UNORTHODOX MONETARY POLICY WITH REAL-TIME MEASUREMENTS

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UNORTHODOX MONETARY POLICY WITH REAL-TIME MEASUREMENTS

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DECLARATION OF ORIGINALITY

I, Ahmet Akgün, certify that

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ABSTRACT

Unorthodox Monetary Policy With

Real-Time Measurements

In this study, asymmetric interest rate corridor which is a part of Central Bank of Republic of Turkey's unorthodox monetary policy is analyzed between the period 2011 and 2017. Using Bayesian filtering methods, output and inflation gaps are determined with the real-time measurements. In light of these gaps, an augmented Taylor rule is implemented to analyze the behavior of the instruments in response to these gaps. Our results indicate that policy rate, upper gap and upper bound do not react to these gaps, yet lower bound answers to control these gaps. Upper and Lower gap reacts only to output gap, whereas gap only responds to inflation gap in our analysis. Moreover, VAR analysis has been conducted on the gap. The gap responds to exchange rate, output gap and inflation gap shocks.

ÖZET

Gerçek Zamanlı Ölçümlerle

Sıra Dışı Para Politikası

Bu çalışmada Türkiye Cumhuriyeti Merkez Bankası'nın uyguladığı alışılmışın dışında para politikasının bir parçası olan asimetrik faiz koridoru 2011 ile 2017 yılları arasındaki veriler kullanılarak incelenmiştir. Bayesian methodları kullanılarak üretim ve enflasyon açığı tespit edilmiştir. Daha sonra bu verilerin ışığında, arttırılmış Taylor kuralı uygulanarak, koridorun enstrümanları üretim ve enflasyon açığına göre nasıl davrandıkları saptanmıştır. Politika faizi ve üst sınır üretim ve enflasyon açığına tepki vermemektedir. Buna rağmen alt sınır bu açıklara tepki vermektedir. Üst ve alt aralık sadece üretim açığına tepki verirken, alt ve üst sınır arasındaki açıklık ise sadece enflasyon açığına tepki vermektedir. Üst ve alt sınır arasındaki aralık üzerine VAR modeli uygulanmıştır. Aralık döviz kuru, üretim açığı ve enflasyon açığına tepki vermektedir.

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CHAPTER 1

INTRODUCTION

After 2008 global financial turmoil, advanced countries have implemented unprecedented monetary policies such as Quantitative Easing (QE) such as in the U.S. As long as these policies are performed, emerging economies with strong macroeconomic backgrounds have experienced strong capital flows from advanced countries. Considering historical economic crises caused by the sudden reversal of capital flows, different emerging market countries have taken different precautionary actions to prevent the negative impact of these flows. For example, Brazil has taken a quantity-based actions just to prevent these capital inflows, whereas Turkey has carried out a more unconventional monetary policy. After tapering of QE, the risk of sudden capital reversals is lessened, yet unconventional monetary policy remained unchanged whilst quantity-based actions were principally stopped. Macroprudential monetary policies are interesting, especially acknowledging that inflation targeting regimes were endured before the distress of 2008. For instance, the Central Bank of the Republic of Turkey (CBRT hereafter) in 2002 announced the Inflation Targeting (IT) regime and administered up to end of 2010. After 2008 crisis severe side effects, CBRT added financial stability into its objectives along with price stability. One of the new policy modification CBRT introduced for this purpose is the asymmetric interest rate corridor.

The asymmetric interest rate corridor has been appealing not only because it is unprecedented, but also the interest rate policy instruments increased from a single policy rate to three. Specifically, the asymmetric interest rate corridor consists of three instruments: overnight borrowing interest rate (lower), overnight lending interest (upper) and the gap between them as depicted below. Also, financial stability is included in Central Bank policy objective with the new policy introduction, yet the main intention of the Central Bank is still price stability controlling for inflation, growth and other macroeconomic variables such as unemployment. Hence, how the new policy instrument works for the main objectives of the central bank is a valid question along with central banks financial stability objective.

Moreover, previous analyses of Central Bank behavior mostly concentrate on the whole sample rather than the information set available to the Central Bank at each decision point. In this paper, we allow the Central Bank to update its estimate of unobservable at each point when new data become available. This allows us to evaluate real-time response of the Central Bank. In our empirical model inflation and output data are lagging with different periods; therefore, they are imperfectly observable whereas potential output is unobservable. As new data comes in Central Bank makes a guess of the unobservable and updates its decision using a Bayes rule.

Hence, the purpose of this research comes from the limited research conducted about the usage of the new data and using real time measurements to estimate the weights and sensibility of the new policy instruments. In this research, instantaneous output gap and inflation gap are estimated by using Bayesian filtering with real time measurement, we put ourselves in the Central Banks shoes when they decide to adjust the interest rates and the gap between them. Hence, this research differs from the previous ones because it does not use filtering to apprehend the use of the policy instruments instead it uses the available data when CBRT decide to accommodate the asymmetric interest rate corridor. In light of real time measurements, using output and inflation gap an augmented Taylor rule is derived to view how these policy instruments are applied, how sensitive the policy instruments to real time output and inflation gap between periods January 2011 to December 2017.

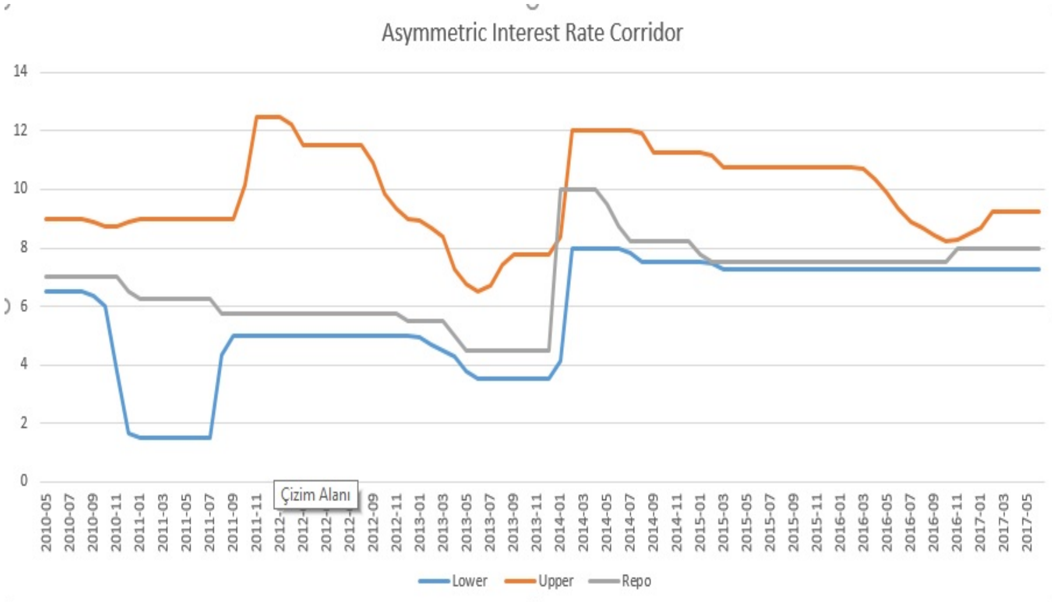

Figure 1. The Asymmetric Interest Rate Corridor

The asymmetric interest rate corridor is shown in Figure 1 from May 2010 to June 2017. The paper will proceed as follows: in the next section there will be a brief literature about the Taylor rule, inflation gap, output gap and the Bayesian Kalman filtering method - Standard Kalman filter. In the third section, there will be a brief discussion on the Taylor rule and the new policy instruments. In the fourth section, the model and the is described. In the fifth section, the data will be presented. In the sixth section, estimation results are shown and the conclusion in the final section.

CHAPTER 2

BRIEF LITERATURE REVIEW

In pursuance of analyzing a central bank behavior, monetary policy rules are derived by McCallum (1988) and Taylor (1993) known as McCallum rule and Taylor rule. These models are distinguished by the approach taken by: the former is a monetary based instrument rule taking nominal GDP as a target, whereas the latter is interest rate based monetary policy rule using interest rate for fine-tuning of the innovations. In general, Taylor rule is applied due to the central banks tend to maneuver by monthly speeches and most of the data available monthly whereas nominal GDP data are announced later on.

As Clarida et al. (1998) noticed that developed countries used the Taylor rule to adapt the interest rate on their policy making, Taylor rule operates quite strongly in advanced countries. Later, various methods have been developed such as backward-looking and forward-looking Taylor rule to evaluate the policy stance. An inflation targeting central bank is assumed to fight inflation severely, so it uses backward-looking Taylor rule. Different studies have been conducted to analyze the central banks priority.

In the Turkish case, Aklan (2008) uses data from August 2001 to September 2006 and test both backward looking Taylor rule which uses the lag of inflation gap and output gap and forward-looking Taylor rule which uses the expectations of inflation and output gap. The results imply that both backward-looking and forward-looking Taylor rule equations explain the policy rate. However, since CBRT has not reacted to inflation shocks at the period, the forward-looking Taylor rule works better.

The simple Taylor rule reacts to both inflation and output gap, whereas for emerging economies, it is discussed that few other macroeconomic variables have been included such as exchange rate in Edwards (2006), lag variables of inflation, money supply and so on.

Inflation gap is the difference between the inflation target set by the central bank and the realized inflation. Actual inflation is announced monthly and estimated with Consumer Price Indexs(CPI) percentage change compared with the 12-month before. Hence, it is easy to predict unless the central bank loses some of its credibility setting an impractical interest rate target. New policy implementation changes the dynamics of the consumer behavior as discussed in infamous Lucas Critique (1976); therefore, inflation gap cannot be estimated via using the previous data. Also, central bank may lose its credibility by changing policy frequently or by not achieving what it is promised. Also, CBRT added financial stability into its basket and uses exchange rate and credit growth as a transmission channel as discussed in Kara (2012). Considering all, instead of using inflation data and target announced, the exchange rate can be a good measure to estimate the inflation gap since past inflation data is redundant and CBRT actively uses this channel.

Output gap, on the other hand, is the deviation of actual output from potential output. Potential output is the supremum of the output produced without giving rise to inflation. When output gap is positive, that is the realized output exceeds the potential output, inflation rises as a response to that and vice versa. Although potential output is crucial for Taylor rule, measuring potential output is cumbersome because of the single fact that it is unobservable. There is a vast literature and methods to estimate the potential output and thereafter the output gap.

Hodrick-Prescott (HP) filtering and quadratic time trending are methods simple and widely used for advanced economies, whereas in emerging markets due to high volatility these methods yield to non-linear filters and predictors to answer unpredictability. Therefore, emerging markets use different methodologies to estimate the potential output.

The Kalman filter algorithm or its derivatives are frequent methods for emerging economies. For instance, for the Turkish economy, Ozbek and Ozlale (2005) used the extended Kalman filter to estimate the output gap for the period between 1988 and 2003. Kara et al. (2007) uses the extended Kalman filter in a multivariate setting and compare the results with standard Kalman filter and HP filter. Alper et al. (2007) used a multivariate Kalman filter to estimate the potential output using movements in exchange rates. Lately, Andic (2018) uses a modified version of a multivariate filter using unemployment and inflation.

CHAPTER 3

THE TAYLOR RULE AND THE ASYMMETRIC INTEREST RATE CORRIDOR

3.1 The Taylor rule

Taylor rule is an interest rate based monetary policy function using output gap and inflation gap for minimizing the loss by regulating the nominal interest rate as shown below.

Equation 1:

$$i_t = r^* + \pi_t + \alpha(y_t - y^*) + \beta(\pi_t - \pi^*)$$

In this equation, i_t is the nominal interest rate set by Central Bank, r^* is the equilibrium interest rate, which is described as the real interest rate when the inflation and the output gap are both zero. π_t is the actual inflation at period t. π^* is the inflation target set by Central bank, which is known only by the Central Bank. y_t is the actual output which is announced later on and unknown at time t. y^* is the potential output, which is dependent on various macroeconomic conditions; therefore, it is unobservable at time t, as well. In this Taylor rule, the nominal interest rate adjusts itself in response to the inflation and the output gap. The coefficients α and β were set to 0.5 to exemplify a central bank giving balanced weights to inflation and output equilibrium. It is assumed by Clarida (1998) that Central banks implementing Inflation Targeting should have the following property: $\beta > 1$.

After Taylor introduced the rule, subject to the needs the components has been expanded. Money supply, the exchange rate is included, for instance, to measure their sole effects on Taylor rule. The coefficients emphasize the significance given by the central bank provided that the coefficients are significant. Taylor Rule is a linear equation; therefore, the coefficients are estimated using Ordinary Least Square method (OLS).

In this model, an augmented Taylor rule where the three components of the asymmetric interest rate corridor by using real time measurements is derived. Alongside with three, our models are aimed to measure whether the gaps between since they are used to construct uncertainty. Hence, the gaps are both effective in monetary policy. The next section will define the components and discusses the usage of these policy instruments.

3.2 The asymmetric interest rate corridor

After the global financial crisis in 2008, advanced economies implemented unprecedented policies for recovery from the crisis. The effects of these policies created volatile global conditions which in turn resulted in capital inflows to emerging economies with robust fundamentals. The fear of sudden reversals of capital flows which is one of the sources of previous crises like Turkeys 1994 crisis encouraged the emerging economies to take precautions against capital flows. CBRT announced the asymmetric interest rate corridor in 2010. As discussed in Aysan (2014) in the overnight markets, central banks offer two standing facilities: a lending and a deposit facility. The previous policy was the conventional symmetric interest rate corridor in which the gap between the lending rate and the borrowing rate with policy rate was narrow and with equal distance. The narrow gap disabled the ability to use the lending rate and the borrowing rate, whilst in the new policy these two have been actively used. Hence, it can be suggested that with the new policy implemented, CBRT increased its interest based monetary tools from one to three. The definitions and the objectivity of these three instruments are defined as follows.

Overnight Lending Rate / Upper Bound: CBRT implements the Overnight lending rate, which can be expressed as the price of money. Banks use Overnight lending rate in case they could not be saturated with the weekly repo auctions. The upper bound can be increased to hinder the economic activity in case the economy is overheated. Also, the overnight lending rate would be called upper bound as discussed in Woodford (2003) the policy rate should be at most as much as the lending since otherwise there is an arbitrage opportunity for the other economic parties. The arbitrage opportunity arises from the fact that if the market interest rate is higher than the lending rate. Then economic parties could borrow from the central bank and then lend to the economy. Lending would increase, because of the arbitrage opportunity, the policy rate diminishes at least to the lending rate.

Overnight Borrowing Rate / Lower Bound: Second instrument is the Overnight borrowing rate, which is the deposit rate for international investors for them to purchase central banks assets to get the benefit of the borrowing rate. The borrowing rate is used to smooth fluctuations in the supply of capital flows. In times of capital inflows decreasing the lower bound would, in principle, discourage the short-term inflows creates a smoother capital inflow. Overnight borrowing rate is also the lower limit of the interest rate in the economy. Hence, the overnight borrowing interest rate can be called lower bound. If the Central Bank borrows money at a higher rate than the market rate, then the economic agents would prefer to borrow to the central bank instead of other economic parties. Borrowing would decrease to get the attention of borrowers; market rate would increase as least with the borrowing rate as far as to the borrowing rate.

One Week Repo Rate / Policy Rate: In the conventional monetary policy regime, sale auctions were arranged at a rate which is predetermined at monthly and announced at Central Bank monetary policy meetings. CBRT tried to guide the demand with a prearranged rate. After implementing the policy framework for financial stability has been an objective, consistent monitoring was required. In the new policy regime, CBRT gives flexibility to the policy rate by steering on a daily basis. Policy rate is adjusted more frequently to consider the credit growth. Also, using sale auctions CBRT intend to control the stability of exchange rate.

Gap: The gap is the divergence between upper and lower bound. The gap is used to discourage short term capital flows by creating uncertainty for foreign investors. Also, via creating uneasiness CBRT puts a quasi-tax (Hoffman 2014) on domestic economy to prevent rapid credit growth. The gap indicates the monetary policy stance on the economy. When the gap is high, CBRT considers tightening, whilst when the gap is low, CBRT tries to boost the economy. Usage of the gap comes with the usage of policy rate. CBRT introduced the mobility of the policy rate to smooth the fluctuations in capital surge. The policy rate is used to create uncertainty within the corridor.

Upper gap and Lower gap: The upper gap is the difference between the upper bound and the policy rate. The upper gap creates an uncertainty for citizens and domestic banks. When the policy rate is close to lower bound, then borrowing from central bank costs more especially when the gap is high. Creating such a constraint acts as if it is a tax and puts pressure on credit growth. Similarly, the lower gap is the difference between the policy rate and the lower bound. The lower bound is also used with the policy rate to create unambiguity for foreign investors. The gap is used to discourage short-term capital flows to the domestic economy. In this paper the macroprudential monetary policy of CBRT is analyzed from the interest rate based monetary policy perspective. A more detailed macroprudential investigations can be found in Kara (2012), Aysan et al. (2014), Aysan et al. (2015), Binici (2016). In Figure 2, the asymmetric interest rate corridor elements are shown: overnight lending rate, overnight borrowing rate, one week policy rate, the lower gap (shown as (i)), the upper gap (shown as (ii)).

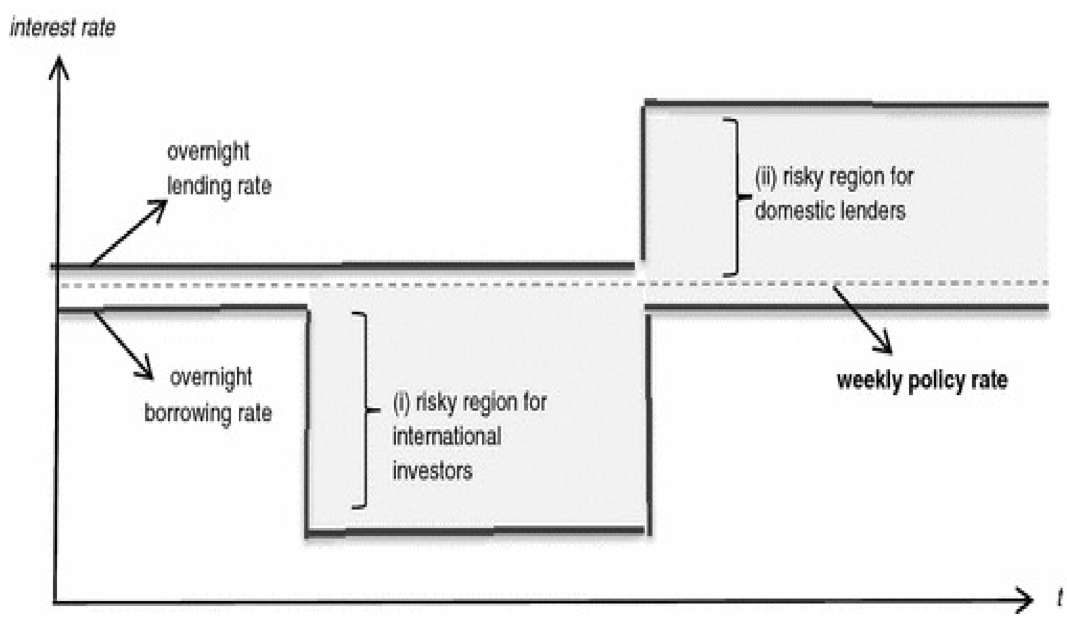

Figure 2. The Asymmetric Interest Rate Corridor

CHAPTER 4

THE MODEL

Standard Kalman Filter (SKF)

The original formulation of the Standard Kalman filter (SKF) is first introduced by Kalman (1960). The formula is a way of solution to the general problem to estimate the state of a discrete-time controlled problem. The general problem is shown in the equation 2.

Equation 2:

$$x_k = Ax_{k-1} + Bu_k + \epsilon_k$$
$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

In equation 2, $x_k \in R^n$ is the state the unobservable, u_k is the other variables affecting the state and ϵ_k is the process Gaussian white noise.

Equation 3:

$$z_k = Hx_k + \rho_k$$
$$cov(\rho_i, \rho_j) = 0 \quad where \;\; i \neq j$$

In equation 3, $z_k \in R^m$ is the measurement what can be observed and ρ_k is the measurement Gaussian white noise. Using these two equations in state space form, a posteriori state is estimated. The SKF is applied simply because we are using real time measurements. By using real-time measurements, we implicitly assume that CBRT has perfect information about the potential output when they decide to adjust the policy rate. Hence, the volatility of gross domestic product (GDP) can be overcome.

The new policy framework is introduced at the end-of-2010. In January 2011, the last available data for GDP is that third quarter of 2010. By using industrial production index (IP), which is announced monthly, and using Friedman (1962) method we estimated the monthly GDP.

After obtaining monthly GDP, we estimate the real time measurement of the output gap and inflation gap to derive Taylor rules for the policy rate, lower and upper bound and lower and upper gaps. For output gap, we first measure the potential output by using the industrial production index for two reasons. First, CBRT adjusts the interest rate corridor monthly and IP is announced monthly, whilst previous quarters GDP is announced at the end of each quarter. The second reason is that when we regress the seasonally adjusted logarithm of real GDP with the seasonally adjusted logarithm of IP, we have an adjusted R-squared of 0.60 from January 2005 to December 2009. Hence, using the seasonally adjusted logarithm of IP can have an explanatory power for the real time GDP. First, our model predicts that a posteriori GDP estimates for the months October, November and December of 2010 which are all unknown when CBRT announces its interest rate policy decision on December 2010. On January 2011, our model uses the GDP a posteriori estimations as true values and estimates a posteriori GDP for the January 2011, similar for February 2011. On March 2011, the actual GDP in the previous quarter is announced and our model updates a posteriori estimates of October, November and December of 2010. Using revealed data, we estimate the January, February and March of 2011 a posteriori estimate. The model continues with the logic that at the end of a quarter, previous quarter data is updated. With the updated data, the measurements of the current quarter are derived again. For the first and the second month of the quarter, since no GDP data is announced, the model assumes that previous a posteriori estimates are true and updates the first and the second month according to the a posteriori estimates.

The GDP a posteriori (gdppost) is calculated by SKF in an SKF to estimate potential output. Hence, after the monthly gdppost is derived, it is used to derive potential output. The equation for gdppost is given below.

Equation 4:

$$ipi_t = H * gdppost_t + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

In equation 4, we assume IP is a measurement of GDP. H coefficient is derived by an OLS estimation from the available data from January 2005 up to time t. By updating the IP for each month, we allow for H to change. ϵ_t is Gaussian white noise.

Equation 5:

$$gdppost_t = F * gdppost_{t-1} + \rho_t$$

$$cov(\rho_i, \rho_j) = 0 \quad where \;\; i \neq j$$

In equation 5, state equation of gdppost is presented. By using OLS estimation, using gdppost equal to the previous GDP we estimate the F coefficient at each time. ρ_t is Gaussian white noise.

Equation 6:

$$gdppost_t = K * pot_t + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

In equation 6, using gdppost estimations, we estimate the potential output taking gdppost as a measurement and potential output as a state variable. K is estimated by using OLS and ϵ_t is Gaussian white noise.

Equation 7:

$$pot_t = G * pot_{t-1} + \rho_t$$

$$cov(\rho_i, \rho_j) = 0 \quad where \;\; i \neq j$$

In equation 7, we assume that potential output follows a linear trend. G is estimated by using OLS estimations and ρ_t is Gaussian white noise.

Inflation data is monthly available so it can be observable unlike actual output. Inflation gap is estimated with SKF using the exchange rate. We assume that the exchange rate can present valuable information about the inflation expectations set by the monetary authority. Using inflation as a state variable and exchange rate as a measure, we estimated the inflation gap.

Equation 8:

$$exch_t = H * inf_t + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

Equation 8 is the measurement equation when obtaining potential inflation. H is estimated by using OLS estimations and ϵ_t is Gaussian white noise.

CBRT has its own expectations on inflation. In this framework since we put ourselves in the Central Bank's shoes, inflation gap is the difference between the actual inflation and the Central Bank's expectations. To calculate the gap, exchange rate is used. As Kara (2012) mentions, the exchange rate is a communication channel for Central Bank's price stability objective.

Equation 9:

$$inf_t = F * inf_{t-1} + \rho_t$$

$$cov(\rho_i, \rho_j) = 0 \quad where \;\; i \neq j$$

Equation 9 is the state equation to estimate potential inflation, then using potential inflation we estimate inflation gap and ρ_t is Gaussian white noise.

After estimating the output gap and inflation gap, we used these two real time estimations in the Taylor rule.

Equation 10:

$$x_t = c + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y^*) + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

The dependent variable denoted as x_t is lower bound, upper bound, gap, lower gap and upper gap. The policy instrument set by CBRT was borrowing interest rate before the new policy is introduced. At the end-of-2010, CBRT added financial stability into its policy objective, all the variables mentioned can have an effect on policy making. Constant, c, is added to measure the real interest rate or the equilibrium interest rate in which the output gap and inflation gap are both zero. It can also be interpreted as the other factor effect on the interest rate such as the current account deficit, credit growth. In our model, exchange rate is used to estimate the inflation gap, using exchange rate is advantageous for two reasons: first, at the end of 2011, CBRT added financial stability to its policy objectives, exchange rate is used to monitor and give the direct signal with an observable data to the market. Second, Turkey is dependent on imports, especially oil and energy. Hence, using the exchange rate which can have a partial explanatory power on oil prices (Beckmann 2017) can be used as an indicator of the undesired price rise. $(\pi_t - \pi_t^*)$ is the inflation gap, $(y_t - y^*)$ is the output gap. Equation 10 is also same as before the 2008 crisis period where CBRT implementing IT regime where the dependent variable is the overnight borrowing rate. After the 2008 crisis, many countries revised their policy objectives and added financial stability into their policy sheet. After the new policy introduced there has been an adaptation period; therefore, we begin our analysis at the beginning of 2011. CBRT had not changed its price stability, according to Clarida (1998) an IT regime should have $\beta > 1$.

Also, CBRT should not change the dependent variables drastically to maintain its credibility on the economy; therefore, adding lag variables of the dependent variable can capture a more detailed information from the Taylor rule (xt1). The following equation is estimated to measure the effect of the lag variable and how the coefficients of inflation and output gap differs.

Equation 11:

$$x_t = c + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y^*) + x_{t-1} + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

In equation 11, as mentioned above, the additional lag variable can indicate how committed the CBRT to its policy objective and how the coefficients distinguish from Equation 10.

As an emerging economy, CBRT is influenced from abroad, especially from advanced economies. Since the new policy is introduced to prevent sudden reversal of the capital flows, CBRT should consider the global factors. In this model, we use the current LIBOR (Intercontinental Exchange London Interbank Offered Rate) to examine whether or not it has an effect on policy instrument. LIBOR rate is used by some of the world's leading banks to charge each other with different maturities. In our study, we hope that since financial stability is disturbed from abroad as well as domestic factors, LIBOR can be in the CBRT's policy area. We expect that LIBOR rate can have a statistically significant effect on lower bound which is the created uncertainty set by CBRT.

Equation 12:

$$x_t = c + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y^*) + usdlibor_t + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

Finally, some of the emerging market interest rates are included in the Taylor rule. By using emerging economies with available data, we can estimate that how the new policy reacts to banks contestants. The emerging market interest rate is derived from the available data to us, from several countries, including Brazil, Russia, South Korea and South Africa.

Equation 13:

$$x_t = c + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y^*) + r_t + \epsilon_t$$

$$cov(\epsilon_i, \epsilon_j) = 0 \quad where \;\; i \neq j$$

In equation 12, the emerging market interest rate is included, and the informal posed question can be whether or not the similar economies imitate each other or not. When we put the above question in a formal way, it can be stated as how influential the contestant markets interest rate on CBRTs interest rate decisions. Our models are from equation 10 to equation 13 with 5 different policy rate instruments. In the introduction, we mentioned that this policy is intriguing because it is unprecedented, but also policy instruments increase to three. The upper and lower gap are actively used by fine-tuning the policy rate; therefore, we are analyzing the three main instruments with two side instruments.

CHAPTER 5

DATA

In this research, our primary objective is to analyze the new monetary policy instruments with the new data from January 2011 to December 2017. Using real time measurements and new data, we analyze the sensitivity of the instruments and how uncertainty is applied in the new policy framework. All data are obtained from databases of Central Bank of Republic of Turkey, Turkish Statistical Institute, OECD and IMF. Data used in the equations are Gross Domestic Product using the Income Approach (GDP), Industrial Production Index (IP), Overnight Borrowing Rate, Overnight Lending Rate, One Week Repo Rate, Consumer Price Index (CPI), Exchange Rate, Emerging Interest Rate, 3-month London interbank offered rate (LIBOR) based on the U.S. Dollar.

Inflation is estimated as the percentage change in the CPI during the last 12 months. For the January 2011, inflation is the fraction of the difference of CPI on January 2011 to January 2010 with January 2010. Previous Inflation is announced by the Turkish Statistical Institute in the beginning of the month.

Gross Domestic Product using Income Approach data is announced quarterly. In Taylor rule monthly data is used to estimate the coefficients by OLS. There are different interpolation techniques for linking the low frequency data to high frequency data like Friedman (1962), Chow & Lin (1971). In this paper, Friedman method is used, since the IP data is available monthly. The GDP data are converted quarterly data to monthly data by using industrial production (IP).

Equation 14:

$$y_t = \frac{ip_t}{ip_q} y_q$$

In equation 14, y_t is the GDP at month t, y_q is the GDP at quarter q, ip_t is the IP at month t and ip_q is the IP at quarter q. The models implicit assumption is that IP is a related series to estimate GDP. Overnight Borrowing and Overnight Lending Rate are both available daily except for holidays. Daily data switch to monthly data by taking the average of the sum of daily data. The exchange rate is the exchange rate basket formed by the mean of Dollar / Turkish lira selling and Euro / Turkish Lira selling rate set by the CBRT. Daily data are converted to monthly series by using the average of the sum of daily series. The emerging market interest rate is composed of 12 countries short-term interest rate. The average of the short-term interest rates of China, Brazil, South Korea, Thailand, Peru, Czechia, Chile, Russia, Colombia, Poland, Mexico and Philippines is taken. After converting each data on a monthly basis, all series are checked whether they are stationary or non-stationary. In order to evade the risk of estimating spurious regressions, Dickey-Fuller (1979) is tested. In addition to Dickey-Fuller test, unit root is tested. All of the instruments in the gap are found to be stationary between the period 2011 and 2017. Taylor rule is estimated for policy rate, upper bound, lower bound, gap, lower gap and upper gap. OLS approach is practiced estimating the augmented Taylor rule equations with the additional components: lag of the dependent variable, emerging countries interest rate and 3-month London interbank offered rate (LIBOR) based on the U.S. Dollar.

CHAPTER 6

ESTIMATION RESULTS

Policy rate estimates for the period between January 2011 and December 2017 and are shown in Table 1. Policy rate reacts to both domestic factors and external factors. Output and inflation gap are used for domestic factors. In equations we tried to capture the external factors with Libor rate and emerging market interest rate. USD Libor rate is the charge between the world's leading banks interactions. The rate can be used as a measure for the global risk factor. Libor is also used to calculate various loans which at some point might affect the CBRT's policy rates.

Our results show that inflation gap and output gap have no statistically significant effect on the policy rate. Even when the inflation gap has an effect as in Equation 10 it is too small. Since the coefficients of the policy rate are less than one, CBRT does not implement an Inflationary Targeting Regime as discussed in Clarida (1998). Signs of the coefficients are also in light with what has been expected.When actual inflation is higher than the targeting, CBRT increases policy rate.

Also, the coefficients of the output gap are all positive, indicating that when the output gap occurs, CBRT increases the policy rate to slow down the economy. The coefficient of the constant term is significant in Equation 10 and 12, whereas it is not significant in Equation 11 and 13. Adding lag variable of the policy rate explains most of the data as can be seen from adjusted R-squared of the Equation 11 is 0.81 whereas the adjusted R-squared of the other equations are at most 0.12. Adding lag variable decreases the coefficients of the output gap, inflation gap and constant to one-tenth of the coefficient in Equation 10. In equation 13 and 14, the Libor rate and emerging market interest rate effect are insignificant.

Table 1. Policy Rate

Policy rate	Equation 10	Equation 11	Equation 12	Equation 13
Constant	4.95*	0.54	4.72*	2.28
	(0.79)	(0.46)	(0.78)	(1.81)
Output Gap	0.24	0.02	0.23	0.22
	(0.11)	(0.05)	(0.11)	(0.11)
Inflation Gap	0.07*	0.001	0.04	0.08*
	(0.02)	(0.01)	(0.03)	(0.03)
Policy rate (-1)	-	0.89*	-	-
	-	(0.05)	-	-
Libor rate	-	-	0.84	-
	-	-	(0.47)	-
Emerging	-	-	-	0.60
	-	-	-	(0.36)
A R-squared	0.09	0.81	0.12	0.11

The lower bound estimates are for the period between January 2011 and December 2017. Lower bound in principle varies with the external factors, not domestic ones. In equations we tried to capture the external factors with Libor rate and emerging market interest rate. USD Libor rate is the charge between the worlds leading banks interactions. The rate can be used as a measure for the global risk factor. Libor is also used to calculate various loans which at some point might affect the CBRTs policy rates. Lower bound estimation results are shown in Table 2.

The estimation results show that the constant is statistically significant in Equation 10 and 12, whilst it is negligible in Equation 11 and 13. The reason is that the effect of lag of lower bound and emerging market interest rate is included in Equation 10 and 12 in constant.

Table 2. Lower Bound

Lower Bound	Equation 10	Equation 11	Equation 12	Equation 13
Constant	-3.16*	0.45	7.65*	2.65
	(0.56)	(0.43)	(1.01)	(2.33)
Output Gap	0.63*	0.001	-0.42*	-0.43*
	(0.08)	(0.05)	(0.13)	(0.14)
Inflation Gap	-0.03	0.012	0.05	0.11*
	(0.01)	(0.01)	(0.03)	(0.03)
Lower bound (-1)	-	0.92*	-	-
	-	(0.03)	-	-
Libor rate	-	-	1.66*	-
	-	-	(0.60)	-
Emerging	-	-	-	1.23
	-	-	-	(0.48)
A R-squared	0.46	0.92	0.22	0.22

Also, lower bound responds to the output gap except when the lag variable is incorporated. The sign of the output gap is negative as expected in Equations 12 and 13. However, in equation 10 the output gap coefficient is significant and positive. When the output gap is positive, that is the actual output is higher than the potential output, CBRT would like to slow down the economy, one way could be diminishing lower bound so that the capital flows would decrease, investment decreases and the economy would slow down. As for the reaction of inflation gap on lower bound, the sign of the coefficient of inflation gap is negative and small and significant in Equation 10. Lower bound responds to inflation gap when the emerging market interest rate is included.

Using equation 11, we use the lower bound as the dependent variable. Lag variable of the lower bound explains the lions share since the adjusted R-squared of the equation 11 is 0.92 and the coefficient is 0.92 which indicates that CBRT commits to the stability of the lower bound. This finding is also consistent with the usage of the policy rate. Policy rate is used to monitor financial stability, not the lower bound. Adding lag of the lower bound makes the inflation gap and output gap coefficients irrelevant. Hence, one can conclude that the lower bound does not react to inflation gap and output gap which are the domestic factors for the economy. This finding is consistent with the assertion the lower bound reacts to external factors. Moreover, when the lag variable is excluded as in Equation 10, the output and inflation gap capture the effect of the lag variable as the coefficients vary significantly from 0.63 to -0.03 for output gap and from 0.001 to 0.012 for the inflation gap.

The USD Libor rate is used to analyze how CBRT switch its policy rate in response to a global shock. Our results indicate that a 100 basis point increase in the USD Libor rate presses the lower bound 166 basis points. The standard deviation is 0.6 and p-value of the coefficient is significant at 1 % confidence level. The result demonstrates that the USD Libor rate might have used as a reference interest rate to examine the global conditions.

The emerging market interest rate is used to analyze how CBRT responds to economies similar to Turkey. 100 basis point boost in emerging market interest rate changes the lower bound by 123 basis points. The t-Statistic is 2.59 which is not significant at 1 % confidence level, however it is significant at 5 % confidence level.

Table 3. Upper Bound

Upper Bound	Equation 10	Equation 11	Equation 12	Equation 13
Constant	11.25*	0.47	11.51*	7.86
	(0.88)	(0.61)	(0.88)	(2.03)
Output Gap	-0.19	0.02	-0.18	-0.21
	(0.12)	(0.05)	(0.12)	(0.12)
Inflation Gap	-0.007	0.008	0.02	-0.002
	(0.03)	(0.01)	(0.03)	(0.03)
Upper bound (-1)	-	0.93*	-	-
	-	(0.04)	-	-
Libor rate	-	-	-0.93	-
	-	-	(0.53)	-
Emerging	-	-	-	0.77
	-	-	-	(0.41)
A R-squared	0.006	0.85	0.03	0.03

Next, the upper bound is used as a dependent variable between January 2011 and December 2017. Upper bound in principle reacts to domestic factors, not the external or global factors. Output gap and inflation gap are used for domestic factors and USD Libor rate, the emerging market interest rate is used for abduction of global factors. Upper bound estimation results are shown in Table 3.

The estimation results show that the constant is statistically significant at 1% confidence level in Equations 10 and 12. The reason is that the effect of lag of the lower bound is included in the constant. The output gap and inflation gap coefficients are all insignificant. The coefficients in Equation 10 is -0.19 and -0.007 with standard deviations 0.12 and 0.03, respectively. When the lag variable is involved the coefficients decrease to nearly one-tenth of as for policy rate and lower bound. And to preserve their values when the USD Libor rate and emerging market interest rates are included separately. The adjusted R-squared of the regressions is quite low, ranging from 0.006 to 0.05 on the contrary to the regression including lag variable. The reason for this finding can be that upper bound creates a gap with the lower bound; therefore, upper gap can react to lower gap instead of output and inflation gaps. Hence, we run similar regressions including the lower rate. Adding lower bound improves the results.

Combining lower bound improves the regression result for Equations 10,12 and 13. Output gap remains insignificant whereas the coefficient for inflation gap is significant at 1% confidence level in Equations 10, 12 and 13. Adjusted R-squared improves; therefore, adding lower bound might be a good predictor for the upper bound.

Adding lag variable explains the lion's share of the upper bound with the coefficient 0.93 and significant at 1% confidence level. Adding lag of the lower bound makes inflation gap and output gap coefficients' irrelevant. Hence, one can conclude that the lower bound does not react to inflation gap and output gap which are the domestic factors for the economy. This finding is consistent with the assertion the lower bound reacts to external factors.

The upper bound does not react to changes in the USD Libor rate and emerging market interest rate. This finding is expected as the upper bound does not respond to external factors. When the lower bound is included USD Libor rate coefficient becomes significant which can be a result of the interdependence of the lower bound and USD Libor rate.

The gap is used as the dependent variable in Equation 10, 11, 12 and 13 as introduced before. The gap is used as a build uncertainty for both domestic and external agents. Hence, the gap can react to both domestic and external factors. The results are shown in Table 4.

Table 4. The Gap

The Gap	Equation 10	Equation 11	Equation 12	Equation 13
Constant	3.14* (1.02)	0.04 (0.34)	3.85 (0.92)	5.21 (2.37)
Output Gap	0.21 (0.15)	0.02 (0.05)	0.24 (0.13)	0.22 (0.14)
Inflation Gap	-0.11* (0.03)	-0.001 (0.01)	-0.03 (0.04)	-0.11* (0.33)
Gap (-1)	- -	0.95* (0.03)	- -	- -
Libor rate	- -	- -	-2.59* (0.55)	- -
Emerging	- -	- -	- -	-0.47 (0.48)
A R-squared	0.12	0.92	0.30	0.12

The estimation results show that the constant is statistically significant in Equation 10 and 12, whilst it is negligible in Equation 11 and 13. The reason is that the effect of lag of lower bound and emerging market interest rate is included in Equation 10 and 12 in constant. This finding is similar to the lower bound results for the constant term.

The output gap does not respond to the gap inasmuch as inflation gaps coefficients are significant in Equations 10 and 12. A 100 basis boost in the USD Libor rate decreases the gap by 259 basis points. A boost in the USD Libor rate increases the lower gap and decreases the upper bound as shown in Table 4 when the lower bound is involved. Hence, this is consistent with the previous findings. The effect of emerging market interest rate is also insignificant at 1 % percent confidence level.

The upper and lower gaps are used to create uncertainty for the credit growth and exchange rate volatility as explained by the usage of these two in Kara (2012). In our study, we implicitly assume that the uncertainty to disable unwanted credit growth and extreme volatility in exchange rates can be captured via USD Libor rate and emerging market interest rate. The USD Libor rate can seize the volatility in global market conditions since the USD Libor rate is used between the worlds leading banks and the emerging market interest rate can grab valuable information on how emerging markets like Turkey can create or deny uncertainty. The results for the upper and lower gaps are shown in Table 5 and Table 6.

The adjusted R-squared of the regressions is nearly one-half for all the regressions for lower gap. This finding might indicate the active usage of lower gap. The lower gap is a risky region for the foreign investors, whereas upper gap is a risky region for domestic lenders.

The constant coefficient for the lower gap is statistically significant in Equation 10 and 12. This might indicate that constant seize the effects of lag variable and emerging market interest rate. For upper gap, the constant term is statistically significant except when the lag of the both gaps is contained. The output gap coefficient is statistically significant in all regressions except when the lag of the

Table 5. The Lower Gap

The Lower Gap	Equation 10	Equation 11	Equation 12	Equation 13
Constant	-3.16*	-1.06	-2.93*	-0.36
	(0.56)	(0.53)	(0.55)	(1.25)
Output Gap	0.64*	0.22	0.65*	0.65*
	(0.08)	(0.08)	(0.07)	(0.07)
Inflation Gap	-0.03	-0.02	-0.005	-0.04
	(0.01)	(0.01)	(0.02)	(0.02)
Lower Gap (-1)	-	0.63	-	-
	-	(0.08)	-	-
Libor rate	-	-	-0.82	-
	-	-	(0.32)	-
Emerging	-	-	-	-0.63
	-	-	-	(0.26)
A R-squared	0.47	0.67	0.50	0.50

upper gap is included. The inflation gap coefficient is statistically significant in all regressions except when the lag of the both gaps is involved.

Apart from other models, lower gap does not respond to its lag variable as much as the other instruments. We reach this finding from the change in the adjusted R-squared of Equation 10 and 11 for lower gap. The previous adjusted R-squared is 0.53 and the new one is 0.68. For upper gap, adjusted R-squared changes from 0.31 to 0.77 for the two equations. Another important result is that the upper gap changes with the USD Libor rate. Emerging market interest rate does not influence both gaps.

Table 6. The Upper Gap

The Upper Gap	Equation 10	Equation 11	Equation 12	Equation 13
Constant	6.30*	0.47	6.78*	5.57*
	(0.84)	(0.67)	(0.79)	(1.97)
Output Gap	-0.43*	-0.02	-0.41*	-0.43
	(0.12)	(0.07)	(0.1)	(0.11)
Inflation Gap	-0.08	0.005	-0.02	-0.08*
	(0.03)	(0.02)	(0.03)	(0.02)
Upper Gap (-1)	-	0.88*	-	-
	-	(0.06)	-	-
Libor rate	-	-	-1.77	-
	-	-	(0.47)	-
Emerging	-	-	-	0.16
	-	-	-	(0.4)
A R-squared	0.18	0.76	0.29	0.16

Aside from the model, VAR models of transmission mechanism in Cholesky ordering are estimated for gap using inflation-based exchange rate, output gap and inflation gap.

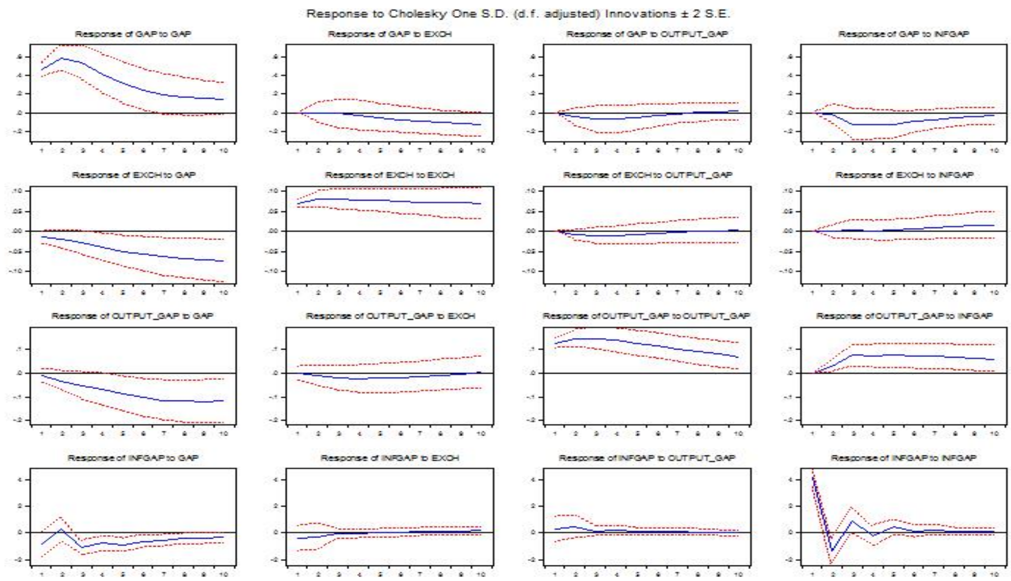

Figure 3. Impulse Response functions in four variables VAR of the Gap

As can be seen in the second row and first column in the Figure 3, the Gap responds to an exchange rate shock persistently and negatively. Although the response is small, in the long run the gap would respond to persistent shocks. The gap would, in principle, decrease as upper bound decreases, which would boost the economy or increase in the lower bound so that capital flows would expands. Third scenario is that both lower bound and upper bound increases with the condition that the hike in the lower bound is more than the hike in the upper bound.

As can be seen in the third row and first column in the Figure 3, the Gap responds to an output gap shock persistently and negatively. Although the response does not affect immediately, after 7-month a change in the gap is seen. Negative effect on the gap can be observed with a drop in upper bound which would boost the economy so that it is unlikely that Central bank would apply. The second scenario is that a decline in the gap could be caused by a hike in the lower bound which would cause capital flow reduction. The third scenario is that both lower bound and upper bound increases with the condition that the hike in the lower bound is more than the hike in the upper bound.

As can be seen in the fourth row and first column in the Figure 3, the Gap responds to an inflation gap shock persistently and negatively. The response is small in the long run, yet it is consistent. The gap would, in principle, decrease as upper bound decreases, which would boost the economy or increase in the lower bound so that capital flows would expands. The third scenario is that both lower bound and upper bound increases with the condition that the hike in the lower bound is more than the hike in the upper bound.

In the second row and fourth column in the Figure 3, the exchange rate responds to inflation gap. This is consistent with the research conducted on exchange rate pass through. The effect is found not significant in our analysis.

CHAPTER 7

THE CONCLUSION

After 2008 financial turmoil, unorthodox monetary policies implemented by advanced economies. The unconventional methods compelled to emerging economies to take precautionary monetary policies. In this regard, Central Bank of Republic of Turkey (CBRT) added financial stability into its policy basket and implemented unconventional interest based monetary policy rule: the asymmetric interest rate corridor along with other macroprudential tools. This research investigates how the new interest rate policy tool of CBRT is managed. An augmented Taylor rule is applied for this investigation.

Output gap and inflation gap are estimated using Bayesian filtering methods to engage an augmented Taylor rule. The contribution of this paper is the usage of real-time data in evaluating the new monetary policy tool for output gap and inflation gap. By using real-time data available at each month to CBRT, we put ourselves into central banks shoes. By putting ourselves in the Central Banks position, we hope to achieve a more comprehensive analysis on the management of the new policy tool instead of just using all data and evaluate the Central Banks decisions as if they have perfect foresight for the whole period.

With the new policy, the bank uses the corridor instead of just single policy rate. The instruments in the corridor are tested in a Taylor rule after obtaining the output and inflation gaps. Lag variable of the instruments is used to detect the stability of the policy appliance. 3-month London interbank offered rate (LIBOR) based on U.S. Dollar is used to capture the global financial risk. Lastly, an average of interest rates from emerging economies including China, Brazil, South Korea, Thailand, Peru, Czechia, Chile, Russia, Colombia, Poland, Mexico and Philippines is employed to catch how similar bank rates affect the central banks decision.

One-week repo rate, called policy rate in our model, is not used to control credit growth and foreign investments by creating ambiguity. Output and inflation gap do not change the policy rate.

Overnight borrowing rate, called lower bound, is used to draw attention for foreign investors. The lower bound is applied against the global factors, The USD Libor rate and emerging market interest rate are used to capture the effect. Our results show that the lower bound rate conducts itself with the lag variable, USD Libor rate and emerging market interest rate. Output and inflation gap has no significant effect on lower bound when the lag variable is included. The reason can be that the bank desires stability in the lower bound or changes itself with the changes from abroad. When USD Libor rate and the emerging market interest rate is added, the output and inflation gap remain significant.

Overnight lending rate, called upper bound, is used to charge domestic banks to control credit growth. Upper bound is applied against the domestic factors, output and inflation gap in our model. The results exhibit that upper bound does not react to real-time output and inflation gap. The reason can be that Turkey is an energy import country, so the central bank might not prioritize the upper bound. Instead the central bank uses the gap between the lower and upper bound, these results are obtained by regressing the lower bound on upper.

The gap between lower bound and upper bound is also used as a policy tool. The gap changes with the inflation gap, not output gap. Also, the lower and upper gaps are regressed according to models introduced. The lower gap does not depend on its lag variable as much as the other instruments do. This finding can be interpreted as the central bank uses lower gap to create uncertainty, whereas the upper gap reacts to changes in the Libor rate.

Apart from models suggested, VAR analysis is conducted on the gap. The Gap responds to an exchange rate shock persistently and negatively, though the effect is small (0.1). The Gap responds to an output gap shock persistently and negatively. The response is small in the long run, yet it is consistent. The Gap responds to an output gap shock persistently, small and negative. In the long run, the effect is consistent. Lastly, an inflation gap shock affects the exchange rate. The effect of the shock is small, hitherto it is persistent.

APPENDIX

DATA

Date	Gap	Lower	Upper	Upper gap	Lower gap	Repo
2011-01	7.5	1.5	9	2.75	4.75	6.25
2011-02	7.5	1.5	9	2.75	4.75	6.25
2011-03	7.5	1.5	9	2.75	4.75	6.25
2011-04	7.5	1.5	9	2.75	4.75	6.25
2011-05	7.5	1.5	9	2.75	4.75	6.25
2011-06	7.5	1.5	9	2.75	4.75	6.25
2011-07	7.5	1.5	9	2.75	4.75	6.25
2011-08	4.67	4.33	9	3.25	1.41	5.75
2011-09	4	5	9	3.25	0.75	5.75
2011-10	5.17	5	10.17	4.42	0.75	5.75
2011-11	7.5	5	12.5	6.75	0.75	5.75
2011-12	7.5	5	12.5	6.75	0.75	5.75
2012-01	7.5	5	12.5	6.75	0.75	5.75
2012-02	7.21	5	12.21	6.46	0.75	5.75
2012-03	6.5	5	11.5	5.75	0.75	5.75
2012-04	6.5	5	11.5	5.75	0.75	5.75
2012-05	6.5	5	11.5	5.75	0.75	5.75
2012-06	6.5	5	11.5	5.75	0.75	5.75
2012-07	6.5	5	11.5	5.75	0.75	5.75
2012-08	6.5	5	11.5	5.75	0.75	5.75
2012-09	5.9	5	10.9	5.15	0.75	5.75
2012-10	4.85	5	9.85	4.1	0.75	5.75
2012-11	4.32	5	9.32	3.57	0.75	5.75
2012-12	4	5	9	3.5	0.5	5.5

Date	Gap	Lower	Upper	Upper gap	Lower gap	Repo
2013-01	4	4.92	8.92	3.42	0.58	5.5
2013-02	4	4.66	8.66	3.16	0.84	5.5
2013-03	3.86	4.5	8.36	2.86	1	5.5
2013-04	3	4.29	7.29	2.29	0.71	5
2013-05	3	3.75	6.75	2.25	0.75	4.5
2013-06	3	3.5	6.5	2	1	4.5
2013-07	3.2	3.5	6.7	2.2	1	4.5
2013-08	3.93	3.5	7.43	2.93	1	4.5
2013-09	4.25	3.5	7.75	3.25	1	4.5
2013-10	4.25	3.5	7.75	3.25	1	4.5
2013-11	4.25	3.5	7.75	3.25	1	4.5
2013-12	4.25	3.5	7.75	3.25	1	4.5
2014-01	4.27	4.11	8.39	-1.61	5.89	10
2014-02	4	8	12	2	2	10
2014-03	4	8	12	2	2	10
2014-04	4	8	12	2	2	10
2014-05	4	8	12	2.5	1.5	9.5
2014-06	4	8	12	3.25	0.75	8.75
2014-07	4.18	7.82	12	3.75	0.42	8.25
2014-08	4.43	7.5	11.93	3.67	0.75	8.25
2014-09	3.75	7.5	11.25	3	0.75	8.25
2014-10	3.75	7.5	11.25	3	0.75	8.25
2014-11	3.75	7.5	11.25	3	0.75	8.25
2014-12	3.75	7.5	11.25	3	0.75	8.25
2015-01	3.75	7.5	11.25	3.5	0.25	7.75
2015-02	3.71	7.46	11.18	3.68	0.038	7.5
2015-03	3.5	7.25	10.75	3.25	0.25	7.5
2015-04	3.5	7.25	10.75	3.25	0.25	7.5
2015-05	3.5	7.25	10.75	3.25	0.25	7.5
2015-06	3.5	7.25	10.75	3.25	0.25	7.5
2015-07	3.5	7.25	10.75	3.25	0.25	7.5
2015-08	3.5	7.25	10.75	3.25	0.25	7.5
2015-09	3.5	7.25	10.75	3.25	0.25	7.5
2015-10	3.5	7.25	10.75	3.25	0.25	7.5
2015-11	3.5	7.25	10.75	3.25	0.25	7.5
2015-12	3.5	7.25	10.75	3.25	0.25	7.5

Date	Gap	Lower	Upper	Upper gap	Lower gap	Repo
2016-01	3.5	7.25	10.75	3.25	0.25	7.5
2016-02	3.5	7.25	10.75	3.25	0.25	7.5
2016-03	3.45	7.25	10.70	3.20	0.25	7.5
2016-04	3.08	7.25	10.33	2.83	0.25	7.5
2016-05	2.63	7.25	9.88	2.38	0.25	7.5
2016-06	2.09	7.25	9.34	1.84	0.25	7.5
2016-07	1.64	7.25	8.89	1.39	0.25	7.5
2016-08	1.44	7.25	8.69	1.19	0.25	7.5
2016-09	1.17	7.25	8.42	0.92	0.25	7.5
2016-10	1	7.25	8.25	0.75	0.25	7.5
2016-11	1.05	7.25	8.30	0.30	0.75	8
2016-12	1.25	7.25	8.5	0.5	0.75	8
2017-01	1.42	7.25	8.67	0.67	0.75	8
2017-02	2	7.25	9.25	1.25	0.75	8
2017-03	2	7.25	9.25	1.25	0.75	8
2017-04	2	7.25	9.25	1.25	0.75	8
2017-05	2	7.25	9.25	1.25	0.75	8
2017-06	2	7.25	9.25	1.25	0.75	8
2017-07	2	7.25	9.25	1.25	0.75	8
2017-08	2	7.25	9.25	1.25	0.75	8
2017-09	2	7.25	9.25	1.25	0.75	8
2017-10	2	7.25	9.25	1.25	0.75	8
2017-11	2	7.25	9.25	1.25	0.75	8
2017-12	2	7.25	9.25	1.25	0.75	8

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