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FINANCIAL CRISIS, MACROPRUDENTIAL POLICIES AND DEPOSITOR DISCIPLINE

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This paper examines to what extent macroprudential policies in the Turkish banking sector affected the functioning of depositor discipline. Our results suggest that depositors' responses for poor bank performance get stronger after the 2008 crisis, when various macroprudential measures were implemented to preserve financial stability. In the aftermath of the crisis, bank behavior toward depositors also alters. Ahead of the crisis, banks did not significantly respond to the discipline exerted by depositors, however, banks begin offering higher rates to curb deposit withdrawals afterwards. Our findings suggest that the implementation of macroprudential tools seem to have a positive impact on financial stability, since, in the post-2008 period, regulatory supervision have been more firmly assisted by the market.

Keywords: Depositor discipline; financial crisis; macroprudential policies.

JEL Classification: G01, G21, G28

1. Introduction

The financial crisis that peaked in 2008 significantly changed the *modus operandi* of monetary policy (Di Giorgio, 2014). It has been a common trend in advanced economies to adopt accommodative monetary policies in the form of low policy rates and generous liquidity support (Claessens *et al.*, 2010; Leaven and Valencia, 2010). Even though these measures have been relatively successful in relieving the uncertainties in the aftermath of the Lehman's collapse, the tendency toward excessive risk-taking has created other concerns. Against the backdrop of low rates, tightened credit spreads and record-low volatilities, macroprudential policies have been accepted as a desirable antidote to the growing worries that sustained low rates will eventually lead to financial instability (De Nicolò *et al.*, 2012; Claessens *et al.*, 2013; Hasan *et al.*, 2013). This perspective

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suggests that macroprudential policies are effective to tame the credit cycle, increasing the likelihood that we have entered after a sustained period of lower structural volatility.

The ultimate aim of accommodative monetary policies has been to enable easy and cheap access to debt and equity financing. Further, unprecedented support from the central banks, in the form of bond purchasing programs, have kept a lid on interest rates, and nurtured the risk appetite of investors. Access to cheaper credit also encourages households to spend more: the higher wealth levels caused by higher asset valuations encourage households to spend a higher fraction of their income. It is however argued that accommodative monetary policies have encouraged banks to take excessive risk (Calomiris, 2013; Claessens *et al.*, 2013; Adrian and Liang, 2014). Ample liquidity at low rates stimulates financial institutions to rebalance their portfolio holdings from risk-free assets towards riskier, higher-yielding assets. The search for yield has mainly resulted in capital flows to emerging economies, and many of these economies now strive to curb the destabilizing effects of these flows on their domestic markets.[1] Framing the goals of monetary policy and macroprudential policies in this way exposes the conflict in between, namely, that the former aims to encourage revitalizing the investment environment and household spending while the latter aims to discourage excessive risk-taking and the amplification of credit cycles.

From the perspective of current monetary policy goals, it is clear that monetary stimuli leave the task of eliminating the risks to macroprudential policies. The implementation of macroprudential policies on several issues calls for further tasks and moves macroprudential policies more squarely into the realm of regulatory and supervisory institutions. Nonetheless, there is skepticism on the effectiveness of those policies in mitigating the adverse effects of monetary policies. Using cross-country analyses, BIS (2014) puts evidence that macroprudential measures, while useful to strengthen banks, have been unable to completely restrain the build-up of financial imbalances, especially where monetary conditions have remained accommodative. Likewise, in his speech Claudio Borio, Head of the Monetary and Economic Department of the Bank for International Settlement (BIS), contends that expectations from macroprudential policies are too high and sometimes optimistic. He defends the idea that macroprudential polices should be implemented with appropriate monetary and fiscal policies, otherwise, he argues, macroprudential policies may be inadequate to tame financial booms and busts (Borio, 2014).

Since there are both optimism and pessimism regarding the effectiveness of macroprudential policies, it can be argued that the support in favor of these policies will likely to continue so for the foreseeable future given that growth concerns and financial stability issues will remain fully unresolved. While the implementation of macroprudential policies has already changed the scope of both central banking and regulatory practice, given the

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[1] Inflation targeting has been adopted by many of emerging economies in the implementation of monetary policy before the 2008 financial crisis. Capital inflows to emerging economies weakened the efficacy of inflation targeting in policy implementation since the interest rate tool alone becomes ineffective to tame inflation. Policy rate hikes had been effective to curb domestic demand before 2008 exacerbated inflation concerns through amplified capital inflows. Rapid credit growth as a consequence of heightened capital inflows led to financial stability concerns (sec Borio and Lowe, 2002; IMF, 2011a, 2011b; Ozkan and Unsal, 2014 for excellent discussions).

limited experience, there is still room about comprehending the impact of macroprudential policies. In contrast with the previous literature, we take a different approach by trying to capture whether depositors' sensitivities towards bank risk have changed along with macroprudential measures. Most evidences suggest stronger depositor discipline during crises due to depositors' increased vulnerability to bank risk (Peria and Schmukler, 2001; (Levy-Yeyati *et al.*, 2004; Kraft and Galac, 2007). This study examines the direction to which depositor discipline evolved in Turkey after the 2008 global financial crisis, the period when the authority bodies have implemented macroprudential tools in order to explicitly preserve the stability of the financial system.

Depositor discipline refers to a situation where depositors or other creditors reward or punish banks for their performance (see e.g., Diamond and Dybvig, 1983; Demirgüç-Kunt and Huizinga, 2004; Disli *et al.* 2013). This disciplining mechanism is considered to be supplementary to regulatory supervision in the aim to promote a safer and more efficient banking system. The deteriorating performance of banks causes withdrawals from banks and/ or forces banks to increase deposit rates to deter further withdrawals. Conversely, depositors are ready to deposit their funds at lower rates if banks have better fundamentals. Depositor discipline in principle leads to both price and quantity adjustments in bank liabilities, which, in turn, would stimulate bank management to reduce risk-taking in order to attract deposits (Park and Peristiani, 1998; Flannery, 1998; Peria and Schmukler, 2001).

Our results provide evidence that the depositors punish their banks for poor performance in Turkey. The disciplinary role of depositors strengthens when the *wake-up-call effect* of the 2008 crisis raises depositors' vulnerability. The results also reveal that banks only begin responding to deposit withdrawal in the aftermath of the 2008 crisis. Overall, we find that depositor discipline is exercised more sturdily as a response to the 2008 crisis. We do not observe any easing impact on depositors' responses toward bank risk stemming from macroprudential policies. This relation also has its reflection in bank behavior. While banks have benefitted from ample funding sources after the crisis, banks are notified about their deteriorating fundamentals successfully in the aftermath of the crisis. This shows that new funding sources have not completely eradicated the need for depositors' money, probably due to the fear of losing stake in deposit market. This is especially important since macroprudential polices in the country aimed at reducing risk in the banking system which can also be driven by the ample capital in the aftermath of the crisis.

We organize this paper as follows. In Section 2, we provide a brief background and review related work about the market discipline and also give guidance how the expansionary policies can impact depositor discipline. In Section 3, we describe the sample of banks and introduce the empirical strategy. Section 4 presents the results. In the last section, we discuss our main findings and try to explain the reason behind some of them.

2. Literature Background

The positive stance to macroprudential policies has instigated central bankers and supervisors to adopt diverse policy tools. The variety of instruments and options at central banks' disposal is crucial in gauging the potential policy responses to the changing global

environment. In view of the increasing risk of price bubbles, various policies were targeted to lending activities. In various countries, loan-to-value (LTV) and debt-servicing ratios were lowered to limit the propensity to lend in many sectors (IMF, 2011a; 2011b; Lim *et al.*, 2011; Claessens *et al.*, 2013). The objective of these measures was to strengthen the banking sector's resilience against a severe adjustment in asset prices. Central banks and supervisory agencies in some countries also put some minimum caps on the capital and liquidity base of commercial banks. To support these policies, also financing restrictions were imposed for loans to reduce the impact of ample liquidity on asset bubbles.

Country-specific cases provide rich insights (see Lim *et al.*, 2011; Claessens, 2014). The Monetary Authority in Singapore, for instance, has used macroprudential measures to control asset price inflation to avoid a build-up of imbalances (Lim *et al.*, 2011). Banks in Singapore maintained cash balances in current accounts with the Monetary Authority of Singapore to meet reserve requirements and settle interbank transactions. Banks were required to maintain a minimum cash balance and a capital adequacy ratio. In addition, the central bank imposes financing restrictions for loans, such as those for motor vehicles and mortgages, and regulates credit facilities of financial institutions.

To improve risk management practices of banks in Hong Kong, the Monetary Authority has introduced various rounds of countercyclical macroprudential measures since October 2009. The latest measures introduced on 22 February 2013 include increasing the upward mortgage rate adjustment for stress testing property mortgage loan applicants' debt-servicing ability. The implementation of macroprudential policies to reduce the LTV ratios seems to be successful. He (2014) reports that caps on LTV ratios have been effective in constraining household leverage, but its effect on housing prices is not sustainable. According to the Monetary Authority, the prudential measures implemented so far have helped lower the actual LTV ratio for new mortgage from an average of 64% before the policy measures to 55% recently, and the debt-servicing ratio from an average of over 40% to a low of 35% in December 2013.

To curb the credit expansion in Thailand, the preferred instrument to control credit expansion is setting the one-day repurchase rate consistent with the objective of achieving the prescribed inflation target (Lim *et al.*, 2011). It should be noted that state-owned financial institutions have grown quickly in recent years as a response to the 2008 crisis, and now reportedly account for 28% of banking assets in the system. Arguably, the rise of these banks has diluted the Bank of Thailand's overall control of credit expansion and its oversight of the banking system.

The authorities in emerging market countries also put close scrutiny on credit institutions. Among many others, China, Hungary, Romania and Mexico conduct policies related to the prudential supervision of credit institutions and the stability of the financial intermediary system. In Turkey, the policymaking institutions have opted to use various measures to manage short-term capital flows to the country in an unconventional monetary policy framework (Aysan *et al.*, 2014). Specifically, the Central Bank of Turkey has put into implementation numerous macroprudential tools, such as required reserve ratios (RRRs) and reserve option mechanism (ROM), to tame domestic credit growth (see Alper *et al.*, 2012; Akçelik *et al.*, 2013; Ermisoglu *et al.*, 2014; Aysan *et al.*, 2015b). Table 1

presents the details of macroprudential policies in the country in a chronological order. The details of the descriptions provide the nature of the macroprudential policies. Related to managing bank risk originating from capital inflows, RRRs were used actively between 4Q10 and 1Q13, first as part of the Central Bank's exit strategy and then to encourage the

Table 1. Macroprudential Policies in Turkey

Measure	Description	Date
Dividend policy	Requires banks to seek approval from the Banking Regulation and Supervision Agency (BRSA) before distributing dividends. The maximum dividend payout for CAR >18% is 20%, for 18%<CAR<16% it is 15% and for 13%<CAR<16% it is 10%.	October 2008; extended in 2010 and 2011
Restrictions on FX lending	Allows non-FX-earnings companies to borrow in FX from local banks (previously, only FX-earning companies could borrow FX), provided FX loan amount is greater than US$5 million and maturity date is longer than a year; bans consumers from taking out FX-linked loans.	June 2009
LTV ceilings	Implements LTV ceilings on housing loans to consumer (at 75%) and on purchases of commercial real estate (at 50%).	December 2010
Guidance to cap credit growth	The authorities provided guidance to banks that credit growth (adjusted for FX movements) in 2011 should not exceed 25%.	Spring 2011
Higher risk weights for consumer loans	Higher risk weights introduced for fast growing consumer loans. For new general purpose loans with maturities below 2 years, the capital adequacy risk weight is increased to 150% (from 100%). For new general purpose loans with a maturity greater than 2 years, the risk weight is increased to 200% (from 100%).	June 2011
Increased provisions for consumer loans	For new (performing) general purpose standard loans (Group 1), general provisions were increased from 1% to 4%. Specific provisions for closely followed up loans (Group 2) increased from 2% to 8%. The higher provisioning requirements are for banks having a consumer loan portfolio exceeding 20% of total loans or having a general purpose loan NPL greater than 8%. If there is a restructuring of the loan allowing maturity extension, a minimum of 10% provisioning is required.	June 2011

Table 1. (*Continued*)

Measure	Description	Date
Limits to credit card payments	If three or more monthly payments within a calendar year are less than half of the outstanding balance for the period, the individual credit card limits cannot be increased and cash advances for such credit cards cannot be permitted, unless the outstanding balance for the period is fully covered.	June 2011
Changes to minimum capital adequacy requirements	Amended by the BRSA in September 2011 to apply to banks with foreign strategic shareholders as of January 2012. The minimum ratio would depend on various factors such as the CDS spread of the parent and its sovereign, EBA stress test results and the public debt ratio in the country of origin.	September 2011
Some sectoral measures for provisions	Determining higher provisions by the BRSA taking into account the riskiness of the particular sectors.	September 2012
Differentiation of tax rate for interest income of deposits	Amended by cabinet decision (1 January 2013) to differentiate 15% tax rate taken from interest income of deposits according to maturity of the deposit. New tax rates are as follows: In TL deposits, rates are 15% for 6 months, 12% for 6–12 months and 10% for more than 1 year. In FX deposits, rates are 18% for 6 months, 15% for 6–12 months and 13% for more than 1 year.	January 2013
Differentiation of resource utilization fund rates	Amended by cabinet decision (1 January 2013) to differentiate resource utilization fund rates taken from credit users. New rates are as follows: 3% for loans given for less than 1 year, 1% for loans given for 1–2 years (before it was 0%), 0.5% for loans given for 2–3 years (before it was 0%) and 0% for loans given for more than 3 years.	January 2013
Withdrawal from a time deposit account before maturity	Depositors can withdraw half of their time deposits at most two times without losing interest income if maturity of their account is 1 year and longer. For cumulative deposit account, the same process is valid if half of the amount is withdrawn at most three times.	January 2013

Table 1. (*Continued*)

Measure	Description	Date
Leverage, capital buffers and capital adequacy	BRSA has issued several regulations within the framework of the harmonization process for Basel III on leverage, capital conservation and countercyclical capital buffers.	January 2014
Measures on credit card usage and consumer loans	The scope of the incremental provision ratios increased for consumer loans. Risk weights of receivables from credit cards and long-term automobile loans that were used in calculating capital adequacy ratios were increased. The minimum payment ratio for credit cards increased, card limits reduced for the first time users and lower income group.	January 2014

Source: BRSA, Central Bank of Turkey and government sources.

extension of the maturities of domestic currency deposits and discipline credit growth. Likewise, ROM supports FX reserve management of the banking system to contain the adverse effects of undesired capital flow volatility. The Central Bank, however, announced in March 2014 that it is considering paying interest on required reserves in a measured way to support banks' profitability given slowing loan growth. The BRSA will step-in if more decisive regulatory action is needed to slow credit growth. The increased risk weightings and higher provisioning for consumer loans in 2011 proved effective in slowing credit growth, and another macroprudential tightening in consumer loans and credit cards went into force in February 2014. As a more direct impact on depositor discipline, the country increased the level of deposit insurance up to 100,000 Turkish Liras in a bid to encourage more savings. This level was 50,000 Turkish Liras in 2004 after the implementation of an effective banking reform as a consequence of the 2001 domestic banking debacle.

Against the background of macroprudential policies worldwide, we aim to contribute to the strand of literature whether or not macroprudential policies in Turkey have helped to relieve the tension between depositors and banks. Among the papers in this part of literature, (Opiela, 2004) finds that in the 18-month period directly preceding the 1997 crisis of Thailand, the disciplining role of depositors have been closer indicating that depositors' motivation did not show drastic changes. Peria and Schmukler (2001) show that in Latin American countries, deposit growth rates and deposit interest costs have been more sensitive to bank risks in post-crisis periods, which is known as the *wake-up-call effect* (Hasan *et al.*, 2013). Levy-Yeyati *et al.* (2004) note that during the crisis periods that occurred in Argentina and Uruguay, macroeconomic shocks have been the main concerns for depositors whereas depositors' sensitivities to bank-specific factors weakened significantly. Kraft and Galac (2007) show that during the crisis of Croatia during 1998–1999,

depositors' vulnerability to interest rates completely disappeared confirming the existence of *flight-to-quality* concerns. In a similar vein, Hosono (2005) does not confirm the impact of crisis on depositor discipline. The author demonstrates that the vulnerability of deposits and deposit cost actually declined in South Korea, Malaysia and Thailand after 1998. Similarly, Hadad *et al.* (2011) investigates the impact of Asian crisis and several regulatory changes in Indonesian banking system concluding that the regulatory changes mitigate the role of depositors in disciplining the banks.

These papers provided varied evidences about the impact of past crises on depositor discipline. Although the evidences are quite mix to conclude about the implications of a crisis on the behavior of depositors, we notice that papers in the literature also do not shed light on the recent crisis episode. Macroprudential policies regularly implemented after 2008 might have significantly altered the way the crises impact depositor discipline. The crisis itself might have sensitized the depositors against deteriorating bank risk (*wake-up call*), however the macroprudential policies might be successful in alleviating the vulnerability among depositors. How this opposite factors function during and aftermath of the 2008 crisis remains unanswered.

3. Data and Summary Statistics

In this study, the sample is a collection of an unbalanced panel of 40 Turkish commercial banks and the data is gathered from the various issues of *Banks* in Turkey published by the Banks Association of Turkey. This sample is composed of quarterly data from 2003:1 to 2014:2. We also include the five Islamic (participation[2] banks since it is found that depositor discipline is also operational among Islamic banks (Aysan *et al.*, 2015a). Twenty-one banks are domestically-owned commercial banks where more than 50% of their shares are owned by Turkish residents, and three are classified as state-owned banks where the majority stakes belong to the state. We do not analyze investment and development banks since they do not collect deposits.

Table 2 reports the variables used in the analysis, their definitions and summary statistics. Bank risk indicators, deposit growth figures and deposit interest rates are presented on two categories defined as pre- and post-crisis periods. This separation allows us to understand the trajectories the main variables follow after the implementation of macroprudential policies in the post-crisis period. We expect that macroprudential polices can be considered as successful if they curtail the adverse effects of expansionary crisis effects. At first glance, the deposit growth rate, "Deposit_growth" before the implementation of macroprudential policies is 5.2% on average. This figure drops to 3.4% after the implementation of the policies. About 1.8% deceleration on deposit growth mimics that depositors became more cautious after the crisis that implies the macroprudential policies have been limited on its expected balancing role. The deposit rates, "Deposit_rate", on the other hand, calculated as the quarterly expenditures for bank deposits to total deposits is

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[2] In Turkey, Islamic banks carry the name of "participation banks". Although the operation practices are totally the same in other Islamic bank practices, the name of participation recalls equity based financing through which customers participate in risk and reward.

Table 2. Summary Statistics, Variables and Definitions

Variable	Definition	Use in Regressions	Pre-Crisis Period					Post-Crisis Period				
			Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Deposit_growth	Log transformation of the ratio of deposit amounts for consecutive years	Level	998	0.052	0.292	−1.435	1.766	408	0.034	0.283	−1.385	1.638
Deposit_rate	Quarterly expenses for bank deposits divided by total deposits	Level	998	0.023	0.013	0.001	0.111	408	0.012	0.005	0.001	0.047
Equity	Book value of equity to total asset excluding fixed assets	Lag	940	0.182	0.156	0.054	0.943	402	0.183	0.161	0.054	0.908
Liquidity	Liquid assets to total deposits	Lag	940	1.479	2.746	0.243	23.441	402	1.364	2.174	0.243	19.261
Loan_quality	Non-performing loans to gross loans	Lag	905	0.076	0.147	0.000	0.946	383	0.045	0.043	0.000	0.290
Bank_size	Log total assets	Level	1406	8.164	2.101	3.443	11.948					
Bank_age	Log value of bank operating quarter-years	Level	1406	4.767	0.680	3.219	6.368					
Branch_coverage	Log value total number of branches	Level	1406	3.899	2.281	0.000	7.158					

Notes: The table reports summary statistics of bank-specific variables with each observation representing a measure for a single bank in a specific quarter. The whole sample is separated into two subsamples to observe the 2008 crisis effects. We present the variables their definitions and level of their uses in the regressions.

2.3% on average. This figure almost halves and falls to 1.2% after macroprudential policies were implemented in the post-crisis period. This reduction in deposit rates gives an impression that banks have not been eager to attract depositors with higher interest rates. Interestingly, the risk indicators, "Equity", "Liquidity" and "Loan_quality", remain almost unchanged, giving an indication that bank fundamentals were not affected by the global crisis.

4. Empirical Strategy

We build an empirical strategy to test the presence of depositor discipline in Turkish market before and after the global financial crisis. This strategy would also yield whether or not a rich set of macroprudential policies in the country have affected depositor discipline. As in most similar studies, we estimate both quantity and interest rate responses to bank risk fundamentals. Only by considering the joint estimation we can understand how depositors react to changing bank risk and how banks react to deposit withdrawals. The joint estimation in fact enables us to differentiate between deposit supply and demand shifts (e.g., Ioannidou and de Dreu, 2006; Karas *et al.*, 2013). A positive association between banks risk and deposit rates might be the outcome of an aggressive strategy to attract deposits. The intention to attract more deposits, to meet risky loan demand for instance, can push banks to raise their deposit rates. This demand would, however, be revealed by the quantity regression, where the relation between bank risk and deposit quantity would also be positive in case of a demand effect.

We begin with a traditional test for the existence of depositor discipline till the implementation of the 2008 crisis. Then, we examine in which direction the depositor discipline has evolved in the post-crisis period. In doing so, we also seek the answer whether or not macroprudential policies achieved to mitigate the possible adverse impact of the crisis on depositors. We examine the impact of the 2008 crisis both on depositors' monitoring incentives and banks' responses. We also observe how bank type influences depositor discipline.

4.1. *Depositors' monitoring*

The 2008 crisis could have remarkably altered the functioning of depositor discipline. Yet, it is blurred how depositors behave in the aftermath of the 2008 crisis. On the one hand, increased risk perception arising from the 2008 crisis may amplify vulnerability of depositors through their deposit amounts. Capital flows to emerging markets may incur the risk-taking incentives of the banks which could then trigger the disciplining role of depositors. On the other hand, macroprudential policies may wipe out the impact of these expansionary policies and reduce banks' incentives to risk-taking which in turn would play a rebalancing role to sustain depositor discipline. On purely theoretical grounds, it is difficult to forecast which of these effects are stronger for the quantity responses of depositors. However, it is more straightforward that during the 2008 crisis the vulnerability of depositors to bank risk indicators differed from that of during pre-crisis periods.

4.2. *Banks' responses*

Banks' incentives to manage deposits through interest rates may differentiate during pre- and post-crisis. While we expect that depositor discipline is operational through quantity and interest rate basis, this mutually working mechanism may not work properly in periods with relatively tranquil and abundant liquidity conditions. A reasonable possibility is that while depositors punish their banks for deteriorating bank fundamentals during the pre-crisis, banks may remain reluctant to offer higher rates to hold their depositors. This is because banks' leverages before the crisis were relatively low during the pre-crisis in Turkish banking system. However, owing partly to external funding opportunities, banks' willingness to lend (risk-taking) has improved considerably in the post-crisis period.

Figures 1 and 2 plot deposits to assets and external funds to assets during pre- and post-crisis periods, respectively. The charts present the simple fits of these ratios across time. The fitted values in Figure 1 show that deposits to assets ratio has in-decline trend during the sample period. A noteworthy sign is the steeper trend during the post-crisis that is calculated for all the banks in the banking system. Figure 1 confirms that banks are mildly dependent on deposits implying the presence of other sources of funds flowing to banks (Aysan *et al.*, 2015b).

Figure 2 supports the information depicted in Figure 1. External funding of the banks in Turkish banking system, in the form of various borrowings (repo, securitization, syndication, bond issuance, etc.), relative to their total assets has been declining before the
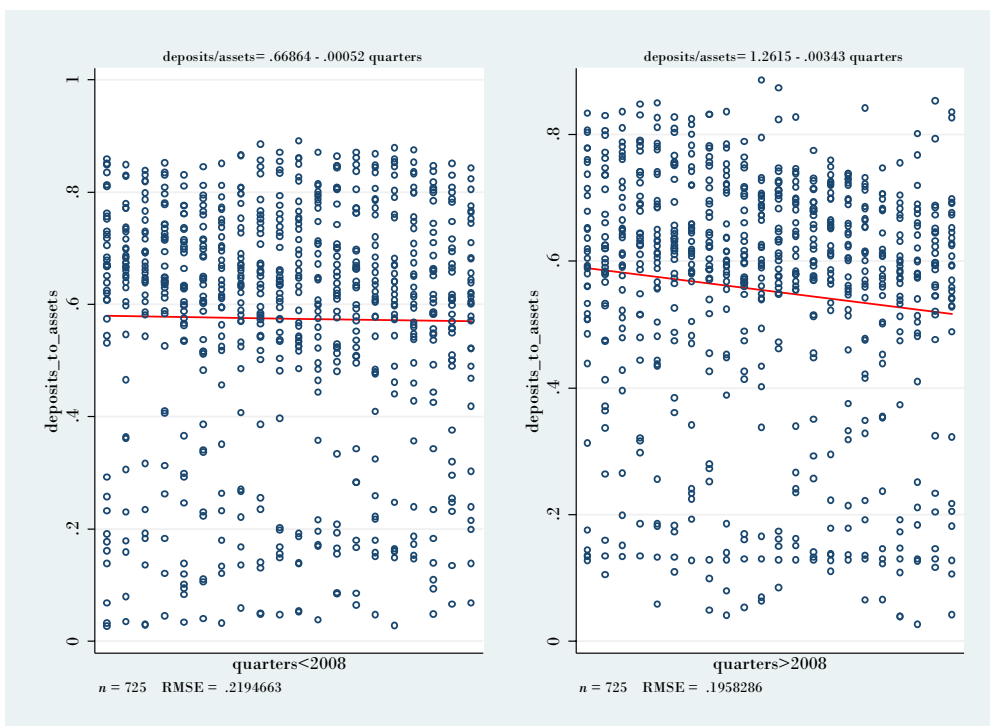

Figure 1. Deposits to Assets Ratios during Pre- and Post-Crisis Periods

Figure 2. External Funding to Assets Ratios during Pre- and Post-Crisis Periods

outbreak of 2008. In the aftermath of the crisis, however, the trend is upward confirming that capital inflows have diversified and enriched the funding sources of the banks in the post-crisis period.

The increasing trend in external funding has an alarming signal and emphasizes the need for careful monitoring against the possibility of the build-up of asset bubbles in Turkish markets. It can be argued that banks do not necessarily need to attract depositors in the post-crisis since external funding would compensate any withdrawal. Nonetheless, banks will opt to keep up good relations with their depositors in order not to lose its depositor base.

4.3. *The impact of bank type*

Depositors may think that there exists an implicit guarantee for state-owned banks that could weaken the depositor discipline mechanism. Moreover, it is found that depositor discipline works differently in Islamic banks. We hypothesize that depositor discipline is weaker among state-owned banks. Yet, we consider that Islamic bank depositors are more responsive to bank risk indicators as found in an earlier study (Aysan *et al.*, 2015a).

Against this backdrop, the following reduced-form quantity and interest rate depositor discipline models are estimated for the whole sample and for the two subsamples of

pre- and post-crisis periods:

$$\text{Deposit\_growth}_{i,t} = \alpha^1_{x,i,t} + \alpha^1_1 * X_{i,t-1} + \alpha^1_2 * C_{i,t-1} + \varepsilon^1_i + \theta^1_t + \mu^1_{i,t}, \qquad (1)$$

$$\text{Deposit\_rate}_{i,t} = \alpha^2_{x,i,t} + \alpha^2_1 * X_{i,t-1} + \alpha^2_2 * C_{i,t-1} + \varepsilon^2_i + \theta^2_t + \mu^2_{i,t} \qquad (2)$$

where the *X*-vector represents bank risk indicators that might be of interest to depositors concerned about bank safety. This vector contains capitalization ("Equity"), bank liquidity conditions ("Liquidity") and loan quality ("Loan_quality"). These variables are included with one-quarter lag to account for the publication delay. The "Equity" variable is measured as the book value of equity to total assets excluding fixed assets. The "Liquidity" and "Loan_quality" variables are calculated as liquid assets to deposits and the ratio of non-performing loans to gross loans, respectively. Under these specifications, it is expected that bank depositors tend to withdraw their deposits with lower capitalization, poorer liquidity conditions and deteriorating loan quality.

The *C*-vector contains other bank-specific controls potentially affecting the reaction variables. As a measure for bank size, the "Bank_size" represents the variable as the natural logarithm of total assets. We define "Bank_age" as the natural logarithm of quarter-years to control for institutional maturity. We also account for the bank outreach across the country with the number of bank branches "Branch_coverage". This variable is also defined as the natural logarithm of total number of branches. This can be an important factor in depositor discipline since it can be argued that the number of bank branches facilitate depositors to withdraw or deposit their money.

The reaction variables are the traditional measures used in the depositor discipline literature. The dependent variable in Equation (1) ("Deposit_growth") is the first difference of the log of deposits for bank *i* during the period *t*, and the dependent variable in Equation (2) ("Deposit_rate") is the quarterly expenses for bank deposits divided by total deposits for bank *i* during the period *t*. We estimate a model using bank fixed effects, i.e., ε^1_i and ε^2_i, both for the quantity and deposit rate regressions to control for unobserved characteristics across banks. Furthermore, in all specifications, we include quarter dummy variables to account for nation-wide shocks and other quarter-specific events that might influence the interest rates, i.e., θ^1_t and θ^2_t. In these regressions $\mu^1_{i,t}$ and $\mu^2_{i,t}$ denote for the error terms.

5. Findings and Discussions

Table 3 presents the results from the quantity and deposit rate regressions. Columns (1)–(3) exhibit the estimation results of quantity equation (see Equation (1)), whereas columns (4)–(6) refer to the estimation results of deposit rate equation (see Equation (2)). To test whether our results are robust to alternative sample compositions for each equation, we produce three sets of estimates. In doing so, we observe the degree to which depositors exercise different discipline. Columns (1) and (4) report the results for all banks with different ownership types. In columns (2) and (5), we exclude Islamic banks since the operative conditions and risk-free banking might enable different depositor discipline

Table 3. Tests for Market Discipline: Full Sample Period 2003Q1–2014Q2

	(1) Deposit_growth	(2) Deposit_growth	(3) Deposit_growth	(4) Deposit_rate	(5) Deposit_rate	(6) Deposit_rate
Equity	0.9561***	1.0519***	0.9731***	−0.0104	−0.0109	−0.0099
	(0.000)	(0.000)	(0.000)	(0.128)	(0.141)	(0.168)
Liquidity	0.0391***	0.0403***	0.0396***	−0.0008***	−0.0008***	−0.0007***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Loan_quality	−0.1440	−0.1559	−0.1844	0.0135*	0.0138*	0.0066
	(0.305)	(0.283)	(0.302)	(0.100)	(0.088)	(0.393)
Bank_size	0.1475***	0.1804***	0.1475***	0.0025**	0.0023*	0.0024**
	(0.001)	(0.000)	(0.001)	(0.028)	(0.085)	(0.050)
Bank_age	−0.0615	0.0257	−0.0615	0.0077	0.0070	0.0034
	(0.462)	(0.749)	(0.542)	(0.101)	(0.182)	(0.435)
Branch_coverage	−0.0172	−0.0114	−0.0170	−0.0004	−0.0007	−0.0006
	(0.306)	(0.522)	(0.308)	(0.755)	(0.614)	(0.636)
Constant	−1.1584*	−1.6476***	−1.1352	−0.0465**	−0.0137	−0.0214
	(0.057)	(0.004)	(0.104)	(0.044)	(0.599)	(0.297)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State-owned banks	Yes	Yes	–	Yes	Yes	–
Private-owned banks	Yes	Yes	Yes	Yes	Yes	Yes
Foreign-owned banks	Yes	Yes	Yes	Yes	Yes	Yes
Participation banks	Yes	–	Yes	Yes	–	Yes
Observations	1,456	1,292	1,323	1,456	1,292	1,323
R-squared	0.148	0.155	0.152	0.602	0.618	0.549
Number of banks	40	35	37	40	35	37

Notes: The table reports the full sample estimates in the time dimension covering the period 2003Q1–2012Q4. The dependent variable in columns (1)–(3) is "Deposit_growth", which is calculated as the log transformation of the ratio of deposit amounts for consecutive years. The dependent variable in columns (4)–(6) is "Deposit_rate", which is calculated as the quarterly deposit expenses divided by total bank deposits. The bank fundamentals are represented by "Equity", "Liquidity" and "Loan_quality". "Equity" denotes the book value of equity to total assets excluding fixed assets. "Liquidity" is equal to liquid assets to total deposits. "Loan_quality" is the ratio of non-performing loans to gross loans. The control-vector contains "Bank_size", "Bank_age" and "Branch_coverage". "Bank_size" variable is computed as the log transformation of total assets. "Bank_age" variable is the natural logarithm of quarter-years the bank operates in the country. To test whether bank type is important in depositor discipline, for each equation we produce three sets of estimates: Columns (1) and (4) report the results for all banks with different ownership types; in columns (2) and (5), we exclude Islamic (participation) banks; in columns (3) and (6), we exclude state-owned banks. Quarter-year dummy variables are included in all specifications but their coefficient estimates are not reported. The regression method is fixed effect estimator with heteroskedasticity and within-panel serial correlation robust standard errors. The *p*-values shown in parentheses. *** indicates the 1% significance level, ** for 5% level and * for 10% level, respectively.

(see Aysan *et al.*, 2015b). The last columns (3) and (6) exclude state-owned banks since they provide depositors weaker incentives for monitoring and disciplining (Caprio and Honohan, 2004). We first estimate the presence of depositor discipline in the Turkish banking system for the whole sample. Then we estimate this relation for the pre- and post-crisis periods to observe how depositor discipline evolved during post-crisis.

The estimation results in Table 3 confirm that there exists depositor discipline in the Turkish banking system. This finding does not vary across different bank compositions. Except for loan quality, the coefficients of bank risk variables do have the expected signs. This is possible due to relatively low level of non-performing loans in the Turkish banking system even in the aftermath of the crisis. The regression results suggest that depositors monitor their banks against their poor performance and withdraw their money as a punishment. Banks also try to attract withdrawn deposit by offering higher rates. The adverse liquidity shocks especially instigate banks to increase their rates. Regarding the equity shocks, the impact is insignificant but with expected sign.

Tables 4 and 5 present the results for the quantity and deposit rate regressions for the pre- and post-crisis periods, respectively, to observe the possible change in depositor discipline. The findings by splitting the sample as pre- and post-crisis suggest that depositors become more vulnerable to poor bank performance. The parameter estimates for bank risk variables indicate stricter punishment in the post-crisis period. This implies that depositors' perceptions of bank risk become more sensitive in the post-crisis period.[3]

Prior to the outbreak of the 2008 crisis, the estimation results yield that depositors were mildly responsive to bank capitalization and liquidity conditions ("Equity", "Liquidity").[4] The outbreak of the crisis has augmented depositors' responses. This implies that the introduction of macroprudential measures made a signaling effect about the banking system's vulnerability, making the depositors more vigilant towards bank risk, and therefore, we consider this finding as supportive to regulatory actions in preserving financial stability.

The results of the deposit rate equations presented in Table 5 suggest that banks are not eager to attract deposit against withdrawals in the pre-crisis period. However, banks tend to attract depositors during the post-crisis even though they have found ampler external funding. The full functioning of depositor discipline mechanism during the post-crisis period under more funding opportunities warns against excessive risk-taking or build-up of asset bubbles. This possibility also indicates that macroprudential policies have been insufficient to *completely* wipe out bank related concerns. This may be the evidence that when markets are at buoyant condition, banks can compensate the withdrawal of deposit with other sources of funds.

We observe that depositors' vulnerability to bank risk changes with the variation of the sample composition. Specifically, market discipline becomes more marked with different sample bundles. When state-owned banks are excluded from the sample, the degree of disciplining remains almost unchanged rejecting the loose depositor discipline among state-owned banks. As to whether Islamic depositors were more or less sensitive to bank capitalization than conventional depositors, the evidence suggests that quantity vulnerability to bank risk indicators is less among Islamic bank depositors, even less than state-owned banks. This can be the possible outcome of dual depositor insurance scheme in the

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[3] We test the equality of parameter estimates that are generated from two different regressions, estimated on two different samples. The test results suggest statistically significant difference which allows us to interpret on the value of regression coefficients, i.e., varying depositor vulnerability. These test results are available upon request from the authors.

[4] Quantity disciplining is not functional on non-performing loans. This might be the direct result of less concern put on low non-performing loans in Turkish banking system. This was also evident in the whole sample.

Table 4. Regression Results for Deposit Growth during Pre- and Post-Crisis Periods

	(1) Post_crisis	(2) Pre_crisis	(3) Post_crisis	(4) Pre_crisis	(5) Post_crisis	(6) Pre_crisis
Equity	2.4678***	1.1512***	2.4876***	1.2874***	2.4849***	1.1830***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Liquidity	0.0688***	0.0588***	0.0690***	0.0609***	0.0691***	0.0594***
	(0.002)	(0.000)	(0.003)	(0.000)	(0.002)	(0.000)
Loan_quality	−1.2757*	0.0066	−1.2981*	0.0062	−1.2843*	−0.0133
	(0.064)	(0.961)	(0.068)	(0.965)	(0.064)	(0.934)
Bank_size	0.3647***	0.1427**	0.3672***	0.1953***	0.3705***	0.1437**
	(0.000)	(0.011)	(0.000)	(0.005)	(0.000)	(0.013)
Bank_age	−0.0118	−0.2332*	−0.1094	−0.0973	0.1192	−0.2459*
	(0.968)	(0.059)	(0.723)	(0.364)	(0.741)	(0.060)
Branch_coverage	−0.0463	0.0063	−0.0495	0.0227	−0.0486	0.0071
	(0.470)	(0.836)	(0.460)	(0.448)	(0.462)	(0.818)
Constant	−3.3159**	−0.3457	−2.8459*	−1.4187*	−3.9145**	−0.2458
	(0.033)	(0.635)	(0.076)	(0.053)	(0.029)	(0.718)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State-owned banks	Yes	Yes	Yes	Yes	–	–
Private-owned banks	Yes	Yes	Yes	Yes	Yes	Yes
Foreign-owned banks	Yes	Yes	Yes	Yes	Yes	Yes
Participation banks	Yes	Yes	–	–	Yes	Yes
Observations	551	905	503	789	497	826
R-squared	0.267	0.192	0.270	0.202	0.270	0.199
Number of banks	34	39	30	34	31	36

Notes: The table reports the regression results for the pre- and post-crisis periods. The pre-crisis years include the years before 2009 and post-crisis year include the years till the end of 2012. The dependent variable is "Deposit_growth", which is calculated as the log transformation of the ratio of deposit amounts for consecutive years. The bank fundamentals are represented by "Equity", "Liquidity" and "Loan_quality". "Equity" denotes the book value of equity to total assets excluding fixed assets. "Liquidity" is equal to liquid assets to total deposits. "Loan_quality" is the ratio of non-performing loans to gross loans. The control-vector contains "Bank_size", "Bank_age" and "Branch_coverage". "Bank_size" variable is computed as the log transformation of total assets. "Bank_age" variable is the natural logarithm of quarter-years the bank operates in the country. To test whether bank type is important in depositor discipline, for each equation we produce three sets of estimates: Columns (1) and (2) report the results for all banks with different ownership types; in columns (3) and (4), we exclude Islamic (participation) banks; in columns (5) and (6), we exclude state-owned banks. Quarter-year dummy variables are included in all specifications but their coefficient estimates are not reported. The regression method is fixed effect estimator with heteroskedasticity and within-panel serial correlation robust standard errors. The *p*-values shown in parentheses. *** indicates the 1% significance level, ** for 5% level and for 10% level, respectively.

Turkish banking system till 2006. Aysan *et al.* (2015a) argue that the dual insurance scheme might have given an impression to Islamic bank depositors that the Islamic insurance motivated mutual supervision among Islamic banks.[5] The overall regression results

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[5] Please see Aysan *et al.*, 2015b, about the details of dual deposit insurance scheme in Turkey till 2006.

Table 5. Regression Results for Deposit Rate during Pre- and Post-Crisis Periods

	(1) Post_crisis	(2) Pre_crisis	(3) Post_crisis	(4) Pre_crisis	(5) Post_crisis	(6) Pre_crisis
Equity	−0.0126***	−0.0145	−0.0130***	−0.0151	−0.0127***	−0.0146
	(0.010)	(0.147)	(0.007)	(0.156)	(0.010)	(0.140)
Liquidity	−0.0004***	−0.0005	−0.0004***	−0.0005	−0.0004***	−0.0004
	(0.002)	(0.148)	(0.001)	(0.129)	(0.002)	(0.184)
Loan_quality	0.0013	0.0128	0.0020	0.0132	0.0013	0.0065
	(0.859)	(0.118)	(0.798)	(0.105)	(0.861)	(0.452)
Bank_size	−0.0003	0.0017	−0.0004	0.0013	−0.0004	0.0013
	(0.824)	(0.304)	(0.817)	(0.497)	(0.778)	(0.433)
Bank_age	−0.0053	0.0137*	−0.0016	0.0107	−0.0086	0.0102
	(0.614)	(0.090)	(0.883)	(0.223)	(0.471)	(0.231)
Branch_coverage	0.0006	0.0006	0.0007	0.0002	0.0006	0.0001
	(0.642)	(0.730)	(0.607)	(0.888)	(0.621)	(0.957)
Constant	0.0402	−0.0704*	0.0222	−0.0269	0.0561	−0.0232
	(0.483)	(0.068)	(0.723)	(0.537)	(0.373)	(0.533)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State-owned banks	Yes	Yes	Yes	Yes	–	–
Private-owned banks	Yes	Yes	Yes	Yes	Yes	Yes
Foreign-owned banks	Yes	Yes	Yes	Yes	Yes	Yes
Participation banks	Yes	Yes	–	–	Yes	Yes
Observations	551	905	503	789	497	826
R-squared	0.314	0.439	0.326	0.475	0.304	0.374
Number of banks	34	39	30	34	31	36

Notes: The table reports the regression results for the pre- and post-crisis periods. The pre-crisis years include the years before 2009 and post-crisis year include the years till the end of 2012. The dependent variable is "Deposit_rate", which is calculated as the quarterly deposit expenses divided by total bank deposits. The bank fundamentals are represented by "Equity", "Liquidity" and "Loan_quality". "Equity" denotes the book value of equity to total assets excluding fixed assets. "Liquidity" is equal to liquid assets to total deposits. "Loan_quality" is the ratio of non-performing loans to gross loans. The control-vector contains "Bank_size", "Bank_age" and "Branch_coverage". "Bank_size" variable is computed as the log transformation of total assets. "Bank_age" variable is the natural logarithm of quarter-years the bank operates in the country. To test whether bank type is important in depositor discipline, for each equation we produce three sets of estimates: Columns (1) and (2) report the results for all banks with different ownership types; in columns (3) and (4), we exclude Islamic (participation) banks; in columns (5) and (6), we exclude state-owned banks. Quarter-year dummy variables are included in all specifications but their coefficient estimates are not reported. The regression method is fixed effect estimator with heteroskedasticity and within-panel serial correlation robust standard errors. The *p*-values shown in parentheses. *** indicates the 1% significance level, ** for 5% level and * for 10% level, respectively.

are robust to different bank risk definitions. We tried several other variables to proxy for bank risk as shown in Table 6, we obtained very similar results confirming the findings.

This study has studied the nexus between macroprudential policies and depositor discipline in an emerging market country during a crisis period but in a relatively

Table 6. Alternative Bank Risk Indicators

Variable	Definition
Equity	– Book value of equity to total assets
Liquidity	– Liquid assets to total assets
	– Loan loss provisions to gross loans
Loan_quality	– Non-performing loans to total assets

Notes: The table shows the alternative bank risk indicators used for robustness checks.

capital-abundant environment. The results suggested a stronger monitoring from depositors and significant responses from banks during the post-crisis period which have been insignificant during the pre-crisis period. The results may *prima facie* seem interesting since banks have found increasing amount of external funding in the post-crisis period. This suggests that riskier banks respond significantly to depositors' punishment even though they can support their liabilities with external funds. However, this relationship does not hold during the pre-crisis when banks' lending momentum was relatively low and when they were less able to displace deposits with external funds. When banks pursue more aggressive lending policies during the post-crisis period, they also follow aggressive strategy toward deposits even though external funds are enough to compensate displaced deposits. These results are also confirmed by the pattern deposits to assets and external funds to assets ratios followed during the sample period. The bold evidence in this study suggests that the implementation of macroprudential tools seem to have a positive impact on financial stability, since regulatory supervision is more firmly assisted by the market in the post-crisis period.

6. Concluding Remarks

Market discipline has the potential role for maintaining financial stability by partly transferring the monitoring responsibility to depositors. It may encourage banks to augment the capital base and hold safer asset portfolio. Although the impacts of various types of crisis within the context of depositor discipline are examined, the impact of the 2008 crisis still needs a comprehensive research. The implementation of various expansionary fiscal and monetary measures in advanced countries has resulted in massive capital flows to emerging countries. Many emerging countries had a solid stance to mitigate the adverse impact of these inflows via various macroprudential policies. However, there is an active controversy on the success of these policies. In this study, we examined the impact of macroprudential policies from the perspective of depositors. In particular, we studied the degree to which macroprudential policies have changed depositors' sensitivities to bank risks.

From the perspective of supplementing regulatory discipline with depositor discipline in emerging economies, our results present a successful exercise in Turkey between 2003Q1 and 2014Q2. We find that successful experience is mainly driven by the robust depositor

discipline in the post-crisis period. Before the outbreak of the 2008 crisis, we find that depositors exercised disciplining through the volume of deposits, but banks did not significantly respond to displaced deposits through the interest rate mechanism. The post-crisis period experience suggests that depositors' vulnerability to bank risk gets more sensitive after 2008 with the activation of interest rates to bank risk. We highlighted that depositors' vulnerability did not stem from significant deterioration during the post-crisis period since bank risk indicators did not demonstrate significant variation during pre- and post-crisis periods.

From the perspective of financial stability, depositor discipline worked as functional, even when the banking system was buoyant with external funds. This showed that banks tried to attract depositors through offering higher deposit rates even though external funds supported their funding level.

In this study, we also found evidence that depositor discipline varies across different bank types. State-owned bank depositors appear to exercise similar discipline on their banks than their private counterparts. Moreover, Islamic bank depositors exercised a more loose discipline in the country, probably due to different insurance schemes in the country till 2006.

Although this study's aim was to verify the impact of macroprudential period on depositor discipline, for future research, it would be interesting to verify whether the endorsement of various macroprudential measures is in conflict with the increase in deposit–insurance coverage. Furthermore, the chronological indexations of macroprudential policies in this study can provide us additional insights about the magnitude of market discipline.

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