Effectiveness of Monetary Policy: Evidence from Turkey

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Abstract

Effectiveness of monetary policy depends on the degree to which policy interest rate affects all other financial prices, including the entire term structure of interest rates, credit rates, exchange rates and asset prices. An effective monetary policy framework can be seen as a pre-condition for well-functioning financial markets. However, effectiveness of the monetary policy is not straightforward to measure and requires empirical work to understand the effects of financial infrastructure, competitiveness of financial markets as well as current economic conditions. This paper examines the effectiveness of the monetary policy in Turkey by focusing on the interest rate pass-through behavior by means of an Interacted Panel Vector Autoregressive (IPVAR) approach. The results suggest that policy rate innovations transmit fully in less than eight months. Regulatory quality of the country, competition, liquidity, and profitability of banking sector, dollarization and exchange rate flexibility, inflation, and term structure have a positive effect on interest rate pass-through. Short-term credit ratio, GDP growth, monetary growth, and capital inflows have a negative effect.

Keywords: Interest Rate Pass-through; Deposit and Credit Channels; Policy and Market Rates; Banking Sector; Interacted Panel Vector Autoregressive Methodology.

JEL Classification: E43; E44; E58; F41.

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1. Introduction

Transmission from central bank policy rates to banks' deposit and credit rates is crucial for the well-being of an economy. Central banks implement policy rules toward two main policy objectives, namely price stability and output stability. Their most important tool to achieve the objectives is the control of liquidity in the banking sector and hence the short-term interbank interest rate. The effectiveness of this policy tool depends on various channels of transmission. If a central banks raises its policy rate but retail rates, asset prices and exchange rates do not respond then policy turns out to be ineffective. Hence identifying different transmission mechanisms is central in understanding the effectiveness of central banks' actions (Loayza and Schmidt-Hebbel, 2002).

The existing literature has already identified various channels of monetary transmission. These channels consist of short- and long-term interest rate channels, credit channel, exchange-rate channel, asset channel, and balance-sheet channel. The main monetary policy transmission channel runs from the overnight interbank interest rate to short-term interest rates. This channel basically works as follows: suppose that in line with its counter-cyclical monetary policy stance, central bank is interested in inducing economic stimulus in response to weakening economic conditions. As a first step, it purchases financial assets to inject additional liquidity into the banking system. This additional liquidity reduces the overnight interbank rates. The ability to borrow at lower overnight rates encourages the banks to purchase additional short-term government papers, leading to further cascade of reductions in the short-term risk-free interest rates. This is the interest-rate channel at work (Mishra et al., 2012).

This study aims to test how much policy rates transmit to credit and deposit rates of banks operating in Turkey, i.e. the short-term interest rate pass-through. We limit our analysis period to 2002-2014 since it has been the longest stable period in Turkish monetary policy and banking environment. We employ interacted panel vector autoregressive (IPVAR) methodology in our analysis (Towbin and Weber, 2011) owing to its analytical strength as well as versatility. It mainly allows us to understand pass-through of policy rates to market rates at various values of other economic variables which are present as interactions.

Effectiveness of transmission channels require a competitive banking sector, well-developed stock and credit markets, a fully liquid financial sector, totally independent central bank, maximum quality of institutional and regulatory environment, a floating exchange rate regime, full market development and effective secondary market for government securities (Cotarelli and Kourelis, 1994; Cottarelli et al., 1995; Cecchetti, 1999; Ehrmann et al., 2001; De Bondt (2002); Sorensen and Werner, 2006; Leiderman et al., 2006; Ito and Sato, 2006; Betancourt et al. (2008); Frisancho-Marischal and Howells (2009); Mishra et al. 2012; Saborowski and Weber, 2013; Leroy and Lucotte, 2015). Following this long recipe of the earlier literature, we use proxies representing these factors as interaction variables. There are five constructs: Regulatory quality and competitiveness, dollarization, financial development, banking sector features, and macroeconomic features. We measure regulatory quality and competitiveness by means of regulatory quality index, Boone indicator, and Herfindahl-Hirschman Index. We use ratio of foreign currency loans and foreign currency position to measure dollarization; GDP per capita, broad money and short-term credit rate to measure financial development; liquidity, profitability and bad asset ratio to notate attributes of banking

sector; and lastly we use Turkish LIBOR, Turkish industrial production index, consumer price index, and financial account of GDP as macroeconomic variables.

Our results show that short-term interest rate pass-through is positively related to regulatory environment and competition in banking sector. Increased competition and higher regulatory quality cause an increase in pass-through. Profitability, liquidity, bad asset ratio, exchange rate flexibility, and dollarization have a positive effect on pass-through, too. On the other hand, domestic macroeconomic and international variables and development of financial system have ambiguous effects on pass-through. GDP per capita and broad money have negative effect on the speed of pass-through, whereas short term credits ratio increase transmission in deposit rate, but decrease transmission in credit rates. Growth of industrial production index and financial account of GDP decreases pass-through to both type of rates. Turkish LIBOR and inflation have a negative effect on transmission to deposit rates and a positive effect on transmission to credit rates. Inclusion of each different interaction variable in the IPVAR specifications implies a different duration for completion of pass-through, where those durations are typically less than 8 months.

Our results suggest important hints to policy makers. First, policy makers should improve regulatory quality and banking sector competition while reducing banking concentration. Second, since dollarization has a positive effect on interest rate pass-through, they should not enforce use of national currency in banking transactions. In other words, globalization does not slow down interest rate pass-through. Third, liquidity and profitability in banking positively affect the pass-through; therefore, banking sector's stability should be enhanced. Fourth, growth in production, broad money, and financial development, and capital inflows lower the degree of pass-through. Finally, inflation and term structure have a positive effect on interest rate pass-through.

This paper contributes to interest rate pass-through literature by employing an IPVAR methodology allowing one to measure impulse-response functions conditional upon certain values of other variables of concern, i.e. the interaction variables. In that, the paper employs a comprehensive list of interaction variables so as to shed light on monetary policy effectiveness in Turkey and finds that policy rates are transmitted to retail rates within 8 months in Turkey in the 2002-2014 period.

The remainder of the paper is structured as follows: Section 2 introduces the related literature and elaborates the interest-rate pass-through in Turkey; and Section 3 presents data, estimation method and empirical analysis. Section 4 concludes the study in association with policy discussions and recommendations.

2. A Brief Review of the Literature

A. Monetary Transmission

We can define the transmission mechanism between central bank rates and market interest rates using three different approaches. The first approach, monetary policy approach, measures the pass-through from monetary policy rate to retail rates directly. The second approach is named as cost of funds approach and measures the pass-through from longer-term market rates towards retail rates. The third approach combines the first two: firstly, pass-through from monetary policy rate to long-term market rates is measured and secondly the

pass-through from short-and long-term market rates to retail rates is computed (Egert and MacDonald, 2009).

Literature has identified various channels of monetary transmission. These channels consist of short- and long-term interest rate channels, credit channel, exchange-rate channel, asset channel, and balance-sheet channel. The main monetary policy transmission channel runs from the overnight interbank interest rate to short-term interest rates. This channel basically works as follows: Suppose that as a result of its counter-cyclical monetary policy objective, central bank is interested in creating further economic stimulus in response to weakening economic conditions. As a first step, government purchases financial assets to inject additional liquidity into the banking system. This additional liquidity in the banking system then reduces the overnight interbank rates. Being able to borrow at a lower overnight interest rates, banks tend to purchase additional short-term government papers, leading to further cascade of reductions in the short-term risk-free interest rates (Mishra et al., 2012).

Alternatively, the central bank can use another policy tool such as the reserve requirements. In response to weakening economic conditions, central bank may now decrease the required reserve ratio so as to leave banks with excess cash balances. Banks can again purchase more government securities, inducing a fall in interest rates on government securities. Finally, the central bank may want to intervene directly in financial markets by purchasing short-term government securities. The sellers of these securities will now have excess cash and they may deposit in the banking system. This would again cause a fall in the interbank rates. This relationship is named as "short-term interest rate channel" (Mishra et al., 2012).

The changes in short-term interest rate may also affect overall economic conditions, investors' willingness to take risks and the price of risk. This channel is named as "credit channel." The effect on short-term interest rates on floating exchange rates can be measured as "exchange-rate channel." The effect of short-term interest rates on long-term interest rates can be named as "long-term interest rates channel." Long-term interest rates affect asset prices usually in the "asset-price channel" and lastly, changes in asset prices that can affect company values directly or indirectly is called "balance-sheet channel" (Mishra et al., 2012).

Effectiveness of transmission channels require competitive banking sector, well-developed stock and credit markets, and freely floating exchange rates. Some assumptions, such as a fully liquid financial sector, totally independent central bank, maximum quality of institutional and regulatory environment, a floating exchange rate regime, full market development and an effective secondary market for government securities are necessary to keep the transmission level at 100%. No countries have yet arrived that level where pass-through is higher for developed countries than emerging markets, and low-income countries own the lowest pass-through rates (Mishra et al., 2012).

Why do banks not adjust their loan rates completely to policy rates? Is there credit stickiness? According to the empirical study of Berger and Udell (1992), there is credit rationing and loan rate stickiness exists in the US. Customer relations, monopoly power, and default risk can be used to explain the tradeoff between risk sharing and benefits of credits for both banks and credit users. Credit rationing can be limited if protective contracts for both parties can be designed (Fried and Howitt, 1980). Stiglitz and Weiss (1981) explain credit rationing based on asymmetric information models. They argue that loan rates stay sticky in practice, even though the theory requires flexibility to comply with demand and supply changes. Banks avoid changing

loan rates easily to attract more customers. They know that new customers attracted by new rates will be from a higher risk group, which would reduce bank profits. Klemperer (1987) explains loan rate stickiness by using learning costs, transaction costs, and artificial costs imposed on loans by firms. These switching costs determine loan rate stickiness and corporate strategy of financial firms. Contrarily, some studies do not find credit rationing in some countries, such as Chile (Bernstein and Fuentes, 2004).

B. Interest Rate Pass-through

Literature about interest rate pass-through can be classified into two sections. Many studies focus on individual countries and try to find out the temporary changes in pass-through levels, structural breakdowns and determinants of pass-through in each country. Interest rate pass-through in developing economies is asymmetrical between types of credits and deposits. Pass-through between market interest rates and corporate and consumer loan rates in Hungarian market can be depicted as quick for 1997-2004 period, because major fraction of pass-through is realized in two months. Results indicate perfect pass-through in corporate loans; somewhat lower pass-through in consumer loans; and a lower level pass-through in deposit rates. Speed of adjustments on bank rates are influenced by the sign of yield shocks, size of the changes and volatility of market rate, and distance of bank rates from their long-run equilibrium level (Horvath et al., 2004). Monetary transmissions on interest rates and credit channels in Poland for the period of 1995-2002 show that credit channel is affected by degree of capitalization and bank's size. Pass-through rate in Poland is comparable to that in Euro zone for the same period (Wrobel and Pawlowska, 2002). More profitable and riskier banks reflect interest rate changes faster than less profitable and less risky banks in Poland. However, the opposite is true for term deposits (Chmielewski, 2004). Pass-through in lending rates is not complete and alternative credit rates have diverse pass-through rates in Ireland between 1980 and 2001. Additionally, there a number of structural breaks in the analysis period (Bredin et al., 2001).

Interest rate pass-through in developed economies is not more homogenous. Pass-through for the UK for 1985-2001 should not be taken granted, it is time-varying and the change in the pass-through depends on whether the perceived gap between bank's rates and market rates (base rates) is widening or narrowing (Hoffman and Mizen, 2004). Larger credit institutions adjust their lending rates to market rates faster than smaller credit institutions in Germany for 1993-2000 period. Banks that use savings deposits as a major refinancing instrument have sticky lending rates compared to other banks. Riskier banks in terms of long-term lending adjust their lending rates faster than the banks which cover their long-term commitments. Banks in longer term relationships with customers have stickier rates than the banks with shorter-term relationships (Weth, 2002). Small and less liquid banks transmit policy rates faster than bigger and liquid banks do, and bank lending channel has been quite important for the US monetary policy from 1976 to 1993 (Kashyap and Stein, 2000).

Studies in the second group compare a group of similar and diverse countries' pass-through rates and classify countries based on their characteristics. Comparative studies find differences in pass-through rates between developed and less-developed country groups. Developed countries have a higher rate of pass-through, basically because of more flexible exchange rate regimes and more developed financial systems. Studies also observe time-dependency in pass-through rates: Pass-through is high and increasing in time between 2003-

2008 (financial stability period). However, 2008 crisis reversed the increasing trend: Banks increased precautionary liquidity holdings, non-performing loans jumped up and inflation level fell down (Saborowski and Weber, 2013). Long term interest rates, asset prices, tightness of monetary conditions, exchange rates, financial fragility, and inflation are some factors that affect monetary transmission mechanism (Kamin et al., 1998). Monetary transmission mechanism in low income countries is weak. Putting methodological deficiencies aside, there are also stabilization issues. Stabilization problems are hard to tackle and acute. Therefore, it is very challenging to enhance the effectiveness of monetary policy in low income countries (Mishra and Pontiel, 2012). Weak financial market structure reduces effectiveness of securities markets. Therefore, interest rate and asset prices pass-through are weak if they exist at all in less developed countries. Since central bank intervention is heavy and exchange rate flexibility is low, exchange rate channel is undermined. Competition is imperfect in banking sector, and cost of lending is high. Moreover, banks hold excess reserves and mostly domestic public bonds. The role of intermediation in banking sectors is not deservedly undertaken, and therefore bank lending channel is impaired. As a result, monetary transmission is weak due to problems in financial market structure in low income countries (Mishra et al., 2012). A positive correlation can be found between interest rate pass-through and per capita GDP, inflation, exchange rate flexibility, credit quality, overhead costs, and banking competition. There is a negative correlation between interest rate pass-through and market volatility and excess banking liquidity (Gigineishvili, 2011). Structure of financial system, banking sector concentration, capital flows and barriers to entry and size and efficiency of the money market are found to be other affecting factors (Cottarelli and Kourelis, 1994).

Interest rate pass-through in European countries before the European Monetary Union (EMU) was established shows asymmetries in adjustment processes and structural breaks, which would indicate problems in the application of a single monetary policy (Sander and Kleimeier, 2000). Member countries converge slowly as their national banking systems adjust to the new monetary regime, but structural breaks can occur by the official circulation of euro (Marotta, 2009). Size, liquidity, capitalization of individual banks, small banks, banks' health, availability of alternative finance may be important in terms of monetary policy (Ehrmann et al., 2001; Cecchetti, 1999).

Studies done at the beginning of the EMU process display similar results. There are structural breaks, high level of heterogeneity due to country level factors, such as GDP growth and bank specific factors, and the speed of pass-through is different in member countries. Even though the results suggest increase in the efficiency of monetary policy, the market is fragmented and far from convergence (Sander and Kleimeier, 2003, 2006; Kok Sorensen and Werner, 2006; Angeloni et al., 2003). However, convergence should be likely because monetary policy of many countries are in line, and cyclical behaviors of economies are similar (Mihov, 2001).

Findings of studies changed after several years of establishment of the EMU. Stronger competition leads lower interest rates spreads and stronger pass-through in interest rates. Competition is stronger in the loan market than that in the deposit market. Competition should be increased to fasten up the pass-through in monetary transmission mechanism (Van Leuvensteijn et al.,2006). Pass-through in developed European economies hit the bottom after the 2008 crisis. Especially, the difference between lending rates and policy rates are at record levels low in Germany and the US, but higher in other countries (Illes and Lombardi, 2013).

Pass-through in the US is higher for both bank deposit rates and lending rates in the US compared to Euro area for both short and long run (Kwapil and Scharler, 2007).

Studies of interest rate pass-through in Asian countries display lower convergence rates. Pass-through in developed Asian countries is stickier. Deposit rate pass-through is higher than lending rate pass-through in both developed and less developed countries (Singh et al., 2008). Tai et al. (2012) analyze interest rate pass-through in Asian countries for the period of 1988-2010. Their results suggest that almost all countries have very low pass-through from market rates to deposit and credit rates in the post-crisis period. Malaysia is the only exception, indicating a more efficient monetary transmission in Asia.

C. Interest Rate Pass-through in Turkey

Turkey suffered from its less developed financial markets and macroeconomic instability for years before 2000s. The restrictions in financial markets were intense before 2000 banking crisis, they gradually reduce afterwards thanks to reforms in financial sector and growth trend in world financial markets. We can draw a parallel line between pre-2000 Turkey and the low income countries depicted in Mishra et al. (2012). They summarize the problems in low income countries evidently: High cost of credits and weak competition in the financial sector force banks to hold high level of reserves and domestic public bonds when deposit channel enlarges. It causes frictions in interest rate and bank lending pass-through along with other restrictions in monetary transmission channels. Turkey's banking and economic system was suffering from these problems evidently. Credits provided to private sectors were limited, and loan rate stickiness was unclear before 2000s. Taking into account high indebtedness, chronic-high inflation, and high macroeconomic instability, this result was not surprising (Aydin, 2007). Credit markets developed after 2000s by assigning a pioneering role on banks. Credit channel enlarged due to a reduction in perceived risk: Reduction in public indebtedness, reduction in interest and inflation rates, and permanent financial stability period allowed banks to provide more credits. As the newly emerged private bonds market is still in its infancy, bank lending remains as the main source of debt financing in Turkey.

Earlier studies suggest contradicting results on policy transmission. Interest rate pass-through is very effective; exchange rate pass-through has a semi-strong power; stock market and credit channel pass-through is not effective in Turkish economy (Kasapoglu, 2007). Ornek (2009) argues that stock market and banking credit channels are not effective in Turkey. Suggesting M2 aggregate of money to be an effective tool to manage monetary policy, Peker and Canbazoglu (2011) argue that credit channel is effective. Tests reveal asymmetries in all lending rates, i.e. banks adjust themselves to increases faster than decreases. Moreover, reluctance to adjust the policy rate varies based on the credit rate, which may be interpreted as heterogeneity or temporariness in the market (Yildirim, 2012). Aktan et al. (2014) find a positive relationship between expansionary monetary policies and risk taking behavior for 2002-2013 period. Accordingly, risk taking behavior declines in policy rates. However, if interest rates fall below their long-run average, the sign of the relationship reverts to negative. The smaller the bank size, the stronger this effect is. Ucak and Yildirak (2012) find stronger pass-through for corporate loans and weaker pass-through for housing and cash rates. Capital adequacy ratio plays a role in credit channel of pass-through (Degirmen and Ozag, 2007). Basci et al. (2006) can be visited for more on improvements in transmission mechanism in Turkey after 2000s.

3. Empirical Analysis

A. Data and Variables

i. Interest Rates

We adopt the first method of Egert and MacDonald (2009) to measure the transmission between Turkish policy rate and retail interest rates. This method is called the monetary policy approach; it measures the pass-through from monetary policy rate to retail rates directly.

In our analysis, the policy rate of the Central Bank of Turkey (CBRT) is constructed as a combination of three different rate settings: from the beginning of our sample, February 1 2002, until May 20 2010, the CBRT used the overnight repo rate as its policy rate with a symmetric corridor around. After this date, the Bank replaced its policy rate with the weekly repo rate until the third quarter of 2010. Then it adopted a complex interest rate corridor system with a central rate of weekly repo surrounded by upper and lower bounds of overnight repo rates having an asymmetric structure most of the time. By means of such a complex system of rates, the CBRT enjoyed a great flexibility against rapid and massive capital inflows as well as domestic credit market imbalances. In line with the agenda of the Monetary Policy Committee, the policy rates are subject to potential change typically in the second half of every month, not necessarily reflecting perfect periodicity. So, while compiling our policy rate series we first chained different policy rates at a daily frequency as of the dates given above. The chain is composed of the overnight policy rate until 20 May 2010, the weekly policy rate until October 2010 and the effective funding rate onwards. At the end, the daily series of policy rates was re-expressed at monthly frequency using monthly averages. Our final series, hence, is a combination of time-weighted averages of three different policy rates possibly yielding the best possible proxy for the stance of monetary policy.

Regarding the deposit and credit rates, the CBRT distinguishes deposit rates as 1-, 3-, 6, 12-month and more than 12-month rates. Average maturities of deposit accounts in Turkish banking sector as of 2013 is as follows: 19% of all deposits are drawing accounts, 15% are deposited up to 1-month, and 53% are deposited up to 3-months, whereas the average maturity of all deposits remains less than 3 months (BRSA, 2013). Since drawing accounts earn no interest, we used 1-month and 3-month deposits to proxy Turkish retail deposit market rates. On the credit side, we used commercial credit rates, allocated in Turkish liras. We have got consumer, auto, housing, and commercial credit rates, allocated in Turkish liras, Euro and dollars. We prefer using commercial rates, because they are linked more with the real economy, however, we perform the analyses for consumer rates as well. Note that all rates we study are Turkish lira deposit and loan rates. Market interest rate data were collected from the Electronic Data Delivery System of the CBRT and were expressed as volume-weighted series. The weekly data published every Friday were converted to monthly frequency as in the case of policy rate data. Figures 1 and 2 display the evolution of policy, deposit and credit rates. A first glance at these figures suggests that the lines are smoother for deposits and more volatile for credits, which might be indicative of higher susceptibility of credit rates to policy rates.

The analysis period covers February 2002-December 2014. The CBRT started inflation targeting in January 2002, at the same time the reference policy rate is determined as CBRT O/N borrowing rate. The feature of this period is to have very high and volatile rates in the overall economy. High interest rates mitigated as inflation fell down during late 2000s. We also analyze the 2008-2014 sub-period as a more stable period, where interest rates are rather

lower and more stable, inflation is limited, banking sector is more functional in intermediation and credit market is operating more efficiently.

[Please insert Figure 1 here]

Turkish bank credit rates in the analysis period can be seen in Figure 1. Rates shrink to lower than 20% level in 2014 from above 70% in 2002. Auto, house, and commercial credit rates were lower than policy rate in many months of 2002 and beginning months of 2003; moreover, only house credit rates were lower than policy rate on July and August 2007. The reason for the former can be high competition in banking sector at the initial stage of credit boom, and the reason for the latter can be great confusion of households to keep their mortgages in the forthcoming crisis period. Mortgage market was newly established in Turkey in 2005 and as an infant industry trust in the system was less in 2007 than it is today.

[Please insert Figure 2 here]

Figure 2 shows the evolution of deposit rates and the policy rate in Turkey. Deposit rates can be depicted as lower bound compared to credit rates. Rates fell down to 10% level in 2014 from above 60% level in 2002. Probably, due to high liquidity in the credit boom around 2004, deposit rates were lower than policy rate. A different period, when 1-month deposit rates were lower than the policy rate is 2014.

ii. Correlations among Interest Rates

We follow Mishra et al. (2012) to measure the contemporaneous and longer term correlation between the policy rate and deposit and credit rates. We compute correlations by means of changes in interest rates. Contemporaneous correlation is the static correlation between policy rate and each of the credit and deposit types during the analysis period. Short-term and long-term correlation is measured based on the following estimation.

$$y_t = \alpha y_{t-1} + \beta y_{t-2} + \nu x_t + \delta x_{t-1} + \eta x_{t-2} + \varepsilon_t \quad (1)$$

where y represents the policy rate, x represents each of credit and deposit rates, and t is the time subscript, which is measured as a month. We estimate the equation one by one for each of credit and deposit types. ν is the measure for short-term correlation (1-month lag). Long-term correlation is measured by $(\nu + \delta + \eta)/(1 - \alpha - \beta)$. Table 1 displays the results.

[Please insert Table 1 here]

Table 1 shows the results of correlation analysis. The contemporaneous correlation between policy rate and retail rates is 64% on average for retail credits. This indicates a 0,64% increase in average credits within a month following a 1% increase in the policy rate. Short-term effect (1 month) on average credits is 41%. However, the longer-run effect is much higher, 82%. The results show that pass-through in credit market is incomplete, and compared to the results in Mishra et al. (2012), pass-through in credit rates places Turkey among her emerging market peers.

The results are stronger for deposits. Contemporaneous correlation between policy rate and discount rates is 85%. Short-term effect is 87%, and long-term effect is 96%. Pass-through is almost complete in the long-and short-run deposits markets. These values are compatible with values of emerging markets and developed economies analyzed in Mishra et al. (2012).

iii. Interaction Variables

As explained subsequently, we employ a number of interaction variables so as to measure impulse-response functions conditional upon their first and third quantiles, differentiating the speed and intensity of interest rate pass-through. Marginal effect of a change in the interaction variable affects dynamic relationship among endogenous variables and it also affects the level of the variables (Towbin and Weber, 2011). Since the relationship between policy rate and retail rates is long-termed and complicated; it is open to influence from many other variables (Mishra et al., 2012). Earlier single and cross country studies suggest potential variables affecting pass-through mechanism. We can call these variables as structural characteristics of an economy. Financial structure, regulatory and institutional quality constitute a major part of structural characteristics of an economy; thus they are determinants of effectiveness of monetary policy (Cecchetti, 1999; Cotarelli and Kourelis, 1994; Ehrmann et al., 2001; Saborowski and Weber, 2013). We collect a list of prospective interaction variables based on literature survey. After eliminating the ones not available for Turkish economy, we are left with 16 variables and grouped these interaction variables as 'competition and regulatory quality', 'exchange rate flexibility and dollarization', 'financial development', 'banking sector related variables', and 'macroeconomic variables'.

Regarding the aforementioned country characteristics, we measure regulatory quality using the World Bank Regulatory Quality Index (RQI). Following Mishra et al. (2012) and Saborowski and Weber (2013), we expect that weaker regulatory environments generate uncertainty in the financial system and induce higher costs of financial intermediation. As a result, banks' sensitivity to policy rate declines, and pass-through mechanism slows down. Lower competition and higher concentration in the banking industry end up with the same effect. Having a look at the banking sector competition and concentration, lower competition or higher concentration results in higher margins, thus low interest rate pass-through in the banking industry (Sorensen and Werner, 2006; Saborowski and Weber, 2013; Mishra et al, 2012 Cottarelli and Kourelis, 1994; Cottarelli et al., 1995). To measure banking sector competition, we employ two alternative variables. The first one is Boone indicator (Boone, 2008), which is an index of banking sector competition. We obtained Boone series for Turkey from St. Louis FED web site. The second variable to assess competitiveness is Herfindahl-Hirschman Index (HHI), which measures concentration in a sector. We compute the HHI index annually for 2002-2014 period for Turkish banking sector on the basis of their asset shares where data on total assets of banks were taken from the Banks Association of Turkey.

Dollarization and flexibility in exchange rate regime are also important as interest rate pass-through can be weaker in highly dollarized economies and low exchange rate flexibility (Mishra et al, 2012; Saborowski and Weber, 2013). Dollarization also makes banks vulnerable to exchange rate risks and can have a positive impact on interest rate pass-through (Leiderman et al., 2006). We measure exchange rate flexibility as the ratio of foreign currency loans to M2 monetary aggregate (FCLM2). Dollarization is measured as foreign currency position (difference between foreign currency liabilities and foreign currency assets) to equity in the banking industry. We can call this ratio in short as net foreign currency position (NFCP). The data for foreign currency deposits and M2 are obtained from CBRT and Ministry of Development, foreign currency position to equity ratios are obtained from the Banks Association of Turkey.

Financial development has an expected positive effect on interest rate pass-through. It increases the variety of alternative investment tools, thus enhancing competition (Cotarelli and

Kourelis, 1994; Saborowski and Weber, 2013). We use per capita GDP (GDPPC) and broad money (M2GDP) to measure financial development. We obtain these series from the World Bank Databank. Additionally, we employ average short term credits-to-all credits ratio (STC) as a proxy for financial development. STC shows the density of short-term investments over all investments. It is a signal for the reliability of financial system. Density of short term credits is expected to be lower in developed financial systems. Longer-term credits become wide-spread as trust to the financial market increases. The STC ratio evolved to 35% from 55% in the 14-year sample period in Turkish banking sector. The drop in short-term credits ratio may be a signal of trust in the investments in Turkey. STC series were obtained from the Bank Association of Turkey.

Cecchetti (1999) emphasize the role of financial structures and soundness of banking industry. He uses number of publicly traded firms, publicly traded firms per capita, market capitalization-to-GDP, corporate debt-to-GDP, bank loans-to-GDP, and bank health ratios. We do not use these variables because some of these variables are not available for Turkey, and some variables make sense only in panel data. We should also mention that capital markets and bank debt are the only sources of financing in Turkey. There was not an actively functioning corporate debt market until 2010. And it is still an infant industry. Thus, we think the variables that assess the soundness of banking, such as liquidity, profitability, and bad debt ratios are more important in the Turkish case.

We use liquid assets-to-total assets (LIQ), revenues before interest -to-expenses before interest (NIRE), return on equity (ROE), non-performing loans to total assets (NPL) in the overall banking system as banking level variables. Higher liquidity is expected to limit banks' sensitivity (or responsiveness) to policy rates. Banks reflect changes in policy rates to their own rates more slowly in case of cash abundance. A likely reason for high liquidity might be limited amount of profitable investment projects in the economy (Sorensen and Werner, 2006; Saborowski and Weber, 2013). Thus, liquidity is one of the most important factors that affect monetary transmission mechanism. We use liquid assets-to-total assets ratio as our first proxy for liquidity. Another proxy we used for liquidity is the revenues before interest-to-expenses before interest ratio. This ratio can also be used as a proxy for profitability. Both variables are collected from the Banks Association of Turkey. We use ROE to measure the profitability in banking sector. It is a proxy for market power. We expect interest rate pass-through to be lower as ROE increases (Sorensen and Werner, 2006). Starting from 9% in 2002, return on equity fluctuated to higher-than-15% level where it was around 11% in 2014. We believe, liquidity and profitability of the system affects pass-through especially on the credit side, deposits are less affected from these factors. Low quality assets induce problems in crisis periods by blotting liquidity. Pass-through cannot be completed in these periods since banks have to apply credit rationing rules. Following Saborowski and Weber (2013), we use nonperforming loans to total assets ratio as a proxy for asset quality. Banking sectors variables are obtained from the Banks Association of Turkey.

Macroeconomic developments, conveying to their direct impacts on the banking industry, should also be taken under consideration. LIBOR is a short-term borrowing rate for AA-rated financial institutions. We can use LIBOR as a proxy for term structure (Hull, 2015). Term structure is an indicator of future growth of economy. Frisancho-Marischal and Howells (2009) finds a positive relationship between LIBOR and interest rate pass-through, but Betancourt et al. (2008) find a negative relationship. There is not a consensus about the effect of LIBOR in the literature. TRLIBOR rates were obtained from the Banks Association of Turkey.

We averaged the daily bid and ask values of overnight rates for each month to compute monthly averages of TRLIBOR. Additionally, we use growth rate of the Industrial Production Index (IPI) as another measure of economic growth. De Bondt (2002) suggests that industrial production growth would encourage banks to modify the allocation of their portfolios towards riskier projects and that would increase interest rate pass-through. However, since the perceived risk of borrowers is pro-cyclical, a reverse effect would also be possible (Leroy and Lucotte, 2015). We use CPI to measure inflation and expect a positive relation between pass-through and inflation as in Ito and Sato (2006). Finally, ratio of financial account to GDP (FAGDP) was used to address the effects of capital inflows and outflows on the interest rate pass-through behavior. FAGDP is included to address the post-crisis Turkish experience with capital inflows inducing rapid credit expansion. To the best of our knowledge, this variable was not previously used in the literature to address interest rate pass-through behavior. Nevertheless, it is not trivial to compute the FAGDP series due to the absence of a monthly measure of GDP. We overcame this limitation by creating a monthly version of GDP following the Turkish industrial production as a proxy variable. That is, GDP figure for a quarter was distributed to the months within that quarter in proportion with the respective industrial production figures of months. Capital inflows have a pro-cyclical nature, but we do not know how they affect interest rate pass-through.

[Please insert Table 2 here]

Regulatory quality index (RQI), exchange rate flexibility (FCLM2), dollarization(NFCP), short-term credits to total credits (STC), liquid assets to total assets (LIQ), revenues before interest to expenses before interest (NIRE), return on equity (ROE), nonperforming loans ratio (NPL), Herfindahl-Hirschman Index (HHI), dollarization (NFCP), per capita GDP (GDPPC), broad money (M2GDP), and Boone indicator values are measured annually. We computed the annual first difference for these variables and attributed the same annual values for all months in the same year. TRLIBOR is released daily. We use the monthly average TRLIBOR as the monthly value. CPI (inflation), industrial production index (TRIPI), and financial account GDP (FAGDP) are released monthly. Wherever needed and applicable, the data series were seasonally adjusted using the Census-X12 technique. We compute percentage changes in CPI, IPI, and regulatory quality index; we use first differences in all other variables to assure stationarity. A list of variables, their abbreviations, sources and groups can be found in Table 2. Descriptive statistics of our variables are presented in Table 3 and 4.

[Please insert Table 3 here]

[Please insert Table 4 here]

B. Estimation Strategy

In order to measure the interest rate pass-through from policy rates to selected market interest rates conditional upon a number of important variables, we use an IVAR model whose extended version for panel data (IPVAR) is proposed by Towbin and Weber (2011). IVAR model in recursive form is written as;

$A_{0t}Y_t = C_{0t} + \sum_{k=1}^{L} A_{kt}Y_{t-k} + u_t \qquad t = 1,2,\ldots,T \qquad u_t \sim N(0,\Sigma)$	(2)
$A_{kt} = D_k^0 + D_k^1 X_t$	(3)

Notice that Equation 2 is the well-known presentation of a VAR setup except for the interaction relationship (A_{kt}) which is defined in Equation 3. Substituting Equation (3) in Equation (2) yields:

$$A_0 Y_t = C_0 + \sum_{k=1}^{L} A_k Y_{t-k} + C_1 X_t + \sum_{k=1}^{L} B_k X_t Y_{t-k} + u_t \qquad t = 1, 2, \ldots, T \tag{4}$$

where Y_t is a vector of endogenous variables, C_0 is vector of intercept, X_t represents interacted variable and $X_t Y_{t-k}$ is the interaction term. A_k , C_1 and B_k are parameter vectors for endogenous variables, interacted variable and interaction term, respectively. A_0 is a lower triangular matrix which means that the impulse response functions are based on Cholesky decomposition, where the contemporaneous ordering of endogenous variables is important. This model allows that the interacted variable influences the dynamic relationship among endogenous variables. All variables including interaction variables should be stationary in order the model to predict the confidence intervals with minimum error.

The nature of interaction in the IVAR specification is such that interaction terms not only affect the main variables of concern, but also they influence the relationship among them. This approach yields an array of IVAR estimates among which the researcher picks the ones corresponding to certain values of the interaction variables and subsequently calculate the impulse-response functions. Those certain values of continuous interaction variables are typically chosen as the 10^{th}-90^{th} or 25^{th}-75^{th} percentiles. For categorical interaction variables this choice is even trivial. Ultimately, the researcher is able to observe different impulse-response functions at different values of interaction variables.

An interacted panel VAR (IPVAR) has several advantages over alternative VAR specifications. Compared to an ordinary VAR including exogenous variables, IPVAR provides higher flexibility in capturing the effects of exogenous variables. Instead of a crude control for exogenous variables, IPVAR allows researcher to obtain an array of different VAR estimates at different percentiles of the exogenous variable, herein used as interaction variables. It is trivial that an IPVAR is a more capable tool compared to a panel VAR, as well, owing to the inclusion of interactions of variables. So, impulse response functions can be computed at selected low and high percentiles of the interaction variables. The same is valid for combinations of different percentiles of different interaction variables in the case of IPVARs with more than one interaction variables. In that, interaction variables can be seen as catalyzers. As a close rival, we could consider a factor augmented VAR (FAVAR) modeling framework owing to its high capability to capture composite effects of a number of variables on vector autoregressive dynamics, like Varlik et al. (2015). Having observed its limited transparency, i.e. the difficulties in interpreting the factors embedded within VAR, we purposefully avoided using a FAVAR specification. As a final point regarding our methodological choices, we must admit we have not included questions about potentially asymmetric response of deposit and credit rates to hikes and cuts of the central bank's policy rate. Such choice of ours solely originates from a tendency to keep modeling framework simple enough. Since we do not use panel data, the model that we employ can be called interacted VAR (IVAR).

C. Estimates

The IPVAR modeling framework of subsection 4-1 provides us with interesting findings once it is implemented on data described in the previous subsection. In this subsection we describe our empirical estimates following the same conceptual grouping of variables as in subsection 4-A. While presenting the mechanism of interaction among our variables of interest, we use impulse-response functions (response functions in short) and display the cumulative response of deposit and credit rates upon introduction of a one standard deviation positive shock to CBRT's policy interest rate. Shape and interpretation of response functions are not different from their counterparts in other types of VAR analysis except that alternative computational instances of response functions are produced in the case of IPVAR. Specifically, we present each response function twice, once maintaining the interaction variable at its 25^{th} and once at 75^{th} percentile. This allows us to observe the impact of policy rate changes on deposit (or credit) rates under two different economic setups: Intuitively, lower and higher values of interaction variables should be immune to choices of interaction variable's percentiles. 25^{th} and 75^{th} percentile values of interaction variables for cumulative response of deposit and credit rates to policy rates are presented in Table 5.

[Please insert Table 5 here]

In vector autoregressive analysis, contemporaneous ordering of variables resides as a fundamental issue. Orthogonalization of original residuals and hence the shape and scale of impulse-response functions depend on how the variables of interest are ordered. The results we subsequently present are based on the ordering of "Policy rate, Deposit rate, Credit rate" which indicates that policy rate is the most exogenous variable receiving the earlier shocks and transmitting those to other variables. Upon a positive innovation to policy rate, banks are supposed to adjust the rates on deposits they receive. So the cost perception of banking industry will adjust once the policy rate has been subject to changes by the central bank. Finally, banks re-adjust their credit rates so as to remain profitable and competitive. Our preliminary analyses indicated that orderings of "Policy rate, Deposit rate, Credit rate" and "Policy rate, Credit rate, Deposit rate" yield almost the same response functions, i.e. the estimates remain intact. Therefore, we present the impulse-response functions that are based on the first ordering in the remainder of the paper. Based on Schwarz Information Criterion, lag order for our vector autoregressive specifications was set to one-month.

For notational ease, we maintain the notation of (Policy rate, Deposit rate, Credit rate / Interaction variable) in Figures 3 through 18. This notation shows how the endogenous variables are ordered and which interaction variable has been employed.

Time horizon of response functions is chosen as 18 months. It corresponds to typical control horizon of an inflation targeting central bank during which shocks received by the system are expected to dissipate in and disappear. In terms of an impulse-response function, a response function must converge to zero over the chosen time horizon, or equivalently a cumulative response function must settle at a plateau.

Figures 3 through 18 display the impulse response functions for one interaction variable at a time, where the same information is tabulated as in Table 5. The right hand side graph shows the impulse response functions for 25^{th} quartile of each interaction variable whereas the left hand side graph shows the 75^{th} quartile of the interaction variable. The following

paragraphs elaborate the estimated impulse-response functions prior to the in-depth discussion of the next section.

Competitiveness and regulatory environment: Impulse response functions for Boone indicator is displayed in Figure 3. Responses of both deposit and credit rates are higher for higher values, i.e. the 75th percentile as compared to the 25th percentile, of Boone indicator. As competition drops down, level of pass-through increases. The higher the level of Boone indicator, the lower the competition in the market. That is, higher degrees of competition limit the pricing power of banks. We see a compatible pattern in HHI in Figure 4: Higher level of HHI indicates higher concentration; thus lower competition. Pass-through increases in both credits and deposits as concentration increases. On the other hand, interest rate pass-through is not very responsive to regulatory quality index (RQI). As can be seen in Figure 5, it has negative effect on deposit rates and almost no effect on credit rates. RQI series is reducing in time while policy rates are reducing. Banks do not reflect drops in policy rates to deposit rates because of the fierce competition in deposits. Banks had to increase deposits in order to increase deposits/ credits ratio, and therefore, they offer very generous rates for deposits. Deposit/ credit ratio is 0,84 for 2014; which is a historical low record. The governor of the CBRT announced that they can intervene to increase it (Milliyet, 2014). On the other hand, there is huge demand towards bank credits, and therefore, banks do not have to reflect falling rates to the credits (in accordance with credit rationing hypothesis).

Operating characteristics of the banking industry: All variables, NPL, NIRE, ROE, and LIQ, which represent operating characteristics of banking sector have positive relationship with interest rate pass-through as Figures 6-9 present. These results are robust to 2008-2014 sub-period and also other sensitivity checks. NPL is expected to have a positive relationship with pass-through but the relationship of all other variables with pass-through is negative or ambiguous in earlier findings. The fact is that profitability and liquidity increase pass-through in Turkish case.

Financial development: Per capita GDP (GDPPC) and broad money (M2GDP) have a negative effect on interest rate pass-through as Figures 10 and 11 respectively present. This result is totally counterintuitive. Moreover, STC provides ambiguous effect on pass-through: Pass-through is higher for deposit rates, and lower for credit rates for higher values of STC (Figure 12). We expect, financial development expedites pass-through, however, the Turkish case presents a contradictory example. When we observe the data, we see a routine pattern of increase in GDPPC and M2GDP, and a routine pattern of decrease in STC. It seems pass-through is higher for the initial years of the sampling period, and lower for the later years, regardless of these interaction variables. However, sensitivity analyses do not represent robust effects for the more stable 2008-2014 period; therefore, we can conclude that financial development has ambiguous effects on interest rate pass-through.

Dollarization: Exchange rate flexibility (FCLM2) has a positive effect on interest rate pass-through while dollarization (NFCP) has almost no effect, as can be seen in Figures 13 and 14 respectively. The former is an expected relationship, but the relationship between the latter and interest rate pass-through is not known. Sensitivity test results support a positive relationship between the two. We can conclude that dollarization does not have a negative significant effect on pass-through.

Domestic macroeconomic environment: Figures 15 and 16 show the impulse response functions of TRLIBOR and CPI inflation, respectively. Both variables have positive effect on

interest rate pass-through as compatible with expectations. Figures 17 and 18 show the impulse response functions of TRIPI and FAGDP, respectively. Growth of economic activity (TRIPI) and financial account of GDP (FAGDP) has negative effect on interest rate pass-through. The negative effect of industrial production is compatible with the negative effect of GDP per capita. It seems that growth does not have a positive effect on pass-through in Turkey for 2002-2014 period. We can rationalize the negative effect of FAGDP by emphasizing its pro-cyclical nature and economy's negative relationship with GDP and industrial growth. Economic growth causes interest rate pass-through to drop, however, capital inflows increase during economic upturns. The 2008-2014 analysis provides counter-results, but this result is robust for other sensitivity tests. 2008-2014 results may reflect the impact of 2008 crisis. Capital inflows are in a diminishing trend in this period.

Table 6 shows the expected and realized effects of interaction variables. RQI, NIRE, ROE, LIQ, GDPPC, M2GDP, and TRIPI are surprising us with the effect. But, these variables can have different effects of pass-through in different countries. For example, Sabarowski and Weber, (2013) find that some variables are significant in cross country analysis but they turn out be insignificant in within country tests.

[Please insert Table 6 here]

D. Sensitivity Tests

The results in Section 3.3 document the pass-through measured in the order of policy rate, 1-month deposit rates, and commercial credits in the VAR equations. Some results are compatible with expectations, but some are confusing. In order to test the validity of our results, we run some sensitivity tests. First, we run the same analysis for 2008-2014 sub-period. We believe that some deviations from expected results can be originated from the important changes in pre-2008 period. Afterwards, we re-run the analysis by changing endogenous variables. We replaced 1-month deposit rates to 3-month deposit rates; and we also replaced 1-month deposit rates back and altered commercial credits with consumer credits to follow up the changes from the original results and understand the differences.

Even though the effect of most interaction variables are in line with the findings of the earlier literature, we believe that some periodic fluctuations cause deceiving results. The pre-2008 period displays huge drops in overall interest rates and dramatic changes in many other macro variables in Turkey for 2008-2014 period. Therefore, we re-run the analysis for post-2008 period. We present the results in Supplement 1. The results can be summarized as stronger for the more stable sub-period: The power of interaction is stronger for all variables. The only problem is in GDPPC. The effect of GDPPC is negative and stronger for this sub-period, contrary to expectations. We can interpret this result as either there is a structural problem in the system or increases in GDP really causes decline in interest rate pass-through.

Second, we run the VAR in the order of policy rate, 3-month deposit rate, and commercial credits. The results are presented in Supplement 2. As expected, the results are not much different from the results obtained by using 1-month deposit rates. The only differences are observed in competition and regulatory environment variables: They result positively stronger in the second equation. Additionally, there is a slight negative effect of macroeconomic environment variables on the pass-through when we use 3-month deposit rates. But the general impact of interaction variables on endogenous variables does not change.

This result is not surprising, because both 1-month and 3-month deposits are short-termed, there should be slight difference in the effects of these deposits on the overall economy.

Lastly, we replaced commercial credits with consumer credits and do not change the ordering of the variables in the new equation: Policy rate, 1-month deposit rate, and consumer credits. The results are presented in Supplement 3. The results suggest those: Increase in HHI has a positive effect on pass-through to credits and a negative effect on pass-through to deposits. The effect of competition in pass-through is lessened in total, because the negative impact on deposits is greater than the positive impact on credits. Increase in exchange rate flexibility reduces pass-through to credits, and increase in dollarization reduces pass-through to deposits. Individuals seem to be more sensitive to exchange rates fluctuations than so are firms. Moreover, as NPL increases pass-through to credits falls down. NPL is another sensitive factor to individual consumers. Additionally, consumers seem to be less sensitive to inflation, financial development, and changes in LIBOR: Increases in CPI and GDPPC have negative effect on the pass-through to deposits. This effect would be negative in the case of commercial credits. Likewise, increase in TRLIBOR has no effect on the pass-through to deposits. This effect would be negative in the case of commercial credits.

4. Discussion and Concluding Remarks

Findings of the previous section indicate that interest rate pass-through behavior, or pricing decisions by banks following a monetary policy interest rate innovation, has both structural and cyclical associations with other variables. In this section, we dig in our estimates to reveal workable insights. In broad terms, in line with Cottarelli et al. (1995) and Mishra et al. (2012), we find a positive relationship between competitiveness in banking industry and interest rate pass-through. This finding is supported by the negative relative relationship between banking sector concentration and interest rate pass-through. This result is similar to Cottarelli and Kourelis (1994), Cottarelli et al. (1995), Sorensen and Werner (2006), Saborowski and Weber (2013), and Mishra et al. (2012). On the other hand, our finding indicating a negative relationship between regulatory quality and interest rate pass-through is different from the findings of Mishra et al. (2012) and Saborowski and Weber (2013). This no relationship may be temporary, and it evolves towards a positive one as stability in interest rates increase. The relationship between RQI and pass-through turns out to be positive for 2008-2014 period.

These measurements suggest maintaining a sufficient degree of competitiveness and as low concentration as possible in the banking industry. Regulatory quality gains importance in the last half of the analysis period. It is salutary that bank regulation in Turkey was enhanced after the devastating impact of the 2001 crisis of Turkey, especially by means of the Banking Law No 5411 legislated and enacted on 19 October 20015 and 01 November 2005, respectively.

Banks' operational characteristics suggest more upon what is said by competitiveness and concentration. In that, our specifications suggest that when banks are more liquid and profitable, they tend to reflect policy rate changes to their deposit and credit rates more. These results contradict with Gigineshvili (2011) and Sabarowski and Weber (2013), which find a negative relation between interest rate pass-through and liquidity in their cross-country analysis. However, Sabarowski and Weber (2013) do not find the same relationship in country-by-country analysis. It can be a similar case in Turkey, banking sector variables may behave differently in different countries. Moreover, Turkey has special sub-periods regarding liquidity in the analysis period. These findings are likely to be associated with massive cuts of policy rates

at the beginning of our sample period and after the Global Financial Crisis during which banks might have enjoyed ample liquidity.

In tandem with Mishra et al. (2012) and Saborowski and Weber (2013), our findings suggest higher interest rate pass-through with higher exchange rate flexibility. Literature is split up about dollarization: one group defends a positive relationship (Leiderman et al., 2006), and the other claims a negative relationship (Saborowski and Weber, 2013). Our findings are consistent with those of Leiderman et al. (2006). The higher the dollarization, the faster the monetary transmission.

We observe a very surprising outcome when financial development indicators are used as interaction variables. Per capita GDP, ratio of broad money-to-GDP (M2GDP), and ratio of financial accounts to GDP (FAGDP) reduce interest rates pass-through to deposits and credits, both. These results contradict with earlier research (Cottarelli and Kourelis, 1994; Saborowski and Weber, 2013).

The term structure proxy, TRLIBOR, increases pass-through in general. This outcome is consistent with Frisancho-Marischal and Howell (2009), which finds a positive relationship between pass-through and LIBOR. On the other hand, 2008-2014 results provide a contradictory outcome, which is consistent with Betancourt et al (2008), which finds a negative relationship between LIBOR and pass-through. Industrial production growth, on the other hand, reduces pass-through. This result is contradicting De Bondt (2002) and justify Leroy and Lucotte (2015); however, it is in line with our findings for GDPPC and M2GDP.

Facing higher domestic inflation, degree of pass-through becomes higher for retail rates. This result is consistent with Cottarelli and Kourelis (1994) and Gigineshvili (2011). Noting that inflation in this study is actual rather than expected inflation, this suggests that banks become more sensitive to possible declines in their real profits on credits once they have observed higher inflation. Equivalently, banks seem to update their expectations in an adaptive manner. On the other hand, banks do not seem to be that much sensitive about pass-through in deposit rates. One standard deviation of positive shock in inflation has a slightly positive effect on the pass-through to deposit rates. Consistent with profitability concerns, banks do not reflect policy changes to deposits in order to keep their expectations in higher inflation environments.

On the balance of payments front, despite their essential equality, we use financial account to GDP ratio to address the impacts of capital inflows. Here, higher interest rate pass-through is negatively affected in the case of higher FA/GDP ratios. So the difference between pass-through to credit and deposit rates get lower upon increased capital inflows to Turkey. This result is especially important having observed the fears of the Central Bank of Turkey from fast expansion of domestic credits financed by rapid short-term capital inflows. Indeed, the Bank eloquently tailored its interest rate corridor so as to gently repel inflows of “hot money” in the recent past. Note that higher *de facto* flexibility of the exchange rate regime implies higher pass-through of policy rate innovations to both deposit and credit rates, i.e. banks tend include the price of exchange rate risks in their rates.

References

Aktan, Nejla Adanur, Hulya Kanalici Akay, Mehmet Cinar (2014). The Effect of Monetary Policy on Banks Risk Taking in Turkey. International Journal of Management Economics and Business 10 (21).

Angeloni, Ignazio, Anil K. Kashyap, Benoit Mojon, Daniele Terlizzesse (2003). Monetary Transmission in the Euro Area: Does the Interest Rate Channel Explain All? NBER Working Paper 9984, National Bureau of Economic Research.

Basci, Erdem, Ozgur Ozel, Cagri Sarikaya (2008). The Monetary Transmission Mechanism in Turkey: New Developments. In Transmission Mechanisms for Monetary Policy in Emerging Market Economies. BIS Papers, No: 35.

Berger, Allen N. and Gregory F. Udell (1992). Some Evidence on the Empirical Significance of Credit Rationing. Journal of Political Economy 100(5):1047-1077.

Bernstein, Solange and J. Rodrigo Fuentes (2004). Is There Lending Rate Stickiness in the Chilean Banking Industry? Banking Market Structure and Monetary Policy, Santiago, Chile, Central Bank of Chile.

Betancourt, Rocio, Hernando Vargas, and Norberto Rodriguez (2008). Interest Rate Pass-Through in Colombia: A Micro Banking Perspective. Cuadernos de Economia, 45, 29:58.

Boon, Jan (2008). A New Way to Measure Competition. Economic Journal 118 (531), 1245-1261.

Bredin, Don, Trevor Fitzpatrick and Gered O Reilly (2001). Retail Interest Rate Pass-through: The Irish Experience. Central Bank of Ireland, Technical Paper 06/RT/01.

BRSA (2013). Turk Bankacilik Sektoru Genel Gorunumu. Bankacilik Duzenleme ve Denetleme Kurumu, 2014 (1), Aralik, p. 41.

Cecchetti, Stephen G. (1999). Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism. Federal Reserve Bank of New York Economic Policy Review, July.

Chmielewski, Tomasz (2004). Interest Rate Pass-through in the Polish Banking Sector and Bank-Specific Financial Disturbances. National Bank of Poland. Draft on January 31, 2004.

Cottarelli, Carlo and Angeliki Kourelis (1994). Financial Structure, Bank Lending Rates, and the Transmission Mechanism of Monetary Policy. IMF Working Paper, WP/ 94/38, International Monetary Fund.

Cottarellli, Carlo, Giovanni Ferri and Andrea Generale (1995). Bank Lending Rates and Financial Structure in Italy: A Case Study. IMF Working Paper, WP/95/38, International Monetary Fund.

De Bondt, Gabe (2002). Retail Bank Interest Rate Pass-Through: New Evidence at the Euro Area Level. ECB Working Paper No: 136. European Central Bank

Degirmen, Suleyman and Filiz Ozag (2007). Existence of Bank Capital Channel: An Analysis for the Turkish Banking Sector. Ekonomik Yaklasim 18(63):29-54.

Egert, Balazs and Ronald MacDonald (2009). Monetary Transmission Mechanism in Central and Eastern Europe: Surveying the Surveyable. Journal of Economic Surveys 23(2):277-327.

Ehrmann, Michael, Leonardo Gambacorta, Jorge Martines-Pages, Patrick Sevestre, Andreas Worms (2001). Financial Systems and the Role of Banks in Monetary Policy Transmission in the Euro Area. ECB Working Paper Series No: 105, European Central Bank.

Fried, Joel and Peter Howitt (1980). Credit Rationing and Implicit Contract Theory. Journal of Money, Credit, and Banking 12(3):471-487.

Frisancho-Marischal, Iris Biefang and PeterHowells (2009). Interest Rate Pass-Through and Risk. Centre for Global Finance and Bristol Business School.

Gigineishvili, Nikoloz (2011). Determinants of Interest Rate Pass-through: Do Macroeconomic Conditions and Financial Market Structure Matter? IMF Working Paper WP/11/176, International Monetary Fund.

Hoffman, Boris and Paul Mizen (2004). Interest Rate Pass-through and Monetary Transmission: Evidence from Individual Financial Institutions' Retail Rates. Economica 71:99-123.

Horvath, Csilla, Judit Kreko, Anna Naszodi (2004). Interest Rate Pass-through: The Case of Hungary. Magyar Nemzeti Bank, Budapest.

Hull, John C. (2015). Risk Management and Financial Institutions. 4Th Ed. Wiley. NJ., P. 197.

Illes, Anamaria and Marco Lombardi (2013). Interest Rate Pass-Through since the Financial Crisis. BIS Quarterly Review, September, 57-66.

Ito, Takatoshi and Kiyotaka Sato (2006). Exchange Rate Changes and Inflation in Post-Crisis Asian Economies: VAR Analysis of the Exchange Rate Pass-Through. NBER Working Paper 12395. National Bureau of Economic Research.

Kamin, Steven, Philip Turner, Josef Van't dack (1998). The Transmission Mechanism of Monetary Policy in Emerging Market Economies: An Overview. BIS Policy Papers, No:3 Bank for International Settlements.

Kasapoglu, Ozgur (2007). Parasal Aktarim Mekanizmalari: Turkiye icin Uygulama. Uzmanlik Yeterlilik Tezi, CBRT, Central Bank of Republic of Turkey.

Kashyap, Anil K. and Jeremy C. Stein (2000).What a Million Observations on Banks Say about the Transmission of Monetary Policy? The American Economic Review 90(3):407-428.

Klemperer, Paul (1987). Markets with Consumer Switching Costs. Quarterly Journal of Economics, May, 376:394.

Kwapil, Claudia and Johann Scharler (2007). Interest Rate Pass-through, Monetary Policy Rules and Macroeconomic Stability. Journal of International Money and Finance, 29 (2), 236:251.

Leiderman, L., R. Maino, and E. Parrado, 2006, —Inflation Targeting in Dollarized Economies,|| IMF Working Paper 06/157.

Leroy, Aurelien, and Yannick Lucotte (2015). Structural and Cyclical Determinants of Bank Interest Rate Pass-Through in Eurozone. NBP Working Paper No: 198. Narodowy Bank Polski.

Loayza, Norman and Klaus Schmidt-Hebbel (2002). Monetary Policy Functions and Transmission Mechanisms: An Overview. Monetary Policy: Rules and Transmission Mechanisms. Santiago: Central Bank of Chile.

Marotta, Giuseppe (2009). Structural Breaks in the Lending Interest Rate Pass-through and the Euro. Economic Modelling 26(1):191-205.

Mihov, Ilian and Andrew Scott (2001). Monetary Policy Implementation and Transmission in the European Monetary Union. Economic Policy 16(33):369-406.

Milliyet (2014). Kredi Mevduat Oranı Zirve Yapti. (10.07.2014). Retrieved from: http://uzmanpara.milliyet.com.tr/haber-detay/gundem/kredi-mevduat-orani-zirve-yapti/3595/ on: February 04, 2016.

Mishra, Prachi, Peter J. Montiel (2012). How effective is Monetary Transmission in Low-Income Countries? A Survey of the Empirical Evidence. IMF Working Paper, WP/12/143.

Mishra, Prachi, Peter J. Montiel, Antonio Spilimbergo (2012). Monetary Transmission in Low Income Countries: Effectiveness and Policy Implications. IMF Economic Review 60(2):270-302.

Ornek, Ibrahim (2009). Processing of Monetary Transmission Mechanism Channels in Turkey. Maliye Dergisi 156:104-125.

Peker, Osman and Birgul Canbazoglu (2011). Processing of Bank Lending Channel in Turkey: An Empirical Analysis. Yonetim ve Ekonomi 18 (2). Celal Bayar Universitesi I.I.B.F. Manisa.

Saborowski, Christian and Sebatian Weber (2013). Assessing the Determinants of Interest Rate Transmission through Conditional Impulse Response Functions. IMF Working Paper, WP/13/23.

Sander, Harald and Stefanie Kleimeier (2000). Asymmetric Adjustment of Commercial Bank Interest Rates in the Euro Area: Implications for Monetary Policy. Paper Presented at the Conference Financial Structure, Bank Behavior and Monetary Policy in the EMU, Groningen 5-6 October. Retrieved from: http://citeseerx.ist.psu.edu/ viewdoc/download? doi=10.1.1.200.3270&rep=rep1&type=pdf, on May 5, 2015.

Sander, Harald and Stefanie Kleimeier (2003). Convergence in the Eurozone Retail Banking? What Interest Rate Pass-through Tells Us about Monetary Policy Transmission, Competition, and Integration? LIFE Working Paper 03-009. Limburg Institute of Financial Economics.

Sander, Harald and Stefanie Kleimeier (2006). Convergence of Interest Rate Pass-through in a Wider Euro-Zone? Economic Systems 30:405-423.

Singh, Sukudhew, Ahmad Razi, Norhana Endut and Helmi Ramlee (2008). Impact of Financial Market Developments on the Monetary Transmission Mechanism. BIS Papers, No: 39.

Sorensen, Christoffer Kok and Tomas Werner (2006). Bank Interest Rate Pass-through in the Euro Area A Cross Country Comparison. European Central Bank Working Paper Series, No: 580.

Stiglitz, Joseph E. And Andrew Weiss (1981). Credit Rationing in Markets with Imperfect Informaton. The American Economic Review 71(3):393-410.

Tai, Pih Nee, Siok Kun Sek and Wai Mun Har (2012). Interest Rate Pass-through and Monetary Transmission in Asia. International Journal of Economics and Finance 4(2):163-174.

Towbin, Pascal and Sebastian Weber (2011). A Guide to the Matlab Toolbox for Interacted Panel VAR estimations (IPVAR).

Ucak, Ayhan and Kasirga Yildirak (2012). An Alternative Approach to Analyze the Monetary Transmission in Turkey: An Empirical Analysis on Speed of Adjustment. Finansal Arastirmalar ve Calismalar Dergisi 3 (7). Marmara University.

Van Leuvensteijn, Michiel, Christopher Kok-Sorensen, Jacob A. Bikker and Adrian A.R.J.M. van Rixtel (2008). Impact of Bank Competition on the Interest Rate Pass-through in the Euro Area. European Central Bank Working Paper, No: 885, March.

Varlik, Serdar, Nildag Basak Ceylan and M. Hakan Berument (2015). “Assessing the Effects of a Policy Rate Shock on Market Interest Rates: Interest Rate Pass-Through with a FAVAR Model – The Case of Turkey for the Inflation-Targeting Period”

Weth, Mark A. (2002). The Pass-through from Market Interest Rates to Bank Lending Rates in Germany. Economic Research Centre of the Deutsche Bundesbank, Discussion Paper 11/02.

Wrobel, Ewa and Malgorzata Pawlowska (2002). Monetary Transmission in Poland: Some Evidence on Interest Rate and Credit Channels. National Bank of Poland, Paper No: 24.

Yildirim, Dilem (2012). Interest Rate Pass-through to Turkish Lending Rates: A Threshold Cointegration Analysis. ERC Working Papers in Economics 12/7, September, Economic Research Center, Middle East Technical University.

Figures and Tables – to be placed in the main text at suggested marks of placement

Figure 1: Bank credit rates in Turkey

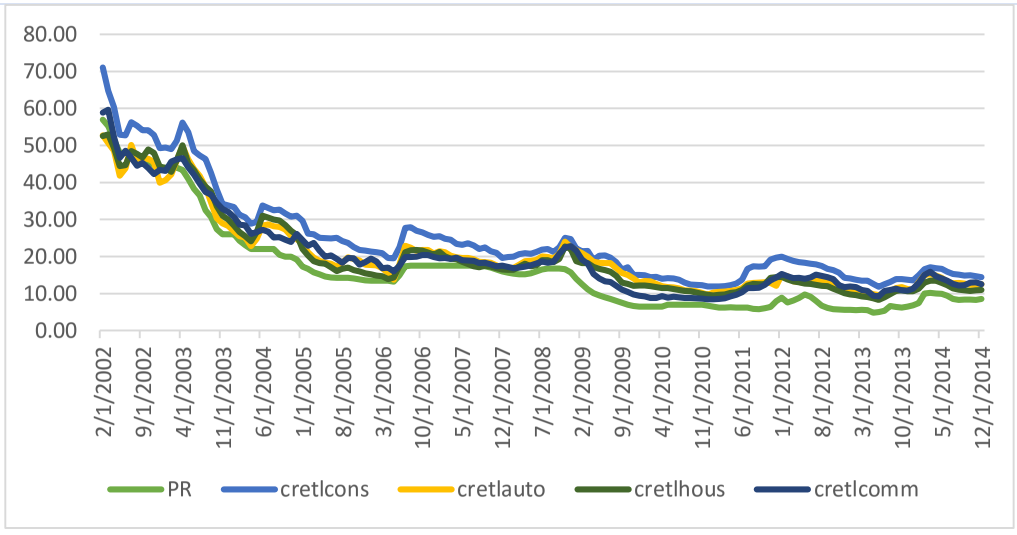

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Figure 2: Bank deposit rates in Turkey

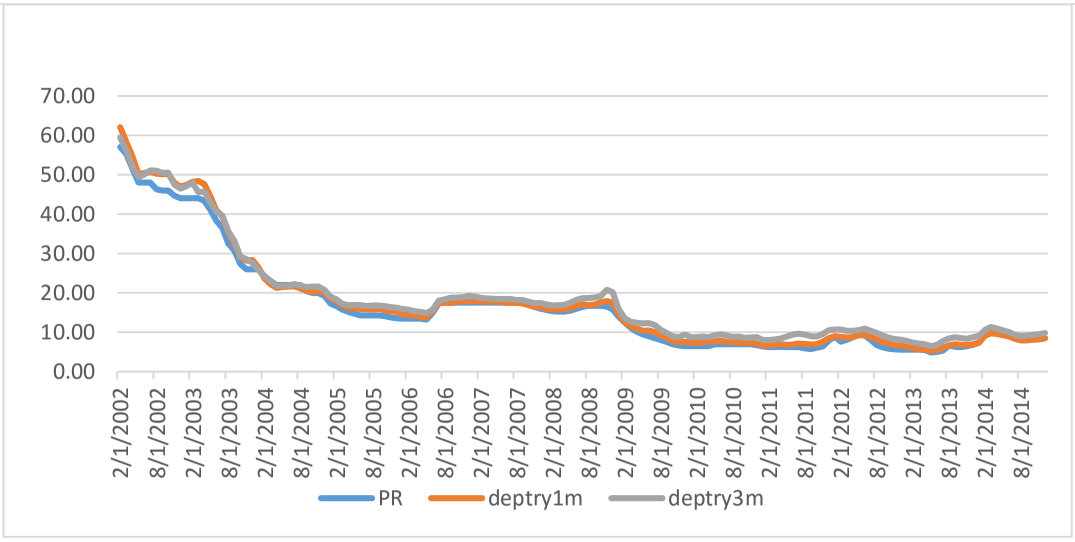

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Table 1: Correlation between policy rate and retail rates				
	Contemporaneous Correlation	Short-Term Effect	Long-Term Effect	R-squared
Consumer Credits	0.64	0.41	0.77	0.99
Auto Credits	0.62	0.32	0.81	0.99
House Credits	0.63	0.45	0.85	0.99
Commercial Credits	0.67	0.46	0.85	0.99
1 Month Deposits	0.89	0.98	0.98	1.00
3 Month Deposits	0.81	0.76	0.94	1.00
Credits Average	0.64	0.41	0.82	0.99
Deposits Average	0.85	0.87	0.96	1.00

Table 2: Interaction Variables

Represents	Abbreviation	Variable	Formula/ Explanation	Source
Competition and regulatory quality	Boone	Boone Indicator		St. Louis FED
	RQI	Regulatory Quality Index		World Bank Databank
	HHI	Herfindahl-Hirschman Index		Self Computed
Banking Sector Features	ROE	Return on Equity		Banks Association of Turkey
	NIRE	Liquidity/ Profitability	Revenues before interest / expenses before interest	Banks Association of Turkey
	LIQ	Liquidity	Liquid assets / total assets	Banks Association of Turkey
	NPL	Non-Performing Loans	Non-performing loans / total assets	Banks Association of Turkey
Financial Development	STC	Short-Term Credits		Banks Association of Turkey
	GDPPC	Per Capita GDP		World Bank Databank
	M2GDP	Broad Money	M2 / GDP	World Bank Databank
Dollarization	FCLM2	Exchange Rate Flexibility	Foreign Currency Loans / M2	CBRT & Ministry of Development
	NFCP	Dollarization	Foreign currency liabilities - assets / equity	Banks Association of Turkey
Macroeconomic Situation	TRLIBOR	Turkish Overnight LIBOR		Banks Association of Turkey
	CPI	Consumer Price Index		Central Bank of Turkey-EDDS
	TRIPI	Turkish Industrial Production Index		Central Bank of Turkey-EDDS
	FAGDP	Financial Account of GDP		Central Bank of Turkey-EDDS

Table 3: Summary Statistics of the Original Time Series Used in the Study (February 2002 - December 2014)

	PR	Cretlcons	Cretlauto	CretlHous	Cretlcomm	Deptl1m	Deptl3m	Boone	HHI	RQI	NPL	NIRE
Number of Observations	155	155	155	155	155	155	155	107	155	155	155	155
Mean	16.33	24.51	20.41	19.89	20.12	17.23	18.25	-0.03	0.00	0.28	4.92	85.27
Median	13.82	20.94	17.94	16.44	17.52	15.18	15.90	-0.02	-0.01	0.30	3.49	73.57
Min	4.85	11.82	9.61	8.30	8.43	5.24	6.48	-0.08	-0.04	0.03	2.58	64.10
25th Percentile	7.00	15.19	12.84	12.01	12.14	7.60	9.26	-0.04	-0.02	0.27	2.80	69.71
75th Percentile	17.50	26.77	22.45	21.75	22.63	17.95	19.12	-0.01	0.03	0.38	4.97	81.08
Max	57.00	71.05	52.72	52.98	59.64	62.02	59.42	-0.01	0.07	0.42	12.70	192.84
Standard Deviation	12.32	12.73	10.70	11.46	11.46	13.18	12.43	0.02	0.03	0.13	3.18	33.60
Skewness	1.63	1.60	1.52	1.49	1.52	1.72	1.71	-1.42	0.51	-0.79	1.62	2.57
Kurtosis	1.90	1.93	1.45	1.19	1.70	2.13	2.09	1.26	-1.04	-0.63	1.17	5.54

Table 3 (Continued): Summary Statistics of the Original Time Series Used in the Study (February 2002 - December 2014)

	ROE	Liquidity	GDPPC	M2GDP	STC	FCLM2	NFCP	TRLIBOR	CPI	Turkish IPI	FAGDPMON
Number of Observations	155	155	155	155	155	155	132	148	154	119	152
Mean	14.56	55.82	8493.48	48.27	0.44	0.00	36.91	15.63	156.52	0.29	-0.06
Median	14.05	55.88	9309.51	48.56	0.43	0.00	33.85	14.04	155.05	0.40	-0.05
Min	9.20	34.12	3570.55	34.59	0.33	0.00	22.27	4.52	76.30	-6.00	-0.23
25th Percentile	12.77	47.66	7117.23	40.47	0.36	0.00	31.56	7.25	115.76	-0.60	-0.10
75th Percentile	16.55	64.34	10515.01	55.36	0.52	0.01	43.85	17.98	190.63	1.45	-0.02
Max	19.50	71.64	10975.07	60.64	0.59	0.01	57.29	47.24	248.82	6.00	0.05
Standard Deviation	3.12	10.88	2385.60	8.98	0.09	0.00	10.91	10.63	47.16	1.87	0.06
Skewness	0.02	-0.31	-0.79	-0.11	0.32	0.24	0.86	1.64	0.22	-0.24	-0.35
Kurtosis	-1.05	-0.77	-0.71	-1.45	-1.25	-1.00	-0.33	2.26	-1.03	1.18	0.03

Table 4: Summary Statistics of the Differenced Time Series Used in the Study (March 2002 - December 2014)

	PR	Cretlcons	Cretlauto	CretlHous	Cretlcomm	Deptl1m	Deptl3m	Boone	HHI	RQI	NPL	NIRE
Number of Observations	154	154	154	154	154	154	154	142	144	154	144	144
Mean	-0.31	-0.37	-0.26	-0.27	-0.30	-0.35	-0.32	0.07	-0.01	0.26	-0.82	9.98
Median	-0.06	-0.24	-0.28	-0.28	-0.17	-0.12	-0.15	0.04	0.01	0.07	-0.50	-0.72
Min	-3.97	-7.46	-6.75	-4.92	-7.36	-4.54	-4.24	-0.05	-0.06	-0.75	-5.00	-35.65
25th Percentile	-0.52	-0.76	-0.84	-0.65	-0.76	-0.44	-0.47	-0.03	-0.03	-0.02	-1.27	-5.99
75th Percentile	0.00	0.13	0.17	0.11	0.38	0.16	0.16	0.06	0.03	0.11	0.13	9.94
Max	2.67	5.21	6.31	4.46	2.49	2.05	2.25	0.68	0.03	2.86	1.53	128.27
Standard Deviation	0.91	1.61	1.61	1.39	1.26	1.01	1.02	0.18	0.03	0.89	1.56	39.79
Skewness	-1.15	-0.57	0.19	0.12	-1.56	-1.97	-1.72	2.97	-0.46	1.91	-1.32	2.10
Kurtosis	4.74	5.39	4.83	3.60	7.41	5.15	4.43	7.91	-1.37	3.24	1.94	3.98

Table 4 (Continued): Summary Statistics of the Differenced Time Series Used in the Study (March 2002 - December 2014)

	ROE	LIQ	GDPPC	M2GDP	STC	FCLM2	NFCP	TRLIBOR	CPI	Turkish IPI	FAGDP
Number of Observations	144	144	154	154	144	144	120	148	153	118	152
Mean	0.15	-2.93	574.68	1.24	-0.02	0.00	3.48	-0.25	0.01	-1.23	-0.06
Median	-1.27	-4.01	610.04	1.49	-0.02	0.00	1.66	-0.11	0.01	-1.32	-0.05
Min	-4.06	-7.99	-1758.37	-5.63	-0.07	0.00	-9.44	-22.86	-0.01	-46.00	-0.23
25th Percentile	-2.02	-4.94	329.04	-0.61	-0.03	0.00	-0.85	-0.54	0.00	-2.00	-0.10
75th Percentile	1.13	-2.22	1261.69	4.72	0.00	0.00	6.25	0.16	0.01	-0.10	-0.02
Max	8.31	6.12	1582.24	6.07	0.04	0.00	22.88	22.99	0.03	26.00	0.05
Standard Deviation	3.74	3.71	889.90	3.56	0.03	0.00	8.20	2.86	0.01	6.10	0.06
Skewness	1.08	1.16	-1.27	-0.33	0.20	-0.77	0.99	0.26	0.64	-2.25	-0.35
Kurtosis	-0.02	0.79	1.25	-0.72	-0.65	-0.64	0.99	55.97	0.72	28.88	0.03

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Table 5: Numerical Summary of Cumulative Impulse-Response Functions					
	Cumulative Response of Deposit Rate to Policy Rate		Cumulative Response of Credit Rate to Policy Rate		
Interaction variable	-at 25th percentile of interaction variable	-at 75th percentile of interaction variable	-at 25th percentile of interaction variable	-at 75th percentile of interaction variable	Figure No
Boone indicator	0.9	1	0.6	0.9	3
HHI	0.9	1	0.7	0.9	4
Regulatory quality	1	0.9	0.9	0.9	5
NPL ratio	0.9	0.9	0.6	1	6
NIRE	0.9	1	0.7	1	7
ROE in banking sector	0.8	0.9	0.9	0.9	8
Liquidity	0.8	0.9	0.8	0.8	9
GDPPC	1	1	1	0.7	10
M2GDP	1	0.8	1	0.9	11
Short-term credits	0.8	0.9	1	0.8	12
FCLM2	0.7	1	0.7	0.9	13
NFCP	0.8	0.8	1	1	14
TRLIBOR	0.8	0.8	0.8	0.9	15
CPI inflation	0.9	1	0.8	1	16
Industrial growth	0.9	0.9	1.2	0.9	17
FA/GDP	1	1	1.1	1	18

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Table 6: Expected and Realized Effects of Interaction Variables on Turkish Interest Rate Pass-Through

Interaction Variable	Expected Effect	Realized Effect on Deposits	Realized Effect on Deposits
Boone	+	+	+
HHI	+	+	+
RQI	+	-	0
NPL	+	0	+
NIRE	-	+	+
ROE	-	+	0
LIQ	-	+	0
GDPPC	+	0	-
M2GDP	+	-	-
STC	+	+	-
FCLM2	+	+	+
NFCP	-	0	0
TRLIBOR	+	0	+
CPI	+	+	+
TRIPI	+	0	-
FAGDP		0	-

Figure 3: Impulse-response functions

(Policy, Deposit, Credit / Boone)

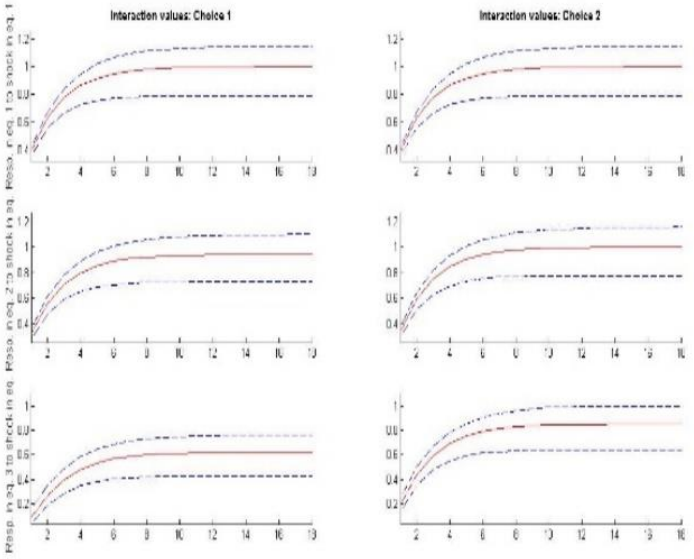

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Figure 4: Impulse-response functions

(Policy, Deposit, Credit / HHI)

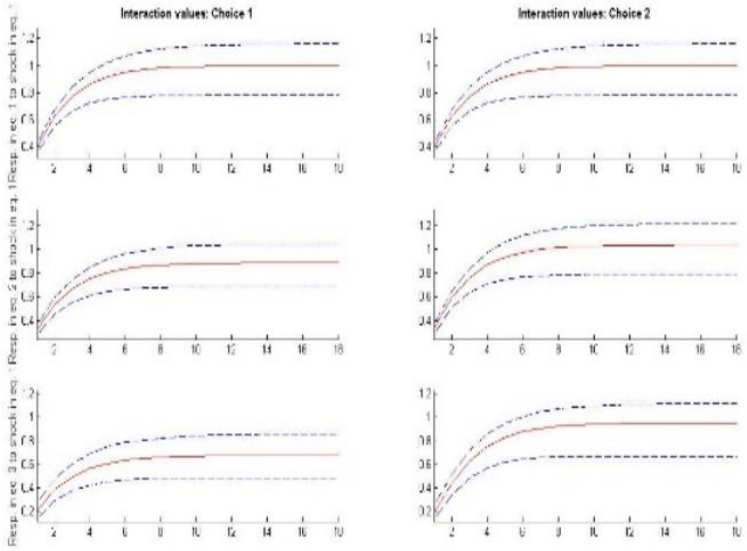

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Figure 5: Impulse-response functions

(Policy, Deposit, Credit / RQI)

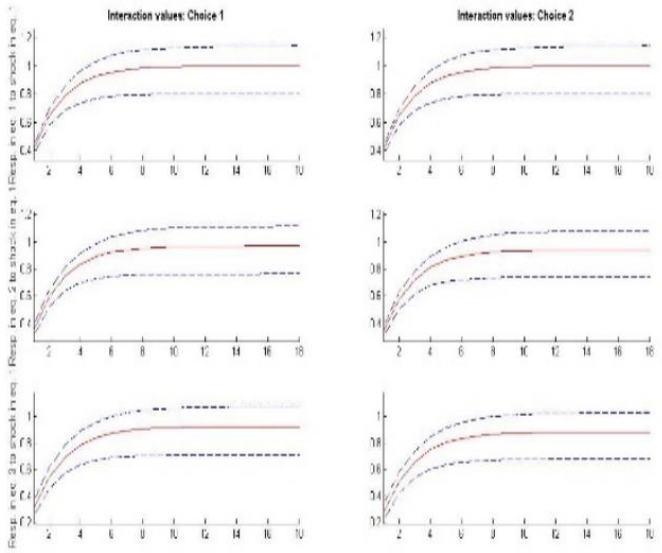

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Figure 6: Impulse-response functions

(Policy, Deposit, Credit / NPL)

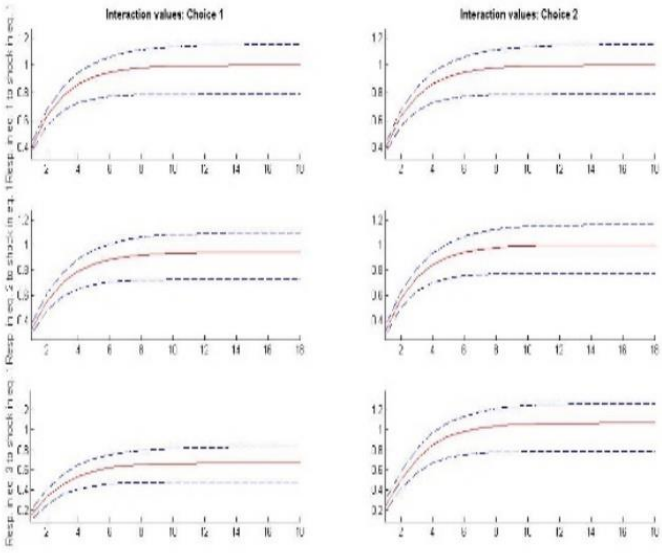

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Figure 7: Impulse-response functions

(Policy, Deposit, Credit / NIRE)

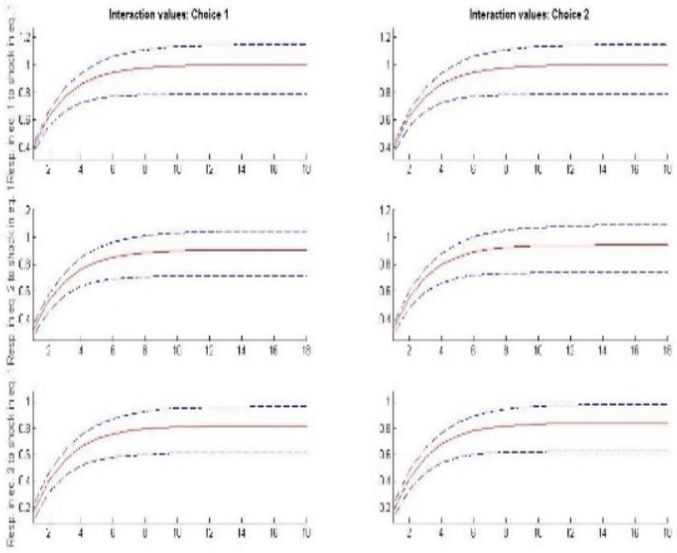

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Figure 8: Impulse-response functions

(Policy, Deposit, Credit / ROE)

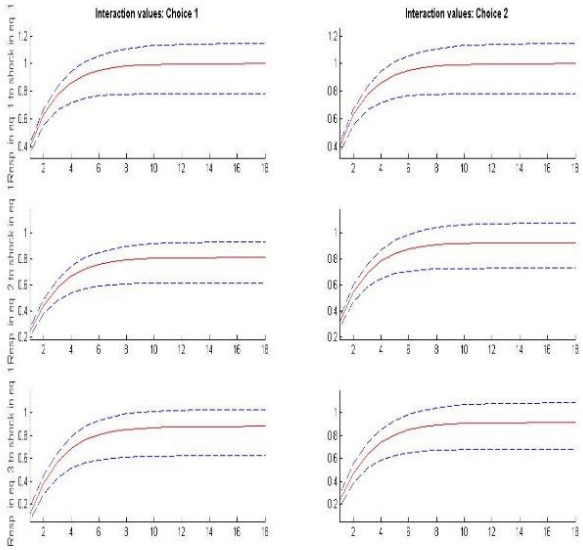

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Figure 9: Impulse-response functions

(Policy, Deposit, Credit / LIQ)

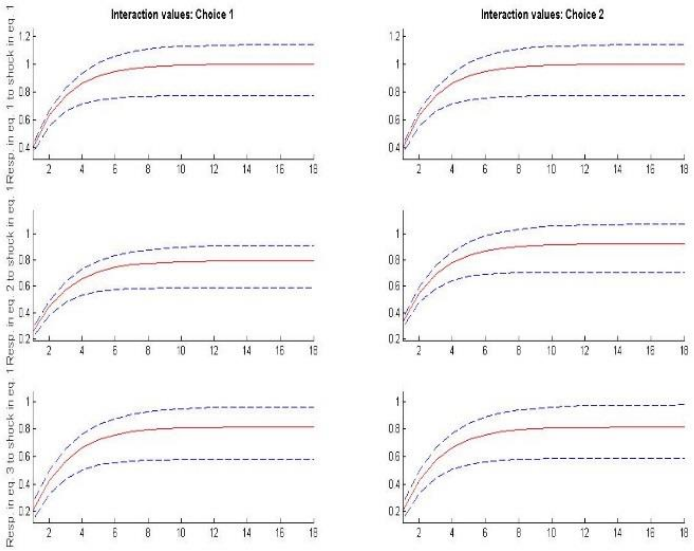

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Figure 10: Impulse-response functions

(Policy, Deposit, Credit / GDPPC)

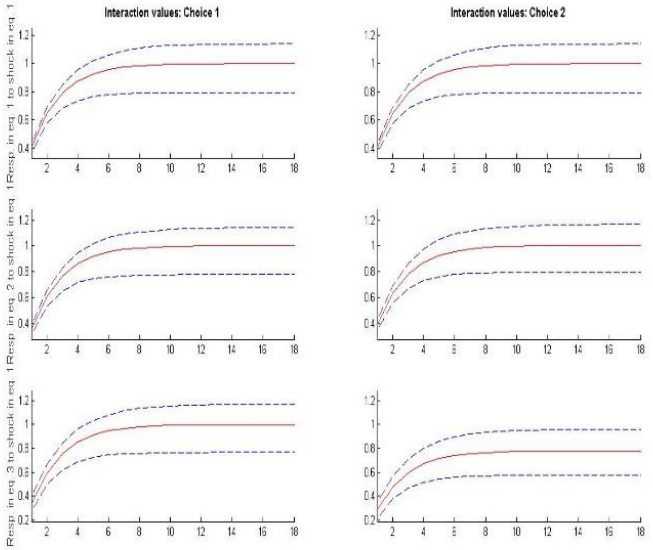

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Figure 11: Impulse-response functions

(Policy, Deposit, Credit / M2GDP)

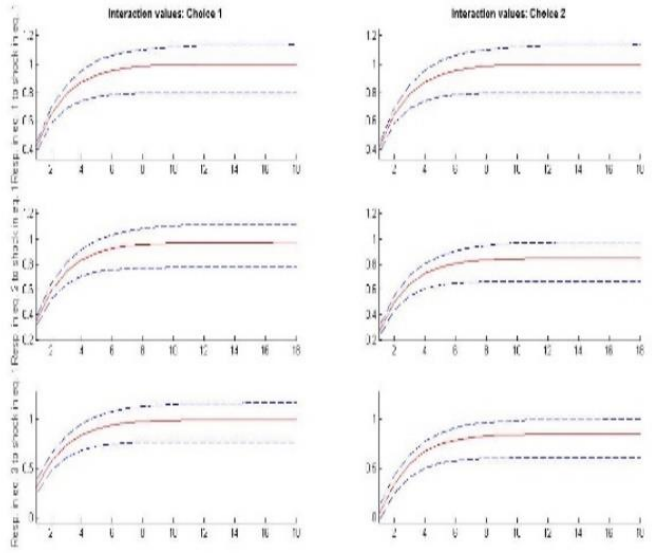

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Figure 12: Impulse-response functions

(Policy, Deposit, Credit / STC)

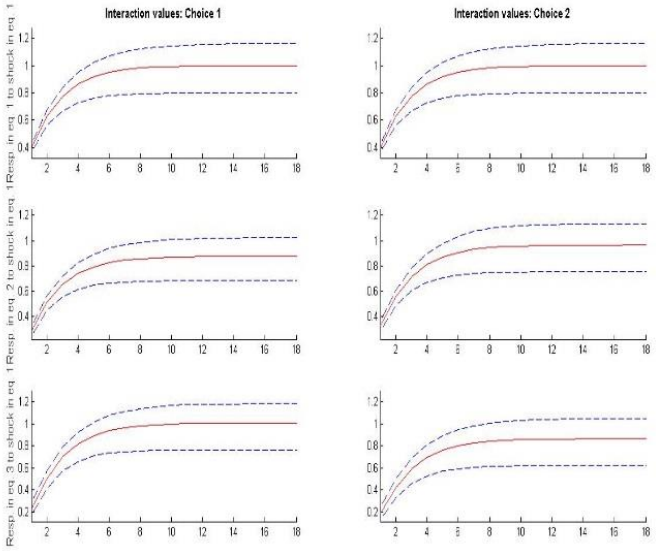

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Figure 13: Impulse-response functions

(Policy, Deposit, Credit / FCLM2)

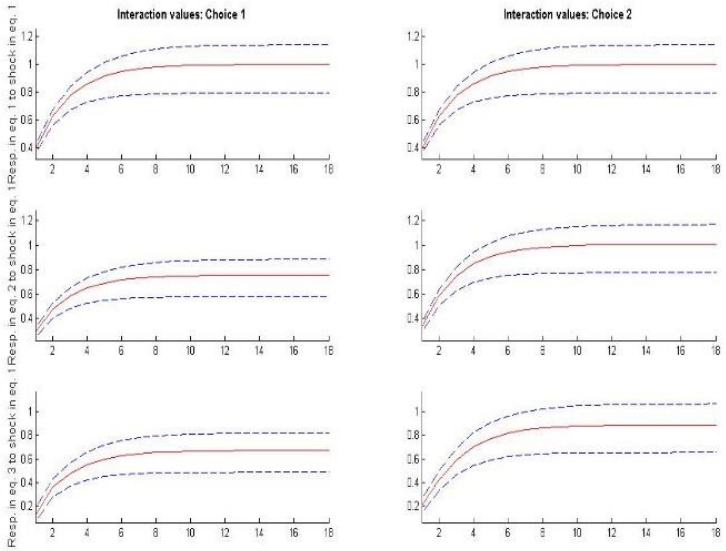

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Figure 14: Impulse-response functions

(Policy, Deposit, Credit / NFCP)

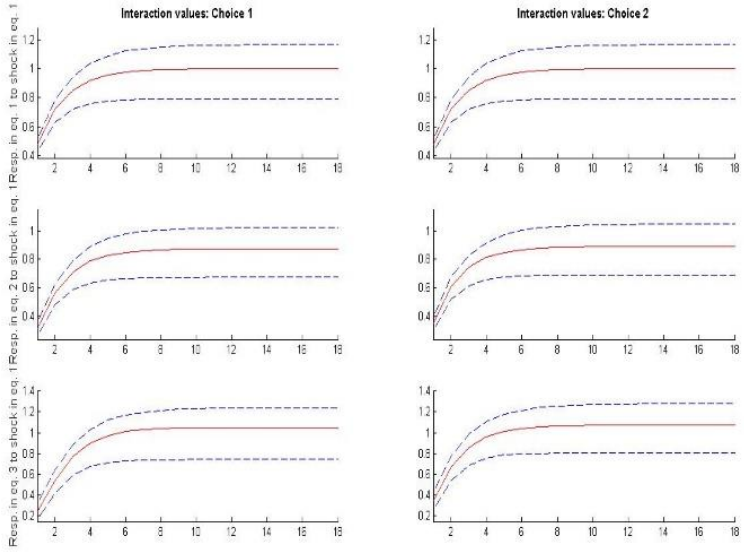

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Figure 15: Impulse-response functions

(Policy, Deposit, Credit / TRLIBOR)

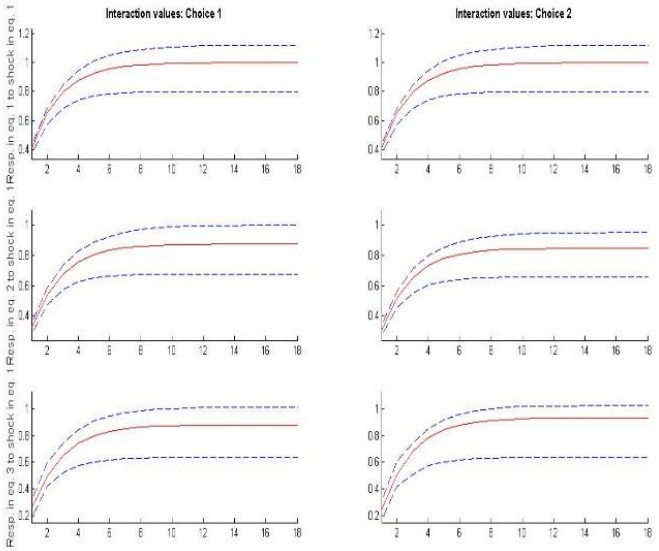

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Figure 16: Impulse-response functions

(Policy, Deposit, Credit / CPI inflation)

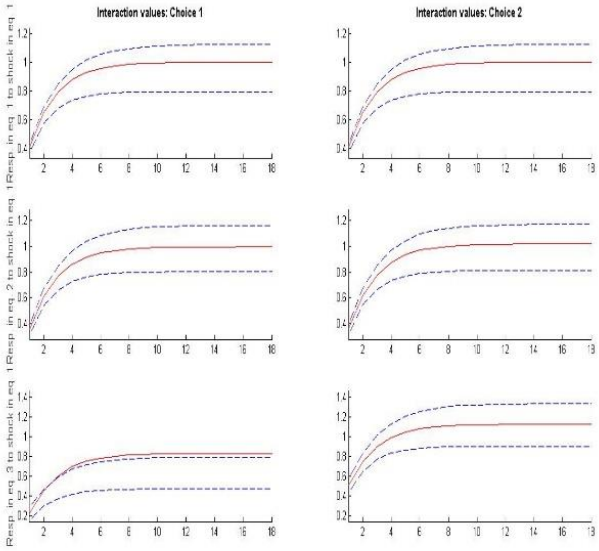

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Figure 17: Impulse-response functions

(Policy, Deposit, Credit / TRIPI)

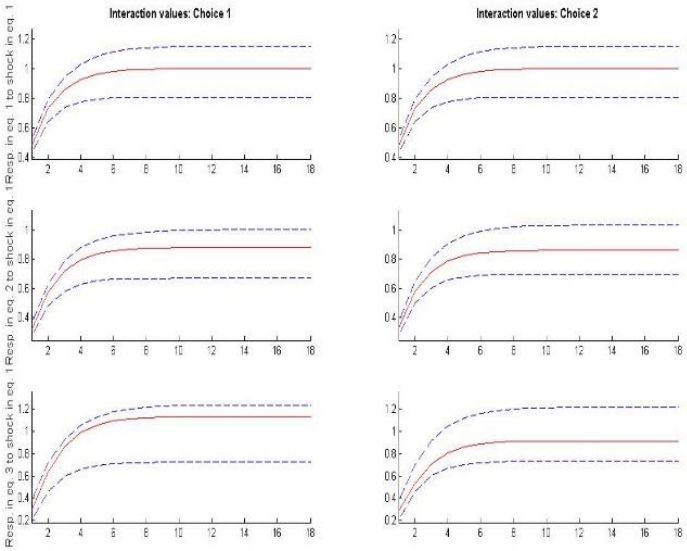

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Figure 18: Impulse-response functions

(Policy, Deposit, Credit / FAGDP)