Reserve Requirements and Bank-Loan Interest Rates

Hayk Tarverdyan[1]

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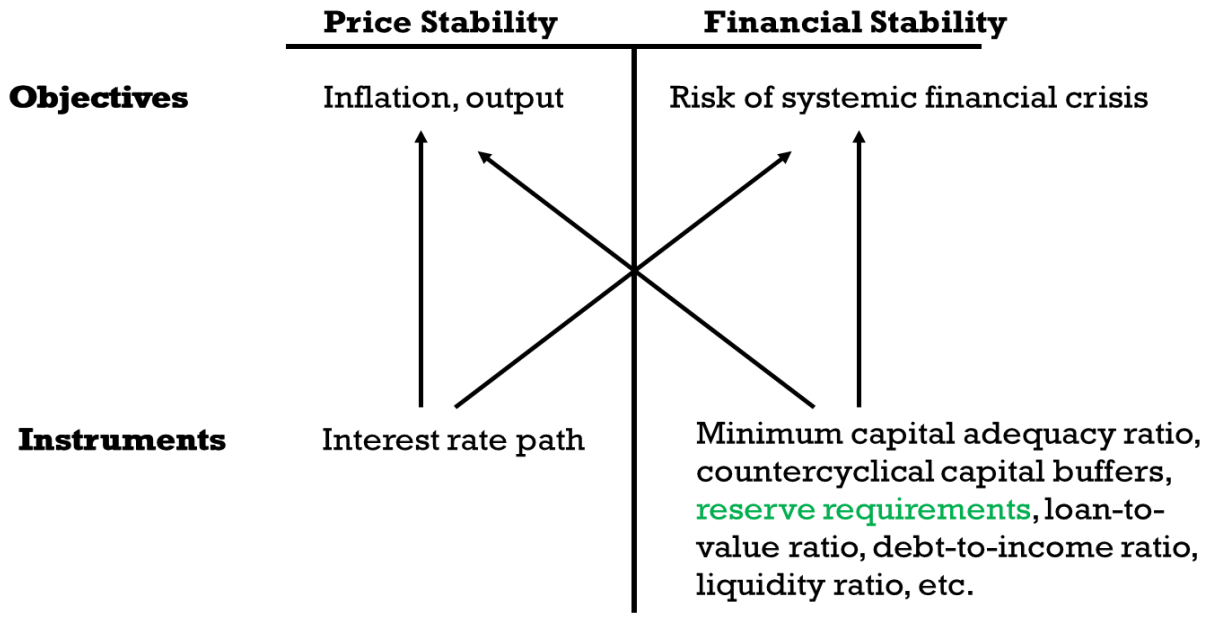
Abstract

Many emerging market economies use reserve requirements to smooth credit cycles, however the exact transmission mechanism remains to be explored. This study tries to examine how reserve requirements transmit to bank-loan interest rates using bank level data for Armenia and taking into account banks' heterogeneous liquidity positions. The results show that if bank's liquidity is high then reserve requirements have almost no impact on bank-loan interest rates and they make only structural changes in bank's balance sheet.

[1] Central Bank of the Republic of Armenia

1 Introduction

After the global financial crisis, the size and the volatility of capital flows into emerging countries have increased substantially. This caused excessive volatility in exchange rate and credit growth in emerging countries. In response, many central banks incorporated financial stability concerns into standard inflation-targeting frameworks and started using various macroprudential tools such as higher reserve requirements. These two goals (price stability and financial stability) have started to work together (graph 1) and it has become important to show how they affect each other.



Graph 1: The interaction of price stability and financial stability: Source O.Blanchard et al. (2012)

In emerging market economies reserve requirements are used for different purposes (financial stability or price stability or both together). For example, in 2011 Central Bank of Malaysia announced that changes in reserve requirements only serve a financial stability objective[2]. In Turkey, the central bank considers reserve requirements as the main instruments for financial stability with a secondary role for price stability.[3] In other countries, use of reserve requirements for price or financial stability objective depends on weights given by central bank for the

[2] Glocker and Towbin (2012)
[3] Basci (2010)

importance of these objectives. In theory, Glocker and Towbin (2012) show under which circumstances reserve requirements are effective as an additional monetary policy tool to achieve price stability or as a macroprudential tool to achieve financial stability. They set up a small-open economy model with financial frictions and banking sector which is subject to reserve requirements and find that if there is no financial friction and the central bank pursues mainly price stability objective then reserve requirements contribute little to economic stability. Higher reserve requirement increases only the interest rate spreads, which increases consumption due to lower deposit rates and lower investment due to higher lending rates. However, they show that if debt is denominated in foreign currency and financial stability objective is important then reserve requirements can be used for price stability objective. An increase in reserve requirements allows to generate an exchange rate depreciation and tougher credit conditions at the same time, while the policy with interest rates have to choose one of them. Edwards and Vegh (1997) discuss reserve requirements as stabilization tool (countercyclical tool) in a stylized small-open economy model. In the model, they show that by increasing reserve requirements policy makers can prevent the economy from credit boom and exchange rate appreciation during huge capital inflows.

In all this models, the effect of reserve requirements is considered as a direct impact on interest rates, mainly as an indirect tax burden on interest rates but the transmission channel of reserve requirements to interest rates is not studied extensively. The most detailed work is by Alper et al. (2016). In their work, they argue that the liquidity position of the bank is important in the transmission of reserves to interest rates. They introduce three main transmission channels and try to show that there exists a liquidity channel. As liquidity, they take the share of government bonds in total actives. By using panel data for Turkish banks they show that liquidity channel exists, and the impact of reserve requirements is different for high and low liquid banks.

This paper contributes to the literature by going one step further. It includes not only somwatic currency loans, but also the foreign currency denominated loans. I expand the definition of liquidity by taking the total liquidity ratio defined as high quality liquid assets divided to total assets. Here the liquidity includes not only government bonds but also cash, total reserves and other liquid assets. I find that for higher liquid banks the impact of reserve requirement is less pronounced than for lower liquid banks. Overall, for the whole banking system the average

impact is positive for commercial loan interest rates in AMD, and is almost zero for commercial loan interest rates in USD. The difference of the results for AMD and USD loans may be the fact that changes in reserve requirements have been done mainly for USD, and the fact that reserves for USD must be held in AMD, which increases the cost of funding.

In the remainder, section 2 details country experiences and changes in reserve requirements in Armenia and its possible transmission channels, section 3 details the data and the methodology of the estimation, section 4 presents the results and section 5 concludes.

2.1 Country Experiences and the Use of RRs in Armenia

2.1.1 Country Experiences

In many studies Reserve Requirements are seen as an indirect tax, but how that indirect tax transmits to interest rates is not studied well. Overall there are two types of tools that reserve requirements are used as:

- Macroprudential policy tool (restrictions on balance sheets, liabilities)[4]
- Liquidity management tool

Most countries use reserve requirements as macroprudential policy tools. They set higher reserve requirements for foreign currency deposits. In some countries the use of reserve requirements is somewhat different. For example, in Croatia,[5] if the credit growth was above some threshold then banks had to reserve more. It is done for not allowing excessive credit growth. In Peru, if the stock of FX credit was above the stock of credit in base period then banks had to reserve more (de-dollarization program 2013-2016)[6]. In Brazil, they use RRs also for managing banks liquidity[7]. Here banks get an interest for reserves equal to policy rate which helps to keep market interest rate close to policy rate. Some percent of the reserves must be held in cash and government bonds, which banks can use when they have liquidity problems. The summary of policies is shown in table 1

[4] Claessens (2014) and Kashyap et al. (2011)
[5] Galac and Kraft (2012)
[6] Castillo et al. (2016)
[7] Robitaille (2011)

Purpose	Country	Policy	MP framework
Macroprudential tool	Uruguay	Higher RR for foreign liabilities for residents	Inflation targeting (interest rate)
		Higher RR for funding from non-residents	
		RRs for funds from foreign banks	
Macroprudential tool	Romania and Serbia	Higher average RRs for FX liabilities	Inflation targeting (interest rate)
Macroprudential tool	Croatia	Higher marginal RRs for new foreign borrowing	Fixed exchange rate regime
	Bulgaria	Higher MRR if credit growth is above some threshold	Currency board
Macroprudential tool	Peru	Higher average and marginal RR for FX	Inflation targeting (interest rate)
		Additional RR if the stock of credit is above some threshold	
Liquidity management tool	Brazil	Banks earn no interest or earn interest < Selic rate or earn at Selic rate	Inflation targeting (interest rate)
		Reserves must consist of cash and Government bonds	

Table 1: Country experiences with Reserve Requirements

2.1.2 The Use of Reserve Requirements in Armenia: Liquidity Management

In Armenia, like other developing countries reserve requirements and other tools were used for mainly macroprudential purposes, although reserve requirements for USD funding are not used for prudential purposes. The main changes have been done in reserve requirements for USD denominated funds. After GFC, mainly for de-dollarization purposes, reserve requirement for AMD decreased from 8% to 4% in 2013, then in 2014 from 4% to 2%, whereas reserve requirements for USD funds was increased from 8% to 12%. In 2010 there were implemented some structural changes in addition to changes in amount. Banks have to reserve in Armenian dram for foreign currency deposits. In December 2014 after oil price shock, mainly for purposes of managing crisis in Armenia, it was doubled from 12% to 24%, then decreased to 20% and

now it is 18%. It was done because at that time there was high demand for FX and low supply. After doubling RR there was created a demand for AMD and banks had to fulfil that demand by selling FX. These changes have been done mainly for prudential purposes. These dynamics changes in RRs are presented in figure 1.

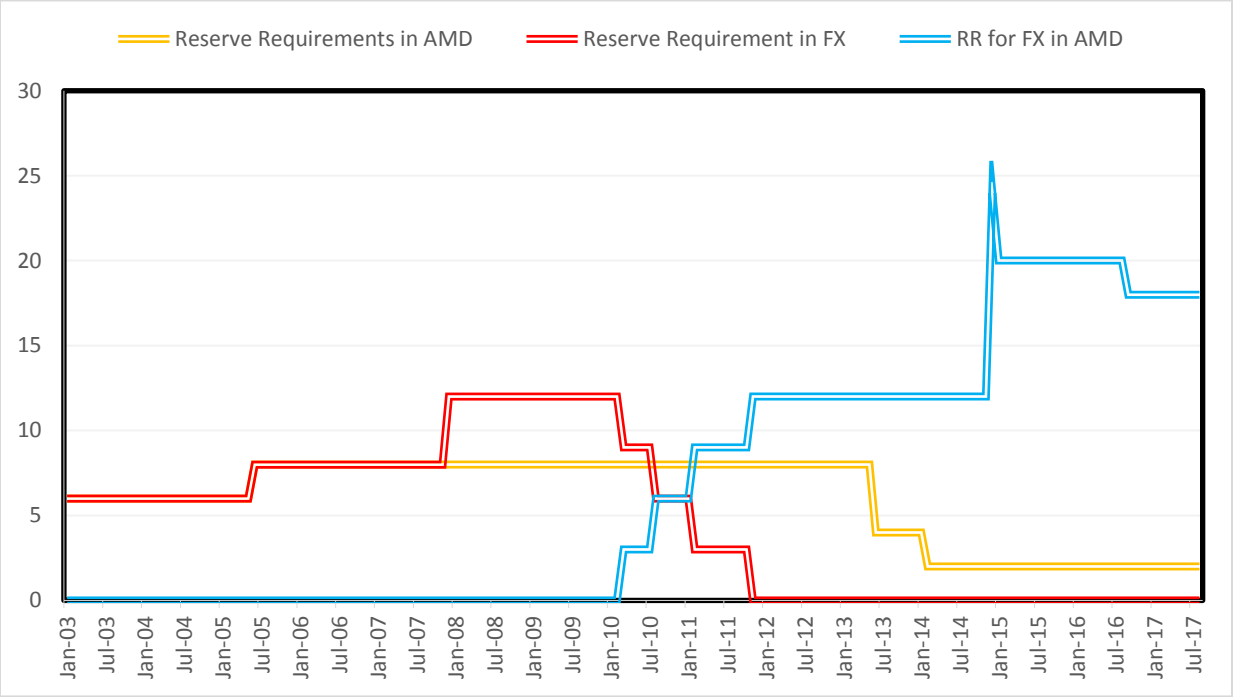


Figure 1: The Dynamics of RRs in Armenia: period January 2013-July 2017

For further analysis, it is important to introduce the liquidity positions of banks in Armenian banking system. The liquidity of banks is regulated by Central Bank of Armenia. CBA defines the minimum level of liquidity that banks must have, which is 15%.[8] In the banking system there must be no excessive liquidity, but in Armenia some banks have excess liquidity, which does not allow policy rate to be decisive in policy making. This stylized fact with the fact that reserve requirements are a part of banks' liquidity raises a question: how reserve requirements affect bank-loan interest rates conditional on liquidity position? So we can see what kind of correlation there is between bank loan interest rates and liquidity positions of banks. The correlation between commercial loan interest rates and total liquidity ratio is negative for AMD and USD denominated loans. It is -0.11 for AMD loans, and -0.56 for USD loans (figure 2.1 and figure

[8] CBA regulation 2: https://www.cba.am/AM/laregulations/kan 2.zip

2.2). So as a preliminary result we can say that reserve requirements affect liquidity positions of banks and then affect bank-loan interest rates.[9]

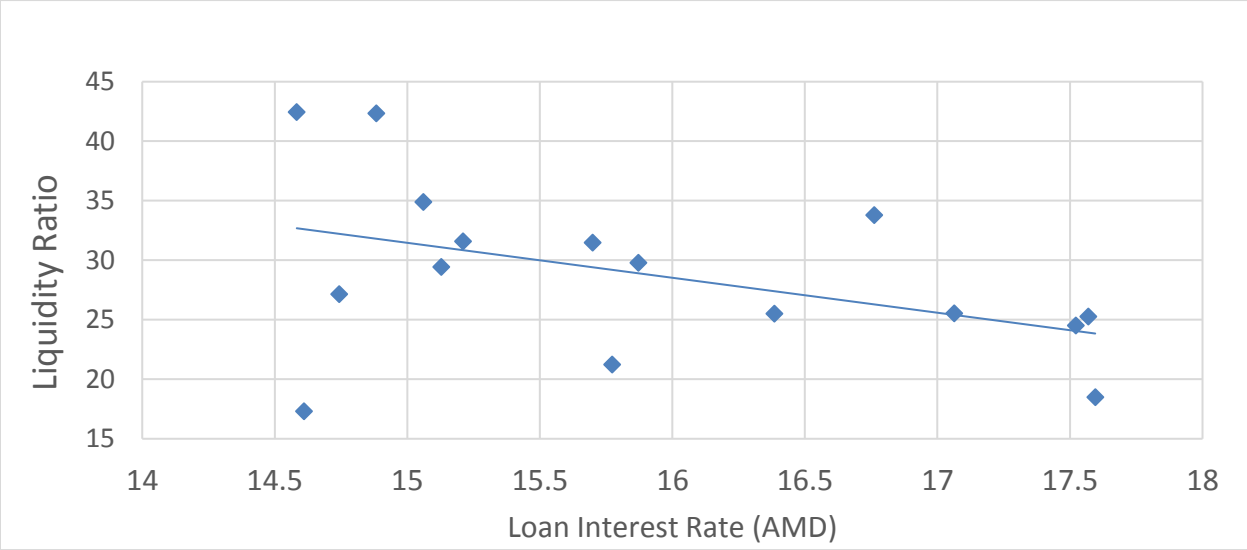


Figure 2.1: The relationship between commercial AMD loan rates and liquidity ratio. Note: the points in the figure are banks, as the axis values are taken the time averages for each bank. Source: Author's calculations

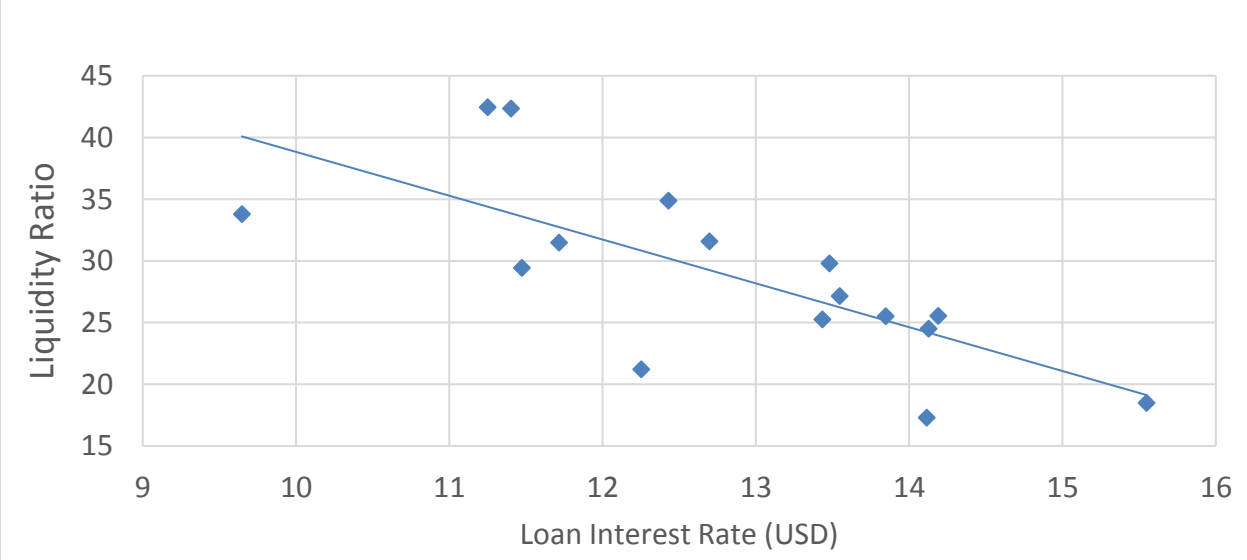


Figure 2.2: The relationship between commercial USD loan rates and liquidity ratio. Note: the points in the figure are banks, as the axis values are taken the time averages for each bank. Source: Author's calculations

[9] The source of all data series: https://www.cba.am/am/SitePages/statmonetaryfinancial.aspx

2.2 The Transmission Channels of Reserve Requirements

In the literature there are three main transmission channels of reserve requirements:

i. Cost channel
ii. Interest rate risk channel
iii. Liquidity channel

Cost channel: Cost channel works if there is a perfect substitutability between deposits and Central bank funding. It works through the following way:

$$RR\uparrow \Longrightarrow \text{Cost of deposit funding}\uparrow \Longrightarrow \text{Deposit rate}\downarrow \Longrightarrow \text{Deposits}\downarrow \Longrightarrow \text{Central Bank funding}\uparrow \Longrightarrow$$
$$\text{Loan rate unchanged} \Longrightarrow \text{Loans unchanged}$$

By increasing RR central bank increases the cost of funding. For compensating this loss bank decreases the deposit rates which decreases the volume of deposits, then banks borrow funds from central bank for increased reserves which makes loans and loan rate unchanged.

In this case increasing reserve requirements brings only changes in the structure of the balance sheet. Let see this in the example. Suppose banks have loans (90$), bonds (10$) and reserves (0$) as assets and liabilities consisting of deposits (100$) and repo with central bank (0$). Suppose central bank increases reserve requirement ratio by 5%. Now banks need 5$ for reserves, they sign repo contract with central bank giving 5$ of bonds for 5$ of reserves. As a result loans remain unchanged, only balance sheet structure has changed.

Assets	**Liabilities**	**Assets**	**Liabilities**
Loans = 90	Deposits = 100	Loans = 90	Deposits = 100
Bonds = 10	Repo = 0	Bonds = 5	Repo = 5
Reserves = 0		Reserves = 5	
		Collateral= 5	
Total 100	**100**	**105**	**105**

When banks get funds from central banks they collateralize funds by bonds but the amount of such collateral is limited so banks can't always rely on central bank funding. So reserve requirements work not only through this channel but also through other channels.

Interest rate risk channel and liquidity channel: As we saw the cost channel has some limitations, because bonds holding by banks are not infinite. Therefore, when banks face liquidity problems they start to attract depositors by increasing deposit rates, which increases the lending rate, and as a result the amount of loans decline. Increased reserve requirement also increases the interest rate risk by affecting the spread between loan and deposit rates, which is defined as the volatility of spread, which increases the deposit rate and then the lending rate.

Interest rate risk channel:

RR↑⟹ Interest rate risk↑⟹ Deposit rate↑⟹ Loan rate↑⟹ Loans↓

Liquidity channel:

RR↑ ⟹ Bank liquidity↓ ⟹ Deposit rate↑ ⟹ Loan rate↑ ⟹ Loans↓

3.1 Data

In my analysis, as a laboratory I take the banking system of Armenia. I have data for 17 commercial banks, the time period starts from January 2013 and ends in November 2017. The frequency of the data is monthly. As dependent variables I consider AMD and USD denominated commercial loans. Commercial loans account for 70% of USD denominated total loans and account for 30% of AMD denominated total loans. Here consumer loans are excluded because their elasticity is small and they are not as sensitive to changes in interest rates as commercial loans.

As I discussed in the previous sections, Central Bank of Armenia mainly changed reserve requirement ratio for USD. It reduced the ratio for AMD funds from 8% to 2% in 2014, and has increased it for USD funds and has made some structural changes. So as a policy variable I take RR ratio. Liquidity ratio is the key variable in my analysis. As liquidity ratio I took the CBA ratio for it (min 15%), which comes from the regulation of banking system. In these analysis, I try to see how the impact of RRs differ from bank-to-bank depending on their liquidity positions and what is the overall impact on commercial interest rates. For that reason I add a new variable to capture the interaction of reserve requirement and liquidity and the overall impact of reserve requirement on interest rates conditional on liquidity position.

In my analysis, I use some control variables. One of them is bank non-performing loans ratio. Bank non-performing loans ratio is an important indicator for bank's decision on setting the price for loans (interest rates). The higher is the NPL ratio the higher will be the loan interest rate. The second important control variable is CBA policy rate. In my analysis, as CBA policy rate I take the overnight rate, which is used in the monetary policy model for Armenia. Other bank level control variables are: deposit rates and exchange rate.

A summary statistics of key variables are presented in table 2 (time period is February 2013-Novemeber 2017). The mean is computed in two steps: at first it was computed the mean for the whole banking system in each period, the total assets are taken as weights. In the second step, the mean of all period was computed.

	Variable	Mean	S.D.	Min.	Max.
1	Commercial loan rates (AMD)%	15.79%	2.57 p.p.	7.1%	24%
2	Commercial loan rates (USD)%	12.89%	1.81 p.p.	6.65%	17.7%
3	Total liquidity ratio%	28.65%	8.96 p.p.	12%	59%
4	RR ratio (AMD)%	2.8%	1.72 p.p.	2%	8%
5	RR ratio (USD)%	16.26%	3.6 p.p.	12%	24%

Table 2: Summary statistics of key variables: February 2013-Novemeber 2017[10]

4.1 The Methodology of the Estimation

In this part, I investigate how banks' interest rates respond to changes in reserve requirements. My main focus is on the impact of liquidity position on bank behavior and its interaction with policies. The main equation for AMD denominated loans is the following

$$i_{i,t} = \beta_0 + \mu_t + \beta_1 i_{i,t-1} + \beta_2 RR_{i,t-1} + \beta_3 PR_{i,t-1} + \beta_4 LR_{i,t-1} + \beta_5 RR_{i,t-1} \times LR_{i,\,t-1} + \beta_6 npl_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $i_{i,t}$ is commercial loan rates for AMD, $PR_{i,t}$ is CBA policy rate (overnight rate) and $RR_{i,t-1}$ is the lagged reserve requirement ratio for AMD, $LR_{i,t-1}$ is the lagged liquidity ratio, $npl_{i,t}$ is bank non-performing loan ratio and μ_t is banks' fixed effects.

[10] Source: https://www.cba.am/am/SitePages/statmonetaryfinancial.aspx

The estimation of this equation was done by AR(1) fixed effect model. This model is appropriate when there are fixed effects in the equation and no potential endogeneity problems exist and therefore no need to use instruments for correcting it[11]. AR term captures the problem related to the fact that the autocorrelation in the error term is 1. The other problem here is related with the bias in the estimators (Nickel bias). Nickel (1981) shows that the estimation is downward biased, but when the observations and time period goes to infinity the bias equals zero. So, taking into account the all above mentioned, the estimation of the equation was done by AR(1) fixed effect model.

The second equation stands for USD denominated commercial loans.

$$i_{i,t} = \beta_0 + \mu_t + \beta_1 i_{i,t-1} + \beta_2 RR_{i,t-1} + \beta_3 DR_{i,t} + \beta_4 LR_{i,t-1} + \beta_5 RR_{i,t-1} \times LR_{i,\,t-1} + \beta_6 npl_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $i_{i,t}$ is commercial loan rates for USD. Here instead of CBA policy rate, I use deposit rate for USD as control variable. The other variables are the same as in the case of AMD denominated loans except that here npl, RRs are taken for USD.

In order to capture the dynamic adjustment and the persistency in interest rates, the lagged value of the dependent variable is also included as a right hand side variable. The monthly frequency of our dataset allows us to work with a long panel (January 2013-November 2017). Here, there are some endogeneity problems, mainly with bank non-performing loans ratio. So in this case, I can't estimate the equation by fixed effect model because there is a need for instrument. For that reason I estimate the equation by Arellano-Bond estimator. For solving the npl's endogeneity problem I define it as fully endogenous variable and use its first lag as an instrument for it. In the model the errors are robust.

[11] 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.

4 The Results and Main Findings

The results are shown in table 3. In the first column of the table are presented the results for commercial loan rates in AMD. The second column presents the result for commercial loan rates in USD.

Consistent with earlier studies[12], I observe that commercial loan rates in AMD are positively correlated with overnight rate (0.168), which means that overnight rate has a significant impact on interest rates. The non-performing loans ratio in the estimations has two interpretation. First, it is positive, which means that banks tighten their lending conditions when NPLs are higher. Second, the estimate of the lagged value of non-performing loans is negative, which can be the result of high competition in loans' market. Banks lower interest rates on loans for getting advantage in competition, although the probability of default is high.

In theory, the coefficient of reserve requirements in the equations must be positive. In my case, the coefficients are positive and highly significant. The coefficients are also economically meaningful, a 1 percentage point increase in reserve requirement increases the AMD and USD interest rates by 148 and 23 basis point respectively. A significant and large size of these coefficients is similar to previous findings in literature (e.g. Gray, 2011). It shows that RRs have a huge impact on lending rates. When there is large capital inflows, raising RRs increases the lending rate, without increasing deposit rates so much, and hence avoid attracting more capital inflows. In this case the impact of RRs is seen as an indirect tax. This indirect tax burden is split between the lenders and the depositors, the weights depend on the degree of access to alternative sources for funding by banks[13] (the cost channel).

However the main focus of the research is the existence of the liquidity channel. For doing this, in the equations a new variable is added, which shows the interaction of liquidity position of the bank and the reserve requirement ratio. Then I show whether the impact of the reserve requirement differs conditional on heterogeneous liquidity positions. High liquid banks are defined as banks that have liquidity which is higher than the liquidity when the net impact of RRs is zero (the threshold). In my analysis, that threshold is 32.84% for AMD loans and 33.28%

[12] Binici et al., (2013)
[13] Reinhart and Reinhart (1999)

for USD loans. The coefficient of this variable must be negative for proving the existence of the liquidity channel. The coefficient of this variable is significant and negative in both cases, suggesting that while higher reserve requirement prompts banks to increase interest rates, this impact is less pronounced for banks with high liquidity position.

At the end, I test whether the net impact of RR ($\beta_2 + \beta_5 LR_{i,t-1}$) is significantly different from zero or not. The test statistics are 0.195 for AMD and 0.032 for USD loans and they are statistically significant. This suggests, that if bank has high liquidity position then the impact of reserve requirement is almost zero, which suggests that the bank behavior will remain the same. As a main finding, higher reserve requirements increase interest rates, when banks do not have any excessive liquidity[14].

I also present, how the impact of reserve requirements has been changed over time.

In the figures 3 and 4, the dynamics of the net impact of reserve requirement on AMD and USD loans are presented. Initially the net impact is high for both currency loans, then it starts to decline and even becomes negative in some periods. This decline can be explained by the policy changes in December 2014 and changes in capital requirement for banks: the minimum amount of capital was increased from 5 billion AMD to 30 billion AMD.

[14] In this case it becomes conditional impact that impact is conditional on how much liquidity a bank has.

Model variables: dependent interest rates	Coefficient	Coefficient
Total Liquidity ratio	0.219***	0.099*
	(0.024)	(0.059)
Policy rate	0.168***	
	(0.034)	
RR in AMD (first lag)	1.484***	
	(0.245)	
RR×LR (first lag)	-0.045***	
	(0.009)	
NPL for AMD loans	0.555**	
	(0.135)	
Loan rate in USD (first lag)		0.162***
		(0.057)
NPL for USD loans		0.144***
		(0.055)
NPL for USD loans (first lag)		-0.096*
		(0.054)
Deposit rate in USD		0.044*
		(0.026)
RR in FX (first lag)		0.233**
		(0.094)
RR×LR (first lag)		-0.007*
		(0.004)
Constant	6.804***	-
	(0.293)	-
Abond Test[15]		
Order 1		0.000
Order 2		0.5063
Sargan Test		0.4934
Observations	652	603
Number of Banks	17	17

Standard errors are robust and are given in parenthesis and adjusted for heteroskedasticity. Sample period February 2013-November 2017. *p<0.1, **p<0.05, ***p<0.01

Table 3: Interest rates and Banks Liquidity

[15] In the table there are presented the p-values of the tests.

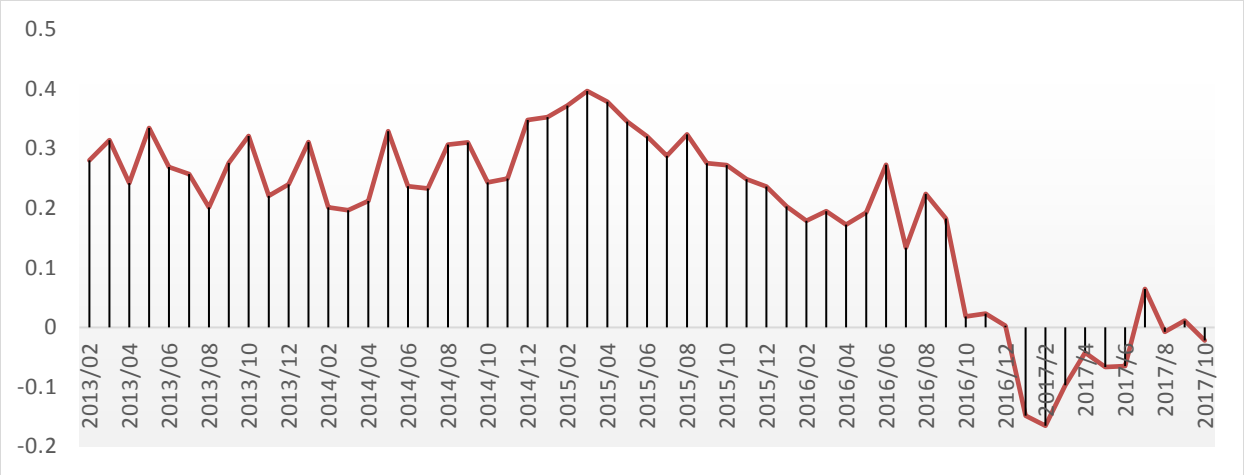


Figure 3: The Dynamics of the Net Impact of Reserve Requirement on AMD loans. Note: period January 2013-November 2017. Source: Author's calculations.

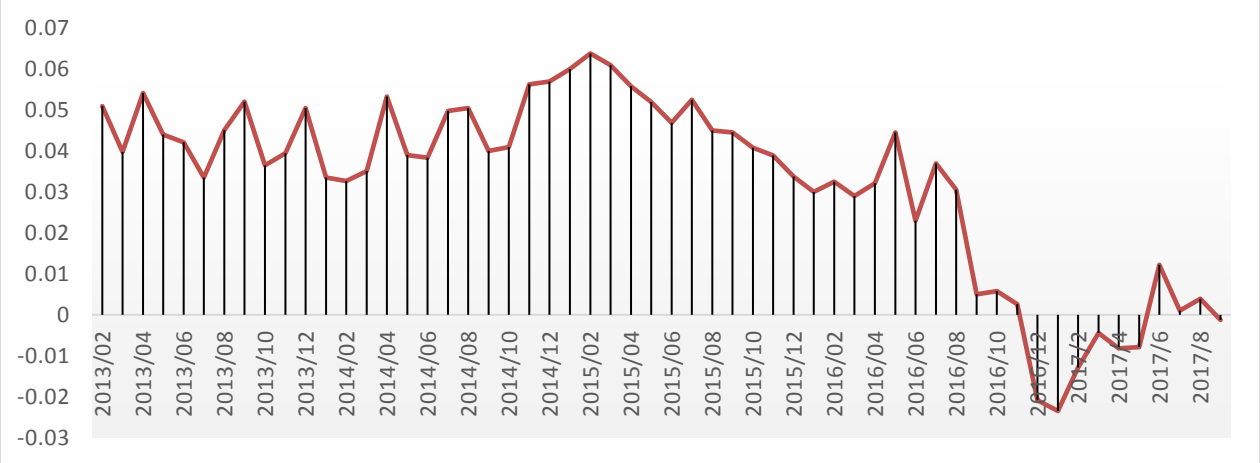


Figure 4: The Dynamics of the Net Impact of Reserve Requirement on USD loans. Note: period January 2013-November 2017. Source: Author's calculations.

5 Concluding Remarks

In this study, I explore the interaction between reserve requirements, bank liquidity position and, bank lending behavior in the context of Armenian banking sector. Both the structure of reserve requirement policy in Armenia and bank-level data allows me to examine the impact of reserve requirements in a deeper direction and identify its possible transmission channels. I show that quantitative policies of central bank, such as reserve requirements, affect banks' funding needs which plays an important role in the transmission of reserve requirements to loan interest rates. The bank's liquidity position has also significant impact on bank lending behavior.

References

Alper, K. 2016. “Reserve Requirements, Liquidity Risk, and Bank Lending Behavior.” *KOÇ UNIVERSITY-TÜSİAD ECONOMIC RESEARCH FORUM.*

Arellano, M., and S. Bond. 1991. “Some Tests of Specification for Panel Data: Monte Carlo Evidence and An Application to Employment Equations” *Review of Economic Studies 58 277-297.*

Basci, E. 2010. “Central Banks and Financial Stability.” Presentation at the ECB High-Level Policy Workshop on Macroprudential Policy, Frankfurt, December 2015.

Binici, M., Erol, H., Kara, H., Özlü, P. and D. Ünalmis 2013. “Interest Rate Corridor: A New Macroprudential Tool?” *CBRT Research Notes in Economics* 1320.

Castillo, P., Vega, H., Serrano, E., and Burga, C. 2016 “De-Dollarization of Credit in Peru: The Role of Unconventional Monetary Policy Tools” *Series de Documentos de Trabajo working paper series.*

Claessens, S. 2014. “An Overview of Macroprudential Policy Tools” *IMF Working Paper wp/14/214.*

Edwards, S., and C. Vegh. 1997. ”Banks and Macroeconomic Disturbances under Predetermined Exchange Rates“ *Journal of Monetary Economics 40(2): 239-78.*

Galac, T., and Kraft, E. 2012 “Monetary and Financial Policies for ‘De-Euroization’- *A Case Study of Recent Croatian Experience” Comparative Economic Studies vol. 54 pp. 443-470.*

Glocker, C., and Towbin, P. 2012. “Reserve Requirements for Price and Financial Stability: When Are They Effective” *International Journal of Central Banking vol. 8, pp. 65-114.*

Gray, S. 2011. “Central Bank Balances and Reserve Requirements”, IMF WP/11/36

Nickel, S. 1981 “Biases in Dynamic Models with Fixed Effects”, *Econometrica vol. 49, no. 6, p.p. 1417-1426*

Reinhart, C. and V. Reinhart 1999. "On the Use of Reserve Requirements in Dealing with Capital Flow Problems" *International Journal of Finance and Economics* vol 4 no 1 pp 27–54.

Robitaille, P. 2011 "Liquidity and Reserve Requirements in Brazil" *Board of Governors of the Federal Reserve System, International Finance Discussion Papers number 1021.*