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DETERMINANTS OF COMMERCIAL BANK LIQUIDITY IN HUNGARY

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Abstract This paper aims to identify determinants of liquidity among Hungarian commercial banks. The data cover the period from 2001 to 2010. Results of panel data regression analysis show that bank liquidity is positively related to capital adequacy of banks, interest rate on loans and bank profitability and negatively related to the size of the bank, interest margin, monetary policy interest rate and the interest rate on interbank transactions. The relation between the growth rate of GDP and bank liquidity is ambiguous.

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Introduction

During the 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 (Bank for International Settlement [BIS], 2009; Teplý, 2011). The crisis showed the importance of adequate liquidity risk measurement and management.

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

The structure of the paper is as follows: the first section characterizes methods of bank liquidity measurement, the following sections describe the methodology and data used and contains results of the analysis. The last section provides concluding remarks.

Methods of bank liquidity measurement

Liquidity is the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses (BIS, 2008). 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 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 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, Nier and Tiesset (2005), there are three mechanisms that banks can use to insure against liquidity crises: (i) Banks hold a 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 can threaten the viability of the bank. (ii) The 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. (iii) 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). The great drawback of this method is the fact that only a few banks publish their liquidity gaps in annual reports. A comparison among a larger number of banks is usually therefore not possible.

Liquidity ratios are various balance sheet ratios which should identify the main liquidity trends. These ratios reflect the fact that a 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 such as Andries (2009); Aspachs et al. (2005); Bunda & Desquilbet (2008); Ghosh (2010); Jiménez, Ongena, Peydró and Saurina (2010); Maechler, Mitra and Worrell (2007); Moore (2010); Praet & Herzberg (2008); Rychtárik (2009) or Tamarisa and Igan (2008) provide various liquidity ratios. For the purpose of this research we will use for evaluation of liquidity positions of Hungarian commercial banks following three different liquidity ratios (1) – (3):

$$L1 = \frac{\text{liquid assets}}{\text{total assets}} \cdot 100(\%) \quad (1)$$

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, a 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 the concept of liquid assets as well. However, this ratio is more focused on the bank's sensitivity to selected types of funding (we included deposits of households, enterprises, and banks and other financial institutions and funds from debt securities issued by the bank). The ratio L2 should therefore capture the bank's vulnerability related to these funding sources. The higher the value of the ratio, the higher is the capacity to absorb liquidity shock.

$$L2 = \frac{\text{liquid assets}}{\text{deposits} + \text{short-term borrowing}} \cdot 100(\%) \quad (2)$$

The liquidity ratio L3 is very similar to the liquidity ratio L2. However, it includes only deposits to households and enterprises. In contrast to the ratio L2, the ratio L3 measures the liquidity of a bank assuming that the bank cannot borrow from other banks in case of liquidity need. This is a relatively strict measure of liquidity but it enables us to capture at least 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. A lower value indicates a bank's increased sensitivity related to deposit withdrawals.

$$L3 = \frac{\text{liquid assets}}{\text{deposits}} \cdot 100(\%) \quad (3)$$

The disadvantage of these liquidity ratios lies in the fact that they do not always capture all, or any of liquidity risk. However, there are still in common use. It is possible to calculate them only on the basis of

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Financial Internet Quarterly „e-Finanse" 2013 vol. 9 | nr 3

eFinanse
financial internet quarterly

publicly available data from bank balance sheets and it is easy to interpret their values.

Methodology and data

As in the case of our previous studies about determinants of liquidity of Czech and Slovak commercial banks (Vodová, 2001, 2012), in order to identify determinants of liquidity of Hungarian commercial banks we use panel data regression analysis. For each liquidity ratio, we estimate equation (4):

$$L_{it} = \alpha + \beta' \cdot X_{it} + \delta_i + \varepsilon_{it} \quad (4)$$

where
L_{it} = one of liquidity ratios (L1 – L3) for bank *i* in time *t*,
X_{it} = vector of explanatory variables for bank *i* in time *t*,
α = constant,
β' = coefficient which represents the slope of variables,
δ_i = fixed effects in bank *i*,
ε_i = error term.

It is evident that the most important task is to choose the appropriate explanatory variables. Although liquidity problems of some banks during the 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 measurement. Only a few studies have aimed to identify determinants of liquidity.

Bank-specific and macroeconomic determinants of liquidity of English banks were studied by Valla and Saes-Escorbiac (2008). They assumed that the liquidity ratio as a measure of liquidity should be dependent on the following factors (the estimated influence on bank liquidity shown in parenthesis): probability of obtaining support from the 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 were analysed by Bunda and Desquilbet (2008). The liquidity ratio as a measure of a bank's liquidity was assumed to be dependent on the individual behaviour of banks, their market and macroeconomic environment and the exchange rate regime, i.e. on the 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 is provided by 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 behaviour (-); bank size measured by a logarithm of total bank assets (+).

The effects of the financial crisis on the liquidity of commercial banks in Latin America and Caribbean countries was investigated by 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 transaction demand for money and therefore lead to decreased liquidity (+); money market interest rate as a measure of the opportunity costs of holding liquidity (-).

Liquidity created by Germany's state-owned savings banks and its determinants has been analyzed by Rauch, Steffen, Hackethal and Tyrrel (2010). According to this study, the 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 the previous period (+); size of the bank measured by total number of bank customers (-); bank profitability (-).

Entirely unique is the approach of Fielding and Shortland (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 (+).

The studies cited above suggest that commercial bank 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 the economic environment). It can be useful to take into account some other influences, such as a financial crisis, changes in regulation or political incidents.

The selection of variables was based on the above cited relevant studies. We considered whether the use of the particular variable makes economic sense in Hungarian conditions. For this reason, we excluded from the analysis variables such as political incidents of the impact of economic reforms. We also considered which other factors could influence the liquidity of Hungarian banks. 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	*Source*	*Estim.eff.*
CAP: the share of equity on total assets of the bank	annual reports	+
NPL: the share of non-performing loans on total volume of loans	annual reports	–
ROE: the share of net profit on bank equity	annual reports	–
TOA: logarithm of total assets of the bank	annual reports	+/–
FIC: dummy variable for financial crisis (1 in 2009 and 2010, 0 in rest of the period)	own	–
GDP: growth rate of gross domestic product (94499BPXZF... GDP volume % change)	IMF	+
INF: inflation rate: (94464..XZF...CPI % change)	IMF	+
IRB: interest rate on interbank transactions: (94460B..ZF... money market rate)	IMF	+
IRL: interest rate on loans: (94460P..ZF... lending rate)	IMF	–
IRM: difference between interest rate on loans (94460P..ZF) and int. rate on deposits (94460L..ZF)	IMF	–
MIR: monetary policy interest rate: (94460...ZF... discount rate)	IMF	–
UNE: unemployment rate: (94467R..ZF...unemployment rate)	IMF	–

Source: Authors' calculations

eFinanse
financial internet quarterly

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 remaining 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 Hungarian 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 entire period. We have excluded specialized banks such as the Hungarian development bank and all building societies.

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

Table 2: Data availability

Indicator	*01*	*02*	*03*	*04*	*05*	*06*	*07*	*08*	*09*	*10*
Total number of banks	41	35	36	35	34	37	37	36	35	35
Number of observed banks	18	23	24	26	29	28	27	27	24	19
Share of observed banks on total assets (in %)	74	87	89	97	96	96	95	97	97	95

Source: Authors' calculations

Results

We used the econometric package EViews 7. After tests of stationarity, we proceeded with regression estimation. We estimated equation (4) separately for each of the four defined liquidity ratios. We gradually changed the content of the vector of explanatory variables Xit. 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 different 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 very high and signs of coefficients correspond with our expectations. The impact of the size of the bank on its liquidity is negative: 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.

Table 3: Determinants of liquidity measured by L1

Variable	*Coefficient*	*St. deviation*
Constant	87.13662*	19.30075
TOA	-5.095472*	1.546050
CAP	0.238202**	0.094421
GDP	0.344432***	0.211787
Adjusted R^2	0.834316	
Total observ.	258	

Source: Authors' calculations
Note: The starred coefficient estimates are significant at the 1% (*), 5% (**) or 10% (***) level

Financial Internet Quarterly „e-Finanse" 2013 vol. 9 | nr 3

The positive influence of the share of capital on total assets is consistent with the assumption that a bank with sufficient capital adequacy should be liquid as well. Although most studies assumed a negative link between business cycle and bank liquidity, the results show that the approach of Moore (2010) can be applied to the Hungarian banking sector. A positive sign of the coefficient signals that cyclical downturn should lower banks' expected transaction 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.

Determinants of liquidity measured by the ratio L2 are presented in *Table 4*. The explanatory power of the model is substantially lower. This liquidity ratio is determined by capital adequacy, interest margin and three different interest rates. The influence of capital adequacy on bank liquidity is the same as in the case of the previous ratio: a bank which is solvent is liquid as well.

The results show also the negative impact of the interest margin which is logical: increase in interest margin stimulates the bank to focus more on lending activity and as a result, the share of liquid assets is decreasing. Monetary policy interest rate can be considered a measure of a bank's ability to provide loans to customers (Lucchetta, 2010). The link between liquid assets and monetary policy interest rate is therefore almost the same as in the case of interest margin: the increase in monetary policy interest rates makes lending activity more attractive and thus leads to lower liquidity.

Table 4: Determinants of liquidity measured by L2

Variable	*Coefficient*	*St. deviation*
Constant	-855527.1	558860.6
CAP	67775.52*	8275.516
IRB	-237152.3**	125729.8
IRL	419523.6**	206619.8
IRM	-246708.2**	125712.0
MIR	-190038.5***	120554.8
Adjusted R^2	0.382408	
Total observ.	245	

Source: Authors' calculations
Note: The starred coefficient estimates are significant at the 1% (*), 5% (**) or 10% (***) level

The signs of two other coefficients correspond neither to our expectations nor to a standard economic theory. The results show the positive link between interest rate on loans and bank liquidity. 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. The same can be true for the behavior of banks on the interbank market: the interest rate on interbank transactions is not the main factor which influences

eFinanse
financial internet quarterly

the incentives of banks to hold liquidity in the form of interbank deposits.
Table 5 shows determinants of liquidity measured by the last liquidity ratio L3. The explanatory power of this last model is slightly higher than the previous. The share of liquid assets on deposits and short term borrowing is determined only by two factors: by bank profitability and growth rate of GDP.

Table 5: Determinants of liquidity measured by L3

Variable	*Coefficient*	*St. deviation*
Constant	-855527.1	558860.6
CAP	67775.52*	8275.516
IRB	-237152.3**	125729.8
IRL	419523.6**	206619.8
IRM	-246708.2**	125712.0
MIR	-190038.5***	120554.8
Adjusted R^2	0.382408	
Total observ.	245	

Source: Authors' calculations
Note: The starred coefficient estimates are significant at the 1% (*), 5% (**) or 10% (***) level

The results show the positive link between profitability and liquidity, which is again inconsistent with standard economic theory. However, this can be explained by the impact of financial crisis: due to the crisis, profitability of many banks declined quite substantially (mainly due to the reduction of their lending activity), liquidity remains almost at the same level or slightly decreased.
The relation between growth rate of GDP and bank liquidity in this model completely differs from that described in *Table 3*. The results of this last model suggest that 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 an economic downturn, lending opportunities are not so promising so banks hold a higher share of liquid assets.

Conclusion

The aim of this paper was to identify determinants of liquidity among Hungarian commercial banks. We have used the panel data regression analysis for four liquidity ratios. We consider four bank specific factors and eight macroeconomic factors and nine of them were at least in some models statistically significant. The results of the models enable us to make the following conclusions.
Bank liquidity decreases with the size of the bank: big banks rely on the interbank market or on the liquidity assistance of the Lender of Last Resort, small and medium sized banks hold a buffer of liquid assets which is fully in accordance with the "too big to fail" hypothesis.
Liquidity is negatively influenced also by the interest margin and monetary policy interest rate. Both factors lead to higher lending activity of banks and thus reduce bank liquidity. The interest rate on interbank transaction has a negative impact on bank liquidity,

Financial Internet Quarterly „e-Finanse" 2013 vol. 9 | nr 3

too; however, we came to the conclusion that the level of the interest rate is not the main factor which influences the incentives of banks to hold liquidity in the form of interbank deposits.
On the contrary, bank liquidity increases with the higher capital adequacy of banks, the higher interest rate on loans and higher bank profitability. As we have expected, solvent banks are liquid as well. However, the positive impact of interest rate on loans and bank profitability is very surprising and can be explained only by the fact that a simple increase in interest rate on loans may not have a direct impact on bank lending (and thus on bank liquidity) – interest margin is more important. We should not take into consideration the identified positive relationship between liquidity and profitability: as we have mentioned, during the financial crisis the profitability of many banks declined quite substantially and liquidity remains almost at the same level or slightly decreased.
The relation between the growth rate of GDP and bank liquidity is ambiguous.
We have also found that unemployment, share of nonperforming loans and financial crisis have no statistically significant effect on the liquidity of Hungarian commercial banks.

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