

# Determinants of Commercial Bank's Liquidity in Slovakia<sup>1</sup>

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## **Abstract**

*This paper aims to identify determinants of liquidity of Slovak commercial banks. We consider bank specific and macroeconomic data over the period from 2001 to 2010 and analyze them with panel data regression analysis. We have found that bank liquidity drops mainly as a result of the financial crisis. Bank liquid assets decreases also with higher bank profitability, higher capital adequacy and with the size of bank. Liquidity measured by lending activity of banks increases with the growth of gross domestic product and bank profitability and decreases with higher unemployment. Key interest rates, interest margin, rate of inflation and the level of non-performing loans have no statistically significant effect on the liquidity of Slovak commercial banks.*

*Keywords: commercial banks, determinants of liquidity, liquidity ratios, panel data regression analysis, Slovakia five, keywords, maximum*

*JEL codes: C23, G01, G21*

## **1. Introduction**

According to Bank for International Settlements (BIS, 2009), many banks struggled to maintain adequate liquidity during global financial crisis. Unprecedented levels of liquidity support were required from central banks in order to sustain the financial system. Even with such extensive support, a number of banks failed, were forced into mergers or required resolution. The crisis showed the importance of adequate liquidity risk measurement and management. Commercial banks were heavily exposed to maturity mismatch both through their balance sheet and off-balance sheet vehicles and through their increased reliance on repo financing (Brunnermeier, 2009). A reduction in funding liquidity then caused significant distress. In response to the freezing up of the interbank market, the European Central Bank and U.S. Federal Reserve injected billions in overnight credit into the interbank market. Some banks needed extra liquidity supports (Orlowski, 2008).

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 Slovakia.

The structure of the paper is following. After introduction as a first chapter, second chapter defines bank liquidity and characterizes methods of its measuring. Chapter 3 deals with previous studies about determinants of liquidity. Chapter 4 describes methodology and data used. Chapter 5 contains results of the analysis. Last chapter captures concluding remarks.

## **2. Bank Liquidity and its Measuring**

Bank for International Settlements (BIS, 2008) defines liquidity as the ability of bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses. Liquidity risk arises from the fundamental role of banks in the maturity transformation of short-term deposits into long-term loans.

The term liquidity risk includes two types of risk: funding liquidity risk and market liquidity 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

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<sup>1</sup> This paper was prepared with financial support of Czech Science Foundation (Project GAČR P403/11/P243: Liquidity risk of commercial banks in the Visegrad countries).

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.

According to Aspachs et al. (2005), there are some mechanisms that banks can use to insure against liquidity crises:

- 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 (Bessis, 2009).

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 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 Moore (2010), Praet and Herzberg (2008) or Rychtárik (2009) provide various liquidity ratios. For the purpose of this research we will use for evaluation of liquidity positions of commercial banks in Slovakia following four different liquidity ratios (1) – (4):

$$L1 = \frac{\text{liquid assets}}{\text{total assets}} \quad (1)$$

The liquidity ratio  $L1$  should give us information about the general liquidity shock absorption capacity of a bank. 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. Thus it is necessary to optimize the relation between liquidity and profitability.

$$L2 = \frac{\text{liquid assets}}{\text{deposits} + \text{short term borrowing}} \quad (2)$$

The liquidity ratio  $L2$  is more focused on the bank's sensitivity to selected types of funding (we included deposits of households, enterprises and other financial institutions). The ratio  $L2$  should therefore capture the bank's vulnerability related to these funding sources. 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.

$$L3 = \frac{\text{loans}}{\text{total assets}} \quad (3)$$

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.

$$L4 = \frac{\text{loans}}{\text{deposits} + \text{short term financing}} \quad (4)$$

The last liquidity ratio  $L4$  relates illiquid assets with liquid liabilities. Its interpretation is the same as in case of ratio  $L3$ : the higher this ratio the less liquid the bank is.

### 3. Determinants of Bank Liquidity

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.

Bank-specific and macroeconomic determinants of liquidity of English banks studied Valla and Saes-Escorbiac (2006). They assumed that the liquidity ratio as a measure of the liquidity should be dependent on following factors (estimated influence on bank liquidity in parenthesis):

- probability of obtaining the support from lender of last resort, which should lower the incentive for holding liquid assets (-),
- interest margin as a measure of opportunity costs of holding liquid assets (-),
- bank profitability, which is according to finance theory negatively correlated with liquidity (-),
- loan growth, where higher loan growth signals increase in illiquid assets (-),
- size of the bank (?),
- gross domestic product growth as an indicator of business cycle (-),
- short term interest rate, which should capture the monetary policy effect (-).

Determinants of liquidity risk of banks from emerging economies with panel data regression analysis are analysed by Bunda and Desquilbet (2008). The liquidity ratio as a measure of bank's liquidity assumed to be dependent on individual behaviour of banks, their market and macroeconomic environment and the exchange rate regime, i.e. on following factors:

- total assets as a measure of the size of the bank (-),
- the ratio of equity to assets as a measure of capital adequacy (+),
- the presence of prudential regulation, which means the obligation for banks to be liquid enough (+),
- the lending interest rate as a measure of lending profitability (-),
- the share of public expenditures on gross domestic product as a measure of supply of relatively liquid assets (+),
- the rate of inflation, which increases the vulnerability of banks to nominal values of loans provided to customers (+),
- the realization of a financial crisis, which could be caused by poor bank liquidity (-),
- the exchange rate regime, where banks in countries with extreme regimes (the independently floating exchange rate regime and hard pegs) were more liquid than in countries with intermediate regimes.

The empirical analysis of the hypothesis that interest rates affect banks' risk taking and the decision to hold liquidity across European countries provides Lucchetta (2007). The liquidity measured by different liquidity ratios should be influenced by:

- behaviour of the bank on the interbank market – the more liquid the bank is the more it lends in the interbank market (+),
- interbank rate as a measure of incentives of banks to hold liquidity (+),
- monetary policy interest rate as a measure of banks ability to provide loans to customers (-),
- share of loans on total assets and share of loan loss provisions on net interest revenues, both as a measure of risk-taking behavior of the bank, where liquid banks should reduce the risk-taking behavior (-),

- bank size measured by logarithm of total bank assets (+).

The effects of the financial crisis on the liquidity of commercial banks in Latin America and Caribbean countries investigated Moore (2010). Liquidity should depend on:

- cash requirements of customers, captured by fluctuations in the cash-to-deposit ratio (-),
- current macroeconomic situation, where a cyclical downturn should lower banks' expected transactions demand for money and therefore lead to decreased liquidity (+),
- money market interest rate as a measure of opportunity costs of holding liquidity (-).

Liquidity created by Germany's state-owned savings banks and its determinants has been analyzed by Rauch et al. (2010). According to this study, following factors can determine bank liquidity:

- monetary policy interest rate, where tightening monetary policy reduces bank liquidity (-),
- level of unemployment, which is connected with demand for loans (-),
- savings quota (+),
- level of liquidity in previous period (+),
- size of the bank measured by total number of bank customers (-),
- bank profitability (-).

Entirely unique is the approach of Fielding (2005). They considered these determinants of liquidity:

- level of economic output (+),
- discount rate (+),
- reserve requirements (?),
- cash-to-deposit ratio (-),
- rate of depreciation of the black market exchange rate (+),
- impact of economic reform (-),
- violent political incidence (+).

Studies cited above 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.

#### 4. Methodology and Data

In order to identify determinants of liquidity of Slovak commercial banks, the panel data regression analysis is used. For each liquidity ratio, we estimate following equation:

$$L_{it} = \alpha + \beta \cdot X_{it} + \delta_i + \varepsilon_{it} \quad (5)$$

where  $L_{it}$  ... one of four liquidity ratios<sup>2</sup> for bank  $i$  in time  $t$ ,  
 $X_{it}$  ... vector of explanatory variables for bank  $i$  in time  $t$ ,  
 $\alpha$  ... constant,  
 $\beta'$  ... coefficient which represents the slope of variables,  
 $\delta_i$  ... fixed effects in bank  $i$ ,  
 $\varepsilon_i$  ... the error term.

It is evident that the most important task is to choose the appropriate explanatory variables. The selection of variables was based on previous relevant studies. We considered whether the use of the particular variable makes economical sense in Slovak 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 the

<sup>2</sup> Liquidity ratios  $L1 - L4$  were calculated according to (1) – (4).

Slovakia. The limiting factor then was the availability of some data. Table 1 shows a list of variables which we have used in regression analysis.

Table 1: Variables definition

Variable	Definition	Source	Estim. effect
<i>CAP</i>	the share of own capital on total assets of the bank	Annual rep.	+
<i>NPL</i>	the share of non-performing loans on total volume of loans	Annual rep.	-
<i>ROE</i>	return on equity: the share of net profit on banks' own capital	Annual rep.	-
<i>TOA</i>	logarithm of total assets of the bank	Annual rep.	+/-
<i>FIC</i>	dummy variable for realization of financial crisis (1 in 2009 and 2010, 0 in rest of the period)	own	-
<i>GDP</i>	Growth rate of gross domestic product growth (93699BPXZF...GDP volume % change)	IMF	+/-
<i>INF</i>	inflation rate: (93664..XZF...CPI % change)	IMF	+
<i>IRB</i>	interest rate on interbank transactions: (93660B..ZF... Money market rate)	IMF	+
<i>IRL</i>	interest rate on loans: (93660P..ZF...Average lending rate)	IMF	-
<i>IRM</i>	difference between interest rate on loans (93660P..ZF...Average lending rate) and interest rate on deposits (93660L..ZF...Average deposit rate)	IMF	-
<i>MIR</i>	monetary policy interest rate – two week repo rate: (93660...ZF... Bank rate)	IMF	-
<i>UNE</i>	Unemployment rate: (93667R..ZF...Unemployment rate)	IMF	-

Source: Author's processing

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 Slovak 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.

Table 2: Data availability

Indicator	01	02	03	04	05	06	07	08	09	10
Total number of banks	16	15	15	15	15	14	13	14	13	12
Number of observed banks	9	9	9	10	11	11	11	11	10	10
% share of observed banks on total assets	56.3	60.0	60.0	66.7	73.3	78.6	84.6	78.6	76.9	83.3

Source: Author's processing and calculations

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

## 5. Results

We use an econometric package EViews 7. After tests of stationarity, we proceed with regression estimation. We estimate (5) 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 mostly correspond with our expectations. The negative influence of bank profitability measured by return on equity is consistent with standard finance theory which emphasizes the negative correlation of liquidity and profitability. The negative impact of financial crisis has been mentioned above. 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.

Although we expected that the bank with sufficient capital adequacy should be liquid, too, the results of the regression show the opposite influence of the share of capital on total assets. It seems that bank with lower capital adequacy pay more attention to liquidity risk management and hold a sufficient buffer of liquid assets. The last explanatory variable which has statistically significant influence on the liquidity is the size of bank. Liquidity is decreasing with the size of the bank. It seems that big banks insure against liquidity crises mainly by strategies connected with the liability side of the balance sheet: 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.

Table 3: Determinants of liquidity measured by *L1* and *L2*<sup>3</sup>

L1			L2		
Variable	Coefficient	Std. deviation	Variable	Coefficient	Std. deviation
C	60.22954*	44.42671	C	52.46774*	5.740596
TOA	-6.85187**	2.961319	CAP	-1.398547**	0.627328
CAP	-0.94658**	0.433215	ROE	-0.196152*	0.050919
ROE	-0.107832*	0.032332	FIC	-24.11466*	3.477067
FIC	-14.44236*	2.578142			
Adjusted R <sup>2</sup>	0.511832		Adjusted R <sup>2</sup>	0.488978	
Total obs.	101		Total obs.	101	

Source: Author's calculations

Table 3 shows also determinants of liquidity measured by the ratio *L2*. The results of the model are almost the same as the results of model for the ratio *L1*. Explanatory power of the model is slightly lower. We found that capital adequacy, bank profitability and financial crisis have the same impact on bank liquidity as in case of model for ratio *L1*. Only the size of the bank measured by logarithm of total assets has no statistically significant influence on the liquidity measured by the ratio *L2*.

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. The negative impact of financial crisis is mentioned above. Although most studies assumed the negative link between business cycle and bank liquidity, the results show that the approach of Moore (2010) is true for Slovak banking sector. Negative sign of the coefficient (and thus positive influence on bank liquidity) signals that cyclical downturn should lower banks' expected transactions demand for money and therefore lead to decreased liquidity. Moreover, this finding is fully consistent with philosophy that 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 (Calza et al., 2001). Growth rate of gross domestic product is

<sup>3</sup> The starred coefficient estimates are significant at the 1 % (\*) or 5 % (\*\*) level.

statistically significant with two years lag which is consistent with the fact that companies and households need some time for accumulating profits and savings.

Signs of other two coefficients do not correspond with our expectations. According to Rauch et al. (2010), the level of unemployment should be connected with demand for loans and act as a proxy for the general health of the economy. Credit risk of borrowers and potential borrowers rises in periods of high unemployment. That is why banks reduce the volume of loans provided and thus increase their liquidity. This was true almost for the whole analyzed period. However, the development in last two crisis years influenced the results very strongly. The negative sign of the coefficient therefore indicates that increase in unemployment rate should increase the bank liquidity. Although this finding may seem to be very surprising, it is entirely consistent with the impact of recession on bank liquidity which was discussed above.

The results show the positive link between profitability and liquidity, which correspond neither to our expectations nor to a standard economic theory. This can be explained again by the impact of financial crisis on banks and their clients. Due to the crisis, bank profitability has declined (mostly because of reduction of profit from trading, partly because of reduction of interest income as well). However, despite the crisis, all banks (with the only exception of OTP Banka Slovensko) even increased their lending activity and thus lower their liquidity. It is possible that the increase in their lending activity was a reaction on growing demand for loans (which is again consistent with our previous findings).

Table 4: Determinants of liquidity measured by L3 and L4<sup>4</sup>

L3			L4		
Variable	Coefficient	Std. deviation	Variable	Coefficient	Std. deviation
C	87.46744*	9.427716	C	128.2233*	15.33698
ROE	-0.081677*	0.023521	ROE	-0.079808**	0.038263
UNE	-2.620626*	0.510014	UNE	-4.266911*	0.829688
GDP(-2)	-2.049753*	0.717591	GDP(-2)	-3.535812*	1.167375
FIC	23.79663*	3.176553	FIC	34.05339*	5.167605
Adjusted R <sup>2</sup>	0.854108		Adjusted R <sup>2</sup>	0.818346	
Total obs.	83		Total obs.	83	

Source: Author's calculations

Table 4 shows also determinants of liquidity measured by the last liquidity ratio *L4*. The results of the model are almost the same as results of the model for the ratio *L3*. We found that bank profitability, unemployment rate, growth rate of gross domestic product with two years lag and the financial crisis have the same impact on bank liquidity as in case of model for ratio *L3*. The last model has again very high explanatory power.

## 6. Conclusion

The aim of this paper was to identify determinants of liquidity of commercial banks in Slovakia. We have used the panel data regression analysis for four liquidity ratios. The results of models enable us to make following conclusions.

Bank liquidity drops mainly as a result of the financial crisis. Bank liquid assets, or more precisely the share of liquid assets in total assets and in deposits and short term funding, decreases also with higher bank profitability, higher capital adequacy and bigger size of bank. Big banks rely more on the interbank market or on a liquidity assistance of the Lender of Last Resort.

Liquidity measured by the share of loans in total assets and in deposits and short term borrowing increases with the growth of gross domestic product: borrowers reduce their debt during expansionary phases and increase the demand for loans in recessions. This fact is also the reason why banks tend to lend more (and thus decrease their liquidity) even in periods of higher unemployment and lower profitability.

<sup>4</sup> The starred coefficient estimates are significant at the 1 % (\*) or 5 % (\*\*) level.

We also found that interest rates (on loans, on interbank transaction and monetary policy interest rates), interest rate margin, the share of non-performing loans and the rate of inflation have no statistically significant effect on the liquidity of Slovak commercial banks.

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