Muhasebe ve Finansman Dergisi- Ağustos 2019 Özel Sayı 185-200

ISSN: 2146-3042
DOI: 10.25095/mufad.606014

New Trends in Central Banking in Turkey; A Study on the Reserve Option Mechanism and the Asymmetric Interest Rate Corridor*

Esra N. KILCI**

ABSTRACT

After 2008-09 Global Financial Crisis, central banks in many emerging market economies including the Central Bank of the Republic of Turkey adopted unconventional monetary policy tools to ensure financial stability in addition to the price stability. In this study, after giving a brief review of reserve option mechanism and asymmetric interest rate corridor practise, we tried to investigate the impact of the CBRT average funding interest rate, which is a component of assymmetric interest rate corridor, on the banking sector credit volume and foreign exchange rates by using monthly dataset covering the period of 2010:01-2019:02 and by empoloying the Fourier ADF unit root test, FourierSHIN conitegration test and Fourier Granger causality test. These techniques have the great advantage of permitting us to test for unit root, cointegration and causality while allowing for multiple structural breaks in the series. The results supported the cointegration and causality relationship between the CBRT average funding interest rate and banking sector credit volume and foreign exchange rates.

Keywords: *CBRT, reserve option mechanism, asymmetric interest rate corridor, credit volume, foreign exchange rates.*

Jel Classification*: E44, E52, E58*

Türkiye'de Merkez Bankacılığı'nda Yeni Trendler: Rezerve Opsiyon Mekanizması ve Asimetrik Faiz Koridoru Üzerine Bir Çalışma

ÖZET

2008-09 Küresel Finansal Krizi ile birlikte, Türkiye Cumhuriyeti Merkez Bankası'nın da içinde yer aldığı birçok gelişmekte olan ülke merkez bankası, fiyat istikrarı hedefine ek olarak, finansal istikrarı sağlayabilmek için, yeni para politkası araçlarını uygulamaya başlamıştır. Bu çalışmada, reserv opsiyon mekanizması ve asimetrik faiz koridoru uygulamalarına ilişkin kısaca bilgi verildikten sonra, 2010:01-2019:02 dönemi aylık verileri ve Fourier ADF birimkök, Fourier SHIN eşbütünleşme testi ve Fourier Granger nedensellik testi kullanılarak, faiz koridorunun bir unsuru olan TCMB ağırlıklı fonlama faiz oranının bankacılık sektörü kredi hacmi ve döviz kurları üzerindeki etkileri analiz edilmiştir. Bu testler, birimkök, eşbütünleşme ve nedenselliği test ederken, analizde çok sayıda yapısal kırılmanın dikkate alınmasına olanak sağlamaktadır. Analiz sonuçları, TCMB ağırlıklı fonlama faiz oranı ile bankacılık sektörü kredi hacmi ve döviz kurları arasındaki eşbütünleşme ve nedensellik ilişkisini desteklemektedir.

Anahtar Kelimeler: *TCMB, rezerv opsiyon mekanizması, asimetrik faiz koridoru, kredi hacmi, döviz kurları*

JEL Sınıflandırması: *E44, E52, E58*

Makale Gönderim Tarihi: 01.06.2019 **Makale Kabul Tarihi: 01.08.2019**
Makale Türü: Araştırma Makalesi

* This paper is a revised and expanded version of a study entitled 'New Trends in Central Banking: A Study on the Reserve Option Mechanism' presented at the V. International Symposium on Accounting and Finance which was held on May 1-4, 2019 in Bursa, Turkey.

** Asst. Prof., Istanbul Arel University, Faculty of Economics and Administrative Sciences, esrakilci@arel.edu.tr. ORCID ID: 0000-0002-2239-4560.

1. INTRODUCTION

Given the fact that the economies with high current account deficits become more vulnerable to financial shocks in case of high volatility in capital flows and severe recessions experienced in the crises of 1994, 2001 and 2008 resulted from sudden stops in capital flows, it is clearly important for the economies to take the current account deficit under control and to balance the external borrowing in order to maintain financial stability. To increase the resilience of the economy against sudden changes in global risk factors, the significance of a flexible approach to monetary policy is an issue which has been emphasized and the new policy framework including non-standard instruments adopted by the Central Bank of the Republic of Turkey (CBRT) needs to be mainly evaluated in this context (Kara and Ekinci, 2018).

It is seen that the both volume and volatility of capital flows into emerging market economies have increased dramatically after 2008-09 Global Financial Crisis, leading to financial and macroeconomic stability challenges such as excessive credit growth and volatility in foreign exchange rates. In response to these developments, central banks in several emerging economies including the CBRT modified financial stability target into the standard inflation-targeting framework and started to implement new monetary policy tools to deal with the negative results of capital flows. In this context, reserve option mechanism (ROM) is a new and unconventional monetary policy tool which has been designed and adopted by the CBRT to increase the resilience of the banking sector and the whole economy in general against the volatility in capital flows and external financial shocks thereby to smooth the foreign exchange (FX) volatility to some extent. This mechanism enables the banks with the option to keep a fraction (up to reserve option ratio) of their Turkish Lira mandatory reserve requirements in USD, Euro and gold (Aslaner et al, 2014).

In this regard, the ratio of Turkish lira required reserves that could be held in FX or gold is determined by the reserve option ratio (ROR) and the amount of FX or gold that could be held per unit of Turkish lira is called the reserve option coefficient (ROC). Banks are free in utilizing the ROM facility in full. Up to what fraction banks will benefit from the ROM that is the level of ROC which makes banks indifferent between utilizing or not utilizing the mechanism will depend on the relative cost of FX and TL funding. The periods in which an acceleration is seen in capital inflows are generally characterized by a fall in FX funding costs relative to TL funding costs or a relaxation of quantity restraints. In case of a relative fall in FX borrowing costs, threshold ROC will increase, causing the banks to keep a higher ratio of their TL reserve requirement liabilities in FX. On the other hand, during a deceleration in capital inflows, there seems a rise in FX funding costs relative to TL funding costs and/or a tightening of external borrowing constraints. This will result in a fall in the exercise of the ROM and loose some of the FX liquidity held by the banks at the CBRT, limiting the depreciation pressures and lowering the possibility of a credit crunch. In sum, the ROM has the potential to restrict both the volatility in the market liquidity and the foreign exchange rates through the automatic stabilizer mechanism (Alper et al, 2013).

Another advantage of the ROM for the banking sector is the short-term Turkish lira swap transactions. Banks generally meet the Turkish lira needs through short-term currency

swap transactions. In this context, the need of the banks for such swap transactions could be reduced and the volatility of capital flows especially of short-term capital flows could be decreased thanks to the ROM. In addition to the decrease in Turkish lira swap transactions, the use of external borrowing for ROM limits the growth of foreign currency denominated loans (Serel and Ozkurt, 2014).

The other instrument aside from the reserve option mechanism, we focus in this study is the asymetric interest rate corridor practice adopted by the CBRT within the post-crisis period. Central banks generally implement the monetary policy in a narrow and symmetrical interest rate corridor with a single policy rate. However, with the post-crisis period, in addition to the reserve option mechanism, the CBRT started to implement an unconventional approach by using the policy framework of multiple policy rates within an asymmetric and wide corridor. The interbank interest rates were often allowed to deviate from the officially announced policy interest rates in order to respond to excessive global financial volatility during this period (Binici et al, 2016). The wide interest rate corridor is a simply a new tool which has been developed by the CBRT to alleviate the balance between price stability and financial stability resulting from the volatility in global markets. Emerging markets including Turkey have become excessively fragile to the global monetary policy developments of the period of 2008-09 Global Financial Crisis. Sudden and large-scale movements in capital flows and changes in global risk appetite lowers the predictability in emerging economies by leading to a great macroeconomic instability. This conditions emphasized the need to adopt new tools to ensure timely response to changes in global liquidity and risk perceptions and made the CBRT adopt a new approach in which it used a wide interest rate corridor with a more active and flexible liquidity management strategy since 2010 (Kara, 2015).

The new system which is called asymmetric interest rate corridor mechanism works as follows. The CBRT narrows or expand the interest rate corridor in some periods depending on financial conditions and risks including capital movements, foreign exchange rate volatility and credit volume with the objective of making the interest rate corridor effective. With this tool, the CBRT aim to effect macroeconomic indicators in financial markets via exchange rate and credit channel. The CBRT might have impacts on liquidity and credit volume by further tightening or easing liquidity transactions and by expanding the interest rate corridor upside or downside. The CBRT, in other words, try to influence credit growth and liquidity transactions as banks typically take into consideration the upper limit of the interest rate corridor in pricing of interest rate risk (TCMB, 2012-2013a-2013b-2014-2015). When the interest rate corridor is widened upwards, the volatility experienced in foreign exchange rates can be reduced in the periods of excessive capital outflows and currency movements. In addition, the CBRT can have control on the credit volume of the banking sector and short-term capital movements by using asymmetric interest rate corridor (Kara and Ekinci, 2018).

There are basically two differences between the system used by the CBRT and the old framework. Firstly, in the traditional system, there is no difference between the short-term average funding rate and the targeted interest rate expected in the money market. On the other hand, in the new framework, these two interest rates can be seperated through liquidity operations. This differentation enables the CBRT to influence the credit and exchange rate channels seperately in spesific periods. Secondly, in the traditional system, the average short-term funding rate is reviewed in monthly frequencies at Monetary Policy Committee meetings. However, in the new framework, the average funding rate can be adjusted in daily

frequencies within the approval of the board members when needed in order to react in a timely manner to the volatility in the global risk appetite. Therefore, the asymmetric interest rate corridor has basically two benefits different from the single-instrument monetary policy; it makes possible to used the credit and exchange rate channels in different directions for price stability and financial stability purposes. The second advatage of the asymmetric interest rate corridior is that the flexibility of the central bank can be adjusted at the daily frequency (Kara, 2012; Serel and Ozkurt, 2014).

From the perspective of capital flows, the asymmetric interest rate corridor functions largely through stabilizing supply of foreign funds and the reserve option mechanism works mainly through lowering the sensitivity of equilibrium exchange rate against shifts in the demand for foreign funds (Aysan et al, 2014a). The purpose of this study is to analyze the relationship between CBRT average funding interest rate and banking sector credit volume as well as foreign exchange rates by using weekly data of 2010:01-2019:02. The contribution of this paper to the literature is that we use Fourier ADF unit root test, Fourier SHIN cointegration test and Fourier Granger causality test by considering the effects of multiple structural breaks in the analysis. These techniques have the great advantage of permitting us to test for unit root, cointegration and causality while allowing for multiple structural breaks in the series and this allows to place greater confidence in the results. The remaining of the paper is constructed as follows: after reviewing ROM and asymmetric interest rate corridor briefly, the next section include the literature review, the third section present the unit root test of Fourier ADF and the cointegration test of Fourier SHIN and the causality test of Fourier Granger. The fourth section describes data and reports empirical results. Finally, the last section concludes the paper by making a general remark.

2. LITERATURE REVIEW

To ensure the financial stability objective, the CBRT has been clear about the financial variables to evaluate the level of financial stability which have been defined as the credit growth and the foreign exchange rate. These variables are especially relevant for monitoring financial stability for small-open economies, while there is no unique definition concerning financial stability, in other words, which variables can best reflect the level of financial stability. Therefore, the strength of the feedback mechanism can be followed by these two key variables (Aysan et al, 2014a). the Central Bank of the Republic of Turkey (CBRT) has been applying a multi-instrument monetary policy strategy within a wide interest rate corridor since 2010 (Kara, 2015). The CBRT utilize asymmetric interest rate corridor mechanism in order to have impact on banking sector credit growth and foreign exchange rates. In the academic literaure, there are a few studies focusing on the impact of central bank new policy mix on credit growth and foreign exchange rates. Some of these are briefly reviewed below.

Oduncu et al (2013), tried to examine the impact of new policy framework on the credit growth volatility by using the weekly bank credit stock data which included total banking sector loans and credit cards and excluded non-performing loans and credit to financial sector in the period of 2006:01-2013:06. After employing GARCH framework in order to analyze the effect of new policy framework on the volatility of credit growth, they found that the new monetary policy mix had a significant contribution to lessen in the volatility of credit growth. Therefore, it can be referred that this new monetary policy

framework contributed to financial stability in Turkey by reducing the credit growth volatility.

Ermişoğlu et al. (2013) analyzed the impacts of additional monetary tightening, which was a new liquidity tool that the Central Bank of the Republic of Turkey used in the period of 2011-2012, on the foreign exchange rates by employing GARCH framework. After using the daily data set belonged to the currency basket in the period of 2011:10-2012:07, their analysis indicated that additional monetary tightening had a significant role in decreasing the volatility of Turkish Lira against foreign exchange rates. They also found that Turkish Lira appreciated against the other emerging market currencies during the days of additional tightening.

Binici et al (2013), focused on the interaction of the interest rate corridor with the credit-deposit spread, which is an important indicator of banks'appetite credit supply, for two periods including 2005:01-2010:05 and 2010:11-2012:12. The results of their analysis suggested that monetary policy was able to influence deposit and credit rates via different channels, through the use of an asymmetric corridor policy jointly an active liquidity management strategy. Accordingly, the interest rate corridor had the potential to affect the credit spread and therefore to be used as a macro-prudential policy tool to smooth domestic credit cycles. Binici et al (2015), in another study, analyzed the impact of alternative policy tools on the credit and deposit rates by using bank level data. They concluded that the impact of policy instruments on deposit and loan rates differed; signaling different policy instruments could have significant implications for bank behavior.

Aysan et al (2014b), analyzed the the effectiveness of macroprudential policies launched by Turkey in late 2010 after the 2008-09 Global Financial Crisis. They examined whether the new policy framework and instruments implemented by CBRT has been effective in buffering the economy from volatile capital flows by using a large panel of 46 countries and utilizing Bruno and Shin (2013a,b)'s methodology. After controlling for a set of domestic and external variables and relative to a group of advanced and emerging countries, their findings show that international capital flows to Turkey have been less sensitive to global factors with the execution of macroprudential policies.

Binici et al (2016) aimed to enlighten the monetary policy stance and the the monetary policy transmission mechanism in the period after end-2010 by analyzing the relationship between multiple policy rates and bank loan/deposit rates by using bank-level flow data and employing panel estimation methods. Their findings indicated that effective rates were more relevant than official rates for the monetary policy transmission and overnight interbank rates specifically played a key role in the pricing of deposits and loans. They argued that the interbank rate was a plausible metric to evaluate the actual stance of monetary policy in an atmosphere of divergence between official and effective rates.

Eroğlu and Kara (2017), investigated the impact of policies implemented by the CBRT on macroeconomic monetary policy after the 2008-09 Global Financial Crisis by testing the dynamic relationship between the policy instruments of the CBRT and the macroeconomic indicators selected in Turkey. After using the monthly dataset belonged to the period of 2010:01-2016:06 and employing VAR analysis, the CBRT's CPI inflation indicator relating to price stability and the capital movements and total credits for financial stability indicators were found to be weak against the model's monetary policy tools. It is also found that a

change in the reserve requirements has been shown to have a significant and partial impact on inflation.

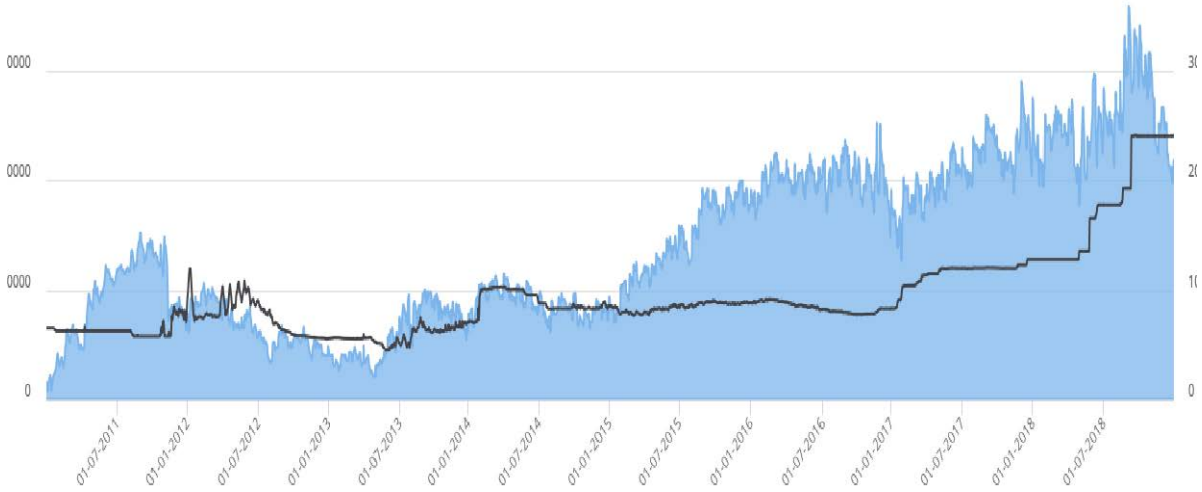
Kara and Afsal (2018) attempted to analyze the effectiveness of the unconventional monetary policy tools implemented in order to maintain both price stability and financial stability by using the data belonged to the period of 2010-2016 in which the CBRT imposed the non-traditional policy instrument to ensure financial stability after the 2008-09 Global Financial Crisis. Their findings indicated that there was a significant causality relationship from the interest rate corridor components, the real effective exchange rate and the consumer price index to the credit volume, in other words, interest rate corridor components had a significant impact on the credit volume. Especially, it has been seen that the credit volume was quite sensitive to the O/N lending rate. Therefore, it can be referred that interest rate corridor components could be used to limit credit expansion effectively. For instance, the CBRT could limit the credit expansion by expanding interest rate corridor upward when it desires to tighten monetary policy.

3. ECONOMETRIC ANALYSIS

3.1. Data and Methodology

In this study, an empirical analysis is carried out to investigate the relationship between the CBRT average funding interest rate[1] and total credit volume of the banking sector as well as foreign echange rates by using the weekly dataset obtained from CBRT Electronic Data Delivery System and covering the period of 2010:01-2019:02. In this context, the CBRT average funding rate as independent variable and total credit volume of the banking sector and foreign exchange rates as dependent variables are included in the analysis.

[1] CBRT average funding rate: This is the weighted average of the cost of funds provided by the CBRT through various channels. Generally, the central bank funding makes a quite large portion of the banks' short term Turkish lira funding at any time. Consequently, the CBT average funding rate does have a critical role in the pricing of loans, deposits and other financial instruments (Kara, 2015: 6).



Source: CBRT EVDS

Graph 1. CBRT Net Average Funding Rate (Percent) and Total Funding (Million TL)

Table 1. Variables and Expected Return (T=149)

	Variable	Measure	Exp. Return
Independent variable	Banking sector credit volüme	CREDIT	(+)
Independent variable	EUR/TRY parity	EUR	(+)
Independent variable	USD/TRY parity	USD	(+)
Dependent variable	CBRT average funding interest rate	INTRATE	(+)

The Fourier ADF unit root test alllows estimation of multiple structural changes with Fourier functions in testing the stationary of series. Contrary to many other methods, it is not necessary to know the number, form or date of the structural changes. The Fourier SHIN cointegration test employed in the following stage also yields strong results against the form and number of structural shifts. Finally, in the third stage, Fourier Granger causality test is used to investigate the causal relationship between the variables by using the flexible Fourier form in order to capture the smooth breaks that exist in VAR system. These tests account for multiple breaks for unit root, cointegration and causality and allow us to place greater confidence in the results.

3.2. Analysis Results

Enders and Jones (2012) propose a new unit-root test by using Fourier function in the deterministic term in a Dickey–Fuller type regression framework that can complement the Fourier LM and DF-GLS unit root tests. It is seen that this test does have good size and power properties.

They consider the following Dickey–Fuller test in which the deterministic term is a time-dependent function specified by α(t):

$$y_t=\alpha(t)+\rho y_{t-1}+\gamma t+\varepsilon_t, \quad (1)$$

where ε_t is a stationary disturbance with variance σ_ε^2 and α(t) is a deterministic function of t. They try to test the null hypothesis of a unit root (i.e., ρ = 1). Any test for ρ = 1 is problematic if α(t) is misspecified, when the form of α(t) is unknown. As an approximation of the unknown functional form of α(t), they consider the Fourier expansion:

$$\alpha(t) = \alpha_0 + \sum_{k=1}^{n} \left(\alpha_k \sin\frac{2\pi kt}{T} + \beta_k \cos\frac{2\pi kt}{T}\right); \quad n \le T/2, \quad (2)$$

where n symbolized the number of frequencies included in the approximation, k stands for a particular frequency, and T denotes the number of observations.

Obviously, the process is linear and the conventional unit root testing methodologies are appropriate, if $\alpha_1 = \beta_1 = \cdots = \alpha_n = \beta_n = 0$. On the other hand, at least one Fourier frequency must be present in the data-generating process, if there is a break or nonlinear trend. An noteworthy advantage of a Fourier approximation is that it is a global approximation, rather than a local. As an useful matter, it is not possible to use a large value of n in a regression framework. The use of many frequency components can lead to an overfitting problem. Therefore, they try to choose the proper frequencies to include in (2), instead of positing the specific form of α(t). For the moment, suppose that they use only a single frequency k and consider the testing regression:

$$\Delta y_t = \rho y_{t-1} + c_1 + c_2 t + c_3 \sin(2\pi kt/T) + c_4 \cos(2\pi kt/T) + e_t. \quad (3)$$

They let τ_{DF_t} symbolize the t -statistic for the null hypothesis ρ = 0 in (3). The asymptotic characteristics of the DF version tests do not differ from those of the LM version of the test and they decide not to show the asymptotic distribution. The important point is that the critical values for the null hypothesis of a unit root will depend only on the frequency k and the sample size T as in the other version tests. Nevertheless, they do not depend on the coefficients of the Fourier terms or other deterministic terms. Thus, Ender and Jones (2012) can systematize critical values using simulations. Critical values of τ_{DF_t} are shown in Table 1a. If the researcher wants to specify the value of k, the test can be carried out directly using these critical values. If the value of k is estimated, the test for a break can be performed as follows.

At the first step: they estimate (3) for all integer values of k such that $1 \le k \le 5$. The regression with the smallest sum of squared residuals (SSR) yields $\hat{k}$. If the residuals exhibit serial correlation, augment (3) with lagged values of Δy_t .

At the second step: they indicate that pretesting for nonlinearities can be conducted. For this, they perform the usual F-test for the null hypothesis: $c_3 = c_4 = 0$. When the unit-root null is imposed on the data-generating process (DGP), the distribution of the F-statistic is non-standard. Thus, they can use the critical values shown in Table 1a at the bottom with the label "Critical values of $F(\hat{k})$" which was stated in their study. The null hypothesis of a linear

trend is not rejected, if the sample value of F is less than the critical value. Under this circumstance, they recommend performing the usual linear Augmented Dickey–Fuller test.

Table 2. ADF and Fourier ADF Unit root Test Results (T=149)

Variables	Frequency	MinSSR	Fourier ADF Test-Statistic	ADF Test-Statistic	F-Statistic
INTRATE	2	34.49751	-0.409916	0.95	-
DINTRATE	2	34.44525	-12.58761	-11.92	4.61
LCREDIT	1	0.011982	-2.240392	-1.45	-
DLCREDIT	2	0.012105	-11.58590	-11.17	2.97
EUR	5	2.539594	-0.436625	-0.57	-
DEUR	5	2.534386	-11.33946	-4.64	2.09
USD	2	2.080738	-0.600966	-0.58	-
DUSD	4	2.076785	-11.40463	-11.08	2.41
	ADF Critical Values		Fourier ADF Critical Values(1-2-4-5)		F ADF F-Statistic
1%	-3,47		-4,37 -3,93 -3,62	-3,55	10,02
5%	-2,88		-3,78 -3,26 -2,98	-2,94	7,41
10%	-2,57		-3,47 -2,92 -2,65	-2,62	6,25

As seen in the Table 2, while the variables have unit-root at its level, they become stationary after their first difference. According to the F-Test results which are used to test the significancy of the trigonometric terms, it seems that trigonometric terms for three variables (intrate, credit, usd) are significant when the values are compared with the F-Statistic Critical Values which are shown in the study of Ender and Jones (2012). As F-statistic value does not seem significant, the ADF test-statistic value is taken into consideration for the eur variable and it becomes stationary after its first difference.

In the literature, there are several co-integration tests developed by Engle-Granger (1987), Gregory-Hansen (1999), Johansen (2000) Hatemi-J (2008) and so on. The main problem with these tests is that the number and form of structural changes has been priorly determined. The test which has been developed by Tsong et al (2016) using Fourier functions, tests the existence of co-integration under the null hypothesis, rather than the absence of it unlike many tests in the literature. The Fourier cointegration test which could be regarded as a generalization of the counterpart in Shin (1994) yields strong results against the form and number of structural changes. The derived test to test the null of co-integration by utilizing Fourier component to accommodate structural breaks of unknown form and number in deterministic terms, take into consideration structural breaks and rather than directly approximating the dates and number or breaks. Thereafter, they formed the limiting distribution of the test under the null hypothesis which depended on the Fourier frequency and dimension of the regressors. The critical values are shown in the study of Tsong et al (2016).

Tsong et al (2016) consider the co-integration regression as follows:

$$y_t = d_t + \acute{x}_t\beta + \eta_t, \quad t=1,2,\ldots..,T, \tag{4}$$

where $\eta_t = \gamma_t + v_{1t}$, $\gamma_t = \gamma_{t-1} + u_t$ with $\gamma_0 = 0$, and $x_t = x_{t-1} + v_{2t}$. Here u_t is an iid process with zero mean and variance ${\sigma_u}^2$. Therefore, γ_t is a random walk with mean zero. The deterministic component d_t in Eq. (4) is supposed as:

$$d_t = \sum_{i=0}^{m} \delta_i t^i + f_1 \tag{5}$$

with m=0 or m=1, and

$$f_t = \alpha_k \sin\left(\frac{2k\pi t}{T}\right) + \beta_k \cos\left(\frac{2k\pi t}{T}\right) \tag{6}$$

The scalar v_{1t} and p-vector v_{2t} are stationary and so, y_t and x_t are all I(1) processes. Evidently, if ${\sigma_u}^2 = 0$, $\eta t = v_{1t}$ is a stationary process, indicating that y_t and x_t are cointegrated. Consequently, the null hypothesis of cointegration against the alternative of non-cointegration could be written as:

$$H_0: {\sigma_u}^2 = 0 \text{ versus } H_1: {\sigma_u}^2 > 0 \tag{7}$$

Under the null hypothesis in Eq. (10), the model described in Eqs. (4)–(6) could be rewritten as;

$$y_t = \sum_{i=0}^{m} \delta_i t^i + \alpha_k \sin\left(\frac{2k\pi t}{T}\right) + \beta_k \cos\left(\frac{2k\pi t}{T}\right) + \acute{x}_t\beta + v_{1t} \tag{8}$$

The FSHIN Co-integration test statistic (denoted by $CI^m{}_f$) to test the null of co-integration with structural breaks against the alternative of non-cointegration is given by:

$$CI^m = T^{-2}\hat{\omega}^{-2}{}_1 \sum_{t=1}^{T} {S^2}_t \tag{9}$$

where $S_t = \sum_{t=1}^{T} \hat{v}_{1t}$ is the partial sum of the ordinary least squares (OLS) residuals from Eq. (9) and $\hat{w}_1^2$ represents the consistent estimator for the long variance of v_{1t}.

Table 3. Fourier SHIN Cointegration Test Results (T=149).

İlişki	Frekans	MinOLS	Fourier Cointegration Test Statistic	SHIN Test Statistic	F-Statistic
FINTRATE-FCREDIT	1	0.10397	0.116201	0.230135	0.835015
FINTRATE-FEUR	3	1.889345	0.074664	0.053711	0.798085
FINTRATE-FUSD	2	1.658174	0.082399	0.055468	1.405962

	FSHIN Critical Values (1-2-3)			F-Statistic Critical Values	SHIN Critic.Value
1%	0,198	0.473	0.507	5.774	0.553
5%	0,124	0.276	0.304	4.066	0.314
10%	0,095	0.200	0.225	3.352	0.231

Table 3 shows the results of the cointegration test. After checking the FSHIN critical values in the first stage, according to the table, the findings indicate that there is a long-run relationship between intrate, credit, eur and usd. However, in the second stage, when compared the F-statistics with the F-statistic critical values stated in the study developed by Tsong (2016), trifonometric values could not be found to be significant. After employing the SHIN test, the findings support the evidence in favor of the long-run relationship between the variables. In other words, the central bank average funding rate does have impact on banking sector credit volume, EUR/TRY and USD/TRY in the lon-run fort he period of 2006:08-2018:12.

In the final stage, it is employed Fourier Granger Causality Test proposed by Enders and Jones (2016) in this study in order to investigate the causal linkages between consumer credit interest rates and NPLs ratio. Econometric examinations are not generally direct and simple, because the linkages between the variables have been subjected to gradual shifts and linear specifications are mostly inappropriate to capture the relationships. Enders and Jones (2016) permits the flexible Fourier form to catch the multiple smooth mean shifts which are likely to be present in the VAR system. In a sense, their results complement those of Enders and Holt (2014) who estimate a VAR with LSTAR mean shifts. While they concentrate on long-run mean shifts, Enders and Jones deal with Granger-causality tests and on the short-run dynamics of the system.

Instead of estimating the number, form, and the size of the breaks, Enders and Jones tried the Flexible Fourier Form to control for breaks in a VAR and after they tested the non-stationary of variables, they considered the linear VAR as following:

$$z_t = \delta + \sum_{i=1}^{11} A_i z_{t-i} + e_t \qquad (10)$$

where δ is a (4x1) vector of intercepts, A_i is a (4×4) coefficient vector and e_t is the vector of innovations. Although the responses seem plausible, they have some problems for two reasons. First, the system given by (10) is misspecified, to the extent that there are neglected structural breaks. Second, the confidence intervals shown in the figure may be unnecessarily large, given that an unrestricted VAR is likely to be over parameterized. In

order to show how neglected breaks can interfere with Granger causality tests, they followed a standard recommendation and limited the VAR by imposing the restrictions implied by the Granger causality tests. Their results indicated that there is very little interaction among the variables. The significant responses are such that series tend to respond only to their own shocks.

Then, Enders and Jones (2016) allowed the deterministic regressors be as following, instead of the VAR given by (10):

$$z_t = \delta(t) + \sum_{i=1}^{11} A_i z_{t-i} + e_t \quad (11)$$

$$\delta(t) = [\delta_1(t), \delta_2(t), \delta_3(t), \delta_4(t)]' \quad (12)$$

and each intercept δ_{it} depends on n Fourier frequencies such that:

$$\delta_i(t) = a_i + b_i t + \sum_{k=1}^{n} a_{ik} \sin\left(\frac{2\pi kt}{T}\right) + b_{ik} cos\left(\frac{2\pi kt}{T}\right) \quad (13)$$

When the Fourier terms are used to control for breaks, the Granger causality results change from those documented before in various important ways. Contrary to the Granger-causality results indicated by the linear VAR, when Enders and Jones (2016) put trigonometric functions into the model, they detected stronger relations and richer sets of interactions between the variables.

Table 4. Fourier Granger Causality Test Results

	Opt. Frequency	Wald-stat	Asymptotic p-value	Bootstrap p-value	Opt. Lag
DINTRATE-DCREDIT	2	28.568	0.001	0.035	10
DINTRATE-DCREDIT	3	32.241	0.000	0.013	10
DINTRATE-DEUR	2	37.595	0.000	0.026	12
DINTRATE-DEUR	3	40.693	0.000	0.009	12
DINTRATE-DUSD	2	40.012	0.000	0.017	12
INTRATE-USD	3	45.271	0.000	0.011	12
INTRATE ⇔ CREDIT					
INTRATE ⇔ EUR					
INTRATE ⇔ USD					

Notes: → denotes to causality. Optimal k (frequency) and p (lag) are determined by Akaike information criterion. Bootstrap p-values are based on 1000 replications. ***, **, and * denote %1, %5, and %10 levels of statistical significance, respectively. Because n>50 in this study, we will take asymptotic p-value in comparison.

Table 4 shows the results of Fourier Granger Causality Test. According to the results, as asymptotic p-value is less than 0.05 in both directions, there seems to be a causality relationship between intrate, credit, eur, usd. Therefore, the findings indicate that the central bank average funding rate do have impacts on banking sector credit volume, EUR/TRY,

USD/TRY in the short-run. In addition, it is seen that all three variables do have impacts on the central bank average funding rate in the short-run.

4. CONCLUSION

2008-09 Global Financial Crisis has adverse effects in terms of real economies and financial markets in both advanced and developing countries. In order to eliminate these negative effects of the crisis and to ensure the financial stability, a number of new tools such as the quantitative easing and interest rate corridor in addition to the traditional monetary policies focusing on price stability have been started to implement within the post-crisis period in central banking. Accordingly, the Central Bank of the Republic of Turkey aimed to increase the flexibility of liquidity and credit management through reserve option mechanism and asymmetric interest rate corridor practises while conducting monetary policy and to focus on the objective of financial stability as well as price stability together with the conventional monetary policy instruments since the year of 2010. With the reserve option mechanism concentrating on effective management of reserve requirements, the CBRT aim to limit the negative effects of excessive volatility in capital flows on the macro-financial indicators of the country to produce a flexible policy for the liquidity needs of the banking sector and to strenghten the foreign exchange reserves. And with the practise of the asymmetric interest rate corridor focusing on effective liquidity management, the CBRT aim to eliminate the adverse effects of exchange rate fluctuations, capital outflows and changes in credit volume on both price stability and financial stability and to minimize financial risks.

This study examines the impact of the CBRT average funding interest rate, an element of asymmetric interest rate corridor, on banking sector credit volume and foreign exchange rates. By using the data belonged to the period of 2010:01-2019:02 and by employing Fourier ADF unit root test, Fourier SHIN cointegration test and Fourier Granger causality test, we try to explain the effect of the CBRT average funding rate and its implications for the monetary policy stance. The results indicate that the CBRT average funding rate do have impacts on banking sector credit volume and foreign exchange rates therefore playing significant role in terms of banking sector and real economy. For instance, when the CBRT average funding interest rate is above the policy interest rate (marginal funding rate or O/N repo rate), it could signal that there is a liquidity squeeze in the financial markets. Therefore, the average funding rate might affect the credit interest rates and hence the credit volume more than the policy interest rates under this condition. This shows that the CBRT can have impacts by adjusting the average interest rate to influence the financial indicators like the deposit-credit interest rates, credit volume and foreign exchange rates.

REFERENCES

Alper, K. - Kara, H. - Yorukoglu, M. (2013), “Reserve Option Mechanism”, Central Bank Review, 13/1, pp.1-14.

Aslaner, O. - Ciplak, U. - Kara, H. - Kucuksarac, D. (2014), “Reserve Option Mechanism: Does it Work as an Autamatic Stabilize?”, CBRT Working Paper, No: 14/38.

Aysan, A. F. - Fendoglu, S. - Kilinc, M. (2014a), "Managing Short-term Capital Flows in New Central Banking: Unconventional Monetary Policy Framework in Turkey", Eurasian Economic Review, 4(1), pp.45-69.

Aysan, A. F. - Fendoglu, S. - Kilinc, M. (2014b), Macroprudential Policies as Buffer against Volatile Cross-border Capital Flows, CBRT Working Paper, No:14/04. pp.1-25.

Binici, M. - Erol, H. - Kara, H. - Ozlu, P. - Unalmis, D. (2013), "Interest Rate Corridor : A New Macroprudential Tool?", CBRT Research Notes in Economics, 13(20), pp.1-16.

Binici, M. - Kara, H. - Ozlu, P. (2015), "Unconventional Monetary Policy Tools and Bank Interest Rates", Paper Presented at EY International Congress on Economics II (EYC2015), November 5-6, 2015, Ankara, Turkey.

Binici, M. - Kara, H. - Ozlu, P. (2016), "Unconventional Interest Rate Corridor and the Monetary Transmission: Evidence from Turkey", CBRT Working Paper, No: 16/08. pp.1-33.

Enders, W. - Lee, J. (2012), "The Flexible Fourier Form and the Dickey-Fuller Type Unit Root Tests", Economics Letters, 117, pp.196–199.

Enders, W. - Jones, P. (2016), "Grain Prices, Oil Prices, and Multiple Smooth Breaks in a VAR", Studies in Nonlinear Dynamics & Econometrics, 20(4), pp.399-419.

Ermissoglu, E. - Akcelik, Y. - Oduncu, A. - Taskin, T. (2013), "Effects of Additional Monetary Tightening On Exchange Rates " MPRA Paper 46615, University Library of Munich, Germany, pp.1-6.

Eroglu, N. - Kara, F. (2017), "Türkiye'de Makro İhtiyati Para Politikası Araçlarının Makroekonomik Değişkenlere Etkisinin VAR Analizi ile İncelenmesi". İstanbul Üniversitesi İktisat Dergisi, 67(2), ss. 59-88.

Kara, H. (2012), "Küresel Kriz Sonrası Para Politikası". TCMB Çalışma Tebliği. 12/17.

Kara, H. (2015), "Interest Rate Corridor and the Monetary Policy Stance", CBRT Research Notes in Economics, No: 2015-13.

Kara, M. - Afsal, M. S. (2018), "The Effectiveness of Monetary Policy Instruments of CBRT and Transfer Channels for Price Stability", International Journal of Social Science Research, 7(2), pp.275-290.

Kara, M. - Ekinci, M.B. (2018), "New Monetary Policy Frame and Tools of the Central Bank in Turkey", International Journal of Social Science Research, 7(1), pp. 46-61.

Oduncu, A. - Ermisoglu, E. - Polat, T. (2013), "The Effect of CBRT's New Policy Mix on the Volatility of Credit Growth", CBRT Research Notes in Economics, 13/27, pp.1-12.

Serel, A. - Ozkurt, İ. C. (2014), "Geleneksel Olmayan Para Politikası Araçları ve Türkiye Cumhuriyet Merkez Bankası", Yönetim ve Ekonomi Araştırmaları Dergisi, 22, ss.56-71.

TCMB (2012), Enflasyon Raporu IV", TCMB Yayınları, Ankara

TCMB. (2013a), "Parasal Aktarım Mekanizması", TCMB Yayınları, Ankara.

TCMB. (2013b), "Enflasyon Raporu III", Ankara, TCMB Yayınları.

TCMB. (2014), "Makro İhtiyati Politikalar ve Türkiye Uygulaması". TCMB Çalışma Tebliği, Ankara.

TCMB. (2015), "Finansal İstikrar; Türkiye'deki Finansal İstikrar Gelişmeleri". Ankara.

TCMB (2019), EVDS, https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket

Tsong, C. C. - Lee, C. F. - Tsai, L. J. - Hu, T. C. (2016), "The Fourier Approximation and Testing for the Null of Cointegration", Empirical Economics, 51(3), pp.1085-1113.