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THE RELATIONSHIP BETWEEN MONETARY POLICY AND ASSET PRICES: EVIDENCE FROM THE TURKISH ECONOMY*

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Abstract

The developments in the US housing and real estate sectors played an important role during the Global Financial Crisis of 2008. The findings of previous theoretical and empirical studies have revealed that there was a strong relationship between the expansionary monetary policy that included high liquidity and low-interest rates in the US economy and the housing price bubble, which played a central role in the development of the crisis. These developments have revealed the importance of the relationship between monetary policies and asset prices. In this direction, the present study aims to conduct an empirical investigation of the relationship between monetary policies and asset prices in the Turkish economy. In line with this purpose, the SVAR approach was used in the study. The period included within the scope of the present study was determined as 2011:5-2018:5. According to the findings obtained, it is observed that the only significant reactions of monetary policies to the variables included within the model were to the real effective exchange rate and treasury bill rate. Additionally, the effects of monetary policies on the real effective exchange rate, housing price index, BIST 100 index, treasury bill rate, and interest of government securities were found to be significant.

Key words: Asset Prices, Monetary Policy, Turkish Economy, Structural VAR

Jel Code: E52, E58, C22.

1. Introduction

The debate for whether asset prices should have a systematic role in monetary policy was discussed within the context of the Japanese asset price bubble in the 1980s and the 1990s U.S. stock market bubble and came up again with the

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2008 Global Financial Crisis. Before the 2008 Global Financial Crisis, the Federal Reserve's (FED) expansionary monetary policy which covered low-interest rates and abundant liquidity, laid the groundwork for the formation of an unregulated and high credit policy towards the housing sector. As a result of this policy implemented by the FED in the period 2001-2005, house price bubbles began to form in the period between 2003-2006. The process was reversed in 2006 when the house price bubble burst. This led to criticism of the FED for its monetary policy taken before the crisis (Taylor, 2007; Shiller, 2008; Jarocinski and Smets, 2008; Bernanke, 2009; Holt, 2009).

The formation of expansionary monetary policy, comprised of low-interest rates and abundant liquidity, as an important macroeconomic power for the emergence of house price bubbles and the aforementioned changes concerning the house prices leading to financial instability with the macroeconomic outlook, brought up the idea of "taking the asset prices into account" as a way for the central banks' to provide financial stability. But there is a debate over whether central banks should use monetary policy tools to contribute to financial stability in asset markets or not.

There are two arguments in the literature about whether monetary policy should respond to asset price movements. The arguments in question relate to the extent to which monetary policy should respond to asset price movements. According to the traditional central banking approach, asset price movements should affect monetary policy only if it creates inflationary pressure. Therefore, in the traditional central banking approach, monetary policy should not have an additional response to asset price movements. In this regard, it is stated that asset price bubbles are not a direct target of monetary policy (Bernanke and Gertler, 1999). Under this view, it is noted that central banks inhibit the formation of asset price bubbles in reaching its targets of low inflation and stable growth and financial stability contributed to price stability (Bordo and Wheelock 1998; Bernanke and Gertler, 2001; Özatay, 2012). According to another argument, central banks should systematically respond to asset price movements (Kent and Lowe, 1997; Smets, 1997; Cecchetti et al. 2000; Bordo and Jeanne, 2002; Borio and Lowe, 2002, Roubini, 2006; Semmler and Zhang, 2007; Akram and Eitrheim 2008). According to this approach, a central bank that aims to balance inflation at a certain target level can achieve success by adjusting monetary policy tools not only according to low inflation and stable growth targets but also according to asset prices. In this context, central banks should react to all asset prices in the event of a bubble (Cecchetti et al., 2000: 59). Under this view, it is stated that asset prices can give guiding signals on monetary policy decisions. For this reason, asset prices are useful for assessing the suitability and effectiveness of policy actions (Smets, 1997; Leduc and Natal, 2011). From this perspective, which goes beyond the traditional approach, asset price stability should be a key target for central banks. But this does not mean that central banks should directly target asset prices or try to burst asset price bubbles. In such a case, central banks should react to excessive increases in asset prices by setting interest rates. This attitude of the central bank will contribute to the goals of low inflation and stable growth (Cecchetti et al., 2000: 35). According to this understanding, it is believed that central banks that are obliged to ensure price stability can contribute to financial stability by applying strict monetary policies in the event of a sudden increase in asset prices.

In this context, as a result, a central bank that wants to balance production and inflation must necessarily take into account asset price bubbles and contribute to reducing financial fragility by preventing asset price bubbles. Thus, the result is that central banks should be involved in the system with proactive policies. Although this result is convincing, there are some difficulties in practice. First, it is difficult for central banks to determine when the increase in asset prices is based on false expectations and poses a threat to the financial and macroeconomic outlook. However, the presence of delays in the monetary policy transfer mechanism makes it difficult to determine the appropriate policy (Bean, 2004).

After the 2008 crisis, the rationale for the suitability of the pre-crisis approach also remained important, while revealing the need to make monetary policy more sensitive to asset price movements. Consideration of asset prices in the policy-making process contributes to the goal of stable growth, preventing sharp increases in asset prices (Cecchetti et al. 2000; Borio and Lowe 2002; Roubini 2006; Semmler and Zhang 2007; Akram and Eitrheim, 2008).

2. Monetary Policy Practices and Asset Price Developments after the Global Crisis in Turkey

The main aim of the economic policies implemented after the 2008 Global Financial Crisis is to reduce its effects. Accordingly, the Central Bank of the Republic of Turkey (CBRT) increased liquidity support for the markets to limit the effects of the 2008 global financial crisis and also moved to cut interest rates (Keskin, 2018: 168). In November 2008, the CBRT reduced its policy interest by 50 basis points and started the interest rate reduction process. It aimed to protect the functioning of the financial system and the credit market by reducing policy interest rates by 125 and 200 basis points, respectively, in the following periods (Yılmaz, 2009: 15).

After the 2008 Global Financial Crisis, the expansionary monetary policies implemented by the central banks of developed countries, especially the FED, increased capital inflows towards Turkey, causing the exchange rate to fall and the current account balance to deteriorate. The increasing ratio of the current account deficit to GDP has become a significant threat to financial stability. During this period, the decrease in international commodity prices due to the contraction of foreign trade on a global scale led to low inflation levels. This has reduced CBRT's concerns about price stability (CBRT, 2010: 25). Thus, the CBRT had the opportunity to implement a policy aimed to limit the negative effects of the 2008 Global Financial Crisis on the Turkish economy. In this context, the CBRT has expanded its monetary policy to include financial stability. A new understanding of monetary policy has been adopted to reduce risks in the financial system. For this purpose, CBRT has started to use different policy tools such as interest corridor, one-week repo interest, liquidity management, and mandatory reserves in addition to short-term interest rates, which are the main policy tool. (CBRT, 2013: 12).

In order to achieve price stability and financial stability goals using new policy tools, the CBRT has decoded credit and exchange rate variables as intermediate variables. In this way, it can be stated that the CBRT provides monetary policy communication through loans and exchange rates. The use of credit and exchange rate variables to achieve final goals means that the CBRT does not directly include asset prices when creating monetary policy. The fact that the asset prices are not directly included in the monetary policy objective function means that asset prices are only considered in the context of their relationship with the elements of total demand and cost (Kara, 2012: 6-7).

After the 2008 global financial crisis, the expansionary monetary policies implemented by the central banks of developed countries led to increased liquidity levels on a global scale. Due to the increased abundance of liquidity, it can be stated that the CBRT has significantly reduced policy interest rates since 2010. The expansionary monetary policy implemented after 2010 has led to a significant increase in house prices since 2011. However, the expansionary monetary policies implemented by the central banks of developed countries have had the effect of lowering the exchange rate by increasing capital inflows towards Turkey. In addition, this decrease in policy interest has raised stock price indices.

FED's termination of its quantitative easing policy in 2014 and its first rate hike in 2015 have caused volatility in financial markets and the exchange rate in Turkey. FED's tightening monetary policy has boosted sales of both treasury bonds and government bonds. In order to limit the impact of these developments on inflation expectations, the CBRT embarked on monetary tightening towards the end of 2016. In this context, policy interest was increased by 50 basis points (CBRT, 2016: 32). After the implementation of the shrinking monetary policy of the CBRT, there were some negative events in the housing sector. There have been sharp rises in the exchange rate and a fall in stock prices. As of mid-2019, the CBRT's policy interest rate reduction has led to house prices and the exchange rate entering an upward trend.

3. Method, Data Set and Model

Structural VAR Model

It is stated that the VAR model has some disadvantages in its use in economic research. Due to the VAR model's characteristics such as being separated by using the method of Cholesky, sensitive to the covariant matrix variable ranking, being bound to the arbitrary introduction of constraints identification, and not having an obligatory correlation with the economic theory, the results can show changes depending on the ranking, conflicting with the economic theory and be misleading. (Brooks, 2008; Enders, 2014). In the face of such disadvantages or criticism, the SVAR model was developed by Sims (1986) and Bernanke (1986).

The structural form of the VAR model, consisting of two variables such as y and x and with a period lag; and the stationary series of variables y_t and x_t, can be considered as follows to express the terms white noise error with standard deviation ε_{y_t} and ε_{x_t}, σ_y and σ_x, respectively.

$$y_t = \beta_{10} - \beta_{12}x_t + \gamma_{11}y_{t-1} + \gamma_{12}x_{t-1} + \varepsilon_{y_t} \tag{1}$$

$$x_t = \beta_{20} - \beta_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}x_{t-1} + \varepsilon_{x_t} \tag{2}$$

In a system consisting of equations (1) and (2); β_{12} and β_{21} shows the simultaneous effect of x_t to y_t and y_t to x_t, respectively. ε_{y_t} and ε_{x_t}variables can be expressed as shocks on y_t and x_t. β_{12} and β_{21} its coefficients take values other than zero, will cause the error terms $\varepsilon_{y_t}$and ε_{x_t} to have indirect effects on x_t and y_t, respectively. This will result in a violation of the assumption that error terms are unrelated to independent variables. In order to predict the model according to econometric criteria, structural equations must be converted into reduced pattern equations (Kutlar, 2009: 345-348). The SVAR form in the above equation system can be written with the matrix algebra as follows:

$$\begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix} \begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{y_t} \\ \varepsilon_{x_t} \end{bmatrix} \quad \text{and} \tag{3}$$

$$A = \begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix}, v_t = \begin{bmatrix} y_t \\ x_t \end{bmatrix}, \Gamma_0 = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix}, \Gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}, and\ \varepsilon_t = \begin{bmatrix} \varepsilon_{y_t} \\ \varepsilon_{x_t} \end{bmatrix} \tag{4}$$

The closed form of the system of equations is in its $Av_t = \Gamma_0 + \Gamma_1 v_{t-1} + \varepsilon_t$ form. When both sides of the equation are multiplied by A^{-1}

$$A^{-1}Av_t = A^{-1}\Gamma_0 + A^{-1}\Gamma_1 v_{t-1} + A^{-1}\varepsilon_t \tag{5}$$

$$B = A^{-1}\Gamma_1, \Theta = A^{-1}\Gamma_0, and\ e_t = A^{-1}\varepsilon_t \tag{6}$$

the standard form for the VAR model can be written in the $v_t = \Theta + Bv_{t-1} + e_t$ format.

The standardized form of the VAR system obtained using matrix algebra can be written as:

$$y_t = \theta_1 + \alpha_{11}y_{t-1} + \alpha_{12}x_{t-1} + e_{1_t} \tag{7}$$

$$x_t = \theta_2 + \alpha_{21}y_{t-1} + \alpha_{22}x_{t-1} + e_{2_t} \tag{8}$$

Error terms e_{1_t}, and e_{2_t}; consists of a combination of ε_{y_t} and ε_{x_t}error terms contained in the SVAR model. Distributed around zero median and autocovariance are series with zero constant variance. Error terms can be expressed as a combination of two shocks as follows:

$$e_{1_t} = (\varepsilon_{y_t} - \beta_{12}\varepsilon_{x_t})/(1 - \beta_{12}\beta_{21}) \quad (9)$$

$$e_{2_t} = (\varepsilon_{x_t} - \beta_{21}\varepsilon_{y_t})/(1 - \beta_{12}\beta_{21}) \quad (10)$$

Although error terms e_{1_t} and e_{2_t} and autocovarians are series equal to zero, and if their coefficients β_{12} and β_{21} are different from zero, there will be a correlation relationship with each other. Covariance between error terms,

$$E(e_{1_t}, e_{2_t}) = E\left[\frac{(\varepsilon_{y_t} - \beta_{12}\varepsilon_{x_t})(\varepsilon_{x_t} - \beta_{21}\varepsilon_{y_t})}{(1 - \beta_{12}\beta_{21})^2}\right] = -(\beta_{21}\sigma_y^2 + \beta_{12}\sigma_x^2)/(1 - \beta_{12}\beta_{21})^2 \quad (11)$$

could be written as such. The closed form for the model's error variance/covariance matrix and time-independent Matrix elements is as follows (Kutlar, 2009; Enders, 2014; Sevüktekin and Çınar, 2017):

$$\Sigma = \begin{bmatrix} var(e_{1_t}) & cov(e_{1_t}, e_{2_t}) \\ cov(e_{1_t}, e_{2_t}) & var(e_{2_t}) \end{bmatrix} \quad (12)$$

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix} \quad (13)$$

In equation 13, σ_1^2 *and* σ_2^2 and y_t *and* x_t refers to the variance of its variables in the Matrix, respectively, and σ_{12} *and* σ_{21} refers to the covariance between error terms. The correlation between error terms reflects the simultaneous relationship between variables.

Since there are white noise processes of ε_{y_t} and ε_{x_t} in equation (9) and (10), the variance-covariance matrix in equation (13) is shown,e_{1_t} and e_{2_t} are error terms distributed with constant variance around the zero mean and does not contain autocorrelation. If the Matrix a^{-1} is known when evaluated in the context of the equation (5) and (6); it will be $\Gamma_1 = AB$ *and* $\varepsilon_t = Ae_t$.

In structural VAR analysis, a number of $(n^2 - n)/2$ constraints must be placed on the simultaneous constraint matrix, including the number of variables in the n matrix (Enders, 2014). Since it is known that the diagonal elements of Matrix A are identical, there is a number of $(n^2 - n)$ unknown elements in the Matrix. However, there are $var(\varepsilon_t)$ n pieces. So the total number of unknown variables will be $(n^2 - n) + n = n^2$. Since its Σ matrix is symmetric, it contains $(n^2 + n)/2$

elements. In summary, the constraints to be placed in the model allow the structural VAR model to be estimated.

Data Set

The study covers the period 2011:5-2018: 5 and uses monthly data in the analysis. The period of the study was determined so that maximum observation can be obtained for all variables. The SVAR model used in the study consists of 7 internal variables. The variables used in the study are monetary policy (MP), gold prices (GLD), stock market index (BIST), government bond interest (GBIR), house price index (HPI), Treasury bond interest (TBIR), and exchange rate (RER). In the study, the BIST interbank money market overnight interest rate variable was used to represent monetary policy. The weighted average price of 1 ounce of gold in USD, representing gold prices, was used in the BIST 100 Index according to the closing prices representing the stock market index (January 1986=1). In the model, the 10-year government bond interest rate was used, which is a reference to the long-term interest rate in terms of maturity, representing the interest on government bonds. Another variable included in the model is Treasury bond interest. 3-month Treasury bond interest, which is a reference to the short-term interest rate, was used as Treasury bond interest. It is arranged to show weighted average compound interest rates applied to Treasury Bills that are 3 months overdue in the related variable used bond market. The House Price Index (2017=100) is included in the model representing house prices. The last variable included in the model is the exchange rate. The exchange rate is included in the model as Real Effective-CPI based (2003=100).

Table 1. Variables, Symbols of Variables and Data Sources

Variable	Symbol	Data Source
BIST Interbank money market overnight interest rate	MP	CBRT
Gold Prices	GLD	CBRT
BIST 100 Index	BIST	CBRT
10-Year Government Bond Interest Rate	GBIR	investing.com
Housing Price Index	HPI	CBRT
3-Month Treasury Bond Interest Rate	TBIR	Borsa Istanbul
Real Effective Exchange Rate	RER	CBRT

As it can be seen from Table 1, BIST inter-bank overnight interest rate in the money market, gold prices, the BIST 100 index, HPI, and the real effective exchange rate were obtained from CBRT; the interest rate of 10-year government bonds was obtained from investing.com; 3-month Treasury bill interest rate was obtained from BIST. The variables BIST 100 index, House Price Index and gold prices are included in the model in logarithmic form. Seasonality and calendar effects were not detected in the variables.

The Model

Seven internal variables were studied in the analysis of the relationship between monetary policy and asset prices. These are the monetary policy interest rate, gold prices, real effective exchange rate, stock prices, house price index, Treasury bond interest rate, and government bond interest rate. The SVAR system with seven variables and one lag for monetary policy asset prices can be shown in the following format.

$$\begin{bmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} & \beta_{17} \\ \beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} \\ \beta_{31} & \beta_{32} & 1 & \beta_{34} & \beta_{35} & \beta_{36} & \beta_{37} \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} & \beta_{46} & \beta_{47} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & \beta_{56} & \beta_{57} \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 & \beta_{67} \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & 1 \end{bmatrix} \begin{bmatrix} MP_t \\ GLD_t \\ RER_t \\ BIST_t \\ HPI_t \\ TBIR_t \\ GBIR_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ \beta_{40} \\ \beta_{50} \\ \beta_{60} \\ \beta_{70} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} & \gamma_{16} & \gamma_{17} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \gamma_{25} & \gamma_{26} & \gamma_{27} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} & \gamma_{35} & \gamma_{36} & \gamma_{37} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} & \gamma_{45} & \gamma_{46} & \gamma_{47} \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & \gamma_{55} & \gamma_{56} & \gamma_{57} \\ \gamma_{61} & \gamma_{62} & \gamma_{63} & \gamma_{64} & \gamma_{65} & \gamma_{66} & \gamma_{67} \\ \gamma_{71} & \gamma_{72} & \gamma_{73} & \gamma_{74} & \gamma_{75} & \gamma_{76} & \gamma_{77} \end{bmatrix} \begin{bmatrix} MP_{t-1} \\ GLD_{t-1} \\ RER_{t-1} \\ BIST_{t-1} \\ HPI_{t-1} \\ TBIR_{t-1} \\ GBIR_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{MP_t} \\ \varepsilon_{GLD_t} \\ \varepsilon_{RER_t} \\ \varepsilon_{BIST_t} \\ \varepsilon_{HPI_t} \\ \varepsilon_{TBIR} \\ \varepsilon_{GBIR_t} \end{bmatrix} \quad (14)$$

In the SVAR model, The Matrix A is treated as a matrix of simultaneous coefficients; the reduced VAR model with constraints to be placed on The Matrix A can be estimated by the least squares method. The study examined both the impact of monetary policy on asset prices and the role of asset prices in monetary policy practices. In this direction, the SVAR model is considered with the constraints set in two different specifications.

Specification (1)

$\varepsilon_t = Ae_t$ In the model established in the context of equality, the constraints placed on the simultaneous effect matrix in the first specification are discussed in equation (15).

$$\begin{bmatrix} \varepsilon_{MP_t} \\ \varepsilon_{GLD_t} \\ \varepsilon_{RER_t} \\ \varepsilon_{BIST_t} \\ \varepsilon_{HPI_t} \\ \varepsilon_{TBIR_t} \\ \varepsilon_{GBIR_t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & 0 & 1 & 0 & 0 \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & 0 & 1 & 0 \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & 0 & \beta_{76} & 1 \end{bmatrix} \begin{bmatrix} e_{MP_t} \\ e_{GLD_t} \\ e_{RER_t} \\ e_{BIST_t} \\ e_{HPI_t} \\ e_{TBIR_t} \\ e_{GBIR_t} \end{bmatrix} \quad (15)$$

The first row of the matrix shown in equation (15) shows the simultaneous response of the first variable in the model to other variable shocks, while the first column shows the simultaneous effect of shocks occurring in the variable on other variables. Since the model attempts to analyze the relationship between monetary policy asset prices, the monetary policy variable in the first specification, it is assumed that the BIST interbank overnight interest rate has a simultaneous effect on all other variables.

Another constraint placed on the simultaneous coefficient matrix is that gold prices are simultaneously affected only by monetary policy, based on the fact that

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they are sensitive to the international financial conjuncture. Taking into account the foresight that in Turkey, a developing economy where economic competitiveness is low, and the real effective exchange rate changes depending on the currency values in international markets, it is assumed that the real effective exchange rate reacts simultaneously only to gold prices and monetary policy. Due to the investments made in gold having a traditional dimension, in other words, local and cultural preferences being effective on gold investments, it is the point of movement for the transitivity of the exchange prices traded in organized markets not to be interpreted simultaneously to gold prices.

Another constraint placed on the model is that in the context of the effective market hypothesis, stock prices respond simultaneously to shocks occurring in monetary policy, gold prices, and the real effective exchange rate. The constraint on house prices is that house prices react simultaneously to monetary policy, gold prices and the real effective exchange rate as the housing-finance bond in Turkey is weak. However, it is assumed that the Treasury bond interest rate reacts synchronously to monetary policy, gold prices, real effective exchange rate, and stock prices in the constraints placed on the simultaneous coefficient Matrix. The constraint in question is included in the model in the context of the effective market hypothesis. Government bonds, on the other hand, are assumed to be the longest-term investment vehicle, simultaneously affected by all other variables different than the house price. If all constraints placed in the simultaneous coefficient matrix are subjected to a general evaluation, the constraints are important for limiting simultaneous relationships that cannot be explained economically or can be rejected, rather than including economically possible simultaneous relationships in the model.

Specification (2)

$\varepsilon_t = Ae_t$ In the model established in the context of equality, the constraints placed on the simultaneous effect matrix in the second specification are discussed in equation (16).

$$\begin{bmatrix} \varepsilon_{GLD_t} \\ \varepsilon_{RER_t} \\ \varepsilon_{BIST_t} \\ \varepsilon_{HPI_t} \\ \varepsilon_{TBIR_t} \\ \varepsilon_{GBIR_t} \\ \varepsilon_{MP_t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & 0 & 1 & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & 0 & 1 & 0 & 0 \\ \beta_{61} & \beta_{62} & \beta_{63} & 0 & \beta_{65} & 1 & 0 \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & 1 \end{bmatrix} \begin{bmatrix} e_{GLD} \\ e_{RER_t} \\ e_{BIST_t} \\ e_{HPI_t} \\ e_{TBIR_t} \\ e_{GBIR_t} \\ e_{MP_t} \end{bmatrix} \quad (16)$$

Another composition of the constraints placed on the simultaneous coefficient matrix in the SVAR model in the analysis of the relationship between monetary policy and asset prices is the alternative model shown in equation (16), which we call the second specification. In the model, all other constraints placed on the first model within the framework of economic theory and expectations remain constant, but the simultaneous effects of all variables on monetary policy are released. In other words, under this assumption, it was assumed that the central bank reacted instantly to changes in asset prices. In today's conditions, it is expressed under this assumption that central banks immediately reach the data and create appropriate policies.

4. Empirical Findings

The most important feature sought for series in analyses using time series is that they provide the stasis condition. The fact that the median and variance of the series do not show a systematic change or that the stationarity condition, expressed as the series is free of periodic fluctuations, causes the results of the analysis to be misleading. If Series are not stationary at level values, they can be stationary by taking their differences. Thus, the problem of containing false regression results can be avoided (MacKinnon, 1991: 1-17). In this context, whether the series provide the stationarity condition or not has been tested with the most commonly used Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests in the literature.

According to the results in Tables 2 and 3, pp, lnGLD, RER, lnBIST, GBIR, TBIR, lnHPI variables were found to be stationary when the first differences were taken. The results of the stationarity analysis were evaluated and interpreted within the framework of the results achieved from ADF and PP unit root tests. In this direction, the variables included in the model were used by taking the first differences.

Table 2. Augmented Dickey-Fuller (ADF) Unit Root test results

Variables	**ADF Test Statistics (Level)**		**ADF Test Statistics (First Difference)**		**Decision**
	Intercept	**Trend & Intercept**	**Intercept**	**Trend & Intercept**	
MP	-1.818197 [0.3694]	-2.715258 [0.2334]	-6.364435 [0.0000]	-6.349196 [0.0000]	I(1)
InGLD	-1.590408 [0.4830]	-1.893600 [0.6489]	-7.298489 [0.0000]	-7.272613 [0.0000]	I(1)
RER	-0.306947 [0.9185]	-1.641523 [0.7680]	-7.286419 [0.0000]	-7.341813 [0.0000]	I(1)
lnBIST	-1.352364 [0.6017]	-2.674457 [0.2498]	-8.678930 [0.0000]	-8.626012 [0.0000]	I(1)
GBIR	-0.738852 [0.8305]	-1.970905 [0.6083]	-8.818317 [0.0000]	-8.994014 [0.0000]	I(1)
TBIR	-0.303200 [0.9190]	-1.522213 [0.8142]	-8.623034 [0.0000]	-8.757901 [0.0000]	I(1)
lnHPI	0.086901	-2.071655	-4.735945	-4.713858	I(1)

		[0.9629]	[0.5535]	[0.0002]	[0.0014]	
Critical Values	%1	-3.510259	-4.071006	-3.511262	-4.072415	
	%5	-2.896346	-3.464198	-2.896779	-3.464865	
	%10	-2.585396	-3.158586	-2.585626	-3.158974	

Note: The values in [ ] show the values in probability values. Critical values are derived from MacKinnon (1996).
Source: Authors' calculations

Table 3. Phillips-Perron (PP) Unit Root test Results

Variables		**PP Test Statistics (Level)**		**PP Test Statistics (First Difference)**		**Decision**
		Intercept	**Trend & Intercept**	**Intercept**	**Trend & Intercept**	
MP		-1.171222 [0.6836]	-2.179110 [0.4946]	-6.117108 [0.0000]	-6.093120 [0.0000]	I(1)
InGLD		-1.391622 0.5827	-1.687890 0.7481	-7.161080 [0.0000]	-7.097732 [0.0000]	I(1)
RER		-0.616878 [0.8603]	-2.062129 [0.5589]	-7.271032 [0.0000]	-7.427409 [0.0000]	I(1)
lnBIST		-1.349094 [0.6032]	-2.734103 [0.2260]	-8.740548 [0.0000]	-8.678286 [0.0000]	I(1)
TBIR		-0.364177 [0.9095]	-1.549110 [0.8044]	-8.640088 [0.0000]	-8.723746 [0.0000]	I(1)
GBIR		-0.785748 [0.8178]	-2.036583 [0.5728]	-8.806810 [0.0000]	-8.986272 [0.0000]	I(1)
lnHPI		-0.309976 [0.9776]	-2.050982 [0.5649]	-4.735945 [0.0002]	-4.713858 [0.0014]	I(1)
Critical Values	%1	-3.510259	-4.071006	-3.511262	-4.072415	
	%5	-2.896346	-3.464198	-2.896779	-3.464865	
	%10	-2.585396	-3.158586	-2.585626	-3.158974	

Note: The values in [ ] show the values in probability values. Critical values are derived from MacKinnon (1996).
Source: Authors' calculations

Furthermore, the most appropriate lag length for the prediction model was determined in the study. The Lag length was determined according to Likelihood ratio (LR), final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ) criteria. Table 4 summarizes the lag length test results. According to the test results, it was decided that the lag was 1 in the model used, as three criteria for the optimal length of lag showed a lag of 1.

Table 4. Lag Length Test Results

Lag	LogL	LR	FPE	AIC	RS	HQ
0	228,5410	NA	6.93 e-12	-5.830026	-5.615353*	-5.744232
1	***302,1211***	***131.6696****	***3.65 e-12****	*-6.476870*	***-4.759488***	***-5.790521****
2	326,3473	38.88955	7.23 e-12	-5.824930	-2.604838	-4.538026
3	366,7963	57.48008	9.83 e-12	-5.599903	-0.877101	-3.712443
4	408,5059	51.58813	1.40 e-11	-5.408049	0.817463	-2.920033
5	447,9540	41.52432	2.42 e-11	-5.156683	2.571538	-2.068112
6	495,5346	41.32008	4.06 e-11	-5.119333	4.111598	-1.430206
7	558,4031	43.01525	6.15 e-11	-5.484292	5.249349	-1.194610
8	684,8046	63.20077	2.90 e-11	-7.521174*	4.715176	-2.630937

Note: * shows the optimal level of lag determined according to the criteria.
Source: Authors' calculations

The study tested whether the predicted model contained a structural problem. In this context, it was first tested with the help of the LM (Lagrange Multiplier) autocorrelation test to determine whether there is an autocorrelation problem in the model or not. According to the test results outlined in Table 5, the model is tested against the alternative hypothesis that there is autocorrelation in the model, the basic hypothesis of autocorrelation could not be rejected until the 8th level of lag (probability value > 0.05, thus, the hypothesis H0 cannot be rejected). In this context, it can be stated that there is no autocorrelation problem in the model.

Table 5. Autocorrelation Test Results

LM Autocorrelation Test		
Lags	**LM statistics**	**Probability value**
1	33.99302	0.9492
2	31.73831	0.9735
3	52.52912	0.3390
4	58.69849	0.1616
5	34.54336	0.9413
6	52.66823	0.3341
7	45.35559	0.6217
8	38.46440	0.8606

Source: Authors' calculations

Whether there is a problem with changing variance in the model or not was tested with the help of the White heteroskedasticity test. The basic hypothesis that error term variance is constant has been tested against the alternative hypothesis that the error term variance changes throughout the sample. According to the test results outlined in Table 6, the basic hypothesis of constant variance cannot be rejected at the significance level of 5% (the H0 hypothesis cannot be rejected because 0.0900 > 0.05). In this direction, it can be stated that there are no changing variance problems in the model.

Table 6. White Heteroskedasticity Test

Chi-Square	Degree of freedom	Probability value
430,0427	392	0.0900

Source: Authors' calculations

The normal distribution of the remnants of the predicted model was tested with the help of the Jarque-Bera normality test. The basic hypothesis that the residuals of the model are normally distributed has been tested against the alternative hypothesis that the residues are not normally distributed. The test results are summarized in Table 5. Accordingly, the H_0 hypothesis, which refers to the normal distribution of residues, could not be rejected at the 5% significance level (the H_0 hypothesis cannot be rejected because it is 0.3696 > 0.05). It can be expressed that the residuals of the model show a normal distribution.

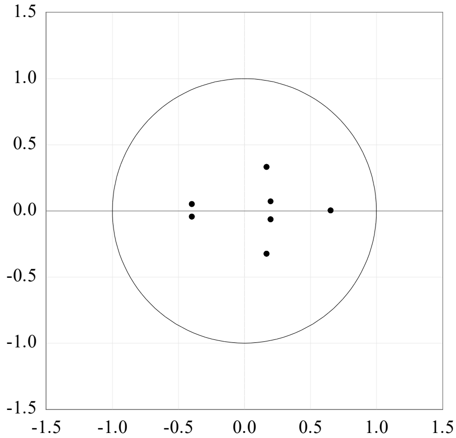
Table 7. Normality Test Results

Equation	Jarque-Bera	Degree of freedom	Probability value
1	5.532037	2	0.0629
2	3.101468	2	0.2121
3	0.624366	2	0.7318
4	1.378599	2	0.5019
5	0.636246	2	0.7275
6	2.714880	2	0.2573
7	1.137907	2	0.5661
The Model	15.137907	14	0.3696

Source: Authors' calculations

Figure 1 shows the inverse roots of the AR characteristic polynomial for the predicted Model. It has been observed that the inverse roots of the AR characteristic polynomial of the model are within the unit circle. In this context, it can be stated that the model does not contain any problems in terms of stationarity and stability conditions are provided.

Figure 1. Inverse roots of the AR Characteristic Polynomial



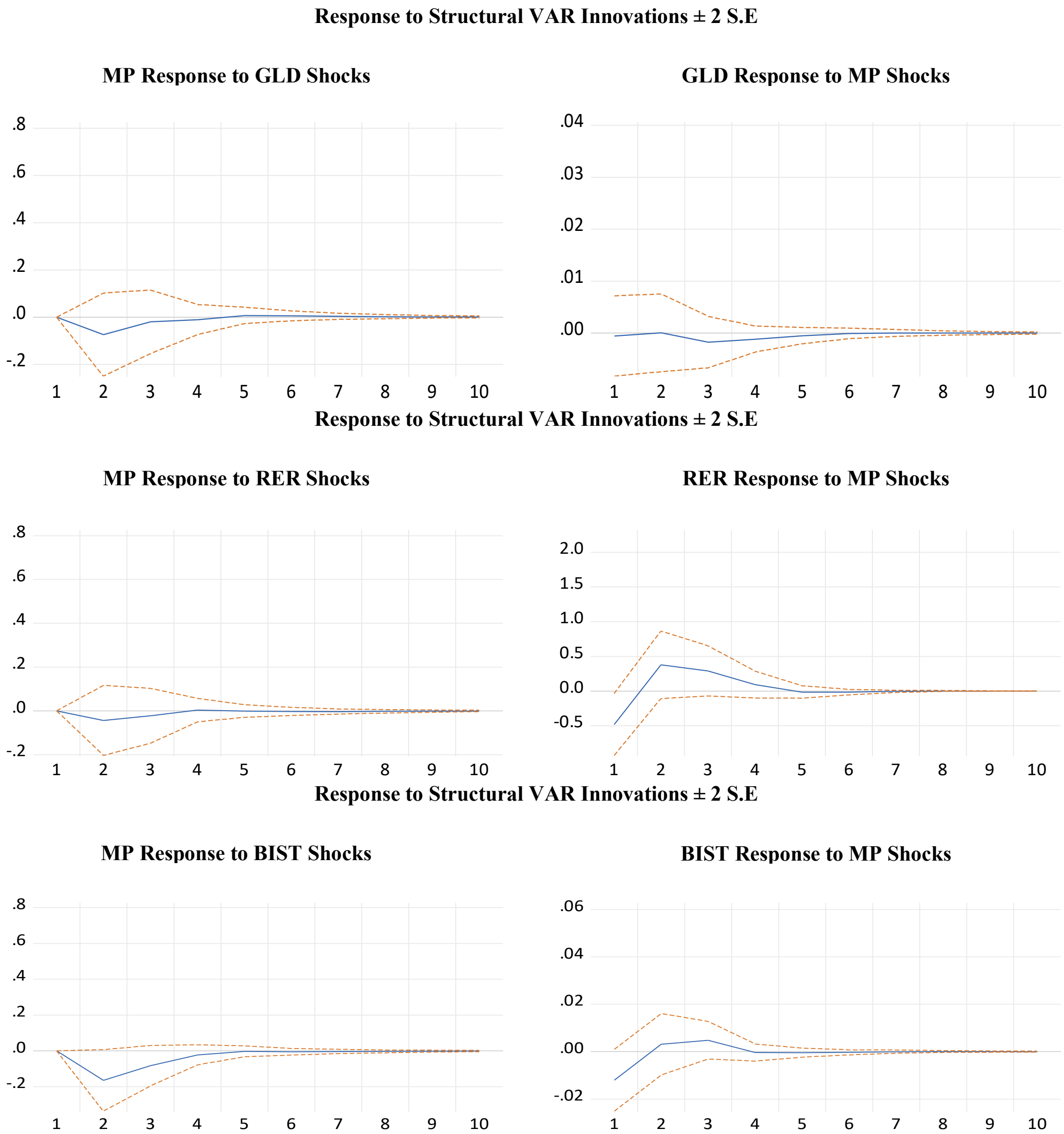
Source: Authors' estimates

The VAR model, which was established for the purpose of evaluating the relationship between monetary policy and asset prices, was evaluated according to econometric criteria and was determined by the above tests that it is a usable model as of its results. However, it has been stated above that the theoretical constraints imposed on the SVAR model must be as much as the number of $(n^2 - n)/2$ constraints in order to provide the condition for full determination. With the number of constraints in both specifications exceeding the said value (Number of constraints placed on the model: 25 >$(n^2 - n)/2 = 21)$); both models are over-determined. The basic hypothesis that over-determination is appropriate for the model has been tested with the help of the LR test for both specifications. Accordingly, the basic hypothesis that over-identification is appropriate could not be rejected for both models *(LR test statistic for the first specification = the value of sample test statistic and 2.480405, p = 0.4788, the second specification for the LR test statistic = sample statistic and the test 1.187115 value=0.7561)*. Therefore, it can be stated that the theoretical constraints determined in the study are valid.

In econometric research, the interpretation of coefficients for VAR models is not a preferred method. Instead of it, interpretation of effect response functions and variance decomposition results related to the predicted VAR model allow more effective results to be obtained. Impulse-response functions show the reaction of other variables to a unit standard deviation shock that will occur in error terms of stationary internal variables in the VAR model (Sevüktekin and Çınar, 2017: 510-515). Here, standard deviation shocks are used instead of unit shocks, taking into account the fact that the units of measurement of variables will differ and the effect response functions will not allow being evaluated. Variance decomposition is a method that shows how much of the changes occurring in one variable are caused by its shocks, and how much of it is caused by shocks in other variables (Brooks, 2008: 290-292). Although with effect-response functions, it can be determined which variable shocks occur and how the variables react to these shocks, variance decomposition attempts to determine what percentage of change in one variable is caused by its own, and what percentage is caused by other variables (Özer and

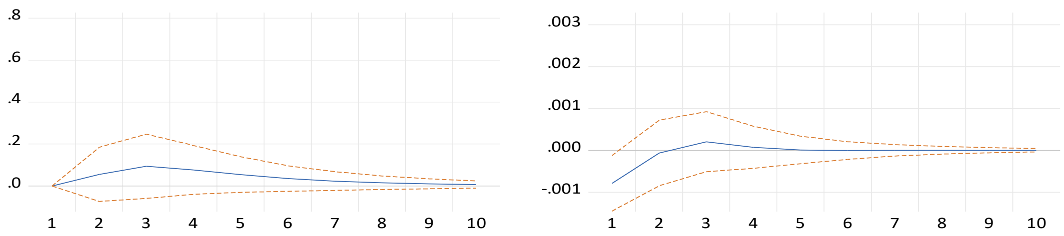
Kutlu, 2019: 221). Figure 2 shows the effect response functions for the first specification.

Figure 2. Impulse-Response Functions Monetary Policy and Asset Prices (Specification-1)



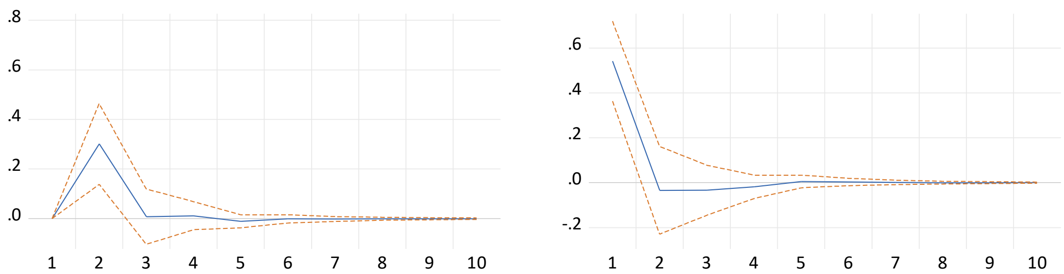
Response to Structural VAR Innovations ± 2 S.E

MP Response to HPI Shocks | **HPI Response to MP Shocks**



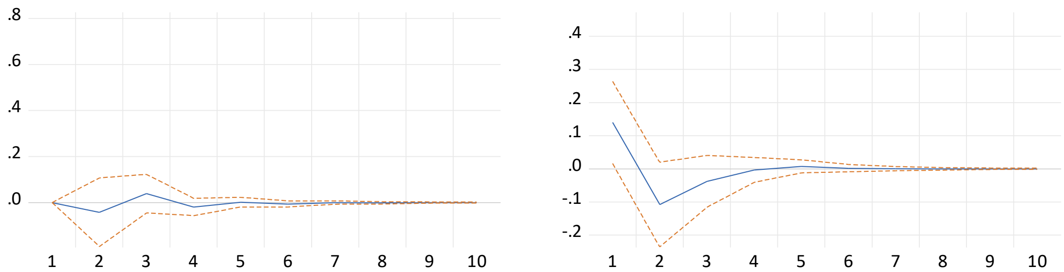
Response to Structural VAR Innovations ± 2 S.E

MP Response to TBIR Shocks | **TBIR Response to MP Shocks**



Response to Structural VAR Innovations ± 2 S.E

MP Response to GBIR Shocks | **GBIR Response to MP Shocks**



Source: Authors' estimates

The first chart shows the impulse response functions on monetary policy and gold prices. Monetary policy reacts negatively to a positive standard deviation shock in gold prices from the first period to the fourth period. However, gold prices reacted negatively in the first period to a positive shock in monetary policy, in other words to a narrowing monetary policy, and in the second period, the effect in question disappeared. These results were found to be statistically insignificant.

The second chart shows the impulse response functions related to monetary policy and the real effective exchange rate. As can be seen from the chart, a standard deviation positive shock in the real effective exchange negatively affects monetary policy in the first four periods. However, a standard deviation positive shock in monetary policy reveals a negative and strong impact on the real effective exchange rate in the first period. The monetary policy response to real effective exchange rate shocks is statistically insignificant, while the effect of monetary policy shocks on the real effective exchange rate is statistically insignificant from the second period.

The third chart includes monetary policy and impulse response functions for the BIST 100 index. As can be seen from the chart, a standard deviation in the BIST 100 index reacts negatively to a positive shock in the first five periods of monetary policy. In addition, the BIST 100 index reacts negatively in the first period to a standard deviation shock occurring in monetary policy. The reaction of the BIST 100 index to a standard deviation shock in monetary policy was found to be statistically insignificant.

The fourth chart shows the impulse response functions for the relationship between monetary policy and house prices. As can be seen from the chart, monetary policy has been responding positively to a standard deviation shock in house prices since the first period. However, a shrinking monetary policy affects house prices negatively and strongly in the first two periods. However, the monetary policy response to house price shocks was statistically insignificant.

The fifth chart contains the impulse response functions on monetary policy and Treasury bond interest. As can be seen from the chart, monetary policy response to a standard deviation shock in Treasury bond interest rates has been positive in the first four periods. However, a positive shock of a standard deviation in monetary policy is, in other words, the practice of narrowing monetary policy affects Treasury bond interest rates positively and strongly in the first period.

The final chart shows the impulse response functions on monetary policy and government bond interest rates. Accordingly, a standard deviation shock in government bond interest affects monetary policy negatively in the first two periods. However, the government bond interest rate reacts positively and strongly in the first period to a standard deviation shock occurring in monetary policy. However, the monetary policy response to government bond interest rate shocks was statistically insignificant.

Table 8 shows the result of a variance decomposition analysis of a monetary policy variable. As the table shows, it is possible to say that the change in monetary policy was caused by 100% changes in itself in the first month. In the following periods, a large part of the change in monetary policy is again due to itself. Looking at the explanatory power of other variables, Treasury bond interest, and stock price are at a level that can attract attention.

Table 8. Monetary Policy Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	0.714280	100,0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.852771	82.12620	0.745281	0.270182	3.731401	0.411814	12.46513	0.249989
3	0.863753	80.13707	0.780403	0.332543	4.566803	1.582470	12.15714	0.443568
4	0.867783	79.39586	0.788349	0.330825	4.593295	2.340165	12.06146	0.490049
5	0.869605	79.06384	0.791450	0.329713	4.574914	2.723925	12.02800	0.488160
6	0.870395	78.92126	0.793970	0.330379	4.570685	2.884154	12.00639	0.493156
7	0.870727	78.86149	0.794864	0.331686	4.568866	2.952389	11.99790	0.492805
8	0.870871	78.83529	0.794968	0.332182	4.568761	2.981741	11.99405	0.493005
9	0.870933	78.82414	0.794991	0.332365	4.568490	2.994570	11.99248	0.492966
10	0.870960	78.81925	0.795008	0.332430	4.568392	3.000150	11.99179	0.492985

Source: Authors' estimates

Table 9 contains the results of the analysis of variance decomposition of the gold price variable. As the table shows, 99.9% of the change in gold prices is due to the own shocks in the first month. Although most of the changes in gold prices in the following periods are again due to itself, the house price index from the second period stands out compared to other variables in terms of explanatory strength. This sets the stage for the inference that housing and gold investment are seen as substitutes for each other as asset preferences in the Turkish economy. Another point to focus on is that it suggests a relationship between the two markets due to its sensitivity to the international conjuncture in terms of the formation of gold and stock prices in accordance with the international literature. But the traditional dimension of gold investment in the Turkish economy, in other words, the impact of local and cultural preferences on gold investment, leads to a decrease in the link between the two markets in question. In particular, an organized market such as the stock market and the gold market, where its traditional dimensions outweigh, reveals that the investor profile is different.

Table 9. Gold Price Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	0.035116	0.025004	99.97500	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.036402	0.023448	95.96966	1.364503	0.022540	2.325472	0.294368	1.19 E-05
3	0.036875	0.247884	93.51943	1.549862	0.038714	4.068822	0.364135	0.211152
4	0.037078	0.344612	92.57645	1.535764	0.048208	4.922955	0.360316	0.211694
5	0.037165	0.360739	92.15437	1.540743	0.078069	5.287559	0.361354	0.217166
6	0.037201	0.360410	91.97664	1.542983	0.088129	5.453642	0.361419	0.216782
7	0.037217	0.360109	91.89868	1.542873	0.091446	5.527985	0.361612	0.217300
8	0.037224	0.359976	91.86507	1.542748	0.092225	5.560722	0.361906	0.217353
9	0.037227	0.359922	91.85047	1.542709	0.092625	5.574844	0.361984	0.217445
10	0.037228	0.359900	91.84420	1.542707	0.092795	5.580924	0.362016	0.217462

Source: Authors' estimates

Table 10 below shows the results of real effective exchange rate variance decomposition. As can be seen from the table, 94.4% of the change in the real effective exchange rate in the first period is due to changes in itself, and 5.4% is due to changes in monetary policy. Although the change in the real effective exchange rate in the first period has no effect on stock prices, it has a 6% share since the second period. Similarly, the effect of gold prices in the first period is very small, but its effect has increased since the second period. As a result, real effective exchange rate variance decomposition results highlight monetary policy, stock prices, and gold prices in terms of disclosure power.

Table 10. Real Effective Exchange Rate Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	2.063909	5.462805	0.051143	94.48605	0.000000	0.000000	0.000000	0.000000
2	2.353502	6.788506	3.639153	78.25927	6.186805	0.174671	1.840625	3.110973
3	2.392580	8.033257	5.157595	75.79404	6.015741	0.170294	1.792496	3.036573
4	2.400085	8.137271	5.134126	75.41767	6.126422	0.178988	1.982815	3.022705
5	2.400751	8.135894	5.137918	75.38459	6.140635	0.179427	1.981842	3.039691
6	2.400855	8.139390	5.140246	75.37850	6.140538	0.179429	1.981698	3.040195
7	2.400877	8.139561	5.140153	75.37733	6.141108	0.179477	1.982138	3.040232
8	2.400879	8.139556	5.140178	75.37722	6.141115	0.179482	1.982135	3.040317
9	2.400879	8.139565	5.140182	75.37720	6.141115	0.179482	1.982135	3.040323
10	2.400879	8.139565	5.140182	75.37719	6.141118	0.179482	1.982135	3.040323

Source: Authors' estimates

Table 11 contains the results of the stock price variance decomposition. As can be seen from the table, 81.6% of the change in BIST 100 in the first period is due to itself, 14.2% to the real effective exchange rate, and 4% to changes in monetary policy. Since the second period, the explanatory power of the real effective exchange rate has decreased, but the explanatory power of gold prices has increased. However, compared to other variables, it is seen that the real effective exchange rate stands out in explaining the change in stock prices.

Table 11. BIST 100 Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	0.060024	4.011577	0.111256	14.20928	81.66789	0.000000	0.000000	0.000000
2	0.063056	3.880995	5.208516	12.87588	74.23305	0.394973	2.838749	0.567835
3	0.063834	4.353251	5.086085	12.66650	72.47484	1.191073	3.654886	0.573362
4	0.063968	4.338446	5.067882	12.63471	72.23663	1.477682	3.647221	0.597429
5	0.064020	4.336430	5.082667	12.61679	72.12074	1.595357	3.651254	0.596755
6	0.064037	4.336327	5.080704	12.61208	72.08416	1.638745	3.650578	0.597402
7	0.064045	4.335315	5.079728	12.60993	72.06880	1.658809	3.650144	0.597274
8	0.064048	4.334899	5.079262	12.60883	72.06217	1.667673	3.649819	0.597344
9	0.064049	4.334715	5.079091	12.60834	72.05918	1.671610	3.649739	0.597326
10	0.064050	4.334635	5.079021	12.60813	72.05790	1.673296	3.649684	0.597335

Source: Authors' estimates

Table 12 shows the results of the house price index variance decomposition. As can be seen from the table, 85.8% of the change in house prices in the first period is due to itself, 6.8% is due to the real effective exchange rate, and 6.56% is due to changes in monetary policy. As a result, the real effective exchange rate and monetary policy were most effective after the changes in itself on house prices. Another issue that should be highlighted here is that the share market is insignificant in explaining house price changes. This results in a low housing-finance bond in the Turkish economy. Related results reveal that housing investment is preferred for reasons such as status, social security and it is an alternative/non-complementary market to the stock market.

Table 12. House Price Index Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	0.003066	6.565519	0.717927	6.888367	0.000000	85.82819	0.000000	0.000000
2	0.003732	4.458982	2.607214	4.783977	0.006964	85.44487	1.477796	1.220198
3	0.003941	4.269510	2.915047	4.439506	0.037647	85.83793	1.330301	1.170061
4	0.004026	4.123305	2.899970	4.399178	0.264319	85.88169	1.290621	1.140920
5	0.004061	4.054466	2.861523	4.365661	0.333355	85.98427	1.274212	1.126508
6	0.004076	4.024842	2.845930	4.344184	0.354864	86.03513	1.273425	1.121625
7	0.004082	4.012145	2.840097	4.334291	0.361093	86.06002	1.272326	1.120030
8	0.004085	4.006681	2.837973	4.330239	0.363993	86.06994	1.271880	1.119289
9	0.004086	4.004343	2.837028	4.328578	0.365381	86.07412	1.271578	1.118972
10	0.004087	4.003328	2.836604	4.327869	0.366012	86.07591	1.271459	1.118821

Source: Authors' estimates

Table 13 contains the results of treasury bond interest variance decomposition. As can be seen from the table, 52.3% of the changes in Treasury bond interest in the first period are due to itself, 36.3% due to monetary policy, and 8.2% due to changes in the real effective exchange rate. In the first period, the power of stock prices to explain the change in Treasury bond interest was 1.5%, while in the following periods, this effect appears to have increased. This related result reveals the power of short-term interest rates, which are the central bank's main policy tool to influence Treasury bond rates, which are one of the market rates.

Table 13. Treasury Bond Interest Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	0.899214	36.34504	1.434493	8.248573	1.576201	0.000000	52.39569	0.000000
2	0.947281	32.88105	1.435371	8.674456	6.945636	0.777080	48.20896	1.077450
3	0.954358	32.51885	1.853270	8.571279	6.882009	1.316603	47.69537	1.162613
4	0.957220	32.36250	1.849894	8.525809	6.846004	1.678600	47.57348	1.163704
5	0.958012	32.31186	1.851460	8.511765	6.834695	1.810871	47.49618	1.183169
6	0.958326	32.29179	1.853730	8.508176	6.830961	1.865822	47.46670	1.182820
7	0.958456	32.28321	1.853488	8.506570	6.831060	1.888508	47.45388	1.183282
8	0.958509	32.27960	1.853362	8.505853	6.830606	1.898694	47.44873	1.183154
9	0.958533	32.27800	1.853309	8.505491	6.830446	1.903163	47.44642	1.183170
10	0.958543	32.27732	1.853294	8.505340	6.830341	1.905106	47.44545	1.183150

Source: Authors' estimates

Table 14 contains the results of government bond interest variance decomposition. As can be seen from the table, the change in government bond interest is affected by 50.8% of itself in the first period, 18% from the real effective exchange rate, 10.1% from Treasury bond interest rate, 5.9% from monetary policy, and 5.3% from gold prices. These relevant results can be evaluated in the context of the expectations hypothesis. When the power to directly influence short-term interest rates of central banks is taken into account, monetary policy decisions affect long-term interest rates by influencing market expectations as well as affecting short-term interest rates. Therefore, according to this hypothesis, long-term interest

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rates are shaped by the current state of short-term interests and according to the short-term interest expectations of market participants.

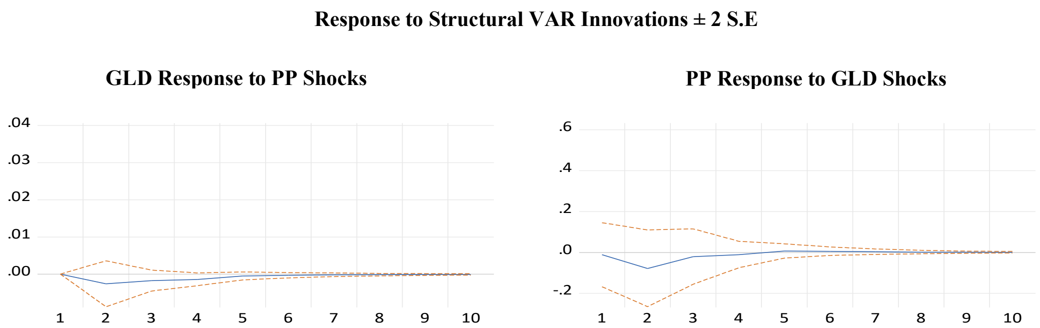
Table 14. Government Bond Interest Rate Variance Decomposition Results

Period	S.E.	MP	GLD	RER	BIST	HPI	TBIR	GBIR
1	0.572131	5.999828	5.377463	18.03503	9.530419	0.000000	10.19760	50.85966
2	0.621982	8.061728	6.403718	15.26527	15.27335	0.998709	8.683266	45.31396
3	0.630050	8.211128	6.386829	15.02420	15.52459	1.698451	8.625556	44.52925
4	0.632002	8.163157	6.397728	14.94571	15.43064	2.009729	8.618796	44.43423
5	0.632444	8.166051	6.398320	14.92717	15.41502	2.109987	8.607193	44.37626
6	0.632638	8.161950	6.396784	14.92084	15.41502	2.151618	8.602044	44.35174
7	0.632701	8.160366	6.395536	14.91855	15.41253	2.169595	8.600346	44.34308
8	0.632731	8.159609	6.394985	14.91724	15.41157	2.177938	8.599699	44.33896
9	0.632743	8.159295	6.394767	14.91670	15.41103	2.181549	8.599397	44.33726
10	0.632749	8.159153	6.394683	14.91647	15.41081	2.183115	8.599269	44.33651

Source: Authors' estimates

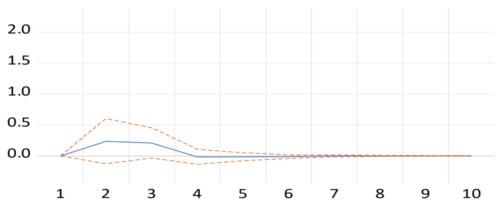
In this study, which discussed the relationship between monetary policy and asset prices, the first specification was built on the assumption that asset prices react simultaneously to monetary policy and the constraints set within the framework of economic theory and expectations. In the second specification, monetary policy is allowed to react simultaneously to asset prices, provided that other constraints remain constant. In this context, the results of effect response functions and variance decomposition analysis related to the model created by alternative constraints are given below.

Figure 3. Impulse-Response Functions Monetary Policy and Asset Prices (Specification-2)

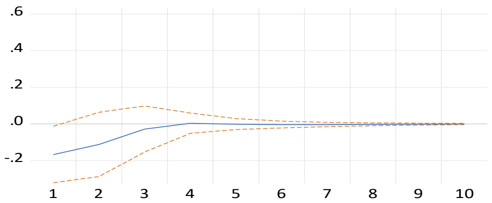


Response to Structural VAR Innovations ± 2 S.E

RER Response to MP Shocks

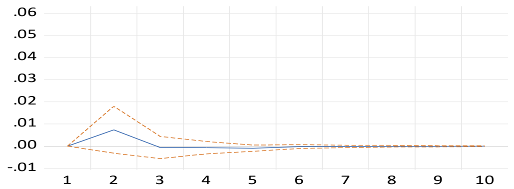


MP Response to RER Shocks

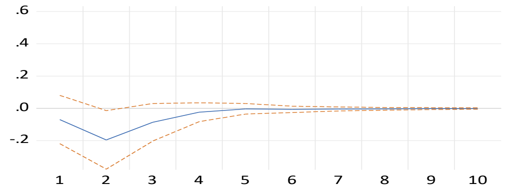


Response to Structural VAR Innovations ± 2 S.E

BIST Response to MP Shocks

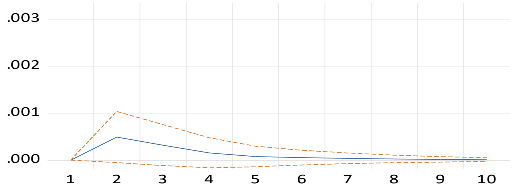


MP Response to BIST Shocks

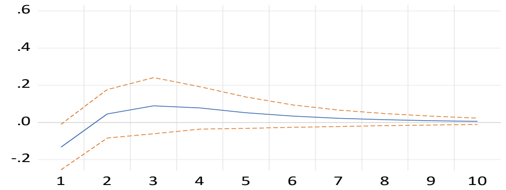


Response to Structural VAR Innovations ± 2 S.E

HPI Response to MP Shocks

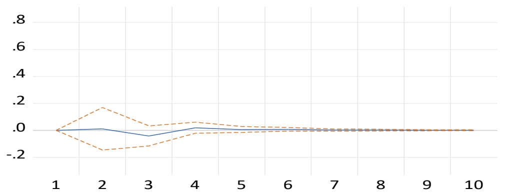


MP Response to HPI Shocks

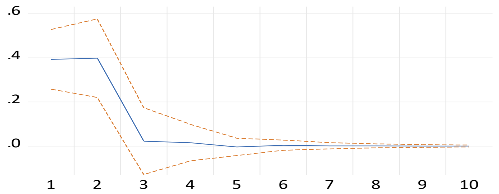


Response to Structural VAR Innovations ± 2 S.E

TBIR Response to PP Shocks

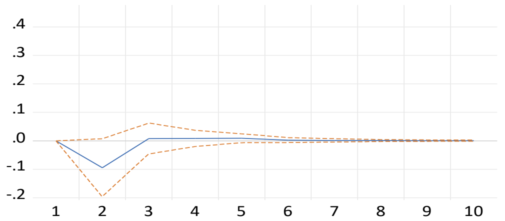


MP Response to TBIR Shocks

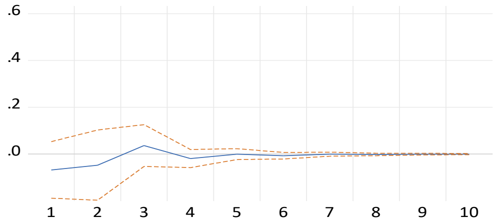


Response to Structural VAR Innovations ± 2 S.E

GBIR Response to MP Shocks



MP Response to GBIR Shocks



Source: Authors' estimates

Figure 3 shows the effect response functions related to the second specification. The first chart in the figure shows the impulse response functions for the relationship between monetary policy and gold prices. As can be seen, gold prices react negatively in the first five periods to a positive shock of a standard deviation in monetary policy. However, the response of monetary policy to a positive shock in the gold price is negative in the first four periods. But these results were statistically insignificant.

The second chart shows the impulse response functions related to monetary policy and the real effective exchange rate. As can be seen from the chart, the reaction of the real effective exchange rate to a standard deviation shock occurring in monetary policy, in other words to a narrowing monetary policy, was positive in the first four periods. However, the monetary policy response to real effective exchange rate shocks has been negative and strong in the first four periods. Although the response of the real effective exchange rate to monetary policy shocks was statistically insignificant, the response of monetary policy to real effective exchange rate shocks was only significant in the first period.

The third chart shows the relationship between monetary policy and the BIST 100 index. Accordingly, the response of BIST 100 to monetary policy shocks is positive in the first three periods, while a standard deviation occurring in BIST 100 is negative in the response of monetary policy to a positive shock. According to the effect response functions, the results in question are statistically insignificant.

The fourth chart shows the impulse response functions for the relationship between monetary policy and house prices. Accordingly, the response of house prices to a standard deviation shock occurring in monetary policy is positive. However, the monetary policy gives a negative and strong response to a standard deviation shock in house prices in the first period. According to the impulse response functions, the relationship between house prices and monetary policy is statistically insignificant.

The fifth chart shows the impulse response functions for monetary policy and treasury bond interest rate relations. Accordingly, the treasury bond interest rate does not respond to a standard deviation shock occurring in monetary policy in the first two periods. Looking at the response of monetary policy to treasury bond interest rate shocks, it seems that monetary policy responded positively and strongly to treasury bond shocks in the first four periods. The relationship between treasury bond interest rates to monetary policy shocks was statistically insignificant.

The final chart shows the impulse response functions for monetary policy and the government bond interest rate relationship. As can be seen from the chart, the reaction of government bond interest rates to a standard deviation shock occurring in monetary policy is negative in the first three periods. However, the response of monetary policy to a positive shock occurring at the government bond interest rate is negative in the first two periods. According to the impulse response function in question, the monetary policy government bond interest rate relationship was statistically insignificant.

Table 15 contains the results of a variance analysis of monetary policy obtained from the second specification. As can be seen from the table, the change in monetary policy is due to itself at 58.7% in the first month, the Treasury bond interest rate at 30.3%, the real effective exchange rate at 5.4%, and the house price index at 3.4%. In subsequent periods, stock prices account for about 6% of the change in monetary policy.

Table 15. Monetary Policy Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	0.713128	0.025084	5.496473	0.945239	3.454826	30.38878	0.920404	58.76920
2	0.854740	0.856112	5.539307	5.922500	2.696212	42.90036	0.956998	41.12851
3	0.865879	0.890070	5.501875	6.772805	3.709364	41.86840	1.105779	40.15171
4	0.870147	0.896307	5.450053	6.783469	4.476605	41.48890	1.145824	39.75884
5	0.871873	0.899173	5.428641	6.758086	4.820131	41.32707	1.141335	39.62556
6	0.872669	0.901408	5.420468	6.751196	4.968023	41.25348	1.146728	39.55869
7	0.872995	0.902206	5.418212	6.748300	5.029922	41.22282	1.146022	39.53251
8	0.873140	0.902271	5.417050	6.747727	5.057346	41.20924	1.146158	39.52020
9	0.873200	0.902280	5.416522	6.747239	5.069247	41.20352	1.146064	39.51513
10	0.873227	0.902291	5.416274	6.747048	5.074444	41.20100	1.146069	39.51287

Source: Authors' estimates

Table 16 contains the results of variance decomposition of gold prices. As can be seen from the table, the change in gold prices is 100% due to their changes in the first month. Although most of the change in gold prices in the following periods is again due to itself, since the second period, the house price index and the real effective exchange rate stand out compared to other variables in terms of explanatory strength. A large part of the change in gold prices in the following periods is again due to itself. This result does not appear to explain the change in gold prices, and the variables included in the model do not have a significant effect.

Table 16. Gold Prices Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	0.035116	100,0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.036364	96.19048	1.314056	0.039127	1.919113	0.021687	0.008572	0.506960
3	0.036866	93.59029	1.397721	0.039663	3.450648	0.532865	0.280950	0.707867
4	0.037070	92.63415	1.398293	0.061201	4.180168	0.595485	0.288082	0.842616
5	0.037161	92.19430	1.410758	0.099576	4.525372	0.619104	0.296118	0.854767
6	0.037197	92.01710	1.413655	0.111281	4.685217	0.618320	0.295786	0.858640
7	0.037213	91.93943	1.413561	0.115091	4.758016	0.617814	0.296548	0.859542
8	0.037219	91.90636	1.413466	0.116038	4.789549	0.617589	0.296689	0.860311
9	0.037222	91.89190	1.413452	0.116528	4.803148	0.617496	0.296840	0.860641
10	0.037224	91.88568	1.413464	0.116738	4.808985	0.617458	0.296877	0.860797

Source: Authors' estimates

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Table 17 contains the results of real effective exchange rate variance decomposition. As can be seen from the table, the change in the real effective exchange rate is due to changes in itself by 99.9% in the first month. It can be stated that most of the change in the real effective exchange rate in the following periods is again caused by it. However, since the second period, the interest rate of gold and stock prices, as well as the interest rate of treasury bills and the interest rate of government bonds, had an effect on explaining the change in the real effective exchange rate.

Table 17. Real Effective Exchange Rate Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	2.063909	0.035782	99.96422	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.355958	3.523228	80.38090	4.970360	0.033213	6.451165	3.629630	1.011508
3	2.395107	4.992993	78.07189	4.812314	0.063153	6.797028	3.514874	1.747751
4	2.402440	4.970157	77.75164	4.956939	0.070111	7.012642	3.497577	1.740937
5	2.403108	4.973878	77.71445	4.969362	0.070192	7.012924	3.516480	1.742717
6	2.403212	4.976104	77.70890	4.969152	0.070445	7.013808	3.516652	1.744938
7	2.403234	4.976016	77.70786	4.969820	0.070478	7.014220	3.516669	1.744940
8	2.403236	4.976040	77.70773	4.969825	0.070481	7.014215	3.516761	1.744944
9	2.403236	4.976044	77.70772	4.969825	0.070481	7.014219	3.516765	1.744950
10	2.403236	4.976044	77.70771	4.969828	0.070481	7.014219	3.516766	1.744950

Source: Authors' estimates

Table 18 contains the results of BIST 100 variance decomposition. As can be seen from the table, 82.7% of the change in BIST 100 in the first period is due to itself and 17% due to the real effective exchange rate. Although the change in monetary policy in the BIST 100 in the first period has no effect on the explanation, there is a 1% explanatory power from the second period. However, since the second period, gold prices have an explanatory power of 5%. In this case, the change in BIST 100 is largely due to itself. In terms of the variables included in the model, the real effective exchange rate and gold prices stand out.

Table 18. BIST 100 Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	0.060024	0.133356	17.07635	82.79029	0.000000	0.000000	0.000000	0.000000
2	0.063130	5.179643	15.45637	75.05067	0.851963	1.284558	0.820493	1.356306
3	0.063837	5.068067	15.35403	73.41873	1.627189	2.369056	0.825876	1.337052
4	0.063975	5.049093	15.30389	73.15471	1.894502	2.399798	0.854103	1.343904
5	0.064025	5.063967	15.28474	73.04432	1.992108	2.396211	0.854099	1.364558
6	0.064043	5.061809	15.27911	73.00583	2.033683	2.399841	0.854874	1.364852
7	0.064051	5.060866	15.27639	72.99081	2.052700	2.399335	0.854679	1.365228
8	0.064054	5.060401	15.27500	72.98413	2.061375	2.399109	0.854760	1.365223
9	0.064055	5.060237	15.27441	72.98119	2.065101	2.399013	0.854743	1.365306
10	0.064056	5.060167	15.27415	72.97991	2.066707	2.398971	0.854757	1.365332

Source: Authors' estimates

Table 19 shows the results of the house price index variance decomposition analysis. As can be seen from the table, the change in house prices is due to itself by 89.3% in the first month. Although the real effective exchange rate has an effect of 9.9% in explaining the change in house prices in the first period, the other variables included in the model have no effect. In the following periods, the impact of house prices continues strongly in explaining the change in house prices, but the real effective exchange rate and gold prices stand out compared to other variables.

Table 19. House Price Index Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	0.003066	0.650738	9.951094	0.000000	89.39817	0.000000	0.000000	0.000000
2	0.003707	2.603669	6.961367	5.72 E-05	86.82365	0.177770	1.662832	1.770659
3	0.003919	2.901073	6.483559	0.079836	86.21888	0.433628	1.633899	2.249120
4	0.004004	2.884508	6.382731	0.352364	86.04140	0.434034	1.601405	2.303562
5	0.004039	2.845860	6.315292	0.432669	86.09385	0.429484	1.582984	2.299866
6	0.004054	2.830564	6.278571	0.457446	86.12917	0.426482	1.577140	2.300626
7	0.004060	2.824823	6.262482	0.465056	86.14499	0.425170	1.575359	2.302124
8	0.004063	2.822737	6.255849	0.468630	86.15038	0.424620	1.574555	2.303225
9	0.004064	2.821801	6.253084	0.470335	86.15254	0.424407	1.574204	2.303630
10	0.004065	2.821382	6.251894	0.471102	86.15349	0.424310	1.574033	2.303793

Source: Authors' estimates

Table 20 contains the results of the treasury bond interest rate variance decomposition. As can be seen from the table, the interest rate on treasury bills in the first period is affected by itself at 77.2%, by the real effective exchange rate at 17.6%, and by the stock price at 3.4%. Although the explanatory strength of the treasury bond interest rate continues in the following periods, the impact of the real effective exchange rate and stock prices also continues. Monetary policy, on the other hand, was ineffective in explaining the change in the interest rate of treasury bills.

Table 20. Treasury Bond Interest Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	0.899214	1.671544	17.63088	3.418296	0.000000	77.27928	0.000000	0.000000
2	0.946241	1.648267	16.91874	8.301152	0.758122	71.28949	1.068966	0.015263
3	0.953884	2.054048	16.70562	8.203373	1.491039	70.21952	1.123156	0.203242
4	0.956404	2.051490	16.63181	8.166691	1.810311	69.97474	1.121491	0.243460
5	0.957235	2.052446	16.60296	8.152836	1.937012	69.86412	1.143745	0.246875
6	0.957537	2.054575	16.59510	8.148815	1.985583	69.82002	1.143146	0.252768
7	0.957671	2.054255	16.59128	8.148823	2.007804	69.80100	1.143767	0.253064
8	0.957723	2.054112	16.58969	8.148295	2.017502	69.79337	1.143642	0.253390
9	0.957747	2.054050	16.58892	8.148100	2.021839	69.78993	1.143686	0.253475
10	0.957757	2.054032	16.58861	8.147981	2.023685	69.78848	1.143672	0.253540

Source: Authors' estimates

Table 21 shows the government bond interest variance decomposition results. As can be seen from the table, the interest rate on government bonds is affected by itself at 51.8% in the first period, by the real effective exchange rate at 22%, by the stock price at 10.3%, by the treasury bond interest rate at 10.1%, and by the gold price at 5%. In the first period, house prices and monetary policy have no power to explain government bond interest rates. In the second period, house

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prices and monetary policy seem to have a very small share in explaining the change in question. However, the results of the government bond interest variance analysis show that the government bond is most affected by itself. The effect of real effective exchange rates, stock prices, and treasury bond interest rates on explaining government bond interest rates is greater when compared to other variables.

Table 21. Government Bond Interest Rate Variance Decomposition Results (Specification-2)

Period	S.E.	GLD	RER	BIST	HPI	TBIR	GBIR	MP
1	0.572131	5.557230	22.02910	10.39081	0.000000	10.15730	51.86556	0.000000
2	0.623179	6.456854	18.68175	15.09651	1.917943	10.06442	45.49224	2.290289
3	0.630738	6.441633	18.50029	15.43169	2.574725	10.03616	44.76447	2.251036
4	0.632633	6.453654	18.40575	15.34196	2.857690	9.991810	44.69402	2.255107
5	0.633078	6.453732	18.38557	15.32394	2.939811	9.992083	44.63346	2.271407
6	0.633275	6.452055	18.37760	15.32495	2.978864	9.986192	44.60896	2.271386
7	0.633337	6.450792	18.37464	15.32259	2.996060	9.984390	44.60018	2.271352
8	0.633367	6.450248	18.37300	15.32171	3.004100	9.983487	44.59616	2.271296
9	0.633379	6.450033	18.37234	15.32119	3.007517	9.983110	44.59449	2.271322
10	0.633385	6.449949	18.37205	15.32099	3.008990	9.982939	44.59375	2.271337

Source: Authors' estimates

5. Conclusions

Interest in the relationship between monetary policy and asset prices increased especially with the 2008 global financial crisis. However, it is noticeable that the literature is quite limited, particularly in Turkey's economy. In this study, the relationship between monetary policy and asset prices in Turkey's economy, using the SVAR model, is analyzed. The SVAR model was studied with two different specifications.

In both specifications used to analyze the relationship between monetary policy and asset prices, no significant impact of monetary policy on gold prices and gold prices on monetary policy could be determined. In the first specification, the negative response of the real effective exchange rate to monetary policy shocks in the first period was found to be significant when monetary policy was evaluated in the context of the real effective exchange rate relationship in the context of impulse response functions and variance decomposition results. However, no significant response of monetary policy to real effective exchange rate shocks has been determined. According to the second specification, built on the assumption that the monetary policy variable reacts synchronously to all other variables, the effect of monetary policy on the real effective exchange rate was insignificant, while the negative response of monetary policy to real effective exchange rate shocks was significant. These findings on the monetary policy real effective exchange rate relationship show that monetary policy decisions react to the real effective exchange rate variable and that the real effective exchange rate is also affected by monetary policy. When the monetary policy stock prices relationship is evaluated in the context of impulse response functions and variance decomposition results, while the effect of stock prices on monetary policy is insignificant in both specifications, we can speak of the existence of the effect of monetary policy on stock prices, especially when the variance decomposition results are considered. When the monetary policy house prices relationship is evaluated in the context of impulse response functions and variance decomposition results, while in the first specification the response of housing prices to monetary policy shocks are deemed important, the effect of monetary policy on housing prices has been identified as insignificant in both specifications. The housing sector is closely related to many sectors, and the experience of the 2008 global financial crisis has revealed the need to closely monitor the sector in house prices. But while house prices in the Turkish economy are affected by monetary policy decisions, house prices are not taken into account in the policy-making process. When the impulse response functions related to the monetary policy treasury bond interest rate and variance decomposition analysis results were evaluated, both the effect of treasury bond interest rates on monetary policy and the effect of monetary policy on Treasury bond interest rates were found to be important and significant. It can be said that monetary policy decisions lead to an increase in short-term interest rates within the next term by changing the current short-term interest rate and expectations. When results of the monetary policy government bond interest rate are examined, the reaction of the government bond interest rate to monetary policy shocks in the first specification was found to be significant, while the monetary policy response to government bond interest rate shocks was found to be insignificant. However, in the second specification, both the effect of government bond interest rates on monetary policy and the effect of monetary policy on government bond interest rates were found to be insignificant.

The empirical findings obtained from the study reveal that the monetary policy is powerful and effective to affect asset prices. This result is consistent with the findings of previous studies (Brailsford et al., 2006; McDonald and Stokes, 2013; Tan and Wu, 2014; Hnatkovska et al., 2016; Nocera and Roma, 2017; Zhang and Huang, 2017). However, another result obtained from the study reveals that the monetary policy has a significant response only to the real effective exchange rate and the treasury bill rate. This result does not exactly match with the contributions made to the literature especially after the crisis. As a matter of fact, the contributions made to the literature in the post-crisis period reveal the necessity of taking into account asset prices in monetary policy practices (Bjørnland and Jacobsen, 2010; Kara, 2012).

The study shows that the exchange rate has a direct effect on CBRT's interest rate adjustments. Given the production structure of the Turkish economy, which is largely dependent on imports, developments in the exchange rate have an effect on inflation. This causes the CBRT to consider exchange rate shocks in its policy-making process. However, the 2008 global financial crisis showed that developments in the financial sector had a significant impact on real economic activity. In this context, the most important outcome of the crisis is that central banks create policies taking into account risks in the financial system and developments in asset prices. But based on the study's findings, it can be stated that the CBRT ignores the prices of assets such as gold, stocks, housing, government bonds in its interest rate adjustments. Again, based on the findings of the study, it can be said that the CBRT's policy decisions are strong and effective, which can affect asset prices. Based on these conclusions, the central bank's consideration of asset prices in the policymaking process can be expressed as an important policy behavior that should be used effectively to ensure both price and financial stability.

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