quarters) in some sectors; while their effects are temporary (return to equilibrium within 4 quarters) in others.

Keywords: Monetary Policy, Transmission Mechanism, Inflation, ARDL Bounds Test, ECM.

PREFACE

After the COVID-19's pandemic, the levels of inflation increased globally, especially in the emerging markets. The fact that will require the central banks to intervene in order to stabilize the price levels. However, this intervention requires a clearer view on how the policy is transmitted to the economy and to what extent it can affect it.

This study examines the effects of the monetary policy on the Turkish economy emphasizing the role of the transmission mechanisms (the channels through which the monetary policy affects the economy). It analyzes these effects at a sectoral level rather than the aggregate level to provide a clearer view and help enhancing the policy accuracy.

In truth, this thesis would not see the light without the patience, the help, and the guidance of my supervisor Doç. Dr. Güzin Emel AKKUŞ. I would also like to thank Prof. Dr. Muhittin KAPLAN who supervised my model and who taught us all about modelling and econometrics at first, and all the tutors in the English department of economics for all the provided knowledge.

The psychological support from friends and family is as important as the cognitive and scientific assistance. I would love to thank my parents for everything. I cannot thank my dear mother Bariza CHIBOUT enough for all her support, sacrifices, and confidence not just during my master's degree, but in all my life aspects. I would love to thank my dear father Abbes DEKHILI for his confidence, support, and sacrifices. I would like to thank my sister Imene for supporting me during my whole life, for being a sister and a best friend and my sister Nour El-Houda who translated my abstract to the Turkish language and helped me in almost every educational administrative procedure. I would like to thank my brothers, sisters, cousins, uncles, aunts and my whole family without forgetting a special thanks to my cousin Abd El-Hakim for the good time we spend together and the fruitful debates we used to have. My close friends also played an important role in supporting me and being by my side, I would like to mention my dear friends Akrem Mohammed LAMRI, DR. Abd EL-Fateh DOUDOU, Anis ZIGHMI, and Ainar. In the end and above all, I thank my almighty ALLAH for the countless blessings, Alhamdulillah.

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INTRODUCTION

The monetary transmission mechanisms are the channels through which the monetary policy affects the real economy variables. Therefore, a fine understanding of the monetary transmission mechanisms is the main pillar for the success of the inflation targeting regime. In addition, the increasing level of inflation in middle-income countries makes such an understanding a prerequisite. However, understanding the interactions between such mechanisms and the inflation aggregately rather than at a sectoral level will not serve a clear view of how precisely the monetary policy affects inflation, and therefore the policy accuracy will be limited.

In this study, we will examine how the inflation levels are affected by changes in the monetary policy transmission mechanisms at a sectoral level. The study will analyze the Turkish case exclusively and cover the period between 2008Q1 and 2021Q2. The first chapter of the study is an overview of the development of the Turkish financial system from 2001 to 2021. The focus of this chapter will be on the policy instruments and conducts of the central bank during this period in addition to the inflation, the exchange rate, interest rate, and banking system developments.

After the overview, the second chapter will structure the theoretical framework, within which the three main transmission channels (interest rate, credit, exchange rate channels) will be discussed thoroughly. Each of the three channels will be presented separately, providing the theoretical and the empirical backgrounds. In the empirical sections, both Turkish and Foreign studies will be presented and compared.

In the last chapter, an empirical analysis is conducted to investigate the relationship between the economic sectors' inflation and the monetary policy transmission mechanism in the short and the long run, where the sectors of the study are determined based on the high-level aggregation of the NACE Rev2. To that end, the Autoregressive Distributed Lag bounds test is employed to determine the cointegration between the variables of the analysis. Then the Error Correction Model is used to establish the short and long-run dynamics separately, in addition to determining the convergence speed from the short run to the long run.

CHAPTER 1

THE DEVELOPMENT OF THE TURKISH FINANCIAL SYSTEM

(2002-2020)

Before the 2000's crisis, the Turkish economy faced some structural economic problems such as high levels of inflation, a fragile banking sector, and a large government deficit. These problems coupled with the absence of substantial reforms and low capital inflow led the Turkish economy to fall into a banking crisis by the end of 2000. The crisis had some severe impacts on the Turkish economy as a whole and particularly the financial system. The GDP contracted by 5.7 percent, the budget balance increased to 12 percent of GDP, the public debt reached 79 percent of GDP, and the inflation rate skyrocketed to almost 68.5 percent. Although the central bank intervened to stop the depreciation, the Turkish Lira lost 130 percent of its values in just three quarters of 2001.

However, the economy recovered quickly in the post-crisis period. According to the World Bank, from 2001 to 2007, the Turkish real growth increased drastically with peaks near 9.8 percent. The high real growth resulted in doubling the size of the economy by 2007. The inflation rate fell below 10 percent in 2004, which increased the credibility of the central bank and gave room for an interest rate cut. The budget balance and the public debt went respectively below 2 percent and 60 percent of GDP (Bongini, Chiarlone, and Ferri, 2009, p. 184-185).

The recovery was mainly due to the reforms conducted by the country authorities. These reforms aimed to ensure debt repayments in time and prevent currency depreciation. To that end and after the amendments of 25 April 2001, the central bank set its main targets as price stability. It also tried to reduce its credibility gap relying on the 2002-2004 agreement with the IMF, which provides the country with fresh funds.

As a result of these reforms, the banking sector recovered, stabilized, and expanded. This thrive was a result of the reduction in public debt, the low levels of interest rates and inflation, the high capital inflow, In addition to the establishment of the independent Banking Regulatory and

Supervisory Agency (BRSA). The main task of BRSA is to oversee and regulate the banking sector according to the Turkish banking laws and to ensure a stable and reliable financial system.

Table 1-1: Key Macroeconomic indicators in Turkey: 2001-2007

	2001	2002	2003	2004	2005	2006	2007
GDP growth (%)	-5.8	6.5	5.8	9.8	8.9	6.9	5
Inflation (%)	53.5	47.2	21.9	8.6	8.2	9.6	8.8
Interest rates (interbank rate, annual average)	92	49.5	36.2	21.8	14.8	15.6	17.2
Public Debt/GDP (%)	77.9	74	67.7	59.6	52.7	46.5	39.9
Budget Balance/GDP (%)	-23.9	-10.2	-9	-4.4	-1.2	-0.8	-1.5

Source: St. Louis Fed, 2020; World Bank, 2020; Countryeconomy.com, 2020.

However, the Turkish economy had the inconvenience of being sensitive to the international market mood. For instance, a massive sell-off in the international market in 2006 led the YTR (Yeni Turkish Lira) to depreciate by 30 percent against the euro. That obliged the central bank to raise the interest rate to contain inflation and further depreciation. After the international financial crisis of 2008, the exchange rate followed a downward trend (currency depreciation). The reasons behind such depreciation were the unstable geopolitical sphere since 2011, the uncertainty about the global monetary policy after 2013, the coup attempt in 2016, the incline towards protectionism in international trade and monetary policy after 2016, and the 2020's pandemic.

The inflation was stable in the post-financial crisis period of 2008-2012 since the global inflation levels were low and capital inflow helped the exchange rate to maintain its stability. However, it witnessed an uprising trend, especially after 2014. The reasons behind such elevated levels of inflation were the continuous currency depreciation, the capital outflow, the deterioration in the local pricing behavior, the uncertainty about the global monetary policy (the United states' and developed countries' monetary policies), the local political instabilities, and the COVID-19's pandemic.

To counter inflation's uprising trend, cease the exchange rate depreciation, and protect banks from external shocks, the central bank applied some unorthodox complementary instruments during the financial crisis and the period of hot money inflow. However, these tools had some

adverse effects on policy predictability, especially in the post-crisis period. To get over such effects, the central bank conducted a simplification process that ended in 2018 and led to the adoption of the one-week repo as the sole policy instrument.

1.1. The Monetary Policy Framework of the Turkish Central Bank

After the enacted amendments on 25 April 2001, the main goal of the central bank became ensuring price stability. That gives it the freedom of choice in terms of policy and policy instruments with respect to the growth and employment objectives of the government.

In 2002, the central bank chose the short-term interest rate as the main policy tool to attain some significant accomplishments in lowering inflation. However, after the international financial crisis, this tool proved insufficient due to the rise in the short-term capital flows that threatened the financial stability in the emerging markets. Therefore, the central bank was obliged to adopt some unorthodox complementary instruments such as the interest rate corridors and the reserve option mechanism to preserve financial stability and absorb external shocks.

After 2012, the central bank went through a process of simplification aiming to use only one interest rate as a policy instrument instead of several rates, which will improve the policy accuracy and predictability. This process lasted for six years, during this period and aftermath, the country witnessed a lot of fluctuation, mostly increases in inflation levels and depreciation in the exchange rate.

The changes were not limited to the policy instruments, the exchange rate regime changed as well. The central bank switched from the crawling peg exchange rate —A system that allows the fixed exchange rate currency to fluctuate within a band— to the floating exchange rate regime — A regime where the rate is determined by the demand and the supply of the currency— with the consent of the government on 22 February 2001. The currency kept appreciating until 2006 where the international markets witnessed major selloffs followed by the international crisis. In the aftermath, the Lira started its continuous depreciation due to several reasons that we will discuss in-depth in the following sections.

The main changes in inflation policy were when the central bank adopted the implicit inflation targeting regime in the period between 2003 and 2006—the central bank targets nominal variables adopted only internally without being announced to the public— The goal behind adopting such regime was to attain the preconditions for the explicit inflation targeting regime — the central bank target nominal variables and announce them to the public— In addition, the central bank reinforced its technical and institutional infrastructures and removed the factors restricting the monetary policy effectiveness.

After 2012, the developed economies started recovering from the 2008's crisis and began a monetary policy tightening after the long-lasting quantitative easing, which made the emerging markets bear the side effects of the resulted capital outflow. These side effects were mainly affecting inflation and exchange rate as we will illustrate in the next sections.

1.1.1. An Overview of The Exchange Rate Development in Turkey

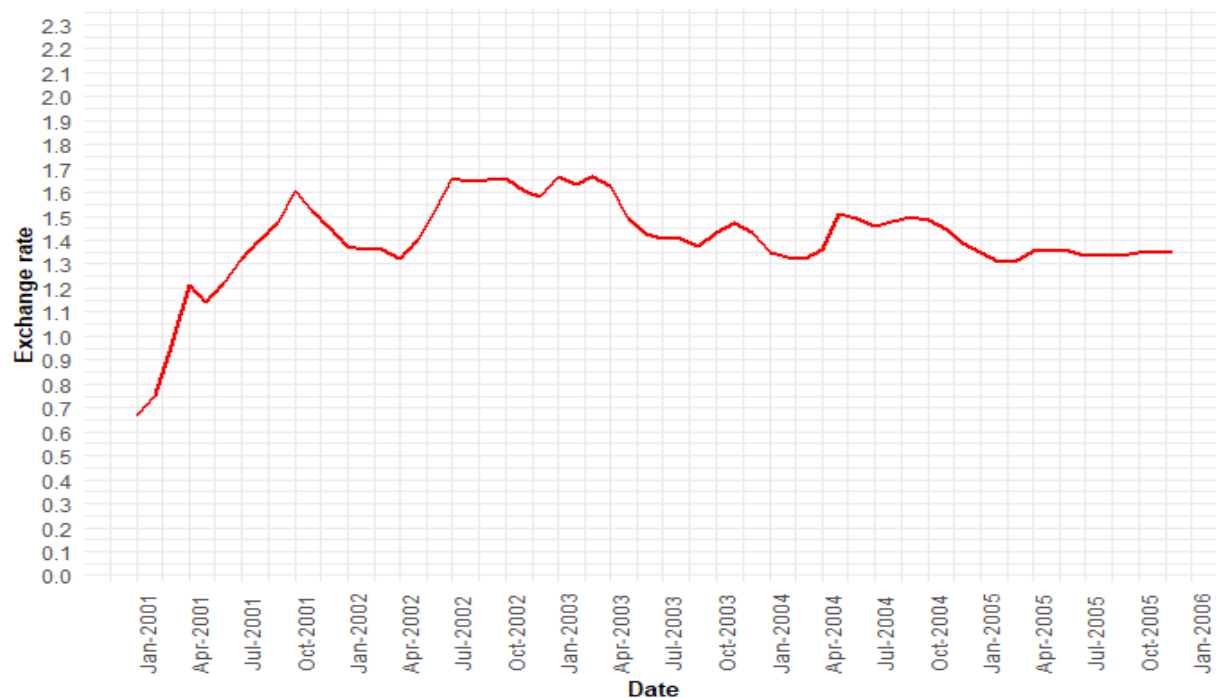
On 22 February 2001, the central bank switched from the crawling peg to the floating exchange rate regime, under which the exchange rates are determined by the demand and supply. Although this regime does not require foreign currency reserves, the central bank kept sure to hold significant foreign currency reserves. It used these reserves as means of intervention in the FX market to counter external or internal shocks and preserve the price stability.

During the period of the implicit inflation targeting regime (2001-2005), the exchange rate went up and down without making significant changes compared to the following periods, where in 2003 the Turkish lira appreciated 7 percent compared to the basket of foreign currencies (EUR and USD). The appreciation was due to the decline in the levels of uncertainty stemming from the Iraq war. However, this appreciation did not last long in 2004. The Turkish Lira depreciated about 11 percent, and the main reasons behind that were the widening current account deficit and the uncertainty caused by some news about a probable increase in the FED rates. In 2005, the Turkish Lira appreciated by 5.6 percent due to the removal of the previous year's uncertainty.

After 2005, the USD/TRY and EUR/TRY exchange rates followed a general upward trend, the long series of depreciation started in Spring 2006 with a 30 percent depreciation in TL against the euro. The cause of this depreciation was some major sell-off that occurred in the international

market, in addition to the appointment of the new central bank governor. The depreciation was followed by an appreciation in 2007 that resulted from the central bank's tight monetary policy coupled with the aggressive FX intervention.

Figure 1-1: USD and TRY monthly exchange rate: 2001-2005



Source: Federal Reserve Bank of St. Louis.

In 2008, the Lira depreciated again affected by the long-lasting supply shocks from the previous year and the liquidity crisis in the international markets due to subprime mortgage concerns in the US. This fact led the central bank to cease the FX buying auctions to strengthen banks' liquidity.

In the period between 2009 and 2012, the USD depreciated worldwide after the adoption of the quantitative easing program—an unconventional monetary policy conducted by the Fed to tackle the worsened macro-financial imbalances through large scale government bonds and financial security purchases at a near-zero rate—.

The program aimed to counter 2008's global financial crisis, but the low levels of interest rates caused the short-term capital to flow towards the emerging markets where risk premiums are high. The excessive inflow of such capital caused instability in these markets. However, the central bank prevented the excessive appreciation that may happen as a result of this inflow by cutting its policy rate and by using some unorthodox tools such as the interest rate corridor and the reserve option mechanism.

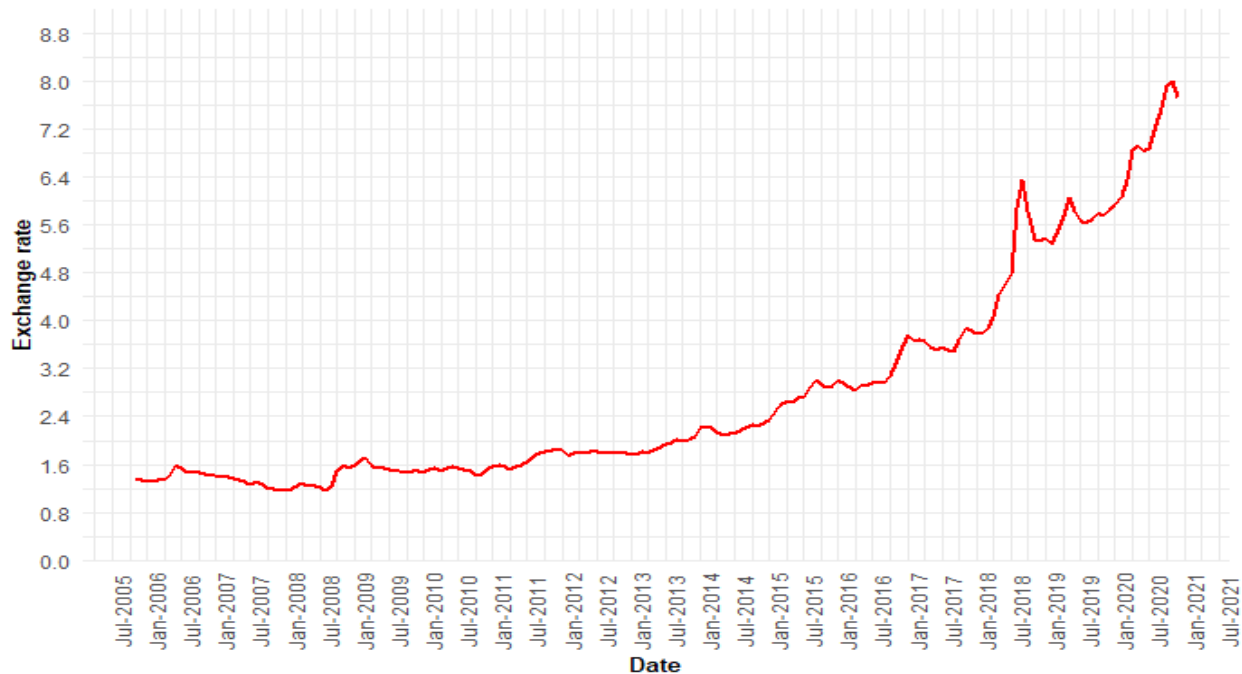
The period of 2013-2015 witnessed elevated levels of uncertainty about the global monetary policy—whether the loose monetary policy in advanced economies will last longer or central banks will adopt tighter monetary policies— in addition to concerns about the global economic growth. These concerns led to the short-term capital outflow from the emerging markets leading its currencies to lose their value. The Turkish lira lost almost 60 percent of its value during this period because of the mentioned international conjuncture in addition to local and geopolitical tensions (the Syrian crisis).

After the US elections in 2016, the level of uncertainty went high globally causing high volatility in terms of capital flows and forcing advanced economies to raise their interest rates to counter potential capital outflow. Furthermore, the failed coup attempt in turkey worsened the Turkish scenario compared to other emerging markets. All this together had a hugely adverse effect on the Turkish exchange rate.

In 2017-2018 the Turkish lira depreciated drastically mainly because of the inclination toward protectionism in international trade, especially in the United States. In addition to the continued normalization in monetary policy by the advanced economies —re-tightening their monetary policies— and the depressed capital inflow due to the Turkish geopolitical developments. The central bank responded aggressively to protect the economy and preserve stability by tightening its monetary policy. As a result, the decline in the exchange rate in 2019 was limited.

However, in 2020 the exchange rate resumed its depreciation due to the global and local pandemic effects. Where the macro-financial risks increased, the expectations deteriorated, the levels of uncertainty spiked, capital outflowed from emerging markets, individuals tended to dollarize their assets, and firms reduced their foreign liabilities.

Figure 1-2: USD and TRY monthly exchange rate: 2006-2020



Source: Federal Reserve Bank of St. Louis.

1.1.2. The Price stability in Turkey and The Inflation Targeting Regime

During the Turkish economic crisis, the inflation levels recorded unprecedented peaks of almost 70 percent, especially at the end of 2001 and the beginning of 2002. During this period, the global conjuncture was undergoing some fluctuations after the 09/11 terrorist attacks, especially the global financial market. These fluctuations had an unexpected adverse effect on the domestic inflation rate. To that end, the government and the central bank established a program called “Strengthening the Turkish Economy” intending to increase the resilience of the economy to external shocks, ensure price stability, and preserve the economy from any kind of unexpected crisis. Within this program, the central bank adopted the implicit inflation targeting regime in 2003 to set the preconditions for an explicit one in 2006.

From 2002 to 2005, the central bank conducted a stability program to ensure bank rehabilitation, fiscal discipline, and low levels of public debt. Within the framework of this program, the central bank conducted a set of financial structural reforms such as changing the TURKSTAT's price indices _changes in the base year_ and transiting to the New Turkish Lira in 2005. These factors helped boost the central bank's credibility, eliminated the transactions, accounting, operational, and technical difficulties. It also made the currency more comprehensible and comparable. They emphasized the determination of the central bank to stabilize the economy and decrease the levels of inflation. All that together led the inflation levels to decline drastically from almost 70 percent to the one-digit level of 07 percent after 30 years of high inflation. During this period, the central bank succeeded in hitting below all its implicit inflation targets as shown in Figure 1-3.

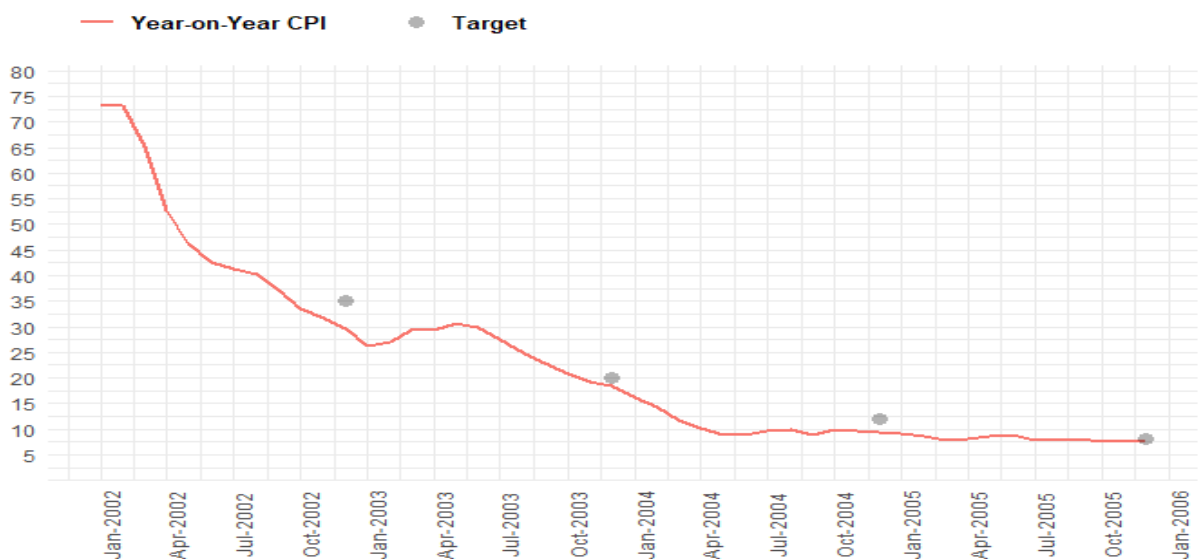
In 2006 and after the disinflation process, institutional reforms, and financial stability accomplishments, the central bank announced the adoption of the explicit inflation targeting regime. Under the framework of this regime, it replaced the consumer price index year from 1994 to 2003. In addition, they established new mechanisms of setting inflation targets and accountability for these targets, and they gave the monetary policy committee new purviews.

The new inflation targeting mechanism allowed the government and the central bank to decide jointly about the inflation targets for the next three years and then announce them to the public. These targets are set as the year-on-year percentage change of the CPI, in other words, the central bank announces their targeted yearly percentage change of the CPI for the next three years.

Furthermore, an accountability mechanism was established in cases where the inflation rate deviates from the targets. Within the framework of this mechanism and due to the inevitability of inflation fluctuation, the central bank set an uncertainty band of two percent around the inflation target rate, within which the inflation rate would fluctuate normally. However, if the inflation rate deviates out of these bands, the central bank is obliged to inform the public and the government about the reasons behind such deviation and the measures to be taken under the accountability system and article 42 of the law. In addition to the mentioned changes, the role of the MPC changed from an advisor to a policymaker by obtaining the right to vote on the interest rate decisions at their monthly meetings.

Under the inflation targeting regime, the levels of inflation were above target in the period between 2006 (the year of explicit inflation targeting adoption) and 2008. In this period, the developed countries tightened their monetary policy as a countermeasure to the increasing concerns about inflation. This decision caused a currency depreciation and a massive capital outflow in the developing countries and amongst them Turkey. This depreciation had an adverse effect on inflation and pushed it above the target boundaries as shown in Figure 1-4. The central bank's efforts to contain the inflation rate and drop it back within the target's boundaries failed. This failure was due to the hikes in the unprocessed food prices, which were caused by weather conditions, in addition to the global increase in prices of energy during this period.

Figure 1-3: Inflation rates and Targets in Turkey: 2002-2005



Source: CBRT, 2020; TURKSTAT, 2020.

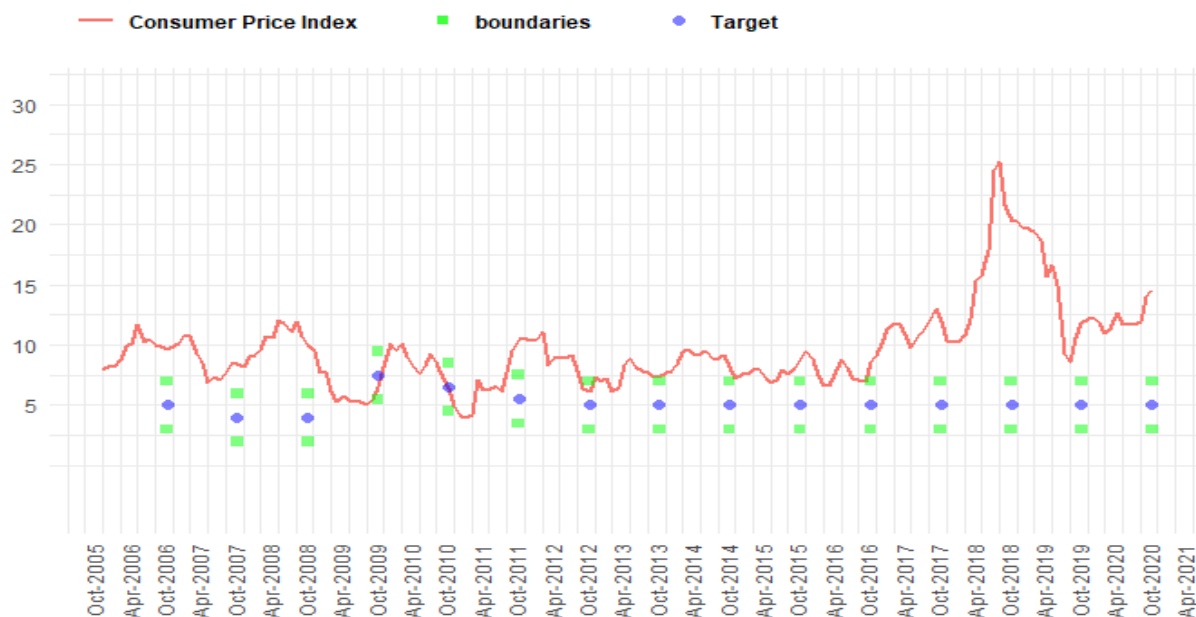
From 2009 to 2011, the level of global inflation declined due to the recession following the 2008's financial crisis. That had a positive effect on domestic inflation leading it to lay back within the target boundaries during this period. However, the consistent changes in prices of food followed by a depreciation in the Turkish lira kept the inflation volatile, to increase in the end from

6.4 percent in December 2010 to 10.45 percent in December 2011. That increase introduced a new era of above-target inflation rates.

From 2011 through 2012, the inflation rate declined from 10.45 percent by the end of 2011 to 6.16 percent by the end of 2012. The decrement in the inflation rate was due to the decrease in the prices of non-agricultural products and the exchange rate stability. Even though the inflation deteriorated in that period because of the government tax and price adjustments (especially of the energy prices), the inflation rate kept laying within the target boundaries.

The general outlook of the period of 2013-2017 was inflation levels that fluctuates above the target boundaries reaching the two digits level in 2017. These elevated levels of inflation were due to several reasons such as the non-stopped Turkish Lira depreciation, the increase in food and energy prices, the tax and wage adjustments in 2016 and 2017, and the low capital inflow especially in 2013 because of the uncertainty about the global monetary policy.

Figure 1-4: Inflation rates and Targets in Turkey: 2006-2020



Source: CBRT, 2020; TURKSTAT, 2020.

After 2017, the inflation rate increased drastically, particularly in the second and the third quarters of 2018 where the Turkish lira depreciated insanely to lose half its value. This event

resulted in a massive deterioration in the domestic pricing behavior, leading the inflation rate to increase from 11.92 percent by the end of 2017 to 20.30 percent as of December 2018. After the diminishment of the accumulative effects of the Turkish lira depreciation in 2018, the inflation rate recovered in 2019 benefitting also from the central banks' tightened monetary policy. However, the inflation levels kept fluctuating above the boundaries of the targets as shown in Figure 1-4.

In 2020 the levels of inflation deteriorated again, furthering the gap between the current inflation rate level and the targeted. The pandemic was the main reason behind this deterioration, in addition to its side effects on individuals' behaviors and how the latter affected the local currency, as mentioned in the exchange rate development section.

1.1.3. The Development of The Monetary Policy Instruments of the Turkish Central Bank

In 2002 and within the framework of price stability, the central bank set the short-term interest rates as its main monetary policy instrument. The new policy instrument had a big impact on inflation and was the main reason to reduce it during the implicit inflation targeting period (2002-2005). The central bank benefited from that favorable inflation development and conducted a set of rates cut during this period.

In 2006, the central bank adopted the explicit inflation targeting regime. In the meantime, the global conjuncture was undergoing some fluctuations, instability, and high levels of inflation that last until 2008. This global conjuncture resulted in a massive capital outflow, which resulted in a 30% depreciation in the New Turkish Lira (TRY). After the depreciation, the central bank was obliged to tighten its monetary policy, mainly by increasing the levels of the short-term interest rates and suspending the foreign exchange buying auctions.

After 2008's financial crisis and due to the sudden slump in economic activity, the worldwide inflation fell and the capital outflow from developed countries with expansionary monetary policy (low-interest rate levels) to the emerging markets (with high-interest rate levels). The capital inflow in emerging markets gave room for their central banks to cut interest rates and cause shocks in such economies. The central bank benefited from that face and conducted an

expansionary monetary policy mainly by cutting its policy rate by 650 basis points between December 2008 and April 2009, as shown in Figure 1-5.

Figure 1-5: Interest Rate Developments in Turkey: 2006-2009



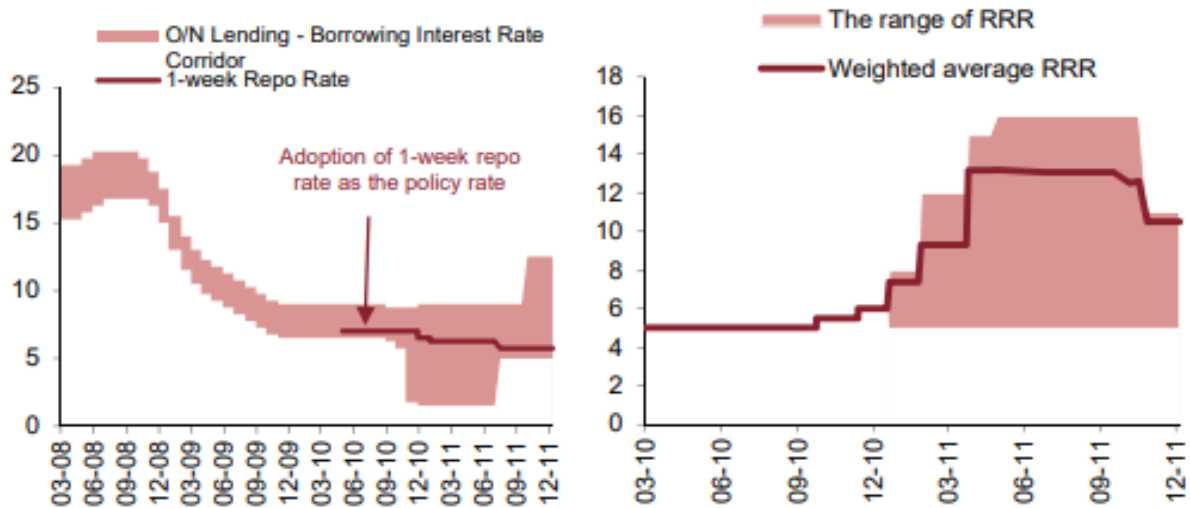
Source: CBRT, monetary and exchange rate policy for 2010.

However, the global imbalances and the domestic macro-financial risks led the central bank to redesign its policy approach by applying a technical rate adjustment and launching a new policy strategy.

In May 2010, the central bank adopted the one-week repo as its policy rate instead of the overnight rate, and by the end of 2010, it started considering financial stability along with price stability. For that sake, the central bank developed new complementary instruments such as the interest rate corridor and the reserve requirement ratios.

According to its definition, the interest rate corridor is the margin between the overnight lending and borrowing rates of the central bank, which aims to prevent market rates from over-deviating from the policy rate. In other words, banks with excess reserves can lend to the central bank at an overnight maturity, and banks with a need for funds can borrow short-term liquidity at an overnight maturity as well. Therefore, the rates at which the central bank charges these banks create a corridor that works as a boundary with an upper _the lending rate_ and lower limit _borrowing rate_ within which the market rate operates. The interest rate corridor and the policy rate are set to be revised together monthly by the Monetary Policy Committee (MPC).

Figure 1-6: Policy Instruments Development in Turkey: 2008-2011

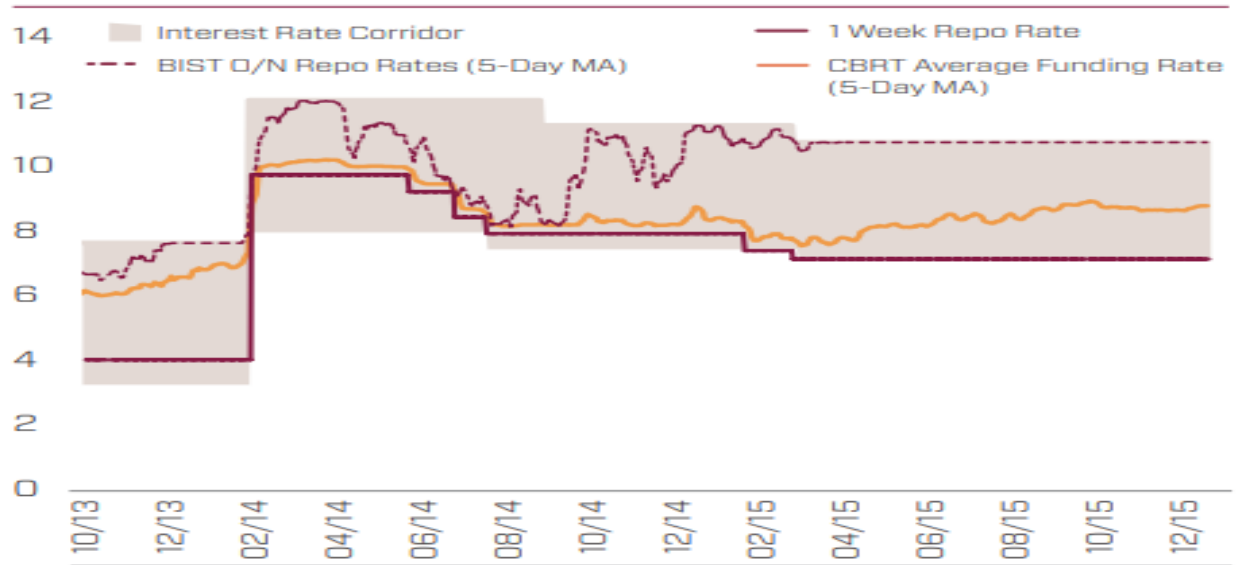


Source: CBRT, 2011's annual report.

The second developed instrument is called the Reserve Option Mechanism (ROM). It intended to counter the impacts of the unfavorable volatility of capital movement (especially external shocks) in the financial system and the economy. The ROM allows banks to hold a portion of their reserve requirements in foreign exchange (FX) rather than TL, to protect themselves from external shocks.

In late 2013 the Fed slowed its quantitative monetary easing leading the global financial markets to fluctuate, which hurts the emerging markets. In addition to global markets fluctuations, Turkey experienced some political problems, which worsened the volatility in the local financial market. This volatility harmed price stability, the fact that prompted the central bank to tighten the monetary policy by increasing the one-week repo from 4.5 percent to 10 percent in early 2014. By mid-2014 (from May to July), the heightened levels of uncertainty declined to lead the rising inflation trend to slow down and allowing the central bank to cut its one-week repo by 175 basis points, from 10 percent to 8.25 percent. Again, between January and February 2015, the central bank exploited the low levels of uncertainty and cut the one-week repo by 75 basis points, from 8.25 percent to 7.5 percent. Every cut in the policy rate was coupled by an equivalent cut in the overnight borrowing-lending rates to preserve the symmetry of the interest rate corridor as in Figure 1-7.

Figure 1-7: Interest Rates Development in Turkey: 2013-2014



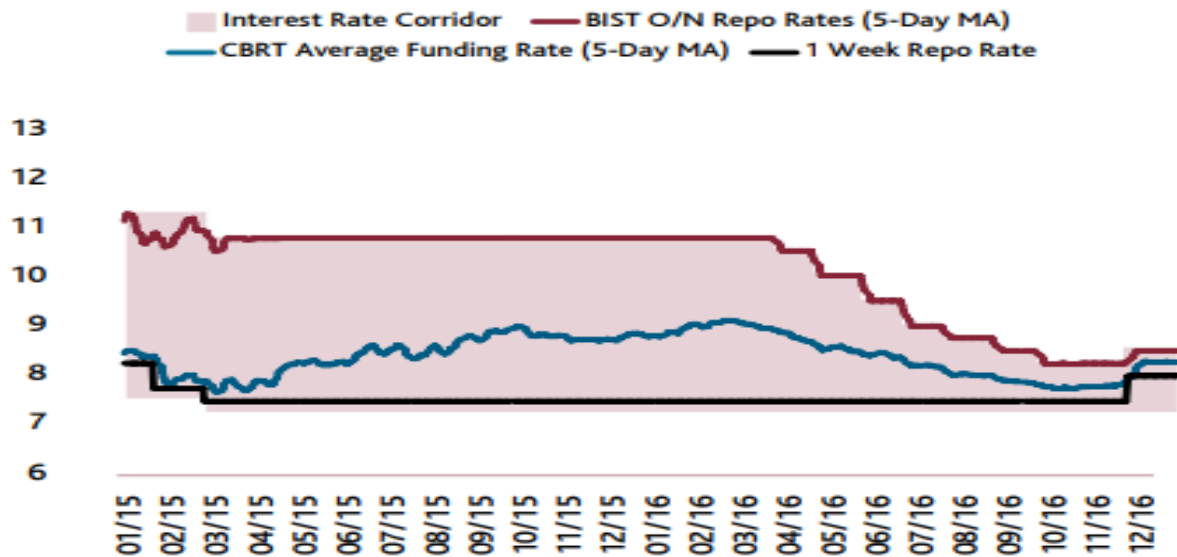
Source: CBRT, 2014's annual report.

In 2016 the global markets went mad after the Chinese economy went below 8%-10% of annual growth, which is an unprecedented event in the last 30 years. This slowdown caused the prices of oil to decrease drastically to trade below 30 dollars, which was the lowest price in 12 years. The levels of uncertainty heightened, and expectations were mixed especially when the Fed raised its policy rate from 0% to 0.25% causing more selloffs in the global financial markets.

The central bank responded to these selloffs and uncertainty by narrowing the interest rate corridor to ensure a low level of volatility transmission to the local market. It decreased the overnight lending by 250 basis points from 10.75 percent to 8.25 percent. And kept the overnight borrowing rate and the one-week repo rate unchanged at 7.25 percent and 7.5 percent respectively, making the corridor width one hundred basis points (the difference between the borrowing-lending overnight rates) as in Figure 1-8.

In late 2016, the central bank tightened its monetary policy as a countermeasure to the US upwards policy rate revision that would result in a capital outflow and currency depreciation. To that end, the central bank increased the one-week repo rate by 50 basis points and the overnight lending rate by 25 basis points, which made the corridor broader and gave more room to market rates.

Figure 1-8: Interest Rates Development in Turkey: 2015-2016



Source: CBRT, 2016's annual report.

To preserve the financial stability, FX liquidity, and protect banks from external shocks during this volatile period, the central bank conducted a gradual cutting of the foreign currency required reserve ratios and the reserve option ratio —The amount of FX or gold that can be held per unit of Turkish lira—

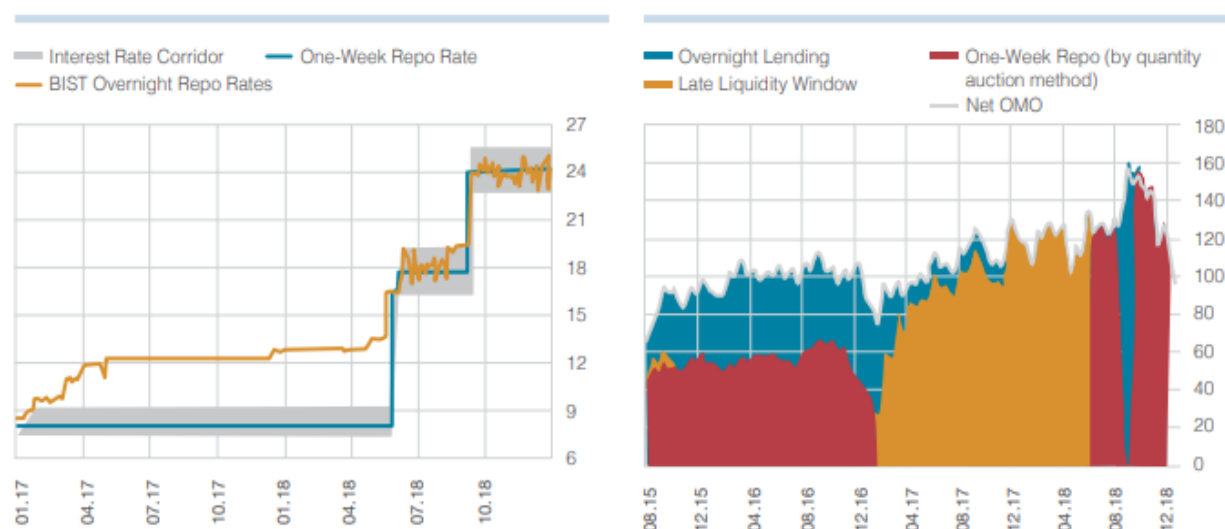
In early 2017, and because of the adverse effects of exchange rate volatility on inflation and liquidity (especially of the foreign currency), the central bank took a variety of liquidity measures such as:

- Ceased the one-week repo rate auctions conduct and intensified the use of late liquidity window as the main instrument to fund the financial system —The LLW is a borrowing facility provided by the central bank to banks with temporary liquidity need to prevent problems in their payment systems— as shown in Figure 1-9.
- Limited its funding supplied through Borsa Istanbul (BIST) interbank repo and reverse repo market.
- Reduced the foreign currency required reserve ratios.

As a result of the Turkish Lira depreciation, the inflation level rose due to the rise in imported goods prices, which led the central bank to conduct a tightening monetary policy by raising its LLW three times, the first by 75 basis points from 11 percent to 11.75 percent in March 2017, again by 50 basis points from 11.75 percent to 12.25 percent in April 2017, and the last was by 50 basis points from 12.25 percent to 12.75 percent in December 2017.

Within the ROM framework, the central bank lowered its FX facility upper limit from 60 percent to 55 percent, to increase the banking system's FX liquidity. Given the persistent deterioration in pricing behavior and inflation expectations, the central bank targeted a more predictable and simplified monetary policy. It adopted the one-week repo rate as its sole policy rate in May 2018, instead of a complex system of multiple rates made the monetary policy complicated and its effects less predictable. During this year, the central bank conducted a strong monetary tightening by raising the one-week repo rates by 750 basis points from 16.5 percent to 17.75 percent in July, and from 17.75 percent to 24 percent in September. In addition, it revised the interest rate corridor and set its borders with a margin of +/- 150 basis points around the policy rate. The FX facility's upper limit was lowered again to 45 percent, to increase the FX liquidity in the banking system. Increasing the liquidity aimed to counter the exchange rate volatility's adverse impacts on inflation.

Figure 1-9: CBRT's Short-term Rates and Funding: 2017-2018



Source: CBRT, 2018's annual report

The weakening cumulative effects of the depreciation of the Turkish Lira caused the inflation rates to decrease in mid-2019 and gave room for the central bank to cut its policy rates. The policy rates were caught gradually, starting from July 2019 at 24 percent ending at 8.25 percent in May 2020. During this period, the banking system used the central bank swap facilities intensively to get its funds (a sizeable portion of the funds was via TL currency swap transactions) rather than the open market operations (OMO), which was mainly conducted through the one-week repo.

In terms of reserve requirements, the central bank's amendment to law NO. 1211 subjected what to be found appropriate in the on- and off-balance sheet items to the reserve requirements. In addition, they linked the reserve requirement ratios and remuneration rates to the banks' real loan growth rate.

In August 2020, and under a tight monetary policy, the central bank suspended the funding through the one-week repo auctions and replaced it with the traditional repo auctions. This conduct increased the cost of borrowing compared to the one-week repo cheap funds. And decreased the borrowing limits of the banks at the central bank's overnight transactions market to half.

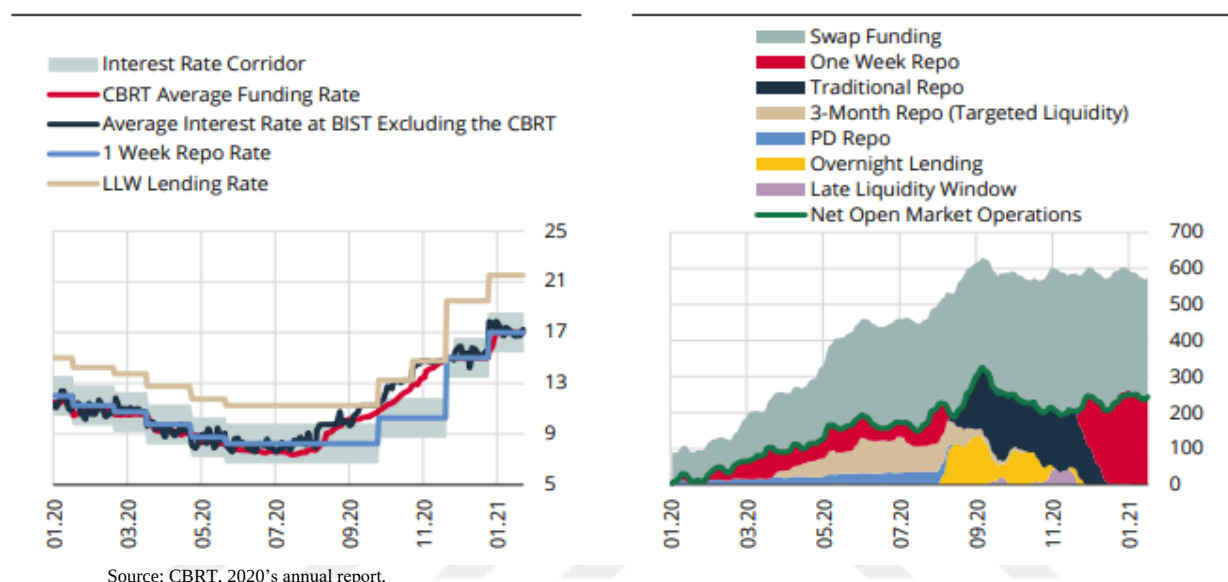
Furthermore, the central bank increased its RR for both TL and FX and revoked the linkage between the loan growth rate and the reserve requirements and remuneration, instead, the same RR rate was applied to all banks.

As of 20 November 2020, the one-week repo auctions were re-established at a rate of 10.25 percent instead of the traditional repo auctions. The re-establishment aimed to enhance the market rate predictability. Since they went out of the corridor when they were conducting the traditional repo auctions, as shown in Figure 1-10.

Due to the pandemic, the labor unit cost increased leading inflation to increase as well. In this regard, the central bank adopted a tight monetary policy to counter the adverse impacts of the rise in inflation, contain the rise in inflation expectations, and bring back the disinflation process. Within the tight monetary policy, the policy rate increased gradually from 10.25 percent in November to 17 percent in December 2020 as shown in Figure 1-10. The interest rates of the TL currency and the TL-gold swap markets were set to be at the same rate as the one-week repo rate.

In this context, the swap market rates were raised from 11.75 percent in November to 17 percent in December 2020.

Figure 1-10: CBRT's Short-term Rates and Funding: 2020-2021



1.2. An Overview of The Turkish Banking System

Before 2001 the Turkish banking system was too fragile and faced a lot of structural problems. The most important amongst such problems were the open foreign exchange positions of banks, where a bank borrows in foreign currency to invest in high-yielding government bonds in local currency. Also, the problem of maturities mismatch — the short-term liabilities exceed the level of short-term assets — that arose from financing the public sector, buying its long-term securities while relying on short-term funds (Özatay and sak, 2003).

The risks of such problems accumulated, resulting in 21 private banks being taken over by the banking authority between 1997-2003 and causing the 2001's crisis. The estimated cost of rescuing the state-owned banks and the troubled private banks taken by the Saving Deposit Insurance Fund (SDIF) during the crisis was around 44 billion dollars.

In the post-crisis period, the Banking Regulation and Supervision Agency (BRSA) tightened the controlling and accountability systems with a bundle of strict rules. In addition, the

Turkish government conducted a set of banking reforms in line with international and European standards. All together led to a stronger banking system, which proved its resilience against external shocks during 2008's financial crisis, 2014's local economic fluctuations, 2016's global financial markets' frictions and domestic coup attempt impacts, and the 2020's pandemic.

1.2.1. An overview of the Banking System 2001-2020

The accumulated banks' heavy FX open positions and their dependence on high-interest rates paid on T-bills for their earnings, damaged the Turkish banking system throughout the years before the crisis, made the banking and financial systems too fragile, and led finally to the 2001's crisis.

In late 2000, the levels of interest rates skyrocketed, causing a decline in the prices of the T-bills, which harmed the balance sheets of banks (especially the state-owned ones) and made the funding requirements more difficult. By early 2001, the Turkish lira depreciated sharply worsening the economic environment leading the borrowers to face some difficulties to pay their due installments to banks and increasing the level of non-performing loans (NPLs). In addition, banks had to bear major losses due to their heavy un-hedged FX open positions. As a result, around 10 banks were taken over by the SDIF between October 2000 and 2001, the banking system net losses increased from almost a half-billion dollars in 1999 to 3.7 billion dollars in 2001, the number of banks in the banking system decreased by almost 20 banks, and their total assets decreased by 13.9% in the period between 1999 and 2001 as shown in Table 1-2.

After the 2001's crisis, the government launched economic reforms to repair the crisis damages and develop the economy benefitting from a new IMF standby agreement (February 2002, SBA). The banking program embedded within these reforms focused on four pillars (Yildirim and Davutyan, 2017):

- Resolution for banks under the SDIF.
- Restructuring the state-owned banks.
- Recapitalization of private banks.
- Improving the supervision, risk control, and competition in the banking system

Table 1-2: Number of banks, total assets, and net profit in the Turkish Banking System

Years	Number of Banks					Total	Total Assets (Million \$)	Net Profit/Losses (Million \$)
	State-owned Deposit Banks	Privately -owned Deposit Banks	Foreign Deposit Banks	Banks Under the Deposit Ins. Fund	Development and Inv. Banks			
1999	4	31	19	8	19	81	133,533	-566
2000	4	28	18	11	18	79	154,947	-4,687
2001	3	22	15	6	15	61	115,020	-3,570

Source: The bank Association of Turkey 2020.

From 2001 to 2005, the number of banks, branches, and employees in the Turkish banking system decreased due to the closure of insolvent banks, mergers, and acquisitions (Table 1-3). The state-owned banks decreased the number of their branches by almost 25 percent, and the number of their employees nearly halved in the period between 1999-2006. Similarly, but not at the same magnitude, the branches of the privately owned banks decreased by almost 10 percent and their employees by 5 percent in the same period. Overall, the decrease in the numbers of branches and employees in the banking system was less sharp than the state-owned banks, which was due to the less intense decrease in privately owned banks' branches and employees.

The case for the foreign banks was different, because of the post-crisis stable, well-regulated, and profitable banking system, foreign banks increased their presence in the Turkish banking sector. They either acquired SDIF banks, bought shares in the operating Turkish banks, or made partnerships with the existing banks. The foreign bank's average number of branches in the post-crisis period increased almost eight times, and the average number of employees increased as well by more than seven times. As shown in Table 1-4.

As of 2005, the Turkish banking system finalized the adoption of the Basel-II requirements, with a stricter, more efficient, and more accurate risk-controlling system. These reforms along with changes in the fiscal and monetary economic policies reshaped the Turkish banking system and prepared the environment for its growth. After 2005 the number of banks,

branches, and employees in the banking sector grew exponentially due to the increase in the sector's profitability.

The international financial crisis was the first real test for the strength and resilience against external shocks for the Turkish banking system. The huge short-term capital inflow triggered an appreciation in the currency, which widened the deficit gap in the current account. And caused a significant increase in the credit market, which caused an increase in the aggregate demand and destabilized the prices. The central banks intervened by using unorthodox instruments (interest rate corridor and ROM) to preserve the price stability and shield the financial markets from the short-term capital inflow/outflow shocks. It also conducted a set of interest rate cuts to cease the lira appreciation and shrink the current account deficit gap. All that together with the well-regulated banking sector resulted in a resilient financial and banking system that was one of the least affected by the international financial crisis.

2016 was a year full of difficulties for the Turkish economy internally and externally. The election of Donald Trump in the United States increased the global uncertainty about the US economic policies, the fed raising the interest rate fuelled the capital outflow from the developing markets and increased the demand for the US dollar, the failed military coup in Turkey and its adverse impacts on the economy, all together were the new challenges for the Turkish banking and financial system. To help the banks and the economy get over these struggles, the central bank conducted a set of interest rate cuts to stimulate the economic growth that was below the expected. It decreased the TL and FX reserve requirements by 50 basis points and provided around 1.5 billion dollars to the liquidity pool to protect the banking system from internal and external shocks. The Central bank's measurement coupled with the adequate liquidity in the Turkish banking system allowed the financial system and the banking sector to pass the crisis without major interruptions.

Table 1-3: Number of Banks, Branches, and employees in the Turkish Banking System

Years	Number of Banks				Number of Branches (including foreign branches)				Number of Employees			
	State-owned Deposit Banks	Privately-owned Deposit Banks	Foreign Deposit Banks	Total	State-owned Deposit Banks	Privately-owned Deposit Banks	Foreign Deposit Banks	Total	State-owned Deposit Banks	Privately-owned Deposit Banks	Foreign Deposit Banks	Total
2001	3	22	15	61	2,725	3,523	233	6,908	56,108	64,380	5,395	137,495
2002	3	20	15	54	2,019	3,659	206	6,106	40,158	66,869	5,416	123,271
2003	3	18	13	50	1,971	3,594	209	5,966	37,994	70,614	5,481	123,249
2004	3	18	13	48	2,149	3,729	209	6,106	39,467	76,880	5,880	127,163
2005	3	17	13	47	2,035	3,799	393	6,247	38,046	78,806	10,610	132,258
2006	3	14	15	46	2,149	3,582	1,072	6,849	39,223	73,220	25,794	143,143
2007	3	11	18	46	2,203	3,625	1,741	7,618	41,056	75,124	36,707	158,534
2008	3	11	17	45	2,416	4,290	2,034	8,790	43,333	82,158	40,567	171,598
2009	3	11	17	45	2,530	4,390	2,062	9,027	44,856	82,270	39,676	172,402
2010	3	11	17	45	2,744	4,582	2,096	9,465	47,235	83,633	42,013	178,503
2011	3	11	16	44	2,909	4,944	1,938	9,834	50,239	89,047	37,047	181,418
2012	3	12	16	45	3,079	5,100	2,012	10,234	51,587	90,612	38,772	186,098
2013	3	11	17	45	3,397	5,339	2,244	11,021	54,466	93,365	44,159	197,465
2014	3	11	19	47	3,500	5,455	2,226	11,223	55,851	95,839	43,446	200,886
2015	3	9	21	47	3,681	4,299	3,170	11,193	58,211	74,756	62,646	201,204
2016	3	9	21	47	3,702	4,132	2,905	10,781	57,586	73,742	59,804	196,699
2017	3	9	21	47	3,677	4,013	2,809	10,550	58,502	73,460	56,079	193,504
2018	3	9	21	47	3,718	3,963	2,718	10,454	60,195	72,025	54,478	192,313
2019	3	9	21	47	3,707	3,785	2,644	10,199	60,365	69,071	54,000	188,837

Source: The bank Association of Turkey 2020.

In general, in the period between 2001 and 2021, the banking system grew at a rapid pace and showed a high resilience against internal and external shocks. During this period, the banking sector's total assets grew by almost 6.6 times. The total quality measured by loans to total assets ratio increased more than two times due to the increase in economic activity and the profitability measured by average return on equity was around 15% during this period, as shown in Table 1-4.

Table 1-4: Total assets, Assets Quality, and Profitability in the Turkish Banking System

Years	Total Assets (Million \$)	Assets Quality	Profitability	Years	Total Assets (Million \$)	Assets Quality	Profitability
		Total Loans (net)/ Total Assets	Average Return on Shareholders' Equity			Total Loans (net)/ Total Assets	Average Return on Shareholders' Equity
2001	115,020	24.6	-69.9	2011	614,491	57.2	13.8
2002	129,700	26.5	11.2	2012	730,278	59.2	13.0
2003	179,253	28.0	15.8	2013	767,635	62.1	12.8
2004	229,328	33.7	14.0	2014	811,513	64.1	11.0
2005	295,849	38.6	10.6	2015	766,250	65.2	10.2
2006	344,947	45.0	18.9	2016	737,482	66.1	12.6
2007	484,061	50.0	19.5	2017	820,552	66.9	14.3
2008	463,839	52.0	15.4	2018	692,361	64.7	13.4
2009	536,901	47.7	18.3	2019	707,388	62.3	10.6
2010	625,570	52.9	16.5				

Source: The bank Association of Turkey 2020.

CHAPTER 2

The Transmission Channels of The Monetary Policy

The main objective of central banks around the world is to ensure price stability, in addition to other goals such as attaining full employment and supporting government policies. To do so, they implement policy changes using their set of policy instruments, which can affect the general economy through the transmission mechanism channels.

The monetary transmission mechanism (MTM) channels are the ways with which changes in the nominal money stock, or the short-term nominal interest rate initiated by the monetary policy impact inflation and real variables (Ireland, 2005). In other words, the transmission mechanisms are the channels that transmit the monetary policy decisions into changes in the gross domestic product and inflation (Taylor, 1995). However, these monetary policy decisions may not be transmitted into changes in real GDP and inflation accurately as the central banks desire, which may cause some serious and unwanted consequences. For that sake, conducting a monetary policy requires a clear view of how precisely this policy is going to affect the economic variables and the different markets. Therefore, defining these transmission mechanisms and the different channels through which they operate gives a better understanding of the speed and the intensity with which they affect the other variables and the markets. Besides, that helps to specify the adequate timing for a policy change and the appropriate instruments to be used by the central banks. In other words, it clarifies the conditions and the limitations for central banks while taking their decisions (Loayza and Schmidt-Hebbel, 2002).

Fredric Mishkin identifies the main channels of transmission as the interest rate channel, the exchange rate channel, other asset price channels, and the credit channel. These transmission mechanisms have been a controversial subject in macroeconomics for many years. The considerable disagreement amongst economists was about which of these channels is dominant over the others. In other words, the different views that are raised on this topic are mainly about the relative importance of each channel (Taylor, 1995).

The relative importance of each channel is not derived from the channel itself. Rather from the influence of the structural features of a particular economy. So, the way these channels work

may differ from one economy to another, given their characteristics (size and openness) and structural differences (Loayza and Schmidt-Hebbel, 2002).

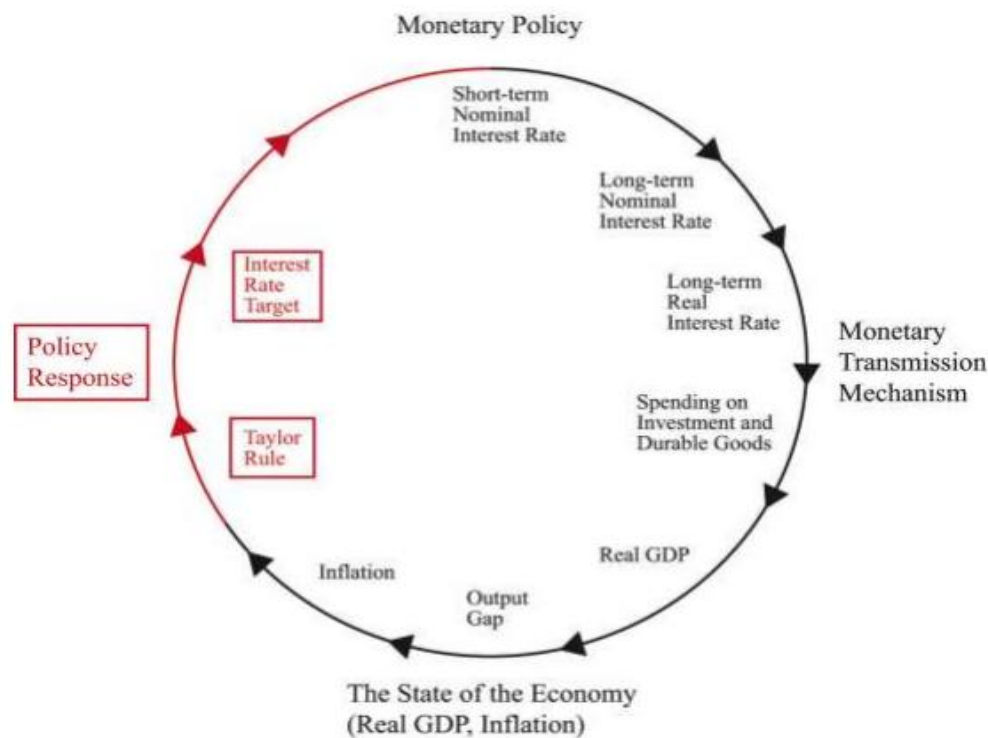
Both empirical and theoretical overviews of these channels will be presented in the subsections below to give a better understanding and raise the different points of view.

2.1. Interest Rate Channel

2.1.1. The Interest Rate Channel in the Literature

In order to study the interest rate channel, the first thing is to establish the mechanism through which the short run interest rates are transferred into market rate. Then how the latter affects the economic variables such as output and inflation and how these economic variables are to affect the policy making.

Figure 2-1: Monetary Policy Transmission Mechanism – The Interest Rate Channel



Source: Macroeconomics: Theory Through Applications, Andrew John, Russell Cooper, 2012.

The way with which the monetary policy short-term interest rates are transmitted to the market rate —long-term nominal interest rate— and how the latter impacts both loans and deposits are the key determinants of the monetary policy effectiveness (Égert and MacDonald, 2006). The long-term nominal interest rate can be defined using the term structure of the interest rate model. This long-term nominal interest rate is the weighted average of the expected future short-term interest rates. So, when an increase in short-term interest rate is anticipated by the market actors as temporary —the future short-term interest rate would return to its initial value gradually after the central bank reach its goals— the long-term interest rate increase would be less than the short-term one. Meanwhile, if an increase in the short-term interest rate is anticipated as the beginning of a series of increases, it would make the long-term interest rate increase more than the short-term one (Taylor, 1995).

After explaining how the short-term rates affect and transmit to the long-term rates (the market rates), now we use the marginal cost model developed by Stephen Rousseas to explain the pass-through from market rates to banks' rates charged for loans and deposits:

$$r^B = \gamma_0 + \gamma_1 \cdot r^M$$

r^B = bank interest rate. γ_0 = a constant mark-up.

γ_1 = marginal funding costs faced by banks (market rate).

r^M = marginal cost price approximated to a comparable market interest rate.

When loans and deposits are perfectly elastic with respect to the bank interest rates, the γ_1 (pass-through parameter) equals 1. In other words, when banks have asymmetric information and the absence of risks or moral hazard, the change in market rates passes fully to the banks' interest rate. In some cases, the γ_1 may exceed the 1 when banks are overshooting —charging high-interest rates— in an attempt to counter the moral hazard and the adverse selection problems in the economy instead of lowering the loans supply. In general, the γ_1 is less than 1 where banks are less responsive to changes in the market rate, which is due to the imperfect substitution between

bank deposits and other investment facilities, the bank loans and external finance, and the switching cost that arises from changing from one bank to another.

Other factors may also affect the pass-through parameter, such as the interest rate cycle and inflation. The interest rate cycle affects the banking behavior setting their lending and borrowing interest rates. When market rates are rising, banks tend to adjust their lending rates quicker than their borrowing. Meanwhile, when interest rates are falling banks tend to adjust their borrowing rates first (Weth, 2002). Inflation may also play a role in the mechanism of interest rate pass-through. The frequent price adjustment in a high inflation market accelerates the process of interest rate pass-through and vice versa (Égert and MacDonald, 2006).

According to the Keynesian view of the MTM, monetary policy affects the real economy through interest rates, which affect business decisions about investment and spending and thereby affect the aggregate demand, output, and consequently inflation. The New Keynesians suggest that the change in interest rate does not affect only investment; it also affects consumers' decisions about their expenditures on both durable goods and housing. Since consumers rely mostly on credit to fund such expenditures.

For Keynes, people have three motives for holding and demanding money. The use of money as means of transaction (Transaction motive), as a precaution for unexpected expenditures (Precautionary motive), or as additional money above that needed as a precaution or for the transaction, which is used to speculate (Speculative motive).

$$M^d = L(Y, r)$$

M^d = Money demand.

Y = Income.

r = Interest rate

Income is positively related to Transactions and precautionary demands. While all three demands of money (Speculative, transactions', and precautionary) are negatively related to the interest rate. So, the more is the income, the more is the money demand (speculative, transactions', and precautionary). While the interest rates increase leads to less money demand and higher demand for bonds. This transition between money and bonds will be explained in detail in the following sections.

Individuals hold either cash or bonds. Their decision to hold either money (cash) or bonds is based on the expected return of each. He assumed that the expected return of money was zero since banks paid no interest on deposits as nowadays. But the value of money comes from its high liquidity compared to bonds, in addition to being less risky to hold in the long term. On the other hand, the expected return of bonds is flowing from two sources: the interest payment of the bond and the expected return of capital gains. The capital gains and losses occur when the prices of bonds change from the value at which the individual bought them.

When investors expect the interest rates to fall, they would expect a capital gain since their bonds pay a higher rate than the rates of future bonds. Whereas those who expect the interest rate to rise would expect capital loss and prefer to hold money instead of bonds. Keynes thought that people have a certain level of interest rate they consider as the normal interest rate. So, when the current interest rate is higher than the normal interest rate, individuals would expect a capital gain in the future, and they prefer to hold bonds instead of money. In other words, the high-interest rates would cause lower demand for money, and a higher demand for bonds, and vice versa.

The Keynesian assumption that considers the level of normal interest rate different from an individual to another suggests that the higher is the interest rate, the more are the investors who expect a capital gain, and the more they will demand bonds by giving up money. Whereas the lower is the interest rate, the less are the investors who expect a capital gain, and the less they will hold bonds instead of money. Based on this assumption, Keynes established a negative relationship between money demand and interest rate.

The money supply is considered to be exogenous and controlled by the central bank's policy. So, any increase in the money supply (expansionary monetary policy) will lead individuals to demand more bonds at the current interest rate, which will push the interest rate paid by the suppliers of bonds to go down. This fall in the interest rate will lower the cost of capital for investors, which will influence their decisions to invest more, and also facilitate the consumption of durable goods. Therefore, the investment and consumption increase will lead the output to increase as well. As shown below:

$$\uparrow \mathbf{M} \rightarrow \downarrow \mathbf{r} \rightarrow \uparrow \mathbf{I} + \uparrow \mathbf{C} \rightarrow \uparrow \mathbf{Y}$$

M: money supply. r: the interest rate. I: investment.

C: consumption. Y: aggregate demand.

In contrast to the Keynesian's liquidity preference theory of money demand (LPT), Milton Friedman's quantity theory of money demand (QTM) does not include only money and bonds, people can allocate their wealth also amongst other assets such as equities and real assets (such as durable goods).

$$\frac{M_d}{P} = f(Y^p; r_b - r_m, r_e - r_m; \pi^e - r_m)$$

Y^p = Permanent income (expected average income throughout one's life).

$r_b - r_m$ = Excess return on bonds over money.

$r_e - r_m$ = Excess return on equities over money.

$\pi^e - r_m$ = Excess return on goods over money.

Individuals always aim to maximize their utility, and to do that, they keep reallocating their wealth amongst these assets when the marginal rates of return are not in equilibrium. For example, let's assume that the central bank conducts an expansionary monetary policy, while marginal rates are in equilibrium and wealth is allocated amongst different assets. The expansionary monetary policy will increase individuals' money holding, which makes it lose its marginal rate of return in favor of other assets. The excess money balances will be spent on other assets such as bonds, equities, and real assets (ex: durable goods...). The prices of these assets will increase until the marginal rates of return are in equilibrium again (Snowdon and Vane, 2005, p.167). The excessive demand of these assets will increase the level of aggregate demand and consequently the output and inflation.

In general, Friedman and the monetarists are in favor of a non-interventionist policy (the monetary authorities do not intervene to stabilize the economy). They believe that in the long run, the monetary policy has only an inflationary effect on the economy. They consider the private

sector as stable, and they emphasize the insufficient knowledge we have about the economy to predict the outcomes of such policies. On the other hand, Keynesians believe that such policies are to be used to stabilize the economy and keep it at equilibrium while facing the aggregate demand or supply shocks that may cause prolonged fluctuations to the economy (Froyen, 2013, p. 209).

The change in monetary policy does not stop at affecting the level of output. Instead, it works like a virtuous circle starting from the short-term interest rate moving to affect the long-term interest rate, which is to some extent important due to its influence on the cost of capital. The cost of capital in turn affects the investment and consumption decision-making and consequently the aggregate demand, output (GDP), and inflation (Taylor, 1995). The changes that occurred in GDP and inflation affect the short-run interest rate for the next period since they are amongst the parameters used by the Federal Reserve's reaction function to set the short-term interest rate (As shown in Figure 2-1).

The simple reaction function known as the Taylor Rule is how the monetary authority determines the short-term interest rate is based on reacting to two economic variables: inflation and output. As shown in the following equation:

$$r = \pi + r^t + gy + h(\pi - \pi^*)$$

r = short-term interest rate (policy rate). π = inflation rate.

r^t = real interest rate.

y = percentage deviation from real output.

π^* = inflation targeted rate.

g, h = are coefficients.

Although there is no consensus about the size of these coefficients(g and h), still there are some consensuses about the form of the equation and the signs these coefficients take. Taylor conducted an empirical study that covers the G7 economies and suggested that these coefficients should take the following values where: $g=0.5$, $h=0.5$ (Taylor, 1993). Other scholars' empirical

studies suggest that g should take a higher value near 1 (Brayton, Levin, Tryon, and Williams, 1997).

2.1.2. Empirical Studies on the Interest Rate Channel

This section shows the results of some empirical studies concerning the interest rate channel in Turkey and worldwide.

Butkiewicz and Ozdogan analyzed the MTM in Turkey, they estimated a Vector Autoregressive model in the period between 1996 and 2007 using monthly data. Their results suggest a strong interest rate channel that affects more the price level in the first period (before 2002). Whereas in the second period (after 2002) the effects on the real output were much stronger than the first period, due to the credibility and the independence of the central bank after the monetary reforms (Butkiewicz and Ozdogan, 2009).

Tunç and Kiliç reached similar results while trying to understand the mechanisms of the monetary policy shocks in Turkey. They used a Structural Vector Autoregressive model covering the period spans from 2006 to 2013. They tried to analyze four different shocks: two externals represented by commodity prices and global demand, and two domestic shocks represented by interest rate and risk premium. Their findings indicate that a positive repo rate shock appreciates the domestic currency, decreases the inflation rate and the domestic activity (Tunc and Kilinc, 2014).

Saraç and Ucan investigated the interest rate channel in Turkey using the Kalman Filter approach and the Switching Markov model covering the period between 1990 to 2011. Their results suggest that the performance of the MTM and particularly the interest rate channel has increased after 2002. The increase in performance is due to the adoption of the inflation targeting regime, where price stability became the main objective of the Turkish central bank (Sarac and Ucan, 2013).

Another attempt was by Büyükakın, Bozkurt, and Cengiz who investigated the interest rate channel in Turkey. Their study covered the period between 1990 and 2007 using both Granger Causality and Todo-Yamamoto Causality tests. The results from the Granger Causality test suggest that any change in the interest rate affects investment, inflation, and output. Likewise, the Yodo-Yamamoto Causality test indicates that a change in interest rate affects investment and output as well (Büyükakın, Bozkurt, and Cengiz, 2009).

However, other research on the interest rate channel in Turkey shows that this channel is either not working or partially working (have a temporary effect on the economy):

Both the Vector Autoregressive and the Factor Augmented Vector Autoregressive models (FAVAR) were used to examine the interest rate channel and the exchange rate channel in Mexico and Turkey. The study focused on the period of inflation targeting regime, which is from 2002 to 2014. The extracted results suggest a partially working interest rate channel in turkey and similarly for the exchange rate in Mexico, while the FAVAR suggests a none working interest rate channel nor exchange rate channel for both countries. The sterility of these channels might be a result of many economic factors such as a shallow financial system, a low level of economic openness, and the applied monetary policies (Altay and Atgür, 2017).

Similarly, Erdoğan and Yıldırım applied the Vector Autoregressive model on a sample period that spans from 1995 to 2008. They tried to investigate the existence of an interest rate channel in Turkey. To that end, they split the period into two sub-periods, before and after the reforms (1995-2002 and 2002-2008 respectively). The study show evidence that the interest rate channel worked effectively before the reforms, where the country was applying a Monetarist monetary policy (non-interventionist approach). However, the channel became more effective after the 2002's reforms, due to the central bank independence and its active role in the economy as a guarantor of price stability (Erdoğan, and Yıldırım, 2010).

Another investigation aimed to measure the effectiveness of the Turkish MTM in the period between 2004 and 2013 using a Vector Autoregressive model. The results of the investigation indicate that the interest rate, the credit, and the exchange rate channels are all working. Though the interest rate was working effectively, the exchange rate had higher relative importance. This relative importance is the result of the accelerated global integration of the Turkish economy and

the growing foreign debt of companies and banks, which gives much weight to the exchange rate channel (Turhan and Gumus, 2014).

In terms of foreign empirical studies of the MTM in general and the interest rate channel in particular, a conducted study of the interest rate channel in the Philippines. The study used the Vector Error Correction Model, covering the period spans from 1987 to 2003, quarterly. The findings indicate a significant impact of the interest rate channel on GDP and inflation (Dakila and Jr. Paraso, 2005).

Another attempt aimed to examine the effects of the interest rate in the Romanian financial system. Ailincă applied the Analysis of Variance model using monthly data, in the period span from 2007 to 2014. The results show a negative relationship between the interest rates (interbank and bank's interest rates) and inflation. However, the high correlation of various interest rates made it difficult to determine which of these interest rates is relatively important and most significant (Ailincă, 2016).

In the case of Zambia, a study covered the period of 1980-2011 on an annual basis using a Vector Error Correction model. The findings of this study show a negative relationship between the interest rate and the GDP and inflation (Kalikeka and Sheefani, 2013).

To analyze the interest rate transmission channel in the Visegrad countries (Czech Republic, Slovak Republic, Hungary, and Poland), Mirdala used the Structural Vector Autoregressive model to cover the period of analysis spans from 1999Q1 to 2003Q3. He finds evidence of a negative relationship between the interest rate and inflation in Poland. Meanwhile, a positive interest rate shock affects inflation positively in the Czech Republic, Slovak Republic, and Hungary. This positive relationship is the result of the signal function, where individuals increase their inflation expectations due to the signal of the higher interest rates (Mirdala, 2009).

To investigate the role policy rates, play in affecting both output and inflation in India. Mohanty used the Structural Autoregressive model on quarterly macroeconomic data, for the period span from 1996 to 2011. His results suggest a negative relationship between the interest rate and both inflation and output. The interest rate affects the real GDP with a lag of two quarters,

and inflation with a lag of three quarters, which means that the transmission to GDP is faster than to inflation (Mohanty, 2012).

In Kenya, Gitonga applied the Vector Autoregressive model on quarterly data from 2005 to 2013 to analyze the Kenyan interest rate channel effectiveness. The results show a weak effect of the interest rate channel on both GDP and inflation. The explanation of these results was the excess of liquidity in banks, which is caused by the lack of low-risk lending in the country. That excess of liquidity in the banking system made the financial sector less sensitive to the interest rate changes and so are the output and inflation. (Gitonga, 2015).

Similar to the Kenyan case, the interest rate channel has a low relative impact on the Chinese economy. A Chinese study estimated a Vector Autoregressive model to analyze the interest rate channel covering the period of 1998 to 2008, monthly. The study finds that the money supply is relatively more important than the interest rate channel, denying the belief of a strong traditional interest rate channel. The low relative importance of the interest rate channel is due to the lack of development in the Chinese money market, and the high reliance of the authorities on money supply as a policy tool (Long, Wu, and Zhang, 2010).

It is worth mentioning that the economic sectors can behave differently while reacting to a monetary policy shock. A study conducted by the research department at the central bank of Canada used the Vector Autoregressive model to analyze the transmission mechanisms at both aggregate and sectoral levels in Canada and The United States. The study covered the period spans from 1961 to 1999, quarterly. The findings at the aggregate level show that a contractionary monetary policy leads to a decrease in both output and inflation, which means a negative relationship between the interest rate and both inflation and output. At the sectoral level, the speed, spread, and magnitude of the interest rate channel's impacts vary amongst the sectors. At the level of expenditures, the export reacts quicker than the imports, the investment responds better than consumption, the durable goods reaction is stronger than to the semi-durable goods, whereas the non-durable goods do not respond to the changes in monetary policy at all. At the level of production, the reaction of the construction is faster, while manufacturing is slower but stronger, and the service response is significant (Farès and Srouf, 2001).

2.2. Exchange Rate Channel

2.2.1. Exchange Rate Channel in the Literature

Besides the interest rate channel and the credit channel, the exchange rate plays a significant role as a monetary policy transmission channel, particularly after the world economies' internationalization, where the monetary policy can provoke a change in the price level, imports, and investment by simply affecting the levels of the exchange rate.

For instance, an expansionary monetary policy leads the interest rate to decrease causing an imbalance in the foreign and domestic currencies' deposits, where the domestic currency's deposits become more attractive due to their higher yields compared to the foreign ones. This attractiveness of the domestic currency's deposits will lead to a rise in the domestic currency value (an appreciation). The appreciation in the domestic currency makes the exported goods less attractive by being more expensive, which causes the net export to fall. That will lead to a decrease in the aggregate demand and consequently inflation (Mishkin, 1995).

The exchange rate transmission occurs through two stages: the first stage represents the short-term interest effects on the exchange rate, while the second represents the pass-through from the exchange rate to the imports and domestic prices (Égert and MacDonald, 2006).

To explain the relationship between the Exchange rate and the interest rate (the first stage) we will be using the portfolio balance approach. In this approach money is only one form of the financial assets amongst which individuals set their portfolios. The approach considers the process of equilibrating the demand and supply of financial assets as the determinant of the Exchange rate.

According to the approach, an increase in the money supply causes a direct decrease in the interest rate. The interest rate decrease leads to a portfolio adjustment, where individuals substitute their domestic bonds with money and foreign bonds. This adjustment will cause a depreciation in the domestic currency. The following equations explain how the approach works:

$$W = M + D + FR$$

W = The wealth. M= Money demand.

D= Demand for domestic bonds.

F= Demand for foreign bonds in terms of foreign currency.

R= Exchange rate.

FR= Demand for foreign bonds in terms of domestic currency

The equation (1) could be written as the following equations:

$$\begin{aligned} \text{i.} \quad & M = a(r, r') \cdot W \\ \text{ii.} \quad & D = b(r, r') \cdot W \\ \text{iii.} \quad & RF = c(r, r') \cdot W \\ \text{iv.} \quad & R = \frac{W-M-D}{F} = \frac{W-aW-bW}{F} = (1-a-b) W/F \end{aligned}$$

r = Domestic interest rate

r' = Foreign interest rate

a, b, c = Coefficients relating W to M, D, RF. These coefficients are the function of domestic and foreign interest rates (they change as the foreign and domestic interest rates change)

Money and its coefficient (a) are negatively related to both r and r' , domestic bonds and their coefficient (b) are positively related to r and negatively related to r' , while foreign bonds measured by domestic currency and their coefficient (c) are negatively related to r and positively related to r' .

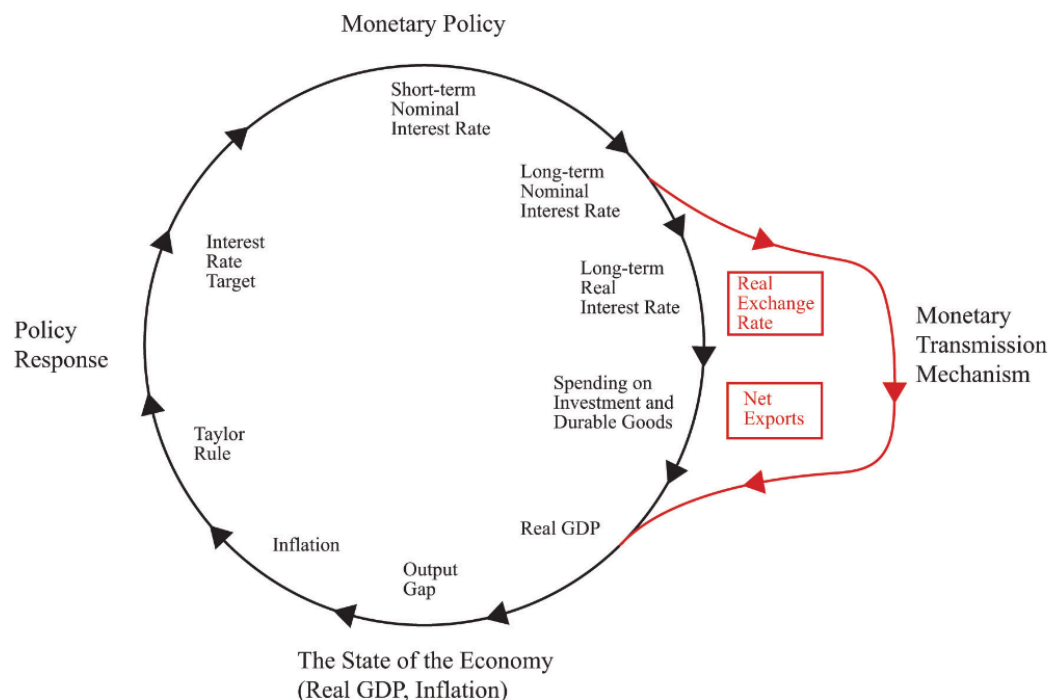
From (iv) we can say that the exchange rate (R) is positively related to wealth and negatively related to a, b, and F. Since exchange rate (R) is negatively related to (b), and the latter is negatively related to (r') and positively related to (r). Then the exchange rate is positively related to the foreign interest rate and negatively related to the domestic interest rate.

The second stage represents the exchange rate pass-through (ERPT), which is the response of imports and domestic prices to the change in the exchange rate. It works at two scales :

- 1- The monetary policy-induced change in the exchange rate will affect the prices of the imported final goods, which will be translated into a change in the prices of the consumer goods.
- 2- The monetary policy-induced change in the exchange rate will alter the prices of the imported intermediary goods, which will affect the cost of production for producers using such goods. The cost effect will be reflected in the prices of the consumed final goods.

Note that the export is also affected by the exchange rate, where a depreciation will cause an increase in the export. This increase will affect the net export positively, which will offset some of the initial depreciation and vice versa.

Figure 2-2: Monetary Policy Transmission Mechanism – The Exchange Rate Channel



Source: Macroeconomics: Theory Through Applications, Andrew John, Russell Cooper, 2012.

The exchange rate pass-through level depends on the macroeconomic conditions, economic environment, and economic conduct. For instance, there is evidence that low inflation is largely associated with low inflation persistence (the long-lasting effects of shocks on inflation). The low inflation persistence affects the firm price adjustment decisions. Under the premise of rational expectations, firms expect less movement in their costs and the prices of competing firms in the future. This will strip the firms' pricing power and make them pass through less of the depreciation in the exchange rate into higher price levels (Taylor, 2000).

In line with Taylor's findings, empirical studies suggested that the pass-through level in emerging markets adopting inflation targeting policy is lower, which is due to the success of these countries to keep the inflation level low and hence a less persistence of inflation (Caselli and Roitman, 2016). The pass-through to the domestic prices was less during and after the 2008 financial crisis in the emerging markets, which is due to the low global inflation (Jasova, Moessner, and Takats, 2019).

The exchange rate changing direction and period could affect the pass-through degree as well. In the long run, the exchange rate depreciation has a higher pass-through than the appreciation. This phenomenon is explained by the public choice theory of rent-seeking (when an individual tries to increase his share of existing wealth instead of creating a new one). Under this theory, exporters exploit the dependency of importers on their products, so they pass through the depreciation to the importer's prices and preserve their mark-ups. Meanwhile, they increase their mark-ups by not allowing the pass-through to the importers' prices in case of an appreciation (Brun-Aguerre, Fuertes, and Greenwood-Nimmo, 2017).

A considerable literature has examined the pricing strategies and their implications on the pass-through. The first strategy is known as the PCP (producer currency pricing). In this strategy, the exporters choose to price products in their currencies, which makes the prices of the importers affected by the exchange rate movements and makes the ERPT level absolute (one). Whereas in the second strategy known as the LCP (local currency pricing), exporters set the prices in the importers' local currencies, which insulates the prices from the exchange rate movements and guarantees a zero ERPT (Égert and MacDonald, 2006).

Conversely, the ERPT is partially working in the OECD countries, which contradicts the PCP absolute ERPT and the LCP zero ERPT arguments. Furthermore, unlike Taylor's findings,

the inflation levels are weakly correlated with the ERPT in these countries. In other words, low levels of inflation are not sufficient enough to make the ERPT decline. Meanwhile, the changes in the composition of the import bundles have a substantial influence on the ERPT. The pass-through to the energy and the raw material prices is close to one and less than one (partial) when it comes to the prices of the food and the manufacturing products (Campa and Goldberg, 2002).

2.2.2. Empirical Studies on the Exchange rate Channel

After the 2001 banking crisis in Turkey, the Turkish central bank conducted a set of reforms to stabilize the prices and stimulate the economy such as adopting the inflation targeting regime and switching from the fixed to the float exchange rate regime. As a result of these changes, the exchange rate channel started playing a substantial role in the economy relative to the pre-crisis period.

In an attempt to investigate the importance of the exchange rate, a study used the Vector Autoregressive model covering the period between 1987:01 to 2009:05. The study split this period into two sub-periods: During the crawling peg exchange rate regime (from 1987:01 to 2001:12), and after the adoption of float exchange rate and inflation targeting regimes (from 2001:12 to 2009:05). The results suggest that the adoption of the crawling peg exchange rate regime boosts the ERPT to inflation. However, the ERPT diminishes after adopting the inflation targeting due to the low levels of inflation. Moreover, the ERPT of depreciation was higher than that of appreciation, which made the exchange rate the main channel fuelling inflation in Turkey (Civcir and Akçağlayan, 2010).

Investigating the impacts of policy instruments on the intermediate targets such as the control of the growth of credit supply and the short-term capital inflows, and the effects of the latter on the price stability in Turkey, Incekara and Amanov covered the period from 2010:11 to 2017:08 using the Johansen cointegration test, the Vector Error Correction Model, and the Granger causality test. Amongst the results, they found a positive relationship between the exchange rate and inflation in the short and long terms, where an increase of 10% in the USD exchange rate leads

to an increase of 1.4% in CPI because of the rise in the prices of imported goods. The policy instrument was found not to affect the exchange rate in the long run (Incekara and Amanov, 2018).

Another investigation of the Turkish monetary transmission mechanisms used the Vector Autoregressive model to cover the period from 2005 to 2017. The investigation results indicate a significant role of the exchange rate channel in transmitting the monetary policy to the real sector, but the transmission to inflation is relatively weak (Okur, Akkuş, & Durmaz, 2019).

Turhan and Gümüş found Similar results when analyzing the relative importance of the monetary transmission mechanism channels in Turkey. They covered the period between 2003 and 2014 using the Vector Autoregressive model. Their key finding is that the exchange rate channel is the most important channel transmitting the monetary policy effects to the real economy. This high importance is due to the high volatility in the exchange rate, which is the result of the unorthodox tools used by the Turkish central bank to sustain financial stability (Turhan and Gümüş, 2014).

At the foreign level, a study tried to determine whether globalization has changed the relative importance of the monetary policy transmission channels in Brazil, Chile, and Korea or not. In this study, they used a Structural Vector Autoregressive model for the period starting from the year of the inflation targeting adoption in each country and ending in 2009:12. The results show the relative importance of both the exchange rate channel and the share price channel over the interest rate channel and the credit channel in these countries. This relative importance is due to globalization and international trade development (Tahir, 2009).

In Vietnam Hung and Pfau examined the monetary transmission mechanisms using a Vector Autoregressive model for the period between 1996:2Q and 2005:4Q. Their results suggest that the exchange rate channel along with the credit channel are the most effective channels in terms of transmitting the monetary policy effects to output and inflation, while the interest rate channel is weaker in the transmission process due to the late interest rate liberalization in Vietnam — Central bank gives the commercial banks some freedom in pricing their loans and deposits — (Le & Pfau, 2009).

In Pakistan, a study used the Vector Autoregressive model to analyze the monetary transmission mechanisms for the period between 1996:07 and 2004:03. The study concludes that the exchange rate plays a less significant role in transmitting the monetary policy to the real economy, which is due to the slow price adjustment in the country (Agha, Ahmed, Mubarik, & Shah, 2005).

A different approach was used to investigate the effects of the monetary policy transmission mechanisms in Nigeria. The study analyzed these effects at a sectoral level rather than the aggregate one. It employed a Vector Autoregressive model for the years 1986:Q1-2009:Q4. The findings suggest that the exchange rate is the most effective channel in transmitting the monetary policy to the building, construction, mining, services, wholesale, and retail sectors. While its effects are weak relative to the interest rate in sectors such as agriculture and manufacturing (Philip, Ifeakachukwu, & Olufemi, 2011).

2.3. Credit Channel

2.3.1. Credit Channel in the Literature

Some scholars undermined the belief in a strong traditional channel, they emphasize a weak effect of the cost of capital on the components of aggregate demand. Instead, they introduced what is called “The Credit Channel”. According to Ben S. Bernanke, this channel might explain the shortcomings in the analysis of the MTM. Though they undermined the notion of a sole strong traditional channel of interest, they did not consider the credit channel as an independent. They considered it as a complementary mechanism that propagates the effects of the traditional channel of interest rate (Bernanke and Gertler, 1995).

The reliance solely on the traditional channel (interest rate channel) gave a rise to a bunch of shortcomings and gaps in the analysis of the monetary transmission mechanisms and their effects on the economy. According to Bernanke and Gertler, these shortcomings could be summarized as:

- A- Timing: Most of the components of spending such as the fixed investment react to an unanticipated monetary policy after the end of the interest rate effects, which makes it hard to determine the effects of interest rate on spending empirically.
- B- Magnitude: The effects on the real economy are proportionally larger than the cost of capital effects on spending components. This means that the traditional channel does not explain the whole effect on the economy.
- C- Composition: Most of the monetary policy's effects are on short-term rates which are supposed to affect short-life assets. However, the effects of the monetary policy are on long-life assets, mostly residential investments.

According to the advocates of the Credit view, the monetary policy affects not only the interest rate but also the external finance premium (EFP) — the difference between the cost that the borrower is going to bear by raising his funds externally and the opportunity cost of raising it internally— which could explain better the gaps in the analysis of MTM. To understand this EFP well, we need to explain the mechanisms with which the monetary policy affects this external finance premium (the balance sheet channel and the bank lending channel). These mechanisms will be discussed in the sections below.

2.3.1.1. The Balance Sheet Channel:

The monetary policy can affect the lending process not just through the interest rate but also through the external finance premium which depends heavily on the firm's financial positions (balance sheet). The more are the firm's financial positions the lower is the external finance premium since it can use these positions to guarantee more collateral for its credit, or it can finance a big share of its investment internally without relying on external credit. The monetary policy could affect the balance sheet in two ways, direct and indirect way:

- Directly: a tight monetary policy causes an increase in the short-term interest rates. The increase in short-term rates affects interest expenses of the firms' short-term debts, on which they rely to finance their inventories. This leads to a reduction in the cash flow of these firms and weakens their balance sheets, which will increase their external finance premium and decrease their ability to borrow. This will result in less investment and less output, as shown below:

$$\downarrow \mathbf{M} \rightarrow \uparrow \mathbf{r} \rightarrow \downarrow \mathbf{Cash\ flow} \rightarrow \uparrow \mathbf{EFP} \rightarrow \downarrow \mathbf{Lending} \rightarrow \downarrow \mathbf{I} \rightarrow \downarrow \mathbf{Y}$$

$\mathbf{M}$ = Money supply.

$\mathbf{r}$ = Interest rate.

$\mathbf{I}$ = Investment.

$\mathbf{Y}$ = Output.

The tight monetary policy can also cause a decline in the value of the firms' assets, which are usually used as collateral for their external funds. In other words, it increases the external finance premium and decreases the ability of firms to borrow, the latter diminishes the investment and the output, as shown in this schematic:

$$\downarrow \mathbf{M} \rightarrow \downarrow \mathbf{P}_e \rightarrow \uparrow \mathbf{EFP} \rightarrow \downarrow \mathbf{Lending} \rightarrow \downarrow \mathbf{I} \rightarrow \downarrow \mathbf{Y}$$

$\mathbf{P}_e$ = Firms' assets prices.

- Indirectly: a tight monetary policy affects the consumers spending negatively, which in turn reduces the firms' revenues and financial positions, elevating their external finance premium and making the borrowing process harder for them. The decrease in lending will cause investment and consequently output decrease. as in the following schematic:

$$\downarrow \mathbf{M} \rightarrow \uparrow \mathbf{r} \rightarrow \downarrow \mathbf{C} \rightarrow \downarrow \mathbf{Net\ worth} \rightarrow \uparrow \mathbf{EFP} \rightarrow \downarrow \mathbf{Lending} \rightarrow \downarrow \mathbf{I} \rightarrow \downarrow \mathbf{Y}$$

$\mathbf{C}$ = Consumption.

In both cases (direct and indirect ways) the change in the firm's financial positions leads to a change in the external finance premium. In conclusion, a change in the lending caused by the EFP affects investment and spending, which affects the output and consequently the prices.

2.3.1.2. The Bank Lending Channel:

The bank lending channel works mainly through commercial banks, which are considered as the main source of intermediate credit for some typical kinds of borrowers such as small and medium-sized firms (SMEs) due to their inability to access the credit market. In such environments where banks and SMEs are involved, the problems of moral hazard and asymmetric information arise. Thus, any disruption in the lending process will lead eventually to causing some losses to these firms (Mishkin, 1995).

For instance, a contractionary monetary policy will decrease the banks' core deposits and reserves, which will result in an inward shift in the banks' loans. That will make the borrowing firms incur some losses due to being shut off credit or bearing costs of searching for new sources of credit. Therefore, the investments will decrease causing the output to decrease as well. The summary will be shown in the schematic below:

$$\downarrow M \rightarrow \downarrow \text{bank deposits and reserves} \rightarrow \downarrow \text{bank loans} \rightarrow \downarrow I \rightarrow \downarrow Y$$

However, scholars failed to empirically identify the separate impacts of the bank lending channel and the balance sheet channel, since both banks' and firms' decisions about credit and their balance sheets are affected by changes in the monetary policy. However, the identification of a general credit channel is empirically feasible rather than identifying each separately (Bernanke and Gertler, 1995).

In addition to the standard credit channel which works through the balance sheet and the lending channel, several papers are emphasizing other conduits for the credit channel such as the trade channel and the bank capital channel.

2.3.1.3. The Trade Channel:

The trade channel is defined as the delayed payments amongst traders, in other words, it is an agreement between the buyer and the seller to purchase goods and pay at a later scheduled time. Normally this kind of credit is more expansive than the ordinary bank credit, but in the contractionary monetary policy periods, this credit becomes more stable and cheaper than banks'

credit, which makes it a potential substitute to the bank credit and affects the credit channel as a whole.

2.3.1.4. The Bank Capital Channel:

Bank's capital plays a decisive role in determining the volume of loans to be supplied, given banks capital requirement — the amount of capital the banks are required to keep aside to keep itself solvent in times of crisis or unanticipated losses — In contractionary periods, the financing becomes more expansive because banks pay higher interest for deposits meanwhile their assets remain the same due to the mismatch maturity. Therefore, they lower their loans to remain above the legal minimum capital requirement.

2.3.2. Empirical Studies on the Credit Channel

This section summarizes some empirical studies concerning the credit channel in Turkey and worldwide.

In an attempt to investigate the role of banks in the monetary transmission mechanisms in Turkey, a study analyzed the impacts of monetary policy changes on banks' loan supply before and after the 2001 crisis. They utilized a dynamic panel data technique (Dynamic Generalized method of moments) using a set of microeconomic data to cover the period of 1988-2009. The results suggest a much stronger bank lending channel after 2001 due to the reforms that followed 2001's crisis, the bank characteristics such as the earnings capability, the size, the liquidity, the capitalization, the quality of the assets, and the managerial efficiency affect the way lending channel responds to monetary policies (Ozsuca and Akbostanci, 2012).

Another analysis on the role of the credit channel in the transmission mechanisms of monetary policy used a multivariate threshold autoregressive model to cover the period from 1986:01 to 2009:10. The results of the analysis indicate a less effective credit channel compared to the interest rate channel, especially in the low inflation regime (Catik and Karaçuka, 2011).

Mercan and Canbay examined the credit channel in Brazil, Indonesia, India, South Africa, and Turkey using a Panel Granger Causality model covering the period between 2001:1Q and 2019:Q4. The results imply that the interest rate granger causes the credit volume, and the latter granger causes inflation. At the same time, there is no causal relationship between the growth and the credit channel, which makes this channel fragile and working partially in these five economies. This fragility is due to some structural problems such as uncertainties, fiscal dominance, assets and liabilities dollarization, and high ERPT (Mercan and Canbay, 2020).

Another way to investigate the trade credit channel in Turkey was to analyze its effects at a micro-level, where a study applied a panel data fixed effect model on a large data set of corporate firms to analyze such effects in the period of 1996:2008. The results indicate that the small firms cling to the trade credits especially in tight monetary policy periods due to the access constraints to bank loans. Whereas large firms rely more on bank loans even when the monetary policy is tightened. The type of firm can also affect its access to bank loans when conditions are tightened. The manufacturing export-oriented firms tend to have fewer constraints accessing the bank loans compared to manufacturing domestic-oriented firms and non-manufacturing firms both domestic and export-oriented (Özlü and Yalçın, 2010).

At the foreign level, in Eritrea, a study used a Vector Autoregressive Model between 1996-2001 to investigate the monetary transmission mechanisms. The results show that the credit channel works effectively through the credit given to the government. Moreover, the reserve requirement ratio is the most effective policy tool to affect inflation but not the output (Mangesha and Holmes, 2013).

Another study of the credit channel is of Austria, where it used both the Vector Error Correction model and Granger Causality tests covering the period spanning from 1983:12 to 2000:09. The study findings suggest that the real sector is overly sensitive to the credit channel specifically to the lending channel due to the high reliance of Austrian firms on bank credits rather than other financial resources (Krylova, 2002).

To evaluate the importance of the credit channel in the Tunisian economy, a study used a Vector Autoregressive model to cover the period between 1965 and 2015. The results of this study

show that the credit channel works effectively and affects both inflation and output (Ali and Moheddine, 2017).

Based on the results extracted from a Structural Vector Autoregressive Model, the Nigerian monetary policy credit channel was ineffective in the period between 1986:01 and 2006:04. This infectivity is due to the high liquidity and liability management in Nigerian banks (Ogun and Akinlo 2010).



CHAPTER 3

AN EMPIRICAL ANALYSIS OF THE MONETARY TRANSMISSION MECHANISMS

An extensive part of the literature gave importance to the aggregate relationship between the monetary policy transmission mechanisms and inflation. However, few emphasized the sectorial relationship amongst them, where sectors are found to behave distinctively to the same monetary policy shock. The transmission channels worked in some sectors and not in others, the fact that will give the policymaker a better understanding of the implication of his policies, increase the policies accuracy and preserve the economy from the unwanted consequences.

In this study, both short-run and long-run relationships between sectorial inflation and the monetary policy's transmission channels are investigated. The examined transmission channels are interest rate, exchange rate, and credit. To investigate such a relationship, an econometric study is conducted using time series data for each sector. The study relied on the Autoregressive distributed lag (ARDL) model's bound test, to assess the presence of a long-run relationship amongst time series that are integrated at various levels such as $I(0)$ and $I(1)$. After that, an Error Correction Model (ECM) is applied to capture both short and long-term effects of the transmission mechanisms on sectorial inflation.

In the sections below, the data selection is analyzed and explained, the methodology is described in detail. Then, the necessary tests are applied, the models and the diagnostics are realized, and the results are explicated and interpreted.

3.1. Data

In this study, we used data that describes the real economic activities, inflation, policy instruments, and transmission channels. The study data covers the period from 2008Q1 to 2021Q2, which is extracted from the central bank data central (EVDS). The (1-14 days) weighted average repo rate is used as a representative for both the policy rate and the interest rate channel. The real effective exchange rate based on the consumer price index is used as a measure of the impact of

the exchange rate channel since it measures the relative strength of the Turkish lira in comparison with Turkey's trading partners' currencies by taking into consideration the trade volume. The loans quantity is used as a proxy for the credit channel (the lending channel) since it is hard to measure the effect of the balance sheet channel.

In terms of sectorial data (output and Inflation), we classify the sectors based on the high-level aggregation (A10) of the second revision of the Statistical classification of economic activities in the European Community (NACE Rev2).

Table 3-1: The High-Level Aggregation (A10) of the NACE Rev2

	Description
1	Agriculture, forestry, and fishing.
2	Manufacturing, mining, and quarrying, and other industry.
3	Construction.
4	Wholesale and retail trade, transportation and storage, accommodation, and food service activities.
5	Information and communication.
6	Financial and insurance activities.
7	Real estate activities.
8	Professional, scientific, technical, administration, and support service activities.
9	Public administration, defense, education, human health, and social work activities.
10	Other services.

Source: Eurostat 2008.

In the study, the GDP in current prices for each A10's sector is used to represent the sectorial output. Whereas the unavailability of the consumer price index under such disaggregation led to the use of GDP deflator instead as a proxy for inflation. The GDP deflator is calculated by using the current price GDP and the chained weighted GDP, which is similar to the real GDP. In the agriculture, forestry, and fishing sector's GDP, we find a seasonal pattern in the data, which is adjusted by using the additive moving average method.

Table 3-2: Selected Variables for Monetary Policy, Transmission Channels, and Sectorial GDP and Inflation

<i>AGGREGATE DATA</i>		<i>Description</i>	<i>Description</i>
RR		1 – 14 Days weighted average repo rate	EVDS
REER		Real effective exchange rate based on CPI	EVDS
LOANS		Loans quantity level	EVDS
<i>SECTORIAL DATA</i>			
<i>Inflation</i>	<i>GDP</i>		
<i>AGRIDEF</i>	<i>AGRI</i>	Agriculture, forestry, and fishing.	EVDS
<i>MFCTDEF</i>	<i>MFCT</i>	Manufacturing, mining, and quarrying, and other industry.	EVDS
<i>CONSTDEF</i>	<i>CONST</i>	Construction.	EVDS
<i>TRDDEF</i>	<i>TRD</i>	Wholesale and retail trade, transportation and storage, accommodation, and food service activities.	EVDS
<i>INCODEF</i>	<i>INCO</i>	Information and communication.	EVDS
<i>FIAREF</i>	<i>FIA</i>	Financial and insurance activities.	EVDS
<i>REESTDEF</i>	<i>REEST</i>	Real estate activities.	EVDS
<i>PSTASDEF</i>	<i>PASTAS</i>	Professional, scientific, technical, administration, and support service activities.	EVDS
<i>ADEHSDEF</i>	<i>ADEHS</i>	Public administration, defense, education, human health, and social work activities.	EVDS
<i>OSERVDEF</i>	<i>OSERV</i>	Other services.	EVDS

3.2. Methodology

The first stage in our empirical study is to check for stationarity, which is one of the most important concepts of time series data. The stationarity suggests that the time series properties (mean and variance) do not change over time and the covariance value between two observations depends on the range between these two observations and not the time itself (Gujarati, Porter, 2009, p. 740-744). These assumptions are indispensable since the regression models for non-stationary variables give spurious results and using the tests and econometric tools (t-test, central limit theorem ...) for such kind of series will not be possible (Granger and Newbold, 1974). Due to the importance of stationarity unit root tests are often applied to check for it.

To understand where the unit root tests are derived from, let us simply assume time series of $Y(t)$:

$$Y(t) = \phi Y(t-1) + \varepsilon(t) \quad \dots (1)$$

$$\text{Var}(Y(t)) = \phi^2 \text{Var}(Y(t-1)) + \text{Var}(\varepsilon(t))$$

To have stationary series, the Variance must be constant over time; Therefore, the following must hold:

$$\text{Var}(Y(t)) = \text{Var}(Y(t-1))$$

So :

$$\text{Var}(Y(t)) = \phi^2 \text{Var}(Y(t)) + \sigma^2$$

$$(1-\phi^2) \cdot \text{Var}(Y(t)) = \sigma^2$$

$$\text{Var}(Y(t)) = \frac{\sigma^2}{1-\phi^2}$$

In the case where the $\phi = 1$ (the unit root case), the variance value goes to infinite levels, which means the time series is not stationary. In the case where $\phi > 1$, then the variance is negative which has no real economic meaning. The last case is $\phi < 1$, where the time series has a finite constant variance.

To achieve the unit root tests equation form, the equation (1) will be re-written this way:

$$Y(t) - Y(t-1) = \phi Y(t-1) - Y(t-1) + \varepsilon(t)$$

$$\Delta Y(t) = (\phi - 1).Y(t-1) + \varepsilon(t)$$

$$\Delta Y(t) = \rho.Y(t-1) + \varepsilon(t) \quad \dots (2)$$

Testing the presence of a unit root requires running a simple regression of the equation (2) with a null hypothesis of $\rho = 0$ and an alternative hypothesis of $\rho < 0$. However, under the null hypothesis that implies that our series is non-stationary, using the t-test is not a choice since the central limit theorem does not apply for the non-stationary series. The solution for that is to compare the t-statistics we get from our regression to a Dickey-Fuller distribution. Since ρ should be negative for our series to be stationary, then the t-statistics should be less than the Dickey-Fuller distribution critical value.

After understanding the unit root test origin and solutions, we are going to examine its importance for our case. Briefly, the importance of the stationarity test is to make sure that our variables are not of order beyond $I(1)$ since it is not compatible with the ARDL model. To that end, the Augmented Dickey-Fuller (ADF) test is used.

The ADF was developed by David A. Dickey and Wayne A. Fuller in 1981. It is a unit root test that allows testing for the unit roots in the presence of serially correlated error terms by including the lagged values of the dependent variable in the test equation. The number of the lagged values included is raised until the error term in that equation becomes serially uncorrelated (Gujarati and Porter, 2009, p. 754-760).

The augmented Dickey-Fuller test estimates an improved version of the equation (2), as shown below:

$$\Delta Y(t) = \rho.Y(t-1) + \sum_{i=1}^n a(i). \Delta Y(t-i) + \varepsilon(t)$$

Where $\sum_{i=1}^n a(i). \Delta Y(t-i)$ represents the sum of lagged differences added so that the error term $\varepsilon(t)$ becomes serially uncorrelated. It is worth mentioning that our time series can have an intercept and a trend that might affect the stationarity test, and which can be included in the unit root tests.

$$\Delta Y(t) = \alpha + \beta \text{Trend} + \rho.Y(t-1) + \sum_{i=1}^n a(i). \Delta Y(t-i) + \varepsilon(t)$$

Since the data is integrated at distinct orders such as $I(0)$ and $I(1)$, the use of ordinary cointegration tests to establish long-term relationships becomes impossible. In this case, The ARDL bounds testing approach is the alternative for a long-run analysis. It makes it possible to test for cointegration between variables that are integrated at distinct orders but not beyond $I(1)$ (Parasan and Shin, 1998).

The generalized ARDL(p, q, r, s, u) models of the sectorial inflation is as follow:

$$\begin{aligned} \Delta \text{AGRIDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h. \Delta \text{AGRIDEF}(t-h) + \sum_{i=0}^q \sigma_i. \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i. \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i. \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i. \Delta \text{AGRI}(t-i) + \left(\omega_1. \text{AGRIDEF}(t-i) + \omega_2. \text{RR}(t-i) + \right. \\ & \left. \omega_3. \text{REER}(t-i) + \omega_4. \text{LOANS}(t-i) + \omega_5. \text{AGRI}(t-i) \right) + \varepsilon(t) \end{aligned}$$

$$\begin{aligned} \Delta \text{MFCTDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h. \Delta \text{MFCTDEF}(t-h) + \sum_{i=0}^q \sigma_i. \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i. \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i. \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i. \Delta \text{AGRI}(t-i) + \left(\omega_1. \text{MFCTDEF}(t-i) + \omega_2. \text{RR}(t-i) + \right. \\ & \left. \omega_3. \text{REER}(t-i) + \omega_4. \text{LOANS}(t-i) + \omega_5. \text{MFCT}(t-i) \right) + \varepsilon(t) \end{aligned}$$

$$\begin{aligned} \Delta \text{CONSTDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h. \Delta \text{CONSTDEF}(t-h) + \sum_{i=0}^q \sigma_i. \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i. \Delta \text{REER}(t-i) \\ & + \sum_{i=0}^s \phi_i. \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i. \Delta \text{AGRI}(t-i) + \left(\omega_1. \text{CONSTDEF}(t-i) + \omega_2. \text{RR}(t-i) + \right. \\ & \left. \omega_3. \text{REER}(t-i) + \omega_4. \text{LOANS}(t-i) + \omega_5. \text{CONST}(t-i) \right) + \varepsilon(t) \end{aligned}$$

$$\begin{aligned}\Delta \text{TRDDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{TRDDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{TRDDEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{TRD}(t-i) \right) + \varepsilon(t)\end{aligned}$$

$$\begin{aligned}\Delta \text{INCODEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{INCODEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{INCODEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{INCO}(t-i) \right) + \varepsilon(t)\end{aligned}$$

$$\begin{aligned}\Delta \text{FIADEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{FIADEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{FIADEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{FIA}(t-i) \right) + \varepsilon(t)\end{aligned}$$

$$\begin{aligned}\Delta \text{REESTDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{REESTDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{REESTDEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{REEST}(t-i) \right) + \varepsilon(t)\end{aligned}$$

$$\begin{aligned}\Delta \text{PSTASDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{PSTASDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{PASTASDEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{PASTAS}(t-i) \right) + \varepsilon(t)\end{aligned}$$

$$\begin{aligned}\Delta \text{ADEHSDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{ADEHSDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) \\ & + \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{ADEHSDEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{ADEHS}(t-i) \right) + \varepsilon(t)\end{aligned}$$

$$\begin{aligned}\Delta \text{OSERVDEF}(t) = & \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{OSERVDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\ & \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \left(\omega_1 \cdot \text{OSERVDEF}(t-i) + \omega_2 \cdot \text{RR}(t-i) + \right. \\ & \left. \omega_3 \cdot \text{REER}(t-i) + \omega_4 \cdot \text{LOANS}(t-i) + \omega_5 \cdot \text{OSERV}(t-i) \right) + \varepsilon(t)\end{aligned}$$

In terms of numbers of lags (p, q, r, s, u), the Schwarz criterion information is known to be a consistent model lags selection criterion especially for small samples (Lütkepohl, 2007, p.151-157). In addition to its superiority with the ARDL model over the ARDL-AIC (Parasan and Shin, 1998).

In the model's equations, the first part (before the brackets) represents the short-run dynamics. Whereas the second part (between brackets) represents long-run dynamics. The first step after defining the general structure of the ARDL model is to run the bounds testing approach for each equation. The bounds approach estimates an Ordinary Least Squares to run an F-test for the joint significance of the $\omega_{1,2,3...i}$ coefficients, which allows determining the existence of a long-run relationship.

The test takes H_0 as the null hypothesis suggesting the absence of long-run relationship, and H_1 as the alternative hypothesis:

$$H_0: \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = 0.$$

$$H_1: \omega_1 \neq \omega_2 \neq \omega_3 \neq \omega_4 \neq \omega_5 \neq 0.$$

The bounds testing approach provides two critical values $I(0)$ and $I(1)$, to which the F-statistics is compared. If the value of F-statistics is above the $I(1)$ we reject the null hypothesis (H_0); In other words, we confirm the existence of a long-run relationship. If it is below $I(0)$ we fail to reject the null hypothesis (H_0), which implies the absence of a long-run relationship. The last case is when the F-statistics is between the $I(0)$ and $I(1)$, in such a case, the result suggests that the existence of a long-run relationship is inconclusive and therefore analyzing the long-run relationships will not be possible. In the presence of a long-run relationship, the CUSUM test is applied to check for coefficients constancy. In other words, it is a model stability test.

The ECM model can be reached through a linear transformation of the ARDL model (Banerjee et Al, 1993, p46-68). The ECM model captures both short-run and long-run dynamics. The general ECM models for sectorial inflation are as follow:

$$\Delta \text{AGRIDEF}(t) = \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{AGRIDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t)$$

$$\Delta \text{MFCTDEF}(t) = \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{MFCTDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t)$$

$$\begin{aligned}
\Delta \text{CONSTDEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{CONSTDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) \\
&\quad + \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{TRDDEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{TRDDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\
&\quad \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{INCODEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{INCODEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\
&\quad \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{FIADEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{FIADEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\
&\quad \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{REESTDEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{REESTDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\
&\quad \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{PSTASDEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{PSTASDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\
&\quad \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{ADEHSDEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{ADEHSDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) \\
&\quad + \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t) \\
\Delta \text{OSERVDEF}(t) &= \alpha + \sum_{h=1}^p \beta_h \cdot \Delta \text{OSERVDEF}(t-h) + \sum_{i=0}^q \sigma_i \cdot \Delta \text{RR}(t-i) + \sum_{i=0}^r \partial_i \cdot \Delta \text{REER}(t-i) + \\
&\quad \sum_{i=0}^s \phi_i \cdot \Delta \text{LOANS}(t-i) + \sum_{i=0}^u \gamma_i \cdot \Delta \text{AGRI}(t-i) + \lambda \text{ECT} + \varepsilon(t)
\end{aligned}$$

Where λ represents the adjustment speed; In other words, the speed at which the short-run equilibrium converges towards the long-run equilibrium path. The speed of adjustment coefficient takes a negative value where $-1 > \lambda > 0$. The error correction term ECT on the other hand represents the long-run equation error term $v(t)$ or simply the difference between the long-run dependent variable and the independent variables.

3.2.1. The Unit Root Test

It is important to determine the order of integration before applying the ARDL model. Since implementing such a model requires time series that are not beyond the first order of integration .i.e. $I(1)$. To this end, the ADF test is applied to all the time series to be included in our model. The characteristics of the ADF test (intercept, trend, and breaking points) were determined

graphically and included for each test. The used series are logarithmically transformed, due to their exponentially incremental nature.

Table 3-3: Augmented Dickey-Fuller Test Results

		Augmented Dickey fuller	
Variable		I(0)	I(1)
Transmission Channels	RR	-3.5026**	-
	REER	-5.9456***	-
	LOANS	-0.9581	-5.5314***
Sectorial GDP	AGRI	-1.557583	-10.24915***
	MFCT	-3.5303**	-
	CONST	-1.7727	-2.9765**
	TRD	-6.6727***	-
	INCO	-8.1652***	-
	FIA	-5.2510***	-
	REEST	0.8401	-7.1788***
	PASTAS	-0.7867	-2.9807**
	ADEHS	-0.0757	-8.1070***
	OSERV	-5.1811**	-
Sectorial GDP Deflator	AGRIDEF	-1.0788	-12.8739***
	MFCTDEF	2.3754	-5.5028***
	CONSTDEF	-4.8886***	-
	TRDDEF	1.6187	-8.2205***
	INCDEF	2.2560	-14.7881***
	FIADef	-0.3486	-11.3842***
	REESTDEF	1.2086	-8.9715***
	PSTASDEF	2.0244	-4.7914***
	ADEHSDEF	1.7044	-2.9628**
	OSERVDEF	0.2403	-9.9352***

*Denotes significance at 10% level, ** denotes significance at 5% level, and *** denotes significance at 1% level.

As shown in Table 3-3, the data time series are integrated at different levels but not beyond the I(1), which allows the implementation of the ARDL bounds test. Therefore, the ARDL bounds test is applicable to test for cointegration.

3.2.2. The ARDL Bounds Test

The ADF test results allowed the use of the ARDL bounds test for cointegration to establish the long-run relationships between sectorial inflation on one hand and the sectoral GDP, the interest rate, the exchange rate, and the loans on the other hand. The table below summarizes the test results:

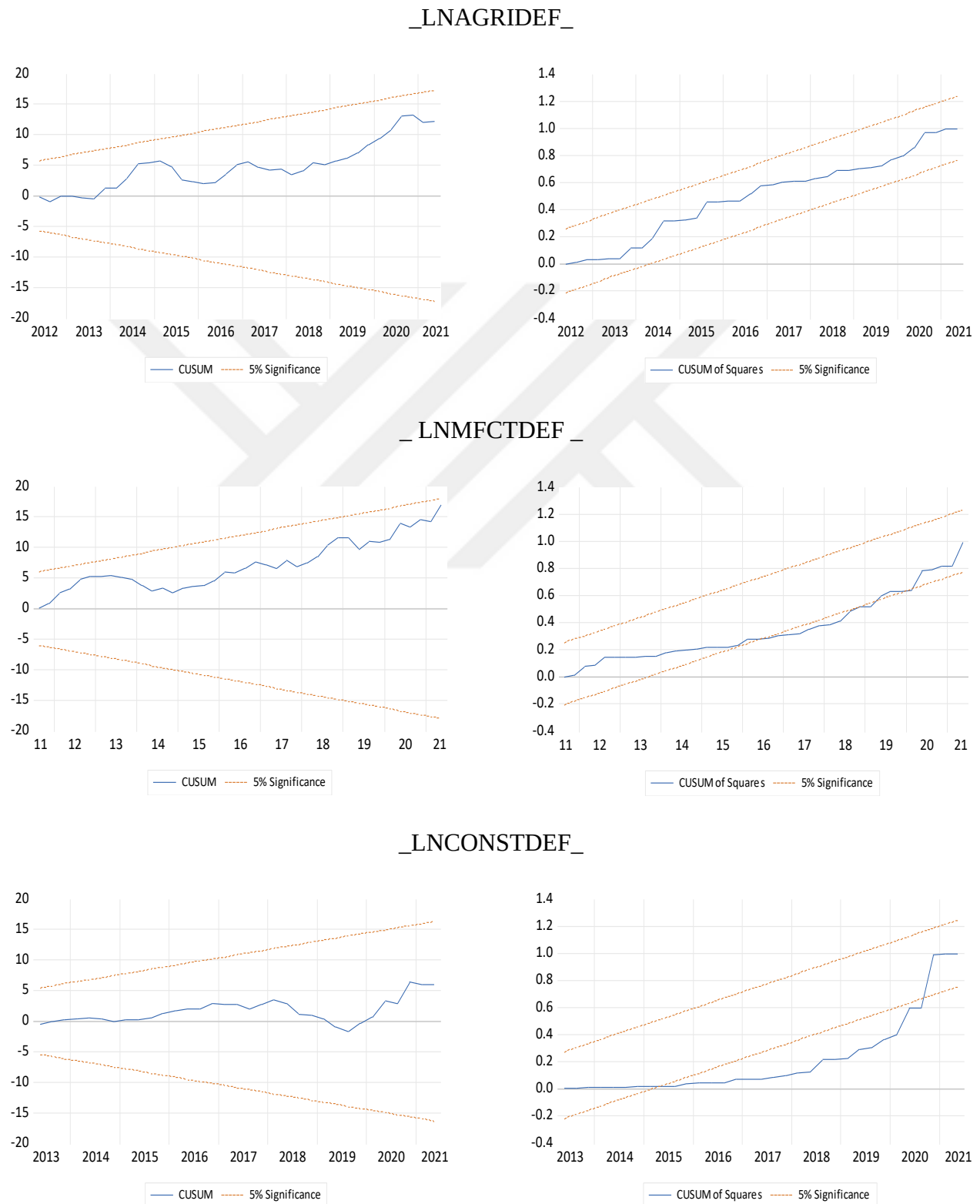
Table 3-4: The ARDL Bounds Test Results

Models	bound test							ARDL order
	f-statistics	1%		5%		10%		
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
LNAGRIDEF	5.7908***	3.74	5.06	2.86	4.01	2.45	3.52	(4,0,0,0,4)
LNMFCTDEF	15.6261***							(1,1,0,3,1)
LNCONSTDEF	8.1293***							(4,0,0,4,4)
LNTRDDEF	12.2139***							(4,2,0,1,0)
LNINCODEF	12.6029***							(4,2,2,0,0)
LNFIADDEF	18.5183***							(3,0,0,0,0)
LNREESTDEF	8.7059***							(1,0,1,0,0)
LNPSTASDEF	4.3553**							(1,1,2,0,1)
LNADEHSDEF	15.0581***							(4,0,0,0,0)
LNOSERVDEF	12.8010***							(2,0,0,0,1)

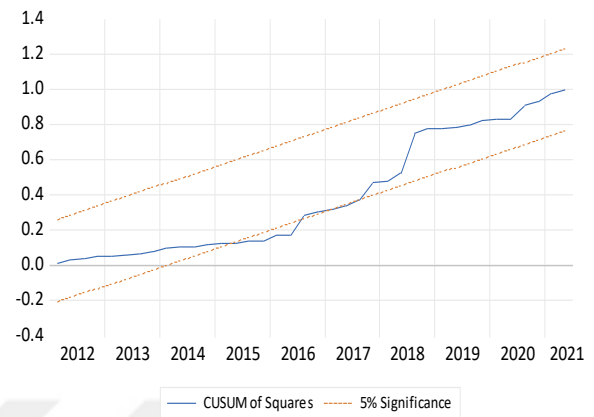
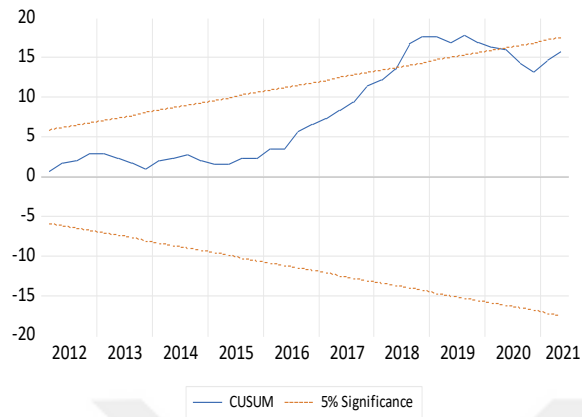
*Denotes significance at 10% level, ** denotes significance at 5% level, and *** denotes significance at 1% level. The ARDL order is selected based on the Schwarz information criteria. The significance level values are for a model with an intercept.

Since the F-statistics is greater than the I(1) at a 5% significance level for all the economic sectors, we can conclude that there is a cointegration amongst the variables at a 5% significance level in all of the tested models. After the bound test, it is important to check for the model stability using the CUSUM and CUSUM squared tests, the absence of auto-correlation using the LM test, and the absence of heteroscedasticity using the Breusch Pagan Godfrey test.

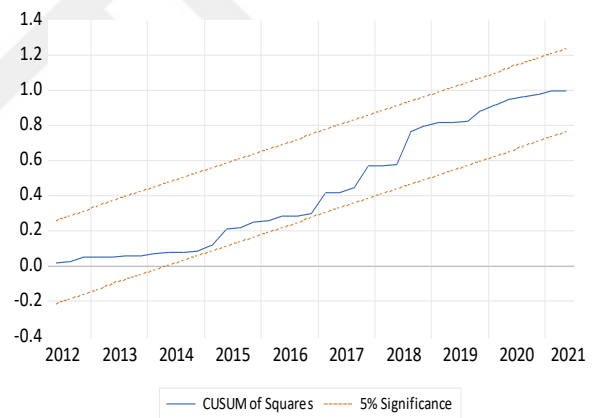
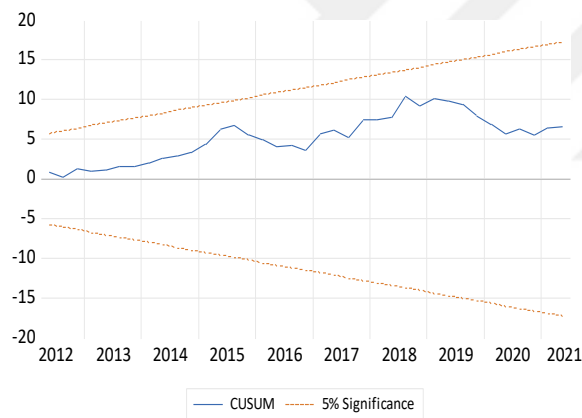
Figure 3-1: CUSUM and CUSUM of Squares Stability Tests



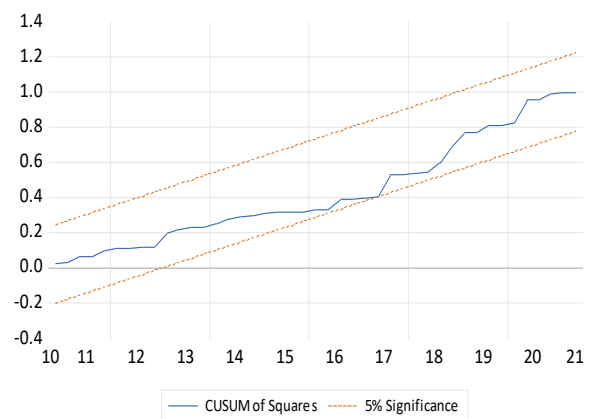
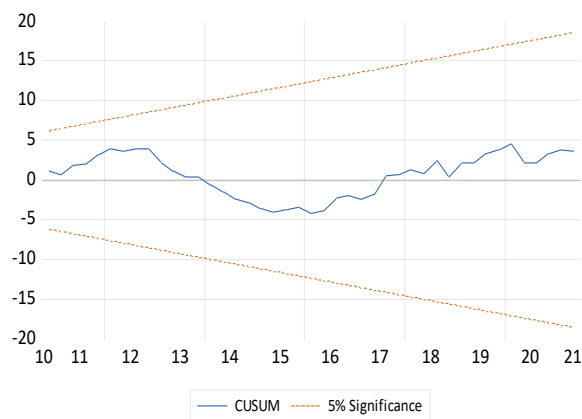
LNTRDDEF



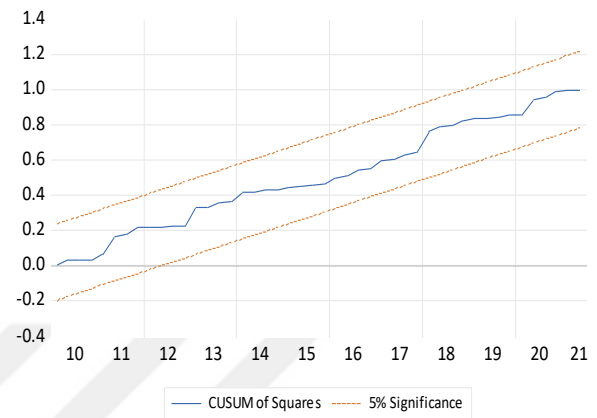
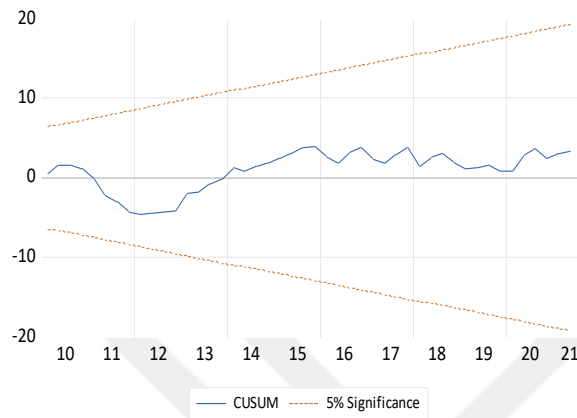
LNINCODEF



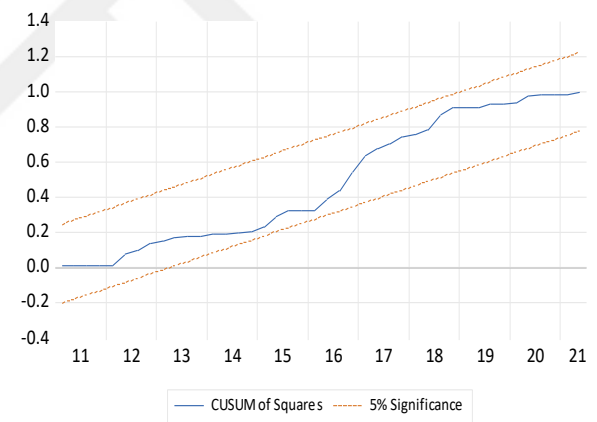
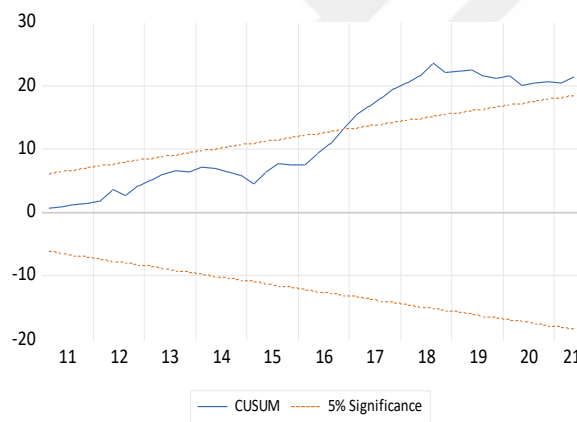
LNFIADDEF



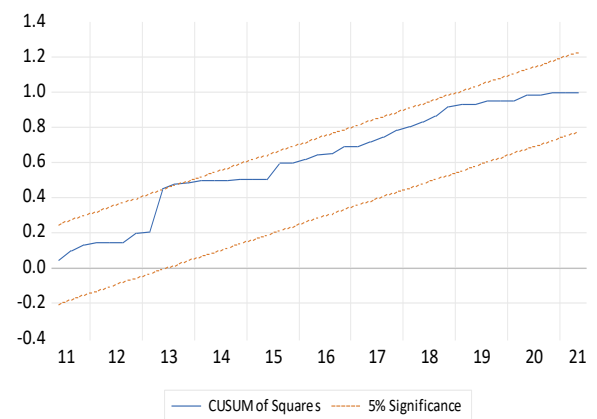
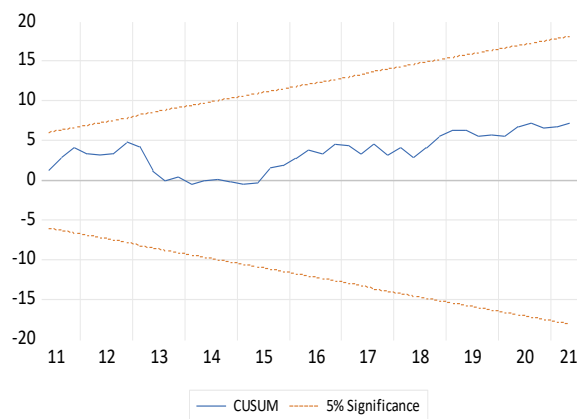
LNREESTDEF

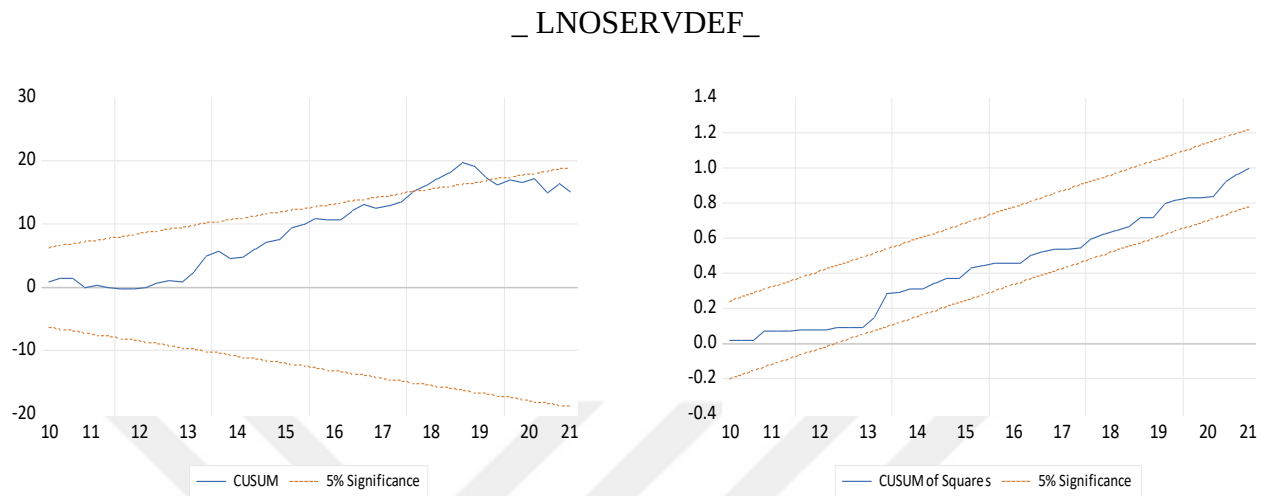


LNPSTASDEF



LNADEHSDEF





From figure 3-1, we can see that 4 models out of 10 are stable. The stable models are the LNAGRIDEF, LNINCODEF, LNFIADDEF, and LNREESTDEF since they are laying within the significance borderline in both the CUSUM and CUSUM of squares tests. Whereas the other 6 models are not stable. We can see different breaking points at different times in each of the 6 models. The table below summarizes the breaking points in each model.

Table 3-5: The Breaking Points in the CUSUM and CUSUM of Squares Tests

	CUSUM	CUSUM of Squares
LNMFCTDEF	-	2016Q3
LNCONSTDEF	-	Multiple
LNTRDDEF	2018Q1	2015Q2
LNPSTASDEF	2016Q4	-
LNADDEHSDEF	-	2013Q2
LNOSERVDEF	2018Q1	-

To stabilize the models, dummy variables are required at each breaking point. Therefore, we will re-run the bounds tests using these dummies for the unstable models.

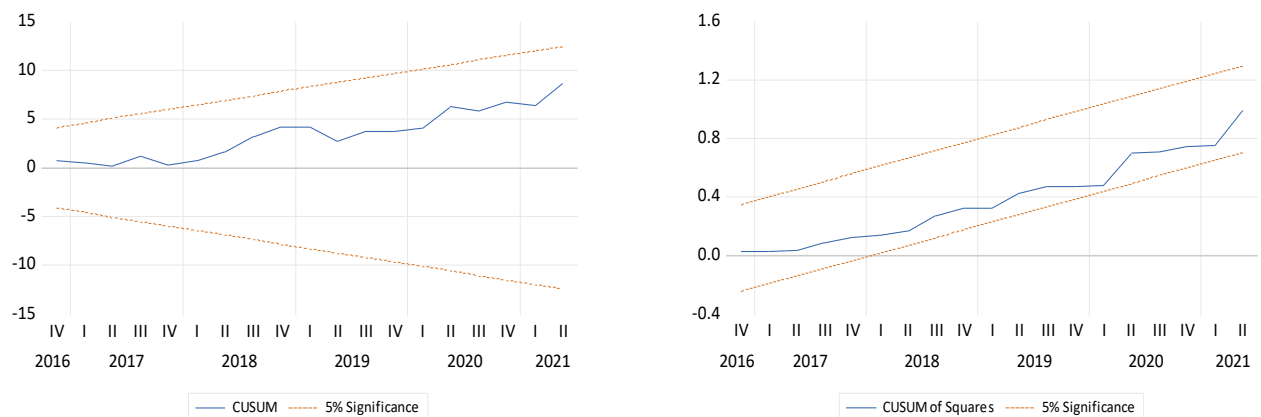
Table 3-6: The ARDL Bounds Test (2) Results

Models	bound test							ARDL order
	f-statistics	1%		5%		10%		
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
LNAGRIDEF	5.7908***	3.74	5.06	2.86	4.01	2.45	3.52	(4,0,0,0,4)
LNMFACTDEF	15.3203***							(1,1,0,3,1)
LNCONSTDEF	5.7871***							(6,6,0,3,6)
LNTRDDEF	15.6440***							(4,0,4,1,4)
LNINCODEF	12.6029***							(4,2,2,0,0)
LNFIADDEF	18.5183***							(3,0,0,0,0)
LNREESTDEF	8.7059***							(1,0,1,0,0)
LNPSTASDEF	11.6443***							(2,1,1,3,0)
LNADEHSDEF	12.9128***							(4,0,0,0,1)
LNOSERVDEF	11.9822***							(2,0,0,0,1)

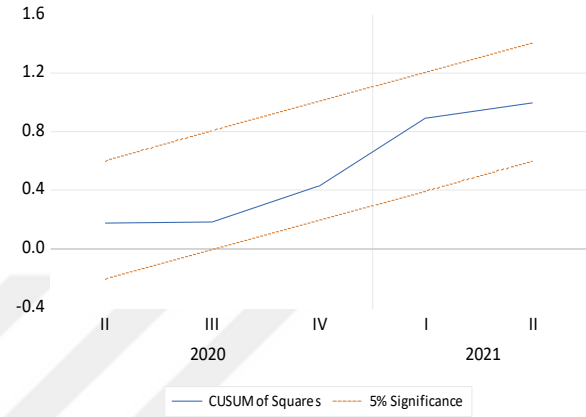
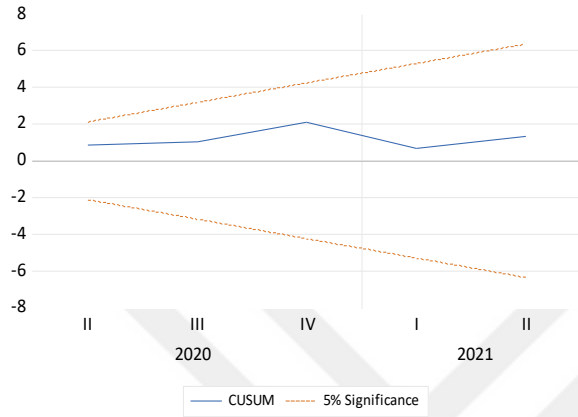
*Denotes significance at 10% level, ** denotes significance at 5% level, and *** denotes significance at 1% level. The ARDL order is selected based on the Schwarz information criteria. The significance level values are for a model with an intercept.

Figure 3-2: Diagnosed Models' CUSUM and CUSUM of Squares Stability Tests

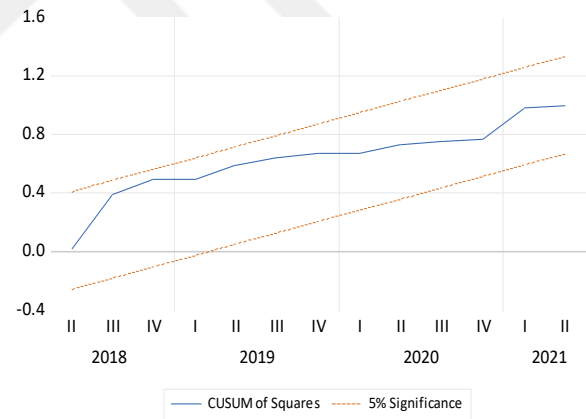
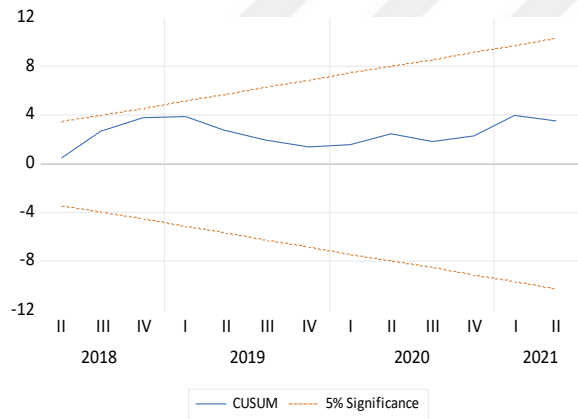
LNMFCDEF



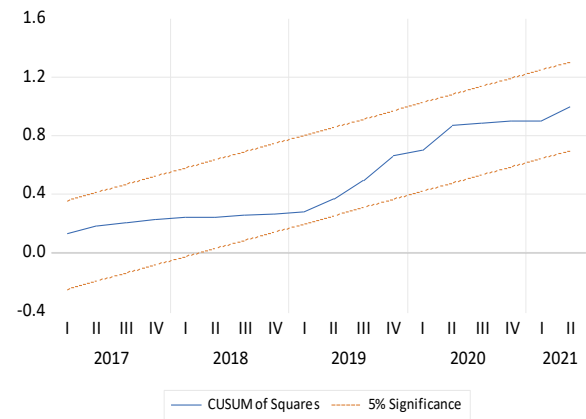
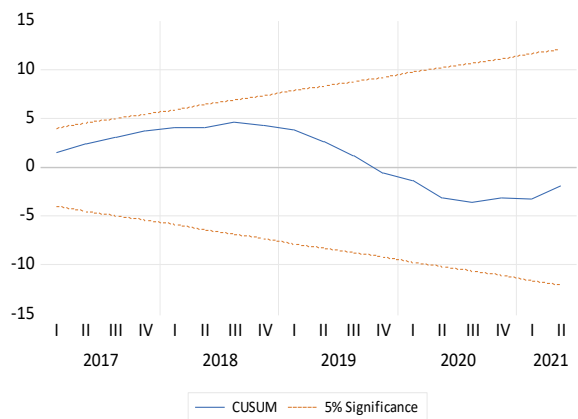
LNCONSTDEF



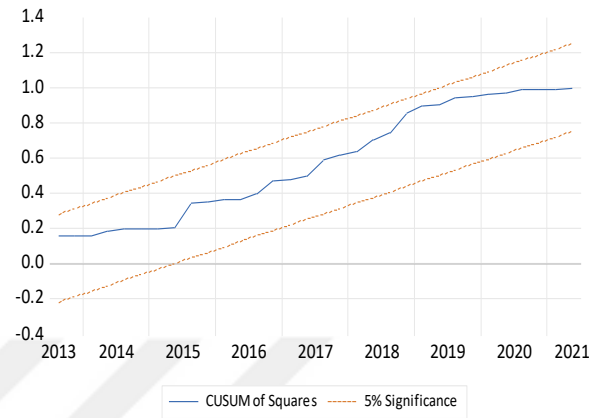
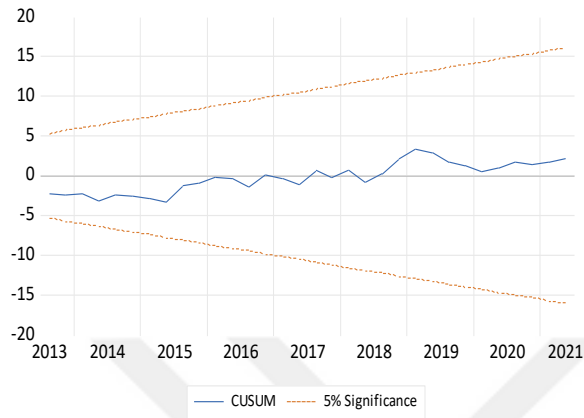
LNTRDDEF



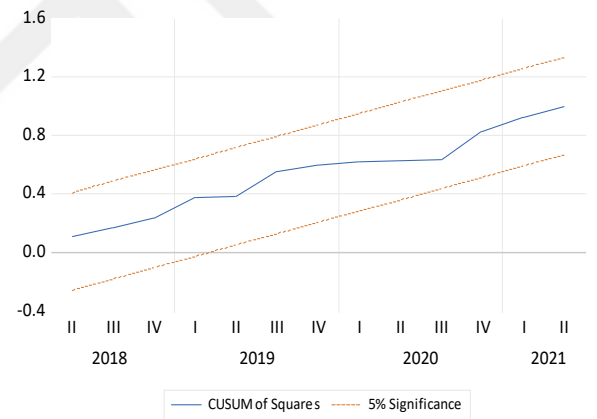
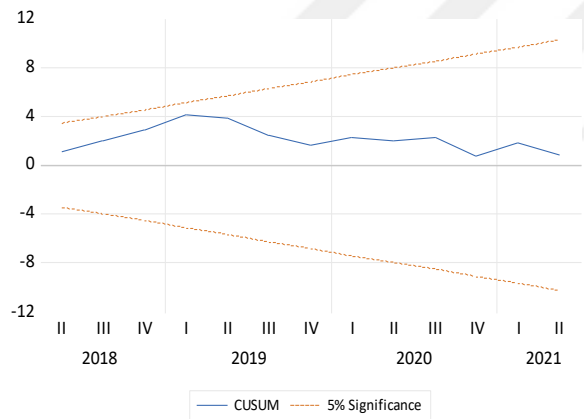
LNPASTASDEF



_ LNADEHSDEF _



_ LNOSERVDEF _



From figure 3-2, we can see that the tests' results emphasize the constancy of the coefficients, which means that the unstable models became stable by adding dummy variables. After confirming the stability of the coefficients and consequently the model, testing the residuals for both autocorrelation and heteroscedasticity is necessary to evaluate the model's assumptions.

From Table 3-7, we can see that all the probability values are above the 5% significance level. Thus, we failed to reject the null hypothesis in all the tests, which means that all the models residuals have no autocorrelation nor heteroscedasticity.

Table 3-7: Heteroscedasticity and Autocorrelation Tests

Models	Breusch Pagan Godfrey test		LM test	
	Null Hypothesis: Homoskedasticity		No Serial Correlation	
	F-statistic	Probability	F-statistic	Probability
LNAGRIDEF	0.4891	0.9081	1.2350	0.3151
LNMFCTDEF	1.0676	0.4108	2.1260	0.1530
LNCONSTDEF	0.9323	0.5762	1.0007	0.4377
LNTRDDEF	0.6221	0.8593	0.0020	0.9643
LNINCODEF	0.8993	0.5560	1.5397	0.2135
LNFIADDEF	0.6644	0.7006	1.4692	0.2420
LNREESTDEF	1.7533	0.1301	3.3884	0.0723
LNPNSTASDEF	1.9738	0.0554	3.3728	0.0612
LNADHSDEF	0.4828	0.8909	0.8075	0.3745
LNOSERVDEF	1.3883	0.2289	0.0500	0.8240

The autocorrelation LM test lags are specified using the Schwarz information criteria.

3.2.3. The Error Correction Model

The results of table 3-8 indicate that the only significant coefficient in the LNAGRIDEF model is the LNAGRI (the agriculture's GDP). So in the long run, the only variable affecting the inflation in the agriculture, forestry, and fishing sector is the GDP of the sector itself. The sector's inflation is affected positively by its GDP, where a 1 per cent increase in the GDP leads to a 0.97 per cent increase in the inflation of the sector. Theoretically speaking, the increase in production raises the income levels and consequently fuels the demand and leads the prices to increase. In general, an increase in the GDP leads to a faster increase in demand compared to the increase in production, which pushes the firms to increase their prices. A decrease in loans by 1 per cent

increases inflation by 0.11 per cent, which is due to the increased costs that firms will bear because of being shut off credit or while trying to find new sources of credit.

Table 3-8: The long-run Equation of the LNAGRIDEF.

LNAGRIDEF: COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.1251	1.1724	0.1741
LNREER	0.1632	0.7003	0.3558
LNLOANS**	-0.1111	-1.8442	0.0309
LNAGRI***	0.9753	6.7617	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-9: The Error Correction Equation of the LNAGRIDEF

LNAGRIDEF ECM REGRESSION			
Variables	Coefficient	t-Statistic	Probability
C	-5.9723	-5.6561	0.0000
D(LNAGRIDEF(-1))***	-0.6147	-7.1623	0.0000
D(LNAGRIDEF(-2))***	-0.6913	-9.9145	0.0000
D(LNAGRIDEF(-3))***	-0.8030	-16.5155	0.0000
D(LNAGRI)***	0.5879	11.5414	0.0000
D(LNAGRI(-1))**	0.2174	2.0167	0.0510
D(LNAGRI(-2))***	0.3586	3.9631	0.0003
D(LNAGRI(-3))***	0.4232	6.1434	0.0000
CointEq(-1)***	-0.5706	-5.6643	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

As shown in Table 3-9, in the short run the previous increases in the sector's inflation affect the current inflation negatively, where a 1 per cent increase in the prices in previous periods leads to a 2.11 per cent decrease in the current inflation. Whereas the increase in production in previous periods affects the current inflation positively, where a 1 per cent increase in the production causes a 1.59 increase in the current prices in the short run. The error correction term (CointEq(-1)) is negative and significant with the value of -0.5706, which means that the short-run converges towards the long-run at an adjustment speed of 57.06% per period (quarter). In other words, the deviations caused by short-run shocks decrease by 57.06% each period, but the permanent shocks converge slowly to a value that is higher than the long-run equilibrium.

Table 3-10 shows that the LNLOANS (the credit channel), LNREER (the exchange rate channel), and LNMFCCT (output) coefficients are significant in the long run, whereas the LNRR (the interest rate channel) is not significant. Thus, we can say that the loans and the real effective exchange rate affect the manufacturing, mining, quarrying, and other industry negatively in the long run, where a 1 per cent appreciation in the Turkish lira leads to a 0.79 per cent decrease in the sector's inflation. The appreciation in the currency lowers the prices of the intermediate goods used in the manufacturing sectors which will cause a decrease in the prices of the sector. Likewise, a 1 per cent decrease in loans levels causes a 0.24 per cent increase in the sector's inflation. This is due to the costs that arise either from being shut off credit or searching for a new credit source, which can charge higher rates, all this together will push the prices up in the sector. The sector's GDP affects its inflation positively in the long run, where a 1 per cent increase in the sector's GDP equals a 0.75 per cent increase in the sector's inflation. The increase in GDP fuels the demand, which makes firms' supply unable to keep up with demand and push the prices upward.

Table 3-10: The long-run Equation of the LNMFCCTDEF

LNMFCCTDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.0639	1.3819	0.1749
LNREER***	-0.7993	-4.063	0.0002
LNLOANS***	-0.2391	-2.7319	0.0094
LNMFCCT***	0.7530	5.3865	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-11: The Error Correction Equation of the LNMFCCTDEF

LNMFCCTDEF ECM REGRESSION			
Variables	Coefficient	t-Statistic	Probability
C***	-0.1023	-6.8981	0.0000
D(LNRR)***	0.0613	3.4389	0.0014
D(LNLOANS)***	0.3109	4.5802	0.0000
D(LNLOANS(-1))***	0.3548	4.8428	0.0000
D(LNLOANS(-2))***	-0.2898	-3.9495	0.0003
D(LNMFCCT)***	0.0762	2.9210	0.0058
DUMMYMFCCTDEF	0.0117	0.7071	0.4837
CointEq(-1)***	-0.2667	-9.1901	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the LNMFCTDEF model, the interest rate channel affects the current inflation positively in the short run, where a 1 per cent increase leads to a 0.06 per cent increase in the current inflation. This can be explained by the price puzzle, where the monetary policy responds to an increase in future inflation by increasing the interest rate, however, this increase is not enough to prevent inflation increase (Sims, 1992). Likewise, the loans are affecting the sector's prices positively in the short run, where a 1 per cent increase in loans leads to a 0.38 per cent increase in the sector's inflation. In the short run, the loans affect the consumption levels positively and consequently the demand and prices. The GDP effects are similar to its long-run effects but at a lower degree (0.07 per cent). The error correction term (CointEq(-1)) is negative, significant, and equals -0.2667, which means that the short-run converges towards the long-run equilibrium. The speed of convergence from the short-run to the long-run is relatively slow, where the short-run adjusts only by 26.67% each quarter towards its long-run equilibrium (table 3-11). The short-run shocks last longer in this sector compared to the agriculture sector for example.

Table 3-12: The long-run Equation of the LNCONSTDEF

LNCONSTDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.0950	1.716	0.1024
LNREER	-0.1808	-1.2078	0.2419
LNLOANS	0.0298	0.3423	0.7359
LNCONST***	0.4676	4.2944	0.0004

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the long run, the only variable that affects the construction sector's inflation is its GDP. Where a 1 per cent increase in the sector's GDP is reflected as a 0.47 per cent increase in its inflation. Whereas the other variable such as the loans (the credit channel), the real effective exchange rate (the exchange rate channel), and the interest rate (the interest rate channel) have no effect in the long run (Table 3-12).

Table 3-13: The Error Correction Equation of the LNCONSTDEF

LNCONSTDEF ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	-3.0254	-5.9414	0.0000
D(LNCONSTDEF(-1))	-0.0182	-0.1254	0.9014
D(LNCONSTDEF(-2))***	0.4312	3.134	0.0055
D(LNCONSTDEF(-3))	-0.0085	-0.0457	0.9640
D(LNCONSTDEF(-4))***	1.3326	7.9028	0.0000

D(LNCONSTDEF(-5))**	0.6580	2.8273	0.0108
D(LNRR)***	-0.1678	-3.4367	0.0028
D(LNRR(-1))**	-0.1340	-2.1523	0.0444
D(LNRR(-2))***	-0.1477	-3.2924	0.0038
D(LNRR(-3))	0.0050	0.095	0.9252
D(LNRR(-4))***	-0.1429	-2.9019	0.0091
D(LNRR(-5))**	-0.1474	-2.8472	0.0103
D(LNLOANS)	0.3861	1.7285	0.1001
D(LNLOANS(-1))	-0.3402	-1.4511	0.1630
D(LNLOANS(-2))	0.4843	1.9209	0.0699
D(LNCONST)***	0.4287	6.491	0.0000
D(LNCONST(-1))	-0.0779	-0.8274	0.4189
D(LNCONST(-2))	-0.1159	-1.4556	0.1618
D(LNCONST(-3))	0.0476	0.7256	0.4769
D(LNCONST(-4))***	-0.30001	-4.2591	0.0004
D(LNCONST(-5))**	-0.1668	-2.1196	0.0474
DUMMYCONSTDEF	0.0306	0.9341	0.3619
DUMMYCONSTDEF02	-0.0546	-1.1394	0.2687
DUMMYCONSTDEF03**	-0.1182	-2.493	0.0221
CointEq(-1)***	-0.9593	-5.9183	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the construction sector's short-run equation, we can observe the phenomena of inflation persistence, where a one-time shock persists for longer periods. The inflation rate of previous periods affects the current inflation rate positively where a 1 per cent shock to the inflation in previous periods leads to a 2.42 per cent increase in inflation in the current period. In the short, the interest rate is found to be an effective counter to the inflation in this sector, where a 1 per cent increase leads to a 0.74 per cent decrease in inflation. This decrease is due to the consumers preferring to increase their savings instead of buying services of this sector and also the high cost that stands as a barrier for borrowers to consume. On the other hand, the GDP has a negative effect of 0.04 on inflation for every 1 per cent increase in GDP in the short run. The explanation for that might be that such production does not require a long time to increase supply compared to sectors such as manufacturing or agriculture, however in the long run the demand would outpace the supply. Therefore the increase in supply may exceed the demand in the short run, and matched with the high competitiveness in such sector in Turkey, all together would lead to a decrease in the prices of the sector in the short run. The LNCONSTDEF error correction term (CointEq(-1)) is negative, significant, and equals to -0.9593. So the short-run shocks adjust to the long-run

equilibrium at a speed of 95.93% per quarter, which means that the short-run deviation lasts less than 2 quarters before fading out towards the long-run equilibrium (table 3-13).

The results of table 3-14 suggest that the exchange rate channel represented by LNREER is the only channel that influences the wholesale and retail trade, transportation and storage, accommodation, and food service activities in the long run. The 1 per cent appreciation in the Turkish lira leads to a 1.4 per cent decrease in the sector's inflation. Generally, this sector has some dependence on imports, so any increase in the value of the domestic currency will lead to a decrease in the prices in such sectors. Note that transportation is not solely related to the exchange rate, but the oil prices as well. The interest rate channel represented by LNRR, the credit channel represented by LNLOANS, and the output represented by the sector's GDP (LNTRD) are not significant. That means that these channels along with the output have no effect on the inflation in this sector in the long run.

Table 3-14: The long-run Equation of the LNTRDDEF

LNTRDDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.0928	1.5001	0.1441
LNREER***	-1.4205	-4.3014	0.0002
LNLOANS	0.2413	1.5198	0.139
LNTRD	-0.0468	-0.1569	0.8764

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-15: The Error Correction Equation of the LNTRDDEF

LNTRDDEF ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	1.8296	9.4692	0.0000
D(LNTRDDEF(-1))	-0.1968	-1.9759	0.0574
D(LNTRDDEF(-2))***	-0.4251	-4.2013	0.0002
D(LNTRDDEF(-3))	-0.1561	-1.9601	0.0593
D(LNREER)**	-0.1239	-2.5828	0.0149
D(LNREER(-1))***	0.1588	3.9149	0.0050
D(LNREER(-2))***	0.0822	2.1768	0.0375
D(LNREER(-3))***	0.1373	3.6869	0.0009

D(LNLOANS)***	0.3857	3.9951	0.0004
D(LNTRD)	0.0439	1.7407	0.0920
D(LNTRD(-1))***	0.0919	3.5757	0.0012
D(LNTRD(-2))***	0.0741	3.1349	0.0038
D(LNTRD(-3))***	0.0943	3.9066	0.0005
DUMMYTRDDEF	-0.0071	-0.5612	0.5788
DUMMYTRDDEF02	-0.0246	-1.9096	0.0658
CointEq(-1)***	-0.2538	-9.4153	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

The previous periods' inflation affects the current inflation negatively by 0.79 for each one per cent increase. Whereas the inflation in the sector is affected positively by the exchange rate, where a 1 per cent increase in exchange rate results in a 0.38 per cent increase in inflation. It is also affected by 0.39 per cent for every 1 per cent increase in the loans, which is due to the increase in consumption and aggregate demand. The GDP has a positive effect on the sector's inflation due to the faster increase in aggregate demand compared to aggregate supply. The error correction term (CointEq(-1)) is negative (-0.2538) and significant, which means that the short-run part of the model converges towards the long-run equilibrium at a rate of 25.38% per quarter (table 3-15).

In the sector of information and communication, it is found that the three transmission channels of interest rate, credit, and exchange rate are working effectively in the long run. An increase of interest rate by 1 per cent increases the sector's inflation by 0.17 per cent, which is due to the increase in the cost of capital that resulted from the interest rate positive shock. The inflation of the sector has a negative relationship with the exchange rate, where a 1 per cent appreciation leads to a 0.91 decrease in the inflation level. This negative relationship is due to the outsourcing of intermediate goods and services in this sector (import) and the general pricing behavior that uses the dollar as a pricing basis to cover external debt obligations or preserve wealth. Loans affect the inflation level of the sector positively since it stimulates consumption which will push the aggregate demand up and consequently the inflation (table 3-16).

Table 3-16: The long-run Equation of the LNINCODEF

LNINCODEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR**	0.1788	2.3375	0.0249
LNREER***	-0.9106	-3.4779	0.0013
LNLOANS***	0.3602	3.7823	0.0006
LNINCO	-0.1923	-1.1886	0.2422

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-17: The Error Correction Equation of the LNINCODEF

LNINCO ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	0.8026	8.6829	0.0000
D(LNINCODEF(-1))***	-0.5749	-7.0151	0.0000
D(LNINCODEF(-2))**	-0.2455	-2.4528	0.0190
D(LNINCODEF(-3))***	-0.4512	-5.7087	0.0000
D(LNRR)***	0.0646	4.5456	0.0001
D(LNRR(-1))***	-0.0567	-3.6442	0.0008
D(LNREER)**	-0.0723	-2.4251	0.0203
D(LNREER(-1))***	0.2109	6.4633	0.0000
CointEq(-1)***	-0.1739	-8.3562	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the short run, the previous periods' inflation has a negative effect of 1.27 per cent on the current inflation rate, whereas the interest rate has a positive effect of 0.06 per cent on inflation, and likewise is the exchange rate with an effect of 0.14 per cent. The error correction term is negative with a value of 0.1739 and significant. That means the short-run deviation from the long run adjust towards the equilibrium with a constant speed of 17.39 per cent each period (table 3-17).

In the sector of Finance and insurance activities, a depreciation of the domestic currency by 1 per cent leads to an increase in the sector's inflation by 0.39 per cent (table 3-18). That might be because of the external debts, where firms need to price according to foreign currencies such as the US dollars to be able to meet their external obligations. Similarly, an increase in loans by 1 per cent will decrease the sector's inflation by 0.21 per cent since it is an essential element of the sector's supply. However, an increase in the GDP of the sector will lead inflation to decrease like the other sectors.

Table 3-18: The long-run Equation of the LNFIADDEF

LNFIADDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.0418	1.099	0.2779
LNREER**	-0.3938	-2.5244	0.0154
LNLOANS***	-0.2144	-4.0175	0.0002
LNFIADDEF***	0.6131	7.1896	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-19: The Error Correction Equation of the LNFIADDEF

LNFIADDEF ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	0.5576	10.4033	0.0000
D(LNFIADDEF(-1))	-0.0118	-0.1291	0.8978
D(LNFIADDEF(-2))***	0.2341	2.7834	0.0080
CointEq(-1)***	-0.7544	-10.0601	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the short run, the previous periods' inflation has a positive effect of 0.22 per cent on the current inflation (table 3-19). However, it fades out so fast to the long-run equilibrium since the error correction term is equal to -0.7544. In other words, it takes less than two quarters for the short-run shock to fade out due to the high speed of adjustment (75.44 per cent per quarter).

In the sector of real estate activities, the interest rate and the exchange rate channels have no effect on inflation in the long run, whereas the credit channel and output affect inflation in opposite directions. Loans affect inflation negatively in the long run, where a 1 per cent decrease in loans leads to a 0.11 per cent increase in inflation. In contrast, a 1 per cent increase in GDP leads to a 0.91 per cent increase in inflation (table 3-20).

Table 3-20: The long-run Equation of the LNREESTDEF

LNREESTDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.0072	1.0037	0.3208
LNREER	-0.0477	-1.3056	0.1982
LNLOANS***	-0.1124	-5.7606	0.0000
LNREEST***	0.9061	18.0550	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-21: The Error Correction Equation of the LNREESTDEF

LNREESTDEF ECM REGRESSION			
Variables	Coefficient	t-Statistic	Probability
C***	-6.478478	-6.8596	0.0000
D(LNREER)***	-0.0686	-2.7221	0.0091
CointEq(-1)***	-0.765	-6.8786	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the short run, the exchange rate affects the inflation in this sector negatively, which is due to the change in prices of imported intermediate goods used in the construction of the houses. In addition, the pricing behavior adopts the dollar as a pricing basis due to several reasons such as covering the external debts of the sector's operating firms. However, the speed of adjustment of inflation towards the long run is 76.5 per cent which is quite high (table 3-21).

In the sector of professional, scientific, technical, administration, and support service activities, the exchange rate channel plays a decisive role in the long run followed by the credit channel, while the interest rate channel and the output are found to have no effect. A depreciation of 1 per cent in the Turkish lira leads to a 1.79 per cent increase in the sector's inflation, this can be due to two factors. The first is the pricing behavior where individuals use the US dollar as a pricing basis, which might be due to external debts, maximizing profits, or preserving wealth. The second is the more expansive imported goods and outsourced services. In contrast, the loans have a positive effect on the sector's inflation, where a 1 per cent increase in the level of loans leads to a 0.47 per cent increase in the sector's inflation. This positive relationship is the result of the impact loans have on consumption. The increase in loans means more credit for consumers and consequently a higher aggregate demand and inflation (table 3-22).

Table 3-22: The long-run Equation of the LNPASTASDEF

LNPASTASDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.2022	1.5775	0.1230
LNREER***	-1.7941	-3.2591	0.0024
LNLOANS**	0.4710	2.2702	0.0290
LNPASTAS	-0.4406	-1.3610	0.1815

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-23: The Error Correction Equation of the LNPASTASDEF

LNPASTASDEF ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	0.9975	8.3920	0.0000
D(LNPASTASDEF(-1))***	-0.5278	-5.7764	0.0000
D(LNRR)***	0.0683	5.1629	0.0000
D(LNREER)	-0.0268	-0.8831	0.3827
D(LNLOANS)***	0.3075	5.0763	0.0000
D(LNLOANS(-1))	-0.0385	-0.6987	0.4890
D(LNLOANS(-2))***	-0.2310	-4.1787	0.0002
DUMMYPASTASDEF	0.0025	0.2067	0.8373
CointEq(-1)***	-0.0920	-8.0219	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the short run, the previous period's inflation affects the current inflation negatively by 0.53 per cent for every 1 per cent shock. The interest rate increase of 1 per cent affects the inflation in the sector positively which may be due to the price puzzle. Loans affect inflation positively like in the long run but at a lower degree. The error correction term is negative (-0.092) and significant, which means the short-run dynamics adjust to the long run at a slow pace of 9.2 per cent per quarter (table 3-23).

In the public administration, defense, education, human health, and social work activities sector, the credit channel and the output are the only factors affecting the sector's inflation in the long run. Whereas the interest rate and the exchange rate channels have no effect. An increase in the loans by 1 per cent leads to a decrease in inflation by 0.05 per cent. The negative effect is due to the decrease in costs that arises when loans are scarce, costs such as searching for a new source for credit or being shut off credit for some time. The increase in GDP by 1 per cent leads to an increase in the sector's inflation by 0.79 per cent, which has the same impact across all the economic sectors in this study (table 3-24).

Table 3-24: The long-run Equation of the LNADEHSDEF

LNADEHSDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	-0.0114	-0.7721	0.4447
LNREER	0.0295	6026	0.5503
LNLOANS**	-0.0583	-2.0976	0.0425
LNADEHS***	0.7943	16.5426	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-25: The Error Correction Equation of the LNADEHSDEF

LNADEHSDEF ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	-6.1099	-8.3575	0.0000
D(LNADEHSDEF(-1))**	-0.1991	-2.7004	0.0102
D(LNADEHSDEF(-2))**	-0.1871	-2.2488	0.0303
D(LNADEHSDEF(-3))***	-0.3979	-5.5626	0.0000
D(LNADEHS)***	0.4102	6.9811	0.0000
DUMMYADEHSDEF***	-0.0564	-3.3967	0.0016
CointEq(-1)***	-0.7659	-8.4372	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the short run, the previous periods' inflation affects the current inflation negatively. Meanwhile, the GDP affects the current inflation positively as is the case in the long run. The error correction term equals -0.7659 and is significant, which means the short term dynamics adjust to the long-run equilibrium at a fast pace of 76.59 per cent. In other words, if the short-run shocks are not permanent, their impacts fade in almost two quarters (table 3-23).

In the sector of other services, the loans affect inflation negatively with a decrease in inflation of 0.18 per cent for every 1 per cent increase in loans. Whereas a 1 per cent increase in the output leads to a 0.93 per cent increase in inflation.

Table 3-26: The long-run Equation of the LNOSERVDEF

LNOSERVDEF COINTEGRATION EQUATION			
Variables	Coefficient	t-Statistic	Probability
LNRR	0.0213	0.7247	0.4726
LNREER	0.0666	0.4308	0.6687
LNLOANS**	-0.1787	-2.1586	0.0365
LNOSERV***	0.9323	6.0617	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

Table 3-27: The Error Correction Equation of the LNOSERVDEF

LNOSERVDEF ECM REGRESSION			
Variables	coefficient	t-Statistic	Probability
C***	-2.3217	-8.0095	0.0000
D(LNOSERVDEF(-1))***	-0.3530	-3.4091	0.0014
D(LNOSERV)***	0.1584	5.3946	0.0000
DUMMYOSERVDEF	0.0071	0.3176	0.7524
CointEq(-1)***	-0.3529	-8.0922	0.0000

*Denotes significance at 10% level, ** denotes significance at 5% level, and*** denotes significance at 1% level.

In the short run, the previous period's inflation affects the current inflation negatively, with a 0.35 per cent decrease for each 1 per cent increase in the previous period. Whereas the sector's GDP affects inflation positively by 0.16 per cent for each 1 per cent increase. These short-run dynamics adjust to the long-run equilibrium at a moderate rate of 35.29 per cent each quarter.

3.3. The Summary of The Empirical Results

From the ECM model's results, we can see that the economic sectors are reacting differently to changes in monetary policy. In the long run, the effects of the exchange rate channel and the credit channel are found across many sectors (except the construction and the agriculture, forestry, and fishing sectors) compared to the interest rate channel that affects only the information and communication sector.

In terms of the long-run effects' strength, the exchange rate channel seems to have the strongest effect on sectors' inflation with less presence in the services sectors. Its effects are always negative which means that a depreciation in the currency leads to an increase in the prices of the affected sectors. This relationship is theoretically legit since the currency depreciation will raise the prices of the imported final and intermediate goods, which raises the inflation in the sector. It is worth mentioning that the increase in prices in wholesale and retail trade, transportation and storage, accommodation and food service activities, Professional, scientific, technical, administration, and support service activities is disproportionate with the increase in the exchange rate. In other words, the percentage increase in the prices is higher than the percentage increase in the exchange rate. This disproportionate change might be due to overshooting while adjusting prices to avoid losses in the future shocks or the sectors' actors trying to maximize their profits while the market is panicking and the uncertainty is quite high.

The credit channel affects relatively more sectors, but the strength of its effects is moderate in almost all the sectors and sometimes weak in others (the public administration, defense, education, human health, and social work activities sector). In general, the loans are found to have a negative impact in almost all the sectors. In other words, a decrease in the level of loans leads to an increase in the sectors' prices, which might be due to the increased costs of production, and therefore this increase is reflected in the prices. In the sector of information and communication and the sector of professional, scientific, technical, administration, and support service activities, the loans' quantity affects the inflation rate positively, which might be due to

the increase in consumption resulting from the abundance of loans. It is worth mentioning that loans seem to have distinct effects across the sectors where sometimes the prices are affected negatively through the production costs and other times positively through the consumption.

The interest rate channel is not effective in the long run since it has no presence in all the sectors except the information and communication sector where its effects are positive but weak.

In the short run, the exchange rate effect and sectorial presence are weaker than in the long run. the exchange rate has a general negative relationship with inflation in the short and long run, where a depreciation leads always to higher inflation rates. The credit channel is also weaker in terms of presence but its effects are positive and as strong as in the long run. The positive effect suggests that the credit channel affects the prices by affecting consumption, where an increase in the loans leads to an increase in consumption and consequently inflation. The interest rate is found to be more effective in the short run compared to the long run, where we can see its significance in several sectors. Its effects are positive in all the affected sectors, where an increase in interest rate leads to an increase in the sector's price level (inflation), which might be the result of the price puzzle. However, it is worth studying whether firms in these sectors react to such increases in the interest (their credit cost) by lowering their investments as the theory suggests or increasing their prices without changing their level of investment.

The deviation from the long-run equilibrium caused by the short-run shocks lasts for distinct periods in each sector. Short-run shocks last less than three quarters in sectors such as construction, financial and insurance activities, real estate activities, and public administration, defense, education, human health, and social work activities. Whereas in other sectors such as agriculture, forestry and fishing, manufacturing, mining and quarrying and other industry, wholesale and retail trade, transportation and storage, accommodation and food service activities, information and communication, and other services, the short-run shocks last longer (5-17 quarters) before adjusting to the long-run equilibrium. And the exception is the professional, scientific, technical, administration, and support service activities, where 95 percent of the effect of the shocks last almost 32 quarters.

CONCLUSION

The study examined how inflation in different economic disaggregations (sectors) react to the changes in the transmission mechanisms through which the monetary policy is canalized. The importance of such a study lies within the clearer view it serves on how precisely the monetary policy affects inflation. It will also help enhance the monetary policy accuracy, avoid undesired consequences, and allow targeting specific sectors rather than the whole economy. To that end, the first chapter provides an overview of the evolution of the Turkish monetary policy instruments and conducts, exchange rate, banking sector, and inflation between the years 2001-2021. The general picture that has been seen in such an evolution is the upward trend the inflation rate follows, driven by the continuous depreciation in the domestic currency. Although the adoption of a tight monetary policy to counter the increasing inflation levels and to cease the currency depreciation, the price levels along with the exchange rate continued their deterioration.

In the second chapter, the theoretical background was drawn. It analyzed the monetary policy transmission mechanisms systematically, from the initial change in the monetary policy to the first stage where the channels are affected, and ending by how the channel transfer such effects to the economy in general and inflation specifically. The three main transmission channels represented by exchange rate channel, credit channel, and interest rate channel were examined thoroughly. The interest rate channel, which is the traditional channel since it was considered as the sole channel through which monetary policies are transferred to the economy. This channel is believed to affect inflation negatively through either affecting consumption decisions regarding durable goods or through affecting the cost of capital and therefore investment, output, and inflation. However, in many empirical cases, the results were contrasting this belief, which is referred to as the price puzzle. After the increase in international trade in the last century, a new channel emerged around the exchange rate named the exchange rate channel. This channel is supposed to affect inflation negatively by affecting the prices of imported goods and therefore output and consequently inflation. However, this channel can affect inflation directly when the imported goods are final goods destined for consumption. The last channel is the credit channel, which is concerned with how the borrowing and lending process affects the economy, and how the latter is affected by the monetary policy. This channel is considered as an amplifier of the

traditional channel's effect and it works through two mechanisms. The balance sheet mechanism emphasizes the role monetary policy plays in affecting the firms' balance sheets (financial positions). This mechanism gives importance to a firm's balance sheet since it determines its ability to fund its inventories and investments internally or at least provide collaterals for its debts. This will affect the borrowing and lending process in the end. The second mechanism is bank lending, which emphasizes the role monetary policy plays in affecting the banks' core deposits and reserves and consequently the borrowing and lending process.

In the third chapter, the study tested empirically the effects that the credit channel, the interest rate channel and the exchange rate channel have on the economic sectors' inflation in Turkey. The quarterly one-week repo, real effective exchange rate, the quantity of banking loans were used as representatives for the interest rate channel, the exchange rate channel, and the credit channel respectively. In addition, the GDP and inflation of each sector were included. To realize the analysis, the Autoregressive Distributed Lag (ARDL) bound test was applied since the data is stationary at different levels. The CUSUM and CUSUMQ tests were used to check for the coefficients constancy (model stability). After proving the presence of cointegration and making the necessary changes to have stable models, the Error Correction Model (ECM) was extracted from the ARDL model through a simple linear transformation. Moreover, the diagnosis tests were applied to avoid the presence of autocorrelation and heteroscedasticity. The results indicate that inflation in the different economic sectors behaves differently to shocks in the monetary transmission mechanisms.

In terms of sectoral spread, the credit channel affects more sectors than the other channels, followed by the exchange rate, and then the interest rate. The interest rate channel effectiveness is confined to the short run and it has no effect in the long run, while the exchange rate and the credit channels affect the sectors' inflation in the long run and the short run but to a lesser degree. However, the exchange rate channel seems to have the strongest effects on sectors' inflation when considering the relative importance. While the credit and interest channels have moderate and weak effects, respectively.

In line with the literature, the exchange rate affects sectorial inflation negatively in both the short and long run. On the other hand, the credit channel has a mixed effect in the long run (positive effect in some sectors and negative in others) and a positive one in the short run. The

literature suggest a positive relationship between the credit channel and the inflation where the increase in the credit levels lead to an increase in the consumption and therefore an increase in the aggregate demand and consequently inflation. Whereas the negative relationship seen in this study might be the result of the decrease in the cost beard by firms while searching for credit since the credit is widely available. Finally, the interest rate affects inflation positively in contrast with the literature and only in the short run, which is referred to as the price puzzle.

It is worth mentioning that short-run shocks are found to be temporary in some sectors and persistent in others.



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