



Hacettepe University Graduate School of Social Sciences
Department of Economics

**THE INTERACTION OF INTEREST RATES, INFLATION,
EXCHANGE RATES AND ECONOMIC GROWTH IN
TURKEY: 2000 - 2021**

Ece GAZIOĞLU

Master's Thesis

Ankara, 2023

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ABSTRACT

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This thesis studies the effects of interest rates on mainly the real output and price level for Turkish economy by using VAR and SVAR models. The study first reviews the literature related to the interest rates, economic growth, price level, exchange rate, and current account interaction, and then examines the Turkish economy for the last 20-year period using quarterly data between the year 2000 and 2021. The study takes the short-term interest rate as the prominent monetary policy instrument variable and searches its' impacts on some other macroeconomic variables. The variables used for the analysis are; quarterly data of interest rate on deposits, CPI data for inflation, real GDP data for economic growth, real effective exchange rates, and current account balance data. The study finds that monetary policy is an effective policy but interest rate shocks affect the GDP, and create impact on economic growth with a time lag as expected. On the other hand, interest rate and monetary policy is affective on exchange rates and price stability in a form of a little shocks. Therefore, we conclude that authorities should be very careful about implementing monetary policy and using the interest rates as a policy instrument because discretionary monetary policy implementations will easily lead to a price instability in Turkish economy.

Keywords: Interest Rates, Reel Exchange Rate, Real GDP, CPI

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INTRODUCTION

Economic policies are described as a wide range of fiscal and monetary actions that are taken in order to manage and adjust the economy to disturbances. Fiscal policy refers to the way the governments shape their taxation and spending in order to achieve certain goals such as employment and growth. Monetary policy, on the other hand, implies the actions taken by the monetary authorities and central banks to attain ultimate goals such as price and financial stabilities by utilizing various monetary policy tools.

In the 1970s, monetary policy has undergone some changes since it began to come to the fore with the diversification of the tools needed for a solution to the new generation crises and the diversity of the problems caused by the effects of financial liberalization. The increase in the amount of financial transactions, capital mobility, and sudden foreign capital inflows and outflows in particular, emerged the necessity to attach weight also to the financial and price stability in many economies including the Turkish economy.

The interest rate has always been the most important tool for conducting monetary policies. The Central Bank of Turkish Republic (CBRT) has also been conducting Turkish monetary policy by using interest rates as an intermediate target and operational monetary policy tool for a long time. Together with supply side shocks during epidemic, the expansionary policies created massive inflationary pressures on almost all the economies. Blaming such policies as the main reason for sharp increases in inflation, many countries and their monetary authorities put the price stability as a major target of their monetary policies all over the world. Aiming to ensure price and financial stability after the Covid-19 global epidemic, the monetary policy in almost all countries used the interest rates in a contractionary manner. Anti-inflationary measures became a priority issue, and the fight against inflation has been given with use of the interest rates in a prominent and conventional manner in many economies.

In Turkey, however; just the opposite, a new monetary policy is announced, and implementing a low and negative interest rate policy has claimed to be a new policy for Turkish economy. It is called “heterodox” and unconventional monetary policy that

gives to economic growth a priority. Trying to keep the economic growth rate at a plausible-high level with a policy of supplying “cheap credits” to business (with negative real interest rates) was the main pillar of such policy. The monetary authorities and government have seen high interest rates as a real reason behind price hikes and instability. Therefore, they believed that if interest rate is decreased, the inflation would come down to a reasonable rate. For them the “high” interests were the reason for high inflation. When this policy is started to be implemented, the inflation in Turkish economy was about 14 percent. Suffering from high inflation over the 50 years, the Turkish governments in the last 20 years, following a devastating banking and financial crisis of 2001 had succeeded to bring the rate down finally to one-digit. However, in the year 2022, such policy of pro-growth and based on depreciating domestic currency against the major currencies currency has led to tremendous inflation at the rate of 90 percent and series current account deficit despite a major depreciation of national currency. The inflation is now has two-sided: 1) the cost of production increased dramatically thanks to depreciation of Turkish Lira and also 2) demand increased thanks to the credit expansion as a result of negative interest rates.

Considering inflation as a the most serious problem in the Turkish economy for more than 50 years in Turkey, and that the recent discussions about whether the interest rate is the cause or the result of inflation, it seems important to examine the effects of interest rate as a monetary policy instrument on the other macroeconomic variables such as economic growth, inflation, and current account deficit.

This study, therefore; examines the interaction and relationship between interest rates, economic growth, and inflation, real effective exchange rate and current account, and applies a time series analysis. The quarterly data on the rate on three-month time deposits as interest rate, real GDP data for economic growth, and Consumer price Index (CPI) for reflecting inflation are used as data series and covering 22 years between 2000 Q1 and 2021 Q4.

The thesis work consists of two main chapters. In the first chapter, the variables, their relations with each other, and their effects on the economy were examined with help of the related literature. In this context, the influences of monetary policy on the

real economy; the effects of a modification in the interest rate on the real exchange rate, current account balance, growth, and inflation have been tried to be investigated comprehensively. This chapter also look at the monetary policy strategies of the Central Bank of the Republic of Turkey for the period 2000-2021, and policy switches and structural changes over time were expressed chronologically based on the framework drawn in the annual Monetary and Exchange Rate Policy Reports of the CBRT. Meanwhile, I will try to give some emphasizes on the implementing instrument of the monetary policy over years, and approaches in different kind. A literature review of various empirical studies on the relationship between interest rates, exchange rates, and the main macro variables for Turkey and other countries is also presented in this chapter together with the methodology, econometric techniques, tests and analysis methods used in the study.

The second chapter contains information about the data used in the study and the findings of econometric analysis. The relationship between interest rates, real exchange rate, current account balance, growth, and inflation is estimated and the interaction among those variables for the Turkish economy is analysed.

The results were stated and these results were interpreted from an economic point of view in the conclusion.

Within this framework, the study aims to show the reflection of the events since the year 2001, the 2008 crises, and especially the political climate in Turkey in the last 20 years on the economy and the effect of the determined interest rates on main macroeconomic variables.

CHAPTER 1

1. THE THEORY AND LITERATURE

As a monetary policy tool of all the Central Banks, the interest rate instrument has core role in order to ensure price stability and financial stability. Due to the Covid-19 global epidemic, the economies of almost all countries including Turkey have contracted and expansionary monetary policies have been implemented. The inflationary pressures created by the expansionary monetary policies have become a priority issue in almost all countries. In order to cope with price stability prominent tool that is used has been the interest rate. For more than 50 years, Turkish economy has been suffering from a high and volatile inflation problem. In the last 20 years Central Bank of Republic of Türkiye (CBRT) has chosen price stability as a major goal of monetary policy. Even though a success has been reached in reducing the inflation rates down, the last four years in particular inflation and monetary policy of CBRT became a center issue once again in Turkish economy. Particularly, the way that government imposed rules on how to use of the interest rate became a central issue for many analysts. Despite extremely high cost and price increases in Turkish economy, the government forced the CBRT to reduce policy rates further affected macro-economic variables and changed the exchange rates and therefore current account deficit, and economic growth as well. So this study focus on the effect of interest rate changes on other macroeconomic variables and inspect the influences and degree of causes of such a policy shift of the interest rate.

1.1. THE INTEREST RATE

Interest rate decisions by central banks, hold an important part in shaping monetary policy outlook and thereby the forthcoming path of economies.

The Interest Rate; can be described as the borrowing and lending price of capital, or as the reward for saving. In other words, it can be defined as the cost of the money used by the person who demands the fund, and the return on the capital of the person

who lent the fund. Interest rates affect economic agents' expectations for the future and therefore their behavior today. The level of interest rates shaped by the implemented monetary policies creates effects on macroeconomic variables such as economic growth, foreign trade balance, budget balance, employment, and inflation. For example, in an economy where capital movements are free, relatively high-interest rates will attract foreign investors and create foreign currency inflow to the country, and therefore, consumption and investment expenditures will increase and savings will decrease due to the enlargement of the real money supply caused from the appreciation of the national currency. The current account balance will be negatively affected by the increase in imports and the decrease in savings. Continuum of this, may cause a deficit in the current account balance, which makes the country's economy fragile and open to the negative effects of external factors. The fact that the interest rates are set well below the required level and even at negative levels also creates problems in the economies. Low-interest rates will not encourage savings, which may cause a savings gap and external debt, as well as may cause economic individuals not to borrow and spend, and slow down the growth of the country by not creating economic dynamism. In this context, the interest rate is an important policy instrument.

1.2. THE INTEREST RATE AND THE EXCHANGE RATE

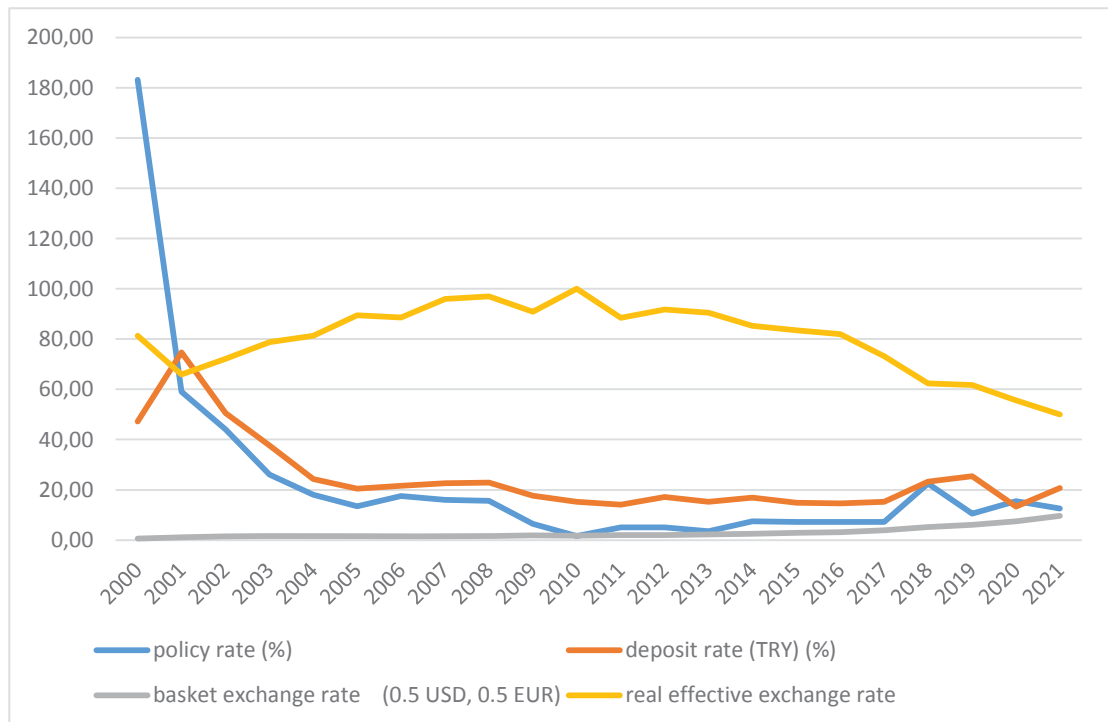
The exchange rate can be described as the price of a country's currency in terms of other country's currencies. The nominal effective exchange rate can be described as the weighted average value of a national currency in terms of a basket of currencies of an economy's trade partners that hold a significant place in that economy's trade flows. The real effective exchange rate is derived from the nominal effective exchange rate by considering the relative prices. The Central Bank of the Republic of Türkiye (CBRT) defines the real effective exchange rate as;

“is computed as the weighted geometric average of the prices in Turkey relative to the prices of its principal trade partners in international markets. The real effective exchange rate can be formulated as follows:

$$REER = \prod_{i=1}^N \left[\frac{P_{TUR}}{P_i * e_{i,TUR}} \right]^{w_i}$$

where, w_i is country i 's weight in Turkey's REER index, P_{TUR} is the price index in Turkey, P_i is the price index in country i , $e_{i,TUR}$ is the nominal exchange rate of country i in terms of Turkish Lira (TL), and N is the number of countries included in the analysis. An increase in the REER represents an appreciation of the TL in real terms, denoting a rise in the value of Turkish commodities in terms of foreign commodities" (CBRT, REER Metadata).

Graph 1, Relationship Between Interest Rates and Exchange Rates 2000 - 2021



(created with CBRT data)

The real exchange rates and nominal exchange rates relation is depending upon rational expectations and rigidity of wages and prices.

“Because of slow adjustment of wages and goods prices, an increase in the nominal exchange rate usually brings about an increase in the real exchange rate in the short run. Over the long run, however, the real exchange

rate will converge to its equilibrium value as prices and/or nominal exchange rates adjust” (Taylor, 1995).

1.3. THE INTERACTION BETWEEN INTEREST RATE AND THE CURRENT ACCOUNT

The current account balance is the most fundamental sub-balance of the balance of payments, which shows the mutual transactions of an economy with other economies. It shows the export and import gap, and other transactions such as tourism and transportation that causes foreign exchange earnings or losings (Eğilmez, 2013). The current account balance shows the difference between total exports and revenues and total imports and expenses. Therefore, it is closely related to national income and has effects on the macroeconomic variables of an economy, such as the general price level.

Current Account Balance = (Earnings from exports of goods + Earnings from exports of services + other earnings) – (Expences of imports of goods + Expences of imports of services + other expences) +/- current transfers (Eğilmez, 2012)

The interest rate and current account relation can be explained by relying on the Mundell - Fleming model. Mundell (1963) and Fleming (1962) examine the effects of the policies implemented on the real economy under the assumptions that are open market, perfect capital mobility, and imperfect substitution of domestic and import goods. In this model, the monetary and fiscal policies’ influences on the real economy may be different depending on whether the exchange rate is fixed or floating and the interest rate elasticity of capital. If Policy A is an expansionary monetary policy and Policy B is an expansionary fiscal policy, Fleming (1962) argues that;

“under a floating rate, Policy A will require, to restore payments equilibrium, a deeper exchange depreciation, and will consequently bring about a greater improvement in the trade balance, and a greater stimulus to income and

output, than Policy B. The superiority of Policy A over Policy B as a means of increasing income and output depends notably, as we have seen, on the sensitivity of international capital movements to changes in the rate of interest. At zero sensitivity, there is nothing to choose between the two policies. If the sensitivity is infinite, the level of income resulting from Policy A will exceed that resulting from Policy B in much the same proportion as the money stock under A exceeds that under B.”

According to the Mundell-Fleming model, for example, as a result of a fiscal expansion that increases aggregate demand, a hike in domestic interest rates will prompt foreign capital inflows into the country. This will cause the appreciation of the national currency and imports will increase while exports decrease. Thus, a deficit will occur in the current account and external debt will increase. According to Mundell(1963), when there is implied expansionary monetary policy by open market purchase of domestic securities in a flexible exchange rate regime;

“This results in an increase in bank reserves, a multiple expansion of money and credit, and downward pressure on the rate of interest. But the interest rate is prevented from falling by an outflow of capital, which causes a deficit in the balance of payments, and a depreciation of the exchange rate. In turn, the exchange rate depreciation (normally) improves the balance of trade and stimulates, by the multiplier process, income and employment.”

Especially in developing countries such as Turkey, the low level of domestic savings, the need for external funds, dependence on foreign energy, and the negative effects of short-term capital inflows and outflows cause the current account deficit problem.

1.4 THE INTEREST RATE AND THE ECONOMIC GROWTH

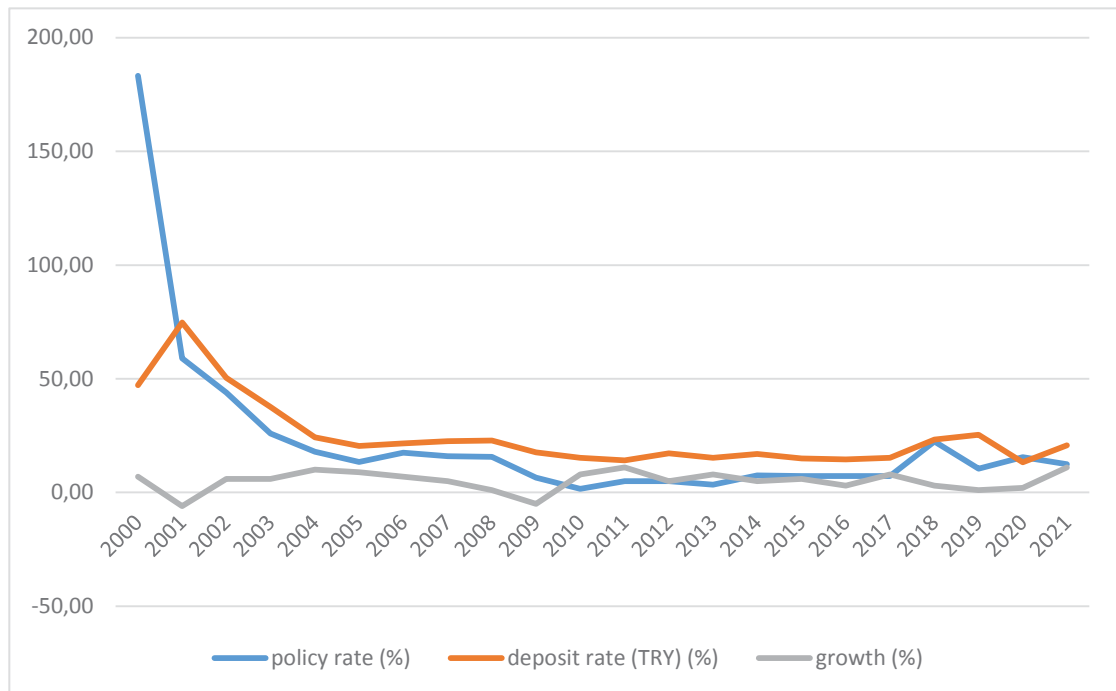
Economic growth is a very consequential subject matter in developing countries such as Turkey. In particular, economic and political instabilities and the resulting populist practices causes monetary and fiscal policy mismatching and unstable growth.

This unstable growth environment, causes foreign exchange inflows to be in the form of short-term capital inflows and outflows rather than for investment purposes in countries such as Turkey which has insufficient domestic savings and a requirement for foreign funds, and this affects growth even more undesirably.

It is argued that low-interest rates will encourage investment expenditures and growth in the economy in Keynesian and Neoclassical theories. Under the assumption that the interest rate is freely determined by market conditions, the argument that the interest rate affects growth is based on the work of McKinnon (1973) and Shaw (1973). McKinnon's (1973) and Shaw's (1973) studies on financial liberalization especially interest rate liberalization, argue that in a liberalized financial sector, fund suppliers can prefer productive investment assets rather than unproductive ones and therefore fund supply and of course amount of credit increase in the economy. Thus this will affect growth positively. In Obansa et al.(2013).;

“McKinnon (1973) argued that supply rather than demand for loan-able fund constrains investment in developing countries. He further put forward that this is because financial sectors in developing countries are highly repressed and the demand for loan-able fund exceeds the supply. In this way, an increase in interest rate will attract increases in deposits of loan able funds; thereby leading to increases in financial deepening, investment and economic growth.”

Graph 2, Relationship Between Interest Rates and Growth 2000 - 2021



(Created with CBRT data)

The Central Bank affects market rates by dint of the interest rate corridor it has determined. It is anticipated that the increase in interest rates to suppress consumption, therefore economic growth. As seen in Graph 2, it can be said that a hike in interest rates, especially after 2015, negatively affects economic growth. However, in recent years, private banks have tended to avoid lending due to the low-interest rate preference of the CBRT, and this gap was tried to fill by public banks. The high-interest rate and high growth after 2020 can be explained by this situation.

1.5 THE INTEREST RATE AND THE INFLATION

High and continuous inflation since the second half of the 1970s is one of the biggest economic problems in Turkey today and affects individuals from all components of society. Due to high inflation, the purchasing power of households has been decreasing, and loss of welfare and unstable growth occurred. An environment of stability that will occur at the general level of prices will help firms and individuals make more logical and longer-term decisions in their consumption, investment, and

savings by helping them to create more accurate expectations. Also, price stability will lure long-term foreign savers to invest in the economy in productive areas, and thence the country's competitive power in global markets will increase (CBRT, 2004).

Short-term interest rates are the core monetary policy tool employed in almost all economies around the world that adopts inflation targeting. Interest rate policies in developing countries are generally aimed at controlling inflation to obtain more balanced exchange rates and aggregate demand. In an environment of short-term capital inflows and outflows, short-term interest rates are one of the most effective monetary policy tools for the battle against inflation by keeping in check demand and exchange rates (Uçak & Şahan, 2019).

The correlation between inflation and interest rates is in close harmony with the basic dynamics of the economy. If demand-driven inflation prevails in the economy, setting interest rates at a higher level than the actual inflation rate may prevent price increases. However, if the interest rate increase is held beneath the actual inflation rate, price increases cannot be stopped. Quite the reverse, if there is cost-driven inflation in the economy, the increase in interest rates cannot prevent inflation, on the contrary, it can increase the inflation rate by increasing credit costs. However, this situation is diverse to the internal dynamics of economies. One of the most important determinants of inflation in countries like Turkey, which cannot use its national currency in trade, is the increase in exchange rates. If the production is dependent on imported inputs, an upward movement in the exchange rate creates cost-push inflation over production costs. Interest rate hikes can be effective in curbing cost-driven inflation in Turkey. Increasing interest rates causes foreign capital inflows, increases the amount of foreign currency, and lowers the exchange rate. The downward movement in the exchange rate can prevent price increases by reducing costs (Eğilmez, 2021).

1.5.1 The Fisher Effect

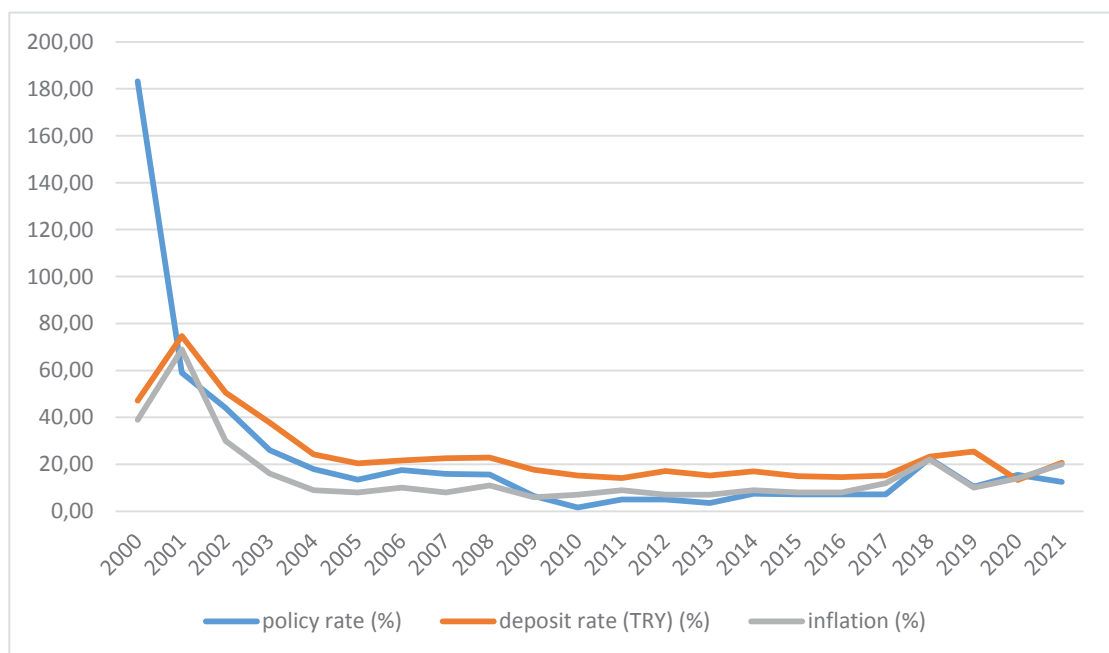
The theoretical foundations of the relation between interest rate and inflation date back to Fisher (1930). The Fisher Equation reflects that there is a positive correlation between nominal interest rates, and the nominal interest rate (i) is the sum of the real interest rate (r) and inflation rate (π). The Fisher Equation;

$$\dot{i} = r + \pi$$

shows that the nominal interest rate can change for two reasons. According to this; A change in the nominal interest rate may result from a change in the real interest rate or from a change in the inflation rate.

“The quantity theory and the Fisher equation together tell us how money growth affects the nominal interest rate. According to the quantity theory, an increase in the rate of money growth of 1 percent causes a 1 percent increase in the rate of inflation. According to the Fisher equation, a 1 percent increase in the rate of inflation in turn causes a 1 percent increase in the nominal interest rate. The one-for-one relation between the inflation rate and the nominal interest rate is called the Fisher effect” (Mankiw, 2010: 94-95).

Graph 3, Relationship Between Interest Rates and Inflation 2000 - 2021



(Created with CBRT data)

1.5.2 The Taylor Rule

When setting interest rates that will help achieve low and stable inflation rates but will not create a negative effect on output, the central banks follow up The Taylor Rule.

The Taylor Rule, an opinion on the policies to be implemented by central banks in the execution of monetary policy that is put forward by John Taylor in 1993, can be expressed as “the change to be made in short-term interest rates by considering the difference between the actual inflation and the targeted inflation, and the difference between the realized GDP and the potential GDP level”(Akalm & Tokucu, 2007).

$$r = \pi + 0.5(y - y^*) + 0.5(\pi - \pi^*) + 2$$

r = the interest rate that is set by the central bank

π = actual inflation rate

π^* = expected inflation rate

y = real GDP

y^* = potential GDP

According to the equation $(y - y^*)$ represents a deviation of production, and $(\pi - \pi^*)$ represents a deviation of inflation. The central bank will change the short-term interest rate (r) depending on the deviations in inflation and production. In this equation, it is accepted that an alteration of the interest rate will have an influence on both inflation and growth (Taylor, 1993).

Accordingly, central banks will show a tendency of increasing interest rates when there is an expectation that the GDP and inflation rates will be above the targeted values or they will tend to decrease the interest rates in the opposite case, within the framework of the Taylor Rule.

1.6 THE MONETARY TRANSMISSION MECHANISM

Economic policies basically can be described as the total of a wide range of fiscal or monetary actions that are taken in order to manage the economy. Fiscal policy refers to the way governments shape their taxation and spending methods in order to achieve certain goals such as employment and growth. Monetary policy, on the other hand, implies the set of decisions that are taken by central banks to attain goals such as price stability and financial stability by utilizing various tools.

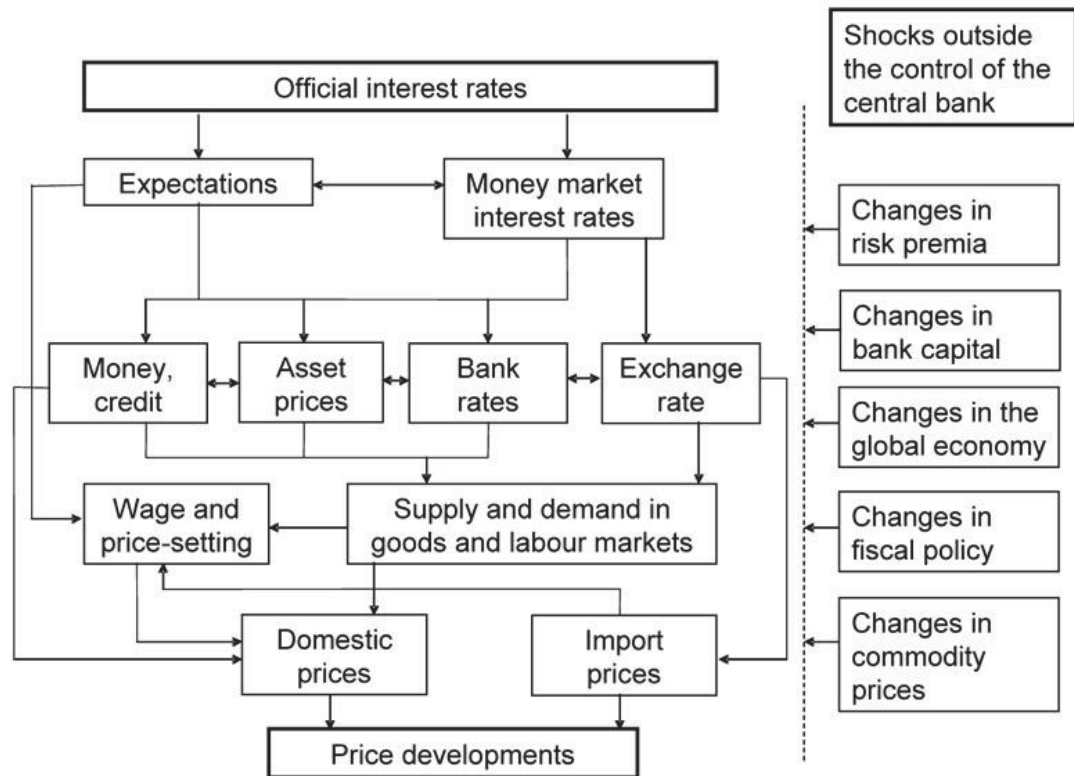
When the empirical studies on the outcomes of monetary policy are examined the effective working principle of monetary policy, it is seen that it has clear effects on

GDP. When a contractionary policy, a shock in monetary policy is implicated, it creates a transmission effect by interest rates and has a reducing impact on GDP and the general level of price. Implementation of contractionary monetary policy will not have much effect in the short run due to consumption habits initially, but in the long run, demand will decrease. With this decrease in demand, inventories will increase, which will cause a drop in net investments, thus a shrink in production and GDP (Bernanke & Gertler, 1995).

The ability of monetary policy to affect the real economy is one of the most important problems of economic theory. Monetary policy, which was operated as a reinforcement element for other policies in attaining sustainable growth and full employment targets before the 1970s, has gained a structure that aims to assure price stability after the high inflation epoch that started with the oil crisis in the 1970s. In addition, in this period, it has emerged as a necessity to understand the extent and how these policies have an impact on the economy in order for central banks to achieve their goals through the policies they implement. In this context, in order to determine how it affects economic activity and inflation and to determine effective policy tools, studies on the functioning of the monetary transmission mechanism have gained momentum since the 1980s (CBRT,2013, Parasal Aktarım Mekanizması).

The monetary transmission mechanism can be described as ways of the affecting the real economic variables via monetary policy. The monetary transmission mechanism can be explained in three steps. The first step describes the transmission of changes in monetary policy implementations to variables such as interest rates, asset prices, expectations, and exchange rates. On the second step, these variables affect the demand for domestic and imported goods, on the final step, the total demand and domestic pricing behaviors are determined, and domestic prices and import prices form inflation. In addition, interest rates have direct effects on inflation, and exchange rates have direct effects on the demand for imported goods (CBRT, 2013, Parasal Aktarım Mekanizması).

Graph 4, The Monetary Transmission Mechanism



(source: ECB, Transmission mechanism of monetary policy)

In the 1930s, as a result of the success of the fiscal policy-oriented implications pioneered by John Maynard Keynes in solving the problems that emerged with the economic crisis, also known as the Great Depression, the fiscal policy-oriented economic approach began to adopt. According to the Keynesian view, if an implemented monetary policy cannot affect interest rates, it will have no effect on total production. According to Keynesian economists, the monetary transmission channel operates in the path that alterations in the money supply primarily operate the interest rate which has an impact on investment expenditures and investment expenditures affect total production. (Kasapoglu, 2007). However, this approach has begun to be questioned with the emergence of the monetarist view. The monetarist view put forward the necessity of including also different transmission channels such as credit growth, expectation, and exchange rate channel in the analysis. In the 1980s, along with the supply-side economics view and the liberal approach began to adopt by almost all world economies, and this increased the mobility of goods and capital. Since the beginning of

the 2000s, the volume of financial transactions in the world economy started to increase rapidly. Also, it can be said that this increase is caused by the increase in product diversity and derivative transactions in financial markets. All these happenings revealed the necessity of updating the classical money transfer mechanism and reinterpreting transmission channels.

The monetary transmission mechanism channels differs over time as well as differs across the economic development of countries. According to Başçı & Özel & Sarıkaya (2007);

“Uncertainty about the underlying monetary transmission mechanism may be more pronounced in emerging market economies than in developed ones. Small open emerging market economies are typically characterized by high exchange rate pass-through, asset and liability dollarization, currency and maturity mismatches in balance sheets of banks and firms, external financing constraints, and fiscal dominance. Macroeconomic relationships are generally blurred by the role of exchange rates in both growth and inflation dynamics. This implies that the credit and aggregate demand channels may not respond properly to a change in interest rates. Therefore, the small open economy context complicates the interest rate channel beyond that observed in conventional mechanisms. Instead, the macroeconomic environment may be shaped by exchange rates driven by the direction and magnitude of capital flows.”

The global financial crisis, which has affected the whole world since the last quarter of 2008, had also affected the Turkish economy. In this framework, the CBRT started to attach importance to financial stability in addition to its main objective, price stability. It has designed a policy framework that aims to balance fluctuations, especially arising from external balance and capital flows, in order to limit macro-financial risks, and has formed its new policy based on credit growth and exchange rate. In addendum to the short-term interest rates that have been employed as a policy tool, the CBRT has also employed different policy tools that complement each other, such as reserve requirement rate, a corridor for interest rate, management of liquidity, and reserve option mechanism. The use of these instruments has led to credit and exchange

rate channels becoming more important in the monetary transmission mechanism (CBRT, 2013, Parasal Aktarım Mekanizması). However, considering the lack of depth in financial markets in developing countries such as Turkey, the risky investment environment created by market volatility, economic insecurity, and the evaluation of the already low savings as gold, housing, or foreign currency at the most, it is understood that the traditional transmission mechanism still maintains its importance and validity.

1.7. MONETARY POLICY IN TURKEY IN THE 2000-2021 PERIOD

It can be said that inflation is the biggest problem in the recent years of the Turkish economy. While high inflation and the fragility brought about by foreign dependency on production and energy describe the Turkish economy, inflation is both the cause and the result of the economic crises experienced periodically since the 1990s. For this reason, various monetary policies have been implemented by the CBRT, whose main objective is to ensure price stability.

1.7.1. 2000 AND BEFORE CENTRAL BANK MONETARY POLICY

In 1999, for reducing inflation, the Exchange-Rate-Based Stabilization (ERBS) Program supported by the IMF was announced by CBRT. The main purposes of this program, which is planned to continue for three years, are (i) to reduce consumer inflation to 25 percent at the end of 2000, 12 percent at the end of 2001, and 7 percent in 2002. for such aim, the implementation of a tightening fiscal policy that is consistent, continuous and supported structural reforms, and the coordinated with income, monetary and exchange rate policies are prepared to us together. So, (ii) reducing real interest rates to reasonable levels and, (iii) increasing the economic growth, to achieve a more efficient and fair distribution of resources in the economy are targetted. Within the framework of the policy related to exchange rate, it is planned to announce the exchange rate basket on a daily basis for one year, and to maintain the weights as 1 US Dollar + 0.77 EURO in the calculation of the currency basket (CBRT, 1999).

After the ERBS program, there was a recovery in economic activities. The fall in real interest rates increased the expenditures of consumers because of the cheap credit opportunities and contributed to growth. As a result of the decrease in real interest rates and the stability in the exchange rate, GNP increased by 6.1 percent, and GDP increased by 7.2 percent in 2000. The crisis in November 2000 and February 2001 had a negative impact on consumers and producers, and the rapid rise in interest rates led to a decline in consumption expenditures. In 2000, the value of the Turkish lira in real terms appreciated in terms of foreign currencies. After the November crisis, high-interest rates and the contraction in domestic demand have had an impact on imports. Due to the crisis experienced in February 2001, capital outflow occurred again and this caused a decrease in reserves. In 2000, the CPI increased by 39 percent and the PPI was 32.7 percent. After the crises, due to fluctuations in interest rates, inflation, and exchange rates, the economy was viewed as uncertain (CBRT, 2001).

1.7.2. 2001 "TRANSITION TO STRONG ECONOMY" PROGRAM

The main intention of the new program is to eradicate the instability that has arisen due to the change in the exchange rate regime and to restructure the economy. According to this new program, within the framework of these intentions, the continuous and determined battle against inflation within the floating exchange rate regime, a comprehensive reconstruction of the banking sector, thus establishing a healthy connection between the banking sector and the real sector, enhancing the public finance balance, and an income policy compatible with inflation targets are planned. It is planned to make structural improvements in elements that will run and/or help to run these objectives.

The crises experienced caused serious damage to the banking sector and this situation became a great burden on public finances. A dramatic increase in interest rates and the pressure on exchange rates affected the expectations of the economic agents negatively, therefore the real economy and causing the economy to shrink. With the depreciation of the Turkish lira, a rapid increase was observed in inflation. It was expected that the GNP will decrease by around 3 percent throughout the year, but the growth rate on a seasonally adjusted basis was expected to be positive in the year's last

months. By the floating regime, inflation is expected to accelerate and the increase in WPI and CPI is expected to be 57.6 percent and 52.5 percent at the end of the year. However, as a result of the determined implementation of the program, the rate of price increase is expected to decrease in the second half of the year. It is expected that the decline in imports as a result of the fall of the growth rate and the contraction in domestic demand, and the competitiveness brought by the depreciation of the Turkish lira, will positively affect export and tourism revenues. Thus, the current account will improve in 2001. (CBRT, “Strengthening The Turkish Economy Turkey’s Transition Program”)

1.7.3. 2002-2005 CENTRAL BANK MONETARY POLICY AND IMPLICIT INFLATION TARGETING

According to the decisions that is announced in 2002; it is aimed that, the primary budget surplus be 6.5 percent of GNP, the economic growth rate be around 3 percent, and reducing inflation to 35 percent. In 2002, it was planned to implement a monetary policy strategy called "implicit inflation targeting", which focused on inflation. Until April 2002, the exchange rates decreased both in nominal and real terms. At the beginning of June, inflation expectations showed a great improvement. As of April, the Central Bank started to increase its reserves through foreign exchange buying auctions. With the policies acting consistently with the expectations, the expected real interest rates declined to 15 percent.

In 2002 and 2003, the Central Bank set the short-term interest rates, which were used as the core monetary policy instrument, within the framework of the fight against inflation. In 2002, overnight borrowing interest rates were reduced from 59 percent to 44 percent. In addition, the one-week borrowing interest rate was reduced from 62 percent to 44 percent (CBRT, 2003). Between April and October 2003, short-term interest rates were cut six times. In this sense, the overnight borrowing interest rate, which was 44 percent in April, cut down to 26 percent in October (CBRT, 2004, January 2).

Towards the end of 2002, macroeconomic variables, especially economic growth, started to show a negative look and inflation was in a constant increase until

2005. With the central bank's decision in line with inflation targeting, "implicit inflation targeting" was adopted. With the successful implementation of implicit inflation targeting and its positive effects on the way of reducing inflation, the credibility of the central bank has increased. In 2004, short-run policy rates were reduced from 26 percent to 18 percent (CBRT, 2004, December 20). In 2005, it was decided to drop six zeros from the Turkish lira and this decision had positive results. In this sense, year-end inflation decreased to 7.72 percent, interest rate cuts continued gradually until the end of 2005, and short-term interest rates were reduced to 13.5 percent in December 2005 (CBRT, 2005).

1.7.4. 2006-2009 CENTRAL BANK MONETARY POLICY AND EXPLICIT INFLATION TARGETING

The general framework of the "Explicit Inflation Targeting" regime was announced in 2005 and was adopted in 2006. Significant positive effects occurred in the economy with the strong-willed implementation of policies to ease the impact of the 2001 crisis with the support of international organizations. The dollar rate, which rose as much as 1.8 TL in October 2001, started to loosen as a result of the steps taken at the end of 2001 and the large capital inflows from abroad at the beginning of 2002. High-interest rates began to fall down. With the support of international money flow, the economy showed a growth trend. Consistency with the IMF and close relations with the European Union had a great morale effect on this economic recovery, and it also supported the reduction of inflation with the implementation of "implicit inflation targeting" in the 2002-2005 period. Considering these developments, the "Explicit Inflation Targeting" application was introduced and the inflation target was announced as 5 percent for 2006, and 4 percent for 2007 and 2008. It has been announced that in case of deviating from the policy, an explanation will be made as to why inflation could not be reduced. While the volatility in global markets in the second half of 2006 decreased the risk appetite in global markets, Turkey's CDS premiums increased, and increased financing costs. Because of the depreciation of TL as a result of inflation and rising inflation expectations, the Central Bank increased the policy interest rates. The

policy rate, which was 13.50 on January 23, decreased to 13.25 in April, then increased to 15 in June and to 17.50 in the same month (CBRT, 2006).

The basis of the exchange rate policy in inflation targeting was the formation of exchange rates depending on supply and demand in the market. But in case of highly volatile exchange rates, intervention could be made by CBRT through foreign exchange selling auctions. The depreciation of TL created increasing pressure on inflation due to supply-related reasons. Inflation was above the target, 9.65 percent in 2006. Consumption and imports decreased because of the depreciation of TL. Export-supported growth was 6.0 percent, but it was as not high as 9.0 in 2004 and 8.4 in 2005. Due to the bad conditions in agriculture, the pressure of increasing oil prices, and the deteriorating international markets since the middle of 2006, the Central Bank increased the policy rates and adopted a tight monetary policy, and in 2007 it set the upper limit for inflation as 6 percent. On the other hand, due to the credit expansion, which has been on an enlargement trend since the second half of 2003, the Central Bank cut down the policy interest rates to 17.25 percent in September 2007, to 16.75 percent in October, to 16.25 percent in November and to 15.75 percent in December. The fluctuations in the international markets were effective in this decline. The mortgage crisis started to affect developing countries. In this process, in terms of monetary contraction, the Central Bank continuously reduced the amount of purchases in foreign exchange buying auctions (CBRT, 2007).

The volatility of global markets with the collapse of the US mortgage markets in August 2007 turned into a major crisis in September 2008. On account of the decline in economic activities abroad, commodity prices, especially oil, decreased. In Turkey, the lowest growth rate (0.7 percent) has been recorded since 2002. While Turkey had been able to recover with the effect of long-term borrowing and direct capital inflows since 2001, it had been affected by the negative view of expectations and capital outflows due to the negative trend in international markets since 2007. Capital outflows also had a significant cause of low growth. Low growth also caused deterioration in public balance. The decline in inflation because of the increase in the budget deficit resulted in the Central Bank's lowering of interest rates. On the other hand, the Central Bank set its growth target of 4 percent as 7.5 percent for 2009, 6.5 percent for 2010, and 5.5 percent for 2011. The interest rates in the market began to rise due to the natural contraction in

credit. The economy shrank by 4.7 percent in 2009, despite the public policies that supported the economic activities and the support of the Central Bank by lowering the interest rates. The global crisis that worsened in September 2008 continued in the first half of 2009 as well. However, from the second half of the year, government interventions started to recover the sharply falling growth rates, especially in developed countries. While developed countries supported the economy with stimulus packages, global risk perception began to decline and financial markets began to recover. However, sub-performing loans in the banking sector caused the fragility to continue and credit efficiency to decrease (CBRT, 2008).

The global crisis' affected Turkey negatively, credits contracted from the last quarter of 2008 to the first quarter of 2009. The implication of tax and fiscal incentive packages in the second quarter of 2009 started to support domestic demand, which declined due to high unemployment. On the other hand, foreign demand started to recover in the second quarter. Due to low growth and shrinking imports, the external deficit shrank. In 2009, inflation slowed down due to the global decline in commodity and energy prices that lowered costs, tax incentives and slowed domestic demand. In response to the 2008 global crisis, CBRT, like central banks in almost all countries, lowered interest rates. The policy rate was cut down by 850 basis points. On the other hand, measures against shrinking credits were introduced. These; liquidity ease for banks, three-month repo in addition to the weekly repo, reduction of TL reserve requirement ratio from 6 percent to 5 percent, the extension of foreign exchange deposit maturities for banks, foreign exchange selling auctions in the first half of the year, and limit the increase in rediscount credits (CBRT, 2009).

Table 1, 2008-2021 Economic View of Turkey

years	policy rate	deposit rate (TRY)	basket exchange rate (0.5 USD, 0.5 EUR)	real effective exchange rate	growth	inflation target	inflation	cds
2008	16%	23%	1,59	97,00	1%	4%	10%	350,88
2009	7%	18%	1,85	90,80	-5%	7,5%	6%	278,55
2010	2%	15%	1,74	100,00	8%	6,5%	9%	169,63
2011	5%	14%	2,00	88,40	11%	5,5%	6%	207,5
2012	5%	17%	2,05	91,70	5%	5%	9%	205,35
2013	4%	15%	2,21	90,50	8%	5%	7%	174,36
2014	8%	17%	2,55	85,30	5%	5%	9%	199,33
2015	7%	15%	2,87	83,50	6%	5%	8%	236,02
2016	7%	15%	3,18	82,00	3%	5%	8%	263,46
2017	7%	15%	3,88	73,10	8%	5%	11%	206,09
2018	23%	23%	5,24	62,30	3%	5%	16%	300,57
2019	11%	25%	6,01	61,70	1%	5%	15%	373,36
2020	16%	13%	7,52	55,60	2%	5%	12%	461,96
2021	13%	21%	9,68	50,00	11%	5%	20%	400,5

(Created with CBRT and investing.com data)

1.7.5. 2010 - 2021 CENTRAL BANK MONETARY POLICY

In 2010, monetary expansion continued. On the other hand, with the effect of the slack in economic activity in developed countries, international capital started to prefer developing countries with relatively high-interest rates. The Turkish economy experienced growth because of domestic demand due to the financial measures taken in 2010 and the healed credit conditions. With the relaxation in exchange rates due to the increase in capital inflows, CBRT began to focus on normalization in its policy. While the inflation was brought under control, the Central Bank announced that the weekly repo rate was accepted as the "Policy Rate". It was announced that the 12-month CPI is taken into account in the targeting inflation and the Central Bank will give an account of if the absolute value of this target is two points higher. The overnight interest rates, which were 6.5 percent in the January-June 2010 period, were gradually cut down as of September and were decreased to 1.5 at the end of the year. On the other hand, the

weekly repo rates, which are declared as policy rates, were determined as 7 percent in June. However, this rate was decreased to 6.5 percent in December (CBRT, 2010).

In the first half of 2011, it was aimed to suppress the overvaluation in exchange rates and to the controlled expansion of aggregate demand and loans. Due to the risk appetite in the market, the interest rate band was expanded downwards in order to restrain short-term capital inflows and outflows. Reserves were tried to be increased and Reserve Option Mechanism (ROM) began to be implemented (CBRT, 2011).

As of the first half of 2012, it was aimed to strengthen the reserves by continuously increasing the rates for the gold and foreign currency in the ROM Turkish lira reserve requirement rate over time.

In the first quarter of 2013, the central bank reduced the overnight lending rates from 8.50 percent to 7.50 percent. By May, one-week repo rates, overnight lending, and borrowing rates is cut down by 0.5 percent, therefore, overnight lending rates were 6.5 percent, overnight borrowing rates were 3.5 percent, and one-week repo rates were set as 4.5 percent. In the second half of 2013, capital movements slowed down due to uncertainty in the global markets. The monetary policy committee has taken decision to imply a tightening, for the price and financial stability and raise the upper limit of the interest rate band. In this sense, the overnight lending rate was increased from 6.5 percent to 7.25 percent. With the decision taken to continue the tightening in August, the overnight lending rate was hiked up from 7.25 to 7.75. In the last quarter of 2013, due to the fact that the inflation level was above the target level and the excessive volatility in exchange rates, it was decided to continue the tightening policy (CBRT, 2013).

Due to the grave depreciation of the Turkish Lira in the second half of 2013 and negative inflation expectations, monetary policy continued to be tightened in the first quarter of 2014 and, the very short run repo rate was hiked up from 4.5 percent to 10 percent, the overnight borrowing rate from 3.5 percent to 8 percent, and the overnight lending rate from 7.75 percent to 12 percent. As uncertainties eased in May 2014, one-week repo rates were first cut down by 0.5 percentage points, and then reduced from 9.5 percent to 8.75 percent. In order to support balanced growth and strengthen domestic savings, the central bank has started to pay interest on Turkish lira reserve requirements since November (CBRT, 2014).

Tight monetary policy continued in 2015, as in 2014, and the weighted average funding rate was gradually increased and overnight repo rates were decided to be at the upper band of the corridor. The acceleration of inflation was brought under control with the measures taken. In 2015, the interest rate paid to Turkish lira reserve requirement rates was increased by 50 basis points each in September, October, and December, respectively, resulting in a total of 150 basis points increase (CBRT, 2015).

As of March 2016, the monetary policy was simplified and in this sense, the overnight lending rate was gradually cut down a total of 250 basis points, until September. Due to the uncertainties in the global economy, in order to control the negative expectations both in the exchange rate and on the inflation side, the one-week repo rate was increased by 50 basis points and increased to 8 percent, the overnight lending rate was increased by 25 basis points and increased to 8.50 percent. In August and September, Turkish lira reserve requirement rates were set up by 100 basis points in total. In addition, in August 2016, instruments were diversified in terms of banks' ease of access to liquidity, and the Late Liquidity Window Repo application was introduced (CBRT, 2016).

In the first half of 2017, monetary policy was tightened as of January in order to control the upward inflationary pressure due to the excessive volatility in the exchange rate. In this sense, lending interest rates were increased. The overnight funding amount has been reduced, and the fund needs have been mostly met through the late liquidity window. The tightening policy, which started in January 2017, continued until October. In October and November, inflation accelerated due to uncertainty and excessive fluctuations in exchange rates. The average funding rate was increased by 25 basis points to 12.25, the late liquidity window lending rate was 12.25, the overnight lending rate was 9.25, and the weekly repo rate was 8 percent (CBRT, 2017).

The CBRT continued its tight monetary policy in 2018 due to the rise in inflation, increasing risks, and uncertainties. On May 28, 2018, the CBRT accepted the one-week repo rate as the policy rate and accepted the overnight lending rate as 150 base points above the policy rate and the overnight borrowing rate as 150 base points below the policy rate. Due to the increased risk in August and September and the excessive volatility in exchange rates, a strong monetary tightening was implemented in

September. In this sense, the one-week repo rate was increased to 24 percent (CBRT, 2018).

Tight monetary policy was continued in early 2019. The one-week repo rate was kept constant at 24 percent, and policies to keep liquidity under control were continued. By the late months of 2019, the tight monetary policy implemented had positive results on the exchange rate and inflation. In this sense, the policy rate was reduced from 24 percent to 19.75 percent in July, from 19.75 percent to 16.50 percent in September, and from 16.50 percent to 14 percent in October, especially in line with the slowing down of inflation. Throughout the year, most of the funding needs were met with swaps (CBRT, 2019).

In 2020, the Turkish economy started to slow down in March due to the Covid-19 outbreak. While the pandemic caused a great contraction in the European region, which is Turkey's most important export market, the restriction of travel negatively affected the tourism sector, which provides the largest amount of foreign exchange income. With the gradual relaxation of the pandemic-related restrictions as of June, the positive effects of supportive policies began to emerge. The CBRT continued the rate cut process that started in July 2019 in 2020 as well and cut the policy rate by 375 basis points in total in March, April, and May. The GDP, which fell by 10.8 percent in the second quarter of the year, increased by 15.6 percent in the third quarter, exceeding the pre-pandemic level due to the increase in domestic demand with credit expansion, and the increase in exports because of the other countries' easing pandemic related restrictions. In the last quarter, the increase in economic activity continued, although it lost momentum. As a result, the Turkish economy achieved a positive growth of 1.8% in 2020, supported by credit expansion. Credit expansion provided a recovery in the economy, but harmed inflation. In this period, in addition to the global ambiguous environment, the worsening of domestic inflation expectations and the strengthening of the demand for gold and the dollarization trend, increased the foreign exchange rate and led to a further deterioration in the current account deficit. The CDS, which was 250 points at the beginning of 2020, increased to 635 due to the shrinking risk appetite in the global markets and capital outflows because of the pandemic. CDS, which declined to 285 points with the change of the Central Bank governor in November, closed the year

around this time. However, after the central bank governor was replaced again in March 2021, it started to rise rapidly.

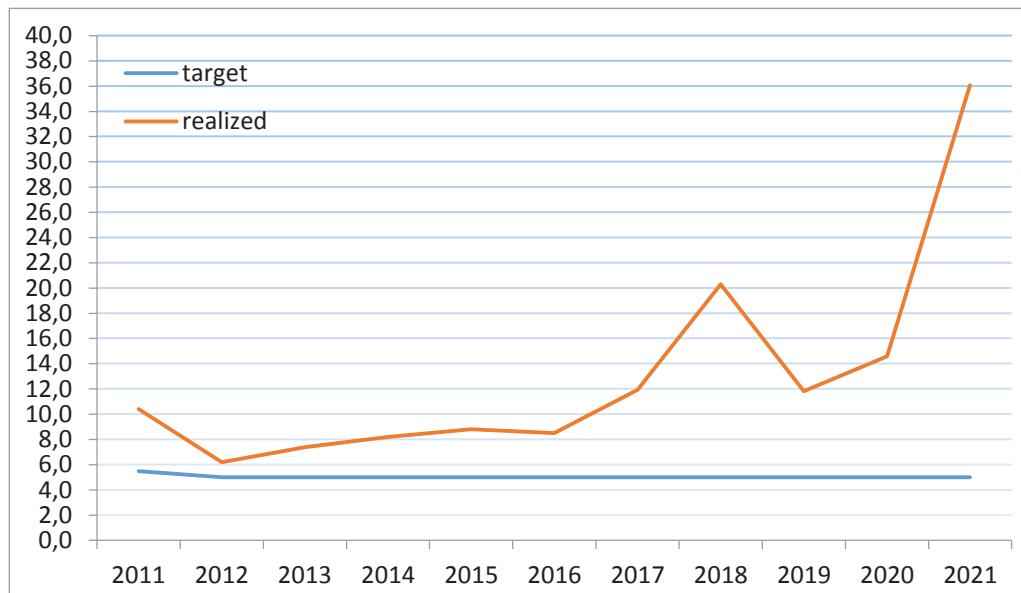
In order to control inflation expectations, it was decided to raise the policy rate by 200 basis points in September and 475 basis points in November. In December, the policy rate was raised from 15 percent to 17 percent, taking into account the 2021 year-end forecast target (CBRT, 2020).

In the first two quarters of 2021, the negative effects of the pandemic and global financial tightening continued on the economy, and economic activity continued, mostly due to domestic demand. Supply-related problems, the increase in international food and commodity prices, and excessive volatility in exchange rates had major and negative effects on inflation. Domestic demand and net exports continued to furnish annual growth in the third quarter, the annual growth rate was 7.4 percent, and the quarterly growth rate was 2.7 percent in this period. The increasing rate of vaccination throughout society had a positive influence on services, tourism, and related sectors and economic activities, which were unfavorably affected by the pandemic. In 2021, exports remained strong with the contribution of the rapid healing in global demand, while imports remained at a relatively low level despite the upswing in economic activity. A significant increase was observed in service revenues in the third quarter with the increasing rate of vaccination throughout society and the lifting of pandemic-related restrictions. Thus, despite the rally in commodity prices, the current account balance improved with the recovery of foreign trade and service revenues. Producer and consumer inflation continued to accelerate in the third and fourth quarters of the year. Addendum to exchange rate fluctuations, upward rally in commodity and energy prices, and supply constraints played an important role in this acceleration. In March, The CBRT implemented strong monetary tightening, a front-loaded rate hike, and increased the policy rate from 17 percent to 19 percent. In the second quarter of 2021, it was stated that the monetary stance will reduce inflation, and within this framework, the CBRT kept the policy rate at the same level in the April-August period but, cut down it by 500 basis points in total in the September-December period. With the monetary tightening in March starting to reduce credits, there has been a significant increase in consumer credit as of the end of May. It was considered that this increase is mainly due to the deferred demand because of the pandemic-related restrictions. After the

judgments taken by the Banking Regulation and Supervision Agency (BRSA) in July and September in order to return consumer credit growth to a moderate course, and the revisions made in the monetary policy stance as of September, a recovery was observed in the commercial credit growth (CBRT, 2021).

With the announcement dated December 21, 2021, the CBRT announced that, in order to enhance the share of the Turkish lira in the total deposit/participation funds in the banking system, will be exempted from the reserve requirement obligation, and persons will be supported, on condition that domestic natural persons convert their foreign exchange deposit accounts and participation funds into Turkish lira deposits and participation accounts (CBRT, 2021).

Graph 5, Inflation Target and Realized Inflation



(created with CBRT data)

Except for 2010 (target was 6.5 percent, the realization was 6.4 percent) and 2012 (target was 5 percent, the realization was 6.2 percent), even approaching was not possible to the 5 percent inflation target determined by the CBRT and the government. After 2017, this situation worsened with the excessive depreciation of the Turkish Lira. In this case, the fact that the CBRT, whose ultimate goal is price stability, has persistently set the inflation target as 5 percent since 2012, undermines credence in the CBRT and its monetary and exchange rate policy.

1.8. LITERATURE REVIEW

In this section, a literature review of various empirical studies on the relationship between interest rates, exchange rates, and the main macro variables for Turkey and other countries is presented.

C. A. Sims (1992) in their study reviewed the outcomes of monetary policy for 5 countries; France, Germany, Japan, the United Kingdom, and the United States for the 1957:1964 – 1989:1991 period. Found that the reaction to the interest rate innovations varies across countries, especially the Exchange rates' response, but to the interest rate shock CPI responded as increasing in every country, and output (industrial production) responded as declining although its response initially fluctuated.

Smets and Wouters (1999) examined the exchange rate channel in Germany for the 1974-1997 period with the VAR model and found that the exchange rate appreciated harshly as a reaction to a raise in the day-to-day rate. Consumer prices fell relatively quickly. Real GDP fell significantly after two quarters and then returned to its starting point. In conclusion, on GDP, the interest and exchange rate channels have different consequences. The interest rate channel leads to the improvement of the trade balance, while the exchange rate channel leads to its deterioration.

Mishkin (1991), in his study covering the 1964-1986 period, examined the both short term and long-term subsistence of the Fisher effect on the US economy. He used OLS and cointegration test methods in his study in which monthly and twelve-month treasury bills interest rate and inflation rate variables were used. The results obtained in the study show that interest rates and inflation are strongly correlated; in the long run, the Fisher effect is present in the US economy, while in the short run is not.

Camarero & Ordóñez & Tamarit (2002) in their study, using the data of Spain for the period 1986-1998, as a result of the SVAR, VECM analysis that they conducted, a monetary contraction which creates a shock in short-term interest rates, caused general price level declining weakly, output shrinking and exchange rate appreciation. In conclusion, monetary policy has a scant but lasting impact on real activity and the interest and exchange rate channels both are efficacious.

Boughara (2009), investigated the monetary transmission mechanism in Morocco and Tunisia for the period 1989 – 2005 and concluded that for Morocco, the

Exchange rate appreciated, Industrial Production decreased, and CPI increased as a response to the interbank rate shock. For Tunisia, the Exchange rate was appreciated, real GDP decreased, and CPI increased as a response to a shock in the Money market rate. The results show that the exchange rate channel is effective in both countries.

Başçı et.al. (2007), in their study that examines the monetary transmission mechanism channels for Turkey, the increase in the interest rate slows down economic activity by reducing the use of credit, improves inflation expectations, and leads to the appreciation of the TL. In conclusion, monetary policy is successful in influencing the main macroeconomic variables.

Kasapoğlu (2007), in their study for the period 1990 - 2006, showed that the nominal exchange rate reacted to the interest rate shock by increasing, contrary to expectations, and IPI and inflation increased as a response. To the exchange rate shock, they found that the IPI's response was not statistically significant, while inflation responded by rising. In conclusion, the traditional interest rate channel works effectively in Turkey, and, although the exchange rate channel has no efficacy in being determinative of the production level, it significantly affects the general level of prices.

Örnek (2009) examined which of the monetary transmission channels works effectively in Turkey using the VAR method for the period 1990-2006. It has been observed that the real exchange rate and production react to the interest rate shock by falling, while the inflation response is statistically insignificant, and the interest rate has high explanatory power of exchange rate, real production, and inflation fluctuations. In Turkey's case, traditional interest rate and exchange rate channels are effective but stock prices and bank credit channels do not give statistically significant results.

Obansa S. A. J., et al. (2013) examined the exchange rate, interest rate and growth relations for Nigeria case, during the 1970-2010 period with VAR analysis. Their analysis resulted as the exchange rate has a stronger effect on economic growth than the interest rate, the effect of interest rate on growth is positive, but its effect decreases over time.

Erdoğan and Yıldırım (2008), investigated the efficacy of the exchange rate channel with the VAR model, for the period 1995:1 – 2006:12. In their study, to an interest rate shock, the real exchange rate and the real GDP responded by decreasing, and the inflation responded by rising. The exchange rate channel is efficient in Turkey.

Büyükkakin et al. (2009) examined the exchange rate channel in Turkey for the period 1990:1 -2007:9, and the response of the real exchange rate, net exports, production, and prices to the monetary policy interest rate shock was estimated. Accordingly, it has been shown that the real exchange rate, net exports, and GDP decreased and inflation increased as a response to the interest rate shock. The monetary policy alterations affect real variables was concluded.

In their study, Cambazoğlu and Karaalp (2012) investigated the exchange rate's efficiency on total output and especially the price level for the period 2003-2010 with the VAR model. It has been observed that the real exchange rate, net exports, and IPI respond to the interest rate shock by falling, while the CPI, although initially falling, rapidly increases afterward. They observed that the exchange rate channel and the interest channel are effective in Turkey.

Sever and Mızrak (2007), in their study examining inflation, interest, and exchange rates relationship with the VAR method for the period 1987-2006, found that exchange rate and inflation reacted to the interest rate shock by increasing but not drastic and that the reaction of inflation to the exchange rate shock was increasing and sharp. It has been concluded that the explanatory power of the exchange rate to inflation is high.

Topçu (2008) examined the functioning of the foreign exchange channel in Turkey with the VAR method for the period 1989 – 2007 and concluded that the interest and real exchange rates had significant effects on the real economy.

In the study of Okur (2017), it was examined whether the exchange rate and interest rate channel works effectively for the period 2008:1-2016:4. A causality amidst exchange rate and interest rate and inflation was observed, and since the interest and exchange rates explain fluctuations of inflation the most, the exchange rate channel of monetary transmission is effective in Turkey, they concluded.

Bozkurt (2021), used the Granger Causality and VAR method for the period of 2011 - 2021 and found that the alterations in the bond interest rate were the Granger cause of the exchange rate, and the changes in the exchange rate were the Granger cause of inflation. It has been observed that the biggest determinant of fluctuations in inflation is the exchange rate, and fluctuations in the exchange rate accelerate inflation by causing significant cost increases in the Turkish economy, which exhibits economic

growth based on external inputs. Accordingly, it was concluded that the effect of bond rates on inflation was indirectly realized through the exchange rate channel.

Karaca (2005), in their analysis made with the data of the 1990:01-2005:07 period, a meaningful relationship wasn't found amid the exchange and interest rate series that they used. When the research was carried out only for the floating exchange rate period, a positive but weak relationship was found between the two variables.

In the study of Uçak and Şahan (2019), with VAR and VECM models, interest rate, inflation, exchange rate, and growth interrelations for the period of 2006 - 2017 were examined. It is concluded that risings in interest rates affect the exchange rate, inflation, and economic growth, negatively. Alterations in interest rates have effects on other macroeconomic indicators.

Title	Monetary Shocks, The Exchange Rate, and The Trade Balance	Exchange Rate versus Monetary Aggregate Targeting: The Turkish Case
Author(s)	Faik Koray, W. Douglas McMillin	Kerim Peren Arin, Timur Han Gur
Year	1999	2009
Country	United States	Turkey
Method	VAR	VAR
Period	1973:01–1993:12, monthly	1986:2 - 2000:3, quarterly
Variables	IPI, CPI, Commodity Prices, Federal Funds Rate, Total Reserves, Nonborrowed Reserves, Foreign IPI, Foreign CPI, Foreign Short-term Interest Rate, Nominal Exchange Rate, Real Trade Balance	Exchange Rate (TL/\$), IPI, CPI, M2 Money Supply (Real), Interbank Rate, Trade Balance
Conclusion(s)	The real exchange rate and trade balance reacted to an increase shock in the federal funds rate by increasing. Although the initial responses of the industrial product and US CPI were not statistically significant, industrial product decreased and CPI increased within the first period examined.	Study's results suggested that exchange rate targeting is not appropriate for Turkey. Industrial production declined and the trade balance increased, as a response to the exchange rate shock. On the other hand, although the CPI initially reacted in a downward direction, it began to show a continuous upward trend in a short time.

Monetary Transmission and Bank Lending in Turkey	Bank Lending Channel of Monetary Transmission in Turkey	Transmission of Credit Channel of Monetary Policy in Turkey: The VAR Approach
Lokman Gündüz	Harun Öztürkler, Affan Hakan Çermikli	Murat Belke, Harun Kaya
2001	2007	2017
Turkey	Turkey	Turkey
VAR	VAR	VAR
1986 - 1998, monthly	1990 - 2006, monthly	2003:1-2016:12, monthly
Wholesale Price Index, Securities Holdings of Banks, Total Bank Loans, Total Bank Deposits, Overnight Interbank Rate, IPI, USD/TRY Real Exchange Rate	Interest Rate, IPI, Wholesale Price Index, M1 Money Supply	CPI, IPI, M2 Money supply, BIST Overnight Repo Rate, Securities Holdings of Banks, Total Bank Loans
The increase in the interest rate causes the dollar exchange rate to appreciate in the first stage, but it results in its depreciation later on. Industrial production reacted as sharply and continuously declined. The initial increase in real activities is not statistically significant. Contractionary monetary policy effected after the second month. The general price level rises with a reaction following the contractionary monetary policy. Exchange rate channel is effective.	It is concluded that the interest rates hike causes an increase in inflation. expansionary monetary policies led to currency appreciation. It has been concluded that interest rate and exchange rate channels work in opposite directions in Turkey.	Industrial production responded to the interest rate shock by falling, while inflation responded by accelerating. In line with the findings obtained from the impulse-response functions, it was concluded that the credit channel is partially effective.

Money Transmission Mechanism in Turkey: Structural VAR Analysis	Relationship Between The Inflation And Nominal Interest Rate: The Case Of Turkey (2004-2013)	The Causal Relationship between Inflation and Interest Rates: The Case of Turkey
Yusuf Ekrem Akbaş, Fatma Zeren, Halil Özekicioğlu	Musa Atgür, N. Oğuzhan Altay	Buhari Doğan, Ömer Eroğlu, Osman Değer
2013	2015	2016
Turkey	Turkey	Turkey
SVAR	DOLS	VAR
2005:01-2013:07, monthly	2004:01 - 2013:12, monthly	2003:01-2015:02, monthly
IPI, USD/TRY Exchange Rate, One-month Deposit	IPI, Three-month Deposit Rate	CPI, Government Bonds Yield

Rate		
It was concluded that the Monetary transmission mechanism is effective in the short run as a result of structural VAR analysis. Therefore, it was apprehended that interest rate and exchange rate shocks have short-term effects on industrial production in Turkey.	The results of this study that covers the period 2004-2013 in Turkey, showed the existence of a long-run relationship between the inflation rate and the nominal interest rate.	According to the results of the analysis, it was concluded that, while there is no causal relationship from the interest rate to the inflation rate, there is a causality from inflation to interest rates.

The Relationship Between Current Account Balance – Real Exchange Rate: The Instance of Turkey	Exchange Rate, Inflation and Interest Rate Relationship in Turkey: 2009-2017 Application	The Effect of Interest Rates on Inflation and Economic Activities: The Case of Turkey
Levent Soner	Hüseyin İřcan, Ayře Durgun Kaygısız	Serap Dursun Güvenbař
2017	2019	2021
Turkey	Turkey	Turkey
ARDL	VAR	VAR
1998:01 - 2016:12, monthly	2009:01-2017:12, monthly	2010-2020
Real Exchange Rate, Current Account, GDP, Oil Prices (USD)	Real Effective Exchange Rate, CPI ve Government Bonds Yield	CBRT Weighted Average Funding Rate, Budget Deficit, Current Account, Unemployment, GDP, CPI, PPI
As a result of the model estimation, there are long-term interrelations between current account, the real exchange rate, real output, and oil price. The model confirms the theory that the real exchange rate and gross domestic product affect the current account negatively. In addition, it has been determined that the changes in oil prices affects current account, significantly.	It has been concluded that the exchange rate fluctuations creates fluctuations in inflation and interest rates, both, meanwhile inflation is the creates changes in interest rates. According to the impulse-response analysis, the interest rate reacted negatively for 12 periods, while inflation reacted negatively from the sixth period to a shock in the exchange rate. The star factor that explains inflation and interest rate changes is the exchange rate.	In this study, it was seen that while the increases in interest rates increase the budget deficit, current account deficit, and unemployment rates, they decrease growth and CPI. There is unidirectional causality from interest to the budget deficit, current account deficit, unemployment, and CPI. There was found Granger causality from interest rates to inflation but not vice versa.

In the studies that examine relationships between economic variables in Turkey, in general, it was concluded that the monetary policy instruments, specifically the interest rate that is used in our study, were effective on the real variables in the economy, particularly on inflation.

1.9. METHOD

Within the framework of the method used in the study, the first thing was investigating the stationarity of the series. For this purpose, descriptive statistics and correlation coefficients of the variables were examined, and Augmented Dickey-Fuller (ADF), Philips Perron (PP) test, and Kwiatkowski, Philips, Schmidt, and Shin (KPSS) unit root tests that are conducted, it was investigated whether the series contained a unit root. Non-stationary series were included in the VAR analysis after taking their first difference $I(1)$ that is, making them first-order integrated series at 1% significance value, and turning them into stationary. That all variables are treated as being endogenous, in this respect, there is no difficulty in deciding which variables are internal and which are external, and the application of the method is simple are among the advantages of VAR models. (Gujarati, 2001: 749-750). Granger causality analysis, which was proposed by Granger (1969) and improved by Sims (1972) in the following years, was applied to investigate the causality relationship between the series. Afterward, the SVAR model was built and the analysis was made with impulse response functions. Finally, the source of the change in the variables was examined with the variance decomposition method in the study.

1.9.1. UNIT ROOT TESTS

Sims (1980) stands against differencing even if the variables are not stationary. Because according to them, the goal of VAR analysis is to define the interrelationships

among the variables, not the parameter estimates. The main counter-argument of them against differencing is that it “throws away” information concerning the comovements in the data (Enders, 1995). However, Granger and Newbold showed that the false regression problem might occur in the results obtained using non-stationary time series. The mean, variance, and covariance of stationary series do not change over time. In non-stationary variables, t , Z , and F distributions cannot be used, and therefore many standard hypotheses become unusable (Granger, Newbold, 1974: 111–120). Therefore, in the first stage of the analysis, the stationarity of the series will be investigated with ADF, PP, and KPSS tests.

ADF models;

Without constant and trend,
$$\Delta Y_t = \gamma Y_{t-1} + \beta_i \sum_{i=1}^m \Delta Y_{t-1} + u_t$$

With constant,
$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \beta_i \sum_{i=1}^m \Delta Y_{t-1} + u_t$$

With constant and trend,
$$\Delta Y_t = \alpha_0 + \alpha_1 t + \gamma Y_{t-1} + \beta_i \sum_{i=1}^m \Delta Y_{t-1} + u_t$$

The null hypothesis of the ADF unit root test is $H_0 : \gamma = 0$, Y variable contains unit root, while alternative hypothesis $H_1 : \gamma < 0$, Y variable does not contain unit root, that the variables have a stationary structure. If the variables have unit root at the $I(0)$ level, it is concluded that they are not stationary, have unit root, if the variables have stationary structure after differentiating, they are $I(1)$. Detailed explanations of unit root tests with time series analysis, and the case of cointegrated variables, can be found in the study (Dickey & Fuller, 1979).

Another commonly used unit root test in the studies is the Phillips Perron (PP) unit root test. This test is a non-parametric test that allows correction in error terms to solve the problem, considering that DF and ADF unit root analyzes are not useful when the relevant assumptions can not be adopted. The models for the PP unit root test are given below;

$$Y_t = \mu + \Phi^1 Y_{t-1} + u_t$$

$$(1 - \Phi^1 L) Y_t = \mu + u_t \quad (\text{Phillips \& Perron, 1988})$$

In the PP unit root test, the null hypothesis is that the series contains unit root. This unit root test, may not adopt the assumptions that the mean of the error terms is equal to zero, there is no autocorrelation, and the variance is constant.

The KPSS unit root test, proposed by Kwiatkowski, Phillips, Schmidt, and Shin, which is another unit root test frequently used in the literature, tests whether the series will be stationary if it is removed the deterministic trend contained in the series. Model of KPSS unit root test;

$$y = x_t \delta + u_k$$

Here x_t is a deterministic complementary element that covers constant and constant trend, the null hypothesis is established as $H_0 : \delta < 1$, the series have no unit root. The alternative hypothesis is established as $H_1 : \delta = 1$.

1.9.2. THE VAR MODEL

The VAR model proposed by Sims with few constraints on the structure of the economy, is a dynamic system that contains the relationships between each variable's own value and the past values of all other variables in the system. Generally, it is frequently used in the analysis of the dynamic effect of changes in the variables within the system on other variables.

Sims criticizes existing models that investigates macroeconomic theories because of containing too many restrictions within a single or few equations. Sims(1980) argues that:

“It should be feasible to estimate large-scale macromodels as unrestricted reduced forms, treating all variables as endogenous.”

The tools that work with the VAR model such as Granger causality, the impulse response analysis, and variance decompositions can be practical in comprehending the relationships between economic variables and in shaping a more well-structured economic model (Enders, 1995).

VAR is useful for describing multivariate high-order systems. A two-variable first-order VAR system can be written as;

$$y_t = b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon y_t \quad (4.10)$$

$$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon z_t \quad (4.11)$$

Under these assumptions;

(1) Both y_t , and z_t series are stationary,

(2) εy_t and εz_t are error terms that are uncorrelated and have σ_y and σ_z standard deviations, respectively.

In the system above, y_t and z_t are interrelated series. For example, $-b_{12}$ reflects the effect of z_t 's change on present value of y (y_t), γ_{21} reflects the effect of change of one-period before value of y_t (y_{t-1}) on present value of z (z_t). The terms εy_t and εz_t represent pure shocks in y_t and z_t . If b_{21} is not equal to zero, εy_t has an indirect effect on z_t , synchronously, if b_{12} is not equal to zero, εz_t has an indirect effect on y_t , synchronously.

(4.10) and (4.11) are not very useful equations since both y_t and z_t have simultaneous effects on each other. By using matrix algebra, this system can be transformed into a more useful form;

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon y_t \\ \varepsilon z_t \end{bmatrix} \quad (4.12)$$

$$Bx_t = \Omega_0 + \Omega_1 x_{t-1} + E_t$$

$$B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \quad x_t = \begin{bmatrix} y_t \\ z_t \end{bmatrix} \quad \Omega_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} \quad \Omega_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \quad E_t = \begin{bmatrix} \varepsilon y_t \\ \varepsilon z_t \end{bmatrix}$$

When this is multiplied by B^{-1} ;

$$X_t = A_0 + A_1 x_{t-1} + e_t \quad (4.13)$$

$$A_0 = B^{-1} \Omega_0$$

$$A_1 = B^{-1} \Omega_1$$

$$e_t = B^{-1} E_t$$

If equation (4.13) is shown in a form like this;

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + e1_t \quad (4.14a)$$

$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + e2_t \quad (4.14b)$$

VAR in a standard form is obtained. And the system ((4.10) and (4.11)) that we derived (4.14a) and (4.14b) (the standard form) is called “primitive system” or “structural VAR”.

The error terms $e1_t$ and $e2_t$, are syntheses of the εy_t and εz_t shocks and since $e_t = B^{-1}\varepsilon_t$, we can derive $e1_t$ and $e2_t$ as;

$$e1_t = \frac{(\varepsilon y_t - b_{12}\varepsilon z_t)}{(1 - b_{12}b_{21})} \quad (4.15)$$

$$e2_t = \frac{(\varepsilon z_t - b_{21}\varepsilon y_t)}{(1 - b_{12}b_{21})} \quad (4.16)$$

1.9.3. THE STRUCTURAL VAR

Economic theories contain behavioral, structural, and/or reduced form relationships that can be incorporated into a VAR analysis. In a Structural VAR, the restrictions of a particular economic model are imposed on the contemporaneous relationship among the variables. The dynamic response of each variable to various economic shocks can be obtained and the restrictions of the model tested (Enders, 1995). Unless the structural VAR model parameters are appropriately restricted, it cannot be estimated with standard VAR model parameters. VAR in a standard form has 9 parameters - 6 coefficient estimates ($a_{10}, a_{11}, a_{12}, a_{20}, a_{21}, a_{22}$) and $\text{var}(e1_t)$, $\text{var}(e2_t)$, and $\text{covar}(e1_t, e2_t)$. Since the primitive system “structural VAR” includes 10 parameters (two intercept coefficients b_{10} and b_{20} , four autoregressive coefficients $\gamma_{11}, \gamma_{12}, \gamma_{21}$, and γ_{22} , two

feedback coefficients b_{12} and b_{21} , and the two standard deviations σ_y and σ_z), one of the parameters has to be restricted to estimate Structural VAR. If this is generalized to a model with p lags: Imposing $(n^2 - n)/2$ restrictions on the structural model is requisite for building the structural model from VAR in a standard form.

$$y_t = b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon y_t \quad (4.10)$$

$$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon z_t \quad (4.11)$$

According to the system proposed by Sims (1980), under the $b_{21} = 0$ restriction, the Structural VAR system; .

$$\begin{aligned} y_t &= b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon y_t \\ z_t &= b_{20} + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon z_t \end{aligned} \quad (4.17)$$

In this system it is seen that z_t have a synchronous impact on y_t but under the restriction $b_{21} = 0$, y_t does not have a synchronous impact on z_t .

$$\begin{bmatrix} 1 & b_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon y_t \\ \varepsilon z_t \end{bmatrix}$$

When this equation is multiplied by $B^{-1} = \begin{bmatrix} 1 & -b_{12} \\ 0 & 1 \end{bmatrix}$

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} 1 & -b_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} 1 & -b_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & -b_{12} \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon y_t \\ \varepsilon z_t \end{bmatrix}$$

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} - b_{12}b_{20} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} - b_{12}\gamma_{21} & \gamma_{12} - b_{12}\gamma_{22} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon y_t - b_{12}\varepsilon z_t \\ \varepsilon z_t \end{bmatrix} \quad (4.18)$$

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + e_{1t} \quad (4.14a)$$

$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + e_{2t} \quad (4.14b)$$

If it is matched that parameters of equation (4.14a) and (4.14b)- The VAR in standard form with (4.18) matrix equation;

$$a_{10} = b_{10} - b_{12}b_{20}$$

$$a_{11} = \gamma_{11} - b_{12}\gamma_{21}$$

$$a_{12} = \gamma_{12} - b_{12}\gamma_{22}$$

$$a_{20} = b_{20}$$

$$a_{21} = \gamma_{21}$$

$$a_{22} = \gamma_{22}$$

$$\text{var}(e1_t) = \sigma_y^2 + b_{12}^2 \sigma_z^2$$

$$\text{var}(e2_t) = \sigma_z^2$$

$$\text{covar}(e1_t, e2_t) = -b_{12}\sigma_z^2$$

$$e1_t = \epsilon y_t - b_{12}\epsilon z_t$$

$e2_t = \epsilon z_t$ shows that, since ϵy_t and ϵz_t are representing terms of pure shocks in y_t and z_t sequences, both ϵy_t and ϵz_t shocks affect y_t , synchronously, but only ϵz_t shock affects z_t , synchronously. This estimation method with coefficient restriction is called Choleski Decomposition.

1.9.4. GRANGER CAUSALITY

Granger causality analysis, introduced by Granger (1969), is tested whether a time series can be used to predict another time series. Under "the error terms are uncorrelated" assumption;

Granger Causality Analysis models;

$$y_t = \sum_{i=1}^m \alpha_i y_{t-i} + \sum_{j=1}^m \beta_j z_{t-j} + \varepsilon_{1t} \quad (4.19)$$

$$z_t = \sum_{i=1}^m \lambda_i z_{t-i} + \sum_{j=1}^m \delta_j y_{t-j} + \varepsilon_{2t} \quad (4.20)$$

While the null hypothesis that used in the analysis is $H_0 : \beta_j = 0$, z is not the Granger cause of y , the alternative hypothesis is $H_1 : \beta_j \neq 0$, z is the Granger cause of y .

If the α_i coefficients in equation (4.19) are statistically different from zero while β_j coefficients are not, one-way causality is mentioned from the z_t variable to the y_t variable. This causality between the variables is represented as $z_t \Rightarrow y_t$. If the λ_i coefficients in equation (4.20) are statistically different from zero while δ_j coefficients are not, there is one-way causality as $y_t \Rightarrow z_t$. If all the coefficients ($\alpha_i, \delta_j, \lambda_i, \beta_j$) in both equations are statistically different from zero, this indicates mutual causality ($y_t \Leftrightarrow z_t$) between the variables, and no causal relationship between the variables if all the coefficients are not statistically different from zero.

The most commonly used to test the significance of the mentioned coefficients is the F-Test. $H_0 : \alpha_1 = \alpha_2 = \dots = \alpha_n = 0$ hypothesis, m and $(n-k)$ degrees of freedom;

$$F = \frac{(RSS_r - RSS_{ur}) / m}{RSS_{ur} / (n - k)}$$

RSS_r : restricted models residual sum of squares

RSS_{ur} : unrestricted models residual sum of squares

The Granger causality test is responsive to the selected lag length in the VAR model. Therefore, before applying the Granger causality test, the appropriate lag lengths of the variables to be used in the VAR model should be determined (Gujarati, 2001, p. 620-1).

1.9.5. THE IMPULSE-RESPONSE FUNCTIONS

Matrix form of equation (4.14a) and (4.14b);

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \quad (4.21)$$

The first-order VAR model (4,13) is when iterated backward;

$$X_t = A_0 + A_1 X_{t-1} + e_t \quad (4.13)$$

$$x_{t-1} = A_0 + A_1 x_{t-2} + e_{t-1}$$

$$X_t = A_0 + A_1(A_0 + A_1 x_{t-2} + e_{t-1}) + e_t$$

$$= (I + A_1)A_0 + A_1^2 x_{t-2} + A_1 e_{t-1} + e_t$$

I is a 2x2 identity matrix

After n iterations;

$$X_t = (I + A_1 + \dots + A_1^n)A_0 + \sum_{i=0}^{n-1} A_1^i e_{t-i} + A_1^{n+1} x_{t-n-1}$$

if iterate backwards over and over again, the expression A_1^n to vanish as n approaches infinity as convergence's prerequisite;

$$X_t = \mu + \sum_{i=0}^{\infty} A_1^i e_t \quad (4.22)$$

Equation (4.22) is the Vector Moving Average(VMA) representation of equation (4.13). In this representation, the sequences y_t and z_t are expressed in terms of the present and past values of shocks e_{1t} and e_{2t} .

The VMA representation is a notable characteristic of Sims' (1980) methodology in that it enables one to see the time path of the effects of the various shocks on the variables contained in the VAR system (Enders, 1995).

$$\mu = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} \quad \bar{y} = \frac{[a_{10}(1-a_{22}) + a_{12}a_{20}]}{\Delta} \quad \bar{z} = \frac{[a_{20}(1-a_{11}) + a_{21}a_{10}]}{\Delta}$$

$$\Delta = (1 - a_{11})(1 - a_{22}) - a_{12}a_{21}$$

With (4.21) and (4.22) equations it can be written as;

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}_i \begin{bmatrix} e1_{t-i} \\ e2_{t-i} \end{bmatrix} \quad (4.23)$$

If equation (4.23) is rewritten in terms of εy_t and εz_t ;

$$\begin{bmatrix} e1_t \\ e2_t \end{bmatrix} = \frac{1}{(1 - b_{12}b_{21})} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} + \begin{bmatrix} \varepsilon y_t \\ \varepsilon z_t \end{bmatrix} \quad (4.24)$$

When (4.23) and (4.24) equation is written together;

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y}_t \\ \bar{z}_t \end{bmatrix} + \frac{1}{(1 - b_{12}b_{21})} \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}_i \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} + \begin{bmatrix} \varepsilon y_t \\ \varepsilon z_t \end{bmatrix}$$

$$\delta = \frac{A_1^i}{(1 - b_{12}b_{21})} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix}$$

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \delta_{11}(i) & \delta_{12}(i) \\ \delta_{21}(i) & \delta_{22}(i) \end{bmatrix} \begin{bmatrix} \varepsilon y_{t-i} \\ \varepsilon z_{t-i} \end{bmatrix} \quad \text{or, simply;}$$

$$X_t = \mu + \sum_{i=0}^{\infty} \delta_i \varepsilon_{t-i} \quad (4.25)$$

The coefficients of δ_i can be employed as the shocks εy_t and εz_t to the y_t and z_t sequences. Four elements of $\delta_{jk}(0)$ matrix are called as impact multipliers. For example, the element $\delta_{12}(0)$ represents the instantaneous response of the y_t sequence to a one-unit change in the εz_t shock, and the element $\delta_{11}(1)$ represents the one-period response of the y_t sequence to a one-unit change in the $\varepsilon_{y_{t-1}}$ shock.

The toted-up effects of changes in εy_t and/or εz_t can be captured by summation of the impulse response function coefficients. For example, the effect of ε_{z_t} on the y_{t+n}

sequence (y_t at the end of n periods) is $\delta_{12}(n)$. If this is generalized, the cumulative effects of ε_{zt} on the y_t sequence at the end of n periods are;

$$\sum_{i=0}^n \delta_{12}(i)$$

The vector moving average (VMA) representation is especially useful for capturing the interaction of the y_t and z_t sequences. However, this methodology cannot be used for estimating under identified Structural VAR model. It must be adopted a restriction on the two-variable VAR system in order to identify the impulse responses (Enders, 1995). This problem can be solve by using Choleski Decomposition.

1.9.6. VARIANCE DECOMPOSITION

The variance decomposition of forecast error is used for analyzing changes in a series in what proportion occurs due to its own shocks and/or in what proportion occurs due to changes in other variables.

Vector Moving Average representation of the VAR model is useful for representing forecast errors as ε_t sequence. If (4.25) equation is used for estimating x_{t+1} , the one-step ahead forecast error is $\delta_0 \varepsilon_{t+1}$. If this is generalized;

$$X_t = \mu + \sum_{i=0}^{\infty} \delta_i \varepsilon_{t-i} \quad (4.25)$$

When equation (4.25) iterate by n periods ahead;

$$X_{t+n} = \mu + \sum_{i=0}^{\infty} \delta_i \varepsilon_{t+n-i}$$

Forecast error is described as difference between the observed value and the expected value. Therefore, n -step ahead forecast error;

$$X_{t+n} - E X_{t+n} = \sum_{i=0}^{n-1} \delta_i \varepsilon_{t+n-i} \quad (4.26)$$

If equation (4.26) adapted to y_t , n -step ahead forecast error of y_t is;

$$Y_{t+n} - E_t Y_{t+n} = \delta_{11}(0)\varepsilon_{y_{t+n}} + \delta_{11}(1)\varepsilon_{y_{t+n-1}} + \dots + \delta_{11}(n-1)\varepsilon_{y_{t+1}} + \delta_{12}(0)\varepsilon_{z_{t+n}} + \delta_{12}(1)\varepsilon_{z_{t+n-1}} + \dots + \delta_{12}(n-1)\varepsilon_{z_{t+1}}$$

The variance of the n -step ahead forecast error variance of y_{t+n} as $\sigma_y(n)^2$;

$$\sigma_y(n)^2 = \sigma_y^2 [\delta_{11}(0)^2 + \delta_{11}(1)^2 + \dots + \delta_{11}(n-1)^2] + \sigma_z^2 [\delta_{12}(0)^2 + \delta_{12}(1)^2 + \dots + \delta_{12}(n-1)^2]$$

Considering that the $\delta_{jk(i)^2}$ coefficients cannot be less than zero, the variance of the forecast error will increase as the forecast period (n) increases. Therefore the proportions of $\sigma_y(n)^2$ due to the shocks ε_{y_t} and ε_{z_t} sequences are;

$$\frac{\sigma_y^2 [\delta_{11}(0)^2 + \delta_{11}(1)^2 + \dots + \delta_{11}(n-1)^2]}{\sigma_y(n)^2} \quad \text{and} \quad \frac{\sigma_z^2 [\delta_{12}(0)^2 + \delta_{12}(1)^2 + \dots + \delta_{12}(n-1)^2]}{\sigma_y(n)^2}$$

The Variance Decomposition shows the proportion of the sequence's own shocks and other variable's shocks, in the changes in a sequence. If ε_{z_t} shock explain by zero proportion of the forecast error variance of y_t at all forecast horizons, this means that the y_t sequence is exogenous, the y_t sequence is independent of the ε_{z_t} shocks, and z_t sequence. At the other extreme, if ε_{z_t} shocks explain all the forecast error variance of the y_t sequence at all forecast horizons, this means that y_t is entirely endogenous.

“In applied research, it is typical for a variable to explain almost all its forecast error variance at short horizons and smaller proportions at longer horizons. We would expect this pattern if ε_{z_t} shocks had little contemporaneous effect on y_t , but acted to affect the y_t sequence with a lag” (Enders, 1995).

CHAPTER 2

2. ECONOMETRICS, ESTIMATION, AND FINDINGS

2.1. DATA

This study examines the interaction and relationship between interest rates, real effective exchange rate¹, current account, growth, and inflation with time series analysis. Rate on three-month time deposits as interest rate, real GDP for reflecting growth, and CPI for reflecting inflation is used. All series used in the study consist of quarterly data covering 22 years between 2000 Q1 – 2021 Q4. Logarithms of all variables except the “deposit” variable were taken to make the variables at the same level and the letter “L” was added to the symbols of the series to indicate this².

It was questioned whether there are seasonal effects in the variables. Except for the "curr_acc" variable, no seasonality was found in the series. The "curr_acc" variable was seasonally adjusted by the X13 ARIMA - SEATS method. To show that the time series are seasonally adjusted, the letters “sa” is added to the symbols of the series.

RStudio integrated development environment (IDE) for R was used for statistical analysis in the study.

The pattern of the series and distribution of them and, inferences that they are symmetrical or not are evaluated by looking at the skewness and kurtosis coefficients. The variables used for the series, descriptive statistics, and correlation coefficients are given in Table 2, Table 3, and Table 4 before the analyzes are made regarding the study.

¹ An increase indicates an appreciation of the economy’s currency against a broad basket of currencies, just as in CBRT EVDS real effective Exchange rate series.

² Since the "curr_acc" variable contains negative values, +23,000,000 was added to the whole series, since the smallest value of the series is -22,681,000, so that its logarithm can be taken, the series was made positive and its

logarithm was taken. The analysis was also made with the version that was not taken logarithm and the version that was made positive by adding 25.000.000 of the current account serie. As a result of the comparison, it was observed that the direction and size of the relations and responses did not change. Therefore, since it gives a smoother image in terms of scale, there was seen no harm in using the logarithm of the serie by adding the minimum value to make it positive.

Table 2, Variables

Variables	Symbols	Description	Source
deposit	deposit.ts	Rate on three-month time deposits denominated in national currency	IMF, International Financial Statistics (IFS)
real effective exchange rate	L_real_exc.ts	CPI based, period averages, 2010 = 100, broad (60 economies) indices	BIS (Bank for International Settlements), BIS statistic explorer
current account	sa_L_curr_acc_p.ts	USD millions	CBRT, EVDS, TP.ODEAYRSUNUM6.Q1, Balance of Payments Detailed Presentation (BPM6)
real GDP	L_real_gdp.ts	Chain-linked GDP, 2010 = 100	IMF, International Financial Statistics (IFS)
CPI	L_cpi1.ts	2010 = 100	CBRT, EVDS

Table 3, Summary Statistics

Variables	n	Mean	sd	Median	Min	Max	Skewness	Kurtosis
deposit.ts	88	0,246	0,150	0,200	0,110	0,870	2,180	4.550
L_real_exc.ts	88	4,368	0,194	4,422	3,785	4,627	-0,978	0,142
sa_L_curr_acc_p.ts	88	16,496	0,568	16,603	12,810	17,126	-3,620	19,188
L_real_gdp.ts	88	18,836	0,396	18,946	17,715	19,633	-0,750	0,271
L_cpi1.ts	88	4,606	0,671	4,633	2,914	5,812	-0,435	-0,153

Table 4, Correlation Coefficients

	deposit.ts	L_real_exc.ts	sa_L_curr_acc_p.ts	L_real_gdp.ts	L_cpi.ts
deposit.ts	1	-0,217842385	0,417609012	0,109787416	-0,683457399
L_real_exc.ts	-0,217842385	1	-0,324873959	0,868747128	-0,402155867
sa_L_curr_acc_p.ts	0,417609012	-0,324873959	1	-0,246366561	-0,178765437
L_real_gdp.ts	0,109787416	0,868747128	-0,246366561	1	-0,700396224
L_cpi.ts	-0,683457399	-0,402155867	-0,178765437	-0,700396224	1

The correlation coefficients for the related variables are included in Table 4 and the correlation coefficient is a representation of the changes that the series used in the study together. It takes values between 0 and 1, these values indicate the strength of the relationship between two variables.

2.2. FINDINGS

2.2.1. Unit Root Tests

For VAR analysis, the series in question must be subjected to some processing as a priority. First, whether the variables are stationary or not was tested by the Extended Dickey-Fuller (Augmented Dickey-Fuller: ADF) Test, Phillips – Perron Test, and Kwiatkowski – Phillips – Schmidt – Shin (KPSS) Test, which are commonly used in the literature. The letter “d” is added to the symbols of the non-stationary series to show that are transformed to stationary by taking their first difference.

Table 5, Unit Root Tests’ Results, I(0)

			test statistics	1 pct	5 pct	10 pct
deposit.ts	ADF	tau3	-2,9076	-4,0400	-3,4500	-3,1500

		phi2	2,9115	6,5000	4,8800	4,1600
		phi3	4,3351	8,7300	6,4900	5,4700
	PP	Z-tau	-2,1652	-4,0660	-3,4613	-3,1566
	KPSS	tau	0,3522	0,2160	0,1460	0,1190
L_real_exc.ts	ADF	tau3	-1,0262	-4,0400	-3,4500	-3,1500
		phi2	1,4719	6,5000	4,8800	4,1600
		phi3	1,7906	8,7300	6,4900	5,4700
	PP	Z-tau	-0,7049	-4,0660	-3,4613	-3,1566
	KPSS	tau	0,5213	0,2160	0,1460	0,1190
sa_L_curr_acc_p.ts	ADF	tau3	-3,6501	-4,0400	-3,4500	-3,1500
		phi2	4,4737	6,5000	4,8800	4,1600
		phi3	6,7102	8,7300	6,4900	5,4700
	PP	Z-tau	-3,7378	-4,0660	-3,4613	-3,1566
	KPSS	tau	0,2581	0,2160	0,1460	0,1190
L_real_gdp.ts	ADF	tau3	-1,2419	-4,0400	-3,4500	-3,1500
		phi2	1,5748	6,5000	4,8800	4,1600
		phi3	0,9803	8,7300	6,4900	5,4700
	PP	Z-tau	-1,2554	-4,0660	-3,4613	-3,1566
	KPSS	tau	0,3904	0,2160	0,1460	0,1190
L_cpi1.ts	ADF	tau3	-5,0225	-4,0400	-3,4500	-3,1500
		phi2	12,5286	6,5000	4,8800	4,1600
		phi3	13,1746	8,7300	6,4900	5,4700
	PP	Z-tau	-5,4142	-4,0660	-3,4613	-3,1566
	KPSS	tau	0,2254	0,2160	0,1460	0,1190

Table 6, Unit Root Tests' Results, I(1)

			test statistics	1 pct	5 pct	10 pct
d.deposit.ts	ADF	tau3	-6,6563	-4,0400	-3,4500	-3,1500
		phi2	14,7775	6,5000	4,8800	4,1600
		phi3	22,1637	8,7300	6,4900	5,4700
	PP	Z-tau	-5,5620	-4,0673	-3,4620	-3,1570
	KPSS	tau	0,0434	0,2160	0,1460	0,1190
d.L_real_exc.ts	ADF	tau3	-7,9137	-4,0400	-3,4500	-3,1500
		phi2	20,9280	6,5000	4,8800	4,1600
		phi3	31,3656	8,7300	6,4900	5,4700
	PP	Z-tau	-9,2452	-4,0673	-3,4620	-3,1570
	KPSS	tau	0,0494	0,2160	0,1460	0,1190
d.sa_L_curr_acc_p.ts	ADF	tau3	-7,7439	-4,0400	-3,4500	-3,1500
		phi2	19,9906	6,5000	4,8800	4,1600
		phi3	29,9859	8,7300	6,4900	5,4700
	PP	Z-tau	-9,9196	-4,0673	-3,4620	-3,1570

	KPSS	tau	0,0237	0,2160	0,1460	0,1190
d.L_real_gdp.ts	ADF	tau3	-5,1434	-4,0400	-3,4500	-3,1500
		phi2	8,9136	6,5000	4,8800	4,1600
		phi3	13,3477	8,7300	6,4900	5,4700
	PP	Z-tau	-7,0333	-4,0673	-3,4620	-3,1570
	KPSS	tau	0,1397	0,2160	0,1460	0,1190

As seen in Table 5, the stationarity of the variables used in the model was questioned by level. Except for the 'CPI' variable, it was found that all variables became stationary after taking the first difference (Table 6).

2.2.2. Optimal Lag Selection

In order for a VAR model to have correct results, as a first step, since VAR model highly sensitive to determined lag, it is necessary to decide the optimal lag length. In the VAR system with lag length p and consisting of n variables, each equation contains $n \cdot p$ coefficient and 1 constant term. Therefore, an increase in the lag length will cause a decrease in the degrees of freedom. For this reason, the optimal lag length should be short enough to not cause a loss in information about the interaction of the series with each other. Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQC), Schwarz Criterion (SC), and Final Prediction Error (FPE) were used to determine the optimal lag for the model. The values obtained according to the mentioned criteria are presented in Table 7.

Table 7, Optimal Lag Selection

	X1	X2	X3	X4	X5	X6
AIC(n)	-28,643030	-29,094393	-28,904406	-28,912887	-28,991795	-29,045797
HQC(n)	-28,287221	-28,442076	-27,955582	-27,667556	-27,449956	-27,207451
SC(n)	-27,756197	-27,468532	-26,539518	-25,808972	-25,148852	-24,463827
FPE(n)	3,64E-13	2,33E-13	2,87E-13	2,95E-13	2,88E-13	2,98E-13

It is seen in Table 7 that the optimal lag length for the model is 2 according to AIC, HQC, and FPE criteria, and 1 according to the Schwarz criterion. Within the framework of these results, it was decided that the lag length of the model should be 2, which is supported by AIC, HQC, and FPE.

2.2.3. Ordering of The Variables

The Impulse-response function and variance decomposition results might change when there is a change in the ordering of the variables since they are calculated based on the structural VAR system that is estimated by using Choleski Decomposition. Because it is needed that a change in the restriction that is adopted, i.e. should it be $b_{12}=0$ or $b_{21}=0$. As it was seen earlier, under the $b_{21}=0$ restriction, z_t has a synchronous effect on y_t but y_t does not have a synchronous effect on z_t . Enders (1995) argues that the general procedure for determining the ordering of the variables is to compare the impulse-response function results obtained with the predicted order, with the impulse-response function results obtained with the changed order. If drastic changes have occurred in the results, the relationship between the variables and how should be the ordering of the variables should be investigated by other methods. Regarding that procedure, the impulse-response function results obtained from the model that is used in this study and the impulse-response function results obtained from the model that has reverse-ordered variables were compared and no significant changes were observed.

The ordering of the variables can be determined by Granger Causality as well as can be determined with respect to economic theory. In this study, it was considered appropriate to order the variables as “d.deposit.ts”, “d.L_real_exc.ts”, “d.sa_L_curr_acc_p.ts”, “d.L_real_gdp.ts”, and “L_cpi1.ts”, in line with the order in which they affect each other in the functioning of the monetary transmission mechanism.

2.2.4. The VAR Model

Table 8, VAR(2) Model Results

VAR Estimation Results:

=====

Endogenous variables: d.deposit.ts, d.L_real_exc.ts, d.sa_L_curr_acc_p.ts,
d.L_real_gdp.ts, L_cpi1.ts

Deterministic variables: const

Sample size: 85

Log Likelihood: 599.933

Roots of the characteristic polynomial:

0.9812 0.6431 0.6431 0.5279 0.5279 0.5105 0.5105 0.289 0.2309 0.2309

Call:

VAR(y = dset33, p = 2, type = "const", exogen = NULL)

Estimation results for equation d.deposit.ts:

```
=====
d.deposit.ts = d.deposit.ts.l1 + d.L_real_exc.ts.l1 + d.sa_L_curr_acc_p.ts.l1 +
d.L_real_gdp.ts.l1 + L_cpi1.ts.l1 + d.deposit.ts.l2 + d.L_real_exc.ts.l2 +
d.sa_L_curr_acc_p.ts.l2 + d.L_real_gdp.ts.l2 + L_cpi1.ts.l2 + const
```

	estimate	std. error	t-value	Pr(> t)		
d.deposit.ts.l1	0.573956	0.110192	5.209	1.65e-06	***	
d.L_real_exc.ts.l1	-0.109756	0.121161	-0.906	0.3679		
d.sa_L_curr_acc_p.ts.l1	0.001029	0.011633	0.088	0.9298		
d.L_real_gdp.ts.l1	0.088696	0.101863	0.871	0.3867		
L_cpi1.ts.l1	-0.165124	0.247772	-0.666	0.5072		
d.deposit.ts.l2	-0.286011	0.115729	-2.471	0.0158	*	
d.L_real_exc.ts.l2	-0.154652	0.107758	-1.435	0.1554		
d.sa_L_curr_acc_p.ts.l2	0.008128	0.011803	0.689	0.4932		
d.L_real_gdp.ts.l2	0.030395	0.081880	0.371	0.7115		
L_cpi1.ts.l2	0.156233	0.243427	0.642	0.5230		
const	0.045882	0.046184	0.993	0.3237		

signif. codes	0 '***'	0,001 '**'	0,01 '*'	0,05 '.'	0,1 ''	1

As it was seen in table 8, all of the roots of the characteristic polynomial (0.9812, 0.6431, 0.6431, 0.5279, 0.5279, 0.5105, 0.5105, 0.289, 0.2309, 0.2309) placing inside of the unit circle, $[-1, 1]$, therefore it can be said that the VAR(2) model examined in this study is stable.

Table 9, VAR(2) Model Diagnostics

serial correlation -
autocorrelation

Portmanteau Test (asymptotic)

data: Residuals of VAR object varmodel332
Chi-squared = 247.28, df = 250, p-value = 0.5367

heteroscedasticity

ARCH (multivariate)

data: Residuals of VAR object varmodel332
Chi-squared = 1155.4, df = 1125, p-value = 0.2581

normal distribution

JB-Test (multivariate)

data: Residuals of VAR object varmodel332
Chi-squared = 3676.1, df = 10, p-value < 2.2e-16

Skewness only (multivariate)

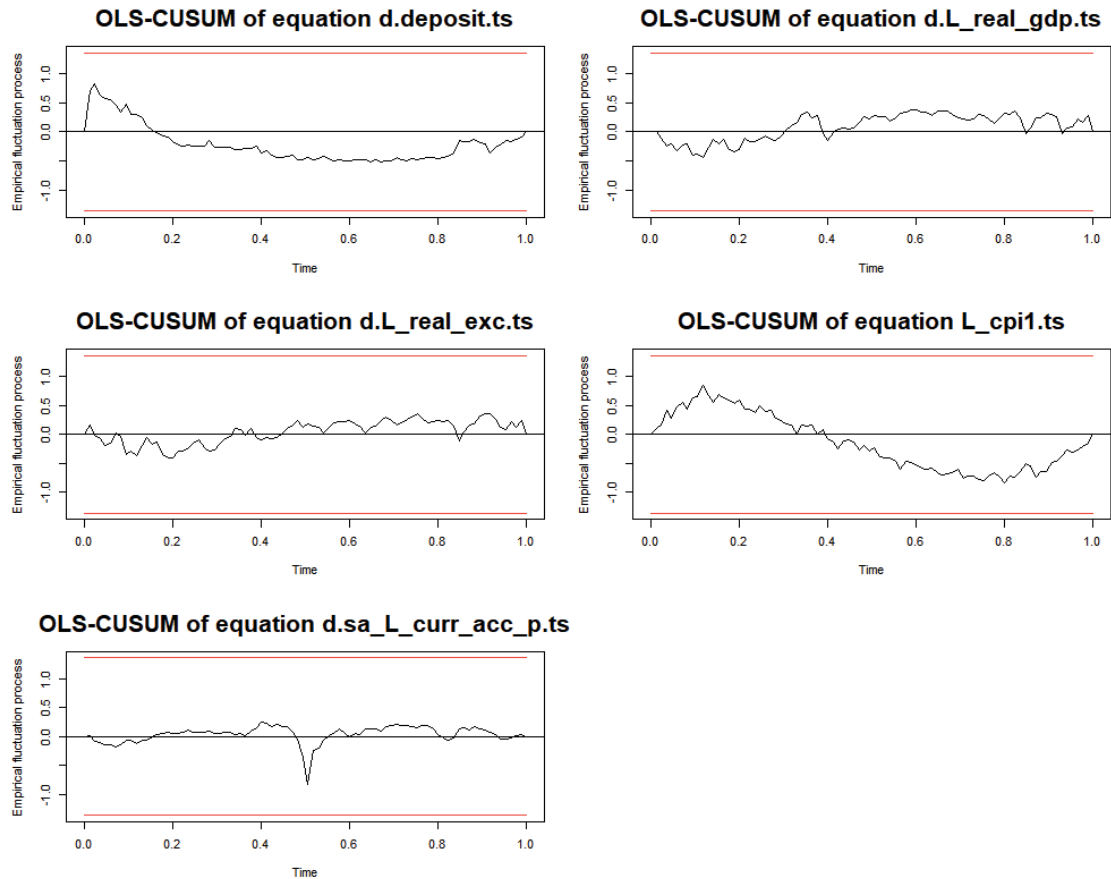
data: Residuals of VAR object varmodel332
Chi-squared = 235.46, df = 5, p-value < 2.2e-16

Kurtosis only (multivariate)

data: Residuals of VAR object varmodel332
Chi-squared = 3440.7, df = 5, p-value < 2.2e-16

Portmanteau Test was conducted for testing whether is there a serial correlation problem in residuals. Since the p-value is bigger than 0.05 (0.5367), there is no serial correlation in residuals. According to ARCH Test results for heteroscedasticity, since the p-value is bigger than 0.05 (0.2581), there is no heteroscedasticity problem, the model's residuals are homoscedastic. Jarque - Berra (JB) Test was conducted for testing the distribution of residuals. By looking at the p-value of the JB Test and also skewness and kurtosis p-values, it is seen that since the p-values of all of them are below 0.05, the model's residuals are not normally distributed.

Graph 6, VAR(2) Model OLS-CUSUM



Lastly, to investigate structural breaks in estimated VAR(2) model's residuals, model was tested with CUSUM Test and it was seen that, since there are no points outside the red lines- outside the confidence interval, the VAR(2) system that is used in the analysis is stable.

2.2.5. Granger Causality

The Granger Causality Test was applied to examine the causality relations between the variables in the model and determine the way of relation. The results of The Granger Causality Test using the 2-lagged VAR model are given in Table 10.

Table 10, Granger Causality Results

Causality	F	df1	df2	p.F	sig.F	Chisq	p.Chisq	sig.Chisq
d.L_real_exc.ts <= d.deposit.ts	8,2669	2	74	0,0006	***	16,5339	0,0003	***
d.sa_L_curr_acc_p.ts <= d.deposit.ts	1,5277	2	74	0,2238		3,0554	0,2170	
d.L_real_gdp.ts <= d.deposit.ts	9,2830	2	74	0,0003	***	18,5661	0,0001	***
L_cpi1.ts <= d.deposit.ts	4,4523	2	74	0,0149	*	8,9045	0,0117	*
d.deposit.ts <= d.L_real_exc.ts	1,4128	2	74	0,2500		2,8255	0,2435	
d.sa_L_curr_acc_p.ts <= d.L_real_exc.ts	0,1679	2	74	0,8458		0,3358	0,8455	
d.L_real_gdp.ts <= d.L_real_exc.ts	1,8746	2	74	0,1606		3,7491	0,1534	
L_cpi1.ts <= d.L_real_exc.ts	5,7362	2	74	0,0048	**	11,4725	0,0032	**
d.deposit.ts <= d.sa_L_curr_acc_p.ts	0,2372	2	74	0,7895		0,4743	0,7889	
d.L_real_exc.ts <= d.sa_L_curr_acc_p.ts	3,5722	2	74	0,0330	*	7,1444	0,0281	*
d.L_real_gdp.ts <= d.sa_L_curr_acc_p.ts	1,1272	2	74	0,3294		2,2544	0,3239	
L_cpi1.ts <= d.sa_L_curr_acc_p.ts	2,5946	2	74	0,0815	.	5,1893	0,0747	.
d.deposit.ts <= d.L_real_gdp.ts	0,4586	2	74	0,6339		0,9172	0,6322	
d.L_real_exc.ts <= d.L_real_gdp.ts	0,8869	2	74	0,4163		1,7737	0,4119	
d.sa_L_curr_acc_p.ts <= d.L_real_gdp.ts	0,2568	2	74	0,7742		0,5136	0,7735	
L_cpi1.ts <= d.L_real_gdp.ts	3,6295	2	74	0,0314	*	7,2589	0,0265	*
d.deposit.ts <= L_cpi1.ts	0,5010	2	74	0,6080		1,0020	0,6059	
d.L_real_exc.ts <= L_cpi1.ts	2,3199	2	74	0,1054		4,6399	0,0983	.
d.sa_L_curr_acc_p.ts <= L_cpi1.ts	0,0272	2	74	0,9731		0,0545	0,9731	
d.L_real_gdp.ts <= L_cpi1.ts	0,6655	2	74	0,5171		1,3309	0,5140	

As results obtained by the Granger Causality Test, there are relations from the “d.deposit.ts” variable to the “d.L_real_exc.ts”, to the “d.L_real_gdp.ts”, and to “L_cpi1.ts”. It was found that there are causal relations from the “d.L_real_exc.ts” and

“d.L_real_gdp.ts” to “L_cpi”.ts”. According to test results, no causality was found from the “d.L_real_exc.ts” to the “d.sa_L_curr_acc_p.ts”, but a causality from the current balance to the “d.L_real_exc.ts” was determined. Observing that causality from the interest rate to the “d.L_real_exc.ts”, from the “d.L_real_exc.ts” to inflation, from the interest rate to real growth, and from real growth to inflation, are crucial for the study.

2.2.6. The Structural VAR and Impulse - Response Functions

Table 11, SVAR Model's A-Matrix with se

d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1 (0)	0 (0)	0 (0)	0 (0)	0 (0)
0,11790541 (0,10846522)	1 (0)	0 (0)	0 (0)	0 (0)
0,06341352 (0,10921655)	0,23752749 (0,10846522)	1 (0)	0 (0)	0 (0)
0,11348446 (0,10943292)	-0,27086210 (0,11148301)	0,02644335 (0,10846523)	1 (0)	0 (0)
0,06685089 (0,11012301)	0,06051291 (0,11528918)	0,00806250 (0,10850314)	0,08911309 (0,10846523)	1 (0)

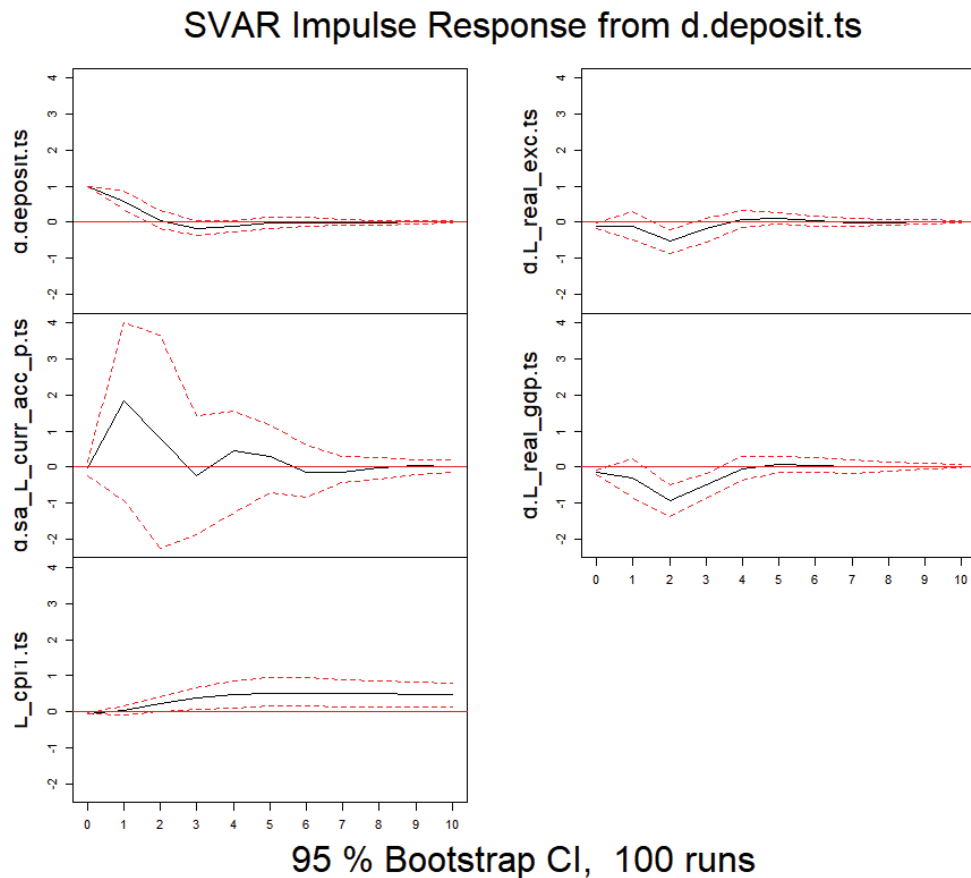
Table 12, SVAR Model Results (a)

shock to "d.deposit.ts"					
	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1	1,00000000	-0,11790541	-0,03540774	-0,14448427	-0,04655518
2	0,58173283	-0,11553341	1,82477796	-0,31034643	0,04198780
3	0,03425741	-0,53122670	0,80636888	-0,92891347	0,21720104
4	-0,17601455	-0,19544143	-0,22883505	-0,50926771	0,37246639
5	-0,10187097	0,08607732	0,43602826	-0,06058636	0,46618180
6	-0,02840002	0,10264657	0,28176288	0,05849968	0,51079428
7	-0,01607255	0,03171338	-0,15674910	0,03071041	0,52051272
8	-0,01997281	-0,01793766	-0,14976064	-0,00195865	0,51351330
9	-0,01394298	-0,01568309	-0,01285471	-0,00136509	0,50406958
10	-0,00221223	0,00290487	0,03137257	0,01363369	0,49431907

11	0,00304859	0,00190914	0,01683864	0,01223290	0,48358031
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The impulse-response functions illustrate the effect of one standard deviation shock in one of the error terms on the endogenous variables' present and future values. In other words, impulse response functions represent the dynamic response of each variable to structural shocks in the VAR model. The responses of variables to interest rate shock obtained for eleven periods from the 2-lagged VAR model are presented in Graph 7. On the vertical axis of the graphs, the direction and percentage of the response of other variables to the one standard deviation increase shock in the related variable, on the horizontal axis the number of periods that passed after the shock was given as 11 quarters. The dashed lines represent the 95% confidence interval (± 2 standard errors) for the responses of the variables and have an essential role in determining the statistical significance of the results.

Graph 7, The Impulse-Responses, shock to interest rate



As seen in Graph 7, the “d.deposit.ts” responded to its shock is as declining from beginning to the fourth period. After the tenth period, the response disappeared. The variable “d.L_real_exc.ts” responded to the interest rate shock by initially dropping by 12%. The actual response of the “d.L_real_exc.ts” appeared with a slight lag, and the real exchange rate rose until the 2nd quarter. It dropped to its lowest point of 53%, below the zero line in the 3rd quarter, then rose to its peak of 10% in the 6th Quarter. The response disappeared after the 9th quarter. The response of the “d.sa_L_curr_acc_p.ts” variable to the interest rate shock was to decrease by 3%, but this decrease was not statistically significant. Then it rose and peaked at 1.82 in the 2nd quarter. The actual response of the “d.sa_L_curr_acc_p.ts” appeared with a lag and the “d.sa_L_curr_acc_p.ts” decreased in the 3rd quarter as expected, due to an appreciation in national currency and increased imports. The response reached its lowest level at 22% below zero in the 4th quarter and disappeared after the 9th quarter. As expected, an increase in interest rates pushed down the real GDP by 14%. The actual reaction of real GDP appeared after the 2nd quarter, with a lag. Between the 2nd and 3rd quarters, Real GDP decreased as a result of the appreciation of TL, the decrease in net exports, and the shrinking demand, reaching its lowest level at 92% below the zero line. It started to increase after the 3rd quarter and reached its highest level of 5% in the 6th quarter. This situation can be thought of as being caused by an increase in imports as a result of the appreciation in TL and the production in Turkey being predominantly dependent on imports. At the end of the 8th quarter, the significant impulse of interest rates on real production disappears.

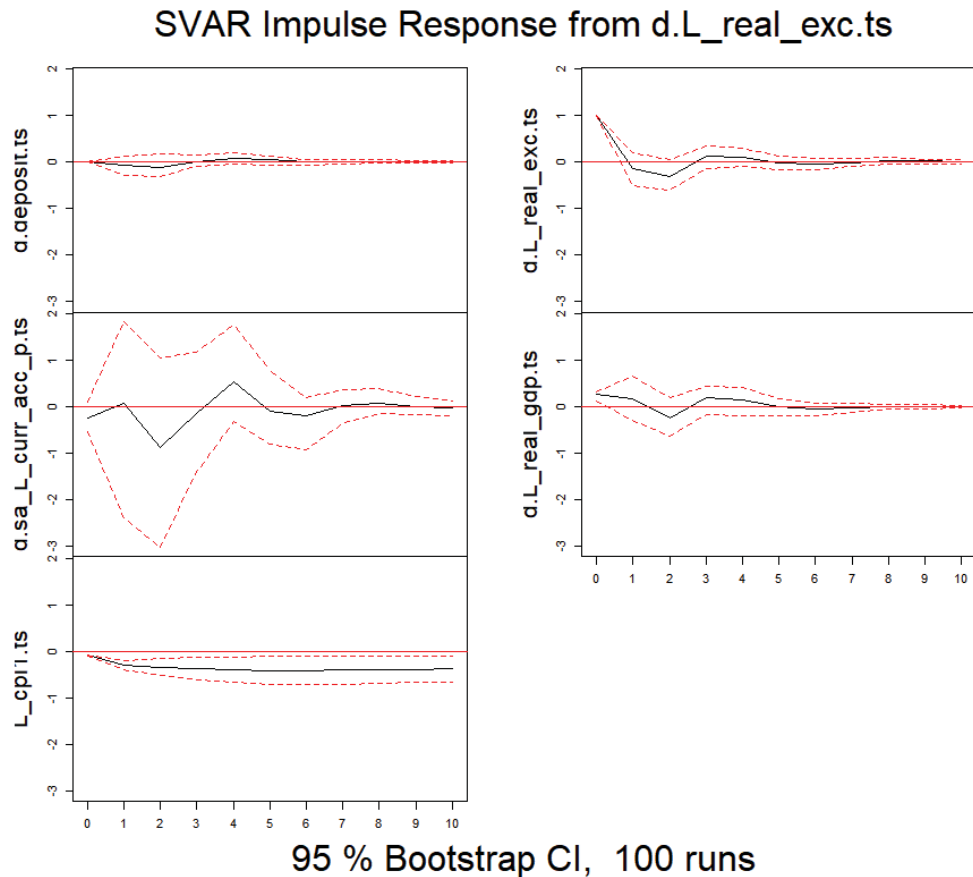
The graph shows that the reactions appeared with lag and became more evident after the 2nd quarter. Statistical significance of response of all variables to the interest rate shock, except the variable "L_cpi1.ts", disappeared at the end of approximately 9 quarters. Although inflation responded to the contractionary interest rate shock by initially falling by 4%, it started to increase again in the first quarter, and this increase accelerated from the second quarter. It is possible to explain the increase in inflation in a short time with the supply-side effect of the contractionary monetary policy. Inflation responded to the interest rate shock by starting to drop after peaking at 52% in the 7th quarter, but since the statistical significance of this response did not disappear in the

examined 11 quarters, it was concluded that inflation in Turkey is sticky, and requires strict and stable intervention.

Table 13, SVAR Model Results (b)

shock to "d.L_real_exc.ts"					
	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpil.ts
1	0	1	-0,23752749	0,27714313	-0,08329493
2	-0,07166494	-0,13607772	0,06514236	0,17679645	-0,28267452
3	-0,12494527	-0,31240286	-0,89167183	-0,23487353	-0,33423539
4	-0,00070256	0,12824821	-0,14466932	0,18689278	-0,37308832
5	0,08099880	0,10268511	0,53627076	0,15232335	-0,39884642
6	0,04172386	-0,01345831	-0,08547167	-0,00113921	-0,40779732
7	0,00020172	-0,03987358	-0,19920890	-0,04385732	-0,40932447
8	-0,00630633	-0,01710799	0,03370802	-0,02521118	-0,40326997
9	0,00185290	0,01352692	0,06800925	0,00223948	-0,39315929
10	0,00572059	0,01769847	0,00858013	0,00954789	-0,38460890
11	0,00227923	0,00439397	-0,02120549	-0,00090250	-0,37752054

Graph 8, The Impulse-Responses, shock to real effective exchange rate



With the accelerating internationalization of economies throughout the world and starting to be adopted flexible exchange rate regimes, examining monetary policy's impacts on exchange rates, as a consequence impacts net exports and output, has begun to consider beneficial (Mishkin, 2001). Because of this, the impacts of the shock in the real effective exchange rate variable ("d.L_real_exc.ts") on the other variables in the system is examined for 11 quarters and shown in Graph 8.

The current account balance responded to the exchange rate shock by falling. The actual reaction emerged in the 3rd quarter and hit its lowest level of 89% below the zero line, then started to increase and reached its highest level of 53% in the 5th quarter. The statistical significance of the reaction of the "d.sa_L_curr_acc_p.ts" to the "d.L_real_exc.ts" shock disappeared after the 7th quarter. Although the real GDP

reacted to the exchange rate shocks with an increase at the beginning, it started to decrease immediately. This decreasing trend accelerated after the 2nd quarter, and the reaction of the real GDP to the “d.L_real_exc.ts” shock reached its lowest level of 23%, below the zero line in the 3rd quarter. The response disappeared at the end of the 9th quarter. Inflation decelerated as a response to the exchange rate shock, hitting its lowest level of 41% below zero in the 7th quarter. In the examined 11-quarter period, the reaction of inflation to the exchange rate shock did not disappear.

2.2.7. Variance Decomposition

The variance decomposition method is used to interpret the parameters in the VAR model and to ascertain the root of the changes in a variable.

Table 14, Variance Decomposition Results

d.deposit.ts					
	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1	1	0	0	0	0
2	0,98166843	0,00003570	0,00000190	0,01539719	0,00289679
3	0,95221078	0,01072349	0,00141752	0,02565770	0,00999051
4	0,94734923	0,01034079	0,00152497	0,02619415	0,01459087
5	0,94084696	0,01539234	0,00224063	0,02594813	0,01557195
6	0,93847060	0,01749893	0,00259394	0,02586109	0,01557544
7	0,93766780	0,01753977	0,00329022	0,02594258	0,01555963
8	0,93763317	0,01756202	0,00329675	0,02594847	0,01555959
9	0,93759592	0,01755871	0,00333708	0,02594803	0,01556026
10	0,93756614	0,01758253	0,00333983	0,02595156	0,01555993
11	0,93755426	0,01758999	0,00334496	0,02595112	0,01555966
12	0,93754879	0,01759017	0,00334812	0,02595271	0,01556021
d.L_real_exc.ts					
	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1	0,01987685	0,98012315	0	0	0
2	0,02183646	0,92696309	0,04946828	0,00021119	0,00152098
3	0,12172855	0,80645374	0,05878577	0,01163913	0,00139280
4	0,12880934	0,77676127	0,07520269	0,01784035	0,00138634
5	0,13081846	0,77073557	0,07667334	0,02003146	0,00174117
6	0,13376825	0,76508094	0,07909186	0,02007361	0,00198534
7	0,13389672	0,76456386	0,07929040	0,02026500	0,00198403
8	0,13395136	0,76427054	0,07946754	0,02025356	0,00205701
9	0,13403564	0,76407220	0,07952523	0,02025263	0,00211430
10	0,13400965	0,76408405	0,07951541	0,02024868	0,00214221
11	0,13399705	0,76402921	0,07954436	0,02026194	0,00216745
12	0,13403281	0,76394483	0,07954400	0,02027569	0,00220269
d.sa_L_curr_acc_p.ts					

	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1	0,00055701	0,00564734	0,99379564	0	0
2	0,03234724	0,00542198	0,96212499	0,00010579	0,00000000
3	0,03814143	0,03008133	0,92967784	0,00203264	0,00006675
4	0,03876324	0,03005946	0,92860407	0,00247244	0,00010079
5	0,04008906	0,03330575	0,92377955	0,00269773	0,00012790
6	0,04074478	0,03330676	0,92307230	0,00274749	0,00012867
7	0,04097025	0,03360200	0,92239016	0,00290316	0,00013443
8	0,04117479	0,03359263	0,92217839	0,00291027	0,00014392
9	0,04117175	0,03362404	0,92212938	0,00293065	0,00014418
10	0,04118196	0,03362707	0,92211193	0,00293058	0,00014845
11	0,04118524	0,03362940	0,92210359	0,00293120	0,00015057
12	0,04118491	0,03363514	0,92209729	0,00293123	0,00015143
d.L_real_gdp.ts					
	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1	0,05112700	0,55083779	0,01055988	0,38747533	0
2	0,07992352	0,52990070	0,01401614	0,36743410	0,00872554
3	0,23847959	0,41973822	0,02892922	0,30485324	0,00799974
4	0,27119114	0,40151924	0,02930794	0,28998703	0,00799465
5	0,26953865	0,40245112	0,03032825	0,28955150	0,00813048
6	0,26967947	0,40147134	0,03154815	0,28880537	0,00849566
7	0,26966254	0,40140371	0,03176970	0,28860634	0,00855770
8	0,26956034	0,40149458	0,03188964	0,28849972	0,00855573
9	0,26953597	0,40146050	0,03196056	0,28848796	0,00855501
10	0,26955445	0,40145717	0,03195873	0,28847449	0,00855516
11	0,26957087	0,40144369	0,03196480	0,28846549	0,00855515
12	0,26956872	0,40144562	0,03196563	0,28846486	0,00855518
L_cpi1.ts					
	d.deposit.ts	d.L_real_exc.ts	d.sa_L_curr_acc_p.ts	d.L_real_gdp.ts	L_cpi1.ts
1	0,03521407	0,07072262	0,01797723	0,17147478	0,70461130
2	0,08647821	0,15276834	0,00581701	0,09179305	0,66314339
3	0,16174272	0,17032554	0,01115993	0,08179709	0,57497473
4	0,22590282	0,17465227	0,01720742	0,07600519	0,50623231
5	0,27138544	0,17651121	0,01880288	0,07052685	0,46277362
6	0,30207093	0,17764747	0,01951681	0,06643377	0,43433102
7	0,32191901	0,17907172	0,02017048	0,06359957	0,41523922
8	0,33497351	0,18024409	0,02069499	0,06167973	0,40240769
9	0,34421955	0,18088463	0,02108980	0,06036792	0,39343810
10	0,35109361	0,18128403	0,02135744	0,05939657	0,38686836
11	0,35629688	0,18163617	0,02154087	0,05863782	0,38188825
12	0,36032928	0,18194464	0,02169043	0,05804325	0,37799240

According to the variance decomposition results for 12 periods obtained from the optimal two-lagged VAR Model, the main source of the change in the "d.L_real_exc.ts" variable is the "d.L_real_exc.ts" variable itself with 98%, followed by the "d.deposit.ts" variable with 2%. As the time period progressed, while the impact of itself on the variance of the "d.L_real_exc" variable decreased, the impact of the

"d.deposit.ts" increased. In the 4th quarter, 78% of the fluctuation in the variance of the "d.L_real_exc.ts" is from the variable itself, 13% from the "d.deposit.ts" variable, 8% from the "d.sa_L_curr_acc_p.ts" variable, 2% from the "d.deposit.ts" variable, "d.L_real_gdp.ts" variable, 0.1% from the "L_cpi1.ts" variable. The finding that the variable that explains "d.L_real_exc.ts" the most after the variable itself is the interest rate, is in line with the general argument that argues a strong link among them in open economies.

After the "d.deposit.ts" shock, the variable itself explained 99%, the variable "d.L_real_exc.ts" 0.5%, and the variable "d.deposit.ts" 0.05% the forecast error variance of the variable "d.sa_L_curr_acc_p.ts" in the first quarter. At the end of the fourth quarter, the share of the interest rate increased to 4%, and the explanatory power of the "d.L_real_exc.ts" increased to 3%.

The changes in "d.L_real_gdp.ts" after the monetary policy interest rate shock are mostly because of the "d.L_real_exc.ts" variable. Approximately 55% of the changes in "d.L_real_gdp.ts" in the first quarter were caused by the "d.L_real_exc.ts", 38 percent by the variable "d.L_real_gdp.ts" itself, and 5% by the interest rate. In the 4th quarter, the "d.L_real_exc.ts" variable is the most explanatory variable with 40% on the "d.L_real_gdp.ts" variable. As the time period lengthened, while the explanatory power of the "d.L_real_exc.ts" and the "d.L_real_gdp.ts" variable itself decreased, the share of the "d.deposit.ts" gradually increased. After the "d.L_real_exc.ts", variable itself by 29%, "d.deposit.ts" by 27%, and "d.sa_L_curr_acc_p.ts" by 3% explain the variance of the "d.L_real_gdp.ts" variable, respectively.

The variance decomposition results for the variable "L_cpi1.ts" show that the biggest source of the changes in inflation is real GDP with 17%, after variable itself. The explanatory power of Real GDP gradually decreased over time. In the 4th quarter, the change in the variance of the "L_cpi1.ts" variable was because of 50% by the variable itself, 22% by the "d.deposit.ts" variable, 17% by the "d.L_real_exc.ts" variable and, 8% by the "d.L_real_gdp.ts" variable. Among these variables, the explanatory power of the interest rate continued to increase as the period lengthened, becoming 33% in the 8th quarter and 36% in the 12th quarter. Due to the interest and real effective exchange rate having significant explanatory power in explaining the cause of the changes the "L_cpi1.ts", considering that the principal objective of the CBRT is price stability, it

can be said that in Turkey, the monetary policy is more effective on inflation than growth.

The conclusions that can be drawn from variance decomposition results are as follows: The interest and the real exchange variables impacted the real economy, significantly and this impact got stronger over time. Since the “d.L_real_exc.ts” and “d.deposit.ts” variables explain the changes in the “d.L_real_gdp.ts” and “L_cpi1.ts” variables predominantly. Via the interest rates, the CBRT can influence the real exchange rate, thus the macroeconomy. Thence, it may be said that, among monetary transmission mechanisms, the interest rate, and exchange rate channels, are effective.

CONCLUSION AND SUGGESTIONS

In this study, it was concluded that the interest rate as a main monetary policy instrument, has impacts on real variables. This finding is similar to finding of the previous studies in the literature so that it is a very powerful tool to play with it and the authorities should be very careful to shift it before conducting the monetary policy. As in Turkish economy case, macroeconomic variables may be affected deeply and the economy may move to some very unpleasant direction such as hiper inflation and financial instability or a sharp current account deficit.

According to the Granger Causality Test findings, I found a causalities from the interest rate to the real effective exchange rate, the real output, and finally to inflation. It was also found that causal relations from the real exchange rate and real output to inflation in Turkish economy. According to the test results, no causality was found from the real exchange rate to the current account balance, but a causality from the current account balance to the real exchange rate was observed. Determining that causality from the interest rate to the real exchange rate, from the real exchange rate to inflation, and from the interest rate to real growth, from real growth to inflation, are crucial finding of this study.

The impulse-response functions and the graphical presentations indicate that when the interest rate is shocked, the real exchange rate reacts. If interest rate is changed as a policy variable, the nominal exchange rate immediately moves. But the actual response came with a little lag and it moves the reel rate up slightly. The cause of such movement could probably come from the process of adjustment in prices. It seems that the response continues for 9 periods. On the other hand, the current account response was not statistically significant at the beginning but with some lag, it responded by a decrease. The important part of this study is to see the effect of interest

rate on economic growth. The reaction of real GDP to interest rate shocks became more evident after the 2nd quarter, with a lag. Between the 2nd and 3rd quarters, real GDP growth starts to decrease due to the appreciation of national currency, decrease in net exports, and the shrinking aggregate demand. However, It increased after the 3rd quarter and reached its highest level in the 6th quarter. This situation can be thought of as being caused by an increase in imports as a result of the appreciation in TL. We should remember that the production in Turkey being predominantly dependent on imports. At the end of the 8th quarter, the significant response of real GDP to interest rate shock disappears. With respect to the results, we may conclude that the reactions of the macroeconomic variables to interest rate shocks appears only with lag, and became more evident after the 2nd quarter.

I should also note that statistical significance of the reaction of all variables to the interest rate shock, except the inflation variable, disappears at the end of approximately 9 quarters. Although inflation rate in Turkey responds to the interest rate initially, it starts to show reverse reaction again in the first quarter, and this change accelerates after the second quarter. It is possible to explain the increase in inflation in a short-time with the supply-side effect of the contractionary monetary policy. Inflation responded to the interest rate shock by starting to slightly drop after its peak in the 7th quarter, but since the statistical significance of this response did not disappear in the examined time period, therefore it was concluded that inflation in Turkey is sticky, and requires strict and stable intervention.

With the gradually increasing momentum of capital mobility, and internationalization of economies all around the world, the effects of monetary policy on the real variables via exchange rate begin to attract more attention. This study also examines such effect of a shock in the real effective exchange rate variable on the other variables in the system. The current account balance responded to the exchange rate shock by falling. The statistical significance of the reaction of the current account balance to the exchange rate shock disappears after the 7th quarter. Although the real GDP reacted to the exchange rate shocks with an increase in the beginning, it started to decrease immediately. This decreasing trend accelerated after the 2nd quarter. The

response disappeared at the end of the 9th quarter. Inflation decelerated as a response to the exchange rate shock. In the examined 11-quarter period, the reaction of inflation to the exchange rate shock did not disappear.

The conclusions that can be drawn from variance decomposition results are as follows: The real exchange rate and the interest rate variables had a significant effect on the real economy, and this effect gets stronger over time. Since the real exchange rate and the interest rate variables explain the changes in the real GDP and CPI variables predominantly. It can be said that the interest rate and exchange rate channels, which are among the monetary transmission mechanism, are very effective channels for Turkish economy.

In this study, I conclude that the interest rate is a consequential monetary policy instrument that has effects on main macroeconomic variables for sure. A discretionary and irresponsible use of interest rates as a policy variable may cause to very strong results. It should be calculated very carefully, and avoid to use it for short term political interest because the effects on some critical macro variable could be devastating.

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