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Factors Impacting Bank Net Interest Margin and the Role of Monetary Policy: Evidence from Turkey

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Abstract

In this study, we investigate factors affecting net interest margin (NIM) of commercial banks in Turkey. Especially, our results highlight the relation between unconventional monetary policy shocks and bank margins. To this end, first, we conduct an identification analysis about which parameters of asymmetric interest corridor framework are important in explaining variations in NIM. Using industry-level data, we show that there exists a pass through from BIST interbank overnight repo/reverse repo market rate and weighted average cost of funding (WACF) to bank loan and deposit rates. As a result of reduced-form Vector Autoregression (VAR) analysis we find the existence of a transmission mechanism from BIST rate and WACF to commercial loan rate, consumer loan rate and deposit rate. Same pass through to loan and deposit rates is also shown in individual bank level with the Panel Vector Autoregression (Panel VAR) analysis in the case of 16 commercial banks in Turkey during the period 2011Q1-2016Q1. After the identification analysis, we examine the relationship between NIM and policy rates through System Generalized Method of Moments (GMM) techniques by controlling bank specific, industry related and macroeconomic factors. We find that a change in the monetary policy rate has significant and positive impact on NIM. Among bank-specific factors, equity ratio and operating expenses are found to be significantly affecting NIM during the sample period. Our empirical findings also stress the significance of lag values of NIM. Estimations conducted with standardized variables indicate that economic significance of lag values and bank specific variables are larger than that of policy.

Key Words: *Monetary Policy, Net Interest Margin, Panel Data Analysis, Pass-Through, Time Series Analysis*

JEL classification: *C22; C23; G21; E58*

Introduction

Considering the fact that financial institutions have valuable contributions to the functioning of the financial system, tracking the efficiency of financial intermediation holds an importance. Bank profitability is an informative aspect of this efficiency. In the literature, net interest margin (NIM)[1] is taken as an indicator of profitability of banks and it is also an informative proxy for the cost of financial intermediation. In the case of higher margins, savers would be less encouraged to deposit funds due to lower return and investors would be less encouraged to obtain loans due to higher paybacks. Such a situation would harm the financial deepening and development through financial exclusion. For instance, Demirgüç-Kunt and Huizinga (2000) find that banks tend to have higher margins in underdeveloped financial systems, while no such relation is observed in developed countries. Higher margins would also restrain the level of real savings and investments (Brock & Suarez, 2000; Barajas, Steiner, & Salazar, 1999). On the other hand, bank profitability may have positive impacts on capital adequacy ratios by increasing capital accumulation. Hence, banking system of a country can be strengthened in the form of higher capital buffers against external shocks (Brock & Suarez, 2000; Barajas et al., 1999). These conflicting effects of the trend in profitability of banking sector emphasize the importance of the investigation of possible determinants of NIM, especially for the policy implication.

After the end of 2010, Turkey has been exercising an asymmetric interest corridor system with active liquidity management in which there is more than one short term rate which may be qualified as policy rate including BIST overnight repo/reverse repo interest rate and CBRT weighted average cost of funding (WACF). Through active liquidity policy of Central Bank of Turkey (CBRT), the monetary policy stance can be altered at a daily frequency manifested in several rates. Thus, parameters of corridor system of CBRT do seem relevant in the process of monetary policy transmission. By means of the pass through towards loan and deposit rates, monetary policy rates are expected to influence bank profitability. Thus, in this work, we aim to explore statistical and economic significance of this recent unconventional monetary policy framework on NIM of commercial banks in Turkey for the period 2011Q1-2016Q1. To this end, first, two parameters of asymmetric corridor framework in Turkey are assessed in terms of the respective pass-through from these rates to bank loan and deposit rates by utilizing industry-level and bank-level data. VAR and panel VAR models are used to examine the role of policy rates in loan and deposit pricing tendencies. As a second step, an econometric model is estimated with dynamic panel methods to reveal the impact of chosen policy rate proxies on NIM by including bank-specific, industry-related and macroeconomic variables as control regressand.

Literature Review

The relation between policy rate and market rates is widely examined theoretically under the concept of interest rate channel of monetary transmission mechanism. As Mishkin (1996) state monetary policy stance has influence on real phenomena like total demand and inflation as well as the financial dynamics through several channels. Apart from credit channel (which is composed of bank lending channel and balance sheet channel), equity price channel and exchange rate channel; interest rate channel is also effective in transmitting the monetary policy alterations to the rest of the economy. Under interest rate channel, monetary policy stance is first transmitted to the short term nominal market rates as well as the bank lending and deposit rates. In the second step, changes in the short term nominal interest rates are transmitted to the long term real interest rates depending on the inflation expectations. In turn, any change in long term real rates is reflected in the real aggregates such as investment and output. Our focus is mainly concentrated on the earlier stages of interest rate channel which emphasizes the pass through between monetary policy rate and banking rates.

1 Empirical literature presents two methods to calculate NIM which are ex-post and ex-ante. Ex-post measure is defined as “the ratio of the difference between realized interest income and interest expense to the total assets of the bank” (Demirgüç-Kunt & Huizinga, 1999). Since loan defaults are not incorporated in ex-ante definitions and interest income and loan losses associated with a particular lending activity tend to materialize in different times, the definition for NIM used in this study is ex-post one.

There are some empirical works related to the abovementioned concept of pass through. De Bondt (2002) uses error correction model and Vector Autoregressive (VAR) model for the relation between market interest rates and retail banking rates in the Euro Area. They find that both in short and long term, there exists a pass through from market interest rates representing the monetary policy stance to bank loan and deposit rates. Additionally, that study includes a co-integration analysis between retail bank and comparable market-based interest rates. Kwapil and Scharler (2006) empirically compare the interest rate pass through in US and Europe with Autoregressive Distributed Lag (ARDL) model. They use monthly data for the period January 1995-September 2003. They find that average pass through from market rates to lending and deposit rates in the long run is lower in Europe than US. Hristov, Hülsewig and Wollmershauser (2014) use panel VAR approach with the data of 11 European countries for the period between 2003 and 2012. Their main finding is that there exists a pass through from market based policy rate to retail bank interest rates. However, due to financial crisis, pass through started to be less complete after the crisis. Especially, widening interest margins are found to be due to structural shocks and extra unidentified shocks.

Turning to the empirical literature for NIM itself, Demirgüç-Kunt and Huizinga (1999) was among the first to establish an association between bank profits and real interest rates. After this study, by including some proxies like “1-year Treasury bill discount rate” or “standard deviation of 90-day bill rate”, some other works of the literature have also tried to reveal the relationship between policy rate and volatility of interest rates on bank margins. However using indirect proxies to mimic the behavior of policy rate does not capture all the characteristics of the impact of monetary policy on spreads. Especially, in a country like Turkey where unconventional monetary policies like asymmetric interest rate corridor and active liquidity management are used, using indirect proxies would be likely to significantly diminish the explanatory power of empirical analysis. Because of this reason and the unique application of monetary policies in Turkey, an empirical identification strategy is conducted to detect the effective policy rate variables regarding to loan and deposit interest rates by using time-series analysis techniques.

There are some works which aim to differentiate policy rate variable over time by considering the application of interest rate corridor. Ganioğlu and Us (2014), for instance, use BIST rate for the period of 2002-2010; one week repo rate for the period of 2010Q2-2011Q4 and weighted average funding rate from 2012Q1 and onwards in their study focusing on different aspects of banking sector including bank profitability measured by NIM. Their results show a positive relation between policy rates and NIM which points out the fact that banks are pricing loans and deposits asymmetrically in the case of a policy tightening characterized by higher interest rates. In terms of the cross-country setup, in the study of Borio, Gambacorta and Hofmann (2015), the impact of short term interest rates and the term structure captured by the shape of yield curve on different bank profitability measures (such as NIM, non-interest income to total assets ratio and return on assets ratio) are investigated. They used dynamic GMM methods to explore abovementioned relations by utilizing the annual data of a sample of 109 large banks of 14 major advanced countries for the period 1995-2012. They find a robust positive relation between short term rates and NIM as well as a positive association between short term rates and ROA.

Apart from the role of market interest rates, the literature describing the factors determining NIM can be categorized into two branches. Theoretical attempts to make sense of NIM started with the pioneer work of Ho and Saunders (1981). Regarding typical bank as a risk-averse dealer operating in financial markets with homogenous product portfolio, they model the optimal bank margin as a function of margin required by risk-neutral bank, volatility of interest rates, size of the banking operations and bank management’s level of risk aversion. Risk-averse dealer model is extended further with later works. McShane and Sharpe (1985) apply a differentiated version of this model to Australian commercial banks. In their framework, the uncertainty is not rooted in dispersion of money market rates, instead it is related to the dispersion of loan and deposit rates. One other variation they make in the model is related to the product portfolio. They include cash and short term money market assets as well as the shareholders’ funds into the balance sheet composition of the typical bank in the model. The specification composed in this study theoretically argues that spread between loan and deposit rates is related to the power of the banks in loan and deposit markets. Similar to the original model, risk aversion, volatility of interest rates and average transaction size are considered.

Allen (1988) later modified theoretical model by arguing that the products of banks are not homogenous and they incorporate the cross-elasticity of demand for products into the framework. Assuming that a bank is providing multiple types of loans, any adjustment for the rate charged on a particular loan (for instance, an increase in the discount of one particular type of loan) is argued to affect the demand for the other loan category. The finding from this work points out that pure spreads can be diminished thanks to the portfolio diversification effect. Bank dealership framework is also adjusted to account for the credit risk by Angbazo (1997). The interaction between interest rate risk and the credit risk is incorporated in their specification. One additional purpose of their work is to assess the impact of credit cycles on NIM. To shed more light on these issues, they also conduct an empirical investigation with US commercial banks for the period 1989-1993. Their analysis yields the conclusion that banks adjust NIM to reflect the changes in default risk premium and interest rate risk premium. In terms of the impact of the credit cycle, the findings show that if the trough phase in the credit cycle is accompanied with increasing overall risk perception then NIM inflates. As a later addition to the theoretical efforts in modeling NIM, Maudos and Guevera (2004) consider average operating costs as an explanatory factor for NIM.

Supplementary to theoretical literature, a vast number of empirical works are done regarding to the determinants of NIM. Among empirical works which are using cross-country banking data, Demirgüç-Kunt and Huizinga (1999) has a framework which is based on a behavioral model of the financial institutions in which several potential motives of the bank profitability are explored (Brock & Suarez, 2000). That framework classifies factors impacting the margin into three groups: bank-specific, industry-related and macroeconomic. In their setting, banking data from 80 countries for the period between 1988 and 1995 are used in the analysis where the econometric method utilized is weighted least squares (WLS). Their portfolio of explanatory variables is extensive and is ranged from financial ratios to industry indicators as well as from competition-related elements to macroeconomic forces. They show that margins of the banks are being affected by bank specific variables, macroeconomic forces, taxing practices and reserve requirements. Demirgüç-Kunt, Laeven and Lavine (2003) work with the data of 72 countries and aim to assess the role financial sector concentration on bank profitability while bank specific factors such as bank size, liquidity, equity ratio and overhead expenses are added to the model and while macroeconomic factors and institutional quality of countries are controlled. They ascertain that the degree of concentration in the industry increases margins.

Brock and Suarez (2000) examine the trend of NIM in Latin American countries and try to understand the factors behind the persistently high margins during that time despite the financial liberalization, abolishment of credit controls and revoke of interest rate ceilings. They reveal that the ratio of non-performing loans to total loans is negatively; on the other hand, high operating costs, capital ratio, liquidity ratio, interest rate volatility and inflation rate are positively associated with bank spreads. As a work interested in the behavior of bank NIM within an economic zone, Kasman, Vardar, Tunç and Okan (2010) examine 29 member countries of European Union (EU) to assess the determinants of commercial bank NIM. The methodology they follow is comprised of the division of sample period into two, specifically two sub-periods of 1995-2000 and 2001-2006. Such a division is deemed necessary to assess the impact of banking sector consolidation in EU on NIM. Moreover, countries in the sample are categorized into two groups which are old and new members of EU. According to the results of pooled ordinary least squares (OLS) regressions, in both sub-periods, bank controls such as operating cost and credit risk are found to contribute positively to bank margins. While again in both sub-periods, bank size and managerial efficiency are detected to be contributing bank margins negatively. In terms of the old and new member country comparison in EU banking system, especially the impact of macroeconomic variables are not robust suggesting that there exists no economic and financial convergence among members of the EU.

As a study for OECD countries, Hawtrey and Liang (2008) conduct an analysis with banking sector data of 19 countries. By applying static linear panel estimation methods, they diagnose that widely referred bank specific variables controlling bank size, operating expenses and credit risk are related to bank NIM positively. One other example of studies which are working with very large cross-country banking data is that of Chen and Liao (2011). Their analysis with banking data of commercial banks, savings banks and bank holding companies in 70 countries for the period between 1992 and 2006 has an aim to identify

empirical factors explaining NIM, ROA and ROE. When we look at the results related to NIM, it is observed that bank specific variables such as operation costs, bank size, credit risk, liquidity risk and capital strength are found as significant empirical determinants of NIM. Moreover, foreign banks are found to be more profitable than their domestic counterparties. In terms of the macro-level variables; GDP growth, inflation rate, regulatory quality and government effectiveness have a negative influence on bank profitability.

Although there is vast amount of single country studies, there are very few regarding to the margins of Turkish banking system. Apart from cross-country studies, we cover some of the works aiming to find determinants of NIM in the context of Turkey. For instance, Kaya (2002) investigate the determinants of bank profitability measures for the period 1997-2000 with the quarterly data set of 44 Turkish banks. Two step method applied in Ho and Saunders (1981) and Brock and Suarez (2000) are also used in this study. Their findings from the first step regressions show that NIM is positively related to capital adequacy, liquidity ratio and the market share of individual banks in whole banking sector. The positive association between pure margin and inflation as well as the public sector debt is supported with the results of second step regressions.

As a work covering more recent time period, Aysan, Dalgıç and Demirci (2010) analyze the determinants of commercial bank NIM for the period after 2001 crisis in Turkey. Single step approach with fixed effects panel regressions yields the conclusion that risk aversion which is proxied by equity ratio and implicit interest payments are important bank-level variables. Additionally, sector concentration measured by Herfindahl and Hirschman Index (HHI) is found to be positively affecting bank margins. Inflation, real GDP growth rate and interbank interest rates appear to be significant macro controls in that study. As a side aim, this work also incorporates a dummy variable in its specification to find the behavior of NIM during global financial crisis time. It is observed that during crisis time, bank NIM in Turkey is increased. Kansoy (2012) also examine the bank margins in Turkish commercial banks. By employing static and dynamic linear panel estimations, they find that bank NIM in Turkey is related to overhead expenses, size of the bank operations, asset quality, risk aversion, inflation and GDP growth. One important finding in this context is that lag of the NIM turns out to be significant explanatory variable in the dynamic setting.

Ganioğlu and Us (2014) focus on the banking structure of Turkey from different perspectives including asset quality, capital adequacy, funding risk, liquidity and more importantly profitability. They run static panel regressions for the periods both before and after the global financial crisis. They find that, before the crisis, the ratio of other operating expenses to total assets (as a representation of cost structure), inflation and reserves of banks denominated in TL as significant variables, while credit risk, other operating expenses and policy rate are significant determinants after the crisis. Similarly, Us (2015) detect credit risk, inflation and other operating expenses as determinants of NIM by using dynamic panel methods.

Parameters of the Asymmetric Interest Corridor System in Turkey

In this section, the unconventional monetary policy framework of CBRT is described while several policy rate parameters are introduced. CBRT started to implement an asymmetric corridor in May 2010 when 1-week repo funding structure was established as a funding tool as indicated in Figure 1. Before that period, CBRT borrowing rate (the rate applied when CBRT borrows the excess liquidity of banks) which is the lower bound of the corridor was the effective policy rate (Ünalmış, 2015). The reason why CBRT borrowing rate can be considered as the policy rate for that period lies on the liquidity position of the banking sector. After 2001 crisis, destabilization of bank balance sheets resulted a net liquidity surplus of banks. Hence, CBRT lending rate (upper bound of the corridor) was relatively ineffective (Kara, 2015). On the other hand, since the end of 2010, Turkish banks has liquidity deficit so CBRT is the net provider of liquidity in the market. After this period, CBRT borrowing rate became relatively ineffective. It should be noted that symmetric corridor applied before mid-2010 had a passive role in the standard inflation targeting regime (Binici, Erol, Kara, Özlü, & Ünalmış, 2013). In this study, we take the effective initiation of new system from the end of 2010, as CBRT has actively used the new corridor system from this date. At the end of 2010, CBRT widened the corridor downwards, increased the volatility of interest rates and reserve requirement ratios to cope with capital flows and to limit excessive credit growth (Binici et al., 2013). Thus, in our

empirical identification analysis, we will not start our sample period from the second quarter of 2010 but we will choose the beginning of 2011 as starting point for our sample.

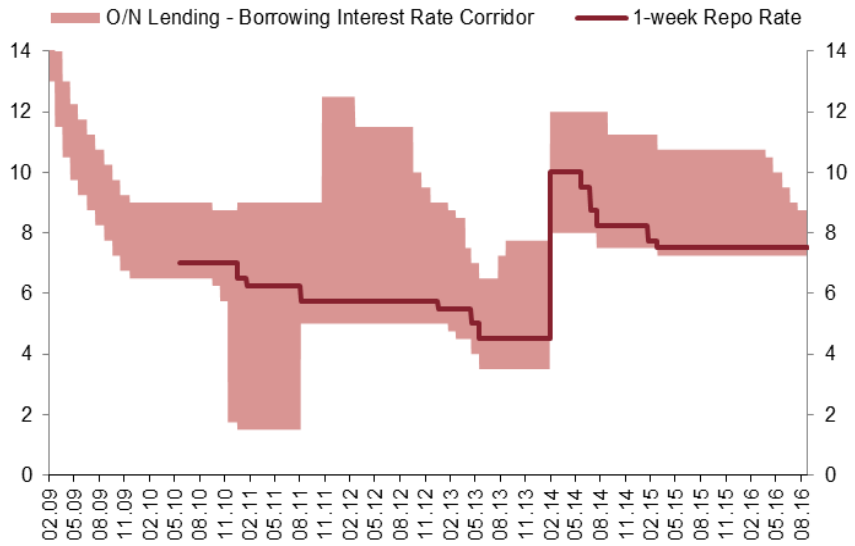


Figure 1: Official Interest Corridor Parameters

Two official parameters of the interest rate corridor, which are CBRT lending and CBRT borrowing rate can be considered as inputs for econometric analysis. However, as emphasized in Kara (2015) and Binici, Kara and Özlü (2016), there are other short term interest rates which are not officially announced by CBRT but are determined by CBRT liquidity policies in new framework. One such rate is CBRT's weighted average cost of funding (WACF). Funding methods of CBRT determine the level of WACF itself. For the period 2011-2016, there were mainly two methods by which CBRT can provide liquidity to financial institutions. First method is through one-week repo funding. After the policy change in May 2010, repurchase agreement transactions are started to be used with which banks can obtain liquidity from CBRT by borrowing for one-week period and pledging Treasury bills as collateral. These repo funding is done through quantity auctions.

Second method is called marginal funding. If one-week repo transactions do not cover funding need of the system, then financial institutions would borrow from money markets. If that is not deemed enough too, then CBRT is engaging another funding method in the interval of overnight period. As it is the case since 2015Q1, there could be times when CBRT does not provide all the liquidity needs of the system with weekly repo funding. In such cases, banks utilize marginal funding opportunity, which is also a repo transaction on overnight basis that is backed by Treasury bills as collateral (Ünalmış, 2015; Kara, 2015). The cost of utilizing marginal funding is the upper bound of the corridor that is CBRT lending rate. Despite the fact that CBRT has been using one-week repo transactions as sole funding method for some time; marginal funding is also extensively utilized since 2015Q1. Thus, there appears an average funding cost of banks which is calculated as a linear combination of cost of two funding methods, that is weighted by the relative importance of particular funding method (weekly or overnight) in whole funding structure of CBRT. WACF is considered important in the loan and deposit pricing of banks since one important components of banks' short term funding in Turkey is CBRT sources (Kara, 2015). Figure 2 shows the funding composition of CBRT, while below equation shows the calculation of WACF (Binici et al., 2016):

$$\text{WACF} = \frac{\text{Weekly Repo} * \text{Weekly Repo Rate} + \text{Overnight Funding} * \text{Marginal Funding Rate}}{\text{Total Funding of CBRT}}$$

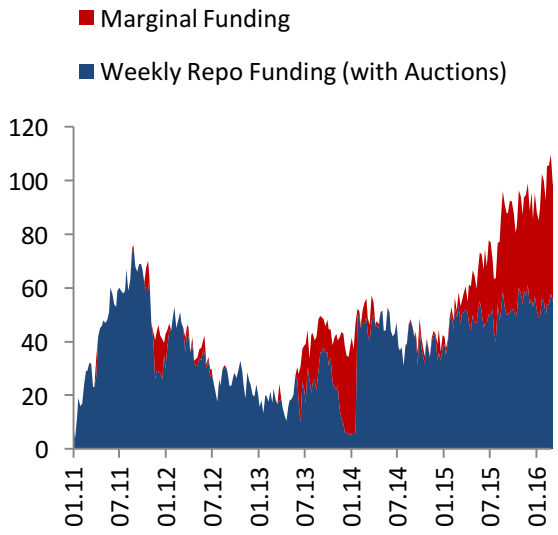


Figure 2: Funding Composition of CBRT (weekly, billion TL)

Apart from CBRT lending, CBRT borrowing and WACF; last parameter of corridor system is BIST overnight rate. Although this is not an officially announced rate by CBRT like WACF, it is determined by the liquidity policy. Banks can borrow from short-term sources other than CBRT in money markets (Ünalmış, 2015). There are two overnight money markets operating under BIST (Küçük, Özlü, Talaslı, Ünalmış, & Yüksel, 2014; Kara, 2015; Binici et al., 2016). First one is the BIST repo/reverse repo market. In this market, not only banks but also other non-bank financial institutions like investment funds and brokerage firms are allowed to engage in transactions. The transactions in this market are subject to reserve requirements (Küçüksaraç & Özel, 2013). Because of the transaction costs arising from reserve requirement rules, interest rate in this market is relatively lower than the rate incurred in the other BIST money market (Ünalmış, 2015). Second market is called BIST interbank repo/reverse repo market. In this market, only banks are allowed to conduct transactions and they are not subject to reserve requirements. Since this market is the largest organized repo market in Turkey (transactions in this market are in the form of repurchase agreement transactions as well), overnight rate incurring this market is taken as a benchmark for other money market instruments in Turkey (Küçüksaraç & Özel, 2013; Küçük et al., 2014). One other money market from which banks can obtain short term liquidity is cross currency swap market, in which banks which have foreign funds can turn them into Turkish lira to allocate loans denominated in local currency. Küçüksaraç and Özel (2013) use Pesaran, Shin and Smith (PSS) co-integration method to prove that there exists a long term relation between BIST overnight rates and cross-currency swap rates. Banks also regard BIST rate as reference rate for funding from non-CBRT sources (Binici et al., 2016). Because of its informative nature and its exemption from reserve requirement costs, we will take this variable as a candidate in our analysis.

As described in Kara (2015) and Ünalmış (2015), the interest rate in BIST money market is determined by supply/demand interaction in funds market. Ünalmış (2015) basically adds the existence of non-CBRT sources to the representation of Kara (2015) where CBRT is the sole provider of short term funds. In this setup, supply curve of liquidity is a step function where CBRT provides certain amount through one-week repo facility at constant rate (curve is horizontal here), non-CBRT sources provide certain amount (supply curve is upward sloping as when price of funds increases, banks would supply more funds to each other) and CBRT can cover remaining liquidity needs at marginal interest rate. On the other hand, demand function for funds derived from banks' behavior is downward sloping until the lower bound of the corridor from which demand line is horizontal as no bank can borrow funds at more advantageous rate than CBRT. By not covering all the liquidity needs of banks, CBRT can let the demand for funds line to cross the supply of funds line at such interest level that CBRT can direct the BIST overnight rate to be occurred in the upper bound of the corridor which is the cost of marginal funding. Hence, the level of BIST overnight rate can be determined by CBRT via corridor setup and composition of funding policy (Binici et al., 2016). The

reference nature of BIST overnight rate that is charged in interbank transactions is important in this context. Küçük et al. (2014) investigate the impact of CBRT liquidity policies on the spread between BIST overnight rate and WACF and find that composition, maturity and costs of CBRT funding are effective in determining BIST spread (see Figure 3 for BIST overnight rate and WACF).

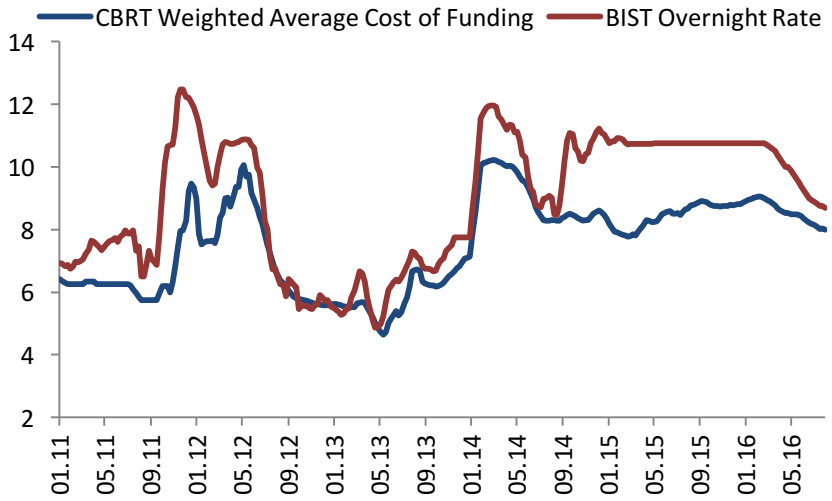


Figure 3: CBRT Weighted Average Cost of Funding and BIST Interbank Overnight Rate (weekly flow values, 4-week moving average)

To the best of our knowledge, the effect of corridor parameters on net interest income of commercial banks has not been investigated in the context of Turkey. However, there are some empirical works that are mainly conducted to determine the impact of corridor parameters on bank loan and deposit rates. Binici et al. (2013) assessed the transmission mechanism of policy rates to commercial loan and deposit rates by using VAR models. Their study includes two sub-period in the sample, one is before May 2010 (before the initiation of asymmetric corridor), and other one is after November 2010 (after the initiation of asymmetric corridor). They used bank level data about rates charged on commercial loans with differing maturities and deposits with three months maturity. Their findings indicate that both commercial loan rates and deposit rates react significantly to CBRT WACF in first sub-period while this impact disappears in the second sub-period. Additionally, they reveal that commercial loan rate becomes responsive to upper bound of the corridor and deposit rate becomes responsive to BIST interbank rate in the second sub-period when corridor system is adopted. Apart from pass-through analysis, they also conduct a panel data analysis with bank level data for the period between December 2012 and November 2013. They found that in explaining commercial loan rates; CBRT lending rate, CBRT borrowing rate and reserve requirement ratio are significant factors. Furthermore, in explaining deposit rate; WACF, CBRT borrowing rate and reserve requirement ratio have statistically significant coefficients. In another study, Binici et al. (2016) tests same relation with bank-level data for the period between June 2010 and December 2014. Their results indicate that BIST overnight rate and WACF are important in explaining commercial and consumer loan rates; whereas, WACF is found to be influential for the pricing of deposit rates. Alper and Çapacıoğlu (2016) also find that BIST rate and WACF are significant explanatory factors for deposit rate.

In the empirical analysis conducted in upcoming sections, CBRT borrowing rate is excluded considering the fact that there exists a liquidity deficit instead of surplus in the banking sector in Turkey during the time when asymmetric interest corridor has been utilized. CBRT lending rate is also excluded as WACF is already representing two main funding structure of CBRT which are weekly repo funding and overnight funding. Additionally, alterations occurring in WACF and BIST rate in the shorter period of time span due to liquidity policy of CBRT as well as the structure of the asymmetric corridor have directed us to utilize these two rates as policy rate proxies.

Data and Methodology

The impact of CBRT policy rate on bank net interest margin is a focal point of this study. Testing the significance of the impact of policy rate on net interest income of commercial banks creates a complication in the case of Turkey given the fact that CBRT has been conducting an unconventional monetary policy characterized by an asymmetric interest rate corridor system with active liquidity management. The nature of monetary policy followed in Turkey since 2010 brings several short term interest rates into the picture for which an additional analysis is required to reveal the level of their impact on bank lending and deposit rates. Thus, first step of empirical analysis in this study involves with the assessment of the monetary transmission mechanism from the parameters of asymmetric interest corridor framework in Turkey to interest rates charged on bank loan and deposits.

We use weekly aggregate level data of BIST overnight rate, CBRT WACF, bank loan rates and bank deposit rates. The sample period is between 2011W1 and 2016W13. CBRT Electronic Data Dissemination System provides flow interest rate data on weekly basis. Interest rates on commercial and consumer loans as well as deposit rates are taken from this source. All loan and deposit rates are Turkish lira denominated. Consumer loan rates represent interest rates charged for housing loans, vehicle loans and general-purpose loans. BIST overnight rate and CBRT WACF are also obtained from the same source. In order to examine the transmission mechanism of CBRT policy rates to bank loan and deposit rates, two reduced form VAR models are considered. First model employs BIST overnight rate as a policy rate, while second one replaces BIST rate with WACF

Table 1: Summary Statistics and Sources for Variables Used in VAR Estimation

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
BIST Overnight Rate	273	8.92	2.19	4.27	12.49	CBRT
CBRT WACF	273	7.49	1.51	4.52	11.93	CBRT
Commercial Loan Rate	273	12.83	2.17	8.09	17.01	CBRT
Consumer Loan Rate	273	14.21	2.06	9.93	18.34	CBRT
Deposit Rate	273	8.83	1.30	5.59	11.15	CBRT

$$\begin{bmatrix} Policy\ Rate_t \\ Deposit_t \\ Commercial_t \\ Consumer_t \end{bmatrix} = \beta_0 + \sum_{i=1}^{k} \left(\beta_i \begin{bmatrix} Policy\ Rate_t \\ Deposit_t \\ Commercial_t \\ Consumer_t \end{bmatrix} \right) + \begin{bmatrix} \varepsilon_{Policy\ Rate_t} \\ \varepsilon_{Deposit_t} \\ \varepsilon_{Commercial_t} \\ \varepsilon_{Consumer_t} \end{bmatrix}$$

In addition of the pass-through from policy rates to bank loan and deposit rates on industry-level, same transmission mechanism is also tested with individual bank-level data as a robustness check. Since bank-level interest rate data is publicly available only with quarterly frequency, empirical works are done with quarterly data. To this end, bank-level quarterly loan and deposit rate data are collected from footnotes of financial statements of individual banks. In footnotes, average rate charged or incurred in interest-bearing assets or liabilities of bank balance sheets are reported. Since rates charged on different types of loan (such as commercial or consumer loans) and deposits (such as commercial or savings deposits) are not provided in balance sheets, robustness query of the pass-through in that categorization can not be conducted. Our sample for this analysis covers the period between 2011Q1 and 2016Q1, which is in line with the sample of econometric analysis in the VAR estimation. This sample period also corresponds to the time span when asymmetric interest corridor was actively used. As it is seen in Table 2, our sample includes 16 Turkish commercial banks. This sample is comprehensive and representative in the sense that listed banks possess 91.04% of the total assets, issue 90.31% of the total loans and collect 95.48% of the total deposits in the Turkish banking industry.

The methodology employed is panel VAR estimation. Panel VAR models are convenient to study the dynamic interactions of several entities at a time by incorporating the cross-sectional structure to the specification. Main difference of panel VAR model structure from the VAR models is that all variables covered by the specification are endogenous, while cross-sectional dimension is integrated with the representation (Canova & Ciccarelli, 2013). The analysis is conducted with Stata software and the code used in the analysis is obtained from Cagala and Glogowsky (2014). In this context, four panel VAR models are estimated between each chosen parameter of interest corridor system (BIST rate and WACF) and bank loan/deposit rates.

In the literature, there are studies that utilize the panel VAR to analyze monetary transmission mechanism. Miyajima, Mohanty and Yetman (2014) examine the effectiveness of the impact of US monetary policy on Asian economies using cross country data. Their findings show that a change in long-term US bond yields affects the domestic short term interest rates and domestic long-term bond yields of sample countries. Moreover, Stakenas and Stasiukynaitė (2016) find that a monetary policy shock occurred in the Eurozone area affected the GDP and credit stock variables in Lithunia. Assenmacher-Wesche and Gerlach (2008) study the transmission of monetary policy shock from US (in addition to credit, housing market and equity shocks) to 17 industrialized countries through a panel VAR model. Leroy and Lucotte (2015) analyze the pass-through in the interest rate channel of the monetary policy framework, by establishing a panel VAR model between bank interest rates and Euro overnight index average money market rate as an indicator of monetary policy.

Table 2: Information about Banks in the Sample of Panel VAR Analysis (values are denominated in TL)

Bank	Foundation Year	Status	Assets	Share in Total Sector	Loans	Share in Total Sector	Deposits	Share in Total Sector
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	1863	public	310,022	13.57%	193,159	13.00%	191,846	14.86%
Türkiye İş Bankası A.Ş.	1924	private	276,020	12.08%	176,237	11.86%	157,795	12.23%
Türkiye Garanti Bankası A.Ş.	1946	foreign	264,330	11.57%	163,990	11.04%	149,021	11.55%
Akbank T.A.Ş.	1948	private	241,041	10.55%	142,647	9.60%	140,476	10.88%
Yapı ve Kredi Bankası A.Ş.	1944	private	223,066	9.77%	150,917	10.16%	133,628	10.35%
Türkiye Halk Bankası A.Ş.	1938	public	195,328	8.55%	132,720	8.93%	125,862	9.75%
Türkiye Vakıflar Bankası T.A.O.	1954	public	189,829	8.31%	125,638	8.46%	115,506	8.95%
Finans Bank A.Ş.	1987	foreign	87,354	3.82%	58,408	3.93%	50,572	3.92%
Denizbank A.Ş.	1997	foreign	86,912	3.80%	53,751	3.62%	50,501	3.91%
Türk Ekonomi Bankası A.Ş.	1927	private	74,886	3.28%	54,884	3.69%	46,495	3.60%
ING Bank A.Ş.	1984	foreign	46,828	2.05%	34,853	2.35%	22,484	1.74%
HSBC Bank A.Ş.	1990	foreign	30,443	1.33%	18,853	1.27%	18,172	1.41%
Şekerbank T.A.Ş.	1953	private	23,049	1.01%	15,869	1.07%	13,817	1.07%
Alternatifbank A.Ş.	1991	foreign	12,805	0.56%	8,290	0.56%	6,487	0.50%
Anadolubank A.Ş.	1996	private	10,553	0.46%	6,944	0.47%	7,196	0.56%
ICBC Turkey Bank A.Ş.	1986	foreign	7,116	0.31%	4,446	0.30%	2,402	0.19%
Cumulative Market Shares (percent)				91.04		90.31		95.48
Total Sector			2,284,222		1,485,626		1,290,655	

Table 3: Summary Statistics and Sources for Variables Used in Panel VAR Estimation

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
BIST Overnight Rate	336	9.28	1.95	6.26	11.98	CBRT
CBRT WACF	336	7.69	1.54	5.11	10.27	CBRT
Loan Rate	336	13.46	1.99	9.11	27.86	Financial Statements of Banks
Deposit Rate	336	8.80	2.14	3.01	13.51	Financial Statements of Banks

In the context of this study four different panel VAR models are specified (between WACF and loan rate, WACF and deposit rate, BIST rate and loan rate as well as BIST rate and deposit rate). Specification of panel VAR models and descriptive statistics are provided as follows where Y_t contains G × 1 vectors of variables for each unit i=1,…,N in a stacked form. In this case, Y_t includes the combinations of two policy rate parameters and loan/deposit rates in individual bank level. The generic index i indicates banks while $A_i(L)$ is a polynomial in the lag operator.

$$Y_t = A_{0i}(t) + A_i(L)Y_{t-1} + u_{it}$$

Second step of the empirical analysis involves the investigation of the relation between NIM and parameters of interest corridor whose impact on loan and deposit rates are evaluated in the first step. To this end, a dynamic panel model is established with the data of 16 commercial banks in Turkey for the period between 2011Q1 and 2016Q1. In order to construct the model, we start with a larger set of independent variables using previous studies in the literature and finally specify our main model considering multicollinearity problem among variables, especially the ones with CBRT policy rates.

Our set consists of the covariates controlling for bank-specific, financial sector-related and macroeconomic factors. Reflecting the arguments from the original model of Ho and Saunders (1981), variables representing the risk aversion (capital to asset ratio), size of the transactions (natural logarithm of total assets), interest rate risk (policy rate and slope of the yield curve) and market power of banks (Herfindahl and Hirschman Index-HHI and concentration ratio for three biggest banks (CR3)) are included in the data collection process. In order to account for the impact of funding risk, the ratio of total deposits to total assets are included. Several bank specific variables such as operating cost structure (proxied by the ratio of other operating expenses to total assets), credit risk (measured by the ratio of gross non-performing loans to total loans (NPL)), liquidity ratio (calculated by the ratio of liquid assets to total assets) and diversification effect in terms of the revenue sources (determined by the net fees and commissions income normalized by total assets) are also included. In order to control for macroeconomic forces, quarterly GDP growth rate and inflation rate are considered as major indicators that may affect net interest income of the commercial banks in Turkey.

Pairwise correlations of covariates display a multicollinearity problem to some extent[2]. The group of covariates are refined according to the pairwise correlations. Lastly, we embedded two lags of the NIM as regressors to incorporate the possibility of persistence in NIM. As Kansoy (2012) emphasizes, static models might not be able to investigate potential dynamism in bank NIM. In Turkey, average maturity for deposits is around three months. Similarly, average maturity period for commercial loans which are mostly priced with floating interest rate structure is also around three months. Thus, repricing decisions made in

2 Other operating expenses are closely related to net fees and commissions as well as the NPL ratio with 39% and 49% correlations respectively. Bank size also seems to be highly correlated with other operating expenses, NPL ratio and liquidity ratio with correlation value ranging from 30% to -56%. For the variables representing the competition in the banking industry, concentration ratio of three biggest banks appears to be more correlated with other variables than HHI measure. Lastly, inflation rate and slope of the yield curve are closely related to policy rate proxies (around 70%) which are the main focuses of this study.

one quarter interval might induce some persistence into the NIM. Hence, to capture persistence of bank margins over time, it is assumed that the current values of NIM are being determined by previous margin values as in Valverde and Rodriguez (2007). In this case, use of dynamic panel methodology can yield consistent and unbiased estimates as claimed by Borio et al. (2015). Hence, we estimate our model with dynamic panel data methods. The final specification in dynamic panel estimation is as follows. Here, μ_i represents individual bank effects and ε_{it} is random disturbance term.

$$NIM_{it}=\alpha+\beta_1(NIM)_{it-1}+\beta_2(NIM)_{it-2}+\beta_3(\text{Policy Rate})_t+\beta_4(\text{Operating Expenses})_{it}+\beta_5(\text{Equity Ratio})_{it}+\beta_6(\text{Deposit Ratio})_{it}+\beta_7(\text{Liquidity Ratio})_{it}+\beta_8(HHI)_t+\beta_9(\text{GDP Growth})_t+\mu_i+\varepsilon_{it}$$

Table 4: Definition and Sources of Data Series Used in Panel Data Analysis

Variable	Definition	Source
NIM	Interest income minus interest expense divided by total assets	Bank Association of Turkey
BIST Rate	Interbank repo/reverse repo market rate charged in BIST	CBRT
WACF	Weighted average cost of funding from CBRT funding channels	CBRT
Operating Expenses	The ratio of other operating expenses to total assets	Bank Association of Turkey
Equity Ratio	The ratio of shareholders' equity to total assets	Bank Association of Turkey
Liquidity Ratio	The ratio of liquid assets to total total assets	Bank Association of Turkey
Deposit Ratio	The ratio of deposits to total assets	Bank Association of Turkey
HHI	Herfindahl and Hirschman Index divided by 1000	Author's Calculations
GDP Growth	Quarter-on-quarter change in GDP (2009 constant prices)	TurkStat

To estimate this model, we utilized system GMM method. System GMM method, developed by Arellano and Bover (1995) and Blundell and Bond (1998), augments Arellano and Bond (1991) estimator by making an additional assumption that first differences of instruments are not related with the unobserved individual effects. In this way, it can increase the efficiency of the estimation by introducing more instruments. System GMM estimator utilizes the original levels equation to generate a system of two equations, one of which is in the form of differences and other one is in the form of levels. Variables in the differenced equation are instrumented by the lagged level values, while variables in the levels equation are instrumented by the lagged difference values (Roodman, 2006).

In our panel estimations, we follow the approach of Borio et al. (2015) and use system GMM estimator. There are some additional considerations in using dynamic panel estimation techniques. We choose to conduct two-step estimation in which covariance matrix is proxied in a way that two-step GMM estimator reaches to the covariance matrix of the moment conditions by economizing the first-step residuals, as Judson and Owen (1996) states. In other words, an initial GMM regression is performed by replacing covariance matrix by a reasonable but arbitrary positive-definite matrix; next, residuals from the first step estimation is used to construct a sandwich proxy for covariance matrix and GMM estimation is re-run to obtain coefficients estimates. These coefficient estimates are robust to any pattern of heteroscedasticity and cross-correlation in the modeling of sandwich covariance matrix estimator (Roodman, 2006). Since our data set is balanced panel, we prefer to use first-differencing instead of forward orthogonal transformation. Lastly, in the first model, at most one lagged levels of the dependent variable is used as instruments. In the second model, at most two lagged levels of the dependent variables is used for instrumentation[3].

Empirical Findings

Before the VAR estimation between policy rates and loan/deposit rate with aggregate banking sector data, we conduct Augmented Dickey-Fuller (ADF) tests to see whether data is stationary. According to ADF test

3 For further discussion, see Roodman (2009).

with intercept as well as the intercept and trend (see Table 5), all interest rates are found to contain unit root. When respective interest rates are differenced, they appear to be stationary. Alternative method to assess the nature of the data in terms of the stationarity is KPSS test (Kwiatkowski, Phillips, Schmidt, & Shin, 1992). Null hypothesis of this test is that data is stationary. Results of the KPSS test are presented in Table 6. These results are mostly in line with the results of ADF test. However, there are contradictions for WACF (when trend and intercept structure are assumed) and for consumer loan rate (when intercept structure is assumed). Differing results might be due to the problems regarding to the structure of sample data including possible structural breaks and outliers. This point is addressed with a multiple breakpoint analysis.

Table 5: ADF Test Results

Variables	Specification	Applied to Levels		Applied to Differences	
		t-statistics	p-value	t-statistics	p-value
BIST Rate	Intercept	-2.25	0.1890	-21.57	0.0000***
	Trend and Intercept	-2.50	0.3271	-21.53	0.0000***
CBRT WACF	Intercept	-2.13	0.2305	-20.18	0.0000***
	Trend and Intercept	-2.94	0.1503	-20.15	0.0000***
Commercial Loan Rate	Intercept	-1.89	0.3323	-14.54	0.0000***
	Trend and Intercept	-2.03	0.5817	-14.51	0.0000***
Consumer Loan Rate	Intercept	-1.78	0.3891	-8.33	0.0000***
	Trend and Intercept	-1.77	0.7162	-8.32	0.0000***
Deposit Rate	Intercept	-1.96	0.3005	-4.97	0.0000***
	Trend and Intercept	-2.31	0.4218	-4.97	0.0003***
*,** and *** denote significance at 10%, 5% and 1% levels respectively.					

Table 6: KPSS Test Results

Variables	Specification	Applied to Levels
		Test Statistics (LM Statistics)
BIST Overnight	Intercept	0.62**
	Trend and Intercept	0.18**
CBRT WACF	Intercept	0.70**
	Trend and Intercept	0.11
Commercial Loans	Intercept	0.54**
	Trend and Intercept	0.13*
Consumer Loans	Intercept	0.18
	Trend and Intercept	0.17**
Deposit	Intercept	0.56**
	Trend and Intercept	0.21**
*,** and *** denote significance at 10%, 5% and 1% levels respectively.		

The existence of structural breaks and outliers in the sample data is examined by employing multiple breakpoint tests. In order to detect the possible structural breaks in the data, the methodology developed by Bai and Perron (1998, 2003) is used. In their setting, different regimes are evaluated by taking potential breaks in the data into consideration. Furthermore, model parameters are categorized in a way that some are regime specific, while some are assumed to be same across regimes. Bai and Perron (1998) developed a global optimization procedure to determine the number of multiple breaks in the data series which in turn minimizes the residual sum of squares. We utilize the F-test to evaluate the validity of null hypothesis stating that there are no breaks against the alternative hypothesis pointing out that there are

some structural breaks in the data series. Hence, null hypothesis of F-test assumes that regime specific parameters are same across different regimes. Additionally, BIC developed by Yao (1988) and LWZ information criteria developed by Liu, Wu and Zidek (1997) are examined. Table 7 summarizes estimated break dates for two interest corridor parameters, commercial loan rate, consumer loan rate and deposit rate. These break dates are controlled with dummy variables in VAR models[4].

Table 7: Multiple Breakpoint Test Results and Number of Estimated Breaks

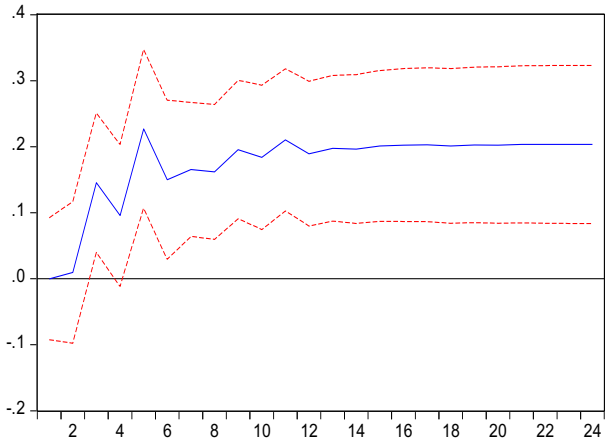
Variables	SIC	LWZ	F-test	Breaks
BIST Rate	3	3	5	10/14/2011, 7/20/2012, 4/26/2013, 1/31/2014, 12/05/2014
CBRT WACF	4	4	5	11/25/2011, 8/31/2012, 12/13/2013, 9/19/2014, 6/26/2015
Commercial Loan Rate	4	4	3	10/28/2011, 11/16/2012, 1/03/2014, 6/19/2015
Consumer Loan Rate	4	4	0	10/14/2011, 10/12/2012, 1/10/2014, 6/26/2015
Deposit Rate	4	4	4	11/18/2011, 9/21/2012, 1/31/2014, 6/26/2015

Figure 4 indicates the accumulated impulse response functions from the VAR model estimated with BIST rate as monetary policy rate. It can be seen that commercial loan rate is significantly reacting to the impulses in BIST overnight rate especially after fourth week. After three months, the impact is stabilized. Impulse-response function states that for the first three months, the response level is 0.19, i.e., one unit standard deviation shock coming to BIST rate is transmitted as 19 basis points response in commercial loan rate in three month period.

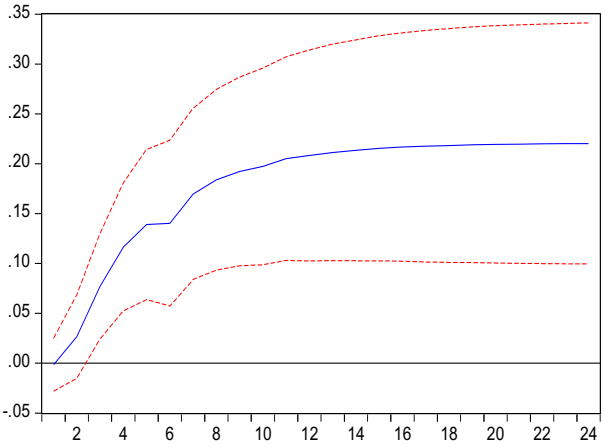
The pass through between BIST rate and consumer loan rate is also evaluated. Accumulated response of consumer loan rate to impulse in BIST overnight rate indicates that transmission is significant after second week and appears to be saturated around three months. The response level in this time interval is 0.208, i.e. shock is transmitted as 20.8 basis points response in consumer loan rate. Similarly, impulse response function is created for the relation between BIST rate and deposit rate (see Figure 4) from which it can be inferred that there exists a pass through from BIST rate to deposit rate. Pass through is especially significant for the whole first quarter after which the impact is stabilized.

4 Additionaly, choice of lag length which describes how many lags of each endogenous variable should be included in the estimation setting holds importance. Enders (2004) argues that setting an upper limit would be appropriate in deciding for lag length. Suggested upper limit is defined as T(1/3) where T represents the number of observations available in the sample data. Akaike Information Criterion (AIC) is employed to determine the lag length. When upper limit of the test is increased, lag length determined as 5 appears to be robust.

Accumulated Response of Commercial Loan Rate to One Unit Cholesky Standard Deviation Impulse in BIST Rate



Accumulated Response of Consumer Loan Rate to One Unit Cholesky Standard Deviation Impulse in BIST Rate



Accumulated Response of Deposit Rate to One Unit Cholesky Standard Deviation Impulse in BIST Rate

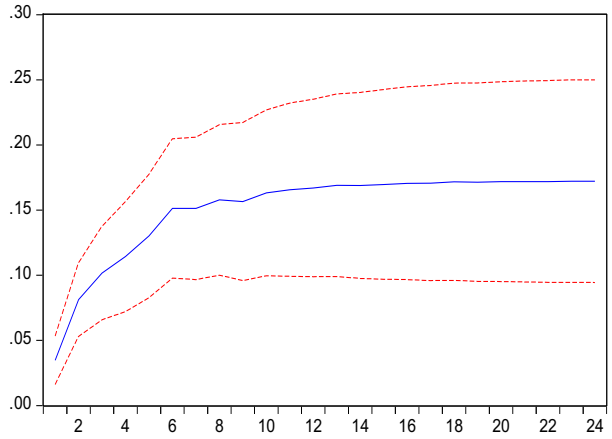


Figure 4: Accumulated Impulse Response Functions

Our data also enables us to investigate the transmission mechanism between CBRT WACF and interest rates charged on loans as well as the interest rates given to deposits. To this end, VAR model is estimated by utilizing CBRT WACF and loan/deposit rates. By referring to multiple breakpoint test results, respective dummy variables are added to the model specifications. When we focus on the WACF as a potential policy rate component, it is evident that a pass-through mechanism can be observed from WACF to commercial loan rate (see Figure 5). One unit standard deviation shock coming to former is transmitted as 16.8 basis points response for the latter in three months.

The pass through from WACF to consumer loan rate is more robust compared to the commercial loan rate (see Figure 5). Despite positive significant reaction of consumer loan rate to the impulse in WACF during initial periods, the impact is stabilized after three months. For the first three months, accumulated response is 13.4 basis points in the presence of one unit standard deviation shock coming to WACF. Lastly, impulse response function that is presented in Figure 27 shows that a pass through from WACF to deposit rate is valid considering the fact that any shocks coming to WACF is transmitted to deposit rate significantly, especially for the first three months. However, similar to the relation with consumer loan rate, the impact is stabilized after three months period.

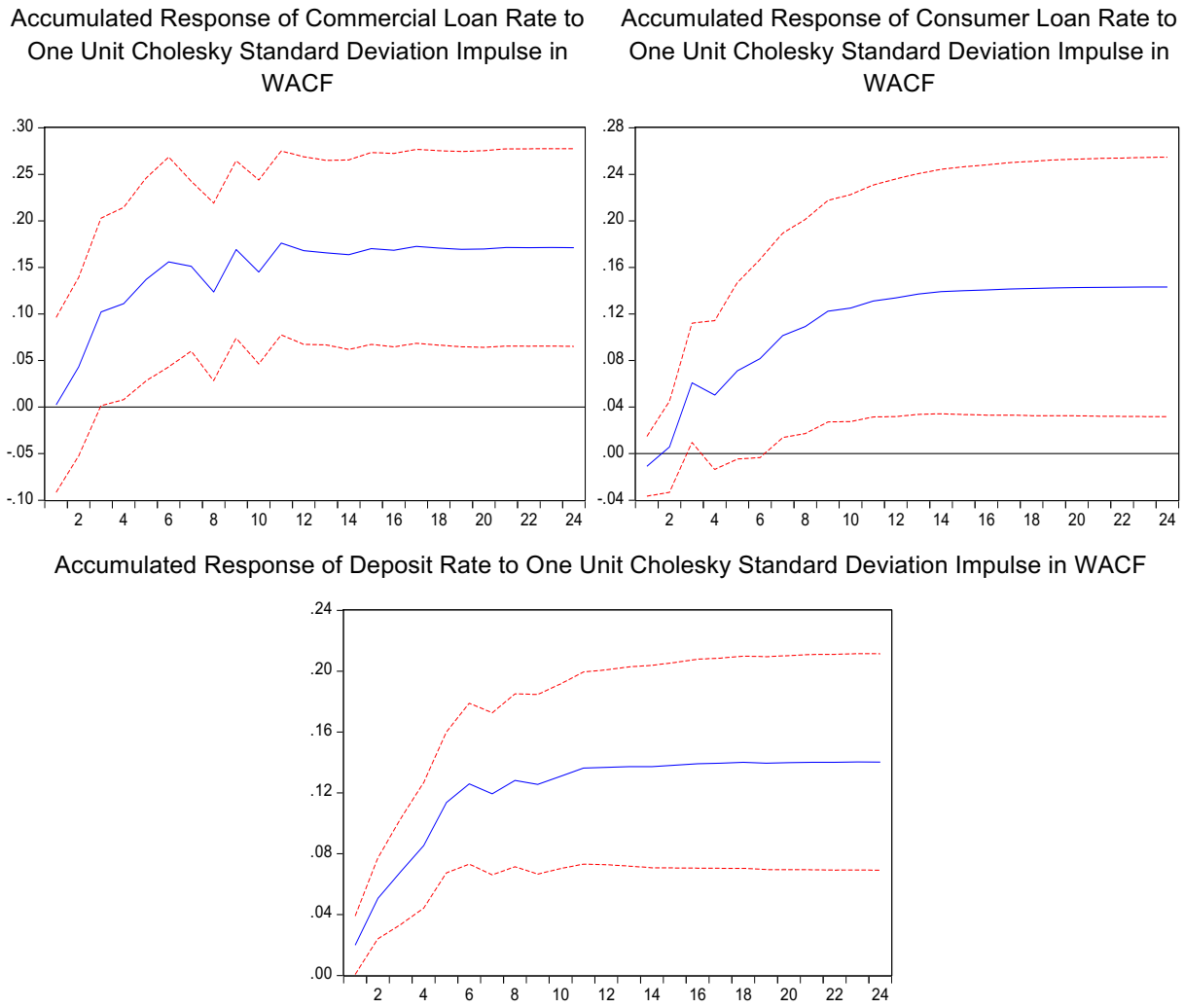


Figure 5: Accumulated Impulse Response Functions

As a robustness check for the monetary transmission mechanism under interest rate channel, we conduct a panel VAR estimation. Panel stationarity tests are applied to the data in levels as an initial step. First chosen method to assess panel stationarity of data is Levin, Lin and Chu (2002) test. Levin-Lin-Chu (LLC) test assumes that there exists a common unit root structure hence the autoregressive component of data generating process is accepted as constant across banks. Null hypothesis of the test indicates the unit root, while alternative hypothesis is in line with the conclusion that data is stationary. Schwarz Information Criterion (SIC) is used to determine the number of lags included in the test equation. As seen in Table 8, all variables are stationary in levels. Furthermore, same data is also tested with Im, Peseran and Shin (2003) methodology. Difference of this method from LLC test is that individual unit root processes are allowed. Autoregressive component is assumed to be panel specific instead of constant across units. Based on the test statistics in Table 8, we do not apply any transformation to the data before analyzing them with panel VAR methods. Furthermore, four lags are exerted in panel VAR models to cover annual pattern as data is in the quarterly frequency. Results appear to be results when one lag is chosen.

Table 8: Panel Unit Root Test Results

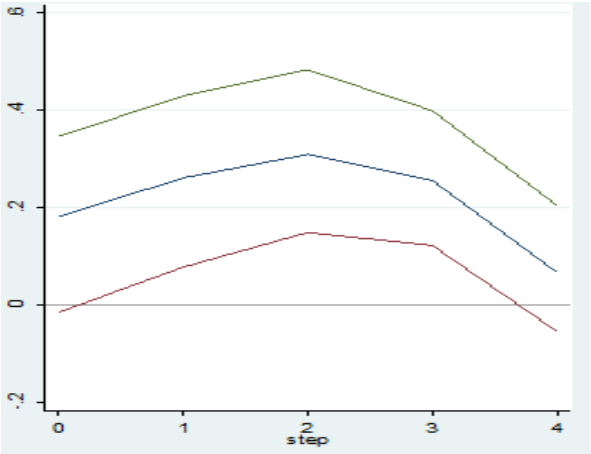
Variables	Specification	Levin-Lin-Chu Test Statistic	p-value	Im-Peseran-Shin Test Statistic	p-value
BIST Overnight Rate	Without Time Trend	-4.3856	0.0000***	-3.4429	0.0003***
	With Time Trend	-2.5745	0.0050***	-4.4560	0.0000***
CBRT Lending Rate	Without Time Trend	-5.5537	0.0000***	-2.4640	0.0069***
	With Time Trend	-3.6047	0.0002***	-2.5400	0.0055***
CBRT WACF	Without Time Trend	-7.1240	0.0000***	-2.9109	0.0018***
	With Time Trend	-6.1859	0.0000***	-3.8603	0.0001***
Loan Rate	Without Time Trend	-3.1807	0.0007***	-2.3660	0.0090***
	With Time Trend	-1.8863	0.0296**	-3.2069	0.0007***
Deposit Rate	Without Time Trend	-2.3413	0.0096***	-2.3146	0.0103**
	With Time Trend	-3.0171	0.0013***	-4.3399	0.0000***

*,** and *** denote significance at 10%, 5% and 1% levels respectively

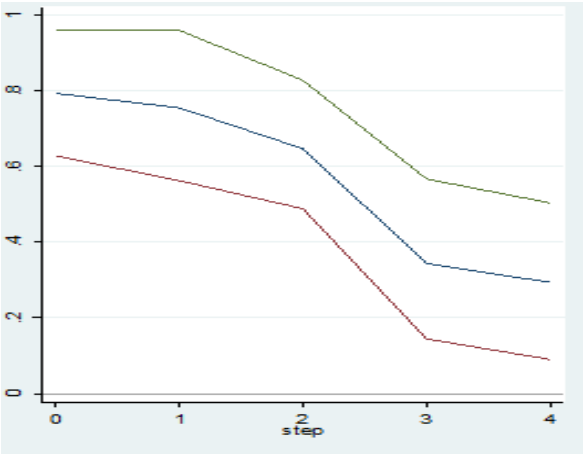
In Figure 6, results for models with BIST rate are provided. Impulse response function displays the initial reaction of loan rate to changes in BIST rate and the level of response increases at initial periods. However, after certain time, the impact gets weaker and eventually becomes insignificant. On the other hand, the response of deposit rate to one unit standard deviation shock in BIST rate seems to be evident. Secondly, CBRT WACF is considered as a monetary policy rate. Composed impulse-responses with CBRT WACF are depicted in Figure 6. Similar to the impact of BIST rate, significant impact of WACF on loan rate is observed at initial periods, but the impact saturates and turns out to be insignificant in later periods. The pass-through between WACF and deposit rate is also evident in this context.

Overall, we argue that bank-level data indicate the existence of pass through from corridor parameters to bank loan and deposit rates for the period between 2011Q1 and 2016Q1 (when interest corridor system was used as an active policy tool). However, the trend and magnitude of pass-through differ across different specifications and policy rate compositions. This situation prevents us from revealing the true nature of the relation between net interest margin and policy rate stance. Hence, econometric estimations seem to be required by controlling several factors with panel data methods.

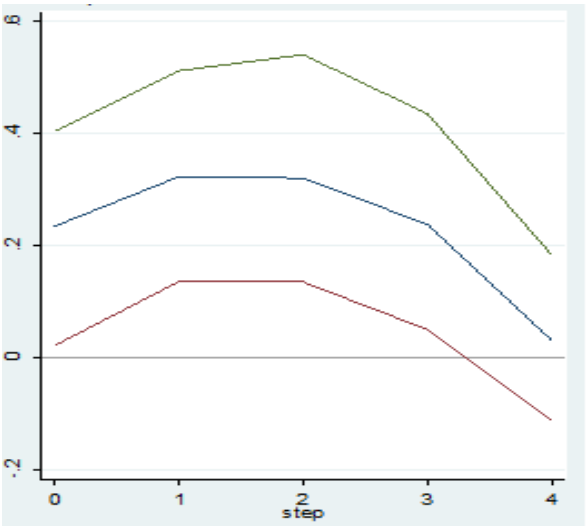
Response of Loan Rate to One Unit Standard Deviation Impulse in BIST Rate



Response of Deposit Rate to One Unit Standard Deviation Impulse in BIST Rate



Response of Loan Rate to One Unit Standard Deviation Impulse in CBRT WACF



Response of Deposit Rate to One Unit Standard Deviation Impulse in CBRT WACF

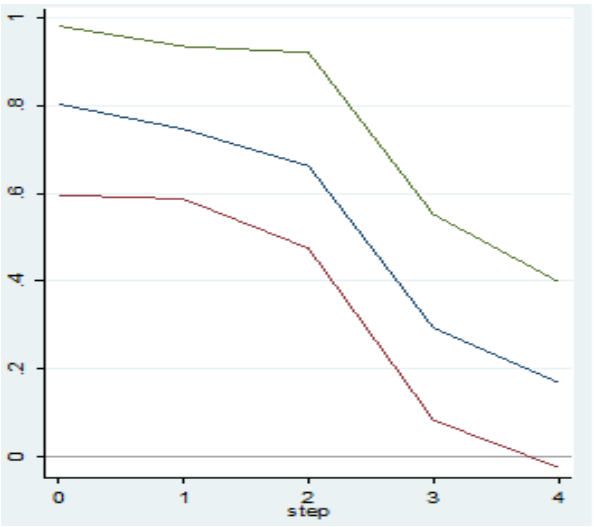


Figure 6: Impulse Response Functions

As a next step, results of the dynamic panel analysis are presented in Table 9. For the period 2011Q1-2016Q1 when asymmetric interest corridor with active liquidity management has been utilized as a monetary policy composition, BIST rate is statistically significant in determining net interest margins of commercial banks in Turkey. Positive coefficient on this variable hints that any monetary policy tightening manifested by higher BIST rate do contribute the banking sector margins. As also seen in Table 9, previous quarter's NIM is found to be positive and statistically significant. Our findings are in line with the view that the persistence of NIM is relatively high. However, second lag of the NIM is not found to be statistically significant in determining contemporaneous values.

Among the bank specific variables, equity ratio is found to be positive and statistically significant at 1% significance level. In other words, well capitalized banks appear to be more profitable. Firstly, positive coefficient is compatible with the earlier theoretical models. Particularly, it can be claimed that risk aversion behavior displayed by banks in Turkey results to hold a premium margin over what a risk neutral bank would require within this sample period (Ho & Saunders, 1981; McShane & Sharpe, 1985; Allen, 1988; Angbazo, 1997; Maudos & Guevera, 2004). Secondly, as empirical works stress, well-capitalized banks would have low level of expected bankruptcy costs for themselves as well as their customers. Higher capital ratios also indicate that if a bank is well capitalized with regard to its perceived risk, thereby

confirming long-term bank solvency; then this situation is directly represented in the form of lower cost of funding for banks. Hence, there would be room to achieve wider interest margins (Abreu & Mendes, 2001). Positive relation between this proxy and NIM is evident in cross-country empirical studies (Demirgüç-Kunt & Huizinga, 1999; Brock & Suarez, 2000; Kasman et al., 2010). Same positive association is also observed in empirical studies focusing on single country banking systems (Williams, 2007; Maudos & Solis, 2009; Aysan et al., 2010; Kansoy, 2012).

NIM is found to be significantly related to operating expenses of commercial banks. Closer examination of the components of this series for the context of Turkish banks shows that other operating expenses is mostly related to costs of branching and loan extension/deposit collection activities such as employee, overheads and amortization expenses. These components of total cost are defined as widely controllable and responsive to the actions of bank management (Marinkovic & Radovic, 2014) Therefore, its level is determined by the scope of interest incurring operations of commercial banks. This situation can also be attributed to the choice of business models for banks. If the specialization of the banking sector leans more towards retail activities, then larger operational costs will be faced than the systems where banks that are more oriented toward wholesale markets (Brock & Suarez, 2000). Banking sector in Turkey is importantly focused on retail activities. A positive association is found between operating expenses and net interest income for Turkish banks. In addition to this argument, empirical studies are in favor of the argument that these expenses are passed on to customers through higher margins. In other words, banks with higher costs would have to operate with considerably higher intermediation margins to preserve bottom-line profitability (Maudos & Guevera, 2004; Williams, 2007; Maudos & Solis, 2009). Among the other variables included in the regression, only GDP growth rate is determined as a significant factor, albeit at 10% significance level. Negative association between NIM and economic activity shows that bank profitability is following a counter-cyclical trend in the examined sample period. Our model finds no significant results for the liquidity position, funding risk and financial sector concentration.

Same model is estimated using CBRT WACF as policy rate instead of BIST rate. As seen in Table 9, we have similar findings. First, we observe that there is a positive association between WACF and NIM showing that as an indication of monetary policy stance under corridor framework, any increase in WACF is expected to increase bank margins. Especially, when we consider the pass through from WACF to loan/deposit rates, banks appear to adjust their margins in the case of any monetary policy tightening through the pricing of loans and deposits. Persistence of NIM is robust as manifested in the statistically significant coefficient of first lag of NIM, whereas second lag has no explanatory power for contemporaneous value. In terms of the bank specific variables, level of risk aversion and operating expenses related to branching activities are positively and significantly associated with NIM. Different than previous findings, quarterly GDP growth is no longer found to be a significant factor. Diagnostics tests for dynamic estimations are also reviewed. We fail to reject the null hypothesis of Sargan test of overidentifying restrictions. Hence, it implies that the instruments are appropriate. The null hypothesis of Arellano-Bond test for autocorrelation applied to the differenced residuals is the non-existence of autocorrelation. We also fail to reject this null hypothesis for both models.

As further analysis, we consider and calculate the standardized variables, i.e., standard scores, by demeaning each series and scaling with sample standard deviation. The models with two policy rates are re-estimated whose results are presented in Table 10. In both models, the economic significance of lag values of NIM as well as bank specific variables such as operating expenses and equity ratio are observed to be larger than that of policy rates. This result appears to be robust across different choice of monetary policy rate (BIST rate and WACF).

Table 9: System GMM Results

	(1) NIM	(2) NIM
NIM(-1)	0.5097*** (0.159)	0.4503*** (0.144)
NIM(-2)	0.1735 (0.128)	0.1527 (0.101)
BIST Rate	0.0196*** (0.003)	
WACF		0.0233*** (0.004)
Operating Expenses	0.2602** (0.113)	0.2647** (0.112)
Equity Ratio	0.0391*** (0.013)	0.0429*** (0.013)
Liquidity Ratio	0.0057 (0.004)	0.0048 (0.003)
Deposit Ratio	-0.0004 (0.003)	-0.0010 (0.003)
HHI	0.1695 (0.345)	0.1580 (0.163)
GDP Growth	-0.0061** (0.002)	-0.0033 (0.002)
Constant	-0.0238 (0.033)	-0.0215 (0.014)
Degrees of Freedom	304	304
# of Banks	16	16
Sargan Test (p-value)	0.99	0.99
Arellano-Bond AR(2) Test (p-value)	0.17	0.17
*,** and *** denote significance at 10%, 5% and 1% levels respectively. Standard errors are given in parantheses.		

Table 10: Estimation Results with Standardized Variables

Variable	**Coefficients**	
NIM(-1)	0.4230***	0.3497***
NIM(-2)	-0.0024	-0.0396
BIST Rate	0.1363*	
WACF		0.1693***
Operating Expenses	0.3786***	0.3671***
Equity Ratio	0.5937**	0.5604***
Liquidity Ratio	0.5911	0.9221
Deposit Ratio	0.0837	0.2175
HHI	-0.1668	0.1294
GDP Growth	-.0034	0.0112
*,** and *** denote significance at 10%, 5% and 1% levels respectively. Standard errors are given in parantheses.		

Conclusions

In this study, we empirically investigate the factors affecting bank NIM in Turkey. We also aim to assess the role of monetary policy rate proxies in the asymmetric interest corridor system implemented by CBRT. Using aggregate time series banking data in the VAR estimations, we demonstrate that there exists a pass-through from BIST overnight rate and CBRT WACF to commercial loan, consumer loan and deposit rates

for the period 2011W1-2016W13. Similarly, the results of panel VAR estimation conducted with individual bank-level data collected from financial statements are supportive of the hypothesis that a transmission channel is effective between policy rates and bank loan/deposit rates. Having established the informative content of policy rate proxies in asymmetric corridor system, we have conducted a dynamic panel analysis to investigate the relation between these proxies and NIM of banking sector by controlling for bank-specific, sector-related and macroeconomic factors. Our findings suggest that there is a positive and significant association between policy rates and NIM of banks. The persistence in bank margins as well as the role of operating expenses, capitalization of banks are proven. Estimations which employ standardized variables to make inference about economic significance suggest that the impact of lag values of NIM and bank specific variables are more prominent than that of policy rates.

References

Abreu, M., & Mendes, V. (2001). Commercial bank interest margins and profitability: evidence for some EU countries. *In Pan-European Conference Jointly Organised by the IEFS-UK & University of Macedonia Economic & Social Sciences*, Thessaloniki, Greece, May (pp. 17-20).

Allen, L. (1988). The determinants of bank interest margins: a note. *Journal of Financial and Quantitative Analysis,* 23(02), 231-235.

Alper, K., & Çapacıoğlu, T. (2016). Bankacılık sektörünün likidite pozisyonu ve mevduat faizleri ile ilişkisi. *TCMB Ekonomi Notları*, (2016-31).

Angbazo, L. (1997). Commercial bank net interest margins, default risk, interest-rate risk, and off-balance sheet banking. *Journal of Banking & Finance*, 21(1), 55-87.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: monte carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29-51.

Assenmacher, K., & Gerlach, S. (2008). Monetary policy, asset prices and macroeconomic conditions: a panel-var study. *National Bank of Belgium Working Paper Research*, No.149.

Aysan, A., Dalgic, C. H., & Demirci, M. (2010). Macroeconomic, sector specific and bank specific determinants of net interest rate margin: what matters more for an emerging market economy? *EcoMod*, (No. 259600015).

Bai, J., & Perron, P. (1998). Estimating and testing linear models with multiple structural changes. *Econometrica*, 47-78.

Bai, J., & Perron, P. (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18(1), 1-22.

Barajas, A., Steiner, R., & Salazar, N. (1999). Interest spreads in banking in Colombia, 1974-96. *IMF Staff Papers*, 46(2), 196-224.

Binici, M., Erol, H., Kara, H., Özlü, P., & Ünalmış, D. (2013). Faiz koridoru bir makro ihtiyati araç olabilir mi?. *TCMB Ekonomi Notları*, (2013-20).

Binici, M., Kara, H., & Özlü, P. (2016). Faiz koridoru ve banka faizleri: parasal aktarım mekanizmasına dair bazı bulgular. *TCMB Çalışma Tebliği*, (2016-08).

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115-143.

Borio, C. E., Gambacorta, L., & Hofmann, B. (2015). The influence of monetary policy on bank profitability. *BIS Working Papers*, (514).

Brock, P. L., & Suarez, L. R. (2000). Understanding the behavior of bank spreads in Latin America. *Journal of Development Economics*, 63(1), 113-134.

Cagala, T., & Glogowsky, U. (2014). Panel vector autoregressions for stata (xtvar).

Canova, F., & Ciccarelli, M. (2013). Panel VAR MODELS: A SURVEY. *Advances in Econometrics*, 31.

Chen, S. H., & Liao, C. C. (2011). Are foreign banks more profitable than domestic banks? Home-and host-country effects of banking market structure, governance, and supervision. *Journal of Banking & Finance*, 35(4), 819-839.

De Bondt, G. (2002). Retail bank interest rate pass-through: new evidence at the Euro Area level. *ECB Working Paper Series*, (136).

Demirgüç-Kunt, A., & Huizinga, H. (2000). Financial structure and bank profitability. *World Bank Policy Research Working Paper*, (2430).

Demirgüç-Kunt, A., Laeven, L., & Levine, R. (2003). Regulations, market structure, institutions, and the cost of financial intermediation (No. w9890). *National Bureau of Economic Research*.

Enders, W. (2004). Applied econometric time series, by Walter. *Technometrics*, 46(2), 264.

Ganioğlu, A., & Us, V. (2014). The structure of the Turkish banking sector before and after the global crisis. *CBRT Working Papers*, (2014-29) .

Hawtrey, K., & Liang, H. (2008). Bank interest margins in OECD countries. *The North American Journal of Economics and Finance*, 19(3), 249-260.

Hristov, N., Hülsewig, O., & Wollmershäuser, T. (2014). The interest rate pass-through in the Euro Area during the global financial crisis. *Journal of Banking & Finance*, 48, 104-119.

Ho, T. S., & Saunders, A. (1981). The determinants of bank interest margins: theory and empirical evidence. *Journal of Financial and Quantitative Analysis*, 16(04), 581-600.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53-74.

Judson, R., & Owen, A. (1996). Estimating dpd models: a practical guide for macroeconomists. *Federal Reserve Board of Governors*.

Kansoy, F. (2012). The determinants of net interest margin in the Turkish banking sector: Does bank ownership matter?. *Journal of BRSA Banking and Financial Markets*, 6(2), 13-49.

Kara, H. (2015). Faiz koridoru ve para politikası duruşu. *TCMB Ekonomi Notları*, (2015-19).

Kasman, A., Tunc, G., Vardar, G., & Okan, B. (2010). Consolidation and commercial bank net interest margins: evidence from the old and new European Union members and candidate countries. *Economic Modelling*, 27(3), 648-655.

Kaya, Y. T. (2002). Türk bankacılık sektöründe karlılığın belirleyicileri. *MSPD Çalışma Raporları*, BDDK Yayınları, 1-16.

Küçük, H., Özlü, P., Talaslı, İ. A., Ünalmış, D., & Yüksel, C. (2014). Interest rate corridor, liquidity management, and the overnight spread. *TCMB Çalışma Tebliği*, (2014-02).

Küçüksaraç, D., & Özel, Ö. (2013). Gecelik vadede kur takası ve BIST repo faizleri arasındaki ilişki. *TCMB Ekonomi Notları*, (2013-15).

Kwapil, C., & Scharler, J. (2006). Limited Pass-through from policy to retail interest rates: empirical evidence and macroeconomic implications. *Monetary Policy and the Economy* Q, 4, 26-36.

Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root?. *Journal of Econometrics*, 54(1-3), 159-178.

Leroy, A., & Lucotte, Y. (2015). Heterogeneous monetary transmission process in the Eurozone: Does banking competition matter?. *International Economics*, 141, 115-134.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1-24.

Liu, J., Wu, S., & Zidek, J. V. (1997). On segmented multivariate regression. Statistica Sinica, 497-525.

Marinković, S., & Radović, O. (2014). Bank net interest margin related to risk, ownership and size: an exploratory study of the Serbian banking industry. *Ekonomska istraživanja*, 27(1), 134-154.

Maudos, J., & De Guevara, J. F. (2004). Factors explaining the interest margin in the banking sectors of the European Union. *Journal of Banking & Finance*, 28(9), 2259-2281.

Maudos, J., & Solís, L. (2009). The determinants of net interest income in the Mexican banking system: An integrated model. *Journal of Banking & Finance*, 33(10), 1920-1931.

McShane, R. W., & Sharpe, I. G. (1985). A time series/cross section analysis of the determinants of australian trading bank loan/deposit interest margins: 1962–1981. *Journal of Banking & Finance*, 9(1), 115-136.

Mishkin, F. S. (1996). The channels of monetary transmission: Lessons for monetary policy (No. w5464). *National Bureau of Economic Research*.

Miyajima, K., Mohanty, M. S., & Yetman, J. (2014). Spillovers of US unconventional monetary policy to Asia: The role of long-term interest rates. *BIS Working Papers*.

Roodman, D. (2006). How to do xtabond2: An introduction to difference and system gmm in stata. *Center for Global Development Working Paper,* (103).

Roodman, D. (2009). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, 71(1), 135-158.

Stakėnas, J., & Stasiukynaitė, R. (2017). Monetary policy transmission: The case of Lithuania. *Baltic Journal of Economics*, 17(1), 1-24.

Us, V. (2015). The Turkish banking sector before and after the global crisis: An ownership breakdown. *CBRT Research Notes in Economics*, (2015-02).

Ünalmış, D. (2015). Faiz koridoru, likidite yönetimi ve para piyasalarında efektif fonlama faizi. *TCMB Ekonomi Notları*, (2015-20).

Valverde, S. C., & Rodriguez, F. F. (2007). The determinants of bank margins in European Banking. *Journal of Banking & Finance*, 31(7), 2043-2063.

Williams, B. (2007). Factors determining net interest margins in Australia: Domestic and foreign banks. *Financial Markets, Institutions & Instruments*, 16(3), 145-165.

Yao, Y. C. (1988). Estimating The number of change-points via schwarz criterion. *Statistics & Probability Letters*, 6(3), 181-189.