Hacettepe University Graduate School of Social Sciences

Department of Economics

A THRESHOLD COINTEGRATION ANALYSIS OF TURKISH LOAN RATES

Muzaffer Emre Kaan GÜMÜŞSOY

Master's Thesis

Ankara, 2020

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ABSTRACT

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After global financial crisis in 2008, new discussions raised in the monetary transmission mechanism literature. In this sense, in end-2010, the Central Bank of Republic of Turkey (CBRT) has adopted unconventional approach where multiple interest rates would be used to conduct a more effective monetary policy. This study assesses how policy-induced changes in interbank money market rates affect commercial banks' interest rates for consumer, vehicle, housing and commercial loans in Turkey over the period of 2011M1-2019M7. To do so, asymmetric threshold cointegration approach by Enders and Siklos (2001) is employed, where threshold autoregressive (TAR) and momentum threshold autoregressive models (MTAR) is used to capture the asymmetric adjustment behaviour of the loan rates. Empirical results show that complete pass-through exists only in consumer and vehicle loan rates while incomplete pass-through exists in housing and commercial loan rates. The asymmetric adjustment behaviour appears to vary across loan types and different model specifications. Specifically, the asymmetric adjustment in housing loan rates in the form of downward rigidities implies that housing loan rates respond faster to increases in interbank money market interest rates. Within this context, our findings suggest that several steps to intensify the competition in banking sector could provide complete and symmetric pass-through processes, which will eventually strengthen the efficiency of monetary transmission mechanism.

Keywords

Interest Rate Pass-Through, Loan interest rates, Asymmetric Threshold Cointegration

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ABBREVIATIONS

ADF	Augmented Dickey- Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributive Lag
BAT	Banks Association of Turkey
BCBS	Basel Committee on Bank Supervision
BIST	Borsa Istanbul
BRSA	Banking Regulation and Supervision Agency
CAR	Capital Adequency Ratio
CBRT	Central Bank of the Republic of Turkey
CDS	Credit Default Swap
DSGE	Dynamic Stochastic General Equilibrium
e.g	for example (exempli gratia)
et al.	and others [et alii (masculine plural), et aliae (feminine plural) or et alia (neutral plural)]
etc.	and so forth (et cetera)
ECM	Error-Correction Model
EMBI	Emerging Market Bond Index
EMU	European Monetary Union
EVDS	Electronic Data Delivery System
GDP	Gross Domestic Product
GFC	Global Financial Crisis
IMF	International Monetary Fund
MENA	Middle East and North Africa

MPC	Monetary Policy Committee
MTAR	Momentum Threshold Autoregressive
NECM	Nonlinear Error-Correction Model
NPL	Non-Performing Loan
PP	Phillips-Perron
ROC	Reserve Option Coefficient
ROE	Return-on-Equity
ROM	Reserve Option Mechanism
TAR	Threshold Autoregressive
OLS	Ordinary Least Squares
UK	United Kingdom

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INTRODUCTION

The monetary transmission mechanism has been one of the major concerns of central banks. This mechanism assesses how policy-oriented changes in nominal variables (money stock and short-term interest rates) affect macroeconomic variables such as economic growth, credit growth and inflation. It is well known that efficiency of the monetary policy is based on the well-operated monetary transmission mechanism. If the changes in policy rates are fully and rapidly transmitted to banks' retail rates, central bank will have complete and faster influences on economic growth and inflation. Contrarily, if incomplete transmission to retail rates is observed, monetary transmission mechanism takes some time and have difficulties to accomplish its ultimate goals. As Turkey started to pursue an unconventional monetary policy approach in mid 2010, where asymmetric wide interest rate corridor was employed, analysing such transmission mechanism have become crucial concern for policy makers.

The interest rate channel constitutes the significant part of the monetary transmission mechanism. Central banks operate their monetary policy under an interest rate corridor by allowing fluctuations in short-term market interest rates to affect the long-term interest rates and hence the credit cycle and economic activity. According to this channel, policy rate changes leads to change in short-term market interest rates and longer-term interest rates in accordance with the term structure. The role of expectations has crucial role on formation of longer-term interest rates since expectations determines the path of policy rate changes along with the risk and term premiums. Therefore, such changes in market interest rates via expectations also affect retail rates where banks consider these market rates as benchmark for the cost of their loans.

The literature investigates the effects of monetary policy changes through interest rate channel. In this context, how policy rate changes are passed to retail rates - named as interest rate pass-through- has become one of the main concerns of policy makers. As the financial system is dominated by banks, the impact of changes in policy rates directly depends on how banks transmit such changes to their retail rates. Hence, the effectiveness of monetary policy is evaluated based on the magnitude (margins) and speed of pass-through from market rates to retail (loan and deposit) rates.

The early theoretical studies focus on the incompleteness of interest rate pass-through process. They suggest that presence of asymmetric information, switching costs and imperfect competition in banking industry might be potential reasons for interest rate stickiness. Moreover, literature grows both theoretically and empirically over years and find further evidences on determinants of pass-through such as the effect of macroeconomic variables, monetary policy implementations, ownership structure of financial system, and bank-specific characteristics.

In this study, we try to shed light on interest rate pass-through in Turkish loan rates (consumer, vehicle, housing and commercial) over the period 2011-2019. In particular, our study addresses the following questions for Turkey. (1) What kind of pass-through do we observe in loan rates- i.e. complete, incomplete or over-complete? (2) Is there any cointegrating relationship between short-term market interest rates and loan rates? (3) If we have incomplete pass-through, why are there rigidities in the adjustment process? (4) Regarding the market disequilibrium, how do loan rates adjust to their long-run equilibrium i.e. is the adjustment process is symmetric or asymmetric? (5) If the adjustment is asymmetric, what are the main sources of such asymmetry? Just as the linear (symmetric) models fail to exhibit asymmetric behaviours, in order to exhibit nonlinear adjustment to long run equilibrium, we utilize non-linear models of threshold autoregression (TAR) model and momentum threshold autoregressive (MTAR) model developed by Enders and Siklos (2001).

The main contribution to the related literature is twofold. First, while previous studies in Turkey such as Aydın (2007), Yüksel & Özcan (2013) and Yıldırım (2014) deal with old-dated period of time, we are interested in up-to-date period of time that ranges from January 2011 to July 2019, which covers the unconventional monetary policy period of the Central Bank of the Republic of Turkey (CBRT) that proposes a wide asymmetric interest rate corridor as policy tool. Secondly, unlike previous studies on Turkey, we enrich our study with a risk measure variable in order to display the effect of financing conditions on loan rates. To the best of our knowledge, from methodological point of view, our study is the first to investigate the such period under related specification.

Our empirical results present that there is a complete pass-through in consumer and vehicle loan rates, while incomplete pass-through exists in housing and commercial loan rates. These findings confirm that monetary policy have an effective role on consumer and vehicle loan rates but not on housing and commercial loan rates in

Turkey. The results further reveal that banks prefer to mark-up a fixed proportion over market rates due to their relevant riskiness. Housing loan rates respond faster to increases in policy rate (rate hike) with respect to decreases in policy rates (rate cut). However, there is no evidence that consumer and commercial loans have asymmetries in their adjustment to long run equilibrium. On the other hand, results for vehicle loans are ambiguous.

The plan of the study is organized as follows. Chapter 1 provides a brief literature review focusing on the theoretical background of interest rate pass-through mechanism and empirical studies that investigates further determinants of rigidities and asymmetries in the pass-through process. Chapter 2 presents an overview of the Turkish economy and recent banking sector indicators. Chapter 3 provides a general review of the monetary policy in Turkey. Chapter 4 describes the data used in the pass-through analysis with some descriptive statistics as well as the estimation methodology. In Chapter 5, empirical findings are discussed. Finally, the last chapter concludes the study.

CHAPTER 1

THE LITERATURE REVIEW OF INTEREST RATE PASS THROUGH

In this section, we review the relevant literature for interest rate pass through. We firstly present the early theoretical studies on the issue and then, uncover the empirical studies, which generally focus on factors affecting the pass-through process. Lastly, we provide a brief summary for the existing empirical studies on Turkey.

1.1 THEORETICAL BACKGROUND OF INTEREST RATE PASS THROUGH

The concept of interest rate pass through is studied broadly in the economic literature. It basically captures the transmission from short-term interest rates to retail rates (deposit and loan rates) of commercial banks. Most studies in the literature focus on the magnitude and speed of pass through to large extent. Although these studies differ by country, period considered and the methodology, they agree on that frictions in pass through mechanism generally arise from factors such as high switching costs, asymmetric information, presence of risk sharing agreements and the degree of competition in the banking system. Beyond these, some macroeconomic and microeconomic factors, such as bank-specific variables and financial structures might lead to frictions and asymmetry in pass-through process.

In the related literature, cost of funding approach is used to a large extent to understand the pass-through process. Specifically, early theories propose that markets are fully competitive, and prices are able to reflect changes in marginal costs. For the loan market, the price of loan rates or cost of funding (marginal costs) is the monetary policy rate Within this approach, banks are able to pass any change in cost of funding to their lending rates. Rousseas (1985) introduces a theoretical model based on the marginal cost pricing for bank loan rates as follow:

$$lending\ rate = k(u) \tag{1.1}$$

where k stands for a mark-up function which represents the degree of monopoly, and u is the cost incurred by commercial banks. Hence, Rousseas (1985) defines a linear mark-up equation as the following:

$$lending\ rate = \alpha + \beta u \tag{1.2}$$

where α stands for a mark-up constant over banks' cost of funds. In this equation, β is the size of pass through from banks' marginal cost that is generally proxied by interbank money market rates (or monetary policy rates) officially announced by central banks.

In their pioneering study, Stiglitz and Weiss (1981) underline asymmetric information to explain the interest rate stickiness.[1] If banks decide that the default risk is high after an increase in policy rate, they will set higher loan rates by extending spread between loan rates and deposit rates. However, if banks accept to give credit to risky borrowers instead of less risky borrowers, adverse selection problem arises in the market. On the other hand, increase in loan rates induce risky borrowers to invest in risky projects (moral hazard). As banks will have to face with default risk as a result of adverse selection and moral hazard, they may prefer not to set higher loan rates, even though there are cost pressures, but to ration total amount of loans. Consequently, such developments in the loan market may generate interest rate stickiness in upward direction and asymmetric adjustment in pass through process.

Banks may prefer to widen spread between loan rate and deposit rate in case of default risk perceived to be high. Fried and Howitt (1980) attempt to explain interest rate stickiness with risk sharing agreements. They propose the theory of non-price credit rationing by using the theory of contracts that has been popularly applied in labor market studies. Their model suggest that parties agree on a contract in which risk-averse borrowers are willing to prefer fixed loan rates and lenders are inclined to set higher loan rates in order to avoid from risks that arise from changes in cost of loans. All these agreements may result in stickier interest rates.

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[1] Cottarelli and Kourelis (1994) defines interest rates stickiness by two explanation: One indicates the inelasticity of demand for bank loans with respect to change loan rates. Second refer to the case that less responsivity of loan rates to change in money market rates and possible in long run.

Klemperer (1987) investigates switching costs by employing a two-period differentiated-products duopoly model. In his model, banks monitor their customers' risk profile and these costs of monitoring are passed through to customers in the form of several fees. Klemperer's model concludes that banks can take the advantage of switching costs; since borrowers have already been locked in agreement that they have to comply with higher loan rates due to high switching costs. The existence of switching costs provides banks an advantage of setting higher rates over their marginal costs, resulting in overpass-though in lending rates. Similarly, Lowe and Rohling (1992) discuss loan rates stickiness from a general equilibrium model perspective and test different types of loans for advanced economies such as United States, Canada, and the United Kingdom. They find that beyond high switching costs, risk sharing agreements are the relevant reasons for reluctance of loan rates to follow changes in marginal cost of loans on a one-to-one basis.

Rotemberg and Saloner (1987) offer a theoretical framework for price rigidities via menu costs theory. They propose that firms will adjust prices when the benefit of changing prices exceeds the costs arising from changing prices such as reprinting price lists etc. In the context of interest rates, when policy rate changes are considered as temporary and negligible; if firms (banks) decide that the benefit of keeping same rates is higher than that of changing rates, they may prefer not to adjust their loan rates. In the end, this arises interest rate stickiness.

Bernanke et al. (1996) develop a dynamic general equilibrium model to show how credit market frictions have impact on large fluctuations in real economy. They argue that price stickiness in credit markets affects the transmission mechanism. In their framework, in case of contractionary monetary policy (rate hike), there is a fall in asset prices, and firms will lose ability to get new loans with their deteriorated balance sheets, which will result in less investment spending. This will eventually create a financial accelerator, that is, as less economic activity causes downward movements in asset prices, the tighter financial conditions will be observed in credit markets, and hence reduction in economic activity. Under these circumstances, banks prefer to overpass-through from policy rates to loan rates in order to avoid default risk emerged due to weakening economic conditions. In this sense, Gerali et al. (2010) build up a dynamic stochastic general equilibrium model to understand the credit market developments in business cycle fluctuations. Their model deliver that sticky bank rates stand for moderating effects of monetary policy shocks. Also, they find that substantial

downturns in credit market due to financial frictions erode bank capital, and this causes an increase in net interest margins[2] and thus reduction in credit volumes. In other words, increasing default risk of firms during economic downturn periods compel banks to set higher lending rates, where such developments end up with overpass-through in lending rates.

The early theoretical contributions uncover the general framework on how loan rates are typically formulated by commercial banks. Most of them agree on the idea that asymmetric information, switching costs and risk sharing agreements prevent smooth monetary transmission by causing rigidity in the interest rate pass-through process.

1.2 EMPIRICAL LITERATURE

Beyond the theoretical studies, empirical studies cover interest rate pass through process from various perspectives. While early empirical studies focus on only single country or cross-country comparisons of pass-through, latter empirical studies reveal that macroeconomic variables, different monetary policy implementations, structure of financial system and bank-specific variables may have substantial roles on the magnitude and speed of interest rate pass-through. In this part, we briefly summarize the relevant studies in this context.

Cottarelli and Kourelis's (1994) cross-country evidences are one of the earlier empirical contributions to the related literature. They compare industrial and developing countries with respect to magnitude and speed of interest rate pass-through. They relate interest rate stickiness to the structure of financial system of the respective country. Specifically, they propose that the existence of alternative financial products, free international capital movements as wells as high competition increase lending flexibility of bank rates, and hence speed up the adjustment process.

The business cycles have considerable effects on banks' pricing behaviours of deposit and loan rates. Banks become less willing to reflect policy rate cuts to their loan rates during recessionary times. However, reflecting the rate cuts is easier for them during

[2] Net interest margin is (net interest income-net interest expense)/ (average interest-earning assets).

the economic expansion periods due to risk perception (Égert & MacDonald, 2009). The macroeconomic environment can also have a role on interest rate pass-through mechanism. Gigineishvili (2011) analyse the pass-through process in a group of 81 countries including low income, developing and developed ones for the period of 2005-2010. He finds that during inflationary periods, banks prefer to modify their rates so quickly that they can protect their profits against inflationary pressures. As for the high volatility periods, the pass-through mechanism weakens, since banks prefer to delay reflecting changes in interest rates on loan rates until uncertainties disappear in financial markets. Aristei and Gallo (2014) analyse interest rate pass-through mechanism in Euro area, employing monthly data over the period of 2003-2011. They show that in high volatility times, the size of short-run pass-through to loan rates remains low, whereas the speed of adjustment of loan rates to its long-run equilibrium is quite high. Moreover, Gigineishvili (2011) finds that higher per capita GDP have positive effects on the margin of interest rate pass-through. Specifically, it implies that advanced financial markets in rich countries support stronger pass-through, and this leads to smooth monetary transmission mechanism in these countries.

The outbreak of global financial crisis (GFC) in 2008 caused high stress in banking industry globally. Central banks, especially in advanced economies, were concerned closely about the monetary transmission mechanism after all. Gambacorta and Illes (2015) investigate the pass-through mechanism in advanced economies such as United States, United Kingdom, Italy, and Spain for the period 1989-2003. They employ the two-step cointegration procedure with an error-correction model (ECM) by introducing risk-related variables, namely delinquency rate and credit default swap (CDS)[3] spreads for banks. They conclude that long-run relationship between policy rates and loan rates is dampened during the GFC due to the deterioration in risk perception of banks. Furthermore, Hristov et al. (2014) investigate the immediate effects of GFC on retail interest rate spreads[4] for Euro area over the period of 2003-2011. They find that while interest rate pass-through is complete before the GFC; however, it becomes incomplete period after GFC. They relate this situation to widening interest rate spreads due to macroeconomic shocks during financial crisis.

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[3] Credit Default Spreads is a derivative instrument that provide insurance for a company (or sovereign entity) defaulting on its credit. For further details, see Hull and White (2002).

[4] The wedge between loan rates and deposits rates.

In the literature, there are also studies that point out the substantial role of structural features of the financial system on interest rate pass-through. Loayza and Hebbel (2002) argue that the variety of financial institutions, competition, ownership structure (public or private) and, diversity in financial products determine how the monetary transmission mechanism work. They propose that in an uncompetitive market, interest rate channel of the transmission mechanism may weaken to some extent. When financial system becomes less diversified in terms of financial products and institutions, effectiveness of asset price channel will be hampered. Similarly, in countries where capital movements are heavily controlled by governments, exchange rate channel of transmission mechanism remains weak. Weber et al. (2009) investigate efficiency of transmission mechanism in Euro area over the period of 1980-2006. They stress that the depth of financial system empowers the role of market expectations which expectedly quickens the pass-through to short term market rates, and eventually to lending rates.

There are several empirical contributions to the related literature analysing the effects of structural breaks such as introduction of Euro. For example, Marotta (2009) investigates the magnitude and speed of interest rate pass-through across European Monetary Union (EMU) countries over the period of 1993-2003. He finds that after the introduction of euro, the pass-through from market rates to banks' rates becomes more complete and faster thanks to the uniformity in monetary policy framework. In another study, de Bondt (2005) provides evidences for euro area. He finds that after the introduction of euro in 1999, while pass-throug to retail rates are incomplete in short-term maturities, it was higher for long-term maturities. Also, the pass-through process has become faster thanks to the environment provided by Stage Three of EMU, which stimulated the competition in banking products and the use of alternative financial instruments. Chionis and Leon (2006) examine the monetary transmission mechanism in Greece for over the period of 1996-2004 by using bivariate cointegration and error correction models. In their analysis, they find that with the accession of Greece to EMU in 2001, bank retail rates (deposit and loan rates) turn out to be more sensitive to the change in policy rates because of common monetary policy framework.

Most studies in the literature focus on the cross-country analysis, which emphasize the differences of structural characteristics of respective countries. Saborowski and Weber (2013) employ a panel VAR model over the period of 2001-2011 for eight groups of countries. They find that countries grouped into G20 and developed markets have

higher pass-through compared to less developed country groups such as the Middle East and North Africa (MENA) and Sub-Saharan Africa countries. They find that better asset quality, exchange rate flexibility, development of financial system and higher competition are considered as the important determinants of pass-through from policy rates to retail rates.

Several studies provide a detailed discussion on how monetary policy framework has impact on the magnitude and speed of pass-through. Bredin et al. (2001) investigate the interest rate pass through in Ireland over the period 1980-2001 and, find that the speed and magnitude of pass through depend on the anticipation effects of monetary policy changes. If a change in monetary policy is expected, the banking sector will respond faster to the policy changes, which improves the effectiveness of interest rate pass through. Mojon (2003) analyses the interest rates of Euro area countries over the period 1979-1998 period and underlines that monetary policy regime affects the pass-through process. More specifically, if central banks have exchange rate targets or credibility problem, they try to adjust money market rates according to their target levels. In this case, banks may prefer not to respond accordingly to money market rate changes due to adjustment costs of updating the retail rates. Consequently, this will result in incompleteness in the pass-through process. As for the central bank transparency, Liu et al. (2008) investigate interest rate pass through in New Zealand over the period of 1994-2004. They find that transparent monetary policy reduces the volatility of official rates and leads to more stable short-term future rates. In this respect, as banks face with less uncertain rates, the degree of pass-through to retail rates becomes more complete.

The literature provides prolific findings on the effects of competition among banks on pass through mechanism. Van Leuvensteijn al. (2008) analyse the effect of market competition on bank interest rates in eight euro area countries 1994-2004 period by using a panel error-correction model. They contribute the literature by introducing a competition measure called Boone indicator.[5] They find that interest rate spreads are substantially lower in case of high competition. This result implies strong interest rate pass-through in terms of the magnitude and speed of adjustment under high competition, which in turn supports the efficiency of monetary transmission mechanism.

[5] Boone indicator introduces an indicator which shows the profit elasticity with respect to marginal costs incurred by banks (Boone, 2008). For details, see. van Leuvensteijn (2008).

Gigineishvili (2011) provides cross-country results by employing return-on-equity (ROE)[6] as a proxy for the degree of competition. The underlying idea is that high profitability of a few banks (high ROE) is a signal of lack of competition in the banking sector and, this implies that banks will become reluctant to marginal changes in market interest rates, which causes to incompleteness in pass-through process.

The bank-specific variables are the other determinants of interest rate pass-through process. Holton and Rodriguez d'Acri (2018) employ monthly data of Euro area over the period 2007-2012, using autoregressive distributed lag (ARDL) and error-correction models. They find that size, capital level, liquidity and asset quality have effects on pass through mechanism both in terms of magnitude and speed. They underline that small banks compared to large banks are more inclined to pass changes in market rates to their loan rates. As for the liquidity, less-liquid banks perform weaker pass through than banks with higher liquidity. Furthermore, they conclude that banks with stronger capital structures have less pass through in magnitude and speed in financial distress periods. Similarly, Stanislawska (2015) assesses the interest rates of Poland over period of 2005-2013 by examining the possible influences of bank characteristics such as bank size, credit portfolio, deposit base, liquidity ratio and capital adequacy ratio (CAR). Their results indicate that the completeness of pass-through is positively correlated to the quality of credit portfolio, stronger deposit base, liquidity ratio and capital adequacy ratio of respective bank.

The co-movement of sovereign bond yields with retail rates is another widely discussed topic in the literature. The underlying idea is that if a country face with the sovereign default risk, such fear of default will induce banks to increase their spreads to protect themselves against negative economic conditions. Eller and Reininger (2016) investigate 21 EU countries over 2003-2014 period by using a panel error correction model. They find that long-term sovereign bond yields have significant reflections on bank loan rates via yield channel. According to the researchers, the reason why some countries' bond yields have no influences on long-term loan rates may lay behind some structural characteristics such as ownership structure of banks and/or level of loans given in foreign currency.

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[6] The return-on-equity (ROE) is a ratio of the profitability of a firm relative to its equity. It is a measure for how a firm utilize investments to make earnings.

The existing literature further examines the asymmetric relationship between official rates (or market rates) and retail rates. The literature agrees on that there are two reasons for asymmetric adjustment i.e. collusive market hypothesis and adverse customer reaction. While the first one implies upward rigidities in deposit rates and downward rigidities in loan rates, the second one implies downward rigidities in deposit rates and upward rigidities in loan rates (Hannan & Berger, 1991; Neumark & Sharpe, 1992). In this context, Payne (2007) analyses the interest rate pass-through by using federal funds rate and mortgage rates of US over the 1987-2005 period, adopting a momentum threshold autoregressive model (MTAR). He finds incomplete pass-through of federal funds rate to mortgage rates with asymmetry in adjustment process. Specifically, mortgage rates adjust faster to the decrease in federal fund rates compared to increase in federal funds rate. Wang and Lee (2009) investigate the US interest rates together with nine Asian countries over the period of 1994-2004. Similarly, they adopt threshold autoregressive and momentum threshold autoregressive models in order to reveal asymmetry in adjustment process. Their results show that only US deposit rates among other countries rates have complete pass-through mechanism. On the other hand, they find asymmetric adjustments for both deposit and lending rates of sample countries. Wang & Lee (2009) relate downward rigidities in lending rates to collusive pricing arrangement hypothesis and upward rigidities in deposit rates to adverse customer hypothesis.

Sander and Kleimeier (2004) analyse interest rates of 13 Euro zone countries over 1993-2002 period, utilizing TAR and MTAR models. Their results show that one can expect downward rigidity for loan rates and upward rigidity for deposit rates in Euro zone. They relate their results to the uncompetitive environment in the banking industry. Becker et al. (2012) focus on UK mortgage rates over 1995-2008 period and analyse the interest rate pass-through under the structure of TAR and MTAR models. They consider a two-stage pass-through process by which the first step is defined from policy rates to market rates and, from market rates to deposit and loan rates as second. They find that while the first step of the pass through is complete, second step is not. They also test the nonlinearities and find that while tightening monetary policy (rate hike) have quick impact on mortgages rates, loosening policy (rate cut) does not have an impact as fast as that of rate hikes.

1.2.1 EMPIRICAL STUDIES ON TURKEY

Although there is a growing literature on analysing the monetary transmission mechanism in Turkey, the number of studies investigating the interest rate pass-through mechanism remains quite scarce. Aydın (2007) uses panel data of individual banks in Turkey over the period of 2001-2005 and finds that central bank has a control over loan rates with one quarter period. Specifically, he shows that while consumer loans such as cash and automobile loans have the complete pass-through due to a highly competitive environment, commercial loans exhibit incomplete pass-through due to high switching costs and lack of deep financial markets. Yüksel and Özcan (2013) investigate the asymmetry in pass-through process for the period of 2001-2011 by employing TAR and MTAR models. They find that for all loan types, speed of adjustment is approximately 2-3 months. They also verify that under MTAR specification all loan types exhibit symmetric adjustment, whereas under TAR specification; only housing loan rates exhibit asymmetric adjustment. Similarly, Yıldırım (2014) adopts TAR and MTAR methodology over a similar sample period, and finds that all loan types exhibit downward rigidity in case of rate cut by the central bank. Specifically, commercial loan rates have the stickiest characteristic in response to the rate cuts. Yıldırım (2014) relates incomplete asymmetric pass-through to the arguments of Aydın (2007), which are high switching costs and lack of deep financial system.

Çavuşoğlu (2010) analyze level and speed of interest rate pass-through from policy rates to Turkish loan rates and deposit rates for the period of 2002-2009, which coincides with implicit inflation targeting experience of CBRT. Her study find that housing loan rates have the largest and fast pass-through since supply and demand conditions in housing loan rates have relatively more sensitive to other loan markets, and competitive market structure may cause complete and faster pass-through mechanism. For the consumer loan rates she finds low degree of pass-through. Her study relates this result with low collateral of loan type and low sensitivity of customers to change in loan rates. Also, commercial loans have the weak pass-through because of tight credit condition in commercial loan market.

Binici et.al (2016) investigate the effectiveness of the Central Bank of the Republic of Turkey (CBRT) unconventional policy framework for the period of 2010-2014 by examining the relationshio between monetary policy elements such as official rates,

effective rates, effective reserve ratio and loan/ deposit rates. They find that loan rates and deposit rates are relatively more responsive to the the interest rates indirectly determined by the polices of CBRT –effective rates- i.e interbank money market rates rather than officially announced rates. Their study underlines that the result is not surprising because interbank money market rates are the benchmark for marginal cost of funding for banks. They also highlight that asymmetric response of loan rates to change in monetary policy rate can be related to pricing power of Turkish banks, which indicates that banks operate in monopolistically competitive enviroment. Conversely, the symmetric relationship between policy rates and deposit rates does not imply high competition in deposit market but the existing of alternative financial instruments.

Uslu & Karahan (2016) analyse the interest rate pass-through mechanism from policy rates to loan rates over the period of 2002-2014. Similar to Yıldırım (2014), they employ interbank money market rate as explanatory variable. Once they find the short-run and long-run relationship between money market rates and consumer. Their study investigate the dynamic relationship through Kalman Filter. They find that after global financial crisis in 2008 pass-through effect become more stable and from late 2010 effects of policy rates on loan rates increase thanks to financial stability concerns of CBRT. Similar to previous studies, Uslu & Karahan (2016) find that consumer loans exhibit complete and faster pass-through compared to other loan types. They relate this result to short term structure of consumer loans and competition structure. For housing loan rates, long term structure and switching costs are the main reasons for incomplete/ weak pass-through. Additionally, their results indicate that loan rates exhibit asymmetric adjustment in response to change in policy rates. They associate this with collusive market hypothesis, since banks rates display downward rigidities. According to authors, uncertainties in global economy, tight credit conditions of banks and economic slowdown in economic activities may cause such asymmetric adjustment.

Recently, Şahin (2019) examines the asymmetric effects of policy rate changes on retail rates, stock prices, the real exchange rate over the period 2002-2008 by using nonlinear vector error-correction model (NVECM). He finds complete and symmetric pass-through from the real policy interest rate (i.e. policy rates minus inflation) to loan rates, especially to housing loan rates. Additionally, his results show that the pass-though is more complete for deposit rates.

In conclusion, our study differs from other prior studies in terms of variable selection, period in question, and some methodological aspects. While previous studies solely focus on relationship between policy rate and loan rates, our study contributes to the related literature by adding risk measure variable –EMBI spread- with an up-to-date observation period, which ranges from 2011 to 2019. Yüksel & Özcan (2013) and Yıldırım (2014) focus on 2002-2010 period; however, we consider 2011-2020 period when the CBRT implemented new unconventional monetary policy in which asymmetric wide interest rate corridor policy was introduced. Although we employ similar methodology of Yüksel & Özcan (2013) in general, our study differs in terms of some methodological points. While they use zero threshold level in their analysis, we employ endogenously determined threshold level that is obtained by grid search method.

CHAPTER 2

AN OVERVIEW OF TURKISH BANKING SYSTEM

2.1 HISTORICAL OVERVIEW

Until 1980s, Turkish banking system was dominated by public banks and hence the price of money capital was determined by the state authorities. During 1970s, Turkish economy suffered from high public debt and high inflation pressures which resulted in negative real interest rates. In 1980, a stabilization program was implemented to solve the foreign debt crisis, and this program was designed as a stand-by agreement with International Monetary Fund (IMF). The program proposed several measures including extensive liberalization for financial markets and foreign trade. The liberalization process of Turkish economy led to an acceleration in banking activities, where the determination of interest rate was left to the market forces. Consequently, Turkish economy witnessed a high degree of competition in banking industry, which supported the diversification in banking sector.

In 1990s, public banks' lending and borrowing decisions deteriorated the Turkish banking industry dynamics. The main activity of banks was financing high government debts via domestic and foreign sources. Particularly, they invested in risk-free government bonds in return for high interest rate payments by the government. At the same time, credit policies of public banks had become too much politicized during these periods and this led to high duty losses of public banks, which in turn inevitably amplified the fragility of the overall economy (Akın et al., 2009). Asian and Russian crises in 1997 and 1998 had contagious effects on Turkish economy as well, which halted the capital inflows and external borrowing sources (Güneş & Yıldırım, 2016). Consequently, in 1999, Turkey again agreed with IMF on a disinflation program, which was designed as anchoring inflation expectations to curb inflationary pressures and to lessen the cost of borrowing of Turkish Treasury. Although Turkey had full commitment to the program in terms of ensuring the price stability and currency-peg regime, it failed to achieve some targets that program had suggested, especially low commitment to privatization of some state-owned enterprises and extensive restructuring of public sector. Together with the rapid credit growth in those years, low degree commitment to

structural reforms unavoidably caused exchange rate risk and further liquidity stress in November 2000. The inevitable bankrupts in the banking sector sparked the subsequent financial crisis in February 2001. Therefore, Turkey witnessed an immediate failure of the disinflation program. With the bankruptcy of some banks, Turkish lira faced with severe devaluation due to speculative attacks in early 2001. The overnight interest rate in the money market skyrocketed to a historical level of 15000 percent, and Turkish economy lost more than 4 percent of its gross national product (Görmez, 2008).

Turkey tackled 2001 financial crisis with extensive structural adjustment programs, which includes with fiscal, monetary and macro-prudential steps. These are summarized as the introduction of new central bank law[7], launching a floating exchange rate regime with an inflation targeting framework, consolidation and restructuring of the banking system and formation of the Banking Regulation and Supervision Agency (BRSA). The banks' restructuring program operated by BRSA constituted an important part of the prudential policies after 2001 crisis. The main components of the program can be summarized as (i) financial restructuring of public banks, (ii) prompting engagement of private capital to enhance private banking, (iii) resolution of Savings Deposit Insurance Fund of Turkey (SDIF) by selling banks after rehabilitation, (iv) taking prudential measures against financial risks and systematic supervising of the banking sector. The main reason why authorities implemented prudential policies based on banking sector was that the considerable part of Turkish financial system had been dominated by banks. Following this process, recovery signals were underway in economic activity thanks to the close-fitting prudential policies and softer global liquidity conditions. Turkey witnessed rapid credit growth after 2001 crisis with the help of global ample conditions. The private credit to GDP ratio was around 20 percent in 2001 and rose dramatically to 40 percent by the end of 2010 (Kara, 2016; Güneş & Yıldırım, 2016).

After 2001 crisis, the successful implementation of prudential policies (mix of monetary and fiscal policies) with structural reforms directly supported the recovery process in terms of various dimensions as mentioned above. The inflation hit single digits,

[7] The instrumental independence of the CBRT was legalized by the Parliament, thereby maintaining the price stability became the ultimate goal of CBRT. By 2011, in addition to maintaining price stability, CBRT was given to take regulatory measures to ensure financial stability in Turkey.

approximately 9 percent by the end of 2004 with restoring in inflation expectations thanks to effective communication steps of CBRT. The nominal interest rates fell gradually from 67 percent in 2002 to 15 percent by the end of 2005. Following improvements in economic fundamentals boosted the consumer and corporate sector confidences. Therefore, credit demand appetite increased dramatically. Moreover, in 2005, Turkey and European Union (EU) initiated negotiations on accessions of Turkey to EU. The reconciliation and prospects with EU and internal political stability both played an important role on reduction in risk premium of Turkish assets, and hence on rapid credit growth that was measured 19 percent over period 2002-2005. The share of foreign banks in the sector was 13.6 percent by July 2005, with an increase from 3.6 percent in 2002, which means that foreign banks participation supported the increasing trend of credit growth (Başçı, 2006). This notable trend was halted by the global financial crisis in 2008 due to the slowdown in the economic activity.

The shockwaves of financial crisis rapidly spread to emerging market economies via several channels such as financial markets and trade channels. Inevitably, Turkish economy, too, was affected from global financial crisis via trade and finance channels. Turkey witnessed a foreign demand shock combined with net capital outflows, depreciation in currency, rise in risk premium and tight liquidity conditions in banking sector. The deteriorations in economic indicators led to uncertainty and decrease in business confidence, which caused slowdown both in investment and consumption spending (Rawdanowicz, 2010). The economy shrank almost 7 percent in the second quarter of 2009, which was a decrease from 7.2 percent average growth rate of 2002-2006 period. However, the financial position of Turkish banking system was not shattered as much as in other emerging markets thanks to the macro prudential policies implemented after 2001 crisis. Uygur (2010) relates this case to the strong balance sheet structure of Turkish banking and to the absence of toxic financial instruments in banking sector's portfolios. Hence, negative effects of global financial crisis on banking sector remained quite limited. On the other hand, the global financial crisis evolved into a sovereign debt crisis in Euro countries. The underlying reason was the efforts of European governments to rescue troubled banks which had previously invested in the US sub-prime mortgage market. The first effects of crisis appeared in Greece in the form of a severe sovereign debt. The contagious effects of the crisis spilled over to other European countries soon after. Eventually, by 2010, Turkish economy was affected directly from the European debt crisis through the trade

channel, since Turkey and EU were close trade partners. However, after 2001 Turkish banking sector were restructured so strong that subsequent effects of global financial crisis and European debt crisis remained limited (Uygur, 2010).

The prolonged effects of financial crisis came up with a collapse of aggregate demand in developed countries. The major central banks initiated quantitative easing policies in order to provide liquidity support to the global financial system. As liquidity became abundant in capital markets, low interest rate environment was recorded, therefore economies paying high yield were favourable areas for financial markets. Following the expansionary policies of developed countries, emerging market economies faced with rapid capital inflows, excessive appreciation in local currency, and thus increase in import demand. These movements triggered further deterioration in current account balance in the form of deficit. The dependency on short-term capital to finance current account deficits led to fragilities in Turkish economy as other emerging market economies after 2008 period. Therefore, Turkey prompted counter-cyclical policies in response to the sudden stop in the capital flows. By April 2010, the Central Bank of Republic of Turkey (CBRT) announced its exit roadmap proposing a tightening in monetary policy and accumulation in foreign reserves. The CBRT adopted new policy mix by pointing out the global imbalances associated with macro-financial risks. The main objective of these policies was to restrict speculative capital inflows (excessive appreciation in local currency), thus to curb excessive credit growth. Previously, the CBRT used borrowing rates as conventional policy tool after 2001 crisis. Since mid-2010, the CBRT adopted unconventional monetary policy in which multiple policy rates are used in an asymmetric corridor as well as reserve requirement ratio as an active policy instrument[8] (Binici et al., 2019).

Following the recession period, combined with the recovery in global economic recovery, economic activity in Turkey was signalling recover signs. Together with the abundant liquidity in banking sector and low interest rate environment, credit growth acceleration caused a positive momentum in private consumption, capacity utilization and hence in investment level. However, during 2007-2014 period, the lower growth with higher current account deficit figures challenged the Turkish economy. While the average growth rate of the economy decelerated to 4 percent from 7 percent which was the average of period of 2002-2006 (Acemoglu & Üçer, 2015).

[8] The details of these instruments are explained in Chapter 3.

In last decade, specifically from 2010 onwards, banking sectors' resilience against downside risks, which caused from geopolitical developments remained steadily thanks to high asset quality, robust capital buffer and liquidity positions.

2.2 AN OUTLOOK FOR THE TURKISH BANKING SECTOR

A considerable part of the Turkish financial system consists of commercial banks. According to the Banks Association of Turkey (BAT), there are 32 deposit banks, 13 development and investment banks and 6 participation banks as of September 2019. The majority of deposit banks are the foreign banks. Specifically, of 32 deposit banks, 21 are foreign, 8 are domestic private and 3 are public banks. (Figure 2.1)

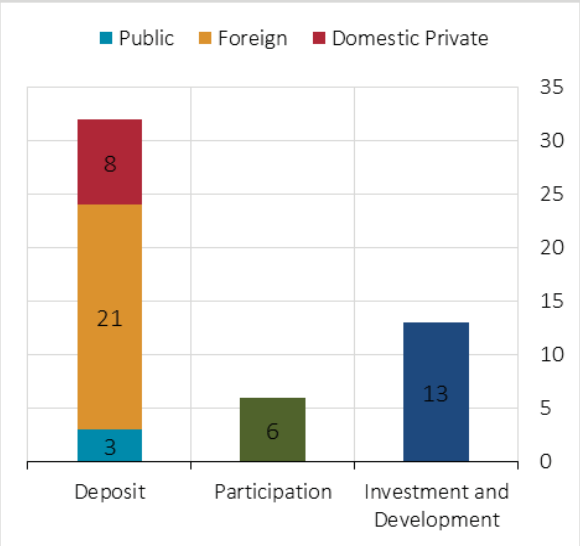

Figure 2.1: Total number of Turkish banks by their ownership

Source: BRSA

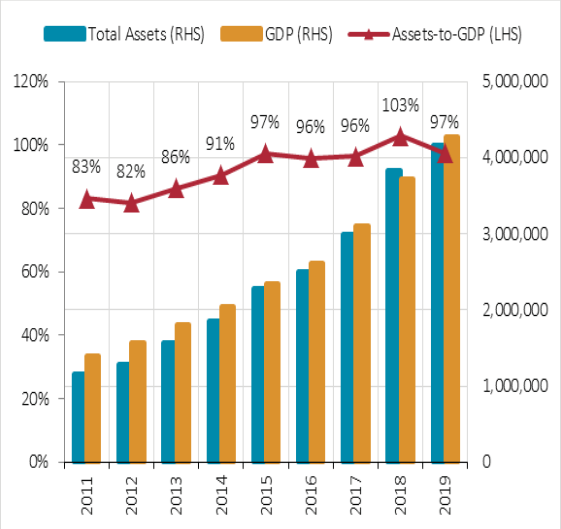

Figure 2.2: Total assets to GDP (million TL)

Source: BRSA

The total assets of the banking sector continually grew over the period of 2011-2019 in parallel with the economic activity in Turkey (Figure 2.2). While the total assets of banking sector reached to around 4,500 billion TL by the end of 2019 from 1,200 billion TL in 2011, the total loans reached to 2,650 billion with an increase from 682 billion TL in 2011. With the increasing momentum of loans and assets, the loan to asset ratio followed an increasing trend until 2019; however, the ratio recorded a slight decrease after mid-2018 due to tight loan appetite of commercial banks and weak demand conditions caused by tight global financial conditions, geopolitical pressures and

sector's tight liquidity preferences (Figure 2.3). However, the negative effects of cautious stance of private banks were partly offset by public banks. Specifically, the annual loan expansion of public banks was recorded 14.3 percent, while total loans of private banks fell by 5.1 percent (CBRT,2019b).

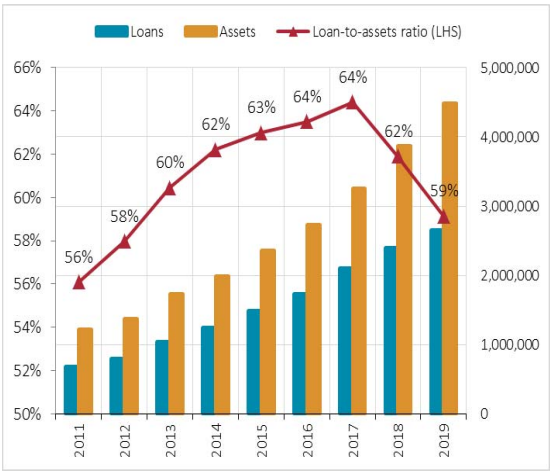

Figure 2.3: Loans, assets, loans-to-assets (million TL)

Source: BRSA

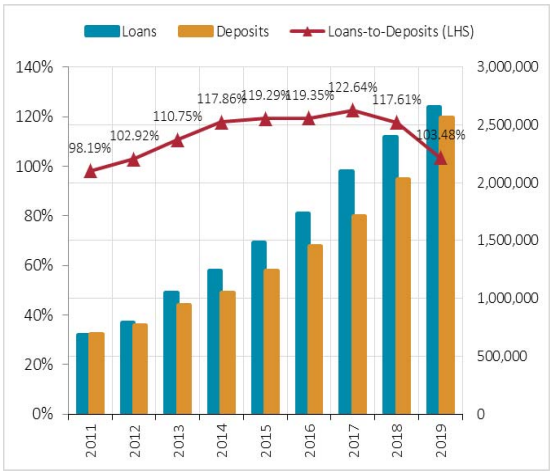

Figure 2.4: Loans to deposits ratio (million TL)

Source: BRSA

The loan-to-deposit ratio exceeds 100 percent over the period of interest (Figure 2.4). This indicates that liabilities of Turkish banking system are not enough to meet internal loan demand. However, by the end of 2019, loans to deposits ratio slightly decreased to 103.48 percent. This can be related to favourable developments in domestic funds and favourable preferences in core liabilities[9], which in turn reduces the vulnerability of banks against external volatilities (CBRT, 2019b).

One of the profitability indicators for banking sector is the capital adequacy ratio (CAR)[10]. It is initially introduced in Basel Accords set by the Basel Committee on Bank Supervision (BCBS). Owing to the measures and the supportive policies implemented by BRSA after 2001 crisis, CAR remained still strong over January 2011-July 2019 period (Figure 2.5). The ratio remained flat over the period and relatively higher than

[9] Core liabilities simply consist of liabilities to households, such as demand or time deposits.
[10] Capital adequacy ratio is a ratio of capital-to-risk weighted assets.

the minimum rate suggested by both Basel III and BRSA, i.e. 8% and 12%, respectively. In August 2018, the negative effects of uncertainties in financial markets, were prevented thanks to the regulations implemented by authorities and banks' prudent behaviours, namely their willingness to maintain robust capital structure against financial distresses. In this sense, the CAR ratios of Turkish banks prove its buffer role that protect banks against such downside risks.

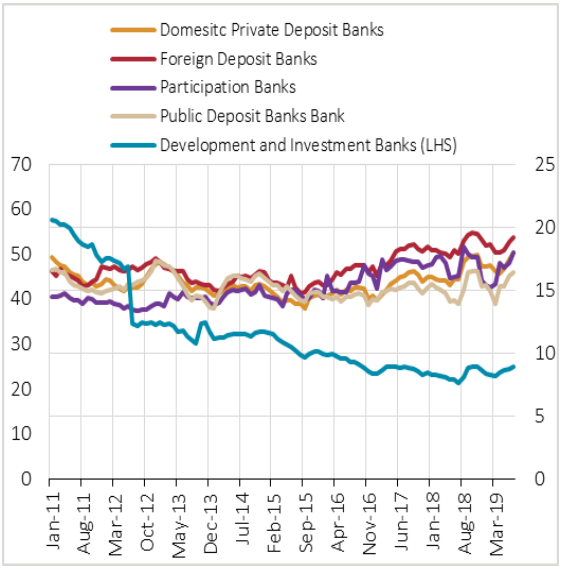

Figure 2.5: Capital Adequacy Ratio of Turkish Banking System (%)

Source: BRSA

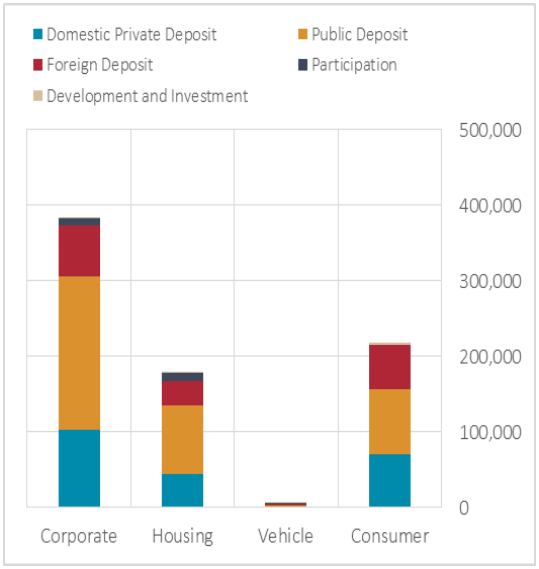

Figure 2.6: Total Loans of Turkish Banking System (million TL)

Source: BRSA

The total loans of Turkish banking sector amounts to approximately 2.6 trillion TL as of December 2019. When focusing on loans, corporate loans have the highest share in total loans, which is approximately 384 billion TL, whereas vehicle loans have the least with 5 billion TL. The public banks have the highest share of corporate, consumer, and housing loans, followed by foreign deposit banks, while participation and development banks have the least share for all loan types (Figure 2.6).

CHAPTER 3

MONETARY POLICY FRAMEWORK IN TURKEY

After the global financial crisis in 2008, flow of capital to emerging markets become volatile and uncertain due to expansionary monetary policy in developed countries. Under ample liquidity conditions, emerging market economies underlined the necessities of new approaches which aim financial stability. For this purpose, Central Bank of the Republic of Turkey (CBRT) implemented a new policy mix to provide financial stability beyond its conventional price stability target. This chapter gives information about the monetary policy framework conducted by CBRT after global financial crisis.

In April 2010, the CBRT declared its exit strategy after the period with low interest rate environment. Within this strategy, the CBRT adopted an unconventional interest rate corridor which prompted a wide and asymmetric corridor. This policy differs from the conventional interest rate corridor system where policy rate is quite close to interbank money market rates. First, the CBRT allows for the asymmetrical difference between policy rates and lower bound of corridor (overnight borrowing) and upper bound of corridor (overnight lending) rates (Figure 3.1).

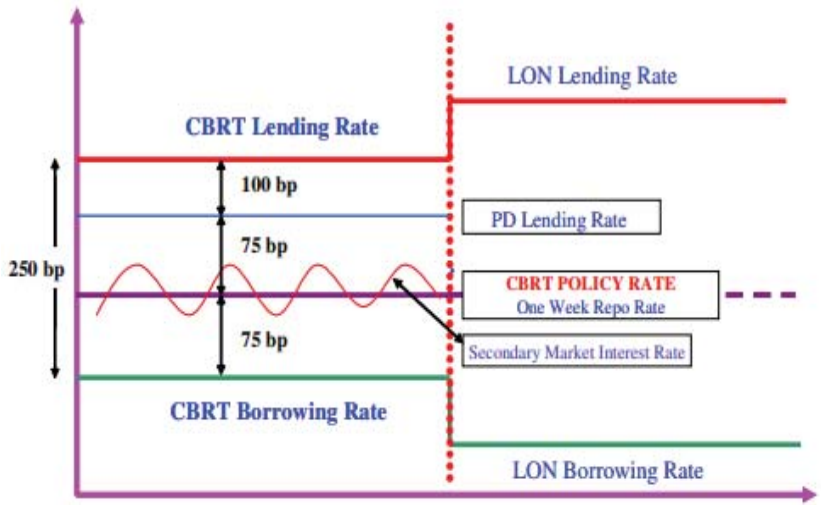

Figure 3.1: Interest rate corridor

Source:CBRT (2010)

Second, this system leads secondary market (money market) rates to diverge from the policy rates, whereby Central Bank aims to discourage the speculative capital inflows by increasing the volatility of short-term interest rates.[11] Therefore, the parameters of the corridor are used effectively as an active policy tool in accordance with the developments in capital flows. In this context, Binici et al. (2016) present the short-term interest rates as depicted in Figure 3.2 and group them into two as official rates and effective rates.

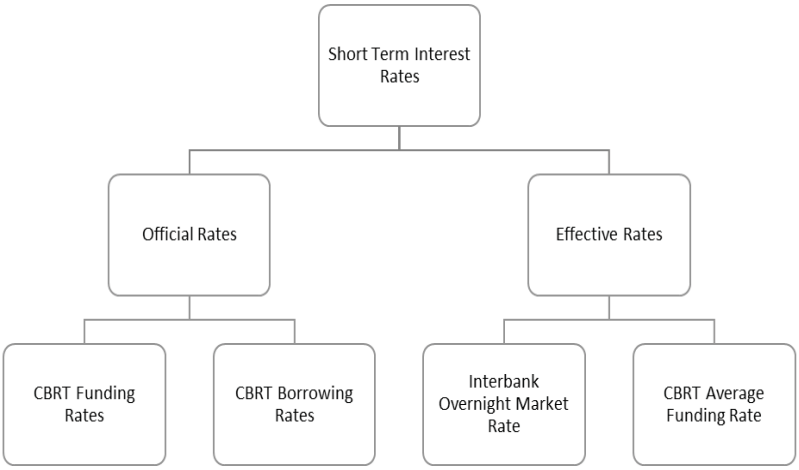

Figure 3.2: Short-term interest rates

Source: Binici et al. (2016)

i. **Official rates**: These rates are announced periodically via policy statements of Monetary Policy Committee (MPC).

   a. **Funding rates:** By using these rates, CBRT provides liquidity to the market. The first one is the one-week repo auction rate, which is designated for reference (policy) rate for monetary policy. Note that overnight borrowing interest rate was taken as policy rate previously. The second one is the overnight lending facility rates, which constitutes the upper bound of the interest rate corridor.

   b. **Borrowing rate:** This rate is used for borrowings of CBRT. However, since the banking system has net liquidity deficit, this rate is remained idle.

[11] Return-to risk ratio compares the average return on an investment with respect to risk that investor have to undertake.

ii. **Effective rates:** These rates are formed in accordance with the CBRT's funding strategy. The combination of effective rates represents the monetary policy stance of CBRT.

a. **CBRT average funding rate**[12]: This rate indicates the weighted average of the interest rates of funds provided by the CBRT operations with banks. It varies with the CBRT's funding composition. The CBRT's reports and announcements often refer to this rate, since it has been regarded as a policy variable.

b. **Interbank overnight market rate:** This rate exists at Borsa Istanbul (BIST) Interbank Repo/ Reverse Repo market, where banks and financial institutions can engage in repo/ reverse repo operations.[13] The CBRT can steer interbank rates via its open market transactions. The interbank rate overnight interest rate can be considered as benchmark rate for pricing of deposit and loan rates.[14]

To this end, in this study, we use interbank overnight rate as an explanatory variable to investigate the transmission from policy rates to loan rates of commercial banks.

In the asymmetric interest rate corridor system, the difference between the overnight lending rate and overnight borrowing rate constitutes the corridor bounds. The CBRT allows short-term market rates to fluctuate within this corridor. According to this policy framework, short-term market rates would not be expected to exceed upper bound of corridor which is overnight lending rate nor to remain below lower bound of corridor which is overnight borrowing rate (Figure 3.3).

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[12] CBRT Average Funding Rate = Weekly Repo Rate*Weekly Repo Rate + Overnight Lending Rate*Overnight Lending)/ Total Funding.

[13] There are two repo markets at Borsa Istanbul. In the Interbank Repo/Reverse Repo market, banks are not obliged to hold required reserves for their direct transactions among themselves, while in the BIST Repo/ Reverse Repo Market, banks can borrow from other market participants and are obliged to hold required reserves. In both markets, interest rates are quite similar to each other, however, there may be divergences due to transactions costs and required reserves. In this study, interest rate of BIST Repo/ Reverse Repo is taken as benchmark rate for banks' cost of funds.

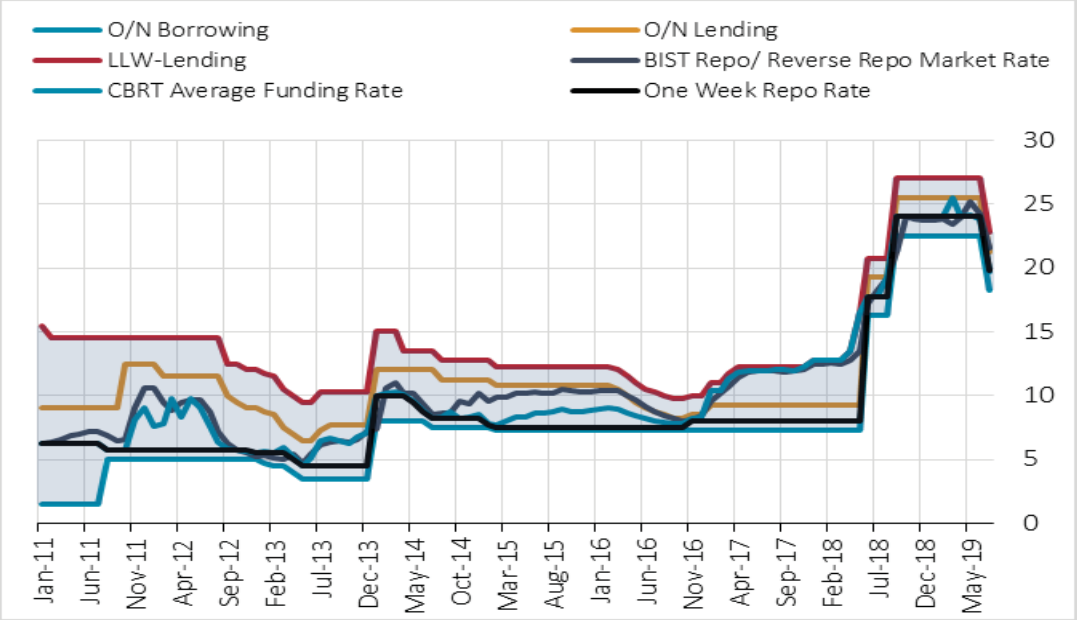

Figure 3.3: CBRT Interest Rates and BIST Interbank Rate (%)

Source: CBRT, BIST

As shown in Figure 3.4, CBRT designates its policy stance by altering the funding composition, which is solely based on the relative share of weekly, overnight funding (marginal funding) and late window liquidity facility. For instance, when the CBRT increases the share of weekly funding, we observe a loosening in CBRT average funding rate, whereas when the CBRT increases the share of overnight funding (marginal funding) we observe a rise in CBRT average funding rate. With the adjustments in the wide interest rate corridor, during March-September 2016 period, the CBRT decided to alter its wide corridor policy to a more simplified one[15], since different funding rates in the corridor made it difficult to understand the monetary stance of the Bank.

Between 2017Q1- 2018Q2 period, following the deteriorations in pricing behaviours resulting from inflation expectations, CBRT implemented tighter monetary policy by raising late window facility rate from 12.75 percent to 13.50 percent, and a large share

[15] On 28 May 2018, CBRT has decided to simplify its operational framework. According to this simplification process, one-week repo rate would be the policy rate of CBRT, and overnight borrowing and lending rates will be set at 150 basis points below and above the one-week repo rate. Accordingly, overnight market rates would converge around the policy rate within a symmetrical corridor of overnight lending and borrowing rates.

of funding was provided through the late window facility (LLW) instead of one-week repo auctions (CBRT, 2018b). Similarly, in the second half of 2018, the unhealthy price formations in financial markets distorted the pricing behaviours, therefore the Monetary Policy Committee (MPC) put tightening steps into effect to support price stability. As a result, the one-week repo auctions rate was suspended in August 2018 and was reopened later in September 2018. In effect, secondary market rates (BIST Repo/Reverse Repo interest rates) were formed around late liquidity window rate. Within these tightening steps, the one-week repo rate was raised to 24 percent with a 625-basis point increase from 17.75 percent in June 2018 (Figure 3.3).

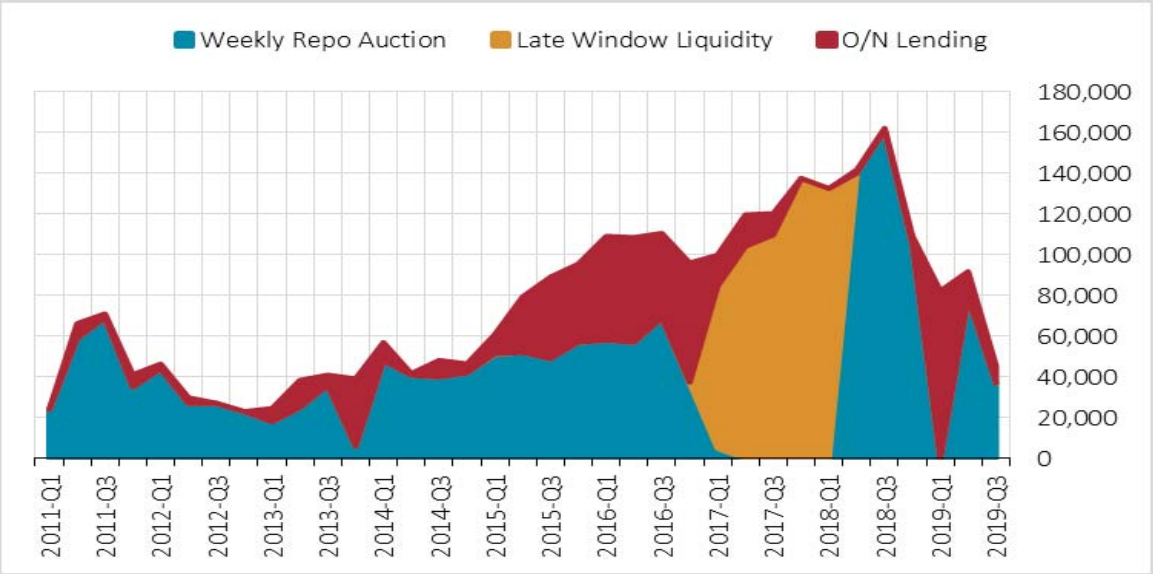

Figure 3.4: CBRT's Funding Composition (Million TL)

Source: CBRT

The risks that emerged from rapid capital inflow and credit growth after global financial crisis take attention of central banks to financial stability concerns. Therefore, central banks started to adopt alternative instruments in response to macro-financial risks. Accordingly, starting from 2010, CBRT used required reserve ratios, range of liabilities and remuneration rates in order to affect the banks' credit lending behaviours (Binici et al., 2016). Alper et al. (2014) show that required reserve policy tool has significant

effects on banks' lending decisions and lessens the trade-off between price stability and financial stability.[16]

The CBRT implemented several unconventional monetary policy tools since 2010 against the fluctuations in capital flows. Besides the unconventional interest rate corridor policy, the CBRT introduced the reserve option mechanism (ROM) in late 2011, which allowed banks to hold their required reserves via foreign currency instead of domestic currency. This policy was designated for countries that deal with short-term capital inflows with high current account deficits. According to this mechanism, when the country experiences capital inflows, foreign funding becomes more preferable for banks, therefore banks will hold their foreign funds as required reserves at central bank, and hence this prevents Turkish lira's excessive appreciation. Conversely, in case of capital outflows, banks will prefer to reduce foreign currency reserve option in CBRT, then to channel their foreign currency into the economy, hence ROM eventually prevents the depreciation of Turkish lira. Küçüksaraç and Özel (2012) calculate the break-even reserve options coefficients (ROC) at which banks remain indifferent between using reserve option facility and alternative sources that can be hold as reserve requirements. They find that the break-even ROC depends on Turkish lira interest rates and foreign currency interest rates i.e. LIBOR, Turkish lira cross-currency swap rates and reserve requirement ratios on foreign funds.[17] Their analysis proposes that break-even ROC is more sensitive to interest rates on foreign currency, which is affected by the risk appetite and external financing conditions. Overall, their study underlines that the reserve option mechanism serves as an automatic stabilizer for fluctuations in exchange rate and is a facility that provides banks room for their liquidity management.

Starting from the late 2017, the CBRT has taken market-oriented steps in order to support financial stability and to contribute efficient functioning of financial markets. The CBRT have taken various market-oriented steps with the aim of improving the flexibility

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[16] Alper et al. (2004) use cost-based reserve requirement ratio, which is $RR^C \approx RR\left(\frac{i_d - i_r}{i_d}\right)$ where i_d is market interest rate, i_r is remuneration rate and RR is required reserve ratio.

[17] Küçüksaraç and Özel (2012) calculates the breakeven ROC as $x = 1 + \frac{1-RR_y}{(Libor+p)} + \frac{swap_{TL} - Libor}{1+swap_{TL}\frac{t}{365}}$

Where RR_y stands for reserve requirement ratio for foreign currency, p for spread that banks pay over LIBOR rate in foreign currency borrowing. For detailed derivation see Küçüksaraç and Özel (2012) study.

in Turkish lira and foreign exchange liquidity management. These operations can be listed as:

- Foreign Exchange Deposits against Turkish lira Deposits Auctions
- Turkish lira Currency Swap Market
- Turkish lira-Settled Forward Foreign Exchange Sale Auctions at CBRT
- TL-Settled Forward Foreign Exchange Transactions at Borsa İstanbul (BIST)
- Turkish lira Gold Swap Market
- Foreign Exchange Gold Swap Market.

With the introduction of these steps, the CBRT aimed to enrich its operational framework to support the transmission mechanism and to assure proper functioning of financial markets (CBRT, 2019a)

CHAPTER 4

DATA AND METHODOLOGY

4.1 DATA

This study examines interest rate pass-through mechanism in Turkish loan rates during the period from January 2011 to July 2019 using a monthly dataset. We use average loan rates (consumer, vehicle, housing, commercial) of the Turkish banking sector which are calculated based on weighted average interest rates for banks loans. The dataset includes all bank types in Turkey, namely public, foreign, private, investment and development banks, except the participation banks. The loan rates in question are obtained from the Central Bank of the Republic of Turkey database (EVDS). In this study, the flow values of loan rates are used, since they provide high-frequency evaluation of the immediate effects of change in policy rates on loan rates (Binici et al., 2016). We start our analysis from January 2011, since during post-2011 period the CBRT has adopted an unconventional interest rate corridor policy by using multiple rates. Such policy change can be considered as a natural experiment by which one can reveal the actual relationship between short-term market rates and lending rates. Table 4.1 presents the summary and descriptive statistics of the variables used in the analysis.

Table 4.1: Descriptive Statistics (2011:01-2019:07)

Variable	Description	Source	Mean	Standard Deviation
Interbank Money Market Rate	The average overnight repo interest rate from the repo transactions in BIST	CBRT	10.8135	5.1291
Consumer Loan Rate	The weighted average interest rates for consumer loans	CBRT	18.1089	5.3088
Housing Loan Rate	The weighted average interest rates for housing loans	CBRT	13.3883	4.1324
Vehicle Loan Rate	The weighted average interest rates for vehicle loans	CBRT	15.5532	5.3170
Commercial Loan Rate	The weighted average interest rates for commercial loans	CBRT	15.4935	5.1929

EMBI Spread	Emerging Market Bond Index of dollar-denominated sovereign bonds issued by Turkey	Bloomberg	303.3398	83.5082

The question of which interest rate should be chosen for monetary policy stance has been discussed broadly in the interest rate pass-through literature. Égert and MacDonald (2009) listed three different approaches. The first one investigates how market interest rates are passed to retail rates (deposit and loan rates), and it is coined as marginal cost of funds approach (de Bondt, 2002). This approach suggests that marginal cost of funds for a bank reflects the opportunity cost of giving loans or investing in money market (repo transactions). The second is the monetary policy approach which aims to measure the direct effect of monetary policy rate on lending rates. The third is the unifying approach which incorporates the previous two into one model. It simply examines the direct transmission from policy rates to market rates at first stage and, from market rates to retail rates at the second stage.

Binici et al. (2016) further question empirically which interest rate would represent the monetary policy stance of CBRT better. They show that effective rates -central bank's average funding rates and interbank money market rate- can be used as benchmark for policy stance of the CBRT, since they have more power for explaining changes in loan and deposit rates. Similarly, Illes et al. (2015) propose that policy rate itself may not be effective for reflecting the changes in cost of banks' funds due to increasing spread between short-term market rates and policy rates. In this study, following Aydın (2004) and Yıldırım (2014), the interbank money market interest rate is employed in order to investigate the pass-through mechanism. This rate is calculated based on the repo transactions at Borsa Istanbul (BIST) Repo Market. The monthly rate is the simple averages of daily data. As mentioned in first chapter, the selection of overnight repo rate (interbank money market rate) as an explanatory variable is in line with the marginal cost of funds approach.

The methodology of this study is inspired by the Grigoli and Mota (2017). They investigate the pass-through from policy rates to deposit and loan rates in Dominican Republic for the 2006-2015 period. They contribute to the literature by adding a set of variables which could affect banks' rates beyond monetary policy rate. They add Emerging Market Bond Index (EMBI), prepared by JP Morgan, as a measure of sovereign default risk, VIX index as external volatility measure, reserve requirement rate as a measure of the existing liquidity from financial system and, non-performing

loan (NPL) rate as an indicator for banks' losses which in turn leads to higher loan rates.

In this study, we add EMBI spread into analysis as a gauge for risk premium[18], since it measures the country's overall risk premium.[19] Although other variables such as VIX index, required reserve ratio, non-performing loan rate, and exchange rate may have impact on the lending rates indirectly, EMBI spread as an individual risk indicator; seems to be relevant more since it correlates more closely with loan rates and interbank money market rates (Figure 4.1).

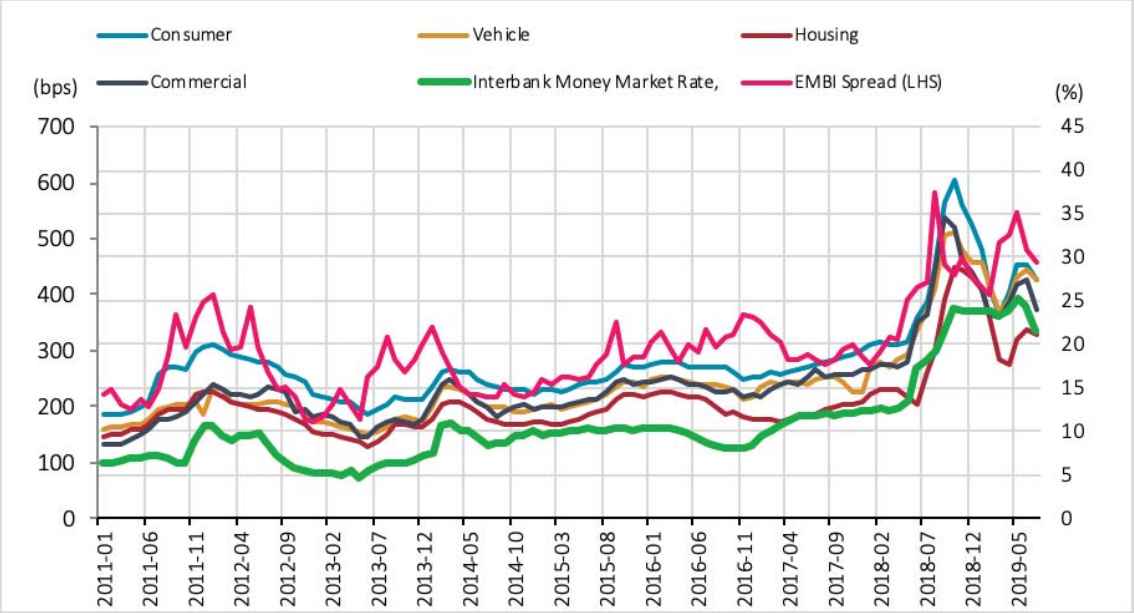

Figure 4.1: Loan rates, Interbank Overnight Repo Rates and EMBI-Spread Index

Source: CBRT, Bloomberg

[18] The EMBI spread provided by JP Morgan is the wedge between the yield on a dollar denominated bond issued by Emerging Market Economy (EME) and corresponding similar bond issued by advanced economies. Binici et al. (2016) show that EMBI spread index affect banks' deposit and loan rates referring the external finance conditions and expectation channel.

[19] Although EMBI spread has been used as a measure for sovereign default risk, Calvo (2002) discusses that both domestic and external factors are inherent in explaining the EMBI spread movements. His study proposes that the risk appetite of foreign investor is the major determinant of this spread. Also, political developments, as an internal factor, have immediate effects on this spread.

During the high volatility times, EMBI spread recorded jumps along with the loan rates due to uncertainties in loan supply and pricing behaviours. For example, particularly in August 2018, unhealthy price formations due to geopolitical tensions followed by tight liquidity preferences of banks led to dramatic increases in both risk premium and loan rates (Figure 4.1).

It is apparent that over the period of interest the spread between the loan rates and interbank money market rates remained positive due to profit-seeking behaviour of banks where the ratio of credits given to non-financial sector to GDP increases moderately (Figure 4.2). Such positive spread between money market rates and loan rates induced banks to provide new loans to the economy (Aydın, 2007). Specifically, as shown in Figure 4.2, consumer loan spread keeps its high levels compared to spread of other loan types because of the high mark-up pricing due to higher credit risk of consumer loans Horvath and Podpiera (2012).

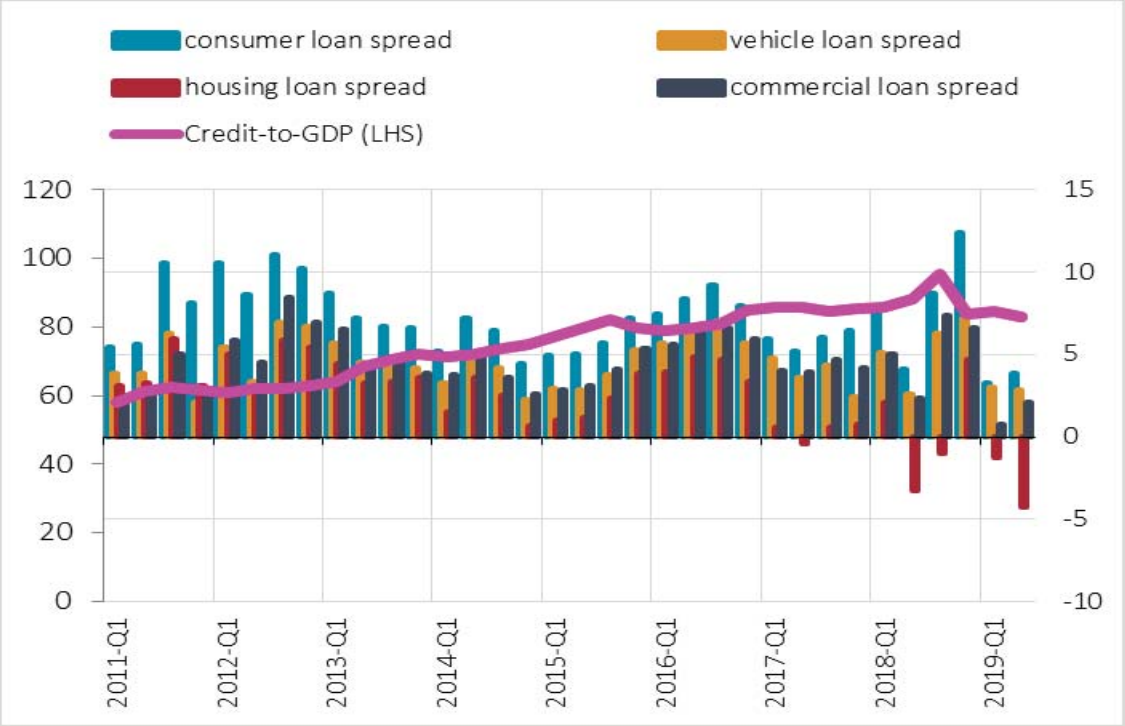

Figure 4.2: Loan Rates Spread and Domestic Credit to Non-Financial Sector (%)

Source: CBRT

4.2 METHODOLOGY

This study investigates interest rate pass-through mechanism from the policy-induced interbank interest rates to loan rates using asymmetric threshold cointegration test. Taking into consideration the asymmetries in the cointegration relationship, threshold autoregressive (TAR) and the momentum threshold autoregressive (MTAR) models of Enders and Siklos (2001) are utilized. More precisely, they extend the Engel-Granger's standard two-step procedure to show that an alternative specification is possible when loan rates adjust asymmetrically in response to changes in interbank money market rate. In addition, Enders and Siklos point out that their attempt to remodelling the standard two-step procedure has better power and size properties relative to those of symmetric adjustment.

For the first step of time series analysis, we perform Augmented Dickey-Fuller (ADF) and Phillips-Perron tests to check the existence of unit roots. The test results are presented in Table 5.1 and Table 5.2. The null hypothesis of having unit root cannot be rejected in level. Given these results, we can say that if each variable is I(1) then there exists at least one long-run stationary (cointegrating) relationship among related variables.

Following the marginal cost pricing model of Rousseas (1985), and de Bondt (2002), the magnitude of long-run pass-through equation can be defined as:

$$r_t = \alpha + \beta_1 mmr_t + \beta_2 embi_t + u_t \tag{4.1}$$

where r_t represent the loan rates (consumer, vehicle, housing, commercial) set by commercial banks, and mmr_t is the marginal cost of banks proxied by interbank money market interest rate used in repo transactions. In equation (4.1), $embi_t$ represents Turkey's country sovereign bond spread, which enters model as risk premium. u_t is the error term representing unobserved heterogeneity.

In this setting, intercept term α stands for the mark-up (down) on loan rates. β_1 measures the degree of pass through from interbank rates to loan rates. In a perfect

competition environment, β_1 is expected to be one ($\beta_1 = 1$), which implies that there is complete pass-through from market rates to loan rates. The pass-through may be incomplete when β_1 is less than one, ($\beta_1 < 1$). This case can arise from several market imperfections such as switching costs, information asymmetries, market power and inelastic demand for bank loans. The over-pass through ($\beta_1 > 1$) can be caused by banks' willingness to reflect upward interest rate movements to offset higher risks rather than rationing credits (de Bondt, 2002; Sander and Kleimeier, 2004). Even though β_2 is likely to be positive, there is no a priori information that changes in risk premium is transmitted positively to banks' loan rates. The sign and significance of β_2 gives information whether loan rates capture the developments in external financing conditions.[20]

Once we estimate equation (4.1) by using ordinary least squares (OLS), Engle and Granger's (1987) two-step-procedure necessitates stationarity tests to detect the presence of cointegration among model variables. Specifically, we use the following equation to test the stationarity of residuals that are previously estimated from equation (4.1):

$$\Delta\hat{u}_t = \rho\hat{u}_{t-1} + \sum_{i=1}^{q} \gamma_i \Delta\hat{u}_{t-i} + \varepsilon_t \tag{4.2}$$

where Δ is the difference operator, q is the number of lagged terms of Δu_t that enables $\varepsilon_t \sim iid(0, \sigma^2)$. Rejecting the null hypothesis of no cointegration (i.e. accepting the alternative hypothesis $(-2 < \rho < 0)$ implies that the residuals in Equation (4.1) are stationary with zero mean, which indicates there exits at least one cointegrating relationship between variables. In symmetric specification, the direction of $\hat{u}_{t-1}$ is not taken into consideration. However, in asymmetric specification with zero threshold, the distinction of positive and negative values of $\hat{u}_{t-1}$ have been taken into consideration in adjustment process.

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[20] Binici et al. (2016) and Grigoli and Mota (2017) add EMBI-spread into their analysis as a risk premium measure which mainly proxies financial fragility of the economy. Both studies find that EMBI spread has significant effects on loan rates.

Enders and Siklos (2001) propose TAR and MTAR models in order to prevent misspecification due to asymmetry in the cointegration process.

First, TAR model is denoted as follow:

$$\Delta\hat{u}_t = \rho_1 I_t \hat{u}_{t-1} + \rho_2(1 - I_t)\hat{u}_{t-1} + \sum_{i=1}^{q} \gamma_i \Delta\hat{u}_{t-i} + \varepsilon_t \tag{4.3}$$

where lagged values of Δu_t ensure $\varepsilon_t \sim iid(0, \sigma^2)$. The indicator variable defined as:

$$I_t = \begin{cases} 1, & \hat{u}_{t-1} \geq \tau \\ 0, & \hat{u}_{t-1} < \tau \end{cases} \tag{4.4}$$

In Equation (4.4), τ is the threshold value and ε_t is independent of u_j where $j < q$. While $\rho_1\hat{u}_{t-1}$denotes the adjustment if $\hat{u}_{t-1}$ is greater than or equal to the threshold value τ; $\rho_2\hat{u}_{t-1}$ denotes the adjustment if $\hat{u}_{t-1}$ is less than the threshold value τ.

Second, Enders and Siklos (2001) provide an alternative variation of TAR model, momentum-TAR model (MTAR), which employs the change in the previous period error term as an indicator variable instead of error term itself.

$$\Delta\hat{u}_t = \rho_1 M_t \hat{u}_{t-1} + \rho_2(1 - M_t)\hat{u}_{t-1} + \sum_{i=1}^{q} \gamma_i \Delta\hat{u}_{t-i} + \varepsilon_t \tag{4.5}$$

where indicator variable is defined as:

$$M_t = \begin{cases} 1, & \Delta\hat{u}_{t-1} \geq \tau \\ 0, & \Delta\hat{u}_{t-1} < \tau \end{cases} \qquad (4.6)$$

In contrast to TAR model, MTAR permits to see the differential effects of changes in disequilibrium. In case of TAR model, loan rate adjustment depends on the degree of deviation $(\hat{u}_{t-1})$ from equilibrium, while in MTAR model the loan rate adjustment depends on change in the deviation $(\Delta\hat{u}_{t-1})$. In other words, MTAR model allows us to see whether adjustment process have more momentum in one side than the other. Similar to TAR model, $\rho_1\hat{u}_{t-1}$ denotes the adjustment if $\Delta\hat{u}_{t-1}$ is greater than or equal to the threshold value τ; and $\rho_2\hat{u}_{t-1}$ denotes the adjustment if Δu_{t-1} is less than the threshold value τ . In order to ensure the i.i.d structure of error terms of Equation (4.3) and Equation (4.5), the Akaike Information Criterion (AIC) is used for the selection of optimal length (q).

In many economic applications, threshold value τ is assumed to be zero; however, Enders and Siklos (2001) utilize Chan's (1993) methodology to find endogenously determined consistent estimates of the threshold value, $\hat{\tau}$. This method suggests to keep 70% of ordered values of $\hat{u}_{t-1}$ ($\Delta\hat{u}_{t-1}$for MTAR specification), which includes the potential threshold value τ. Then it repeatedly estimates the TAR (MTAR) model through OLS and simultaneously uses grid search to find the corresponding optimum threshold value that guarantees the minimum of the sum of squared residuals. The non-zero threshold model, which finds threshold value endogenously, investigates size asymmetry, while model with zero threshold investigates sign asymmetries.

According to Petrucelli and Woolford (1984) and Chan et al. (1985), necessary and sufficient conditions for the stationarity of $\hat{u}_t$ for both models are that $\rho_1 < 0$, $\rho_2 < 0$ and $(1+\rho_1)(1+\rho_2) < 0$. Once these conditions are satisfied and the threshold value τ is known, systems in equations (4.3), (4.4) and (4.5), (4.6) can be considered as at their long-run equilibrium.

In this analysis, there is no a priori assumption that there exists a relationship between related variables. Enders and Siklos (2001) incorporate $\Phi - statistic$ to test the existence of asymmetric cointegration. The null hypothesis of no cointegration is that

$\rho_1 = \rho_2 = 0$ and the test statistics has F-distribution. If the null hypothesis is rejected, then there is an asymmetric cointegration among variables. Additionally, $t - max$ which is the largest t-statistics of ρ_1 and ρ_2, the smallest one is the $t - min\ statistic$. Given the necessary conditions for stationarity $\rho_1 < 0 \text{ and } \rho_2 < 0$, thus it can be said that $t - max$ is the direct test of these conditions.

Enders and Siklos (2001) point out that $\Phi - statistic$ has more power than $t - max$, thus they propose using $\Phi - statistic$ in order to detect asymmetric cointegration among variables when ρ_1 and ρ_2 ensure convergence of the system.

After having long-run relation, one can follow to test existence of symmetry with the null hypothesis of symmetric adjustment $(\rho_1 = \rho_2)$ by using F-statistics. If the null hypothesis is rejected, then this indicates asymmetric adjustment. If the null hypothesis could not be rejected, there exits symmetric adjustment

Once the (a)symmetric cointegration relation has revealed, we can fit the single-equation non-linear threshold error-correction model (NECM) to capture the short-run and long-run dynamics among related variables. Hence, TAR and MTAR type error-correction relations are defined as follow:

$$\Delta r_t = \varphi_0 + \sum_{i=1}^{p} \varphi_i \Delta r_{t-i} + \sum_{i=0}^{q} \delta_i \Delta mmr_{t-i} + \sum_{i=0}^{r} \theta_i \Delta embi_{t-i} + \lambda_1 I_t \hat{u}_{t-1} + \lambda_2 (1 - I_t)\hat{u}_{t-1} + \mathrm{v}_t \tag{4.7}$$

$$\Delta r_t = \varphi_0 + \sum_{i=1}^{p} \varphi_i \Delta r_{t-i} + \sum_{i=0}^{q} \delta_i \Delta mmr_{t-i} + \sum_{i=0}^{r} \theta_i \Delta embi_{t-i} + \lambda_1 M_t \hat{u}_{t-1} + \lambda_2 (1 - M)\hat{u}_{t-1} + \eta_t \tag{4.8}$$

In Equation (4.7) and Equation (4.8), v_t and η_t represent the i.i.d error terms with zero mean and constant variance. $\hat{u}_t$ which is equal to $(\hat{r}_{t-1} - \hat{\alpha} - \beta_1 mmr_{t-1} - \beta_2 embi_{t-1})$

is the previous period error term from Equation (4.1). Δr_t, Δmmr_{t-i} and $\Delta embi_{t-i}$ stand for the differenced value of previous period loan rates, interbank money market rates and EMBI spread, respectively. Δr_{t-i} is the autoregressive term. In Equation (4.7), $I_t \hat{u}_{t-1}$ and $(1 - I_t)\ \hat{u}_{t-1}$ denote TAR type asymmetric error correction terms, while in Equation (4.8), $M_t \hat{u}_{t-1}$ and $(1 - M_t)\hat{u}_{t-1}$ represent the MTAR type of asymmetric error correction terms. Both terms demonstrate the long-run dynamics of the respective models. In other words, these terms are the measurement for the adjustment process. For the short-run dynamics of the models, the coefficient δ_i shows the effect of a change in interbank money market rates on loan rates; θ_i shows the effect of a change in EMBI spread on loan rates. λ_1 and λ_2 are the asymmetric error-correction terms.

The non-linear models help to capture adjustment rigidities of loan rates. In this regard, we try to discuss the economic meaning of asymmetric adjustment. Under TAR type specification in Equation (4.7), if $|\rho_2|>|\rho_1|$, discrepancies resulting from money market increases (rate hike) are corrected more quickly than those of money market decreases (rate cut). Similarly, under MTAR type specification in Equation (4.8), $|\rho_2|>|\rho_1|$ means that increases in deviations due to money market increases (rate hike) are corrected faster than increases in deviations due to money market rate decreases (rate cut). More precisely, if $|\rho_2|>|\rho_1|$, loan rates exhibit downward adjustment rigidities. For the case of $|\rho_2|<|\rho_1|$, once can infer that loan rates exhibit upward adjustment rigidities in response to interbank money market rate changes resulting from the policy changes by central bank. Accordingly, Sander and Kleimeier (2004) interpret that MTAR type adjustment model is more relevant to understand banks' cost minimization behaviours which is based on the idea of smoothing out money market changes.

CHAPTER 5

EMPIRICAL RESULTS

In this study, we mainly investigate the interest rate pass-through from policy-oriented interbank money market rates to consumer, housing, commercial and vehicle loan rates in Turkey over the period 2011-2019. Our analysis particularly highlights the following two questions; (i) whether the interest rate pass-through is complete, incomplete or over-complete and, (ii) whether the adjustment to long-run equilibrium is symmetric or asymmetric.

We use monthly data to display the pass-through mechanism between loan rates and interbank money market rates and, EMBI spread as a risk premium measure. Before starting the time series analysis, we perform the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests in order to test the stationarity of our variables. Both tests have the null hypothesis indicating that the variable in question has a unit root. In Table 5.1, the results of ADF tests show that all series are non-stationary at level, however; after taking first differences all series become stationary.

Table 5.1: ADF Test Results

Level	Lag	Trend and Intercept	First Difference	Lag	Trend and Intercept
Consumer Loan Rate	4	-2.0631	Consumer Loan Rate	3	-5.6551***
Vehicle Loan Rate	2	-1.8355	Vehicle Loan Rate	1	-7.0398***
Housing Loan Rate	1	-3.5887	Housing Loan Rate	1	-5.9147***
Commercial Loan Rate	1	-2.2691	Commercial Loan Rate	1	-5.9190***
Money Market Rate	1	-2.0929	Money Market Rate	1	-5.9528***
EMBI Spread	1	-2.9551	EMBI Spread	1	-11.2283***

Note: *, **, *** denote 10%, 5% and 1% significance lever, respectively. The AIC is used to determine the optimal lag length.

In line with the ADF test results, PP test results provided in Table 5.2 show that after taking first differences, the null hypothesis indicating presence of unit root can be easily rejected at 1 percent significance level. As a result, both unit root tests guarantee that the series are stationary after taking their first differences i.e. all series are I(1).

Table 5.2: Philipps-Perron Test Results

Level	Bandwith	Trend and Intercept	First Difference	Bandwith	Trend and Intercept
Consumer Loan Rate	0	-1.5982	Consumer Loan Rate	8	-4.3274***
Vehicle Loan Rate	3	-1.8321	Vehicle Loan Rate	2	-6.8516***
Housing Loan Rate	2	-2.3564	Housing Loan Rate	11	-4.4392***
Commercial Loan Rate	1	-2.2822	Commercial Loan Rate	8	-5.1942***
Money Market Rate	4	-1.5321	Money Market Rate	1	-6.0312***
EMBI Spread	1	-2.8975	EMBI Spread	5	-11.3885***

Note: *, **, *** denote statistically significant at the 10%, 5% and 1% level respectively. The Akaike Information Criteria is used to determine the optimal lag length. The critical values are taken from MacKinnon (1996).

Table 5.3: Long-Run Estimation Results of Equation (4.1)

	α (1)	β_1 (2)	β_2 (3)	$\beta_1 = 1$ (4)
Consumer Loan Rate	5.9258*** (1.5598)	0.7759*** (0.1517)	0.0125** (0.0050)	Yes [0.1429]
Vehicle Loan Rate	3.7555*** (1.1403)	0.9036*** (0.0858)	0.0066* (0.0040)	Yes [0.2645]
Housing Loan Rate	5.0384*** (1.1830)	0.6752*** (0.1464)	0.0034 (0.0054)	No** [0.0288]
Commercial Loan Rate	3.6846** (0.7040)	0.8221*** (0.0578)	0.0096*** (0.0036)	No*** [0.0027]

Note: *, **, *** denote 10%, 5% and 1% significance level, respectively. The autocorrelation consistent standard errors given in parentheses are obtained from Newey-West heteroscedasticity.

Table 5.3 presents the estimation results of the long-run parameters of all loan types given in Equation (4.1). First, mark-up coefficient $\boldsymbol{\alpha}$ indicates that there is a significant mark-up effect in all loan types, particularly in consumer loan rates. Horvath and Podpiera (2012) anticipate that higher mark-up coefficients are associated with higher risk characteristics for respective loan types. According to Wang and Lee **(2009)**, when banks borrow the short-term funds from interbank money market and utilize them on

long-term loans such as housing loans; mark-ups over loan rates might be observed in order to cover several costs (interest rate risk).[21] In line with these arguments, our findings in the first column of Table 5.3 suggest that consumer loans exhibit the highest mark-up pricing behaviour due to their riskiness. The mark-up exists relatively high due to their long-term structure, which includes long-term risks. Although the commercial loan rates have higher risk by nature, the mark-up coefficient of commercial loan rates remain as the smallest one. Aydın (2004) and Yıldırım (2014) suggest that there is no need for high mark-up policy for commercial loans due to strict credit policies of Turkish banks. They argue that Turkish banks are highly selective on commercial loans, and they only give loans to firms that have good credit scores.

Second, we test the completeness of pass-through mechanism $(\boldsymbol{H_0}: \boldsymbol{\beta_1} = \mathbf{1})$ via Wald test. The classical theory of competition proposes that if there is perfect competition in banking industry, loan rates will equal to marginal cost in the long run. In this study, we use interbank money market rates as a proxy for marginal cost for banks. In this regard, we expect complete pass-through if $\frac{\partial \mathbf{r_t}}{\partial \mathbf{mmr_t}} = 1$. Particularly, the unity of pass-through refers that changes in money market rates are fully reflected in changes in respective loan rates. The second column of Table 5.3 displays the results on the completeness of loan rates. We cannot reject the null hypothesis for consumer and vehicle loan rates, which means the pass-through is complete for these loan rates. However, for both housing and commercial loan rates, we can easily reject the null hypothesis at 5 and 1 percent significance levels, respectively indicating incomplete or weak/incomplete pass-through. This means that banks may not prefer to pass through the changes in interbank money market rates to loan rates but to mark-up loan rates with a fixed proportion. One can remember from the first chapter on the background literature that, an imperfectly competitive market structure, presence of asymmetric information, switching costs and risk sharing agreements might be the underlying reasons for incomplete or stickiness in interest rate pass-through mechanism.

Our results are slightly different from Yıldırım's (2014) findings. While Yıldırım finds complete pass-through in consumer and housing loans, she finds incomplete pass-

[21] Binici et al. (2016) define banks as "maturity transforming agents" by considering their activities of borrowing short-term funds lending long-term loans. Since banks are dependent on short-term financing, they expose to short-term interest rate volatilities. They find that housing (mortgage) loan rates are relatively more sensitive to change in interbank interest rates.

through for vehicle and commercial loans. Her study proposes that high competition environment causes complete pass-through in cash (consumer loans in this study) and housing loan rates. Since Yıldırım's study covers the period 2002-2011, the competition structure of respective loans might have been changed during the period of our interest. As for our results, we suggest that lower price elasticity, presence of switching costs and information asymmetries may result in incomplete pass-through in housing and commercial loans. Aydın (2007) underlines that complete pass-through may enhance central bank's control of steering loan rates, since any change in policy rate have direct effects on interbank money market rates, and thus on loan rates. In this respect, over our analysis period, the CBRT has taken the advantage of enhancing controllability degree on consumer and vehicle loan rates where our test results indicates unity in pass-through process ($\boldsymbol{\beta_1 = 1}$).

Next, $\boldsymbol{\beta_2}$ shows the effect of a change in risk premium (EMBI spread) on loan rates. As previously explained, EMBI spread affects loan rates through external finance condition and expectation channels. Therefore, it is expected that change in the risk measure variable has positive effects on loan rates. According to the test results given in the third column of Table 5.3; although $\boldsymbol{\beta_2}$ coeffcient is found to be statistically significant for all loan types- except for the housing loan rates- changes in risk premiums have limited effect on loan rates.

So far, we have provided evidence for the long-run pass-through from interbank money market rates to loan rates. We reveal that banks prefer to impose high mark-up pricing policy over consumer and housing loan rates. This pricing policy reflects the riskiness of these loan types. To test the completeness of interest rate pass-through, we use Wald test with the null hypothesis imposing the constraint of $\boldsymbol{\beta_1 = 1}$. In the last column of Table 5.3 while we observe that consumer and vehicle loan exhibit complete pass-through, housing and commercial loans exhibit incomplete pass-through in the long run. Furthermore, even though its positive effect remains quite limited, EMBI spread coefficient $\boldsymbol{\beta_2}$ turns out to be significant for all loan variables, except for the housing loan rates. The reason behind this finding might be that Turkish banks put high liens on property being mortgaged; hence any tightening in funding conditions may not have any effect on housing loan rates. With the exception of housing loan rates, even though its effect is small, we can say that an increase in risk premium measure is transmitted positively to loan rates.

As a further step, in order to explore the nonlinear long-run relationship between interbank money market rates and loan rates, TAR and MTAR type cointegration tests are performed. To do so, we use Equation (4.3) and Equation (4.5) along with the indicator functions (4.4) and (4.6), respectively. Table 5.4 lists the estimation results. The necessary and sufficient conditions, $\boldsymbol{\rho_1 < 0}$, $\boldsymbol{\rho_2 < 0}$ and $\boldsymbol{(1+\rho_1)(1+\rho_2) < 0}$, hold for stationarity (convergence) in the long run for both TAR and MTAR models. In the TAR model, the null hypothesis of no cointegration ($\boldsymbol{H_0 : \rho_1 = \rho_2 = 0}$) is strongly rejected at 1 percent based on $\boldsymbol{\phi - statistics}$[22]. Therefore, we can say that there is cointegration between variables for all loan types. After revealing the cointegrating relationship, we proceed to test the null hypothesis of symmetric adjustment ($\boldsymbol{H_0 : \rho_1 = \rho_2}$), which is rejected only for vehicle and housing loan rates at 5 percent and 1 percent significance level, respectively. Based on these results, while the convergence speed of the negative and positive discrepancies of consumer and commercial loan rates are quite similar to each other, the convergence speed of the negative and positive discrepancies of housing and commercial loan rates are quite different from each other.

In the MTAR estimation, null hypothesis of no cointegration is rejected for all loan types at 1 percent significance level. Interestingly, we fail to reject the null hypothesis of symmetric adjustment for all loan types, except for the housing loan rates. We reveal that under MTAR specification housing loan rates exhibit asymmetric cointegration relation.

For both models, the asymmetry in housing and vehicle loan rates exists in the form of $|\rho_2| > |\rho_1|$. This implies that negative divergences from long-run equilibrium resulting from rate hike adjust faster than that of positive divergences resulting from rate cut. Overall, these results support the downward rigidities of these loan rates.

Results so far lead us to address the question of why some loan rates adjust asymmetrically toward their long-run equilibrium. For both models, the speed of adjustment of housing loan rates strongly supports the downward rigidity in the

[22] The critical values are obtained by Monte-Carlo experiment with 5,000 replications.

adjustment process. Specifically, the speed of adjustment of housing loan rates is highest one, while the speed of adjustment of positive adjustment is the slowest in absolute terms, i.e $|\rho_2|>|\rho_1|$. Hannan and Berger (1991) and Neumark and Sharpe (1992) propose that there are two potential reasons for such asymmetry: adverse customer reaction and collusive market hypothesis. The adverse customer reaction hypothesis implies that rigidities exist in reducing the deposit interest rates and in raising loan rates. On the other hand, the collusive market hypothesis implies that rigidities exist in reducing loan rates and in raising deposit interest rates. In our case, housing and vehicle loan rates exhibit asymmetric adjustment in TAR model; however, only housing loan rates exhibit asymmetric adjustment in MTAR model. In the summary Table 5.7, incomplete pass-through and asymmetric adjustment can be observed for housing loan rates in both models. Sander and Kleimeier (2004) explain the downward rigidity in his study for Euro countries by imperfect competition in the banking industry. They claim that the degree of asymmetric adjustment is negatively correlated with the elasticity of related loan demand. When focusing on Turkish banking sector indicators, as of December 2018, the total share of first ten banks recorded at 86 percent in 2017[23]. Moreover, there exists only one bank with an asset size of higher than USD 100 billion and there are six banks with asset size of between USD 40 billion and USD 80 billion (The Banks Association of Turkey, 2018). These figures may support the idea that market concentration causes downward rigidities in loan rates due to the price setting behaviour of banks.

[23] A rule of thumb is that an oligopolistic market structure emerges when the top five firms constitutes more than 60 percent of total market share.

Table 5.4: TAR and MTAR Cointegration Test Results

	Consumer		Vehicle	
	TAR	MTAR	TAR	MTAR
ρ_1	-0.2978*** (-4.5035)	-0.2356*** (-3.7986)	-0.2506*** (-2.8590)	-0.4993** (-4.0469)
ρ_2	-0.2009** (-2.4141)	-0.3239*** (-3.3435)	-0.5208*** (-4.8366)	-0.2962*** (-3.5833)
q	1	1	1	1
τ	0.95	-0.7232	-1.2611	0.4298
ϕ	12.5955*** [0.0000]	12.4309*** [0.0000]	14.8430*** [0.0000]	13.5496*** [0.0000]
$\rho_1 = \rho_2$	0.8696 [0.3511]	0.6055 [0.4365]	4.0849** [0.0460]	2.0168 [0.1587]
AIC	3.0287	3.0314	2.8679	2.8884
Q(10)	5.2698 [0.872]	5.0334 [0.889]	4.4047 [0.927]	4.2562 [0.935]
	Housing		Commercial	
	TAR	MTAR	TAR	MTAR
ρ_1	-0.2617*** (-4.2725)	-0.2285*** (-3.7360)	-0.2897*** (-3.6892)	-0.2391*** (-2.9738)
ρ_2	-0.5154*** (-5.9269)	-0.5559*** (-6.7888)	-0.2242** (-2.3027)	-0.3033*** (-3.0130)
q	2	2	1	1
τ	-1.6715	-0.6312	0.7605	-0.2049
ϕ	22.5572*** [0.0000]	26.2842*** [0.0000]	9.1052*** [0.0002]	9.0808*** [0.0002]
$\rho_1 = \rho_2$	6.9951*** [0.0095]	12.4356*** [0.0007]	-2.3028 [0.5937]	0.2452 [0.6216]
AIC	2.5161	2.4648	2.9372	2.9376
Q(10)	3.343 [0.972]	8.2124 [0.608]	7.9033 [0.638]	7.7954 [0.649]

*, **, *** shows statistical significance level at 10%, 5% and 1% respectively. t-statistics are given in parenthesis and p values are given in brackets.

Our results differ partially from previous studies of interest rate pass-through in Turkey. Yıldırım (2014) shows asymmetric adjustment for all loan types, while Yüksel and Özcan (2013) find symmetric adjustment for all loan types. The underlying difference with these studies might source from the differences in the methodologies or the period of interest chosen, as well as the changing market structure of Turkish banking system.

Table 5.7: Summary and Estimation Results

Loan Type	Mark-up Mark-down	Pass-Through	Pass-Through Mechanism (TAR) $H_{0:}\rho_1 = \rho_2$	Pass-Through Mechanism (MTAR) $H_{0:}\rho_1 = \rho_2$	Hypothesis
Consumer Loan	Mark-up	Complete	Symmetric	Symmetric	-
Vehicle Loan	Mark-up	Complete	Asymmetric	Symmetric	-
Housing Loan	Mark-up	Incomplete	Asymmetric	Asymmetric	Collusive Market Hypothesis / Imperfect Competition
Commercial Loan	Mark-up	Incomplete	Symmetric	Symmetric	-

Table 5.5 and Table 5.6 list the estimation results of TAR and MTAR type-error-correction models, given in Equation (4.7) and Equation (4.8), respectively. Having uncovered the (a)symmetric cointegration relationship among variables, we estimate nonlinear error correction models to discover the short-run and long-run dynamics of loan rates. Table 5.5 shows the estimation results of TAR type ECM. The joint significance of error-correction coefficients, λ_1 and λ_2, guarantees long-run relationship among variables. According to the test results, negative deviations from the long-run equilibrium followed by an increase in money market rates converge faster for vehicle and housing loan rates, supporting the downward rigidities in these loan rates. The joint impact of the difference of money market rate and its lags ($\mathrm{H_0}: \delta_\mathrm{i} = 0$) is statistically is significant at 1 percent level, indicating significant positive effect on loan rates. These results support the weak exogeneity assumption of interbank money market rates. As for the EMBI spread, $(H_0: \theta_i = 0)$, the joint impact of the difference of EMBI spread and its lags are statistically significant at 1 percent level. This suggests that there is a positive effect of EMBI spread on loan rates in the short run.

Table 5.6 displays the test results of MTAR type ECM. Similar to TAR type ECM results, the joint significance of the error correction coefficients are rejected at 1 percent significance level for all loan types, implying long-run cointegration among variables. As for the short-term effects, the joint significance of money market rates and

its lags $(H_0: \delta_i = 0)$ are found to be statistically significant at 1 percent level, which means that there is a positive short run relationship between the money market rates and loan rates. Moreover, there exist joint significance of EMBI spread or its lags $(H_0: \theta_i = 0)$ at 1 percent level. This indicates that loan rates react positively to the changes in the risk measure in the short run.

Given the summary results in Table 5.7, incomplete asymmetric pass-through is observed only for housing loan rates. The asymmetric adjustment exists in the form of downward rigidity $|\rho_2|>|\rho_1|$. De Bondt (2005) relates this to asymmetric information phenomena in which borrowers have limited incentive to pay their loan repayments. However, this may not be the case for the Turkey, since monitoring the customers' risk profiles have been evolved thoroughly over the years. As explained previously, Sander and Kleimeier's (2004) proposition of imperfect competition and presence of high switching costs may lead Turkish loan rates to adjust faster in upward direction rather than downward direction in response to changes in interbank money market interest rates.

Table 5.5: TAR type Error-Correction Model Estimation Results

	Consumer Loan (1)	Vehicle Loan (2)	Housing Loan (3)	Commercial Loan (4)
φ_0	0.0330 [0.7386]	-0.0880 [0.3670]	-0.0975 [0.2197]	0.0724 [0.4621]
φ_1	0.7130*** [0.0000]	0.3028*** [0.0020]	0.6243*** [0.0000]	0.3519 *** [0.0001]
φ_2	-0.1398 [0.1639]	NA	NA	NA
φ_3	NA	NA	NA	NA
φ_4	NA	NA	NA	NA
φ_5	NA	NA	NA	NA
δ_0	0.5538*** [0.0000]	0.4557*** [0.0001]	0.3495*** [0.0003]	0.6121*** [0.0000]
δ_1	-0.4018*** [0.0017]	-0.1419 [0.2692]	-0.0679 [0.5488]	-0.1834 [0.1693]
δ_2	0.0587 [0.6554]	0.057 [0.6301]	-0.1965* [0.0650]	0.0703 [0.5682]
δ_3	0.3619*** [0.0029]	0.2699** [0.0327]	0.1900* [0.0651]	0.2422* [0.0634]
δ_4	-0.2200** [0.0600]	-0.099 [0.4389]	NA	-0.2633** [0.0343]
δ_5	NA	-0.2034* [0.0961]	NA	NA
θ_0	0.0037** [0.0942]	0.0005 [0.8333]	-0.0035** [0.0111]	0.0049** [0.0483]
θ_1	0.0086 *** [0.0003]	0.0096*** [0.0002]	0.0064*** [0.0020]	0.0111*** [0.0000]
θ_2	NA	0.0037 [0.1591]	0.0051** [0.0114]	NA
θ_3	NA	NA	NA	NA
θ_4	NA	NA	NA	NA
λ_1	-0.2000** [0.0013]	-0.0943 [0.2250]	-0.1630*** [0.0024]	-0.2078** [0.0098]
λ_2	-0.1195 [0.1164]	-0.4014*** [0.0001]	-0.3406*** [0.0000]	-0.1147 [0.2222]
Q(10)	5.6501 [0.8440]	12.522 [0.2520]	6.2741 [0.792]	7.564 [0.671]
R-Squared	0.743644	0.621056	0.708638	0.651894
Adjusted R Squared	0.7109	0.5669	0.6755	0.6119
SE of Regression	0.7515	0.7861	0.6813	0.8235
$\lambda_1 = \lambda_2$=0	7.0143*** [0.0015]	8.95149*** [0.0003]	17.1124*** [0.0000]	6.61292*** [0.0021]
F-stat	22.6791*** [0.0000]	11.4723*** [0.0000]	21.4029*** [0.0000]	16.2923*** [0.0000]
$\varphi_i = 0$	43.0258 [0.0000]	3.19322 [0.0020]	8.24956 [0.0000]	4.00245 [0.0001]
$\delta_i = 0$	5.3450*** [0.0007]	5.51973*** [0.0005]	4.26076*** [0.0009]	6.61072*** [0.0000]
$\theta_i = 0$	7.6458*** [0.0009]	6.89766*** [0.0003]	6.8976*** [0.0003]	10.4861*** [0.0001]

*, **, *** shows statistical significance level at 10%, 5% and 1% respectively. F-stat is the overall significance of respective model. Q(10) is the Box-Pierce Q-Statistics for serial autocorrelation up to 10 lags.

Table 5.6:MTAR type Error-Correction Model Estimation Results

	Consumer Loan (1)	Vehicle Loan (2)	Housing Loan (3)	Commercial Loan (4)
φ_0	-0.0168 [0.8302]	0.0208 [0.8166]	-0.0597 [0.3775]	-0.0140 [0.8777]
φ_1	0.7669 [0.0000]	0.2632 [0.0078]	0.7315*** [0.0000]	0.3561*** [0.0002]
φ_2	-0.2666** [0.0178]	NA	0.0775 [0.4710]	NA
φ_3	0.2065** [0.0465]	NA	-0.1736 [0.1440]	NA
φ_4	NA	NA	0.2450** [0.0197]	NA
φ_5	NA	NA	NA	NA
δ_0	0.5076*** [0.0000]	0.4626*** [0.0002]	0.2997*** [0.0015]	0.6277*** [0.0000]
δ_1	-0.3726*** [0.0023]	-0.1052 [0.4244]	-0.1755 [0.1132]	-0.2189 [0.1106]
δ_2	0.1001 [0.4337]	0.0969 [0.4258]	-0.1462 [0.1595]	0.0766 [0.5392]
δ_3	0.2590** [0.0468]	0.2363* [0.0678]	0.2094* [0.0502]	0.2412* [0.0680]
δ_4	-0.2500** [0.0228]	-0.0759 [0.5683]	NA	-0.2785** [0.0268]
δ_5	NA	-0.2296 [0.0686]	NA	NA
θ_0	0.0033 [0.1220]	-0.0002 [0.9335]	-0.0050** [0.0111]	0.0049** [0.0500]
θ_1	0.0078*** [0.0006]	0.0095 [0.0005]	0.0043** [0.0345]	0.0107*** [0.0001]
θ_2	NA	0.0047* [0.0824]	0.0051** [0.0162]	NA
θ_3	NA	NA	-0.0041* [0.0562]	NA
θ_4	NA	NA	NA	NA
λ_1	-0.1426*** [0.0075]	-0.1913* [0.0928]	-0.1555** [0.0111]	-0.1542** [0.0353]
λ_2	-0.3738*** [0.0000]	-0.2169*** [0.0030]	-0.5747*** [0.0000]	-0.2170** [0.0140]
Q(10)	10.030 [0.438]	8.8417 [0.547]	4.8613 [0.900]	7.5858 [0.669]
R-Squared	0.7682	0.5950	0.771295	0.642771
Adjusted R Squared	0.7354	0.5372	0.732718	0.601710
SE of Regression	0.7188	0.8126	0.621485	0.834266
$\lambda_1 = \lambda_2$=0	12.0534*** [0.0000]	5.6793*** [0.0049]	21.2251*** [0.0000]	5.3330*** [0.0065]
F-stat	23.4681*** [0.0000]	10.2861*** [0.0000]	19.9938*** [0.0000]	15.6541*** [0.0000]
$\varphi_i = 0$	30.9946*** [0.0000]	7.4331*** [0.0078]	22.7282*** [0.0000]	3.9185**** [0.0002]
$\delta_i = 0$	6.625805*** [0.0000]	4.009094*** 0.0014	4.588521*** 0.0021	6.727443 [0.0000]
$\theta_i = 0$	6.716013*** 0.0020	4.887851*** 0.0035	6.615166*** [0.0000]	9.196834*** 0.0002

*, **, *** shows statistical significance level at 10%, 5% and 1% respectively. F-stat is the overall significance of respective model. Q(10) is the Box-Pierce Q-Statistics for serial autocorrelation up to 10 lags.

CONCLUSION

This study investigates how policy-induced changes in short-term market interest rates are passed to loan rates for consumer, vehicle, housing and corporate loan rates in Turkey from January 2011 to July 2019. Our results provide insights for asymmetric interest rate pass through of banks' lending rates. We observe that there is a large mark-up policy over for all loan types, especially in consumer and housing loans. This finding might be a result of the relative riskiness of these loan types. Looking at the magnitude of pass-through, only consumer and vehicle loan rates have complete pass-through in the long run. This result is attributed to the competitiveness degree of these loans. To the best of our knowledge, our study differs from the previous studies on Turkey with respect to its selection of variables, up-to-date period of interest and methodology. We find that changes in EMBI spread have a positive impact on consumer, vehicle and commercial loan rates, while there is no significant effect on housing loan rates. This is explained by the regulations on housing loan rates such as high liens on properties that being mortgaged.

We adopt TAR and MTAR model with endogenously determined thresholds to identify the asymmetric adjustments in the long run. Our results show that vehicle loan rates adjust asymmetrically under TAR model, while they exhibit symmetric adjustment under MTAR model. On the other hand, consumer and commercial loan rates exhibit symmetric features in in both models, which means they react symmetrically to changes in policy rates in both directions. Interestingly, housing loan rates exhibit asymmetric adjustment in both model specifications. More specifically, banks in Turkey are faster in reflecting rate hike effects to housing loan rates, while they might delay the effects of rate cuts. From a theoretical perspective, collusive market hypothesis (low competition and existence of high switching costs) can explain the incomplete asymmetric interest rate pass-through characteristics of housing loans. In general, our results support the existence of downward rigidities in housing loan rates.

We use single equation approach to reveal short-run and long-run dynamics. The error-correction models under both TAR and MTAR specifications support the weak exogeneity assumption of short-term market interest rates to loan rates. In this sense, we show that there is a short-run relationship between short-term interbank interest rates and loan rates beyond the long-run relationship.

To sum up, this study reveals different pass-through dynamics of loan rates in response to policy changes indicating the presence of sectoral heterogeneities. In terms of the effectiveness of monetary policy, such incompleteness and/or asymmetries in loan rates may not refer to ineffectiveness of the transmission mechanism, as long as the monetary authorities are aware of the incomplete and/or asymmetric pricing behaviour of the respective loan rates. On the other hand, complete symmetric pass-through increases the controllability degree of CBRT over the loan rates. However, in case central banks are unaware of incompleteness and/or asymmetry, challenging problems may arise in monetary transmission mechanism and hence in functioning of the credit markets. The policy steps towards enhancing high competition in the banking sector could be a conducive way to provide a complete and symmetric pass-through process, which in turn increases the efficiency of monetary transmission mechanism.

Finally, this study can be extended various ways. For instance, as a risk premium variable we exploit EMBI spread, in this sense, future researches can be enriched by introducing some macro-financial variables to the analyses such as bank competition, credit to GDP, default (credit) risk, liquidity premium, degree of openness and depth of financial market etc. Additionally, a recent literature on economic applications suggests developments of non-linear techniques. Therefore, alternative approaches such as smooth transition models can be employed to search for interest rate pass-through.

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