Determinants of commercial banks' liquidity in Poland

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Abstract. The aim of this paper is to identify determinants of liquidity of Polish commercial banks. The data cover the period from 2001 to 2010. The results of panel data regression analysis showed that bank liquidity is strongly determined by overall economic conditions and dropped as a result of financial crisis, economic downturn and increase in unemployment. Bank liquidity decreases also with higher bank profitability, higher interest rate margin and bigger size of banks. On contrary, bank liquidity increases with higher capital adequacy, inflation, share of non-performing loans and interest rates on loans and interbank transaction.

Keywords: liquidity ratios, panel data regression analysis, Polish commercial banks.

JEL Classification: C23, G01, G21
AMS Classification: 62P20

1 Introduction

During global financial crisis, many banks struggled to maintain adequate liquidity. In order to sustain the financial system, unprecedented levels of liquidity support were required from central banks. Even with such extensive support, a number of banks failed, were forced into mergers or required resolution [4], [16]. The crisis showed the importance of adequate liquidity risk measurement and management.

It is evident that liquidity and liquidity risk is very up-to-date and important topic. The aim of this paper is therefore to identify determinants of liquidity of commercial banks in Poland.

The structure of the paper is following. After introduction as a first chapter, second chapter characterizes methods of bank liquidity measurement. Chapter 3 describes methodology and data used. Chapter 4 contains results of the analysis. Last chapter captures concluding remarks.

2 Methods of bank liquidity measurement

Liquidity is the ability of bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses [3]. Liquidity risk arises from the fundamental role of banks in the maturity transformation of short-term deposits into long-term loans. It includes two types of risk:
- Funding liquidity risk is the risk that the bank will not be able to meet efficiently both expected and unexpected current and future cash flow and collateral needs without affecting either daily operations or the financial condition of the firm.
- Market liquidity risk is the risk that a bank cannot easily offset or eliminate a position at the market price because of inadequate market depth or market disruption.

There are three mechanisms that banks can use to insure against liquidity crises [2]:
- Banks hold buffer of liquid assets on the asset side of the balance sheet. A large enough buffer of assets such as cash, balances with central banks and other banks, debt securities issued by governments and similar securities or reverse repo trades reduce the probability that liquidity demands threaten the viability of the bank.
- Second strategy is connected with the liability side of the balance sheet. Banks can rely on the interbank market where they borrow from other banks in case of liquidity demand. However, this strategy is strongly linked with market liquidity risk.
- The last strategy concerns the liability side of the balance sheet, as well. The central bank typically acts as a Lender of Last Resort to provide emergency liquidity assistance to particular illiquid institutions and to provide aggregate liquidity in case of a system-wide shortage.

Liquidity risk can be measured by two main methods: liquidity gap and liquidity ratios. The liquidity gap is the difference between assets and liabilities at both present and future dates. At any date, a positive gap between assets and liabilities is equivalent to a deficit [5].

Liquidity ratios are various balance sheet ratios which should identify main liquidity trends. These ratios reflect the fact that bank should be sure that appropriate, low-cost funding is available in a short time. This might

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involve holding a portfolio of assets than can be easily sold (cash reserves, minimum required reserves or government securities), holding significant volumes of stable liabilities (especially deposits from retail depositors) or maintaining credit lines with other financial institutions.

Various authors like [1], [2], [6], [8], [9], [11], [12], [13], [14] or [15] provide various liquidity ratios. For the purpose of this research we will use for evaluation of liquidity positions of Polish commercial banks following four different liquidity ratios (1) – (4):

$$L1 = \frac{liquid\ assets}{total\ assets} \cdot 100 \tag{1}$$

The liquidity ratio $L1$ should give us information about the general liquidity shock absorption capacity of a bank. Cash, balances with central banks and other banks, debt securities issued by governments and similar securities or reverse repo trades belong to liquid assets. As a general rule, the higher the share of liquid assets in total assets, the higher the capacity to absorb liquidity shock, given that market liquidity is the same for all banks in the sample. Nevertheless, high value of this ratio may be also interpreted as inefficiency. Since liquid assets yield lower income liquidity bears high opportunity costs for the bank. Therefore it is necessary to optimize the relation between liquidity and profitability.

The liquidity ratio $L2$ uses concept of liquid assets as well. However, this ratio is more focused on the bank's sensitivity to deposits (we included deposits of households and enterprises).

$$L2 = \frac{liquid\ assets}{deposits} \cdot 100 \tag{2}$$

The ratio $L2$ measures the liquidity of a bank assuming that the bank cannot borrow from other banks in case of liquidity need. This is relatively strict measure of liquidity but it enables us to capture at least the part of the market liquidity risk. The bank is able to meet its obligations in terms of funding (the volume of liquid assets is high enough to cover volatile funding) if the value of this ratio is 100% or more. Lower value indicates a bank's increased sensitivity related to deposit withdrawals. The higher is the value, the higher is the capacity to absorb liquidity shock.

$$L3 = \frac{loans}{total\ assets} \cdot 100 \tag{3}$$

The ratio $L3$ measures the share of loans in total assets. It indicates what percentage of the assets of the bank is tied up in illiquid loans. Therefore the higher this ratio the less liquid the bank is.

$$L4 = \frac{loans}{deposits} \cdot 100 \tag{4}$$

The last liquidity ratio $L4$ relates illiquid assets with liquid liabilities. Its interpretation is the same as in case of ratio $L4$: the higher this ratio the less liquid the bank is. Lower values of this ratio means that loans provide by the bank are financed by deposits.

These liquidity ratios are still in common. It is possible to calculate them only on the basis of publicly available data from banks´ balance sheets and it is easy to interpret their values. Their disadvantage is the fact that they do not always capture all, or any of liquidity risk.

3   Methodology and data

As in case of our previous studies about determinants of liquidity of Czech and Slovak commercial banks [18] and [19], in order to identify determinants of liquidity of Polish commercial banks we use the panel data regression analysis. For each liquidity ratio, we estimate equation (5):

$$L_{it} = \alpha + \beta \cdot X_{it} + \delta_i + \varepsilon_{it} \tag{5}$$

where L_{it} is one of four liquidity ratios ($L1 - L4$) for bank i in time t, X_{it} is vector of explanatory variables for bank i in time t, α is constant, β' is coefficient which represents the slope of variables, δ_i represents fixed effects in bank i, and ε_i means the error term.

It is evident that the most important task is to choose the appropriate explanatory variables. Although liquidity problems of some banks during global financial crisis re-emphasized the fact that liquidity is very important for functioning of financial markets and the banking sector, an important gap still exists in the empirical literature about liquidity and its measuring. Only few studies aim to identify determinants of liquidity, such as [6], [7], [10], [12] or [17]. The review of these studies can be found in [18] and [19]. These studies suggest that commercial banks' liquidity is determined both by bank specific factors (such as size of the bank, profitability, capital adequacy and factors describing risk position of the bank) as well as macroeconomic factors (such as different types of interest rates, interest margin or indicators of economic environment). It can be useful to take into account some other influences, such as the realization of financial crisis, changes in regulation or political incidents.

The selection of variables was based on above cited relevant studies. We considered whether the use of the particular variable makes economical sense in Polish conditions. For this reason, we excluded from the analysis variables such as political incidents, impact of economic reforms or the exchange rate regime. We also considered which other factors could influence the liquidity of banks in Poland. The limiting factor then was the availability of some data. Table 1 shows a list of variables which we have used in regression analysis.

variable	definition	source	estim. effect
CAP	the share of equity on total assets of the bank	annual rep.	+
NPL	the share of non-performing loans on total volume of loans	annual rep.	-
ROE	return on equity: the share of net profit on banks´ equity	annual rep.	-
TOA	logarithm of total assets of the bank	annual rep.	+/-
FIC	dummy variable for realization of financial crisis (1 in 2008 and 2009, 0 in rest of the period)	own	-
GDP	growth rate of gross domestic product growth (96499BPXZF... GDP volume % change)	IMF	+/-
INF	inflation rate: (96464..XZF...CPI % change)	IMF	+
IRB	interest rate on interbank transactions: (96460B..ZF... money market rate)	IMF	+
IRL	interest rate on loans: (96460P..ZF... lending rate)	IMF	-
IRM	difference between interest rate on loans (96460P..ZF... lending rate) and int. rate on deposits (96460L..ZF...deposit rate)	IMF	-
MIR	monetary policy interest rate repo rate: (96460...ZF... repo rate)	IMF	-
UNE	unemployment rate: (96467R..ZF...unemployment rate)	IMF	-

Table 1 Variables definition

We consider four bank specific factors and eight macroeconomic factors. As it can be seen from Table 1, we expect that three factors could have positive impact on bank liquidity, the rest of factors are expected to have negative impact on bank liquidity. Macroeconomic data were provided by International Financial Statistics of International Monetary Fund (IMF). Bank specific data were obtained from annual reports of Polish banks. We used unconsolidated balance sheet and profit and loss data over the period from 2001 to 2010. The panel is unbalanced as some of the banks do not report over the whole period of time.

	01	02	03	04	05	06	07	08	09	10
total number of banks	69	59	58	5	54	51	50	52	49	49
number of observed banks	26	29	33	35	36	33	32	32	30	27
share of observed banks on total assets (%)	71	74	89	85	85	83	81	80	78	75

Table 2 Data availability

Table 2 shows more details about the sample. As it includes substantial part of the Polish banking sector, we used fixed effects regression.

4 Results

We use an econometric package EViews 7. After tests of stationarity, we proceed with regression estimation. We estimate (6) separately for each of four defined liquidity ratios. We gradually change the content of the vector of

explanatory variables X_{it}. The aim is to find a model which has a high adjusted coefficient of determination and simultaneously the variables used are statistically significant. As it can be seen from following tables, results of the analysis suggest that liquidity ratios are determined by different factors.

If we measure liquidity with ratio *L1*, we find determinants of liquidity in Table 3. The explanatory power of this model is quite high and signs of coefficients correspond with our expectations. The positive influence of the share of capital on total assets is consistent with the assumption that bank with sufficient capital adequacy should be liquid, too. Liquidity is decreasing with the size of the bank. It seems that big banks insure against liquidity crises mainly by passive strategies: they rely on the interbank market or on a liquidity assistance of the Lender of Last Resort. This finding fully corresponds to the well known "too big to fail" hypothesis. If big banks are seeing themselves as "too big to fail", their motivation to hold liquid assets is limited.

Results also show negative impact of interest margin on bank liquidity. This is logical: increase in interest margin stimulates bank to focus more on lending activity and as a result, the share of liquid assets is decreasing. Inflation increases banks´ vulnerability to nominal values of loans provided to customers so during periods of inflation banks hold more liquid assets. The positive coefficient on GDP growth rate signals that according to our expectations, liquidity tends to be inversely related to the business cycle. Most borrowers want to take a loan during expansion when they have valuable investments projects. Banks which want to satisfy the growing demand for loans would face lower liquidity. During economic downturn, lending opportunities are not so good so banks hold higher share of liquid assets. As we have expected, financial crisis and bank liquidity is inversely related. Financial crisis could be caused by poor bank liquidity. However, the effect may be the opposite: financial crisis lead to poor bank liquidity. Financial crisis affects banks in two different ways. First, the volatility of important macroeconomic variables influences unfavorably the business environment of banks. Second, the instability deteriorates the business environment of borrowers; it can worsen their ability to repay the loans which can lead to a decline in bank liquidity. This is fully confirmed also by the last explanatory variable – increase in the rate of unemployment (which may be a result of financial crisis) has negative impact on bank liquidity.

L1			**L2**		
variable	coefficient	st. deviation	variable	coefficient	std. deviation
constant	168.890*	32.4178	constant	-19650.0*	2492.26
CAP	0.33120*	0.11462	CAP	1292.80*	82.8136
TOA	-7.45713*	2.06426	GDP(-1)	591.271**	247.149
IRM	-6.21024*	1.74657	ROE	-60.9919***	35.4199
INF	3.00102*	1.12920	IRL	475.884***	249.782
GDP	-3.09675*	0.99721			
FIC	-14.7652*	4.10656			
UNE	-2.68292*	0.70235			
adjusted R^2	0.678602		adjusted R^2	0.729348	
total observ.	290		total observ.	245	

Table 3 Determinants of liquidity measured by *L1* and *L2*. The starred coefficient estimates are significant at the 1% (*), 5% (**) or 10 % (***) level.

Table 3 shows also determinants of liquidity measured by the ratio *L2*. Explanatory power of the model is slightly higher. The share of liquid assets on bank deposits is determined by bank capital adequacy, profitability, interest rate on loans and growth rate of GDP in previous year. We have discussed the impact of capital adequacy above. The link between bank profitability and liquidity is consistent with standard finance theory which emphasizes the negative correlation of liquidity and profitability. Signs of other two coefficients do not correspond with our expectations. Although most studies assumed the negative link between business cycle and bank liquidity, the results show that the approach of Moore [12] can be applied on Polish banking sector. Positive sign of the coefficient signals that cyclical downturn should lower banks' expected transactions demand for money and therefore lead to decreased liquidity. Moreover, during expansionary phases, companies (which have higher profits) and households (which have higher income) might prefer to rely more on internal sources of finance and reduce the relative proportion of external financing and might reduce their debt levels. In recessions, households and corporations may increase their demand for bank credit in order to smooth out the impact of lower income and profits. Growth rate of gross domestic product is statistically significant with one year lag which is consistent with the fact that companies and households need some time for accumulating profits and savings. The

results show the positive link between interest rate on loans and bank liquidity, which correspond neither to our expectations nor to a standard economic theory. Banks probably focus more on the interest margin or it can highlight the fact that higher lending rates do not encourage banks to lend more. This is consistent with the problem of credit crunch and credit rationing.

Determinants of liquidity measured by the ratio *L3* are presented in Table 4. As high value of this ratio means low liquidity, these results have to be interpreted in reverse: positive sign of the coefficient means negative impact on liquidity and conversely. Explanatory power of the model is very high. Only three variables are statistically significant. The link between bank liquidity and interest rate margin and inflation were described above. Although we estimated negative influence of non-performing loans, results show the opposite effect. This could be a sign of prudent policy of banks: they offset the higher credit risk in previous years with lower lending activity and cautious liquidity risk management.

L3			**L4**		
variable	coefficient	st. deviation	variable	coefficient	std. deviation
constant	53.3822*	3.30393	constant	-22376.7	13811.0
NPL(-2)	-0.32658*	0.09088	IRB	2956.77*	1057.60
IRM	3.32758*	0.69906	GDP	4991.89**	2137.90
INF	-1.65585**	0.70152			
adjusted R^2	0.953329		adjusted R^2	0.621131	
total observ.	220		total observ.	290	

Table 4 Determinants of liquidity measured by *L3* and *L4*. The starred coefficient estimates are significant at the 1% (*), 5% (**) or 10 % (***) level.

Table 4 shows also determinants of liquidity measured by the last liquidity ratio *L4*. The explanatory power of this last model is slightly lower. The share of loans on bank deposits is determined by growth rate of GDP and by the level of interest rate on interbank transactions. As in case of liquidity ratio *L1* (and in opposite to liquidity ratio *L2*), the positive sign of the coefficient (and thus negative influence on bank liquidity) signals that liquidity is inversely related to the business cycle. The impact of interbank interest rate is not in accordance with our expectations but it is the same as in case of impact of interest rate on loans. It seems that overall lending activity (both with other banks and nonfinancial sector) and thus indirectly the liquidity of banks is not determined by the level of interest rates.

5   Conclusion

The aim of this paper was to identify determinants of liquidity of commercial banks in Poland. We have used the panel data regression analysis for four liquidity ratios. We consider four bank specific factors and eight macroeconomic factors and with the only exception of repo interest rate, all variables were at least in some models statistically significant. The results of models enable us to make following conclusions.

Bank liquidity is strongly determined by overall economic conditions and dropped as a result of financial crisis, economic downturn and increase in unemployment. Increase in interest rate margin and bank profitability lowers bank liquidity, too. Liquidity also decreases with the size of the bank: big banks rely on the interbank market or on a liquidity assistance of the Lender of Last Resort, small and medium sized banks hold buffer of liquid assets.

Increases in capital adequacy, inflation, share of non-performing loans and level of interest rate both on loans and interbank transaction have positive impact on bank liquidity.

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