NON-LINEAR STRUCTURE OF THE TURKISH INTEREST RATE TRANSMISSION MECHANISM

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ABSTRACT

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This paper empirically analyses the interest rate transmission mechanism from money market rate to lending rate by utilizing the bank-level data in the distinction of cash, automobile, housing and corporate loans in Turkey. The main objective is to reveal the possible asymmetries of the adjustment process as well as the extent of the pass through. Empirical results indicate that mark-up value is the minimum for corporate rates on average, followed by housing, automobile and cash rates, respectively. Additionally, while large banks follow small mark-up pricing, small banks follow large mark-up pricing for corporate loans. Furthermore, a complete pass through is detected in 75 percent of the corporate loans, whereas the rates of banks that completely react to money market changes are 58 percent for cash and housing loans and 50 percent for automobile loans. We also find evidence that cash loans having high mark-up values do not adjust completely to variations in money market rate. Based on TAR and MTAR models of Enders and Siklos (2001), substantial asymmetries exist for all lending types. In general, adjustment towards the long-run equilibrium is faster when the disequilibrium or change in disequilibrium is above the threshold (upward rigidity).

Keywords: Lending rates, interest rate pass through, non-linear cointegration

ÖZ

TÜRKİYE’DEKİ FAİZ AKTARIM MEKANİZMASININ LİNEER OLMAYAN YAPISI

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Bu çalışmada Türkiye için nakit, taşıt, konut kredileri ve ticari krediler ayrımında banka bazında veriler kullanılarak para piyasası faiz oranından kredi faiz oranlarına aktarım mekanizması analiz edilmiştir. Temel amaç, faiz geçişkenliğinin derecesinin yanı sıra düzeltme sürecindeki olası asimetrileri ortaya çıkarmaktır. Ampirik sonuçlar, ortalamada en düşük sabit kâr marjının ticari kredilerde olduğunu gösterirken, onu sırasıyla konut, taşıt ve nakit krediler takip etmektedir. Ayrıca, ticari kredilerde büyük bankalar daha düşük sabit kâr oranlı fiyatlandırma izlerken, küçük bankalar daha yüksek sabit kâr marjlı fiyatlandırma uygulamaktadır. Ek olarak, ticari kredilerin yüzde 75’inde tam geçişkenlik gözlemlenirken, tam geçişkenlik gösteren bankların oranları nakit ve konut kredileri için yüzde 58, taşıt kredileri için ise yüzde 50’dir. Bulgular, nakit kredilerinde, yüksek sabit kâr oranlı fiyatlandırma yapan bankaların para piyasası faiz oranındaki değişimlere tam geçişkenlik göstermediklerine işaret etmektedir. Enders ve Siklos ‘un (2001) TAR ve MTAR modellerine göre bütün kredi türlerinde asimetriler bulunmaktadır. Genel olarak, uzun dönem dengesinden sapma veya sapmadaki değişim eşik değerinden büyükse uzun dönem dengesine doğru düzeltme daha hızlı gerçekleşmektedir (yukarı yönlü katılık).

Anahtar Kelimeler: Kredi faiz oranları, faiz geçişkenliği, doğrusal olmayan eşbütünleşme

To My Wife and Parents

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CHAPTER 1

INTRODUCTION

Central banks are key players in macro economies as they serve to smooth the current and future spending of economic agents through different policy tools. A convenient way to warrant smoother cycles in the economy is to preserve price stability, which brings inflation targeting forward as arguably the most appropriate policy. Under the inflation targeting framework, the central bank aims to affect aggregate demand primarily by changing its policy rate in such a way that demand-pull inflationary factors are suppressed and inflation uncertainty is reduced. The central bank can achieve this aim through various channels which comprise the so called “transmission mechanism”. The policy rate at which central bank supplies money to the banking system is expected to determine first, the money market rate and then, long-term interest rates since long-term rates are the average of the expected future short-term rates. Long-term rates directly determine the cost and availability of credits together with economic agents’ propensity to consume which together determines the demand.

As mentioned above, policy rate is transmitted to credit markets and hence the demand conditions through the transmission channel. In this context, effectiveness of the monetary policy depends on the extent and speed of the transmission of policy rate changes to credit rates. From this point of view, “monetary policy” could be defined as effective only if the above-mentioned transmission is achieved, requiring policy rate having timely, and substantial impact on lending rates. However, in practice, lending rates may not fully adjust to changes in the policy rate or may react with a lag. Additionally, responses of lending rates to monetary policy shocks could be asymmetric in some circumstances. There could be various reasons for the pass-through being asymmetric and incomplete such as market power, asymmetric information and presence of switching and adjustment costs.

Although most of the existing studies, including Cottarelli and Kourelis (1994), Heffernan (1997) Mojon (2000) and de Bondt (2005) analyse the pass through from the policy rate (or its proxy) to lending rates within a linear context, a new strand accounting for nonlinearities (asymmetries) in the dynamics of the pass through has been gradually emerging due to the reasons mentioned above. In this respect, threshold error-correction models are utilized to reveal short run and long run dynamics of the pass through. Sander and Kleimeier (2004), Hoffman and Milzen (2004), Payne (2006a, 2006b and 2007) and de Bondt (2005) are some well-known examples of papers focusing on the pass–through process via threshold error-correction models with different exogenous or endogenous nonlinear drivers.

This thesis aims to examine the pass through to lending rates in Turkey. We investigate pass through in Turkey to reveal the effectiveness of the monetary authority after the new policy regime, namely inflation targeting (IT). The 2001 banking crisis could be referred as a milestone for the Turkish economy as it has been followed by crucial steps towards fixing the financial sector and improving the fundamentals. IT has been chosen as the new monetary policy regime following this crisis with the main purpose being to suppress inflation in a predetermined range. To achieve this, the monetary policy should have the ability to influence the real economy. For this reason, it is essential both for policy makers and the academia to analyze the dynamics of the transmission mechanism from the policy rate to the bank lending rate to have a better understanding of the monetary policy applications in Turkey.

Our focus is to shed light on the dynamics of response of lending rates to policy rate by utilizing the micro data in Turkey. Using bank level data on interest rates of cash, automobile, housing and corporate loans, we analyze the pass through from money market interest rate, as a proxy of monetary policy rates, to individual banks' lending rates. The selection of the micro data is motivated by the fact that studying with aggregated data may produce aggregation bias and misleading results regarding the actual nature of the pass through (see Granger, 1980 and Zaffaroni, 2004). Moreover, the use of micro data enables us to reveal heterogeneities not only among lending rates but also among banks, which may result from many factors including the size and the owner type of the bank, owner type of the bank.

Methodologically, we adopt threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) models of Enders and Siklos (2001) to reveal the possible asymmetries of the adjustment process in the pass through mechanism. Despite the key role it plays in determining the effectiveness of monetary policy, the pass-through from official to retail loan rates in Turkey is surprisingly under-studied. The only papers, to the best knowledge of the author of this paper, are Aydin (2007) and Ozdemir (2009). This study differs from the existing literature on the pass-through in Turkey in several aspects. Firstly, we use a new dataset ranging from January 2004 to December 2011 which excludes the effect of banking crisis in 2001. Secondly, although we employ bank level micro data similar to Aydin (2007), we allow for nonlinearity in the pass-through process. Thirdly, unlike Ozdemir (2009), we employ endogenously determined threshold values rather than setting exogenous threshold values.

The main lesson of this thesis is threefold. First, empirical results indicate that mark-up value is the minimum for corporate rates on average, followed by housing rates, automobile rates and cash rates, respectively. Additionally, for corporate loans, it is observed that bank size is influential on the mark-up pricing policy so that large (small) banks follow small (large) mark-up pricing. Furthermore, a complete pass through is detected in three fourth of the corporate loans, while the rates of banks that completely react to money market changes are 58% for cash and housing loans and 50% for automobile loans. Second, non-linear tests capture more cointegration relationship between lending rates and money market rate than that of linear test. Besides, MTAR type asymmetry dominates TAR type among the detected non-linear long run relationships. Third, there is evidence that upward rigidities are more distinctive compared to downward rigidities. That is to say, in general, adjustment towards the long run equilibrium is faster when the disequilibrium or change in disequilibrium is above a specific threshold value. However, a few number of banks exhibit downward rigidities in some interest rate types.

The paper is organized as follows. Chapter 2 discusses conceptual framework of the interest rate pass through and Chapter 3 reviews the literature on linear and non-linear pass through. Chapter 4 explains recent developments in Turkish economy. While Chapter 5 describes the data in detail, Chapter 6 explains the TAR and MTAR models within the context of interest rate pass through. Consequently, empirical results are discussed in Chapter 7 and the final chapter concludes the thesis.

CHAPTER 2

CONCEPTUAL FRAMEWORK

Central Banks aims to influence real economy with different channels by using various policy tools. Among various channels, the interest rate channel is the most conventional one and has been subjected to intense scrutiny. It has received even more attention recently with the growing popularity of inflation targeting regime. Interest rate channel of monetary transmission implies that, allowing some degree of price stickiness, changes in the official interest rate are reflected first to the money market rate, marginal costs of funds faced by banks, and then to retail lending rates offered by banks and finally to spending on durable and investment goods. Banks' decisions regarding the interest rate on loans have an impact on the expenditure on durable and investment goods and thus aggregate demand which in turn influence inflation levels.

The vast literature on interest rate pass through assumes full pass through from the official rate to the money market rate and focus on the second step of the pass-through, the one from the money market rate to retail lending rates.[1] Many of the studies, however, provide empirical support for an incomplete and/or sluggish pass-through. There could be many factors decreasing the completeness and the speed of the pass-through from the money market rate or the official rate to lending rates and giving rise to an asymmetric structure.

One of the factors is the switching costs, that is cost incurred by changing lender or switching to a new fund with an existing lender. They are also defined as the regular search costs or shoe leather type costs of moving from one bank to another by Lowe and Rohling (1992). Existence of switching costs gives rise to lending rate stickiness. Costs in filling out loan application forms, acquiring the relevant documentation and the time involved in obtaining information on different lending

[1] In addition, due to the discrete nature of the official rate, some of the studies skip the first step (see Borio and Fritz, 1995).

rates prevent the customers from changing the existing lender. Even small switching costs may lead to a less competitive banking system when the proportion of customers that are new to the market is relatively low. In such an environment, there may not be a, one to one response in lending rates following market rate changes. Klemperer (1987) shows that presence of such costs generates market segmentation and reduces demand elasticities for loans facing each bank. In turn, banks become reluctant to respond to decrease in money market rate, which give incentive to react faster to market rate increases. More specifically, switching costs give rise to downward rigidities, implying that while lenders adjust faster to upward movements in the market rate, they reacts more slowly to downward movements.

Secondly, due to adjustment costs banks might prefer to smooth out interest rates. In the presence of adjustment costs, the lending rate will remain same if those costs are higher than the costs of maintaining a non-equilibrium rate. In this regard, lending rates do not react to small changes in the market rate. In addition, degree of the adjustment cost is influenced by the elasticity of loans demand. If the demand for loans is highly elastic, it should be more costly for banks to increase lending rates since borrowers may shift from one lender to another or give up demanding loans. In this sense, banks react faster to money market rate decreases, whereas they respond more slowly money market rate increases.

The existence of the adjustment cost may result in different reactions of banks depending on whether the change in money market rate is temporary or permanent and expected or unexpected. If the change is considered to be temporary banks do not prefer to change interest rate or react quickly. Consequently, the speed of adjustment is more likely to increase with the degree of anticipated persistence in the change in the marginal cost of funds. Banks are expected to respond slower when the change in money market rate is foreseen. On the other hand, they show quicker reaction to unexpected policy rate changes. These different effects of expected versus unexpected monetary policy actions on interest rate are confirmed by Kuttner (2001), Sun and Sutcliffe (2003), and Lee (2004).

Information asymmetries between lenders and borrowers could also affect the reactions of the banks to changes in marginal cost. Asymmetric information introduces problems of moral hazard and adverse selection. Stiglitz and Weiss (1981) points out that banks may not fully respond to an increase of the policy rate due to two reasons. Firstly, if the bank increases loan rates, firms with safest projects might withdraw from the market since expected return declines. Consequently, new applicants consist of those having more risk (adverse selection). Secondly, higher loan rates may give incentive to borrowers to undertake riskier projects (moral hazard). Hence, in case of asymmetric information, lending rates may exhibit upward stickiness.

The final factor that can vary the pass-through from the money market rate to lending rates is the market power and/or imperfect competition in banking industry. A wide range of factors including barriers to entrance, hidden costs or legal frameworks can influence the market power. Berger (1995) claims that banks having greater market power might price retail rates less competitively due to the low cost of keeping interest rates out of equilibrium, which in turn incurs in a slower downward adjustment for loans.

CHAPTER 3

LITERATURE REVIEW

The effectiveness of the monetary policy depends substantially on the extent and speed of interest rate pass through. Hence, a large volume of empirical research has been devoted to examine qualitative and quantitative properties of the interest rate pass through structure. More specifically, interest rate pass through literature has been mainly focusing on the assessment of the degree and speed of transmission. In this context, the degree of interest rate pass through describes to what extent money market rate (or official rate) changes are reflected to the retail bank rates. Empirical studies conclude that the degree and speed of pass through diverge significantly across countries, markets and time periods, suggesting that banks' reactions to monetary policy impulses differ regarding time periods and structure of the countries and markets.

Despite the possibility of asymmetry (nonlinearity) due to the factors discussed in the previous chapter, most of the empirical literature on the interest rate pass through is based on the assumption of the linearity, that is banks are assumed to react symmetrically to changes in the money market rate. In these studies the degree and speed of pass through is examined through linear error correction models (ECM), which enables one to distinguish between short and long term dynamics.

Linear pass through studies for individual countries dates back to early 1990s. Studies of Cotarelli and Kourelis (1994), Moazzami (1999), Winker (1999) and Bredin, Fitzpatrick and O Reilly (2001) are based on the quantification of the degree and speed of interest rate pass through from money market rate to bank interest rates. Through univariate ECM analyses, these studies reach a consensus that loan rates are sticky, that is they reveal that in the short run lending rates do not fully adjust to changes in the money market rate and adjustment speed is low. However, findings regarding the long run estimation are inconclusive. While complete pass through in the long run is found by Moazzami (1999) for Canada and US, by Cotarelli and

Kourelis (1994) for Canada, US, Ireland and some other countries, Bredin et al. (2001) for Ireland points to an incomplete pass-through to lending rates in the long run.

Although an important part of the literature is based on a single error-correction model, there are also some studies using panel framework and/or vector error correction models (VECM). Aside from the methodology, the context or the research question studied on interest rate pass through may differ among various studies. More specifically, some of the papers investigate pass through from money market rate or official rate to some specific lending rates, or bank level interest rates within a country while other studies use interest rates across countries or across banks to reveal any heterogeneity in pass through.

In the symmetric adjustment literature some of the researchers employ disaggregated data to examine the pass through across the banks within a country. Heterogeneity in responses of banks' retail rates to changes in the money market rate has been documented extensively. In this sense, a panel data framework enables to reveal the extent of pass through at the micro level and the determinants of heterogeneity in price setting behavior of banks. Cottarelli, Ferri and Generale (1995), Berlin and Mester (1999), Weth (2002), Gambacarto (2004), De Graeve et al. (2004) and Aydin (2007) use bank specific micro data to measure the speed and degree of adjustments across banks. Particularly, all studies point out that lending rates are sluggish in response to changes in money market rate, namely banks smooth interest rate that charges to the customers. Cotarelli et al. (1995), Berlin and Mester (1999) and De Grave et al. (2004) indicate that banks react differently to a shock to the money market rate across Italian, UK and Belgian banks, respectively. However, there are controversial results regarding to the degree of lending rate stickiness across banks as well. Weth (2002) for Germany and Gambacorta (2004) for Italy come up with the result that the speed of pass through is almost same across banks in the long run.

There is a vast literature on linear interest rate pass through for European Union. Studies on pass through of changes in money market rates in the Euro area differs from the existing literature in the sense that these studies attempt to reveal the cross-country differences in adjustment process and to answer whether there is a convergence in the pass-through process across member countries after the introduction of European Monetary Union (EMU). To this end, different techniques including structural vector autoregressive (SVAR), VECM and pooled mean group estimators are employed. Mojon (2000) reports that cross country differences in responses of bank rates to official rate changes decreased after the implementation of a single monetary policy, suggesting convergence towards an integrated and more homogenous market. However, later studies with different methods document strong evidence that there is no indication that the differences in the pass through have converged and thus the adjustment process of bank interest rate to variation in market rates has become more homogenous and faster among Euro area countries even after the introduction of EMU (Donnay and Degyrse, 2001; Sorensen and Werner, 2006; Bernhofer and Treeck, 2011). The findings of Heinemann and Schüler (2002) indicate that while mortgage rate is convergent, consumer credits are non-convergent. Apart from the convergence issue, de Bondt (2002 and 2005) points to an increase in the speed of adjustment of bank interest rates since the introduction of the euro.

These studies, however, ignore the possible asymmetric structure in the adjustment process. As discussed in the previous chapter, the presence of switching and adjustment costs, market power and asymmetric information may lead to rigidities in one direction in lending rates and breed an asymmetric structure. The magnitude of money market rate changes could be also effective so that lending rates may not adjust to small changes and/or expected changes in money market rate. With these reasons, a new strand in the literature which accounts for nonlinearities (asymmetries) in the dynamics of the interest rate pass through has been gradually emerging.

Empirical studies investigating asymmetries in the interest rate pass-through generally employ threshold error-correction models (ECMs). In this framework, existing studies can be separated into two in terms of determination of the threshold value. While some of the studies define threshold value exogenously, others determine endogenously. Sander and Kleimeier (2004) for Euro area, Payne (2006a, 2006b and 2007) for US and Becker, Osborn and Yildirim (2012) for UK used methods which allow for an endogenously determined threshold. Borio and Fritz (1995), Hoffman and Mizen (2004), de Bondt, Mojon and Valla (2005) and Fuertes, Heffernan and Kalotychou (2008) describe the threshold value exogenously for twelve developed countries, UK, Euro area and UK, respectively. Horvath, Kreko and Naszodi (2004) used both approaches in their paper for different type of asymmetries to examine Hungarian lending rates. Studies differ with regard to the drivers of the asymmetries as well. Horvath et al. (2004), Sander and Kleimeier (2004), Fuertes et al. (2008) and Becker et al. (2012) find strong evidence that the magnitude of the change in money market rate influences the speed of adjustment of lending rates in Hungary, Euro area, UK and mortgage rate in UK, respectively. There are also findings supporting that sign of money market rate could be one of the drivers of the asymmetries in pass through (Horvath et al., 2004; Payne, 2007; Becker et al, 2012). Moreover, several studies show that adjustment speed depends on gap between the bank rate and the base rate (Hoffman and Mizen, 2004 and Fuertes, 2008).

Horvath et al. (2004) assess the interest rate pass through for Hungary with the help of linear and non-linear threshold error correction models. The data covers 23 individual banks in Hungary ranges from January 2001 to January 2004. They employ both panel data framework and the aggregated data which aggregates loan rates. The study investigates whether the adjustment process of bank rates' changes depend on the size and sign of the money market rate changes. Both aggregated and panel data estimation suggests that corporate loans show nonlinearity in terms of the size of money market rate change. In addition, adjustment of corporate loans following money market rate changes depends on the sign of the latter.

Payne (2006a and 2006b) examine the interest rate pass through from the federal fund rates to the fixed mortgage rate. Using the momentum threshold autoregressive (MTAR) type adjustment procedure suggested by Enders and Siklos (2001), he concludes that federal fund rates and fixed mortgage rates are cointegrated with incomplete pass through and mortgage rates response symmetrically to changes in the federal fund rates. However, his extended study (2007) reveals that adjustable rate mortgages respond asymmetrically to changes in the federal funds rates.

Becker, Osborn and Yildirim (2012) analyze the transmission mechanism to UK mortgage rates in two steps, that is, pass-through from the official rate to the money market rate and from the money market rate to the mortgage rate. Allowing for nonlinearity in both steps, they develop a new bootstrap testing procedure due to the discrete nature of changes in official rate, which combines the methods proposed by Enders and Siklos (2001) and Hansen and Seo (2002). The nonlinear analysis suggests that there exist substantial asymmetries in both steps of the process with these asymmetries depending on past changes in the money market rate. The analysis further reveals that while pass through from policy rate to money market rate is complete, it is incomplete between money market rate and mortgage rate.

Despite the key role it plays in determining the effectiveness of monetary policy, the pass-through from official to retail loan rates in Turkey is surprisingly under-studied. The only papers (of which we are aware) are Aydin (2007) and Ozdemir (2009). Aydin (2007) examines the degree and speed of adjustment of corporate, housing, cash and automobile rates to monetary policy rate by using bank-level micro data in Turkey covering the period June 2001-September 2005. He estimates both short run and long run dynamics with the panel data approach via the method of Pesaran, Shin and Smith (1999) under the assumption of linearity. Ozdemir (2009) investigates the symmetric and asymmetric pass through from money market rate to the lending rate in the banking system of Turkey for the period between April 2001 and December 2006. An aggregated lending rate series is employed, although aggregation may not be proper in this framework since different credit rates will have different dynamics and therefore it may not reveal the real nature of the pass through. Moreover, in the nonlinear threshold ECM analysis, the threshold value is exogenously determined which may prevent to uncover the exact value of the threshold level.

Our study aims to analyze the interest rate pass-through mechanism in Turkey through the threshold autoregressive (TAR) and momentum threshold autoregressive

(MTAR) models of Enders and Siklos (2001). This study differs from the existing literature on the pass-through in Turkey in several aspects. Firstly, we use a new dataset ranging from January 2004 to December 2011 which excludes the effect of banking crisis in 2001. Secondly, although we employ bank level micro data similar to Aydin (2007), we account for nonlinearity in the pass-through process. Thirdly, unlike Ozdemir (2009), we employ endogenously determined threshold values rather than exogenously determined ones.

CHAPTER 4

A BRIEF SUMMARY OF THE TURKISH ECONOMY

Before introducing the data we employ in the next chapter, we will discuss the structure of the Turkish economy together with major changes experienced in the last two decades. The last two decades can be separated into two contrasting episodes, with the financial crisis of 2001 being the breaking point between these episodes. The first episode which spans the period of late 80s and 2001 could be characterized by extremely high levels of macroeconomic and political instability accompanied by weak regulation and supervision scheme while, in day and night contrast with the first episode, the "post 2001 crisis" episode could be defined as a benchmark for how to engineer and rebuild a stable and sound financial system and hence macroeconomic stability.

The main features of the Turkish economy in the first episode were crawling peg exchange regime used as monetary policy framework, high levels of inflation rate despite not being hyperinflation, high real interest rates in tandem with high government debt and low levels of maturity. All these factors naturally took its toll on the banking sector as well which was used to run with major currency mismatch problem. A natural consequence of the above-mentioned economic environment was the vanishing of the intermediation role of banks as they had adopted financing of sovereign debt as their primary and almost solely function. The high levels of real interest rates had further encouraged banks to opt out of providing credit to the real sector. The attractiveness of high interest rates had also given rise to moral hazard and adverse selection problems. On the other hand, persistent uncertainty and high real rates led to permanent decline in investment incentives of nonfinancial firms as they lost their relative profitability and became one of the main drags for growth. In addition, credit participation rate was at a significantly low level comparing with developed countries. This is a major problem in a country where economic agents' main financing source is banking sector. Additionally, persistently high inflation was another major drawback for macro and financial stability. As a natural consequence, economic agents at that time were used to prefer USD due to the fact that Turkish Lira was not considered as a secure currency. Dollarization in the whole economy destructed the transmission mechanism and central bank had to issue money.

Then came the 2001 financial crisis with a sudden stop and currency crisis. Several banks suddenly went bankrupt, Turkish financial markets ceased to function, economic activities slumped and Turkish economy contracted drastically. The response of the Turkish authorities against this shock was so impressive that many crucial steps were taken in a timely manner first, to contain the impact of the crisis on the structure of the economy and second, to drive the economy into a more sound and stable pattern in the longer term. In this respect, The Banking Law was renewed, the Banking Regulation and Supervision Agency was established and Central Bank of the Republic of Turkey gained its independency. These economic reforms entailed a new monetary policy regime which had to be consistent with the specific conditions of Turkey and had to be more easily understandable and applicable. Inflation targeting was chosen as a new monetary policy regime. The main purpose of the new regime as the name suggests downgrading the inflation rate at a persistent and low level. For achieving this aim, monetary policy tools have to affect the real economy. The main monetary tool was defined as short term (then 1 day, now 1 week) repo interest rate. The inflation targeting regime designed as when the Central Bank change the short term repo interest rate regarding with its decision function, retail banks' interest rates changes accordingly. The emphasis is on the word 'accordingly' since if the first interest rate cannot militate the latter, monetary policy would not function properly. Therefore, interest rate transmission mechanism attracts many of the central banks' attention.

CHAPTER 5

DATA

Under the assumption of complete pass-through from the official rate to the money market rate, this study aims to shed light on the interest rate pass through mechanism from money market rate to Turkish bank lending rates in the period between January 2004 and December 2011. To this end, we adopt a bank-level micro approach and use interest rates for automobile, cash, housing and corporate loans quoted by selected banks.[2] The data set mainly comprises of retail banks, which include private, public and foreign banks. The overnight repo rate, calculated from the repo transactions in Istanbul Stock Exchange, is used as a gauge of money market rate. Since the money market rate is announced daily while lending rates are reported weekly with the maturities of 0-12 months, 12-24 months and longer than 24 months, we convert the money market rate into monthly frequency by taking simple averages. As for lending rates, first we take weighted average of each week according to term structure and then averages of weeks.

In order to compare banks for all loan types, only the banks which have data for four loan types are selected and the ones with missing data in any of the loan types are excluded from the sample. The remaining set comprises mainly of 12 deposit banks[3] as investment and development banks do not necessarily have accounts for all loan classes since they are specialized in particular loan types. As an example, an investment bank concentrated on corporate loans may not supply any housing or cash loans consistently. Therefore, missing observations necessitate the exclusion of development banks, investment banks, and some of the deposit banks as well. In sum, data set composes of 12 deposit banks with four loan types, adding up to 48 interest rate series. In addition, these banks including state owned banks as well as

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[2] We restrict our analysis to lending rates and deposit rates are left for future analysis.

[3] Due to the confidentiality restrictions, we are not able to reveal the identity of the banks. Hence, bank names are coded with numbers. Numbers are assigned randomly to the banks, and thus do not represent the size or any other thing about the banks.

private banks constitute more than 80 percent of the total credit supply of the banking sector in 2011.

Weakness of the domestic financial markets in Turkey constrains the funding sources for both households and firms despite the recent rapid developments. This puts banks in the heart of funding as is the case in many other emerging markets. As mentioned in the previous chapter, in 2001, the banking sector experienced very deep and devastating crisis and a number of banks went bankrupt. In the aftermath of the crisis, a full-fledged overhaul of the banking sector had been carried out which paved the way for today's resilient and sound banking system. New regulations scheme, together with economic and political stability baking sector experienced a rapid and stable financial deepening process after the 2001 crisis (Figure 5.1). Not only credit to GDP ratio booms in this period, but also the ratio of financial intermediation services in GDP climbs up (Figure 5.2). It is also worth mentioning that both credit to GDP and financial intermediation services in GDP exhibits steady growth from the second quarter of 2003 to the recent global crisis. In order to eliminate the effects of 2001 crisis and study with more stabilized and strengthened banking sector, we start our analysis from 2004.

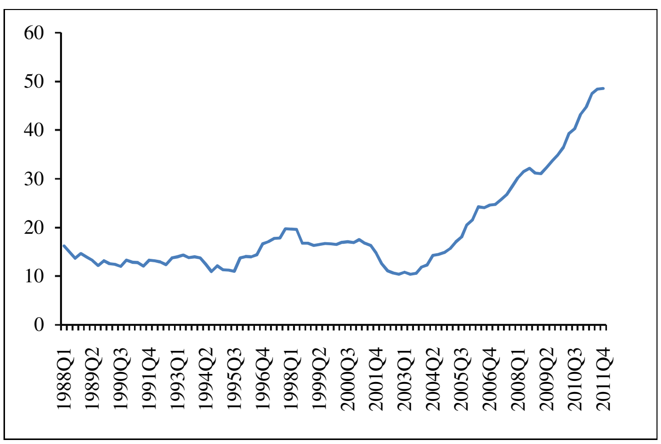

Figure 5.1 Credit to GDP Ratio in Turkey

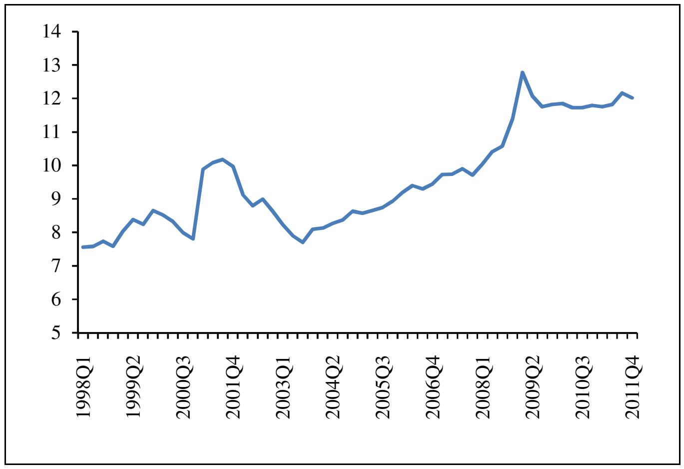

Figure 5.2 Financial Intermediation Services (% of GDP)

Despite the impressive performance of the Turkish banking sector, it is still in the early stages of financial developments. Turkey is on road to European Union (EU) membership and has very strong economic ties with EU. Comparison of the financial sector in Turkey with EU will give a good picture for the potential and the scope for development of the sector. For this purpose, credit to GDP ratios are generated for developing and developed countries in EU. Figure 5.3 exhibits that credit to GDP ratio in the most developed Euro members is around 100 percent, while the ratio is around 50 percent in the developing members of the EU. Despite its distinguishing uptrend, the credit to GDP ratio of around 50 percent in Turkey is still only moderate compared to advanced countries. This implies that Turkish financial system has still considerable scope for expanding intermediation and further deepening.

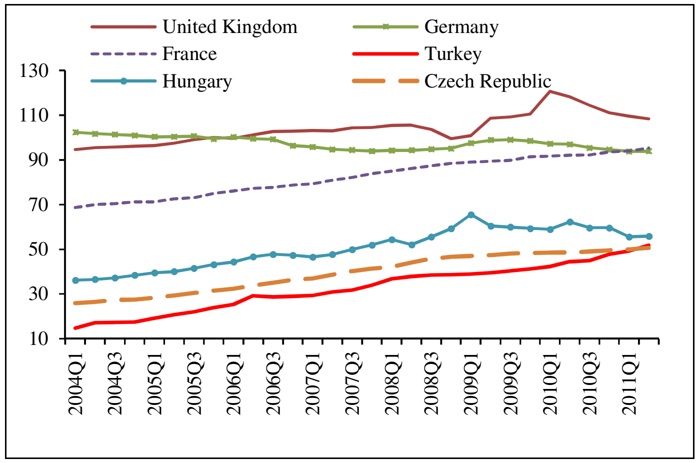

Figure 5.3 Credit to GDP Ratio in Euro Area Countries with Turkey

Due to the rapid credit expansion after 2002, credit-to GDP ratio has increased tremendously. However loan types have differentiated in the paths they followed as housing, cash and corporate loans to GDP ratio more or less soaring together while automobile loans having a bell-shaped curve. That is to say, automobile loans increase faster than GDP for a certain period and then reversal occurs (Figure 5.4). It may be because, other than banking sector financing companies supply significant amount of automobile loans, thus total automobile loans to GDP might be following similar pattern like other credits. The ratio of loan types in the total stock of loans highlights another aspect of financial deepening and penetration rate in Turkey. That is, vast majority of the credits are used by firms for business activity rather than households though the rate of corporate loans declines nearly 25 percentage point between 2003 and 2011 (Figure 5.5). At the same time, households are getting more involved into the banking system by using more finance from the banking sector which can be interpreted as a sign of increase in penetration rate.

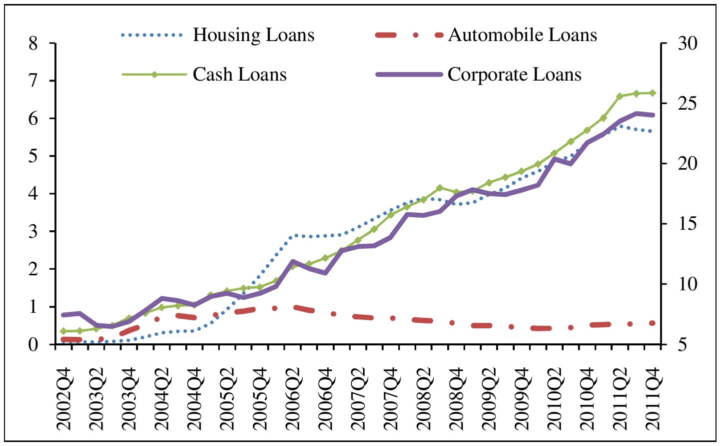

Figure 5.4 Corporate Loans and Subcomponents of Consumer Loans (% of GDP)

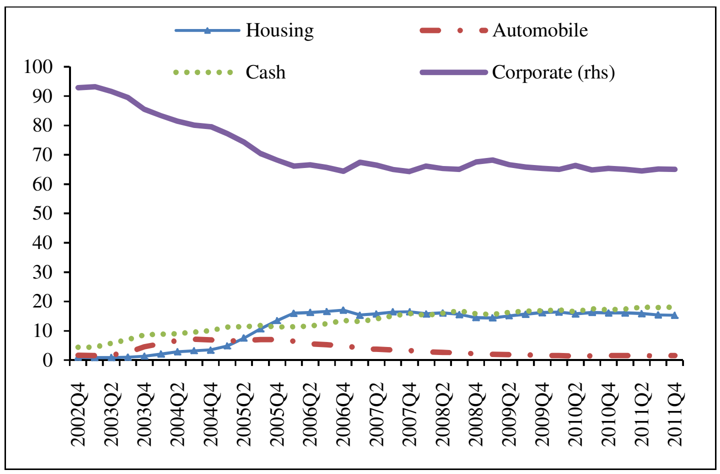

Figure 5.5 The Ratio of Each Loan to Overall Loans

Disaggregated data may carry significant information about the transmission channel of monetary policy. Visual inspection of the data reveals some important implications. Firstly, for each loan type lending rates move together with the money market rate in the period of analysis which implies that monetary policy is effective in influencing the bank rates (Figures 5.6, 5.7, 5.8 and 5.9). However, the co-movement of automobile and housing credits with money market rate is more pronounced than other loan types. The reason behind this could be the high competition among the banks in automobile and housing credit market. Additionally, while money market rate is smooth and less volatile, lending rates exhibit more volatility. However, automobile and housing loans are less volatile than other loan types. That is to say, these loans do not deviate much from the money market rate even in the short run, supporting the high competition. Secondly, in most of the cases money market rate is below the lending rate which can be interpreted that banks follow mark-up pricing while determining the lending rate. Finally, figures obviously exhibit that banks may show different reactions to changes in money market rate. For example, Bank 5 raised its housing rate slightly as a reaction to sudden and high increase in money market rate in June and July, 2006, while Bank 7 increased housing rate dramatically. Similarly, the corporate rate of Bank 4 does not respond to successive decreases in money market rate right after the recent global crisis for a long time, whereas Bank 1 adjusts quickly. Different reactions to change in money market rate presumably depend on the perception and anticipation of the banks.

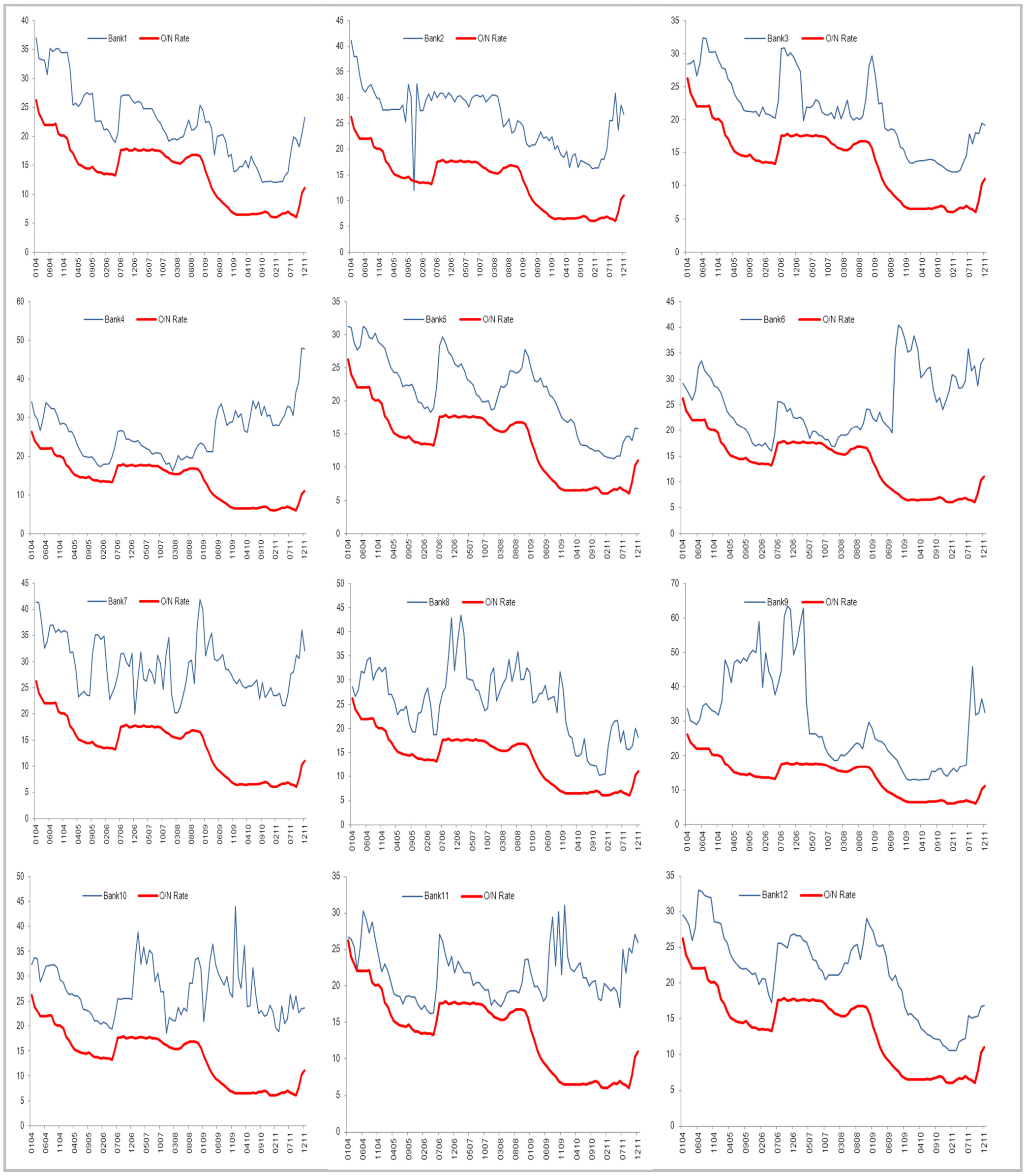

Figure 5.6 Cash Loans and Money Market Rate

Figure 5.7 Housing Loans and Money Market Rate

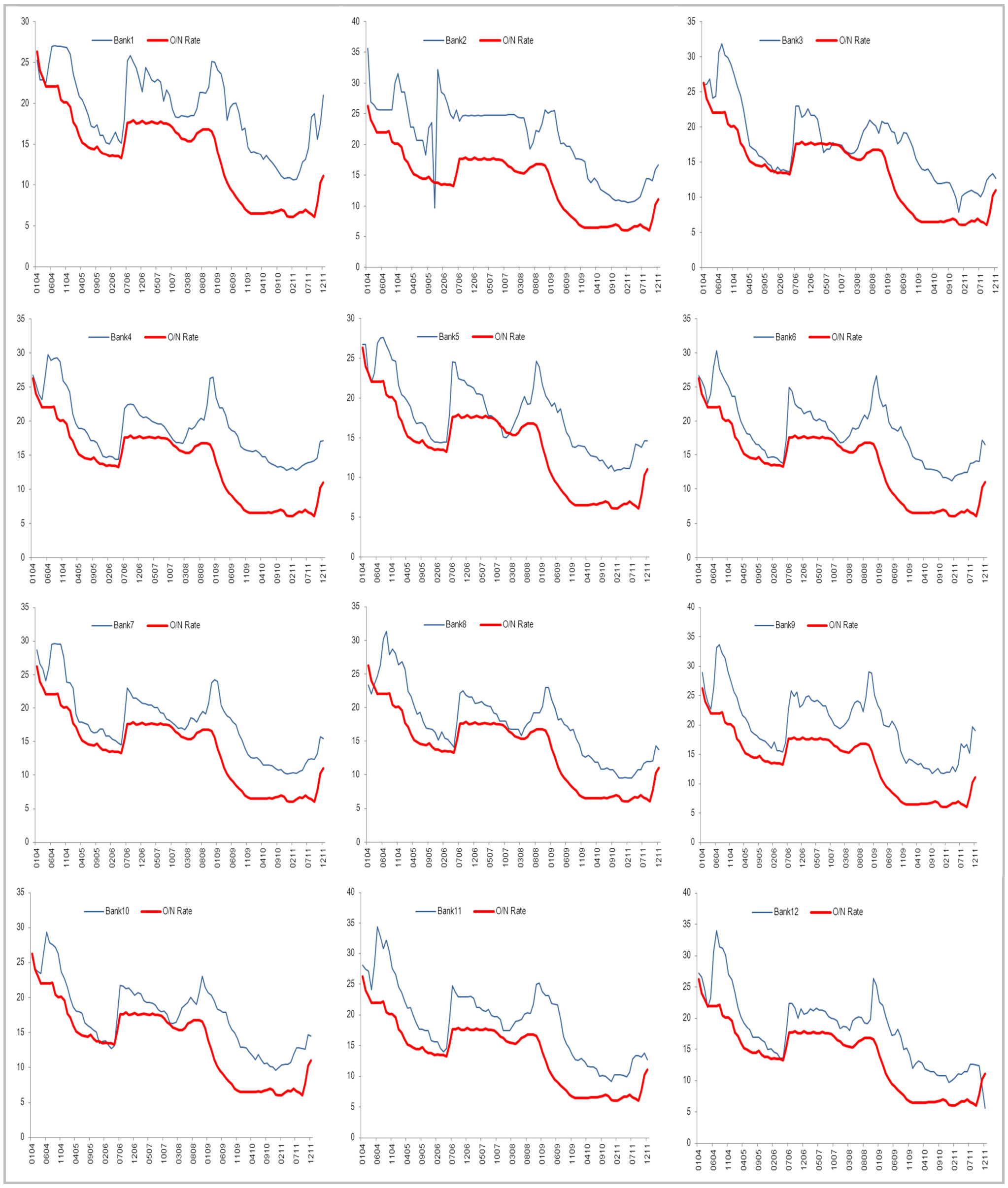

Figure 5.8 Automobile Loans and Money Market Rate

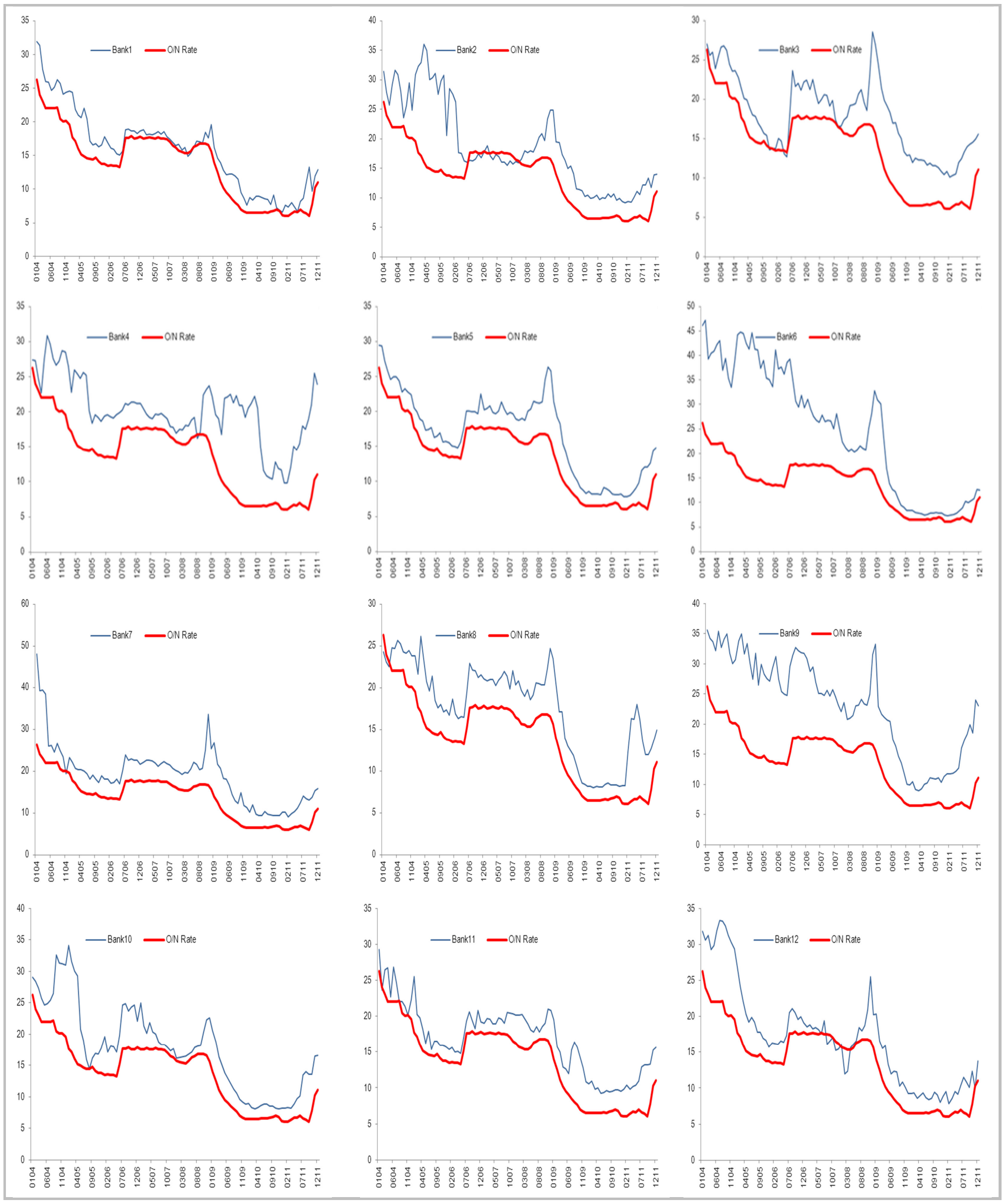

Figure 5.9 Corporate Loans and Money Market Rate

CHAPTER 6

METHODOLOGY

In this study, we examine the interest rate pass through from the money market rate, to the banks' retail lending rates. Overnight repo rate is employed as a gauge to money market rate, which is a proxy for the marginal cost of raising new funds by banks to the economy. In this context, we adopt a single equation modelling technique to reveal short run and long run dynamics of the pass through mechanism under the assumption of weak exogeneity. More specifically, money market rate is assumed to be weakly exogenous to the lending rates since lending rates are not expected to affect market rate movements.

6.1 Linear Modelling

Our starting point for formulizing the interest rate pass through is the linear cointegration test, which provides us not only the existence of a linear long-run relationship between the rates but also the degree of pass through from the money market rate to lending rates. In order to assess the linear adjustment, two step approach of Engle and Granger (1987), based on all interest rates being nonstationary I(1) variables, is adopted. Given the I(1) structure of the variables, the first step is estimating the long run equilibrium relationship through the following static model by Ordinary Least Squares (OLS):

$$lr_{j,t}^{i} = \beta_{0j}^{i} + \beta_{1j}^{i} mmr_t + u_{j,t}^{i} \tag{6.1}$$

where $lr_{j,t}^{i}$ denotes lending rates of the *i*th bank for *j*th type of lending rate at period *t*, mmr_t is the money market rate of month *t,* and $u_{j,t}^{i}$ is the corresponding White Noise disturbance term. The intercept term, β_{0j}^{i}, is the mark up price[4]; and the slope

[4] We assume that banks follow a constant mark-up pricing mechanism that banks charge an additional rate over their marginal cost which is money market rate, see Berlin and Mester (1999).

coefficient, β_{1j}^{i}, denotes the degree of interest rate pass through in the long run. While a complete pass through is presented by $\beta_{1j}^{i}=1$, an incomplete pass through by $\beta_{1j}^{i}<1$.

Although slope estimate of the equation (1) exhibits the extent of pass through, it falls under the criticism of Benarjee, Dolado, Hendry and Smith (1986). They point out that the estimator of the degree of adjustment term is biased and systematically underestimates the true value for finite samples. Bardsen (1989) suggests a new technique to overcome this problem. According to Bardsen, the following autoregressive-distributed lag (ARDL) model can be used to assess the estimators:

$$lr_{j,t}^{i}=\delta_{0j}^{i}+\sum_{k=0}^{p-1}\delta_{kj}^{i}mmr_{t-k}+\sum_{m=1}^{q-1}\phi_{mj}^{i}lr_{j,t-m}^{i}+\delta_{pj}^{i}mmr_{t-p}+\phi_{qj}^{i}lr_{j,t-q}^{i}+u_{j,t}^{i} \qquad (6.2)$$

where p and q are selected according to Akaike's information criterion (AIC) using the upper limit of $p,q=\left[12*\left(\frac{T}{100}\right)^{0.25}\right]$, T denoting the number of observations.

In this framework, an unbiased estimator for degree of interest rate pass through can be calculated as:

$$\varphi_{j}^{i}=-\frac{\phi_{qj}^{i}}{\delta_{pj}^{i}} \qquad (6.3)$$

Now, it is possible to test the completeness of the pass through $\left(H_0:\varphi_j^i=1\right)$ by using the *t-test* with the standard error of φ_j^i given as:

$$se\left(\widehat{\varphi_j^i}\right)=\sqrt{\left(\widehat{\delta_{pj}^i}\right)^{-2}\left[\widehat{\operatorname{var}}\left(\widehat{\phi_{qj}^i}\right)+\left(\widehat{\varphi_j^i}\right)^2\widehat{\operatorname{var}}\left(\widehat{\delta_{pj}^i}\right)+2\widehat{\varphi_j^i}\,\widehat{\operatorname{cov}}\left(\widehat{\delta_{pj}^i},\widehat{\phi_{qj}^i}\right)\right]} \qquad (6.4)$$

The second step of the Engle-Granger cointegration method involves the stationarity test of the residuals obtained from equation (1). Cointegration relationship exists between variables if the residuals are stationary. In order to test for stationarity of the residuals, standard Augmented Dickey Fuller (ADF) regression is estimated with no trend and no constant:

$$\Delta\hat{u}^{i}_{j,t} = \rho^{i}_{1j}\hat{u}^{i}_{j,t-1} + \sum_{k=1}^{p}\rho^{i}_{k+1,j}\Delta\hat{u}^{i}_{j,t-k} + \varepsilon^{i}_{j,t} \tag{6.5}$$

where Δ represents first-differences and p is the required number of lagged changes $\Delta\hat{u}^{i}_{j,t}$ that ensures an iid structure for the disturbance term, $\varepsilon^{i}_{j,t}$. The lag order is determined according to Ljung-Box Q-statistic for residual autocorrelation up to order 12. More specifically, we start estimating equation (5) without any lagged changes of residuals, and then lag is added to the model until autocorrelation problem disappears at 10 % significance level. The Ljung-Box Q-statistic is used to test for autocorrelation since it shows good performance especially in small samples. Once the appropriate lag order is determined, the ADF unit root test can be applied. Rejecting the null hypothesis of $\rho^{i}_{1j} = 0$ suggests stationarity of $\hat{u}^{i}_{j,t}$, i.e. existing of a long-run relationship between the lending rate and the money market rate.

6.2 Non-Linear Modelling

The linear cointegration model assumes symmetric adjustment and do not allow for asymmetry. However, as some empirical studies revealed, it is plausible that adjustment of the lending rate to money market rate changes is not identical under all circumstances but changes in relation to some factors. Accordingly, in this section we focus on the possible existence of asymmetric adjustment. We start with testing for threshold cointegration, and then analyze corresponding non-linear error correction models.

6.2.1 Threshold Cointegration

Enders and Granger (1998) provide strong evidence that the symmetric cointegration test of Engle and Granger (1987) may be biased in the presence of asymmetric adjustment and this may lower the power of the test. This low power may result in a conclusion on the absence of the cointegration relationship although it exists. Consequently, we adopt the TAR and MTAR type cointegration tests of Enders and Siklos (2001) in order to capture the possible non-linearities in the adjustment process.

The TAR model is used to test for the existence of asymmetric cointegration relationship when the adjustment process depends on the level of the disequilibrium. More specifically, in this model, lending rates may adjust differently to disequilibrium when a certain minimum level of deviation is exceeded. In this context, using the residuals obtained in equation (1), equation (5) can be reparametrized to account for asymmetric adjustment as:

$$\Delta \hat{u}^{i}_{j,t} = I_t \rho^{i}_{1j} \hat{u}^{i}_{j,t-1} + (1 - I_t)\rho^{i}_{2j} \hat{u}^{i}_{j,t-1} + \sum_{k=1}^{p} \rho^{i}_{k+2,j} \Delta \hat{u}^{i}_{j,t-k} + \varepsilon^{i}_{j,t} \qquad (6.6)$$

where $\varepsilon^{i}_{j,t}$ is the disturbance term, p is the lag order that ensures the iid structure of the $\varepsilon^{i}_{j,t}$ and I_t is the Heaviside indicator function defined as:

$$I_t = \begin{cases} 1 & \text{if} \quad \hat{u}^{i}_{j,t-1} \geq \tau \\ 0 & \text{if} \quad \hat{u}^{i}_{j,t-1} < \tau \end{cases} \qquad (6.7)$$

where τ is the unknown threshold value. In this TAR setting, ρ^{i}_{1} depicts the speed of adjustment of the lending rate when the distance from the long run equilibrium exceeds the threshold value τ. Similarly, ρ^{i}_{2} shows the adjustment speed of the lending rate when the distance from the long run equilibrium is below the threshold value.

We use Chan's (1993) method which allows one to determine threshold value endogenously. This procedure arranges residuals, $\hat{u}^{i}_{j,t}$, in ascending order and excludes the smallest and the largest 15 % of the residuals to ensure an sufficient number of observations on each side of the threshold. That is, for each potential threshold value τ, which is typically in the middle 70% of the ordered values of the threshold variable $\hat{u}_{t-1}$ $\left(\Delta\hat{u}_{t-1}\right)$, the TAR (MTAR) model is estimated through OLS. The estimate $\hat{\tau}$ is then determined by minimizing the sum of squared residuals (SSR) over these estimations. Threshold cointegration can be tested by the null hypothesis of no cointegration $H_0 : \rho^i_{1j} = \rho^i_{2j} = 0$, against the alternative of cointegration. As the threshold value is not predetermined, the distribution of the test statistic Φ does not have standard normal distribution due to the well-known Davies (1987) problem. Hence, corresponding critical values are obtained through the Monte Carlo simulation. The rejection of the null hypothesis, however, does not guarantee stationarity of $\hat{u}^i_{j,t}$. The necessary and sufficient conditions for the stationarity of the $\left\{\hat{u}^i_{j,t}\right\}$ are provided by Petrucelli and Woolford (1984) as $\rho^i_{1j} < 0$, $\rho^i_{2j} < 0$ and $(1+\rho^i_{1j})(1+\rho^i_{2j}) < 1$ for any value of τ.

Once cointegration is determined and statonarity conditions are satisfied, asymmetry is tested with the null hypothesis that $H_0 : \rho^i_{1j} = \rho^i_{2j}$ via standard F-test. Chan and Tong (1989) points out that using a consistent estimate should establish the asymptotic normality of the coefficients. Chan (1993) shows that searching over the potential threshold values to minimize SSR from the fitted model yields a consistent estimate of the threshold. Hence, it is appropriate to utilize F-statistic to test asymmetry.

The TAR model may fail to detect the cointegration when the adjustment shows more momentum in one direction to the other. In this sense, this study also makes use of the momentum threshold autoregressive (MTAR) type cointegration model which enables us to capture different effects of upward and downward change in the residuals over the sample period. This procedure is very similar to TAR model with the only difference being the form of the indicator function. In MTAR approach, Heaviside indicator depends on the changes in disequilibrium, $\Delta\hat{u}^i_{j,t-1}$, rather than the level, $\hat{u}^i_{j,t-1}$. The new indicator function has the form:

$$I_t = \begin{cases} 1 & \text{if} \quad \Delta \hat{u}^i_{j,t-1} \geq \tau \\ 0 & \text{if} \quad \Delta \hat{u}^i_{j,t-1} < \tau \end{cases} \tag{6.8}$$

With this new Heaviside indicator, once the threshold value is observed through the Chan's procedure discussed above, equation (6) can be estimated by OLS and the rest is same with the TAR approach.

6.2.2 Threshold Error-Correction Models

After the detection of the non-linear cointegration relationship, the next step is to construct threshold error-correction models to capture both short run and long run dynamics of the interest rate pass through simultaneously. The asymmetric error correction model (ECM) is described as follows:

$$\Delta lr^i_{j,t} = \varphi^i_{0j} + \sum_{k=1}^{p} \varphi^i_{kj} \Delta lr^i_{j,t-k} + \sum_{k=1}^{p} \delta^i_{kj} \Delta mmr_{t-k} + \gamma^j_{1j} I_t \hat{u}^i_{j,t-1} + \gamma^j_{2j} (1 - I_t) \hat{u}^i_{j,t-1} + v^i_{1j,t} \tag{6.9}$$

where p is required number of lagged variables of lending rate and money market rate that ensures the i.i.d. structure of the error term, $v^i_{1j,t}$ and $\hat{u}^i_{j,t-1} = lr^i_{j,t} - \beta^i_{0j} - \beta^i_{1j} mmr_{t-1}$. The Heaviside indicator I_t takes the form given in (7) and (8) for TAR-ECM and MTAR-ECM, respectively. γ^j_{1j} and γ^j_{1j} are speed of adjustment coefficients for two different regimes. For TAR-ECM, if the distance from the long run equilibrium in previous month is above (below) the threshold value, then lending rate will respond in a magnitude of $\gamma^j_{1j}(\gamma^j_{2j})$. As for MTAR-ECM, if the previous period's change in the disequilibrium term $\Delta \hat{u}^i_{j,t-1}$ is above (below) the threshold value lending rate will respond in a magnitude of $\gamma^j_{1j}(\gamma^j_{2j})$. φ^i_{kj} represents short run responses of the lending rate to change in its own lags, whereas δ^i_{lj} indicates short run impact of lagged change in money market rate to the lending rate. Testing whether lagged information on money market rate provides any significant information about the lending rate, which is indeed Granger causality test, involves using a standard F-test. Rejection of the null hypothesis of $H_0 : \delta_{lj}^i = 0$ indicates that the money market rate Granger causes lending rates.

As mentioned before, we assume that the money market rate is weakly exogenous to lending rates. To test for this assumption, we construct the nonlinear ECM with the dependent variable being the money market rate as follows:

$$\Delta mmr_{j,t}^i = \widetilde{\varphi_{0j}^i} + \sum_{l=1}^{q} \widetilde{\varphi_{lj}^i} \Delta lr_{j,t-l}^i + \sum_{l=1}^{q} \widetilde{\delta_{lj}^i} \Delta mmr_{t-l} + \widetilde{\gamma_{1j}^i} I_t \hat{u}_{j,t-1}^i + \widetilde{\gamma_{2j}^i} (1 - I_t) \hat{u}_{j,t-1}^i + v_{2j,t}^i \quad (6.10)$$

In this context, weak exogeneity occurs when changes in the money market rate do not respond to the disequilibrium error terms but may still be influenced by lagged changes in lending rate. More specifically, weak exogeneity assumption is supported if the speed of adjustment terms in equation (10), $\tilde{\gamma}_{1j}^i$ and $\tilde{\gamma}_{2j}^i$, are separately insignificant. Whether lagged information on lending rate yields any significant information about the money market rate in the short run can be examined through the null hypothesis $H_0 : \tilde{\varphi}_{1j}^i = 0$. Rejection of the null hypothesis indicates that lending rate Granger causes money market rate.

CHAPTER 7

EMPIRICAL RESULTS

This study aims to reveal the optimal models for the interest rate pass through. In this framework, we start with the application of unit root tests in order to specify integration orders of the interest rates and proceed with testing for cointegration relationships. At first, we estimate linear cointegration equation as in (1) and (2) as a baseline model via Engle-Granger method. Next, allowing for the asymmetries in the pass through mechanism, we test for non-linearity in cointegration by using TAR and MTAR models of Enders and Siklos (2001). Finally, non-linear error correction models are constructed to capture the short run and long run dynamics simultaneously between lending rates and the money market rate.

7.1 Preliminary Result

As we mentioned in section 6.1 and 6.2.1 both linear and non-linear cointegration tests are based on nonstationarity, i.e. I(1), structure of the interest rates. Hence, we begin with testing the null hypothesis of a unit root by using Ng-Perron tests. Ng and Perron (2001) propose four different unit root test statistics that are estimated using generalized least squares (GLS) de-trended data for each variable. These test statistics are modified forms of Phillips and Perron statistic, the Bhargava (1986) statistic and Elliot, Rothenberg and Stock (ERS) point optimal statistic. Traditional unit root tests typically suffer from severe finite sample power and size problems, whereas Ng-Perron test corrects for size distortions and has good power in finite samples. Therefore, we adopt the Ng-Perron method where the test statistic is obtained by a regression using an intercept and lagged dynamic terms, which are determined based on the Modified Akaike Information Criterion (MAIC) as suggested by Ng and Perron (2001).

Based on the test statistics and corresponding critical values, Table 1 reports that null hypothesis of a unit root cannot be rejected at 5% and 10% significance levels.[5] Hence, all lending rates and the money market rate follow a nonstationary, I(1) structure.[6]

7.2 Cointegration Test Results

In this section, we provide both linear and non-linear cointegration test results along with the degree of pass through for each loan rate. First, we begin with analyzing the test results for each loan type and then make overall assessment about the findings.

Besides the Engle-Granger approach, the extent of pass through is also estimated by using Bardsen's approach. As discussed in section 6.1, conclusions on the completeness of the pass-through based on the Engle-Granger approach may not be reliable, due to the biasedness (underestimation) problem underlined by Banerjee et al. (1986, 1993). Bardsen (1989) suggests an alternative simple ARDL based approach to solve this problem and following his approach, Cook (2008) provides significant evidence in favor of the complete pass-through to mortgage rates from money market rate, while using the same interest rates Payne (2006) fail to detect completeness through the Engle-Granger approach. In this sense, in order to avoid the underestimation problem of the degree of pass through and to compare the results with the ones observed from the Engle-Granger method, Bardsen's approach is also applied to obtain the extent of pass through.

7.2.1 Cash Loans

Given the I(1) structures of the interest rates, in this section we begin with analyzing the estimates of the equation (1) for cash loans which yields information about the mark-up (down) and the degree of the pass through. Table 2 reports the slope and intercept coefficients, corresponding standard errors along with the extent of pass

[5] At 10 % significance level, only 1 out of 49 variables is stationary.

[6] Besides Ng and Perron unit root tests, standard ADF and Phillips-Perron unit root tests are also performed but due to similar findings the results are not reported here, available upon request.

through observed according to Bardsen's approach. First column of the Table 2 shows the intercept term which indicates the intermediation margins for cash loans, namely constant mark-up. In general, mark-up values are high and positive, and ranges in a wide interval, indicating a substantial heterogeneity among the banks. The completeness test according to estimates obtained from Engle-Granger method reveals that 7 out of 12 banks (Bank 1, 2, 3, 5, 8, 9, and 12) adjust completely to variations in the money market rate in the long run. Bardsen transformation yields the same results with Engle-Granger method. It is interesting that the slope coefficients for Bank 4 and Bank 6 are negative. This strange result could be explained by Figure 5.6. It shows that until the recent global crisis these cash loan rates move together with the money market rate; however the close link has weakened during the crisis experienced at the end of 2008. It is probable that banks may have thought that the crisis would worsen with declines in the money market rate being temporary, and increased the rates in order to protect themselves, which may produce a negative slope coefficient.

Next, we continue with the cointegration test results given in Table 3. According to the results, the Engle-Granger cointegration test supports a significant cointegration relationship at 5% significance level for only 3 banks out of 12, which are Banks 2, 3 and 8. TAR and MTAR cointegration tests, however, provide empirical support for cointegration for the Banks 2, 8, 11 and Banks 2, 10, 11, respectively.[7] It is worth mentioning that cointegration can be captured by more than one test. For example, all cointegration tests support significant cointegration relationship for Bank 2. In such a case, we use AIC model selection criterion to obtain the model with best fit to the data. According to AIC model selection criterion, as used by Enders and Siklos (2001), results based on the equations (5) and (6) indicate that only Bank 3 out of 12 banks cointegrates symmetrically with money market rate in the long run. While 3 out of 4 nonlinear cointegrations show MTAR type adjustment, only the adjustment of Bank 8 is TAR type. If we investigate the asymmetric pass through cases, we

[7]Critical values and corresponding p-values for TAR and MTAR type cointegration tests are simulated through Monte Carlo simulations, described in Enders and Siklos (2001).

observe that 2 banks (Bank 10 and Bank 11) exhibit incomplete pass through and other two (Bank 2 and Bank 8) shows complete pass through.

7.2.2 Housing Loans

Table 5 represents the mark-up value and the extent of pass through for housing loans according to both Engle-Granger and Bardsen method. To begin with mark-up values, indicating intermediation margin for banks, in general they are relatively small. These values do not diverge a lot from each other representing the homogenous mark-up pricing structure among banks. The results point out that Engle-Granger and Bardsen approaches capture 7 out of 12 banks as adjusting completely to changes in money market rate. However, Engle-Granger captures 2 banks as completely adjusting to changes in money market which are not detected by Bardsen approach. Similarly, Bardsen method captures 2 complete adjustments which are not detected by Engle-Granger. 3 banks (Bank 6, Bank 7 and Bank 10) do not completely react to money market rate according to both approaches.

Regarding cointegration test results, the Engle-Granger cointegration test provides empirical evidence for cointegration at 5% significance level only for the Bank 5. MTAR and TAR type cointegration tests, on the other hand, support cointegration not only for the Bank 5 but also for the Banks 2, 9 and 11, with the last two cases being supported by MTAR type adjustment only. Moreover, according to AIC criterion MTAR type adjustment gives the best for the Banks 5, 9 and 11 while TAR type adjustment outperforms only for the Bank 2. Among the housing loan rates having asymmetric behavior, Bardsen approach fails to find a complete pass-through for only one bank (Bank 11).

7.2.3 Automobile Loans

Table 7 represents the Bardsen and Engle-Granger results along with the mark-up values. Intermediation margins for automobile loans are higher than that of housing loans, but smaller than that of cash loans in general. Moreover, the spread of the mark-up values among banks are not too wide. Comparison of the degree of pass through yields that while Engle-Granger detects only 3 banks as adjusting completely to changes in money market rate, Bardsen approach detects 6 banks as reacting fully to variations in money market rate. These 6 banks include the 3 banks captured by the former method. These results suggest that there is a considerable improvement in detection of complete pass through by the latter method.

Cointegration test results reported in Table 8 indicate that while Engle-Granger approach provides evidence of cointegration for Banks 2 and 3 only, TAR and MTAR type tests uncover a significant cointegration for Banks 2, 5, 8 and 9, with Banks 5 and 9 being supported by MTAR type adjustment only. AIC criterion suggests that linear relationship gives the best fit for only the Bank 3, whereas MTAR type adjustment is selected for Banks 2, 5, 8 and 9. 3 banks out of 4 non-linear cases (Banks 2 and 9) react completely to money market rate, whereas other 2 banks (Banks 5 and 8) exhibit incompleteness along with the non-linearity.[8]

7.2.4 Corporate Loans

Banks supply corporate loans generally at higher amounts and to the fewer customers. As discussed in Chapter 5, the ratio of the corporate loans in total credit market is higher than the total household loans. Mark-up values for corporate loans diverge in a wide range. More specifically, there are examples of banks following small mark-ups, nearly zero, as well as banks applying high intermediation margins (Table 9). As for degree of pass through test, although Engle-Granger method suggests complete pass through in 4 banks, Bardsen approach suggests complete pass through in 9 banks, including the banks detected by former method. Similar to automobile loans, Bardsen approach captures considerably more banks as adjusting fully to changes in money market rate.

Engle-Granger cointegration test results provide empirical evidence for cointegration at 5% significance level for Banks 1, 7, 8 and 11. On the other hand TAR and MTAR

[8] Hence the estimates of Bardsen transformation is consistent and unbiased, we refer to this approach while the name of approach is not written explicitly.

tests detects cointegration for Banks 1, 2, 7, 8 and 9, with Banks 1, 2 and 8 being supported by MTAR type adjustment only. According to AIC criterion, asymmetric cointegration between corporate loans and money market rate outperforms in 5 banks (Banks 1, 2, 7, 8, and 9), in 4 of which (Banks 1, 2, 7 and 8) MTAR gives the best. AIC selects linear cointegration only for Bank 11 as fitting the data best. The investigation of the non-linear cointegration reveals that 4 of 5 non-linear adjustment cases (Bank1, Bank2, Bank7 and Bank8) adjust completely to changes in money market rate, while one bank (Bank9) exhibits an incomplete pass through.

7.2.5 Overall Assessment

The overall picture displays that intermediation margin is the minimum for corporate rates on average, followed by housing rates, automobile rates and cash rates, respectively. De Bondt (2005) suggests that mark-up between the retail rates and the money market rate (or the official rate) can be considered as indicators for the degree of competition in the market, risk, the elasticity of demand, regulatory factors or maturity. Horvath and Podpiera (2009) infer the mark-up value as the gauge of riskiness. In this respect, the low markup for corporate rates might be due to the fact that the market for corporate loans is less risky and/or more competitive than others. Additionally, bank level analysis reveals that setting a small mark-up over the money market rate is not a general behavior of banks for corporate loans. While large banks follow small mark-up pricing, small banks follows large mark-up pricing for corporate loans. However, this is not evident for other loans. Another important result is that cash loans having high mark-up do not adjust completely to variations in the money market rate. It may stem from that banks may evaluate cash loans as more risky, since other loan types more or less depend on the collateral warranty, whereas cash loans are less dependent.

The degree of pass through test results obtained from the Engle-Granger and Bardsen approaches are summarized in Table 2, Table 4, Table 6 and Table 8. Results obtained from Bardsen transformation suggests that 29 out of 48 rates adjust completely to changes in money market rate in the long run, while this number is 21 for the Engle-Granger approach. Hence, with this comparative study, we observe that while the contribution of Bardsen approach is considerably high for automobile and corporate loan rates, it provides no contribution for cash and housing interest rates. This clearly indicates that the underestimation problem of the Engle-Granger approach is more substantial for automobile and corporate loans. In line with Aydin (2007), Engle-Granger results suggest that the pass through from money market rate to corporate loans is incomplete, suggesting a less competitive market for corporate loans. Regarding the Bardsen method, on the other hand, the maximum number of complete pass through is detected for corporate loans followed by housing, cash and automobile loans. Being in line with the mark-up results, Bardsen approach, points to a higher competition among banks in corporate loans market and underline how deceptive the Engle-Granger approach could be. Hence, regarding the mark-up pricing policy and the degree of pass-through, our findings imply that in addition to heterogeneities among banks, there are also sectoral differences in the transmission mechanism.

Besides the degree of the pass-through, the estimates of the equation (5) and (6) enable us to infer about the cointegration between lending rates and the money market rate. Based on the AIC, the non-linear models with the consistent threshold estimates fit the data better than the linear cointegration model for 17 loan rates; only in 3 cases (Banks 2, 8 and 9) linear model fit better, as given in Table 10.[9] AIC selects MTAR model in 14 cases out of 17 non-linear adjustments, whereas it chooses TAR model in 3 cases.[10] MTAR type of adjustment is followed by the considerable number of banks for different types of lending rates. One of the possible explanations might be that banks attempt to smooth out any large market rate change, as stated by Sander and Kleimeirer (2004). On the other hand, none of the lending rates of Banks 4, 6 and 12 are detected as showing cointegration with money market

[9] We use 10% as trimming value to estimate consistent and unbiased estimate of the threshold value by Chan's method. As we repeat the estimations with 15% trimming value, results more or less remain the same, indicating our results are robust in terms of trimming value.

[10] Enders and Siklos (2001) points out that while the power of the test for TAR adjustment is poor compared to that of the Engle-Granger test, the power of the M-TAR test is better than that of the Engle-Granger test.

rate in the long run. Accordingly, it can be inferred that the bank structure is as important in reaction to money market rate as loan type.

In most of the non-linear cointegration cases we observe that while the adjustment speed is high in one regime, it is relatively low and sometimes close to zero in the other regime. If changes in money market rate makes banks to stay at the regime with high speed of adjustment, complete pass through is expected to occur, otherwise incomplete pass through is anticipated. In line with this proposal, our results suggest that 11 rates out of 17 detected asymmetric cointegration relationships completely react to money market rate, other 6 lending rates respond incompletely to changes in money market rate. The different adjustment speeds to the long-run equilibrium will be discussed in more detail in the next section.

Furthermore, there is no evidence that ownership of the bank influence the long-run relationship. That is to say, being a state bank or private bank does not have an effect on cointegration. Moreover, banks size does not create any difference in the long run relationship between lending rates and money market rate. Loan rates of the small banks as well as large banks exhibit co-movements with money market rate in the long run.

We fail to observe a linear or non-linear long run relationship with money market rate for 28 interest rates. This, however, does not mean that these lending rates are not cointegrated with the money market rate. Our analysis is restrained to TAR and MTAR type nonlinearities and if the actual type of asymmetry is different, such as Band-TAR or S-TAR type, then the empirical power of our tests will decrease and this may lead to under-rejection of the null hypothesis of no cointegration. Furthermore, if cointegration test results are evaluated at 10 % significance level, 6 more cointegration relationships are detected, 3 of which are detected as non-linear, and the remainings are linear cointegration relationship.

7.3 Non-Linear Error-Correction Models

After detection of non-linear cointegration relationships, the threshold ECMs as in (9) and (10) are estimated to reveal the nature of asymmetry in adjustment of loan rates as described in section 6.2.2. ECMs are estimated by the OLS, once the lag lengths are determined by Ljung-Box Q statistics with maximum order of 12.

Before focusing on asymmetries in the pass through, the validity of the use of a univariate equation as in (1) opposed to a bivariate system, which depends on weak exogeneity of the money market rate, is tested. That is, weak exogenity of the money market rate to each lending rate is examined by testing significance of the speed of adjustment parameters in each money market rate equation, as discussed in section 6.2.2. In Table 11 and 12, we report the exogeneity test results along with the estimated TAR-ECMs and MTAR-ECMs results, respectively. In general, our findings suggest that the money market rate is in fact weakly exogenous to lending rates at 5 % level. In other words, money market rate is not affected by the lending rates in the long run. However, in 3 out of 17 interest rates (housing loans of Banks 9 and 11, and automobile loans of Bank 5), there is endogeneity problem which implies that it may be more appropriate to construct a bivariate system of equation to capture the dynamics of the interest rate pass through.[11] Since the majority of the series satisfy the weak exogeneity assumption, it is legitimate to move to interpretation of the non-linear ECM results.[12]

Table 11 and 12 represent that lending rates which satisfy the weak exogeneity assumption do not influence money market rate even in the short run. More specifically, lending rates in general do not Granger causes money market rate in the

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[11] Speed of adjustment parameters of cash loans of Bank2 and corporate loans of Bank1 are also significantly different from zero in money market rate equations. However, these coefficients are positive. In order to assert that money market rate converges to the long-run equilibrium, these coefficients should be negative. Hence, we cannot claim that money market rate is affected by these lending rates in the long run. Consequently, these lending rates do not violate the weak exogeneity assumption.

[12] From now on, we do not include 3 interest rate series which do not satisfy the weak exogeneity assumption and continue with the 14 ECMs, 11 of them are MTAR-ECMs and the remaining are TAR-ECMS.

short run, the only exceptions are cash loans of Bank2 and corporate loans of Bank1. On the other hand, in 5 cases out of 14 non-linear estimations, money market rate Granger causes lending rate. Except for 1 (corporate loans of Bank 1), there is uni-directional Granger-causality from money market rate to lending rate.

Next, we discuss the asymmetries in the pass-through process and start with the results obtained from TAR-ECMs. For these models, the coefficients γ_1 and γ_2 describes the speeds at which any disequilibrium in the long-run relationship between money market and retail rate dissipates when level of disequilibrium in the previous period is above and below the threshold value, respectively. Results in Table 11 shows that in 2 of 3 interest rates $|\gamma_1| > |\gamma_2|$, so it appears that adjustment towards the long run equilibrium is faster (slower) when the disequilibrium is above (below) the threshold level. Hence, there is upward adjustment rigidity in two rates and there is downward rigidity in only one rate. As for MTAR-ECMs, the coefficients γ_1 and γ_2 indicates the speeds at which any long run disequilibrium dissipates when change in disequilibrium in the previous period is above and below the threshold value, respectively. Table 12 represents that 7 out of 11 lending rates exhibits upward rigidity, 4 rates shows downward rigidity.

In general most of the non-linear ECM estimation results exhibit upward rigidity, whereas there are also evidences for downward rigidity. Detailed analysis reveals that downward rigidity is captured for only two banks, which are relatively large. According to Berger's (1995) hypothesis, banks having greater market power might price retail rates less competitively incurring in slower downward adjustment for loans. Our result is partly consistent with the Berger's hypothesis if the bank's market share is used as a proxy for market power. It is partly because all large banks do not follow slower downward adjustment.

CHAPTER 8

CONCLUSION

In this study, the pass-through from the money market rate to lending rates is investigated by using micro data in Turkey for the period between 2004 and 2011. We employ bank specific data for cash, automobile, housing and corporate loans and utilize the threshold error-correction models to uncover the possible asymmetries in adjustment process.

Empirical results indicate that mark-up value is the minimum for corporate rates on average, followed by housing rates, automobile rates and cash rates, respectively. Furthermore, while large banks follow small mark-up pricing, small banks follows large mark-up pricing for corporate loans. However, this is not evident for other loans. Our results also suggest that Bardsen transformation makes considerable improvement in detection of the complete pass through when compared to Engle-Granger method. 60 percent of the lending rates react completely in the long run to variation in money market rate according to Bardsen method. While 75 percent of the corporate loans respond fully to money market rate changes, 58 percent of cash and housing loans and only half of the automobile loans react completely to money market rate. This finding might be an indication that in corporate loans market competition is more intense among banks. Another important result is that cash loans having high mark-up values do not adjust completely to variations in money market rate.

Another interesting finding is that 17 out of 48 lending rates are found to cointegrated asymmetrically with the money market rate, whereas symmetric cointegration is detected only in 3 interest rates. Moreover, we find that MTAR type asymmetry dominates TAR type among the detected non-linear long run relationship, where 82 percent of the non-linear cointegration is detected by MTAR method and 18 percent of the non-linear cointegration is found by TAR model.

It is worth nothing that in general weak exogeneity of money market rate with respect to each lending rate is confirmed by the results. With few exceptions, lending rates which satisfy the weak exogeneity assumption do not influence money market rate even in the short run. Furthermore, upward rigidities are more widespread compared to downward rigidities among the banks. That is to say, in general, adjustment towards the long run equilibrium is faster when the disequilibrium or change in disequilibrium is above the threshold value.

Finally, 28 interest rates cannot be detected to cointegrate symmetrically or asymmetrically with the money market rate. However, this does not mean that there is no long run relationship between these rates. Cointegration might be captured by other methods rather than TAR, MTAR and Engle-Granger which might be further research topic.

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APPENDIX

Table A.1 Ng-Perron Unit Root Test

		MZa	MZt	MSB	MPT
	O/N Rate	-0.31	-0.23	0.73	30.94
Cash Loans	Bank1	-0.90	-0.59	0.66	22.71
	Bank2	-0.53	-0.41	0.77	31.43
	Bank3	-2.57	-1.05	0.41	9.19
	Bank4	-0.89	-0.39	0.43	13.83
	Bank5	-0.66	-0.36	0.55	18.94
	Bank6	-4.96	-1.52	0.31	5.08
	Bank7	-2.87	-1.17	0.41	8.46
	Bank8	-5.77	-1.60	0.28	4.55
	Bank9	-7.09	-1.88	0.27	3.46
	Bank10	-6.09	-1.67	0.27	4.27
	Bank11	-1.61	-0.76	0.47	12.89
	Bank12	-4.12	-1.33	0.32	6.09
Housing Loans	Bank1	-2.11	-0.95	0.45	10.92
	Bank2	-0.54	-0.31	0.58	21.07
	Bank3	-2.08	-0.88	0.42	10.51
	Bank4	-1.02	-0.59	0.58	18.85
	Bank5	-0.89	-0.50	0.56	18.65
	Bank6	-1.88	-0.88	0.46	11.88
	Bank7	-1.60	-0.78	0.48	13.23
	Bank8	-3.30	-1.20	0.36	7.35
	Bank9	-1.72	-0.80	0.46	12.41
	Bank10	-2.56	-1.03	0.40	9.12
	Bank11	-1.61	-0.76	0.47	12.89
	Bank12	-4.11	-1.32	0.32	6.09

Table A.1 (continued)

		MZa	MZt	MSB	MPT
Automobile Loans	Bank1	-3.53	-1.32	0.37	6.92
	Bank2	-0.22	-0.16	0.70	29.65
	Bank3	-2.70	-1.00	0.36	8.50
	Bank4	-3.83	-1.30	0.33	6.45
	Bank5	-1.30	-0.64	0.49	14.43
	Bank6	-1.82	-0.84	0.45	11.91
	Bank7	-1.56	-0.75	0.48	13.26
	Bank8	-2.69	-1.03	0.38	8.65
	Bank9	-4.33	-1.41	0.32	5.75
	Bank10	-2.32	-0.95	0.40	9.73
	Bank11	-2.39	-0.91	0.38	9.22
	Bank12	-2.43	-0.75	0.30	8.38
Corporate Loans	Bank1	0.09	0.084	0.96	53.49
	Bank2	-0.92	-0.51	0.55	18.26
	Bank3	-1.72	-0.80	0.46	12.38
	Bank4	-3.62	-1.34	0.37	6.76
	Bank5	-0.81	-0.49	0.61	21.17
	Bank6	0.11	0.087	0.76	36.74
	Bank7	-0.18	-0.14	0.79	36.26
	Bank8	-1.76	-0.83	0.47	12.41
	Bank9	-1.63	-0.84	0.51	13.93
	Bank10	-1.16	-0.66	0.57	17.76
	Bank11	-0.98	-0.57	0.58	18.89
	Bank12	-0.31	-0.23	0.74	31.36

Notes: The lag order for all unit root tests has been determined using the modified AIC (MAIC) suggested by Ng and Perron (2001). The critical values for the above tests have been taken from Ng and Perron (2001):

		MZa	MZt	MSB	MPT
Asymptotic critical values:	1%	-13.80	-2.580	0.174	1.780
	5%	-8.100	-1.980	0.233	3.170
	10%	-5.700	-1.620	0.275	4.450

Table A.2 Mark-up and Speed of Adjustment for Cash Loans

	Engle Granger's Approach				Bardsen Approach		
	Mark-up	Degree of Pass Through					
	$\hat{\alpha}$	$\hat{\beta}$	s.e.	Complete	$\hat{\varphi}$	s.e.	Complete
Bank1	7.30	1.09	0.06	Yes	0.88	0.24	Yes
Bank2	14.13	0.88	0.06	Yes	0.76	0.19	Yes
Bank3	8.26	0.95	0.05	Yes	0.93	0.12	Yes
Bank4	31.18	-0.37	0.12	No	-1.67	0.92	No
Bank5	8.42	0.95	0.05	Yes	1.11	0.19	Yes
Bank6	31.22	-0.44	0.11	No	-0.59	0.52	No
Bank7	22.27	0.50	0.09	No	0.34	0.27	No
Bank8	11.89	0.99	0.10	Yes	1.19	0.32	Yes
Bank9	12.84	1.29	0.24	Yes	1.79	1.39	Yes
Bank10	22.94	0.29	0.10	No	0.09	0.18	No
Bank11	19.98	0.12	0.07	No	0.07	0.18	No
Bank12	8.06	0.99	0.05	Yes	1.18	0.24	Yes

Notes: Critical values for standard normal distribution are 1.645 for 10%, 1.96 for 5% and 2.575 for 1%.

Table A.3 Cointegration Test Results for Cash Loans

	Bank1			Bank2			Bank3		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.140	-0.188	0.097	-0.586	-0.382	-0.290	-0.224	-0.263	-0.247
	(-2.569)	(-2.901)	(0.702)	(-6.265)	(-3.384)	(-2.811)	(-3.601)	(-2.983)	(-3.588)
ρ_2	*NA*	-0.028	-0.181	*NA*	-0.938	-1.187	*NA*	-0.185	-0.039
	NA	(-0.282)	(-3.086)	*NA*	(-6.326)	(-8.143)	*NA*	(-2.091)	(-0.242)
p	0	0	0	0	0	0	0	0	0
τ	*NA*	-3.686	1.224	*NA*	-3.347	-1.630	*NA*	2.400	-1.259
Q(12)	5.221	6.071	11.798	16.364	10.311	10.063	10.040	11.440	11.029
	[0.950]	[0.912]	[0.462]	[0.175]	[0.589]	[0.610]	[0.612]	[0.492]	[0.526]
Φ	*NA*	4.202	4.955	*NA*	25.457	36.699	*NA*	6.566	6.395
	NA	[0.316]	[0.318]	*NA*	[0.000]	[0.000]	*NA*	[0.075]	[0.153]
$\rho_1 = \rho_2$	*NA*	1.838	*NS*	*NA*	8.909	25.178	*NA*	0.393	1.394
	NA	[0.178]	*NS*	*NA*	[0.004]	[0.000]	*NA*	[0.532]	[0.241]
AIC	0.862	0.863	0.854	2.160	2.090	1.949	0.928	0.945	0.939
	Bank4			Bank5			Bank6		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.030	0.017	0.085	-0.100	-0.129	-0.288	-0.117	-0.081	-0.064
	(-0.628)	(-0.304)	(0.883)	(-2.395)	(-2.296)	(-2.578)	(-2.476)	(-1.531)	(-1.053)
ρ_2	*NA*	-0.122	-0.060	*NA*	-0.065	-0.072	*NA*	-0.248	-0.265
	NA	(-1.577)	(-1.160)	*NA*	(-1.072)	(-1.655)	*NA*	(-2.446)	(-2.867)
p	3	3	3	1	1	1	0	0	2
τ	*NA*	-6.093	2.944	*NA*	-1.015	1.278	*NA*	-6.621	-1.244
Q(12)	5.732	4.685	5.939	11.882	12.048	11.664	18.525	17.782	16.524
	[0.929]	[0.968]	[0.919]	[0.455]	[0.442]	[0.473]	[0.101]	[0.122]	[0.168]
Φ	*NA*	1.307	1.106	*NA*	3.122	4.534	*NA*	4.119	4.695
	NA	[0.950]	[0.977]	*NA*	[0.544]	[0.387]	*NA*	[0.328]	[0.308]
$\rho_1 = \rho_2$	*NA*	*NS*	*NS*	*NA*	0.594	3.253	*NA*	2.123	3.157
	NA	*NS*	*NS*	*NA*	[0.443]	[0.075]	*NA*	[0.149]	[0.079]
AIC	1.559	1.555	1.559	0.060	0.075	0.046	1.919	1.917	1.907
	Bank7			Bank8			Bank9		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.280	-0.199	-0.224	-0.269	-0.443	-0.329	-0.109	-0.276	-0.458
	(-3.104)	(-1.637)	(-2.382)	(-3.942)	(-4.517)	(-3.854)	(-2.389)	(-4.225)	(-5.032)
ρ_2	NA	-0.350	-0.596	*NA*	-0.120	-0.177	*NA*	0.022	0.003
	NA	(-3.063)	(-3.095)	*NA*	(-1.324)	(-1.467)	*NA*	(0.385)	(0.051)
p	2	2	2	0	0	0	0	0	1
τ	*NA*	-1.811	-3.346	*NA*	6.080	-0.091	*NA*	17.722	4.270
Q(12)	12.242	12.813	14.796	16.075	14.293	15.732	16.627	17.503	17.756
	[0.426]	[0.383]	[0.253]	[0.188]	[0.282]	[0.204]	[0.164]	[0.132]	[0.123]
Φ	*NA*	5.254	6.584	*NA*	10.960	8.411	*NA*	8.903	12.542
	NA	[0.150]	[0.124]	*NA*	[0.004]	[0.047]	*NA*	[0.016]	[0.003]
$\rho_1 = \rho_2$	*NA*	0.982	3.386	*NA*	5.823	1.050	*NA*	*NS*	*NS*
	NA	[0.324]	[0.069]	*NA*	[0.018]	[0.308]	*NA*	*NS*	*NS*
AIC	2.359	2.369	2.342	2.394	2.354	2.409	3.407	3.310	3.272

Table A.3 (Continued)

	Bank10			Bank11			Bank12		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.224	-0.427	-0.590	-0.206	-0.455	-0.488	-0.132	-0.121	-0.075
	(-2.479)	(-3.105)	(-4.414)	(-2.630)	(-4.483)	(-4.759)	(-2.665)	(-2.155)	(-1.412)
ρ_2	*NA*	-0.111	-0.241	*NA*	-0.136	-0.115	*NA*	-0.163	-0.217
	NA	(-1.043)	(-2.516)	*NA*	(-1.307)	(-1.114)	*NA*	(-1.866)	(-2.286)
p	2	2	0	1	0	0	5	5	0
τ	*NA*	5.959	4.728	*NA*	4.065	0.626	*NA*	-2.552	-0.740
Q(12)	15.842	14.621	16.969	8.951	17.397	16.068	14.919	15.413	17.687
	[0.199]	[0.263]	[0.151]	[0.707]	[0.135]	[0.188]	[0.246]	[0.220]	[0.126]
Φ	*NA*	4.985	12.767	*NA*	10.785	11.817	*NA*	3.566	3.570
	NA	[0.183]	[0.003]	*NA*	[0.004]	[0.006]	*NA*	[0.394]	[0.582]
$\rho_1 = \rho_2$	*NA*	3.708	4.496	*NA*	4.806	6.534	*NA*	0.186	1.691
	NA	[0.057]	[0.037]	*NA*	[0.031]	[0.012]	*NA*	[0.667]	[0.197]
AIC	2.628	2.609	2.649	1.787	1.825	1.816	0.232	0.252	0.380

Notes: ρ_i represents the adjustment parameters with t-statistic in parentheses. p displays the required number of lagged changes to ensure iid residuals in (5) and (6). τ is the threshold value. Q(12) denotes the Ljung-Box Q-statistics for serial correlation up to 12 lags. Φ shows the sample value of threshold cointegration test with simulated p-values (20000 replications) in brackets. $\rho_1 = \rho_2$ reports the null hypothesis of symmetry of the cointegration with p-values in brackets. AIC is used as a model selection criteria which is calculated as log(SSR)+2*k/T, where SSR is the sum of squared residuals, k is the number of regressors and T represents number of observations that is used. *NA* stands for not available and *NS* represents stationarity conditions are not satisfied. MacKinnon critical values for Engle-Granger cointegration test are -3.087 for 10%, -3.398 for 5% and -4.008 for 1% significance level.

Table A.4 Mark-up and Speed of Adjustment for Housing Loans

	Engle Granger's Approach				Bardsen Approach		
	Mark-up	Degree of Pass Through					
	$\hat{\alpha}$	$\hat{\beta}$	s.e.	Complete	$\hat{\varphi}$	s.e.	Complete
Bank1	6.51	0.82	0.05	No	0.78	0.20	Yes
Bank2	4.75	1.23	0.09	No	1.26	0.23	Yes
Bank3	4.27	1.01	0.05	Yes	0.87	0.09	Yes
Bank4	4.58	0.91	0.05	Yes	0.60	0.13	No
Bank5	4.23	0.93	0.05	Yes	0.88	0.17	Yes
Bank6	5.83	0.82	0.07	No	0.58	0.14	No
Bank7	5.28	0.79	0.06	No	0.44	0.17	No
Bank8	4.13	0.96	0.06	Yes	0.81	0.10	Yes
Bank9	5.61	0.96	0.06	Yes	0.85	0.25	Yes
Bank10	4.62	0.86	0.05	No	0.74	0.11	No
Bank11	3.89	0.98	0.05	Yes	0.74	0.11	No
Bank12	4.69	0.96	0.05	Yes	0.80	0.22	Yes

Table A.5 Cointegration Test Results for Housing Loans

	Bank1			Bank2			Bank3		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.129	-0.186	-0.076	-0.269	-0.171	-0.086	-0.145	-0.246	-0.415
	(-2.524)	(-2.972)	(-1.344)	(-3.194)	(-2.036)	(-0.963)	(-3.042)	(-3.557)	(-3.348)
ρ_2	*NA*	-0.020	-0.324	*NA*	-0.779	-0.572	*NA*	-0.061	-0.097
	NA	(-0.236)	(-3.031)	*NA*	(-4.758)	(-4.238)	*NA*	(-0.956)	(-1.915)
p	0	0	0	3	3	1	1	1	1
τ	*NA*	-2.434	-0.482	*NA*	-4.911	-1.507	*NA*	2.090	0.793
Q(12)	16.757	18.167	16.594	8.396	11.871	13.170	9.990	10.096	11.573
	[0.159]	[0.111]	[0.166]	[0.753]	[0.456]	[0.357]	[0.617]	[0.608]	[0.481]
Φ	*NA*	4.397	5.436	*NA*	11.969	9.094	*NA*	6.666	7.526
	NA	[0.282]	[0.224]	*NA*	[0.001]	[0.030]	*NA*	[0.067]	[0.075]
$\rho_1 = \rho_2$	*NA*	2.422	4.202	*NA*	12.520	9.594	*NA*	3.889	5.453
	NA	[0.123]	[0.043]	*NA*	[0.001]	[0.003]	*NA*	[0.052]	[0.022]
AIC	0.509	0.505	0.480	2.315	2.201	2.275	0.341	0.320	0.304
	Bank4			Bank5			Bank6		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.075	-0.133	-0.170	-0.187	-0.281	-0.507	-0.076	-0.112	0.021
	(-2.147)	(-2.628)	(-3.006)	(-3.476)	(-4.045)	(-4.085)	(-1.934)	(-1.931)	(0.299)
ρ_2	*NA*	-0.028	0.011	*NA*	-0.063	-0.059	*NA*	-0.045	-0.112
	NA	(-0.625)	(0.250)	*NA*	(-0.793)	(-1.049)	*NA*	(-0.850)	(-2.436)
p	3	3	2	1	1	2	0	0	0
τ	*NA*	2.224	0.155	*NA*	-1.875	0.743	*NA*	4.542	0.914
Q(12)	15.820	16.190	18.365	15.528	15.352	9.407	12.497	13.413	13.752
	[0.200]	[0.183]	[0.105]	[0.214]	[0.223]	[0.668]	[0.407]	[0.340]	[0.317]
Φ	*NA*	3.542	4.488	*NA*	8.348	8.806	*NA*	2.201	2.979
	NA	[0.411]	[0.371]	*NA*	[0.021]	[0.031]	*NA*	[0.779]	[0.698]
$\rho_1 = \rho_2$	*NA*	2.452	NS	*NA*	4.311	10.671	*NA*	0.720	NS
	NA	[0.121]	NS	*NA*	[0.041]	[0.002]	*NA*	[0.398]	NS
AIC	-0.213	-0.220	-0.209	0.496	0.471	0.294	0.631	0.644	0.621
	Bank7			Bank8			Bank9		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.070	-0.045	-0.025	-0.129	-0.083	-0.090	-0.157	-0.102	-0.055
	(-1.797)	(-1.032)	(-0.623)	(-2.801)	(-1.188)	(-1.895)	(-2.835)	(-1.576)	(-1.004)
ρ_2	*NA*	-0.152	-0.266	*NA*	-0.164	-0.441	*NA*	-0.295	-0.646
	NA	(-1.950)	(-3.289)	*NA*	(-2.701)	(-3.292)	*NA*	(-2.862)	(-5.543)
p	3	3	0	1	1	1	0	0	0
τ	*NA*	-4.015	-1.494	*NA*	3.550	-1.324	*NA*	-3.859	-1.492
Q(12)	18.372	17.676	16.847	15.527	14.544	18.080	9.161	4.935	8.984
	[0.105]	[0.126]	[0.155]	[0.214]	[0.267]	[0.113]	[0.689]	[0.960]	[0.704]
Φ	*NA*	2.334	5.543	*NA*	4.249	7.110	*NA*	5.278	15.693
	NA	[0.723]	[0.234]	*NA*	[0.297]	[0.097]	*NA*	[0.165]	[0.000]
$\rho_1 = \rho_2$	*NA*	1.458	7.134	*NA*	0.757	6.029	*NA*	2.505	21.129
	NA	[0.230]	[0.009]	*NA*	[0.387]	[0.016]	*NA*	[0.117]	[0.000]
AIC	0.278	0.283	0.210	0.450	0.463	0.406	1.045	1.040	0.822

Table A.5 (continued)

	Bank10			Bank11			Bank12		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.081	-0.047	0.075	-0.143	-0.181	-0.430	-0.137	-0.191	-0.228
	(-2.064)	(-0.823)	(0.710)	(-2.811)	(-2.381)	(-3.944)	(-3.097)	(-2.508)	(-3.664)
ρ_2	*NA*	-0.111	-0.101	*NA*	-0.043	-0.063	*NA*	-0.052	0.033
	NA	(-2.056)	(-2.397)	*NA*	(-0.653)	(-1.123)	*NA*	(-0.906)	(0.518)
p	0	0	0	1	2	1	3	2	2
τ	*NA*	2.832	1.172	*NA*	2.470	0.773	*NA*	3.448	-0.045
Q(12)	17.628	16.176	13.177	18.512	17.934	12.820	9.594	15.989	15.363
	[0.127]	[0.183]	[0.356]	[0.101]	[0.118]	[0.382]	[0.652]	[0.192]	[0.222]
Φ	*NA*	2.426	3.091	*NA*	2.959	8.517	*NA*	3.445	6.799
	NA	[0.722]	[0.676]	*NA*	[0.568]	[0.042]	*NA*	[0.455]	[0.110]
$\rho_1 = \rho_2$	*NA*	0.661	*NS*	*NA*	1.929	8.567	*NA*	2.166	NS
	NA	[0.418]	*NS*	*NA*	[0.168]	[0.004]	*NA*	[0.145]	NS
AIC	-0.026	-0.012	-0.031	0.561	0.532	0.491	0.104	0.262	0.194

Table A.6 Mark-up and Speed of Adjustment for Automobile Loans

	Engle Granger's Approach				Bardsen Approach		
	Mark-up	Degree of Pass Through					
	$\hat{\alpha}$	$\hat{\beta}$	s.e.	Complete	$\hat{\varphi}$	s.e.	Complete
Bank1	9.02	0.73	0.05	No	0.68	0.10	No
Bank2	8.02	0.96	0.06	Yes	0.99	0.11	Yes
Bank3	6.24	0.84	0.06	No	0.69	0.16	Yes
Bank4	9.53	0.68	0.05	No	0.55	0.19	No
Bank5	7.88	0.73	0.05	No	0.63	0.11	No
Bank6	8.71	0.72	0.05	No	0.66	0.13	No
Bank7	6.09	0.86	0.04	No	0.73	0.09	No
Bank8	5.83	0.87	0.05	No	0.80	0.07	No
Bank9	8.16	0.88	0.05	No	0.84	0.25	Yes
Bank10	6.56	0.79	0.04	No	0.70	0.17	Yes
Bank11	5.40	0.99	0.06	Yes	0.87	0.12	Yes
Bank12	5.49	0.93	0.06	Yes	0.94	0.20	Yes

Table A.7 Cointegration Test Results for Automobile Loans

	Bank1			Bank2			Bank3		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.139	-0.207	-0.246	-0.485	-0.174	-0.165	-0.146	-0.119	-0.246
	(-2.452)	(-2.561)	(-2.991)	(-5.492)	(-1.776)	(-1.732)	(-3.428)	(-2.604)	(-2.329)
ρ_2	*NA*	-0.079	-0.117	*NA*	-0.952	-1.022	*NA*	-0.264	-0.132
	NA	(-1.023)	(-1.649)	*NA*	(-5.888)	(-6.306)	*NA*	(-3.120)	(-2.937)
p	2	2	1	0	1	1	6	6	6
τ	*NA*	3.666	0.348	*NA*	-3.498	-2.004	*NA*	-3.433	1.110
Q(12)	14.615	17.105	17.193	17.482	17.885	15.750	7.448	7.820	8.418
	[0.263]	[0.146]	[0.142]	[0.132]	[0.119]	[0.203]	[0.827]	[0.799]	[0.752]
Φ	*NA*	3.666	5.731	*NA*	17.531	19.965	*NA*	7.187	6.332
	NA	[0.399]	[0.187]	*NA*	[0.000]	[0.000]	*NA*	[0.035]	[0.118]
$\rho_1 = \rho_2$	*NA*	1.365	1.422	*NA*	19.424	23.683	*NA*	2.544	1.049
	NA	[0.246]	[0.236]	*NA*	[0.000]	[0.000]	*NA*	[0.115]	[0.309]
AIC	0.528	0.534	0.536	2.001	1.753	1.715	-0.024	-0.032	-0.014

	Bank5			Bank5			Bank6		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.114	-0.163	-0.174	-0.143	-0.180	-0.283	-0.105	-0.132	-0.253
	(-3.184)	(-3.311)	(-4.201)	(-3.085)	(-3.359)	(-4.014)	(-2.280)	(-2.015)	(-3.231)
ρ_2	*NA*	-0.066	0.016	*NA*	-0.039	-0.029	*NA*	-0.078	-0.037
	NA	(-1.363)	(-0.27)	*NA*	(-0.434)	(-0.551)	*NA*	(-1.199)	(-0.610)
p	3	3	3	1	1	2	0	0	0
τ	*NA*	2.717	-0.344	*NA*	-3.136	0.187	*NA*	3.969	0.328
Q(12)	15.926	17.033	14.518	16.525	14.567	12.747	16.701	17.015	13.735
	[0.195]	[0.148]	[0.269]	[0.168]	[0.266]	[0.388]	[0.161]	[0.149]	[0.318]
Φ	*NA*	6.095	8.813	*NA*	5.659	8.027	*NA*	2.719	5.347
	NA	[0.086]	[0.030]	*NA*	[0.133]	[0.045]	*NA*	[0.647]	[0.236]
$\rho_1 = \rho_2$	*NA*	2.045	*NS*	*NA*	1.821	8.523	*NA*	0.335	4.793
	NA	[0.156]	*NS*	*NA*	[0.181]	[0.004]	*NA*	[0.564]	[0.031]
AIC	-0.382	-0.384	-0.438	0.082	0.083	-0.121	0.026	0.043	0.340

	Bank7			Bank8			Bank9		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.118	-0.153	-0.068	-0.149	-0.252	-0.277	-0.145	-0.187	-0.299
	(-2.438)	(-2.681)	(-1.364)	(-3.192)	(-3.649)	(-3.796)	(-2.746)	(-2.737)	(-4.339)
ρ_2	NA	-0.029	-0.298	*NA*	-0.072	-0.071	*NA*	-0.083	-0.046
	NA	(-0.320)	(-2.613)	*NA*	(-1.203)	(-1.241)	*NA*	(-0.990)	(-0.579)
p	0	0	0	3	3	3	0	0	1
τ	*NA*	-2.450	-0.545	*NA*	3.420	0.287	*NA*	-1.339	-0.092
Q(12)	7.926	9.981	16.782	15.123	16.334	15.146	13.875	15.602	9.868
	[0.791]	[0.618]	[0.158]	[0.235]	[0.176]	[0.234]	[0.309]	[0.210]	[0.628]
Φ	*NA*	3.605	4.298	*NA*	7.185	7.773	*NA*	4.192	9.493
	NA	[0.432]	[0.388]	*NA*	[0.039]	[0.049]	*NA*	[0.313]	[0.020]
$\rho_1 = \rho_2$	*NA*	1.322	3.413	*NA*	3.956	5.009	*NA*	0.938	5.700
	NA	[0.253]	[0.068]	*NA*	[0.050]	[0.028]	*NA*	[0.335]	[0.019]
AIC	0.364	0.371	0.022	-0.031	-0.054	-0.066	0.731	0.742	0.629

Table A.7 (continued)

	Bank10			Bank11			Bank12		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.114	-0.159	-0.239	-0.135	-0.183	-0.327	-0.112	-0.138	-0.202
	(-2.808)	(-2.592)	(-3.950)	(-2.893)	(-2.885)	(-3.300)	(-1.825)	(-1.941)	(-2.977)
ρ_2	*NA*	-0.080	-0.024	*NA*	-0.081	-0.082	*NA*	-0.034	0.205
	NA	(-1.513)	(-0.46)	*NA*	(-1.204)	(-1.569)	*NA*	(-0.278)	(-1.66)
p	1	1	1	1	1	1	0	0	0
τ	*NA*	3.398	0.191	*NA*	4.682	0.764	*NA*	-2.135	-0.852
Q(12)	17.865	16.578	17.911	16.216	17.645	14.425	10.658	10.670	9.686
	[0.120]	[0.166]	[0.118]	[0.182]	[0.127]	[0.274]	[0.558]	[0.557]	[0.643]
Φ	*NA*	4.382	7.822	*NA*	4.759	6.664	*NA*	1.902	5.744
	NA	[0.282]	[0.066]	*NA*	[0.225]	[0.125]	*NA*	[0.843]	[0.213]
$\rho_1 = \rho_2$	*NA*	0.965	7.303	*NA*	1.221	4.714	*NA*	0.531	*NS*
	NA	[0.328]	[0.008]	*NA*	[0.272]	[0.033]	*NA*	[0.468]	*NS*
AIC	-0.281	-0.271	-0.338	0.516	0.524	0.486	0.939	0.955	0.879

Table A.8 Mark-up and Speed of Adjustment for Corporate Loans

	Engle Granger's Approach				Bardsen Approach		
	Mark-up	Degree of Pass Through					
	$\hat{\alpha}$	$\hat{\beta}$	s.e.	Complete	$\hat{\varphi}$	s.e.	Complete
Bank1	1.45	1.06	0.04	Yes	0.98	0.09	Yes
Bank2	4.68	1.03	0.10	Yes	1.25	0.47	Yes
Bank3	6.99	0.80	0.05	No	1.03	0.27	Yes
Bank4	12.54	0.56	0.07	No	0.48	0.21	No
Bank5	2.45	1.06	0.03	Yes	1.06	0.14	Yes
Bank6	-3.34	2.07	0.14	No	2.55	0.90	Yes
Bank7	2.95	1.18	0.06	No	1.02	0.13	Yes
Bank8	4.53	0.95	0.04	Yes	1.03	0.12	Yes
Bank9	4.48	1.37	0.07	No	1.51	0.26	No
Bank10	2.10	1.15	0.06	No	1.19	0.34	Yes
Bank11	5.38	0.84	0.03	No	0.79	0.07	No
Bank12	0.93	1.18	0.06	No	0.92	0.17	Yes

Table A.9 Cointegration Test Results for Corporate Loans

	Bank1			Bank2			Bank3		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.215	-0.315	-0.506	-0.110	-0.142	-0.549	-0.143	-0.102	0.001
	(-3.471)	(-3.625)	(-5.301)	(-2.063)	(-2.224)	(-3.911)	(-2.701)	(-1.353)	(0.013)
ρ_2	*NA*	-0.115	-0.079	*NA*	-0.048	-0.087	*NA*	-0.185	-0.182
	NA	(-1.325)	(-1.092)	*NA*	(-0.564)	(-0.780)	*NA*	(-2.459)	(-3.043)
p	0	0	0	5	5	5	0	0	0
τ	*NA*	2.003	1.163	*NA*	1.829	1.226	*NA*	2.597	0.686
Q(12)	6.525	6.466	7.064	18.575	18.454	17.198	16.010	16.120	13.083
	[0.887]	[0.891]	[0.853]	[0.099]	[0.103]	[0.142]	[0.191]	[0.186]	[0.363]
Φ	*NA*	7.368	14.486	*NA*	2.513	7.524	*NA*	3.895	4.579
	NA	[0.044]	[0.001]	*NA*	[0.670]	[0.025]	*NA*	[0.372]	[0.377]
$\rho_1 = \rho_2$	*NA*	2.641	12.621	*NA*	0.829	7.637	*NA*	0.611	*NS*
	NA	[0.108]	[0.001]	*NA*	[0.365]	[0.008]	*NA*	[0.436]	*NS*
AIC	0.178	0.171	0.027	1.788	1.800	1.344	0.401	0.415	0.411

	Bank4			Bank5			Bank6		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.147	-0.227	-0.109	-0.090	-0.060	-0.176	-0.138	-0.108	0.118
	(-2.770)	(-2.846)	(-1.897)	(-2.307)	(-1.276)	(-2.118)	(-2.644)	(-1.942)	(-1.347)
ρ_2	*NA*	-0.045	-0.324	*NA*	-0.151	-0.038	*NA*	-0.338	-0.241
	NA	(-0.681)	(-2.692)	*NA*	(-2.292)	(-0.867)	*NA*	(-2.352)	(-4.189)
p	1	0	1	2	2	0	0	0	0
τ	*NA*	4.321	-1.010	*NA*	9.065	2.037	*NA*	-1.186	0.723
Q(12)	15.095	17.728	17.646	8.395	10.048	17.037	5.737	5.784	8.791
	[0.236]	[0.124]	[0.127]	[0.754]	[0.612]	[0.148]	[0.929]	[0.927]	[0.721]
Φ	*NA*	4.236	5.183	*NA*	3.293	2.591	*NA*	4.602	9.577
	NA	[0.306]	[0.285]	*NA*	[0.480]	[0.777]	*NA*	[0.251]	[0.023]
$\rho_1 = \rho_2$	*NA*	3.116	2.638	*NA*	1.305	2.157	*NA*	2.223	*NS*
	NA	[0.081]	[0.108]	*NA*	[0.256]	[0.145]	*NA*	[0.139]	*NS*
AIC	1.111	1.107	1.103	1.909	1.916	1.970	-0.283	-0.285	-0.445

	Bank7			Bank8			Bank9		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.346	-0.438	-0.507	-0.212	-0.263	-0.158	-0.176	-0.427	-0.403
	(-5.503)	(-5.918)	(-5.775)	(-3.639)	(-3.608)	(-2.459)	(-3.064)	(-5.099)	(-4.589)
ρ_2	*NA*	-0.139	-0.062	*NA*	-0.123	-0.533	*NA*	-0.003	-0.022
	NA	(-1.257)	(-0.591)	*NA*	(-1.264)	(-3.503)	*NA*	(-0.04)	(-0.303)
p	0	0	0	0	0	0	0	0	0
τ	*NA*	3.686	0.212	*NA*	-2.038	-0.881	*NA*	4.270	1.857
Q(12)	14.114	10.856	11.489	6.950	8.414	11.059	14.131	16.665	12.745
	[0.294]	[0.541]	[0.488]	[0.861]	[0.752]	[0.524]	[0.292]	[0.163]	[0.388]
Φ	*NA*	18.102	16.664	*NA*	7.231	9.059	*NA*	12.861	10.460
	NA	[0.000]	[0.000]	*NA*	[0.048]	[0.032]	*NA*	[0.002]	[0.014]
$\rho_1 = \rho_2$	*NA*	5.017	10.694	*NA*	1.328	5.157	*NA*	15.198	11.387
	NA	[0.028]	[0.002]	*NA*	[0.252]	[0.025]	*NA*	[0.000]	[0.001]
AIC	1.388	1.356	1.303	0.446	0.453	0.423	1.381	1.251	1.295

Table A.9 (continued)

	Bank10			Bank11			Bank12		
	EG	TAR	MTAR	EG	TAR	MTAR	EG	TAR	MTAR
ρ_1	-0.190	-0.229	0.078	-0.522	-0.657	-0.452	-0.080	-0.052	0.052
	(-2.619)	(-2.708)	(0.654)	(-5.005)	(-4.556)	(-3.956)	(-1.596)	(-0.884)	(0.566)
ρ_2	*NA*	-0.124	-0.272	*NA*	-0.432	-0.744	*NA*	-0.141	-0.129
	NA	(-1.208)	(-3.596)	*NA*	(-3.504)	(-4.008)	*NA*	(-1.630)	(-2.255)
p	8	8	8	3	3	3	2	2	2
τ	*NA*	-2.860	0.443	*NA*	2.321	-0.720	*NA*	-3.483	0.807
Q(12)	13.820	13.900	11.523	15.629	14.148	14.015	15.071	14.054	13.955
	[0.312]	[0.307]	[0.485]	[0.209]	[0.291]	[0.300]	[0.238]	[0.297]	[0.304]
Φ	*NA*	3.779	7.521	*NA*	13.396	13.565	*NA*	1.628	2.751
	NA	[0.310]	[0.050]	*NA*	[0.000]	[0.001]	*NA*	[0.899]	[0.732]
$\rho_1 = \rho_2$	*NA*	0.805	*NS*	*NA*	1.800	2.063	*NA*	0.745	*NS*
	NA	[0.372]	*NS*	*NA*	[0.183]	[0.154]	*NA*	[0.390]	*NS*
AIC	0.784	0.796	0.710	0.390	0.391	0.388	0.643	0.656	0.632

Table A.10 Best Models Based on the AIC

	Automobile Loans	**Housing Loans**	**Cash Loans**	**Corporate Loans**
Bank1				MTAR
Bank2	MTAR	TAR	MTAR	MTAR
Bank3	EG		EG	
Bank4				
Bank5	MTAR	MTAR		
Bank6				
Bank7				MTAR
Bank8	MTAR		TAR	MTAR
Bank9	MTAR	MTAR		TAR
Bank10			MTAR	
Bank11		MTAR	MTAR	EG
Bank12				

Table A.11 TAR-ECM Results

	Cash Loans		Housing Loans		Corporate Loans	
	Bank8	mmr	Bank2	mmr	Bank9	mmr
φ_0	0.402	-0.074	-0.734	-0.059	0.446	-0.090
	[0.292]	[0.260]	[0.037]	[0.358]	[0.059]	[0.182]
φ_1	0.110	0.541	-0.379	0.551	-0.047	0.583
	[0.282]	[0.000]	[0.001]	[0.000]	[0.657]	[0.000]
φ_2	*NA*	*NA*	-0.124	*NA*	*NA*	*NA*
	NA	*NA*	[0.210]	*NA*	*NA*	*NA*
δ_1	0.139	0.020	0.267	-0.017	0.934	-0.018
	[0.774]	[0.252]	[0.629]	[0.327]	[0.004]	[0.553]
δ_2	*NA*	*NA*	-0.195	*NA*	*NA*	*NA*
	NA	*NA*	[0.737]	*NA*	*NA*	*NA*
ρ_1	-0.523	0.004	-0.012	0.029	-0.449	0.043
	[0.000]	[0.829]	[0.889]	[0.062]	[0.000]	[0.155]
ρ_2	-0.127	-0.026	-0.770	0.015	0.047	-0.018
	[0.210]	[0.128]	[0.000]	[0.639]	[0.557]	[0.437]
Q (12)	15.086	7.964	15.853	5.448	21.546	6.155
	[0.237]	[0.788]	[0.198]	[0.941]	[0.043]	[0.908]
$\varphi_i = 0$	1.172	1.329	6.091	0.971	0.199	0.355
	[0.282]	[0.252]	[0.003]	[0.327]	[0.657]	[0.553]
$\delta_i = 0$	0.083	42.596	0.121	45.096	8.935	41.969
	[0.774]	[0.000]	[0.886]	[0.000]	[0.004]	[0.000]

Notes: The coefficients φ_i, δ_i and ρ_i are the estimated values of the equations below:

$$\Delta lr_{j,t}^{i} = \varphi_{0j}^{i} + \sum_{k=1}^{p} \varphi_{kj}^{i} \Delta lr_{j,t-k}^{i} + \sum_{k=1}^{p} \delta_{lj}^{i} \Delta mmr_{t-k} + \gamma_{1j}^{i} I_t \hat{u}_{j,t-1}^{i} + \gamma_{2j}^{i}(1 - I_t)\hat{u}_{j,t-1}^{i} + v_{1j,t}^{i}$$

$$\Delta mmr_{j,t}^{i} = \tilde{\varphi}_{0j}^{i} + \sum_{l=1}^{q} \tilde{\varphi}_{lj}^{i} \Delta lr_{j,t-l}^{i} + \sum_{l=1}^{q} \tilde{\delta}_{lj}^{i} \Delta mmr_{t-l} + \tilde{\gamma}_{1j}^{i} I_t \hat{u}_{j,t-1}^{i} + \tilde{\gamma}_{2j}^{i}(1 - I_t)\hat{u}_{j,t-1}^{i} + v_{2j,t}^{i}$$

P-values are in brackets. Q (12) denotes the Ljung-Box Q-statistics for serial correlation up to 12 lags. $\varphi_i = 0$ tests the joint insignificancy of the change in lagged lending rates. $\delta_i = 0$ tests the joint insignificancy of the change in lagged money market rates. *NA* stands for non-availability.

Table A.12 MTAR-ECM Results

	Cash Loans						Housing Loans			
	Bank2	mmr	Bank10	mmr	Bank11	mmr	Bank5	mmr	Bank9	mmr
φ_0	-0.308	-0.055	0.114	-0.075	0.269	-0.030	0.010	-0.041	-0.014	-0.047
	[0.276]	[0.332]	[0.792]	[0.241]	[0.331]	[0.640]	[0.947]	[0.496]	[0.933]	[0.417]
φ_1	-0.215	0.537	-0.071	0.519	-0.260	0.530	0.655	0.458	0.016	0.597
	[0.027]	[0.000]	[0.558]	[0.000]	[0.030]	[0.000]	[0.000]	[0.000]	[0.874]	[0.000]
φ_2	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	-0.284	*NA*	*NA*	*NA*
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	[0.019]	*NA*	*NA*	*NA*
φ_3	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	0.079	*NA*	*NA*	*NA*
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	[0.476]	*NA*	*NA*	*NA*
δ_1	0.722	-0.057	0.051	0.000	0.880	0.044	0.306	0.046	0.663	-0.046
	[0.063]	[0.004]	[0.929]	[0.994]	[0.015]	[0.113]	[0.344]	[0.393]	[0.020]	[0.184]
δ_2	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	-0.645	*NA*	*NA*	*NA*
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	[0.061]	*NA*	*NA*	*NA*
δ_3	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	0.273	*NA*	*NA*	*NA*
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	[0.365]	*NA*	*NA*	*NA*
ρ_1	-0.132	0.088	-0.540	0.008	-0.336	-0.036	-0.577	-0.099	-0.079	-0.020
	[0.245]	[0.000]	[0.004]	[0.754]	[0.013]	[0.247]	[0.000]	[0.129]	[0.193]	[0.341]
ρ_2	-1.013	0.064	-0.241	-0.028	-0.116	-0.007	-0.114	-0.045	-0.742	-0.099
	[0.000]	[0.064]	[0.021]	[0.071]	[0.276]	[0.767]	[0.095]	[0.079]	[0.000]	[0.023]
Q (12)	7.727	6.679	18.230	6.341	10.303	7.256	12.378	6.587	10.934	7.513
	[0.806]	[0.878]	[0.109]	[0.898]	[0.589]	[0.840]	[0.416]	[0.884]	[0.535]	[0.822]
$\varphi_i = 0$	5.048	8.804	0.346	0.000	4.885	2.562	7.354	0.738	0.025	1.794
	[0.027]	[0.004]	[0.558]	[0.994]	[0.030]	[0.113]	[0.000]	[0.393]	[0.874]	[0.184]
$\delta_i = 0$	3.551	49.147	0.008	37.626	6.133	40.242	1.353	16.211	5.659	38.409
	[0.063]	[0.000]	[0.929]	[0.000]	[0.015]	[0.000]	[0.263]	[0.000]	[0.020]	[0.000]

Table A.12 (continued)

	Housing Loans		Automobile Loans							
	Bank11	mmr	Bank2	mmr	Bank5	mmr	Bank8	mmr	Bank9	mmr
φ_0	-0.097	-0.015	-0.221	-0.046	-0.021	-0.031	0.040	-0.046	0.117	-0.049
	[0.496]	[0.802]	[0.365]	[0.450]	[0.853]	[0.598]	[0.726]	[0.436]	[0.426]	[0.409]
φ_1	0.518	0.425	-0.169	0.565	0.568	0.463	0.286	0.427	0.303	0.500
	[0.000]	[0.000]	[0.059]	[0.000]	[0.000]	[0.000]	[0.007]	[0.000]	[0.005]	[0.000]
φ_2	-0.134	*NA*	*NA*	*NA*	-0.129	*NA*	*NA*	*NA*	*NA*	*NA*
	[0.181]	*NA*	*NA*	*NA*	[0.262]	*NA*	*NA*	*NA*	*NA*	*NA*
φ_3	0.383	*NA*	*NA*	*NA*	0.041	*NA*	*NA*	*NA*	*NA*	*NA*
	[0.001]	*NA*	*NA*	*NA*	[0.691]	*NA*	*NA*	*NA*	*NA*	*NA*
δ_1	0.083	0.089	0.342	-0.006	0.372	0.059	0.228	0.104	0.569	0.019
	[0.772]	[0.094]	[0.337]	[0.783]	[0.092]	[0.283]	[0.206]	[0.061]	[0.025]	[0.655]
δ_2	-0.377	*NA*	*NA*	*NA*	-0.595	*NA*	*NA*	*NA*	*NA*	*NA*
	[0.225]	*NA*	*NA*	*NA*	[0.023]	*NA*	*NA*	*NA*	*NA*	*NA*
δ_3	-0.615	*NA*	*NA*	*NA*	0.05	*NA*	*NA*	*NA*	*NA*	*NA*
	[0.023]	*NA*	*NA*	*NA*	[0.822]	*NA*	*NA*	*NA*	*NA*	*NA*
ρ_1	-0.418	-0.113	-0.179	0.005	-0.376	-0.125	-0.311	-0.072	-0.317	-0.051
	[0.001]	[0.029]	[0.065]	[0.845]	[0.000]	[0.004]	[0.000]	[0.057]	[0.000]	[0.084]
ρ_2	-0.140	-0.002	-1.045	-0.016	-0.053	-0.025	-0.084	-0.051	-0.075	-0.048
	[0.024]	[0.925]	[0.000]	[0.684]	[0.399]	[0.419]	[0.199]	[0.138]	[0.358]	[0.144]
Q (12)	10.846	6.598	15.288	5.411	15.404	5.774	9.284	7.438	7.780	6.417
	[0.542]	[0.883]	[0.226]	[0.943]	[0.220]	[0.927]	[0.678]	[0.827]	[0.802]	[0.894]
$\varphi_i = 0$	8.911	2.866	3.656	0.076	8.151	1.166	7.544	3.587	8.377	0.201
	[0.000]	[0.094]	[0.059]	[0.783]	[0.000]	[0.283]	[0.007]	[0.061]	[0.005]	[0.655]
$\delta_i = 0$	3.222	16.596	0.933	41.258	2.129	21.604	1.619	20.676	5.218	24.458
	[0.027]	[0.000]	[0.337]	[0.000]	[0.103]	[0.000]	[0.206]	[0.000]	[0.025]	[0.000]

Table A.12 (Continued)

	Corporate Loans							
	Bank1	mmr	Bank2	mmr	Bank7	mmr	Bank8	mmr
φ_0	-0.047	-0.130	-0.254	-0.026	-0.041	-0.035	0.057	-0.052
	[0.676]	[0.033]	[0.336]	[0.680]	[0.848]	[0.583]	[0.699]	[0.395]
φ_1	-0.072	0.717	-0.208	0.545	-0.089	0.576	0.008	0.513
	[0.480]	[0.000]	[0.068]	[0.000]	[0.331]	[0.000]	[0.947]	[0.000]
φ_2	*NA*	*NA*	-0.098	*NA*	*NA*	*NA*	*NA*	*NA*
	NA	*NA*	[0.339]	*NA*	*NA*	*NA*	*NA*	*NA*
φ_3	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
δ_1	0.611	-0.157	0.276	0.003	0.661	-0.013	0.410	0.064
	[0.001]	[0.004]	[0.528]	[0.908]	[0.045]	[0.627]	[0.070]	[0.209]
δ_2	*NA*	*NA*	-0.437	*NA*	*NA*	*NA*	*NA*	*NA*
	NA	*NA*	[0.346]	*NA*	*NA*	*NA*	*NA*	*NA*
δ_3	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
ρ_1	-0.361	0.212	-0.098	-0.022	-0.504	-0.009	-0.176	-0.043
	[0.002]	[0.001]	[0.291]	[0.331]	[0.000]	[0.757]	[0.030]	[0.199]
ρ_2	-0.141	-0.062	-0.149	0.003	-0.051	0.015	-0.576	0.028
	[0.071]	[0.131]	[0.017]	[0.819]	[0.649]	[0.647]	[0.003]	[0.715]
Q (12)	6.951	8.090	17.851	5.436	12.663	6.133	7.824	5.739
	[0.861]	[0.778]	[0.120]	[0.942]	[0.394]	[0.909]	[0.799]	[0.929]
$\varphi_i = 0$	0.503	8.586	1.890	0.014	0.954	0.238	0.004	1.599
	[0.480]	[0.004]	[0.157]	[0.908]	[0.331]	[0.627]	[0.947]	[0.209]
$\delta_i = 0$	11.446	55.922	0.463	38.920	4.143	35.427	3.354	30.891
	[0.001]	[0.000]	[0.631]	[0.000]	[0.045]	[0.000]	[0.070]	[0.000]

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YAZARIN

Soyadı : Bozok ....
Adı : İhsan ....
Bölümü : İktisat ....

TEZİN ADI (İngilizce): Non-Linear Structure of the Turkish Interest Rate Transmission Mechanism

TEZİN TÜRÜ : Yüksek Lisans ☒ Doktora ☐

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ☐

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☒

Yazarın imzası .... Tarih ....