

EFFECTIVENESS ANALYSIS OF MONETARY TRANSMISSION MECHANISM IN TURKEY

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ABSTRACT

The Central Bank of the Republic of Turkey (CBRT)'s main target was price stability until the 2008 global crisis, it also focused on financial stability in the post-crisis period. CBRT has implemented new monetary policies that would react against shocks apart from traditional practices to limit the negative effects of the crisis since the end of 2010. The aim of this study is to analyze the effectiveness of the transmission channels of the monetary policies implemented by CBRT, comparing the traditional and new monetary policy periods. In this study, the effectiveness of the change in the monetary policy of the central bank in achieving the stability goals through credit and exchange rate transfer channels was compared as of 2002-2011 and 2011-2020 periods. The structural VAR (SVAR) model was used in the analysis since it allows the structural changes of variables based on economic theory. According to the findings, the effect of credit and exchange rate channels on inflation in 2002-2011 is compatible with the expectations. It was found that interest rate is the most important determinant of the fluctuations in credits and exchange rates. In 2011-2020, the effect of the transmission mechanism of credit and exchange rate channels over interest rates on inflation is compatible with the expectations. The majority of the variations in credits and exchange rates originated from the interest rates. Most of the fluctuations in inflation are caused by exchange rate and credit fluctuations, and the explanatory power of the exchange rate is relatively high.

TÜRKİYE'DE PARASAL AKTARIM MEKANİZMASININ ETKİNLİK ANALİZİ

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ÖZ

2008 Küresel krizine kadar Türkiye Cumhuriyet Merkez Bankası (TCMB)'nin ana hedefi fiyat istikrarı iken, kriz sonrası dönemde finansal istikrar konusuna da odaklanılmıştır. TCMB 2010 sonlarından itibaren krizin olumsuz etkilerini sınırlandırmak amacıyla, geleneksel uygulamalardan ayrılarak, esnek yeni politikalar uygulamaya koymuştur. Bu çalışmanın amacı, TCMB'nin uyguladığı para politikalarının aktarım kanallarının etkinliğinin, geleneksel ve yeni para politikaları dönemlerini karşılaştırarak analiz edilmesidir. Çalışmada, merkez bankasının para politikasında değişikliğe gitmesinin kredi ve döviz kuru aktarım kanalları yoluyla istikrar hedeflerine ulaşmadaki etkinliği, 2002-2011 ve 2011-2020 dönemleri itibarıyla karşılaştırılmıştır. Analizde; değişkenlerin yapısal değişimlerinin ekonomik teoriye dayandırılarak modele dahil edilebilmesine imkân tanınması nedeniyle Yapısal VAR(SVAR) modeli kullanılmıştır. Bulgulara göre 2002-2011 döneminde kredi ve kur kanallarının enflasyon üzerine etkisi beklentiye uygundur, enflasyon hedeflemesi stratejisi başarılı olmuştur. Kredilerdeki ve kurdaki dalgalanmaların en önemli belirleyicinin faiz olduğu tespit edilmiştir. 2011-2020 döneminde kredi ve kur kanallarının faizler üzerinden aktarım mekanizmasının enflasyona etkisi beklenti ile uyumlu gerçekleşmiştir. Kredilerdeki ve kurdaki hareketliliğin büyük bir kısmı faizlerden kaynaklanmıştır. Enflasyondaki hareketlerin önemli kısmının kur ve kredi dalgalanmalarından meydana geldiği, kurun açıklama gücünün nispeten yüksek çıktığı görülmektedir.

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INTRODUCTION

The success of the monetary transmission mechanism varies from country to country in relation to the level of development. Developing economies have structural problems due to foreign-dependent growth models. The features of developing countries such as hypersensitivity to changes in exchange rates, dollarization of assets and liabilities, external financing constraints and fiscal dominance create uncertainty regarding the monetary transmission mechanism. This situation may cause the transmission mechanism to produce results independent of economic fundamentals and inconsistent with the theoretical expectations (CBRT, 2013, p. 2). Monetary policies allow central banks to have control over financial and real economic variables by using monetary instruments. The monetary policy instruments of the central bank are the nominal money stock and short-term interest rates. In practice, central banks are more likely to use the method of determining their monetary policy by changing short-term interest rates. According to the CBRT's Monetary Transmission Mechanism publication in 2013, policy decisions of central banks affect economic activity and inflation mainly through four channels. These channels are; interest channel, exchange rate channel, asset prices channel (credit channel and stock channel) and expectations channel.

There are two main periods in Turkey where monetary policy undergoes structural reforms after the 2001 crisis. The first is the period of inflation targeting strategy, which was implemented implicitly between 2002 and 2005 and openly implemented since 2006. This approach is known as the period of traditional monetary policy by Turkish Central Bank. The second is the period of new monetary policy strategy developed by the CBRT after the global financial crisis that affected the whole world in 2008. The common point of both periods is that they follow an economic crisis. The first period was shaped by the 2001 crisis and the second period by the 2008 global financial crisis. During the period when traditional monetary policy was applied, short-term interest rates were used as policy interest rates. In the new monetary policy implementation, the policy rate was designed to affect the market rate by changing the liquidity volume together with the funding rate. Since the CBRT is a net lender to the market as of 2010, the average funding rate of the central bank stands out as a monetary policy instrument (Kara, 2012:8-9). The CBRT average funding rate represents the weighted average interest rate of the short-term liquidity given to the market by the central bank (Kara, 2015, p. 3-5).

Central banks, which focused on price stability before the crisis, recognized the fragility of their financial systems and entered into a new monetary targeting strategy structured to take into account financial stability. In the wake of the 2008 global crisis, the CBRT achieved the same awareness as all the world's central banks. CBRT implemented a policy composition in which it coordinated short-term interest rates and non-interest rate instruments in line with the goal of price stability and the task of financial stability. Since the last quarter of 2010, the new monetary policy, which has been theoretically revised and implemented, is a pioneering CBRT practice in which a wide interest rate corridor and active liquidity policy are used together.

In this study, the transmission mechanisms of the monetary policies implemented by the central bank were examined based on two different periods. First of all, the effects of the traditional monetary policy implemented in the period between 2002-2011 were discussed. Secondly, the functioning of the new monetary policy implemented in the period between 2011 and 2020, which was implemented from the last quarter of 2010, but whose effects are thought to have begun to be seen as of 2011, has been analyzed. In order to analyze the CBRT's monetary policy, it is necessary to understand how the transmission mechanism works and which interest rate represents the policy interest rate.

In the analysis, the effects of the monetary transmission mechanism were examined through the exchange rate and credit channel, which are the channels highlighted by the central bank with the new monetary policy. For this purpose, the structural VAR (SVAR) model was chosen because it allows the creation of the monetary transmission mechanism in accordance with the economic theory of the processing process.

LITERATURE REVIEW

There are numerous studies on the dynamics and effectiveness of the monetary transmission mechanism. A literature review was conducted by taking into account the methods used to measure the effects of different monetary policies. It has been observed that the VAR and sVAR models are frequently used in most of the studies. Thus, the studies using the sVAR models are heavily considered. The literature review has been examined and shown in Table 1.

Table 1. Literature Review

Authors and Year	Period and Region	Method	Variables	Results / Findings
Peersman G. Smets F. (2001)	1980-1998 quarterly data, Eurozone	VAR model	Domestic real GDP, domestic consumer prices, the exchange rate and the domestic short-term interest rate.	The overall macroeconomic effects of monetary policy shock in the Eurozone have been shown to be very similar to those predicted for the United States and have been surprisingly stable over time.
Boivin,J., Kiley T., Mishkin,S. (2010)	1962Q1-1979Q3; 1984Q1-2008Q4, United States,	Factor-augmented vector autoregression (FAVAR), DSGE model	Short-term policy interest rates, long-term interest rates, equity prices, exchange rate, household and business demand, real GDP, nominal federal funds rate.	Monetary policy innovations have a more muted effect on real activity and inflation rate in recent decades as compared to the effects before 1980. Analysis suggests that these shifts are accounted for by changes in policy behavior and the effect of these changes on expectations, leaving little role for changes in underlying private-sector behavior (outside shifts related to monetary policy changes).
Mohanty,D. (2012)	April 2001-March 2011, India	SVAR	The yield on 10-year government bonds includes the yield of 5-year 'AAA' rated corporate bonds, weighted average lending rate, (Sensex) stock market, Rupees per US dollar (RSUSD).	Policy interest rate increases have been found to have negative effects on output growth, moderate effects on inflation rate, and the importance of the interest rate as a strong monetary policy adventurous has been emphasized.
Li, B. G., Adam, C., Berg, A., Montiel, P., O'Connell, S. (2019).	Low-Income African Countries, Short Data Set	Structural VARs, DSGE	GDP deficit, inflation rate, real exchange rate and nominal interest rate.	It was stated that monetary policy should be passive in the face of uncertainty and short data series would make it difficult to interpret reliably with an SVAR approach.
Cesa-Bianchi, A., Thwaites, G., Vicondoa, A. (2016)	1997:6 - 2015:5, United Kingdom	SVAR	Stock prices, FTSE index, exchange rates, inflation rate, credit volume, nominal and real interest rate rates.	The monetary policy has lasting effects on real interest rates and inflation rates, and that monetary policy affects economic activities, prices, exchange rate and exports.
Raghavan, M., Silvapulle, P., Athanasopoulos, G. (2012)	1980:01-2007:12 Malaysian	SVAR	Oil prices index, Federal Funds rate, industrial production index, monetary total M1, consumer price index, overnight interbank interest rate, nominal effective exchange rate.	Before the crisis, the exchange rate is an important variable in the transmission of interest rate shocks, credit and asset prices are helpful variables. In the post-crisis period, asset prices played a more dominant role in intensifying the impact of both interest rate and currency shocks on output.
Bhuiyan, R. (2012)	Canada 1994 to 2008 monthly	Bayesian structural VAR	Overnight target rate; quarterly treasury bill interest rate, Canadian currency nominal exchange rate in US dollars, consumer price index, real gross domestic product, total M1, US federal funds rate, US industrial production, US consumer price index, world total export commodity price index.	Monetary policy has been found to affect the real economy through both the market interest rate and the exchange rate, the Central Bank of Canada's response to domestic and foreign variables containing information on future inflation rate, and external shocks are a major source of output fluctuations.
Erdogan, S., Yıldırım, D. Ç. (2010)	1995:01-2008:09, Turkey	VAR model	Interbank overnight interest rate, credit interest rate, durable consumer goods expenditures, fixed capital accumulation, CPI.	It was compared for two periods and found that the interest rate channel was active after 2002.
Cambazoglu, B., Karaalp, H. S. (2012).	2003:01- 2010:08, Turkey	VAR	Short-term interest rate, real effective exchange rate, net export volume, consumer price index and industrial production index.	Monetary policy has found that the exchange rate channel can be effective on the general level of prices.

Arıkan, C., Görgün, S., Yalçın, Y. (2018)	2010:05-2016:01, Turkey	VAR	Interest rate corridor lower band-upper band bandwidth, money supply M1, real effective exchange rate, total domestic credit volume, industrial production index and CPI.	The effect of the lower band of the interest rate corridor on the exchange rate and inflation rate, and the effect of the upper band of the interest rate corridor on the money supply were found.
Yalçın, E. Gürel, S. P., (2020)	2011M01- 2018 M01, Turkey	SVAR	Reference interest rate, basket rate consisting of euro and dollar, domestic credit volume, industrial production index, CPI.	Exchange rate and bank credit channels work effectively in transmitting monetary policy.
Özcan, C.C. (2016)	1990Q1-2008Q2, Turkey	VAR	Money supply (M2), industrial production index, dollar rate, interbank overnight interest rate, CPI.	The exchange rate does not have an effect on real activities, but affects the overall level of prices.

METHOD

In this study, structural VAR model (SVAR) which can allow the interaction of the Monetary Transmission Mechanism to the markets compatible with the economic theory in the form of a chain reaction was applied in order to examine the effects of different monetary policy instruments. The analysis was applied in two main periods of structural change after the 2001 crisis in Turkey. The SVAR model is chosen because it considers the assumptions in accordance with economic theory to be included in the analysis and also allows explicit modeling of simultaneous interdependence between variables (Pfaff, 2008, p. 1; Ojaghlou and Demirkale, 2020, p. 146). The Structural Var model was developed by Sims (1986), Bernanke (1986), Shapiro and Watson (1988) to solve the problems encountered in the formation and interpretation of the VAR model in accordance with the economic theory depending on the order of variables. The model is created by distinguishing external shocks in error terms (Güneş *et al.*, 2013:7). In the SVAR analysis, the restrictions on the estimated reduced form model required for the identification of the underlying structural model can be provided by economic theory. Structural shocks can be corrected as the modeling is carried out using short or long-term restrictions. Dynamic effects on different variables could then be evaluated by creating impulse-response functions and variance decomposition using structural shocks. This framework allows an economic interpretation of the shocks for each variable in the model. Estimates obtained through the SVAR are particularly convenient for short-term analysis. SVAR models can be applied where policy tool variables are not weakly exogenous. The model has a dynamic structure that allows information from multiple variables to be included (Balcılar and Tuna, 2009, p. 615). The structural form of the SVAR model is expressed in Equation 1.

$$Ay_t = A_1^*y_{t-1} + \dots + A_p^*y_{t-p} + B\varepsilon_t \quad (1)$$

In the equation, ε_t is unrelated structural shocks, B is the structural parameters of the model, A_p^* is the structural coefficients that differ from their generally reduced form, y_t variables vector, p is the optimal lag length. Since shocks cannot be observed directly, some restrictions are applied to the model. For this, $B\varepsilon_t$ is multiplied by A^{-1} to obtain the residual vector (Equation 2) and A^{-1} is passed to the left side of the equation (Equation 3).

$$Ay_t = A^{-1}A_1^*y_{t-1} + \dots + A^{-1}A_p^*y_{t-p} + A^{-1}B\varepsilon_t \quad (2)$$

$$Ay_t = A_1y_{t-1} + \dots + A_py_{t-p} + u_t \quad (3)$$

In a SVAR model, it is possible to describe shocks by performing impulse-response function and variance decomposition analysis by imposing restrictions on A and/or B matrices. Restrictions for A and B can be added to this model. The reduced form residues (u_t) can be obtained with a variance-covariance matrix with $u_t = A^{-1}B\varepsilon_t$ in a SVAR model (Pfaff, 2008, p. 4; Akbaş *et al.*, 2013, p. 192). Long and short-term restrictions may be included in the model. The short-run matrix is expressed as $S=A^{-1}B$.

Long-term restrictions can be applied in cases where each shock has a continuous effect on at least one variable (Güneş *et al.*, 2013, p. 7). The explanatory power of the variables in the model on the specific variable can be determined by variance decomposition and the usability of the effective variable as a policy tool can be determined by impulse response functions (Özgen and Güloğlu, 2004, p. 103). Monetary policy shocks are represented as temporary short-term interest rate shocks commonly in the literature (Dungey and Fry, 2009, p. 1154). Buckle *et al.* (2007) stated that the effects of monetary policy shocks could disappear from 18 months to 2 years. In this study, the effectiveness of the monetary policy transmission mechanism was analyzed by placing

short-term restrictions on the SVAR model. While writing equation (3), several restrictions of the parameters can be considered. Cholesky's restrictions is used to define the order of short-term restriction shocks.

In Cholesky's restrictions (Equation 4), it is assumed that the value of certain coefficients is zero and u_{1t} immediately affects other variables simultaneously, u_{2t} affects the 2nd, 3rd, and 4th variables simultaneously, u_{3t} affects the 3rd and 4th variables simultaneously and u_{4t} only affect the 4th variable. Accordingly, the short-term restrictions equation is expressed in the SVAR model as follows (Kiss *et al.* 2020, p. 96):

$$\varepsilon_t = Su_t = \begin{bmatrix} s_{11} & 0 & 0 & 0 \\ s_{21} & s_{22} & 0 & 0 \\ s_{31} & s_{32} & s_{33} & 0 \\ s_{41} & s_{42} & s_{43} & s_{44} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix} \quad (4)$$

In this study, for the monetary transmission mechanism of the credit channel; u_{1t} represents interest rate, u_{2t} represents credits, u_{3t} represents industrial production index and u_{4t} represents inflation rate. For the monetary transmission mechanism of the exchange rate channel; u_{1t} represents interest rate, u_{2t} represents exchange rate, u_{3t} represents industrial production index and u_{4t} represents inflation rate.

Impulse-response functions are the effect of one unit of shock on a specific model variable. Here, it is the shock of variable i to variable j in the elements of row i and column j of the matrix $C_k = \frac{dy_t}{d\varepsilon_{t-k}}$, respectively. The impulse response function is statistically significant when both standard error bands in the graph are above or below zero on the y-axis (Weinhagen, 2002, p. 7). The vertical axis measures the magnitude of the response to the effect by scaling so that 1.0 equals one standard deviation. Confidence bands used to determine the statistical significance of an impulse-response represent ± 2 standard errors. At points where the confidence bands do not exceed the line at zero, the impulse-response is considered to be statistically different from zero at a significance level of 5% or less (Ewing, *et al.*, 2007, p. 609-610).

Variance decomposition indicates which shocks are determinant in the short and long term path of certain variables, that is, the proportion of uncertainty of the i variable to be attributed to the j . shock after the h period. It is expressed in Equation 5 the proportion of uncertainty of the i variable to be attributed to the j . shock after the h period (Kiss *et al.* 2020, p. 97).

$$\vartheta D_{i,j,h} = \frac{\sum_{k=0}^h (kc_{i,j})^2}{\sum_{k=0}^h \sum_{l=1}^n (kc_{i,l})^2}$$

Data

In this research, the data are obtained from the Electronic Data Distribution System of the Central Bank of the Republic of Turkey (CBRT, 2021) and the Turkish Statistical Institute (TUIK, 2021). The sample consists of monthly data ranging from 2002: M1 to 2020: M12. In this study, the sample was divided into two periods in order to examine the effects of the policy change, and the effects of the interest rate policy applied in the first and second periods were investigated to the market through the exchange rate and credit channel. As the policy interest rate applied by the Central Bank, this study used the Interbank Overnight Average Interest Rate for the period between 2002:M1 and 2010:M12, and the Central Bank Average Funding Interest Rate data for the period between 2011:M1 and 2020:M12. The graphs of the two policy interest rates in these periods are given in Figure 1. While interest rates tend to decrease regularly in the first period, a much more fluctuating trend is observed in the interest rate applied in the second period. The real effective exchange rate data in the model is calculated by the CBRT using the exchange rates of Turkey's largest trading partners and can be defined as foreign currency per one Turkish Lira. Domestic price level data is calculated by the Turkish Statistical Institute (TUIK) and measured by the consumer price index (CPI:2003=100). As exchange rate data, the average monthly data of the purchase value of an U.S. dollar for Turkish lira was used. Total domestic credit volume data prepared by the CBRT were used to represent the credits. Industrial production index (2005=100) data was obtained, as an indicator of the developments in the production levels of the firms in the industrial sector, which are compiled by TUIK through surveys monthly.



Figure 1. The Interbank Overnight Average Interest Rate (2002: M1 and 2010: M12), and the Central Bank Average Funding Interest Rate (2011: M1 and 2020: M12)

EMPIRICAL FINDINGS

In the study, ADF unit root test was applied to examine the compatibility of the data to the SVAR model. The test results of the data divided into two periods are presented in Table 2. The ADF test is stationary at level for the variable of Interbank Overnight Average Interest rate, which is used as a monetary policy variable for the period between 2002:M1 and 2010:M12. Real effective exchange rate, industrial production index, consumer price index and total credit variables, which have been transformed logarithmically, become stationary at first differences. The seasonal effect has been determined in the industrial production index and adjusted seasonally using the Moving Average (Ratio) method. The Cochrane-Orcutt method was used for the correction of residual autocorrelation in the variable of credit (Hansen, 1990, p. 6-7; Göktaş, 2015, p. 9/18). The series of the central bank funding interest rates used as a monetary policy variable for the period between 2011:M1 and 2020:M12 was found to be stationary at level. Logarithmically transformed dollar rate, total credit and CPI series can be stationary by taking the first difference. The seasonally adjusted industrial production index is stationary at level. LM autocorrelation test results for the SVAR model are given in Table 3. LM tests were not found to be statistically significant in all four models, and it was determined that there was no autocorrelation in the models.

Table 2. ADF Stationarity Test Results

Variables	2002:M1-2010:M12		2011:M1-2020:M12	
	Level ¹	1.Difference ¹	Level ²	1.Difference ²
intf (CBRT funding interest rate)			-4.35***	-3.14*
inta (Interbank overnight average interest rate)	-2.96 **	-4.82 ***		
lrexc (Real effective exchange rate)	-1.67	-6.62***		
lexcd (Dollar exchange rate)			-2.33	-8.31***
ltc (Total credits)	-2.19	-2.64 *	-2.39	-8.17***
lipsa (Industrial production index)	-0.97	-2.85*	-4.96***	-3.57**
lcpi (Consumer price index)	-0.81	-3.58***	-0.54	-4.80***

*%10 **%5; ***%1 are significant levels.

Note: Lag length; AIC (Akaike Information Criterion). Augmented Dickey–Fuller test; ¹ include constant, ² include constant and trend.

Table 3. LM autocorrelation test results for the SVAR model

Period and Transmission Channel	LREstat	Prob.	Lag (criterio)
2002:M1-2010:M12 Exchange Rate Channel	73.95	0.185	4 (LR)
2002:M1-2010:M12 Credit Channel	83.45	0.374	5 (LR)
2011:M1-2020:M12 Exchange Rate Channel	92.84	0.154	5 (AIC)
2011:M1-2020:M12 Credit Channel	121.28	0.258	7 (AIC)

Impulse-Response Functions for Credit Channel Effects (2002:01-2010:12)

The effect of a one-unit increase in the interest rates on the total domestic credit volume decreased in the first three months in line with the theoretical expectation and a statistically significant relationship was observed in the last month. The effect of interest rate policy on the credit channel decreased sharply in the short term, fluctuating in the negative region after the 3rd month and continued its effect for 8 months (Figure 2).

As Mishkin (1995) emphasized that the effect of the credits used on the industrial production will cause a rise in new investment goods of firms. No statistically significant effect was observed according to the impulse response function (Figure 3).

The expected effect of the increase in total credit volume on the overall level of consumer prices is positive. It is also seen that the expected effect occurs rapidly in the first two months. Nevertheless, the confidence interval contains zero value, it cannot be interpreted as statistically significant (Figure 4). CBRT was able to execute effective monetary and fiscal policies to reduce inflation in an environment of increased fiscal discipline (Bayrak & Kanca, 2013, p. 95).

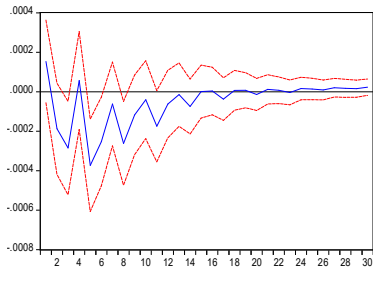


Figure 2. In 2002:01-2010:12 Period, The effect of a 1-unit shock in interest rates on credits

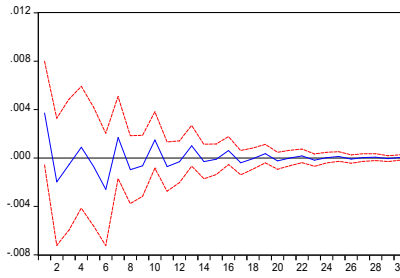


Figure 3. In 2002:01-2010:12 Period, The effect of a 1-unit of shock in credits on industrial production index

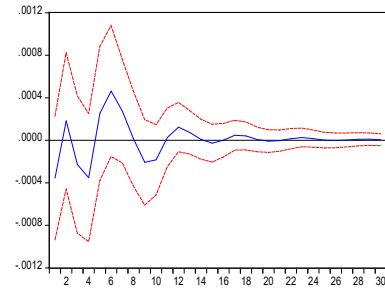


Figure 4. In 2002:01-2010:12 Period, The effect of a 1-unit of shock in credits on CPI

Impulse-Response Functions for Exchange Rate Channel Effects (2002:01-2010:12)

According to the definition of the CBRT, the increase in the real effective exchange rate indicates that TRY has appreciated in real terms, in other words, the price of Turkish goods in terms of foreign goods has increased. The economic theory states that the increase in the interest rate will cause capital inflows to the country and decrease the nominal exchange rates. The reason for the decrease in nominal exchange rates is the decrease in the price of foreign currency, the amount of which is increased under the supply and demand law. In this case, the domestic currency is overvalued. As seen in the impulse response graph, the effect of the shock in the interest rate on the real effective exchange rate increased statistically significantly in the third month. This means that the expected effect of the interest rate shock on the exchange rate has emerged with a three-month delay (Figure 5).

The impulse response function showing the effect of a shock given to the real effective exchange rate on the industrial production index was not found to be statistically significant. In this period, no significant effect of foreign capital entering the country on industrial production was observed. This situation can be interpreted as that the foreign capital entering the country experienced short-term inflows and outflows and left the country by obtaining interest income without turning into productive investments. (Figure 6).

The effect of a shock given to the real effective exchange rate on inflation rate was not statistically significant (Figure 7). In this period, the demand for imported goods, which became relatively cheaper due to the overvalued TRY, increased. In addition, the cost of production has decreased due to the cheaper prices of imported intermediate goods, raw materials and energy. These developments had an effect on inflation in the form of a decrease in demand and cost inflation.

The investment motivation of a significant part of the foreign capital flow in Turkey is the interest rate arbitrage. In this process, the domestic currency gains value, the price of imported oil, raw materials and luxury consumer goods decrease. This process is reflected in inflation, causing inflation to decline. As a result, the current account deficit increases in Turkey, which is heavily dependent on imports for energy and raw materials. This situation causes the economy to turn into a financially fragile structure.

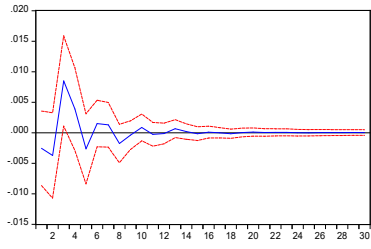


Figure 5. In 2002:01-2010:12 Period, The effect of a 1-unit shock in the interest rate on the real effective exchange rate

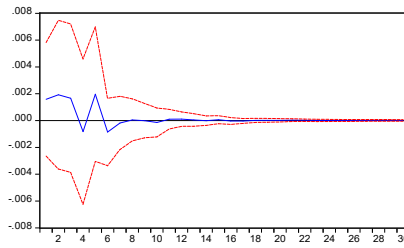


Figure 6. In 2002:01-2010:12 Period, The effect of a 1-unit shock in the real effective exchange rate on the industrial production index

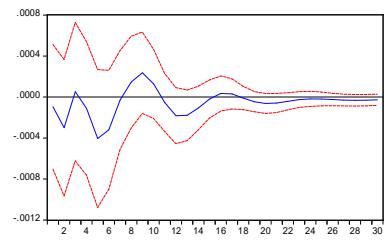


Figure 7. In 2002:01-2010:12 Period, The effect of a 1-unit shock in the real effective exchange rate on the CPI

Impulse-Response Functions for Credit Channel Effects (2011:01-2020:12)

The effect of the interest rate shock on credits was statistically significant and negative in the first and fifth months in accordance with the expectations (Figure 8).

The effect of the interest rate policy on industrial production through the credit channel was not found to be statistically significant (Figure 9). It is thought that reducing the interest rate is not sufficient to increase investments.

Contrary to the theoretical expectation, the effect of the shock in total credits on the industrial production volume is negative and significant (Figure 10). It is observed that industrial development in Turkey could not have been supported from domestic credits sufficiently. Since the interest rate applied to domestic bank credits in Turkey is high, foreign currency debts increased by consider the exchange rate risk (Berkay and Ağcakaya, 2017, p. 14). After the 2008 financial crisis, liquidity increasing policies have been implemented by many developed country central banks. Turkey's external debt stock increased in this period. The share of private sector debt in the total external debt stock has also increased. Turkey's gross external debt stock was 129,643 million USD in 2002 and 304,882 million USD in 2011. The external debt of the private sector was 43,107 million USD in 2002 and 199,719 million USD in 2011. The inability of firms to export adequately increased the sensitivity to exchange rate volatility and fed financial fragility (Ulusoy, 2012, p. 136; Dayar and Sandalcı, 2017, p. 372).

The increase in the credit volume causes a prominent and significant increase in the CPI since the second month, indicating that the credit channel transmission mechanism works in line with the theoretical expectation. Especially the period after 2011 can be defined by the size of the loan volume used in the market. The inflationary effect of the credit channel appears in a short time in the impulse response function (Figure 11).

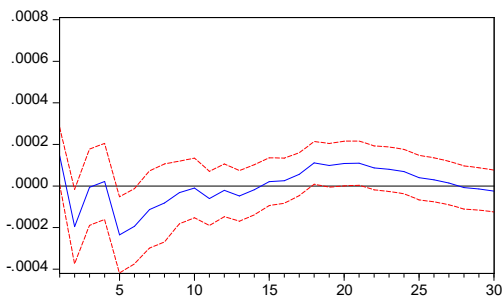


Figure 8. In 2011:01-2020:12 Period, The effect of a 1-unit shock in interest on total credits

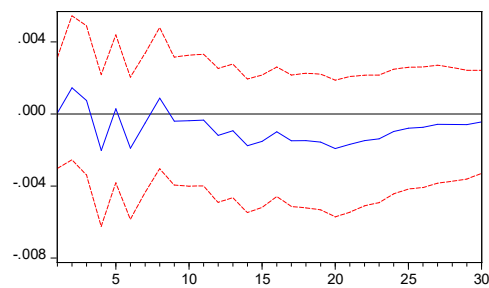


Figure 9. In 2011:01-2020:12 Period, The effect of a 1-unit shock in interest on the industrial production index

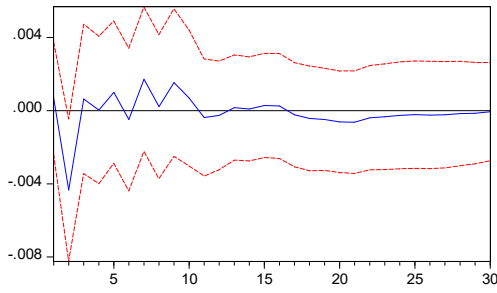


Figure 10. In 2011:01-2020:12 Period, The effect of a 1- unit of shock in credits on industrial production index

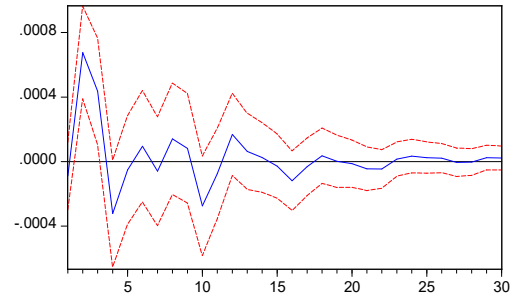


Figure 11. In 2011:01-2020:12 Period, The effect of a 1- unit of shock in credits on CPI

Impulse-Response Functions for Exchange Rate Channel Effects (2011:01-2020:12)

When the transmission mechanism of the exchange rate channel of the monetary policy is evaluated for the period 2011-2020, it is seen that we have obtained results that are in line with the theoretical expectation. The effect of the interest rate shock on the exchange rate appears as a statistically significant and rapid decrease in the first two months (Figure 12).

The impulse response graph showing the effect of the exchange rate on the industrial production index was not found to be statistically significant (Figure 13). Among other factors, exchange rate volatility may affect level of development of the country through its effects on foreign direct investment inflows. Because the higher exchange rate volatility increases uncertainty over the return of the investment. Thus, under high exchange rate volatility foreign direct investment will be lower. This is a negative impact on economic growth. One of the main effects of exchange rate movements is increase in the external debt burden for Turkey (Jamil and Kunst, 2012, p. 88). During this period, the increase in the exchange rate in the Turkish economy, whose industrial production is dependent on imported inputs, increased production costs, decreased profitability and caused economic contraction. As sum up, high exchange rate fluctuations disrupt the efficient allocation of resources and negatively affect the development.

In line with the expectations, the effect of a shock in the exchange rate on inflation rate was statistically significant and positive in the first two months. In the following period, the effect diminished and disappeared (Figure 14).

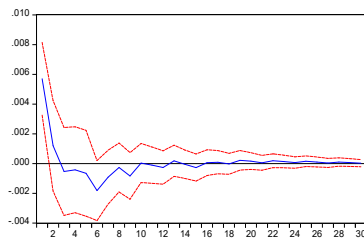


Figure 12. In 2011:01-2020:12 Period, The effect of a 1-unit shock in interest rate on the exchange rate

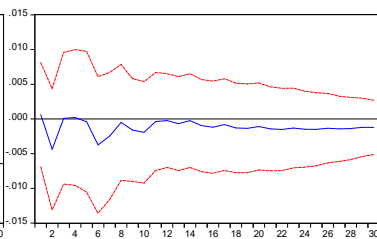


Figure 13. In 2011:01-2020:12 Period, The effect of a 1-unit shock in the exchange rate on the industrial production index

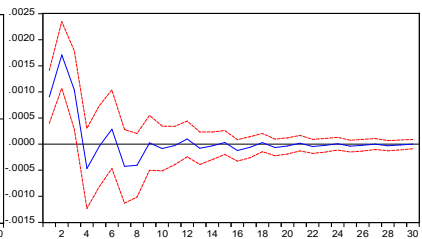


Figure 14. In 2011:01-2020:12 Period, The effect of a 1-unit shock in the exchange rate on the CPI

Variance Decomposition of Exchange Rate Effect (2002:01-2010:12)

The determination power of fluctuations in the interest rate by the exchange rate started with 6% in the 2nd month, reached 15% in the 5th month and then decreased to 10% in the one-year period. The impact of industrial production on the interest rate fluctuations started slightly from the second month and increased to 7% at the end of the year. Similarly, the impact of inflation rate started low and increased to about 2%.

In accordance with the monetary transmission mechanism, it is seen that a significant part of the fluctuations in the exchange rate are caused by interest rate. This effect, which seemed low in the first months, showed a leap from the third month and reached the level of 9% at the end of the year. While the explanatory power of CPI on the changes of exchange rates was quite weak in the first months, it increased in the following period and remained stable at 2%. It is seen that most of the changes in the industrial production index are due to its own internal dynamics during the period. Interest rate has had a relatively large impact on the industrial production index. The power of explaining the movement in the inflation rate by interest rate remained weak in the first 2 months, but increased rapidly afterwards and reached 10% at the end of a year. The effect of the industrial production index on the exchange rate started with 2%, continued to increase and remained stable at 5% over the one-year period. In this period, it is observed that the exchange rate has the lowest effect of the variables that drive inflation rate. While it had a very insignificant effect at the beginning, it reached the level of 3,6 in the following periods.

Variance Decomposition of Credit Impact (2002:01-2010:12)

The credit volume has been affected by the other variables of the system by getting rid of the effects of its internal dynamics since the 3rd month. During this period, the credit channel of the monetary transmission mechanism worked quickly. It is seen that a large part of the movements in the interest rate is due to the change in credit volume. The power of the credits to determine the change in the interest rate reached the highest levels between the 5th and 9th months and achieved the level of 15%. The effect of industrial production has reached 8% at the end of the year with an increasing acceleration. The determination power of the inflation rate has increased again and reached the level of 4,5% at the end of the year. It is seen that the movements in the credits are caused by the fluctuations in the interest rates. This impact increased throughout the year and reached 21,4% at the end of the year. Another important determinant of the movements in credits is the industrial production index, which reached 15% in the 6th month. The effect of CPI gradually increased and reached 5% in the 3rd month. As expected, the effect of credits on industrial production occurred in the early period and reached 4% by the end of the year. The effect of inflation rate emerged with a delay, and its explanatory power reached 6% in the following periods, exceeding that of credits. Interest rates had a slight effect and reached 3,5% at the end of the year. Fluctuations in the inflation rate reacted faster than changes in other variables. The biggest impact came from interest rates. The effect of the interest rate increased over periods and approached 14% at the end of the year. Then, affected by industrial production, it started with 3% and approached 8% at the end of the year. The effect of credits also increased over periods and approached 6% at the end of the year. The impact of industrial production started with 3% and approached 8% at the end of the year. The effect of credits also increased by periods and approached 6% at the end of the year.

Variance Decomposition of Exchange Rate Effect (2011:01-2020:12)

The initial effect of the exchange rate on the interest rate fluctuations was 7,5% and increased in the following periods to around 11%. The effect of CPI was realized as 4%, and the strength of the effect remained almost the same over the one-year period. The biggest impact was due to the industrial production index, which started with 2%, reached 20% at the end of the year with an increasing acceleration. Especially, it is thought that the predominant determinant of the change in the interest rates is the lagged effect of the expansion in the construction sector. The explanatory power of the interest rate was 17,6% in the first period, and decreased in the following months to 13,8% at the end of a one-year period. It is observed that the interest rate has a higher explanatory power on the movements in the industrial production index than the exchange rate. When the levels of these effects are examined, it is seen that the exchange rate reached its highest level with 1,7% in the fifth month and the interest rate reached its highest level with 3,7% in the eighth month. The movements on the consumer price index are determined by the exchange rate by 32,8% in the 3th month, by the interest rate by 12,2% in the 11th month and by the industrial production index by 3,9% in the 12th month. According to these

results, it has been determined that a significant part of the increase in the inflation rate arise from the changes in exchange rates. It is not possible to explain the changes in the industrial production with fluctuations in the exchange rate and the interest rates. The biggest impact of the exchange rate channel of monetary policy in this period is on the inflation rate.

Variance Decomposition of Credit Impact (2011:01-2020:12)

In the second period, 3,5% of the movements in the interest rate originate from credits, 4,2% from the industrial production index and 6% from CPI. The power of credits to determine the movements in the interest rate gradually increases and reaches 21% in the 12th period. The ability of the industrial production index to explain the movements in the interest rates reaches its highest value with 11,6% in the 12th period. The effect of CPI started with 6% and gradually decreased. These results show us that the movements in the interest rates are mostly caused by credits and then the industrial production index. The effect of CPI remained relatively small. Approximately 10% of the volatility in credits in the second month appears to have been caused by the interest rate and 9% from CPI. The impact of the interest rates on credits reached 20% in the sixth month. CPI followed an increasing trend on credits and reached 15% at the end of the year. The effect of the change in credits deriving from the movements in the industrial production index remained relatively weak, rising from around 1% to 6% at the end of the year. It is understood that the biggest determinant of the movements in the industrial production index is total credits. The impact of the credits was 6% in the second month and followed a gradually decreasing course. After the impact of credits on the industrial production index, the movements in CPI were effective on the industrial production index and reached the level of approximately 4% in the following process. It has been observed that the explanatory power of the interest rate reached a maximum of 2%, which remained weak. It is observed that the main determinant of the fluctuations in the inflation rate is credits. Interest rates have the determination power on the fluctuations in the inflation rate after credits and that the effects on the industrial production index remain relatively weak. While the interest rate effect on the fluctuations in the inflation rate is dominant at 9% in the first month, from the second month the credits have a main effect of approximately 20%. In the following periods, the effect of credits reached up to 27%. The effect of the interest rate reached 18% with an upward trend. The effect of the industrial production index appeared with a lag and reached a maximum level of 3,5%, creating a low relative effect. These results indicate that the credit channel of the monetary policy in Turkey has worked effectively in terms of inflation rate in the period studied. However, the effect on industrial production has been observed ineffective.

CONCLUSIONS

In this study, the effects of two different monetary policy strategies put into practice in Turkey were examined for the two periods between 2002 and 2020. The process of the monetary transmission mechanism has been analyzed over the exchange rate and credit channel using the structural VAR model, which allows it to be structured in accordance with the economic theory.

According to the results of the analysis, when the credit channel is examined in the first period (2002-2011), it is observed that the expansionary monetary policy caused an increase in the credit volume. During this period, the expected effect of monetary policy on industrial production did not emerge. It has not been a sufficient policy to reduce interest rates in order to increase investments in the Turkish economy. In this period, the stable stance of the monetary policy and the achievement of fiscal discipline created an atmosphere of confidence and inflation was reduced. According to variance decomposition, it has been determined that the interest rate is the most important determinant of fluctuations in credits.

According to the findings of the exchange rate channel in the period 2002-2011, the effect of the interest rate on the real effective exchange rate was found to increase in line with theoretical expectations with a two-month delay. According to variance decomposition, it has been observed that the most important determinant of the fluctuations in the exchange rate was interest.

When the effectiveness of the credit channel was monitored in the period 2011-2020, it has been seen that the shock in the interest rates resulted in a contraction in the credit volume. The shock in credits has caused an increase in the inflation rate. Therefore, the effect of the interest rates on credits and credits on the inflation rate was in line with expectations. According to variance decomposition, it has been found that most of the movement in credits was due to interest rates and the biggest determinant of inflation rate fluctuations was credits. Although most of the movement in the industrial production index appears to be due to credits, it looks rather weak.

When the findings of the exchange rate channel of the monetary transmission mechanism were examined recently, it was found that the effect of the shock in the interest rate on the exchange rate was negative, the effect of the shock in the exchange rate on inflation was positive, and the findings were in line with the theoretical expectation in this period. According to variance decomposition, interest rate has a high power to explain movements in the exchange rate. It is seen that a significant part of the movements in the inflation rate are caused by exchange rate and credit fluctuations, and the explanatory power of exchange rate is relatively high.

In summary, the period 2002-2011 can be considered successful in terms of inflation targeting strategy, especially in its early years. However, this period is a period in which the TRY is overvalued, the current account deficit has reached very high levels, capital flows are intense, and financial stability is ignored. 2011-2020 period, on the other hand, is a period in which capital flows and credit expansion are monitored more controlled with the new monetary policy. The financial stability target has been successful to a certain extent. However, in the Turkish economy, where the economic growth process largely depends on capital flows, it does not seem possible that only monetary policy instruments will be sufficient to ensure financial stability.

It is considered that monetary and fiscal policies should be used together, and economic policies should be implemented that inspire confidence and free from uncertainty. In addition, it has been concluded that it would be appropriate to implement reformist policies that would offer a permanent solution that deals with the cause of the problem, not its outcome.

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Author Contribution Rate:

The contribution of both authors to the research is 50%, especially in the formation of research hypotheses, selection of the appropriate method and analysis.