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# **RESERVE REQUIREMENTS, LIQUIDITY RISK, AND BANK LENDING BEHAVIOR**

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# **RESERVE REQUIREMENTS, LIQUIDITY RISK, AND BANK LENDING BEHAVIOR<sup>§</sup>**

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## **Abstract**

Although reserve requirements have been used in emerging markets to smooth credit cycles, the exact transmission mechanism remains to be explored. Using bank level data, this study looks inside the black-box to unveil the interaction of reserve requirement policy with bank lending. We identify a new channel that works through a decline in bank liquidity and loan supply due to an increase in reserve requirements. We show that “quantitative tightening” through reserve requirements affect the funding needs and the liquidity position of the banking system. The consequent changes in bank liquidity have a significant impact on the bank lending behavior.

**Keywords:** Monetary transmission mechanism; liquidity channel; reserve requirements; Turkey.

**JEL Classifications:** E44; E51; E52

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## **1. Introduction**

Following the global financial crisis of 2007-2009, the size and the volatility of capital flows into emerging market economies have increased substantially. The new environment created financial and macroeconomic stability challenges such as excessive volatility in exchange rates and credit growth. In response, central banks in many emerging economies incorporated financial stability concerns into standard inflation-targeting frameworks and adopted new monetary policy tools to deal with multiple objectives.

The reaction of many emerging economies to surging capital inflows was to keep policy rates at low levels in order to avoid excessive appreciation of domestic currencies, meanwhile engaging in macro prudential tightening to curb the rapid credit growth. In that context, reserve requirements (RR) have been one of the most popular tools among unconventional monetary policy instruments (see Medina and Roldós, 2014; Hoffman and Löffler, 2014; Frederico et al., 2014; Montoro and Moreno, 2011; Camors and Peydro, 2014 Tovar et al., 2012, Mora, 2014).

Despite the increasing reliance on RR as a policy tool to contain excessive credit growth, the effectiveness of RR and the transmission channels in general have not been studied in detail. In this paper, by using the Turkish economy as a laboratory, we provide empirical evidence for the transmission channels of RR. Our analysis allows us to identify an additional channel, which we call the “liquidity channel”. This channel works through a decline in bank liquidity and loan supply due to an increase in reserve requirements.

Most of the studies in the literature focus on the “cost channel” of the RR where an increase in reserve requirements affects financial intermediation through an implicit tax on the banking system (Fama 1980, Prada 2008, Glocker and Towbin 2012, and Carrera and Vega 2012). However, these studies suggest that, as long as central bank credit and deposits are close substitutes as alternative sources of bank funding, higher RR generally produce a fall in

deposit interest rates, leaving lending rates unchanged. In such a setup, the eventual impact of RR on credit and economic activity is broadly neutral.

In a floating exchange rate regime with short term interest rates as the operating target, the liquidity impact of using reserve requirements may be negligible because the central bank meets the liquidity needs to maintain its interest rate target. Di Giorgio (1999) argues that as the short-term interest rate becomes the standard operating target for monetary policy, RR becomes less relevant as a policy tool. This view assumes that the central bank's provision of liquidity is a perfect substitute for deposits: A bank faced with a liquidity shock due to a RR hike can compensate the diminished funds without a cost by borrowing from the central bank. Therefore, reserve requirement changes would be completely neutral from a loanable funds perspective. However, this view ignores the fact that the bank is typically obliged to pledge sound collateral to borrow from the central bank, especially in emerging economies.

In this paper, we argue the presence of a liquidity channel which implies imperfect substitution between deposits and central bank funding. We maintain that a policy-induced change in the liquidity position of the banking system, through a change in reserve requirements, can alter the bank lending behavior. Because central bank funding is collateralized, the swap of deposits with central bank borrowing depletes the liquid assets of the bank, which implies that central bank funding and bank deposits are not close substitutes.

Throughout the paper, we provide evidence on the liquidity channel. We document that the impact of changes in reserve requirements on loan rates depends on banks' liquidity buffers. RR lead to a change in banks' liquid assets, which in turn have a significant effect on bank lending behavior. Overall, our results lend support to the view that RR—or more generally, any other policy that will affect the liquidity position of the banks—have the potential to be an additional tool for the central banks in emerging economies to relieve the policy trade-offs posed by the volatility of capital flows. These findings are also in line with

the arguments that using RR as a policy tool to stabilize the lending behavior may be particularly relevant for emerging markets where the financial markets are less developed and the transmission from the policy rate to market rates is weaker (see, e.g. Montoro and Moreno, 2011, Frederico et al., 2012).

## 2. Liquidity, Reserve Requirements and Bank Behavior

### 2.1. The Impact of Reserve Requirement on Bank Liquidity: A Balance Sheet View

In order to illustrate the liquidity channel, we start with a simplified hypothetical balance sheet of the banking system where banks' assets are composed of loans, securities, and reserves, while liabilities are customer deposits and short-term funding (either from the Central Bank or money markets). Banks are required to pledge collateral against their borrowings from the Central Bank. When a security is pledged as collateral, it cannot be used during the term of the debt. Hence, we make a distinction between the banks' unencumbered (free) securities, which are available for use, and encumbered securities, which are pledged as collateral. In this example and throughout the paper, we use the ratio of unencumbered (free) government securities as a fraction of total liabilities as the measure for bank liquidity. In line with the current practices of the central banks, we that assume excess reserves are remunerated significantly below the market rates and thus banks do not hold excess reserves. In fact, in the Turkish context, excess reserves are close to zero during our sample period.

**Table 1: A Hike in Reserve Requirement Ratio and Bank Balance Sheet**

a) Before a hike in RR

b) After a hike in RR

Assets		Liabilities		Assets		Liabilities	
Loan:	90	Deposit:	100	Loan:	90	Deposit:	100
Unenc. Sec.:	10	Repo:	0	Unenc. Sec.:	5	Repo:	5
Enc. Sec.:	0			Enc. Sec.	5		
Reserves:	0			Reserves:	5		

Suppose that the bank initially has 100 units of assets which consist of 90 units of loans and 10 units of government securities. Therefore, our measure of liquidity (unencumbered securities / total liabilities) is 10 percent. Table 1 shows how a 5 percentage point hike in RR alters the bank balance sheets. Because the bank cannot cut down its loan commitments immediately, 5 units of additional funding need to be fulfilled by borrowing from the Central Bank, which requires pledging collateral. Hence, the bank's unencumbered securities decline by 5 units, bringing the liquidity ratio from 10 percent to approximately 5 percent ( $=5/105$ ). That is, the banking system's liquidity position deteriorates. According to the liquidity channel we envision in this paper, the significant drop in the liquidity ratios prompts some banks to tighten their lending due to liquidity concerns.<sup>1</sup>

Figure 1 below depicts the first stage of the transmission of the liquidity channel that we envision. As the figure shows, the immediate response of banks to a sharp hike in reserve requirements in 2011 was to increase their borrowing from the Central Bank of Turkey (CBRT) by a similar amount. Because central bank funding is collateralized, as described in Table 1, it depletes the liquid assets of the bank. We hypothesize that, resorting to large scale borrowing from the central bank funding or interbank funding may be costly from a liquidity perspective, which would lead to a decline in loan supply in response to a RR hike. This is especially relevant for emerging economies where almost all interbank funding is collateralized and government bonds are the main source of collateral. Thus, banks with low liquidity buffers may run into collateral constraints rather easily which is particularly undesirable during turbulent times. Combined with possible reputational costs, we argue that liquidity positions may matter for the bank lending behavior even during normal times.

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<sup>1</sup> If reserves are considered as liquid assets, as is the case according to the current regulatory liquidity ratio in Turkey, this conclusion would not hold. However, a great majority of the jurisdictions do not consider reserves as liquid assets. More importantly, from the perspective of loan issuance, it is plausible to exclude (at least partially) the required bank reserves from the definition of liquidity. See Orr and Mellon (1961) for a discussion of this idea.

**Figure 1.**  
**Reserve Requirements and Short-Term Funding from the CBRT**

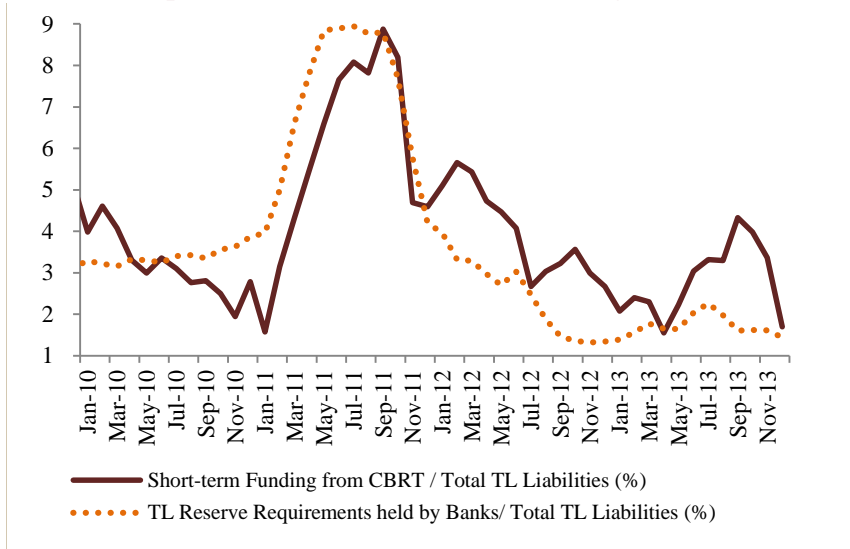
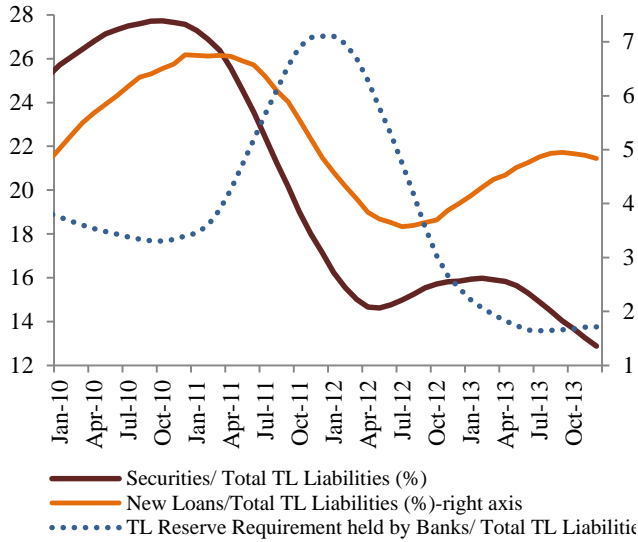


Figure 2 confirms our hypothesis that an increase in reserve requirements is associated with a decline in bank liquidity and hence a decline in bank loans. It is also interesting to note that at the early stages of the quantitative tightening cycle, the decline in bank liquidity is associated with relatively stable bank loans. This observation is consistent with the scenario depicted in Bernanke and Blinder (1992) who argue that due to the contractual nature of bank loans they are slower to adjust. Hence, banks reduce their liquid assets to finance their loans before they adjust their loan books. In our case, there may be an additional reason why loans did not initially respond to changes in reserve requirements. Because the Turkish banking system started the post-2010 period with rather high liquidity ratios, the urge to restore liquidity buffers was much less pronounced. In fact, Figure 3 indicates that banks with higher initial liquidity buffers registered higher loan growth rates during our sample period.

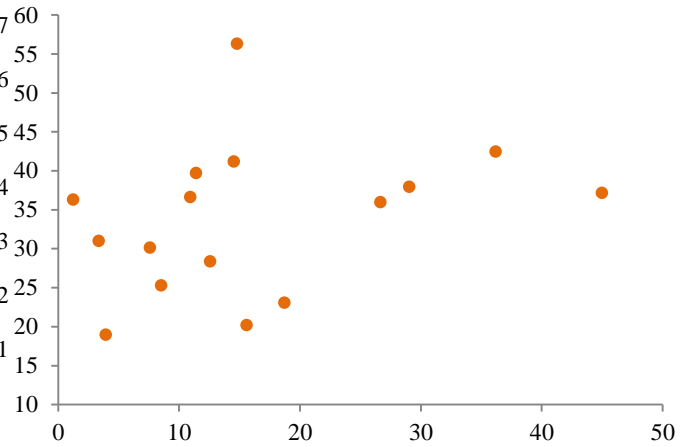


**Figure 2. Liquid Assets, Reserve Requirements and New Loans\***



\*All series are 12-month moving averages.

**Figure 3. Initial Government Bond Holdings and Cumulative Loan Growth\* (percent)**



\* Y-axis denotes credit growth (%  $\Delta$  between November 2010-December 2011) while X-axis denotes Securities /TL Liabilities (% , September-November 2010 Average).

In this paper, we argue that an important source of imperfect substitutability between deposits and central bank lending is related to the liquidity channel. When faced with a tightening in reserve requirements, banks are left with less liquidity buffers to use against unexpected liquidity shocks. The marginal cost of borrowing from the central bank thus increases as the banks take into account the additional liquidity risk, which, in turn, leads to higher lending rates and/or a reduction in the pace of credit growth. We call this mechanism the “liquidity channel”.

The existing literature points to an alternative explanation as to why deposits and central bank funding may not be close substitutes: because the maturity of central bank credit is typically shorter than the maturity of deposits, a larger reliance on central bank credit upon an RR hike adds to interest rate risk (see Betancourt and Vargas, 2008, Herrera et al., 2010). Nevertheless, if the remuneration rate is close to market rates, interest rate risk channel

weakens considerably. In fact, the literature does not provide any empirical support for the existence of a significant interest rate risk channel.

## 2.2. A Summary of the Transmission Mechanism of Reserve Requirements

Our discussions on the monetary transmission mechanism can be summarized along the following lines: Assuming that central bank funding and bank deposits are *perfect substitutes* as loanable funds, and the central bank does not pay interest on reserves (or interest on reserves is lower than market rates), the transmission mechanism of RR can be depicted with the traditional cost channel:

- **Cost channel:** RR ↑ , Cost of deposit funding ↑ , deposit rate ↓ , deposits ↓ , central bank funding ↑ , loan rate (unchanged), loans (unchanged).

If the central bank pays interest on bank reserves at market rates, the above channel would not exist because the increased cost of deposit funding would be compensated by the higher interest payments on reserves. However, even if bank reserves are fully remunerated at market rates, the reserve requirements may still affect bank behavior through the interest rate risk or liquidity channels. As explained earlier, the existence of such channels implies *imperfect substitution* of deposits with central bank funding. In that case, the following channels can be added to the monetary transmission mechanism:

- **Interest rate risk channel:** RR ↑ , interest rate risk ↑ , deposit rate ↑ , loan rate ↑ , loans ↓
- **Liquidity channel:** RR ↑ , bank liquidity ↓ , deposit rate ↑ , loan rate ↑ , loans ↓

The above illustration of the monetary transmission mechanism implies challenges for the empirical analysis. It is almost impossible to identify the individual impact of some of the channels as the impact of interest rate risk and liquidity channels on deposit rates and loans are observationally equivalent. Nevertheless, there are still testable implications that would allow us to assess the effects of reserve requirements on bank behavior. For example, if the

lending rates go up significantly in response to a tightening in reserve requirements, this would lend support to the view that balance sheet effects are dominant rather than the cost channel. In section 3, we empirically investigate the existence of these channels as well as the hypothesis of perfect substitutability between deposit and central bank funding.

The relationship between the liquidity of a bank's portfolio and its loan issuance is not a new topic. Nevertheless, the previous literature either focused on bank liquidity as a factor that weakens the effectiveness of the traditional bank lending channel (see e.g. Kashyap and Stein, 2000, Kishan and Opiela, 2000) or as a factor that enhances loan issuance (see Cornett et al., 2011). What we emphasize in this paper is the change in banks' liquidity positions due to central bank's quantitative policy actions (such as reserve requirements), independent of the central bank's interest rate policy. We argue that even if the central bank keeps the short term money market interest rates at the same level, it can still have an impact on loan supply through quantitative policies by affecting the balance sheet composition of banks.

### **3. Data**

We use the officially announced average reserve requirements weighted across liabilities for different maturities as our measure for reserve requirements. RR are applied to the stock of bank liabilities, which predominantly consist of deposits. Since 2010, there have been several changes to the RR in Turkey. First, the coverage of reserve requirements was expanded. Second, in order to encourage the lengthening of the maturities in deposits and other stable funding sources, the required reserves ratio was differentiated across maturities. Third, the weighted average reserve requirements ratio for the banking sector was raised by about 10 percentage points in several steps. All these measures led to substantial variations in the reserve holdings of the banking system, both across banks and through time, which is not

common in central banking practice. Such variation is critical in helping us identify the different channels of the transmission mechanism empirically.

In our analysis, we consider Turkish Lira (TL) denominated loan rates. CBRT mainly used the reserve requirements for Turkish lira denominated liabilities for countercyclical purposes in the past few years. Liabilities in foreign currencies are also subject to reserve requirements but they have been mostly used for prudential purposes rather than countercyclical credit policy. Therefore, in this study we focus on the movements in the reserve requirements for TL liabilities and their interaction with the bank lending behavior.

Liquidity ratio is the key variable for our analysis. In the empirical analysis, we construct the liquidity ratio as total securities held by each bank as a fraction of its total TL liabilities. Securities consist of total sovereign debt held by commercial banks in their trading portfolio. These securities can be used as collateral when banks need to borrow in the interbank market or they can be sold to meet any sudden liquidity needs that may arise due to policy shocks or deposit runs.

Other bank level control variables that are used in the analysis include non-performing loan (NPL) ratio that is constructed as the volume of non-performing loans as a percentage of total loans. NPL data is disaggregated for the consumer and commercial loans.

Table 2 shows the summary statistics of the key variables in our analysis for the sample period that expands from June 2010 through December 2015. All rates and ratios are expressed as percentages.

**Table 2: Summary Statistics**

					Quantiles			
		Mean	S.D.	Min	0.25	Mdn	0.75	Max
1.	Commercial loan rate	13	3	6	11	13	15	26
2.	Consumer loan rate	14	3	7	12	14	16	24
3.	RR Ratio	10	2	5	10	11	11	14
4.	Liquidity Ratio	9	7	0	5	8	12	45

#### 4. Empirical Analysis

In this section, we investigate how bank loan rates respond to changes in reserve requirements and other liquidity policies of the central bank. Our main focus is the impact of liquid asset holdings on bank behavior and its interaction with central bank liquidity policies. We start with a simple specification on the relationship between reserve requirements and bank lending rates:

$$i_{it} = \beta_0 + \mu_i + \beta_1 i_{i,t-1} + \beta_2 i_t^{O/N} + \beta_3 NPL_{i,t} + \beta_4 RR_{i,t-1} + \beta_6 E_t + \varepsilon_{it}, \quad (21)$$

where  $i_{it}$  interchangeably denotes interest rates on commercial loans or consumer loans on month  $t$ .  $i_t^{O/N}$  is the overnight interest rate. Depending on the specification, we either use central bank overnight lending rate (marginal lending rate) or the average funding rate, which is calculated as the weighted average of central bank funding through interbank market and open market operations with different maturities.  $RR_{i,t-1}$  is the official required reserve ratio from the previous month, and  $NPL_{i,t}$  denotes non-performing loans ratio.  $E_t$  is the monthly percentage change in USD/TL exchange rate.  $\mu_i$  is bank-specific fixed effects. The errors  $\varepsilon_{i,t}$  are clustered at the bank level to address potential heteroscedasticity.

In order to capture the dynamic adjustment and the persistency in interest rates, the lagged value of the dependent variable is included as the right hand side variable. The monthly frequency of our dataset allows us to work with a long panel with over 70 observations per bank, which does not require the use of an Arellano and Bond (1991) type of estimator to address the dynamic structure.<sup>2</sup>

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<sup>2</sup> The Arellano-Bond (1991) estimator is designed for short panels. In long panels, a shock to the cross-sectional fixed effect declines with time and the correlation of the lagged dependent variable with the error term becomes insignificant. Judson and Owen (1999) use Monte-Carlo simulations and show that the so-called “Nickell bias” is no longer significant for panels where the time dimension is larger than 30.

The first column in Table 3 presents the regression results for commercial loan rates. Consistent with the earlier studies (see Binici et al., 2013), we observe that the commercial loan rate is positively related to the O/N lending rate of the central bank (row 2).

**Table 3: Interest Rates and Bank Liquidity**

	(1)	(2)	(3)	(4)	(5)
1. Lagged dependent variable	0.80*** (0.01)	0.80*** (0.01)	0.79*** (0.02)	0.86*** (0.03)	0.70*** (0.02)
2. CBRT O/N Lending Rate $t$	0.19*** (0.02)	0.18*** (0.02)	0.18*** (0.03)	-- --	-- --
3. Average Funding Rate $t$	-- --	-- --	-- --	0.18*** (0.03)	0.32*** (0.02)
4. Non-performing Loan Ratio $i,t$	0.23** (0.08)	0.23** (0.08)	0.23** (0.08)	0.03*** (0.01)	-- --
5. $\% \Delta(\text{USD/TL})_t$	0.03** (0.01)	0.02** (0.01)	0.02* (0.01)	0.01*** (0.01)	0.01** (0.004)
6. $RR_{i,t-1}$	0.12*** (0.02)	0.10*** (0.02)	0.16*** (0.03)	0.15*** (0.02)	0.10*** (0.01)
7. Liquidity Ratio $i,t-1$	-- --	-0.02** (0.01)	0.02* (0.01)	0.007 (0.01)	0.03*** (0.003)
8. $RR_{i,t-1} * \text{Liquidity Ratio}_{i,t-1}$	-- --	-- --	-0.005*** (0.001)	-0.002 (0.001)	-0.002*** (0.001)
9. Constant	-0.43** (0.15)	0.03 (0.24)	-0.45 (0.29)	-0.63*** (0.22)	-0.70*** (0.15)
10. Observations	1330				
11. Number of banks	19				

Notes: Sample period: June 2010 – December 2015. Standard errors are given in parenthesis and adjusted for heteroskedasticity. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

The results also suggest that an increase in non-performing loans prompts the banks to tighten their lending through higher rates (row 4). Furthermore, loan rates are positively correlated with the exchange rate, which may be related to the impact of exchange rate pass-through effect to the inflation expectations (row 5).

If reserve requirements play a significant role in the monetary transmission mechanism, we should expect a positive relationship between  $RR_{it-1}$  and loan rates as long as central bank funding and deposits are imperfect substitutes ( $\beta_4 > 0$ ). Looking at the

relationship between the loan rate and RR, we note that the coefficient on the required reserves ratio is positive and highly significant (row 6). Based on the depiction of the monetary transmission mechanism in section 2, a significant and positive coefficient associated with RR, after controlling for the policy rate implies that the liquidity channel or interest rate risk channel may be operational in driving the loan rates.

The size of the estimated  $\beta_4$  coefficient suggests that the impact of RR on the commercial rate is economically meaningful. In the short run, a 1 percentage point increase in RR is associated with around 10 basis points rise in commercial loan rates. Looking at the long run impact implied by the coefficient on lagged dependent variable ( $\beta_1$ ) in row 1, we note that a 1 percentage point increase in the RR is associated with an increase of about 50 basis points in commercial loan rates. A significant and positive coefficient on the loan rate with such a large size is at odds with the previous literature on RR (e.g. Gray, 2011) where central bank funding and bank deposits are argued to be close substitutes. Reinhart and Reinhart (1999) state that, the way the tax burden of RR is split between lenders and deposit holders depends on the degree of access to alternative sources of funding by banks. But even if we assume that banks' have no access to external funding and thus they reflect the intermediation cost fully to lending rates, the size of the  $\beta_4$  coefficient is still much higher than the levels that can be explained by the cost channel alone.<sup>3</sup>

Next, we take the analysis one step further and directly test the liquidity impact on loan rates. To that end, we add our measure for bank liquidity to equation (21) such that:

$$i_{i,t} = \beta_0 + \mu_i + \beta_1 i_{i,t-1} + \beta_2 i_t^{O/N} + \beta_3 \Delta NPL_{i,t} + \beta_4 RR_{i,t-1} + \beta_5 E_t + \beta_6 LR_{i,t-1} + \beta_7 RR_{i,t-1} \times LR_{i,t-1} + \varepsilon_{it}, \quad (22)$$

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<sup>3</sup> As shown in the previous section, the additional direct intermediation cost incurred by increasing the reserve requirement ratio by 1 percentage point would be close to one percent of the deposit rate. Because the average deposit rates during our sample period is around 8 percent, increasing reserve requirements by one percentage point would, on average, increase the direct intermediation costs of the banks by about 8 basis points.

where  $LR_{it-1}$  is the lagged liquidity ratio. Due to the potential endogeneity between the liquidity ratio and bank loans, we lag the liquidity ratio. We also add an interaction term  $RR_{it-1} \times LR_{it-1}$  to capture the relationship between reserve requirements and bank liquidity. If the liquidity channel is effective, then the positive relationship between interest rates and RR should be amplified for those banks with less liquid portfolios. Put it differently, having more liquidity buffers should weaken the impact of RR on interest rates, implying  $\beta_7 < 0$ .

The second column in Table 3 adds the liquidity ratio to the specification in column one. A liquid portfolio is expected to encourage lending (see e.g. Cornett et al., 2011). This implies that  $\beta_6 < 0$ . The second column shows that the liquidity ratio (LR) is negatively related to the commercial loan rate (row 7), which suggests that higher liquidity buffers implies lower rates because banks are more comfortable in issuing new loans. This finding is consistent with the liquidity channel of reserve requirements, given that RR policy is a major driver of bank liquidity as discussed in the context of Figure 2.

If changes in reserve requirements directly affect bank liquidity, the liquidity ratio would be correlated with RR. Nevertheless, the significance of LR in column 2 suggests that LR has an independent impact on the loan rate even after we filter out the impact of RR. Turning to the economic significance, the regression results imply that an additional 1 percentage point boost in the liquidity buffer holds down the commercial loan rate by 2 basis in the short term, even after we control for the reserve requirements. Taking into account the coefficient of the lagged dependent variable, the implied long run impact is about 10 basis points. These observations suggest that quantitative policies other than RR may also have the potential to affect the bank lending behavior in an economically meaningful way.

One way to assess the significance of the liquidity channel is to see if the positive relationship between RR and loan rates is weaker for those banks with higher levels of liquidity. Recall that the liquidity channel we propose argues that an increase in RR leads to a



decline in bank liquidity, which puts upward pressure on loan rates and a decline in bank loans. Accordingly, if there is a significant liquidity channel, then the impact of RR on loan rates should be more pronounced for those banks that have less liquid balance sheets. In order to test this argument formally, we interact the RR with bank liquidity. The third column shows the results from this specification. As seen in Row 8, the coefficient associated with the interaction term is significant and negative as expected, suggesting that while higher reserve requirements prompt banks to increase their loan rates, this impact is less pronounced for those banks with higher levels of liquidity, consistent with the liquidity channel. In order to test the net impact of LR in equation (22), we check whether  $(\beta_6 + \beta_7 \times RR_{i,t-1})$  is significantly different from zero, evaluated at the mean value of RR. The test statistic is -0.027 and highly significant, confirming the net negative effect of bank liquidity on loan rates.

The last column in Table 3 replicates the analysis for consumer loans.<sup>4</sup> It is interesting to note that the significance of the interaction of bank liquidity with the impact of reserve requirements cannot be generalized to consumer loan rates (row 12, column 2). In other words, liquidity does not seem to play a significant role in the reaction of consumer loan rates to changes in reserve requirements. At first sight this result might seem puzzling as the consumer loans are less liquid assets in nature because of their long maturity and fixed rate, as opposed to the commercial rates which have variable rates with short term maturity.

A potential explanation for the stronger sensitivity of commercial loan rates to changes in liquidity conditions can be attributed to their relatively lower demand elasticity to interest rates compared to consumer loans. Survey evidence by Alper et al. (2010) shows that

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<sup>4</sup> Note that in the regressions for consumer loans, we use central bank average funding rate rather than the overnight lending rate. The reason for using different short term rates for different variables is that the CBRT adopted a multiple instrument approach during most of our sample period, where policy rate has been represented by more than one variable. In order to find the relevant interest rate to be used in each regression, we tried several different versions of the regressions. Our empirical results suggested that banks respond to the central bank overnight lending rate in setting their commercial loans rather than the average funding rate, whereas consumer loans seem to be more sensitive to the average funding rate of the CBRT.

consumer loans, especially mortgages, have the highest degree of sensitivity to interest rates among all loan types, suggesting that banks might be more hesitant to adjust the rates on such loans in the face of moderate fluctuations in bank liquidity. Therefore, one can argue that banks might be less flexible in changing their rates on consumer loans relative to commercial loans when they are faced with idiosyncratic liquidity shocks. This hypothesis implies that the liquidity channel could be observed through the quantity rather than the price of consumer loans. In fact, as a robustness check, we repeated our analysis with loan volumes. There, we detected a significant liquidity channel for the quantity of consumer loans (not shown due to space constraints).<sup>5</sup>

As another robustness check, we also examine the testable implications of the liquidity channel for deposit rates. Recall from section 2.2. that the liquidity channel should manifest itself with almost identical effects on loan rates as well as deposit rates. The fifth column in Table 3 shows the regression results where the dependent variable is the deposit rate on TL liabilities. Note that the results are very similar to those obtained for commercial loan rates in column 3. The positive impact of RR on the deposit rate is significant (row 6). This finding contrasts with the earlier studies which claim that a RR hike unambiguously decreases deposit rates, disregarding the interest rate risk or the liquidity channels (e.g. Towbin and Glocker, 2012; Gray, 2011). While our finding is consistent with both the interest risk and the liquidity channels, the fact that banks with more liquidity are less sensitive to the RR hike (row 8) once again suggests that there is a significant liquidity channel.<sup>6</sup>

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<sup>5</sup> See the working paper version (Alper et al., 2014) for details.

<sup>6</sup> Other robustness checks include considering alternative definitions for LR such as holdings of government bonds as a fraction of total liabilities (as opposed to total TL liabilities) or as a fraction of TL deposits with higher run off rates. We also tested the sensitivity of our results to alternative measures of RR such as official TL reserve requirements adjusted for optional holdings of foreign exchange. Our results did not change under these alternative specifications (not shown).

## 5. Concluding Remarks

In this study, we explore the interaction between reserve requirements, bank balance sheets, and bank lending behavior in the context of Turkey. Both the peculiar structure of the reserve requirement policy in Turkey and the presence of the bank-level data allow us to identify an important additional channel of monetary transmission. We show that quantitative policies of the central bank affect the funding needs and the liquidity position of the banking system. The consequent changes in bank liquidity, in turn, have a significant impact on bank lending behavior. Provided that the liquidity ratios of the banks can be affected by central bank quantitative policies such as reserve requirements, these results imply that monetary policy has an alternative channel distinct from short term interest rate policies.<sup>7</sup> This so called “liquidity channel” eases the trade-off between price stability and financial stability.

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<sup>7</sup> Friedman and Kuttner (2010) provides evidence that during the 2007-2009 financial crises, the policy interest rate and the balance sheet of the Federal Reserve operated as independent instruments.

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