The impact of interest rate corridor on monetary policy efficiency: VEC Granger causality evidence from the central bank of the Republic of Turkey

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A R T I C L E  I N F O

Article history:
Received 1 April 2021
Received in revised form
21 June 2021
Accepted 24 June 2021

Keywords:
Monetary policy
Interest rate corridor
Turkey
Vector error correction
Granger causality
VAR

A B S T R A C T

This paper aimed to analyze the impacts of interest rate corridor policy on monetary efficiency in Turkey, applying the Error Correction Model and VEC Granger causality. The data set consisted of 108 observations for each time series from May 2010 to December 2019. The Granger causality test results indicated a significant impact of the borrowing rate on the inflation rate. Response function revealed that a change in the borrowing interest rate affected the opposite way in the inflation rate with a 3-month lag. An increase in the lending rate caused an increase in the BIST 100 index value. It is concluded that the interest rate corridor implementation successfully increased the flexibility and effectiveness of the monetary policy in Turkey.

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1. Introduction

Throughout history, those who set the rules of the international financial system have also been the owners of economic and political power. Serin et al. (2020) tried to answer the basic questions that will shed light on the dynamics of the global financial system. After the latest global financial crisis, the central banks of advanced countries started to apply expansionary monetary policies by stimulating quantitative easing and zero interest rate policies. Thus, changing global risk perception led to a shift in global excess liquidity from advanced countries to emerging countries. In this context, The Turkish economy has faced macroeconomic stabilities such as excessive credit growth, exchange rate appreciations, volatility capital flows, and external imbalances. Hence, the CBRT has been started to apply mixed policies such as the interest rate corridor, liquidity policy, and required reserves to cope with the adverse conclusion of global excess liquidity since May 2010. Thus, the CBRT gained a more flexible structure by diversifying its monetary policy tools. It gained the ability to influence the credit and exchange rate channels separately.

Recently a lot of academicians such as Alper et al. (2019), Ambler and Rumler (2019), Bayur and Abdioğlu (2020), Bech and Monnet (2013), Binici et al. (2016), Kara (2015), and Berentsen and Monnet (2008) have analyzed the effects of interest corridor policy on financial variables. Taylor (1995) defined the monetary transmission mechanism as the transfer of monetary policy decisions on inflation and real income and classified monetary transmission mechanisms channels into four main groups: exchange rate, credit, asset price, and interest channels and added risk-taking, balance sheet, expectations, and bank credit channels in his classification in addition to that Miskin's types. Bofinger and Wollmershäuser (2001) investigated the monetary transmission mechanism into three categories: Expectations, interest, and quantity theory channels. Whitesell (2006) argued that the interest rate corridor was not effective in controlling the volatility of overnight interest rates. Cambazoğlu and Karaoğlu (2012) analyzed the effect of the exchange rate channel on prices and total output by establishing a VAR model. Haznedaroğlu (2014) explored the interest rate corridor tool using data set including loans, producer price index, one-week repo auction interest rate, and industrial production index. The single equation cointegration analysis method was used. Haznedaroğlu (2014) found that the interest rate corridor positively affected financial
stability and analyzed the effects of the interest rate decisions of the CBRT on inflation. This study found that a long-term inverse relationship between inflation and interest rates. Tetik and Ceylan (2015) investigated the effect of the interest rate corridor policy tool on exchange rates and stocks. This study employed the VAR model. Results indicated that the exchange rate reacted negatively in the first period but positively in the second period. Kara (2015) examined the interaction of liquidity and short-term interest rate policy within the broad interest rate corridor system framework.

Binici et al. (2016) found that a rise in interest rates in the long-run affected the interbank interest rates and central banks can control capital movements and exchange rate volatility through credit channels and exchange rates. Lee (2016) analyzed the interest rate corridor policy by comparing UK and Eurozone data. Two main findings are highlighted in the study. Lee (2016) found that flexibility of banks' decisions small range would decline the volatility in overnight interest rates. Teber (2018) examined the effect of the interest rate corridor policy by comparing UK and Eurozone data. Two main findings are highlighted in the study. Lee (2016) found that flexibility of banks' decisions small range would decline the volatility in overnight interest rates. Teber (2018) examined the effect of the interest rate corridor policy instrument on loan and deposit rates between 2014-2017. It was concluded that with an increase in the lower band interest rate by 1 unit, the deposit interest rates would rise by approximately 1.6 units; that is, a change in the lower band interest rate affects the deposit interest rates in the same direction. Arikan et al. (2018) analyzed the effect of the interest rate corridor on the Turkish economy using the VAR analysis model. Öztürk et al. (2021) examined the impacts of Covid 19 on Turkish monetary policy.

2. Methodology and data set

This study used the econometrics methodology of cointegration, Granger causality tests, and vector error correction mechanism (ECM). The Augmented Dickey-Fuller (ADF) test was carried out on the data. Table 2 indicated that the first difference in the results of the ADF unit root test. Besides that, Phillips Perron (PP) unit root test was used. VAR Analysis was used in the study to capture the relationship between multiple quantities as they change over time. The Johansen cointegration test was used to check the long-term relationship between series. After the stationarity of the series was determined Granger causality test was applied in each set of the variables. To eliminate the autocorrelation problem, the ADF unit root test is shown by Eq. 1:

\[ \Delta Y_t = \beta_0 + \gamma Y_{t-1} + \sum p_i \phi_i \Delta Y_{t-i} + \epsilon_t. \]  

(1)

PP unit root test Eqs. 2 and 3, which are all components of the ADF test, and these equations:

\[ Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \mu_t \]  

(2)

\[ Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \mu_t \]  

(3)

where, \( \alpha \) and \( t \) show trend variables, penalties, and error terms. Johansen cointegration test equations are useful for the following Eqs. 4 and 5. M error term is a good payback.

\[ Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} Y_{t-1} + \sum_{i=1}^{m} \alpha_{2i} X_{t-1} + \mu_t \]  

(4)

\[ Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} Y_{t-1} + \sum_{i=1}^{m} \alpha_{2i} X_{t-1} + \mu_t \]  

(5)

The Granger causality test is applied by the following equations (Takım, 2010).

\[ Y_t = \sum_{i=1}^{m} \alpha_{1i} Y_{t-1} + \sum_{i=1}^{m} \beta_{1i} X_{t-1} + \mu_t \]  

(6)

\[ Y_t = \sum_{i=1}^{m} \alpha_{1i} X_{t-1} + \sum_{i=1}^{m} \beta_{1i} Y_{t-1} + \mu_t \]  

(7)

In the study, the borrowing interest rate, the lower band of the interest corridor, was chosen as a dependent variable. We used logarithms of all series in the analysis. The model equation was shown below,

\[ \ln l_{t} = \alpha_1 + \alpha_2 \ln l_{t-1} + \alpha_3 \ln r_{t-1} + \alpha_4 \ln m_{3t} + \alpha_5 \ln b_{t} + \alpha_6 \ln i_{t} + \alpha_7 \ln s_{t} + \mu_t \]  

(8)

The data set was included monthly 108 observations for each time series from May 2010 to December 2019. The monthly Consumer Price Index of Turkey (CPI), broad money supply (M3), borrowing interest rate (BR), interest rate, lending interest rate (LR), and real effective exchange rate (RER) were obtained from the CBRT, Electronic Data Delivery System. The M3 is the broadest measure of the money supply, which helps policymakers to better understand potential inflationary tendencies. Corridor width was calculated by ourselves. All variables were altered into natural logarithms to stabilize the variability in the data. Table 1 shows variable definitions and data sources.

3. Empirical findings

The results of the Augmented Dickey-Fuller unit root test were shown in Table 2.
that imbalances occurring in the short term will stabilize in a long time. Table 5 shows Granger causality tests on all the variables.

### Table 1: Variable definitions and data sources

| Variables | Definitions | Data Source |
|-----------|-------------|-------------|
| Borrowing Interest Rate (BR) | Interest corridor overnight borrowing interest rate | CBRT |
| Corridor’s width (W) | The width of the interest corridor between the lower and upper band | Our calculations |
| Real Effective Exchange Rate (RER) | Real effective exchange rate based on spreads (2003=100) | CBRT |
| M3 Money Supply (M3) | The largest money supply and provision items monthly average | CBRT |
| BIST 100 Index (BIST) | Monthly average of BIST 100 index closing values | www.investing.com |
| Inflation (CPI) | CPI (%) | CBRT |
| Lending Interest Rate (LR) | Interest corridor upper band, overnight lending interest rate | CBRT |

### Table 2: Augmented dickey-fuller unit root test for all variables

| Variables | Original Level | t-statistics | Probability | 1st difference | Probability |
|-----------|---------------|--------------|-------------|---------------|-------------|
| LBR       | 0.730630      | 0.9923       | -9.712106   | 0.0000        |
| LW        | -1.790144     | 0.3836       | -8.785697   | 0.0000        |
| LRER      | -1.137382     | 0.6998       | -7.818188   | 0.0000        |
| LM3       | 1.614558      | 0.9995       | -9.450245   | 0.0000        |
| LBIST     | -1.725045     | 0.4158       | -1.064977   | 0.0000        |
| LCPI      | -1.584950     | 0.5020       | -7.850722   | 0.0000        |
| LLR       | 0.838740      | 0.9943       | -4.140755   | 0.0013        |

The results of the ADF test indicate that for all the observed variables, the null hypothesis of a unit root is rejected. In other words, the condition of stationarity seems to be satisfied. The PP unit root test was applied by taking the first-order differences of the variables. It was seen that the PP unit root test results supported the ADF unit root test results. Table 3 shows the PP unit root test for all variables. Also, Table 4 shows the VEC error correction test.

### Table 3: PP unit root test for all variables

| Variables | Original Level | t-statistics | Probability | 1st difference | Probability |
|-----------|---------------|--------------|-------------|---------------|-------------|
| LBR       | 0.199047      | 0.9714       | -9.920222   | 0.0000        |
| LW        | -2.076160     | 0.2547       | -9.720208   | 0.0000        |
| LRER      | -0.731947     | 0.8333       | -7.539846   | 0.0000        |
| LM3       | 3.545225      | 10.000       | -9.419444   | 0.0000        |
| LBIST     | -1.738622     | 0.4091       | -1.064898   | 0.0000        |
| LCPI      | -0.827653     | 0.8900       | -8.794937   | 0.0000        |
| LLR       | 0.530290      | 0.9871       | -1.024456   | 0.0000        |

### Table 4: VEC error correction test

| Error Correction | D (LBR) | D (LW) | D (LRER) | D (LM3) | D (LBIST) | D (LCPI) | D (LLR) |
|------------------|---------|--------|----------|---------|-----------|----------|---------|
| Coefficient      | -0.054035 | 0.002531 | 0.0002639 | 0.008777 | 0.018649 | -0.114502 | -0.071330 |
| Standard error   | (0.01674) | (0.03162) | (0.00404) | (0.00241) | (0.01193) | (0.0209) | (0.03841) |
| t-statistics     | [-3.22844] | [0.08005] | [-0.65264] | [3.63718] | [1.56326] | [-1.85730] |

In Table 4, VEC error correction test has been applied. The findings obtained from the test explain that imbalances occurring in the short term will stabilize in a long time. Table 5 shows Granger causality tests on all the variables.

### Table 5: Granger causality tests on all the variables

| Variables | Lag | F-statistics | Probability | Decision |
|-----------|-----|--------------|-------------|----------|
| LRER      | 3   | 6.11329      | 0.0007      | Accepted |
| LBR       | 3   | 14.4234      | 7.08       | Accepted |
| LM3       | 3   | 4.32939      | 0.0065      | Accepted |
| LBIST     | 3   | 11.8113      | 1.06       | Accepted |
| LBR       | 3   | 6.01260      | 0.0097      | Accepted |
| LBIST     | 3   | 0.45907      | 0.7115     | Accepted |
| LCPI      | 3   | 0.71327      | 0.5464     | Accepted |
| LLR       | 3   | 1.65936      | 0.1808     | Accepted |
| LRER      | 3   | 3.91078      | 0.0110     | Accepted |
| LBR       | 3   | 7.02816      | 0.0002     | Accepted |
| LM3       | 3   | 2.60562      | 0.0561     | Accepted |
| LBIST     | 3   | 4.17991      | 0.0079     | Accepted |
| LBIST     | 3   | 1.87944      | 0.1381     | Accepted |
| LCPI      | 3   | 2.53041      | 0.0616     | Accepted |
| LLR       | 3   | 4.94272      | 0.0031     | Accepted |
| LCPI      | 3   | 0.83107      | 0.4799     | Accepted |
| LW        | 3   | 4.06124      | 0.0091     | Accepted |
| LRER      | 3   | 4.47325      | 0.0055     | Accepted |
| LW        | 3   | 2.48800      | 0.0682     | Accepted |
| LM3       | 3   | 8.73684      | 3.05       | Accepted |
| LBIST     | 3   | 0.81760      | 0.4872     | Accepted |
| LCPI      | 3   | 1.15362      | 0.3315     | Accepted |
| LLR       | 3   | 5.05213      | 0.0027     | Accepted |
| LCPI      | 3   | 0.19024      | 0.9028     | Accepted |
4. Conclusion and discussion

After the global crisis, implementing the interest rate corridor policy, CBRT aimed to reach lower inflation rates, prevent fluctuations in exchange rates, increase short-term capital inflows, and tighten monetarily. The effect of the interest rate corridor policy on the M3, BIST 100 index, and inflation was analyzed using monthly data for January 2010-December 2018 period in this study. Granger causality tests within the framework of multivariate cointegrated VAR models were applied to estimate causal linkages between selected financial and economic variables.

This study revealed that when the central bank responded by increasing the borrowing interest rate during periods of high inflation, inflation reacted and decreased after three months. An increase in the lending (upper band) interest rate caused an increase in the value of the BIST 100 index. An increase in the lending rate shrank the M3 money supply. If uncertainty prevailed in the general situation of the economy, the interest rate corridor instrument might create a partial uncertainty in the market regarding interest rates. An interest rate corridor was a functional tool to control capital inflows. It affected the exchange rate channel and the credit channel separately when the country's economy is stable and national and global uncertainties are less. As a result of the analysis, it was concluded that using the interest rate corridor simultaneously with other monetary policy tools has increased its effectiveness on financial stability. These findings supported related academic literature. It was observed that the interest rate corridor monetary policy worked effectively in line with the CBRT’s targets.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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