

# LIQUID ASSETS IN BANKING: WHAT MATTERS IN THE VISEGRAD COUNTRIES?

*Pavla Vodová*

## Introduction

During the global financial crisis, the financial sector has gone through a dramatic re-appraisal of liquidity risk. As a result of a continued drop in the market value of mortgage-backed securities from the subprime segment of the US market and the announcement of problems of some European banks, the interbank market came under extreme strain. This confidence crisis had the following consequences: (i) Amidst increased market nervousness, interbank interest rates sharply rose. (ii) Many segments of the structured credit and mortgage market ceased to trade at all, making it difficult to price outstanding positions. (iii) Investors sometimes failed to raise enough cash through asset sales. (iv) Interbank lending became scarce in a context of liquidity hoarding [17]. 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. However, some banks needed extra liquidity supports [12], [28]. Even with extensive support, a number of banks failed, were forced into mergers or required resolution [8].

Liquidity problems could be seen also in the Hungarian and Polish banking sector. Three Hungarian banks (OTP Bank, FHB Mortgage Bank and MFB – Magyar Fejlesztési Bank) were provided with a loan from the government in March 2009. The loans were provided at market interest rates for three and a half years from the credit line that Hungary received from the International Monetary Fund and the European Union. The primary goal was to ensure the liquidity of banks that have no foreign parent bank. The banks made a commitment that they would use the funds for lending to retail and small and medium-sized entrepreneurs in Hungary. Besides, FHB Mortgage Bank was

granted a HUF 30 billion equity raise [20]. In the Polish banking sector, the situation was not so dramatic. However, the deterioration in the macroeconomic situation weakened the functioning of the interbank market, increased the cost of money on the market and deepened the gap between deposits and loans [30].

It is evident that bank liquidity and liquidity risk is a very up-to-date and an important topic which should be of crucial importance for academics and policymakers. The aim of this paper is therefore to describe the development of liquid assets ratios and to find out determinants which affect their values in the Visegrad countries.

The financial system in the Visegrad countries is traditionally based on banks and credit markets. The Czech Republic, Hungary, Poland and Slovak Republic are a part of an economically integrated area. Although all Visegrad countries are characterized by a universal banking model, activities of banks in the financial markets significantly differ. Various studies investigated various aspects of the functioning of stock markets [36], exchange rates [35], bank concentration, competition and efficiency [34] and financial integration in the Visegrad countries [23], [40]. However, the empirical evidence of determinants of bank liquidity in these countries is still missing (the only complex study of determinants of bank liquidity in these countries uses data only for the period 1994–2004 [16]). The contribution of this paper is therefore obvious.

The paper is structured as follows. The next section defines bank liquidity and characterizes methods of its measuring. Section 2 describes trends in liquid assets in the Visegrad countries. Following sections focus on the model and show results of a regression analysis. The last section captures concluding remarks.

## 1. Bank Liquidity and its Measuring

Bank for International Settlements [7] 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, e.g. the risk that a bank would not have enough liquidity, arises from the fundamental role of banks in the maturity transformation of short-term deposits into long-term loans. According to [22], the term liquidity risk includes three types of risk: central bank liquidity risk, funding liquidity risk and market liquidity risk. Central bank liquidity risk is highly unlikely as it is a risk that the central bank would not be able to supply the liquidity needed to the financial system (in fact, a central bank can only be illiquid to the extent that there is no demand for domestic currency, e.g. in case of hyperinflation or an exchange rate crisis). Funding liquidity risk captures the inability of a bank to service their liabilities as they come due. Market liquidity risk relates to the inability of trading at a fair price with immediacy. The dimension of market liquidity risk includes market depth (the ability to execute large transactions without influencing prices unduly); tightness (the gap between bid and offer prices); intermediacy (the speed with which transaction can be executed); and resilience (the speed with which underlying prices are restored after disturbance) [11].

Central bank liquidity risk, funding liquidity risk and market liquidity risk are intensively interconnected. In normal times, these linkages promote a virtuous circle in financial system liquidity, guaranteeing the smooth functioning of the financial system. In turbulent times, the linkages can be distorted and there is a possibility of reverting from a virtuous to a vicious circle in the economy [22].

The first symptom of a liquidity crisis in the banking sector generally takes the form of a liquidity deficit in the balance sheet of a bank [39]. Bank for International Settlements [7] recommends banks to identify alternative sources of funding that strengthen its capacity to withstand a variety of severe yet plausible institution-specific and market-wide liquidity shocks. Depending on the nature, severity and duration of the liquidity shock, potential sources of funding include the following:

- deposit growth;
- the lengthening of maturities of liabilities;

- new issues of short- and long-term debt instruments;
- intra-group fund transfers, new capital issues, the sale of subsidiaries or lines of business;
- asset securitization;
- the sale of highly liquid assets;
- drawing-down committed facilities;
- and borrowing from the central bank's marginal lending facilities.

However, not all of these options may be available in all circumstances and some may be available only with a substantial time delay. Bank management should regularly review and test its fund-raising options to evaluate their effectiveness at providing liquidity. [2] divide these possibilities into three main 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.
- 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.
- 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. 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 [6]. Liquidity ratios are various balance sheet ratios which should identify main liquidity trends. These ratios reflect the fact that the 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 [24], [31] or [33] provide various liquidity ratios:

- Most common measure of liquidity risk is a liquid asset ratio which is the share of liquid assets on total assets. This ratio should give us information about the general liquidity shock absorption capacity of a bank. As a general rule, the higher the ratio, the higher the capacity to absorb liquidity shock is, 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 a lower income liquidity bears high opportunity costs for the bank. Therefore it is necessary to optimize the relation between liquidity and profitability. The liquid asset ratio has also its shortcoming: it ignores the flow of funds from repayments, increases in liabilities and the demand for bank funds [24].
- The share of liquid assets on deposits and short term borrowing – this ratio is more focused on the bank's sensitivity to selected types of funding (deposits of households, enterprises, banks and other financial institutions and funds from debt securities issued by the bank); it should therefore capture the bank's vulnerability related to these funding sources. The higher is the value of the ratio, the higher is the capacity to absorb liquidity shock.
- The share of liquid assets on deposits – this ratio is very similar to the previous one; however, it includes only deposits to households and enterprises. It 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. A lower value indicates a bank's increased sensitivity related to deposit withdrawals.
- The share of loans on 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.

- The share of loans on deposits – it relates illiquid assets to liquid liabilities. Its interpretation is again: 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 clients' deposits.
- The interbank ratio is computed as a ratio of due from banks over due to banks. This ratio measures the position of a bank in the interbank market. If this ratio is greater than 100 %, then it indicates that the bank is net lender (and thus probably more liquid).

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.

## 2. Trends in the Liquid Asset Ratio in the Visegrad Countries

First, we will focus on the development of liquid asset ratio of banks in the Visegrad countries. We have used unconsolidated balance sheet data over the period from 2000 to 2011. As it can be seen from Tab. 1, the sample includes significant parts of all banking sectors (not only by a number of banks but mainly by their share on total banking assets).

Nevertheless, the share of the observed bank on total assets (mainly for Slovakia) and the number of observed banks (mainly for Hungary and Poland) may appear to be quite low. Partly it is a consequence of a growing role of branches of foreign banks; partly it is because we do not include data from building societies, mortgage banks and from specialized banks like Českomoravská záruční a rozvojová banka, Slovenská záručná a rozvojová banka, Česká exportní banka, Exim banka, Magyar Fejlesztési Bank or Bank Gospodarstwa Krajowego which focus on very special financial products and services. The panel is unbalanced as some of banks do not report over the whole period of time.

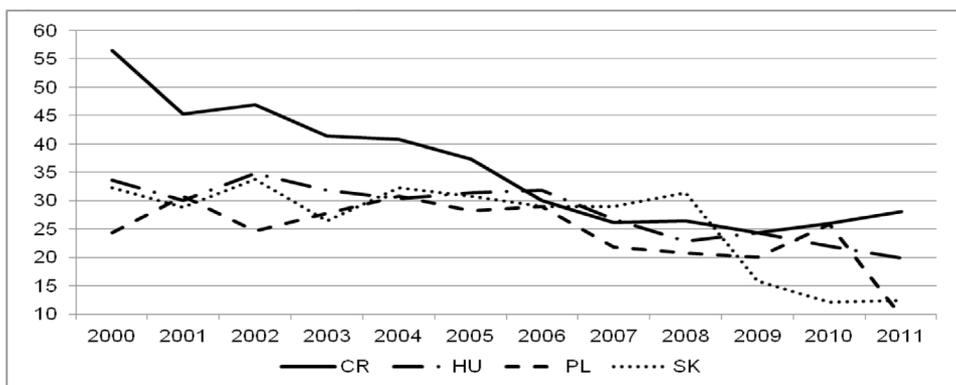
For these banks, we have calculated the liquid asset ratio. We include cash, government bonds, short-term claims on other banks and securities from trading portfolio in liquid assets. As higher value of this ratio means higher liquidity, it is evident that bank liquidity in all Visegrad countries has decreased during the analyzed period (Fig.1).

**Tab. 1: Data Availability**

Indicator	00	01	02	03	04	05	06	07	08	09	10	11
Czech Republic												
Total number of banks	40	38	37	35	35	36	37	37	37	39	41	44
Number of observed banks	14	15	16	16	16	15	13	13	12	12	13	12
Share of observed banks on total assets (in %)	75	77	76	76	74	71	74	74	68	70	70	77
Hungary												
Total number of banks	40	41	39	38	35	34	37	38	36	35	35	35
Number of observed banks	13	18	23	24	26	29	28	27	26	23	21	13
Share of observed banks on total assets (in %)	72	74	84	86	87	88	88	87	88	88	87	83
Poland												
Total number of banks	73	71	62	60	54	54	51	50	52	49	49	44
Number of observed banks	15	23	26	31	34	34	31	30	31	30	27	19
Share of observed banks on total assets (in %)	60	70	73	88	84	84	82	80	79	79	78	74
Slovakia												
Total number of banks	23	21	20	21	21	23	24	26	26	26	29	31
Number of observed banks	11	13	13	13	13	14	12	12	12	11	10	10
Share of observed banks on total assets (in %)	46	58	54	59	59	65	62	65	69	67	65	66

Source: author's processing

**Fig. 1: Liquid Asset Ratio in the Visegrad Countries**



Source: author's calculation

However, the development trends differ among individual countries. Liquidity of Czech banks declined in 2000–2009, due to the mutual effect of a higher lending activity of Czech

banks and of the decrease of balances with central banks and other banks [13]. However, we can see a slightly improvement of liquidity in last two years so the average liquidity position

of Czech banks is better. This is caused mainly by a higher portion of government securities held by banks [15].

The fall in liquidity of Hungarian, Polish and Slovak banks is mainly a result of the financial crisis (this impact is statistically significant for Poland – see Section 4). The financial crisis and bank liquidity can influence each other in both directions: the financial crisis can be caused by poor bank liquidity; or poor bank liquidity can be a result of the financial crisis. The 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.

It is interesting that the financial crisis has affected each banking sector in different year. The liquid asset ratio of Slovak banks fluctuated only slightly during the period 2000–2008; about one-third of assets of Slovak banks were liquid assets. This ratio sharply dropped in 2009. According to the National Bank of Slovakia [26], the year 2009 can be considered with certainty to be a turning point for the banking sector. The economic crisis adversely effected sectors in which Slovak banks have significant credit exposures. Also activities in the interbank market strongly changed: in previous years, Slovak banks mostly received deposits from foreign banks and then conducted sterilization operations with the National Bank of Slovakia. In 2009, after the euro changeover, these operations lost their previous significance. Most banks borrowed funds from other banks with the Eurosystem and invested these funds predominantly in government bonds and in some cases in the interbank market, mainly in transactions with parent banks. The fall of liquidity in 2009 was followed by an even deeper decline in 2010. The amount of liquid assets was adversely affected by the ending of growth trends in government bond investments in 2010. Moreover, there was an increase in the share of foreign bonds, including speculative-grade bonds in certain banks. Some banks also faced the bigger maturity mismatch between assets and liabilities due to a higher share of very short-term deposits which made them more

dependent on the stability of these funds [27]. We can see also slightly improvements in 2011.

When it comes to Polish banks, the liquid asset ratio fluctuated only slightly during the period 2000–2006. In 2007, the liquidity started to decline. Banks financed increased demand for loans both to households and non-financial companies also by reduction of the part of liquid assets. Mainly small and medium sized banks with a poorly developed deposit base used funds from the interbank market [29]. In 2008, the increase in lending activities continued. However, some important structural weaknesses occurred: due to banks exceeded due from banks and the Polish banking sector as a whole became net borrower in the interbank market; household debts in foreign currency grew rapidly (up to more than 25 % of total loan portfolio [30]); and a very high loan-to-deposit ratio which signals that while financing loans, many banks have not enough clients deposits and are dependent on other sources of financing such as loans from other banks or funds from debt securities issuance.

The situation was very similar in the Hungarian banking sector which was affected by the financial crisis already in 2007. According to [20], the internal, structural features of the banking sector have evolved over the years. These specifics are, as in case of the Polish banking sector, a very high loan-to-deposit ratio, long net foreign currency position which resulted from the growing ratio of foreign currency loans (about one third of loans to non-financial companies and even two thirds of loans to households). Moreover, some Hungarian banks provided loans to foreign customers especially from CEE countries which were financed partly by local retail deposits. These structural weaknesses gained special importance due to the worsening financial and economic conditions.

### 3. The Model

In order to identify determinants which affect liquid assets of commercial banks in the Visegrad countries we use the panel data regression analysis (Equation 1).

$$LAR_{it} = \alpha + \beta' \cdot X_{it} + \delta_i + \varepsilon_{it} \quad (1)$$

where  $LAR_{it}$  is liquid asset ratio for bank  $i$  in time  $t$ ,  $X_{it}$  is vector of explanatory variables for

bank  $i$  in time  $t$ ,  $\alpha$  is constant,  $\beta$  is coefficient which represents the slope of variables,  $\delta_i$  represents fixed effects in bank  $i$ , and  $\varepsilon_i$  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 the global financial crisis re-emphasized the fact that liquidity is very important for the functioning of financial markets and the banking sector, an important gap still exists in the empirical literature about liquidity and its measuring. Most studies focus on bid-ask spreads in the market and thus on the measurement and determinants of market liquidity. However, only few studies aim to identify determinants of funding liquidity measured by any liquidity ratio which reflects in part the lack of interest, until recently at least, of some regulators [3].

Aspachs et al. [2] study bank-specific and macroeconomic determinants of liquidity of 57 UK-resident banks, on data on a quarterly basis over the period from 1985Q1 to 2003Q4. They found out that the liquidity ratio is a function of the probability of obtaining the support from a lender of last resort in case of a liquidity shortage (which lowers the incentive to hold liquid assets); short term interest rate which captures the monetary policy effect (the negative regression coefficient signals that when policy rates are high banks respond by holding a smaller amount of liquid assets); growth rate of gross domestic product (banks hold a smaller amount of liquidity in periods of a stronger economic growth); and interest margin as a measure of opportunity costs of holding liquid assets which has a negative impact on liquidity holdings. For foreign owned banks, support from a lender of last resort does not appear to affect their holding of liquid assets. When it comes to short term interest rate and growth rate of gross domestic product, these variables are statistically significant, too, but their effect on bank liquidity is smaller. The interest margin affects liquidity of foreign owned banks positively. Bank profitability; loan growth where a higher loan growth should signal an increase in illiquid assets and size of the bank are not statistically significant.

Determinants of liquidity risk of 1107 banks from 36 emerging economies in the period 1995–2000 were analyzed by [9]. Their main

aim was to explore how the liquidity of commercial banks is affected by the exchange rate regime of the country in which they operate. They found out that in extreme regimes at both ends of the line (i.e. pure floating at one end and currency board and dollarized economies at the other end) banks are more liquid than in intermediate regimes. However, they focus also on other determinants both on the macroeconomic and bank-specific level. According to their results, bank liquidity depends on the individual behavior of banks, their market and macroeconomic environment. Following factors have a positive impact on bank liquidity: capital adequacy (higher capital adequacy is concomitant with higher liquidity); lending interest rate which is consistent with the credit rationing phenomenon; and the share of public expenditures on gross domestic product which measures the supply of relatively liquid assets. On the contrary, the impact of the financial crisis (which is very often caused by poor bank liquidity) is negative. The link between the presence of a prudential regulation (which should be the obligation for banks to be liquid enough and an incentive mechanism for banks to enforce a more efficient liquidity management) is mixed and depends on the used dependent variable (they used different liquidity ratios). The results show that the introduction of the prudential regulation increases confidence in the banking sector so that banks can collect more deposits, thus increasing liquid liabilities, while, at the same time but to a lesser extent, investing more in illiquid projects. The impact size of bank measured by its total assets; the growth rate of gross domestic product; and the rate of inflation are not statistically significant.

The impact of various variables on the share of liquid assets in deposits was investigated by [1]. They use data of the Thailand banking sector in the period of January 1992 to October 1998. They have found that bank liquidity in Thailand increased as a result of a higher discount rate (which they see as a penalty rate of insufficient liquidity) and a higher volatility of the cash to deposit ratio (as a proxy for liquidity risk volatility). However, it appeared that banks hold a higher buffer of liquid assets mainly after the collapse of the baht, i.e. in periods of higher perceived degree of uncertainty or risk of default in the aftermath.

The empirical analysis of the hypothesis that interest rates affect banks' risk taking and the decision to hold liquidity across European countries provides [21]. The analysis is based on data of 5066 European banks over the period from 1998 to 2004. The study came to conclusion that across European countries, the interbank interest rate positively affects the liquidity retained by banks and the decision of a bank to be a lender in the interbank market. The key variable which affects the decision to lend in the interbank market is the liquidity price which depends on the demand and supply of liquidity and on the risk-free interest rate. The increase of this price increases the liquidity supply and thereby the lending in the interbank market. As this new liquidity is invested by borrowers in risky loans, the rise in the risk-free interest rate increases banks' risk-taking behaviour (which is measured by the share of loans on total assets and share of loan loss provisions on net interest revenues). The results also showed that bank size matters: the lender banks tend to be smaller than borrower ones. The relation between the monetary policy interest rate and the decision of a bank to hold liquidity and to lend in the interbank market is negative.

The effects of the financial crisis on the liquidity of commercial banks in Latin America and Caribbean countries investigated [24]. The results based on monthly observations over the period from January 1970 to December 2004 show that liquidity tends to be inversely related to the business cycle in half of the countries studied; and to the volatility of the cash-to-deposit ratio as well (which indicates that commercial banks tend to expand liquidity when the volatility of cash demand by the public rises). The effect of the money market interest rate as a measure of opportunity costs of holding liquidity is mixed: the coefficient is positive in some countries and negative in some other countries (mainly in countries with relatively high interest rates). The relation between the financial crisis and bank liquidity is also mixed: in six out of the nine countries, banks were less liquid during the crisis. This concerns in particular countries where there was a lending boom before the crisis or where banks were subject to large deposit withdrawals during the crisis. In other three countries, banks were more liquid during the crisis. In most of these

countries the banking crisis was accompanied by an exchange rate crisis that probably led banks to be more conservative in their liquidity policies. However, such bank behavior can deepen the crisis if companies cannot access credits to finance their operations.

Liquidity created by all 457 German state-owned savings banks and its determinants in the period from 1997 to 2006 was analyzed by [32]. According to this study, bank liquidity is determined by macroeconomic factors; mainly by the monetary policy interest rate which has a highly significant negative influence on bank liquidity (i.e. tightening monetary policy reduces bank liquidity). The level of unemployment is connected with demand for loans and can also act as a proxy for the general health of the economy and the negative influence means. The negative influence of the level of unemployment indicate that the healthier the economy is, i.e. the lower the unemployment rate, the more liquidity is created by banks. They do not find any bank specific factors, such as bank profitability or size of the bank measured by a total number of bank customers, to have any influence on liquidity creation. Also the savings quota which should indicate the deposit behavior of private clients is not statistically significant.

Entirely unique is the approach of [18]. Except of common determinants, they investigate the impact of violent political incidents arising from conflict between radical Islamic group and the Egyptian state. Based on data for the period 1983–1996, they found out that bank liquidity is pro-cyclical (the level of the economic output is taken into account by the logarithm of real gross domestic product) and responds positively also to increases in the discount rate (although this response seems only to be temporary), to the degree of the macroeconomic instability which is captured by the rate of depreciation of the black market exchange rate. The impact of economic reforms reduced excess liquidity. However, the most important factor which has an impact on bank liquidity is the number of violent political incidents: banks hold excessive liquid reserves in periods of the political instability.

Berger et al. [4] used data of almost all U.S. banks over the period 1993–2003 and explored how banks create liquidity. They tested whether the liquid asset ratio is determined by bank

capital (measured by the share of equity in total assets); bank risk (measured by the standard deviation of banks' return on assets, by the share of risk-weighted assets and off-balance sheet activities in total assets, and by the Z-score which shows the distance to default); bank size (measured by the logarithm of total assets); bank holding company status (a dummy variable if the bank is a part of a holding); merger and acquisition history (a dummy variable for banks which was involved in a merger or acquisition over past three years); local market competition (measured by the Herfindahl-Hirschman index and share of bank market held by medium and large banks); and economic environment (measured by the logarithm of the weighted average population in all markets in which a bank has deposits, by the weighted average population density and by the weighted average income growth). They estimate the regression separately for small, medium and large banks. Their results showed that the most important determinant of the bank liquidity creation is capital adequacy. However, its impact differs by the size of the bank: the relationship between capital and liquidity creation is positive for large banks, insignificant for medium banks and negative for small banks. The different links between bank capital and liquidity for small and large U.S. banks can be explained by two different theories. The financial fragility-crowding out hypothesis suggests that bank capital may impede liquidity creation by making the bank's capital structure less fragile. A fragile capital structure encourages the bank to commit to monitoring its borrowers, and hence allows it to extend loans. Additional equity capital makes it harder for the less fragile bank to commit to monitoring, which in turn hampers the bank's ability to create liquidity. Capital may also reduce liquidity creation because it crowds out deposits. An alternative view – the risk absorption hypothesis – is related to banks' role as risk transformers and emphasizes that higher capital improves banks' ability to absorb risk and hence their ability to create liquidity. The review of studies which supports both hypotheses can be found in [4]. However, they found also some other important determinants of bank liquidity: banks that are members of a holding company, have a retail orientation, and engaged in mergers and acquisitions activity during the prior three years create more liquidity.

Cornet et al. [10] study how banks managed the liquidity shock that occurred during the financial crisis of 2007–2009 by adjusting their holdings of cash and other liquid assets and how these efforts affected credit availability. Their sample included quarterly data of all US commercial banks over the period 2006Q1 through 2009Q2. They estimated regression function separately for small and large banks with following explanatory variables: the share of illiquid assets (such as loans, leases, asset-backed securities, mortgage-backed securities) on total assets; the share of core deposits (i.e. deposits under USD 100 000 plus all transactions deposits) on total assets; bank capital adequacy and the ratio of unused commitments to commitments plus assets. They came to conclusion that during the crisis, the liquidity risk exposure led to greater increases in liquid assets, mirrored by greater decreases in credit origination. In other words, banks with more illiquid asset portfolios increased their holdings of liquid assets and decreased lending. The results showed significant differences between small and large banks. Mainly small banks that relied more heavily on stable sources of financing, i.e. core deposits and capital, continued to lend relative to other banks. Moreover, large banks have higher share of illiquid assets on total assets than small banks and also hold a greater fraction of unused commitments. Large banks are more exposed to liquidity risk than small banks across four dimensions: more undrawn commitments, less capital, less reliance on core deposits and lower liquidity of balance sheet assets. Off-balance sheet liquidity risk materialized as borrowers drew on pre-existing commitments in large quantities.

Berrosipide [5] analyzed a panel dataset using the quarterly balance sheet data for all U.S. commercial banks between 2005 and 2009 with a regression framework which considers the share of liquid assets in total assets as the dependent variable. Potential explanatory variables included the logarithm of total assets (as a proxy for bank size); the Tier 1 capital ratio; the share of core deposits in total assets (as a proxy for the role of stable sources of funding); the unused commitment ratio (as a proxy for off-balance sheet funding liquidity stemming from loans); security write-downs (as a measure of banks' exposure to expected

losses in their securities portfolio); and the share of loan loss reserves in total loans (as a measure of the possibility that a further deterioration in credit quality forces banks to reallocate their assets from risky loans to safe and liquid securities). They found out that banks increased their holdings of liquid assets during the financial crisis also in anticipation of future losses from securities write-downs and expected loan losses. On the contrary, holdings of liquid assets decrease with bank capital and core deposits (which substitute for cash and other liquid assets) and also with size of the bank.

The analysis of liquidity position of foreign owned banks in ten Central and Eastern European economies (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) in the period 1994–2004 is provided by [16]. They used the share of liquid assets in deposits and short term funding as the dependent variable and many explanatory variables, such as bank size (measured by logarithm of total assets); capitalization (measured by the share of equity in total assets); average real deposit rate in the banking system (as a proxy for the cost of holding liquid reserves); real interbank rate (as a measure for the cost of liquidity in the banking system); growth rate of gross domestic product (as a proxy for the stage of the business cycle); level of GDP per capita (as a proxy for a general economic development); and a dummy variable which should indicate banks' transnational status. They found out that transnational banks hold a higher relative volume of liquid assets only in the case of aggregate liquidity shortages. In normal times, liquidity of banks operating in a single country is higher. This is caused by the fact that transnational banks have access to foreign sources of liquidity. Larger banks hold less liquid assets than smaller ones. Bank liquidity is increasing with better capitalization, a higher interbank rate, a lower deposit rate, a lower growth rate of GDP and a lower GDP per capita.

The liquidity buffers of 112 Australian depository institutions in the period from June 2002 to March 2012 are analyzed by [19]. The results showed that depository institutions build up their liquidity buffer during economic downturns and draw them down in economic

upturns (measured by the growth rate of GDP). Liquidity is decreasing with the size of the depository institution (measured by the logarithm of total assets), with a higher lending growth, higher profitability and also during periods of a high interbank interest rate. They also found out that the net interest margin is inversely related to the liquidity buffer which means that banks hold less liquidity when opportunities to earn higher returns on loans are available. However, this impact is not statistically significant.

Hunteanu [25] analyzed the impact of capital adequacy, asset quality (measured by the share of impaired loans in total loans and by the share of loan loss provisions in net interest revenues), interbank funding (measured as a share of interbank assets in interbank liabilities), funding costs (measured as a share of the total interest expenses in total liabilities), costs to income ratio, interbank interest rate, credit risk rate (measured as a share of total exposures in total loans and interests), inflation rate, growth rate of the real GDP and unemployment rate on liquidity of 27 banks active in Romania over the period 2002–2010. The results showed that different factors influence the share of liquid assets in deposits and short term funding in different periods. In the whole analyzed period, bank liquidity is positively linked with loan loss provisions, funding costs and the unemployment rate and negatively linked with the interbank interest rate. Focusing only on the pre-crisis period (2002–2007), bank liquidity increases with higher capital adequacy and decreases with the higher credit risk and inflation rate. In the crisis period (2008–2010), bank liquidity is positively related to loan loss provisions, the interbank interest rate and inflation rate.

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 the Visegrad countries. For this reason, we excluded from the analysis variables such as political incidents. We also considered which other factors could influence the behavior of banks in the interbank market. The limiting factor then was the availability of some data. The list of used variables can be found in Tab. 2.

Tab. 2: Variables Definition

Variable	Source
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 banks' equity	annual reports
TOA: logarithm of total assets of the bank	annual reports
FIC: dummy variable for financial crisis (1 in 2009, 0 in rest of the period for CR and SK, 1 in 2008 and 2009, 0 in rest of the period for PL and HU)	own
GDP: growth rate of gross domestic product (GDP volume % change)	IMF
INF: inflation rate (CPI % change)	IMF
IRB: interest rate on interbank transactions	IMF
IRL: interest rate on loans	IMF
IRM: difference between interest rate on loans and interest rate on deposits	IMF
MIR: monetary policy interest rate	IMF
UNE: unemployment rate	IMF
EUR: exchange rate CZK(HUF, PLN, SKK)/EUR (yearly average)	Oanda Corp.

Source: author's processing

We considered four bank specific factors and nine macroeconomic factors. We do not have an exact expectation of the impact of these factors on the liquid asset ratio because their impact was different in the above cited studies. The macroeconomic data were provided by the International Financial Statistics of the International Monetary Fund (IMF). The data on average exchange rates were provided by Oanda Corporation. The bank specific data were obtained from the unconsolidated balance sheet and profit and loss data of banks' annual reports.

#### 4. Results and Discussion

We used an econometric package EViews 7. After tests of stationarity, normality and multicollinearity, we proceed with regression estimation. We estimated Equation 1 both for all Visegrad countries and as well separately for each country. First we included all explanatory variables which might have an effect on the dependent variable. To reduce the number of explanatory variables, we used information criteria (Akaike, Schwarz and Hannan-Quinn). The aim was to find a regression model with a high value of the adjusted coefficient of determination in which all the variables involved are statistically significant.

Although most studies assumed the negative link between the business cycle and bank liquidity, the results show that the approach of [18] can be applied on banking sectors in the Visegrad countries (Tab. 3). A positive sign of the coefficient signals that the 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 a 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 a lower income and profits. The 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 and therefore it takes some time for changes to be reflected in banks' liquidity. Lagged values are also more likely reflect earlier decisions [4].

**Tab. 3: Determinants of Liquid Assets in the Visegrad Countries**

Variable	Coefficient	Standard deviation
Constant	102.4388*	11.50473
GDP(-1)	0.486145*	0.148849
IRB	-1.807430*	0.412376
IRL	1.067383*	0.412376
NPL(-2)	0.416755*	0.063177
ROE(-2)	0.069589*	0.024944
TOA	-7.174790*	0.990912
Adjusted R <sup>2</sup>	0.742173	
Durbin-Watson stat.	1.722985	
Total observation	669	

Note: The starred coefficient estimates are significant at the 1% (\*), 5% (\*\*) or 10% (\*\*\*) level.

Source: author's estimation

Bank liquidity is positively affected by the interest rate on loans and negatively affected by the interbank interest rate. Although these two effects may appear to be quite surprising, they are consistent with the problem of credit crunch and credit rationing (whose presence in the Czech banking sector was proved by [37]. According to [38], an increase in the interest rate is connected with two effects. The incentive effect increases interest incomes and thus the bank's profit. On the contrary, the risk of the bank's credit portfolio can increase due to an adverse selection effect and thus the profit decreases. So the increase in the interest rate on loans does not have to encourage banks to lend more. As a result, instead of the lending activity, banks focus more on liquid assets (either interbank transactions or trading with securities). The negative impact of the interbank interest rate may have a very similar explanation. Banks may perceive an increase in the interbank interest rate as a signal of a higher risk of interbank lending. Their motivation to lend to other banks (which would increase the liquid assets) is therefore lower. These findings are also in accordance with conclusions of [19] and [24] for the interbank interest rate and of [9] for the interest rate on loans.

We expected a negative influence of non-performing loans but results of the analysis show the opposite effect. This could be a sign of a prudent policy of banks: they offset

a higher credit risk in the previous year with cautious liquidity risk management.

The positive influence of bank profitability is statistically significant with two years lag which is in accordance with [2] who noted that liquidity constrained banks need to accumulate the profit which then may be invest in liquid assets and thus used as a source of liquidity.

According to our findings, small banks are more liquid than big banks in the Visegrad countries. This finding fully corresponds to the well-known "too big to fail" hypothesis. If big banks see themselves as "too big to fail", their motivation to hold liquid assets is limited. In case of a liquidity shortage, they rely on liquidity assistance of a Lender of Last Resort. This is also in accordance with results of [16], [19] and [21].

Capital adequacy, financial crisis, inflation, interest margin, monetary policy interest rate and unemployment rate have no statistically significant impact on liquid assets in the Visegrad countries.

The estimated coefficients that fit best the regression model for the Czech banks are presented in Tab. 4. The explanatory power of the model is quite high. 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, too, and with findings of [4], [9], [16] and [25].

The positive coefficient of the exchange rate CZK/EUR signals that the depreciation of

**Tab. 4: Determinants of Liquid Assets in the Czech Republic**

Variable	Coefficient	Standard deviation
Constant	46.22090*	8.915779
CAP	0.233440**	0.094555
EUR	2.761544*	0.288141
ROE	-0.1995948**	0.092963
Adjusted R <sup>2</sup>	0.746227	
Durbin-Watson stat.	1.761493	
Total observation	167	

Note: The starred coefficient estimates are significant at the 1% (\*) , 5% (\*\*) or 10% (\*\*\*) level.

Source: author's estimation

the Czech koruna leads to a higher liquid asset ratio. Interbank transactions are a substantial part of liquid assets. The Czech banking sector is a net lender in the interbank market [14]; it is therefore highly probable that at least some Czech banks lend also to a foreign bank. The profitability of such transactions increases with the domestic currency depreciation. Therefore, the depreciation of the Czech koruna can stimulate banks to focus more on the international interbank transaction and thus increase their level of liquid assets.

The influence of bank profitability on the value of the liquid asset ratio is opposite than it was for the entire group of the Visegrad countries. However, the negative influence of bank profitability measured by return on equity is consistent with the standard finance theory which emphasizes the negative correlation of liquidity and profitability and with results of [19].

The liquid asset ratio is determined by the capital adequacy, growth rate of GDP and size of the bank in Hungary. The explanatory power of the model for the Hungarian bank is very high (Tab. 5).

**Tab. 5: Determinants of Liquid Assets in Hungary**

Variable	Coefficient	Standard deviation
Constant	145.5259*	19.41154
CAP(-1)	-0.578454*	0.144927
GDP(-2)	-0.395486***	0.228533
TOA	-8.395486*	1.513355
Adjusted R <sup>2</sup>	0.916485	
Durbin-Watson stat.	1.839492	
Total observation	197	

Note: The starred coefficient estimates are significant at the 1% (\*) , 5% (\*\*) or 10% (\*\*\*) level.

Source: author's estimation

As in case of the whole group of the Visegrad countries, liquidity is decreasing with the size of a bank. On the contrary, the link between the business cycle and bank liquidity seems to be opposite: a negative sign of the coefficient signals that banks hold a smaller amount of liquidity in periods of the stronger

economic growth, as in [2] and [24]. However, this impact is statistically significant with two years lag which enable us to make a different conclusion. As two years after the recession banks hold a low level of liquid assets (and two years after the expansion the value of the liquid asset ratio is high a vice versa), it seems that

liquidity tends to be rather positively related to the business cycle (as in case of the entire V4 group and [18]).

A negative sign of the coefficient for capital adequacy can be again a sign of a prudent policy of banks: banks which have lower capital adequacy in the previous year pay more attention to liquidity risk management and hold a higher share of liquid assets [4].

Other variables (the share of non-performing loans, profitability, financial crisis, inflation, all interest rates (interbank, on loans, monetary policy), interest margin, inflation and

unemployment rate) have no statistically significant impact on bank liquidity in Hungary.

Determinants of the liquid asset ratio in Poland can be found in Tab. 6. Again, first we included all explanatory variables which might have an effect on the dependent variable and then we reduced them with the use of information criteria in order to find a regression model with a high value of the adjusted coefficient of determination in which all the variables involved are statistically significant. Two of them – capital adequacy and the size of the bank – have the same impact as in case of Hungary.

**Tab. 6: Determinants of Liquid Assets in Poland**

Variable	Coefficient	Standard deviation
Constant	77.51413*	17.65266
CAP	-0.533819**	0.268021
FIC	-7.468880*	2.390991
GDP(-2)	1.703999*	0.553103
TOA	-5.709038*	1.767866
Adjusted R <sup>2</sup>	0.668959	
Durbin-Watson stat.	1.728812	
Total observation	258	

Note: The starred coefficient estimates are significant at the 1% (\*) , 5% (\*\*) or 10% (\*\*\*) level.

Source: author's estimation

The negative impact of the financial crisis was discussed in Section 2 and is consistent with findings of [9] and [24]. The positive link between the business cycle and growth rate of

GDP is the same as in case of the entire group of the Visegrad countries, only the lag is one year longer. It seems that companies and households need more time for accumulating

**Tab. 7: Determinants of Liquid Assets in Slovakia**

Variable	Coefficient	Standard deviation
Constant	34.23601*	5.075040
CAP(-1)	-0.693248***	0.366619
IRL	2.910604*	0.413125
ROE	-0.178342*	0.064737
UNE	-1.565712*	0.326671
Adjusted R <sup>2</sup>	0.541637	
Durbin-Watson stat.	1.940998	
Total observation	119	

Note: The starred coefficient estimates are significant at the 1% (\*) , 5% (\*\*) or 10% (\*\*\*) level.

Source: author's estimation

the profit and savings before they will reduce their proportion of external financing which would result in higher bank liquidity.

The liquid asset ratio of Slovak banks is determined by bank capital adequacy and profitability, the interest rate on loans and the rate of unemployment (Tab. 7). The link between capital adequacy and bank liquidity shows (as in case of Hungarian and Polish banks) that banks offset lower capital adequacy in the previous year with more cautious liquidity risk management and hold sufficient buffer of liquid assets [4].

Bank liquidity is positively influenced by the interest rate on loans which is again consistent with the problem of credit crunch and credit rationing (as in case of the entire group of the Visegrad countries). More liquid banks are less profitable (as in case of Czech banks and in [19]). The last determinant is unique for Slovakia but is in accordance with [24]: as the level of unemployment is connected with demand for loans and can act as a proxy for general health of the economy, the higher the rate of unemployment the more liquidity is held by banks. No other variable statistically significantly influenced the liquid asset ratio of Slovak banks.

## Conclusion

The aim of this paper was to describe the development of the liquid assets ratio and to find out determinants which affect their values in the Visegrad countries. Liquidity of Czech banks declined in 2000–2009 (due to a higher lending activity and decrease of balances with central banks and other banks) but it has improved during last two years. The drop in the liquid asset ratio of Hungarian, Polish and Slovak banks is mainly a result of the financial crisis. In Slovakia, the crisis influenced sectors in which banks have significant credit exposures. It was accompanied by the change of interbank market activities. Situation in the Polish and Hungarian banking sector was very similar. Some important structural weaknesses occurred in both countries: a very high loan-to-deposit ratio, a high share of foreign debts, and a negative net position in the interbank market. These weaknesses gained special importance due to the worsening financial and economic conditions.

Furthermore, we focused on determinants of the liquid asset ratio. The liquid asset ratio is positively affected by the interest rate on loans, the growth rate of GDP in the previous year, the share of non-performing loans, two years lagged and by bank profitability, two years lagged, and negatively affected by the size of the bank and the interbank interest rate. The liquid asset ratio of Czech banks increases with higher capital adequacy and with the depreciation of the Czech koruna and decreases with higher bank profitability. In Hungary, the liquid asset ratio is determined by bank capital adequacy, the size of the bank and the growth rate of GDP, two years lagged. The impact of all these factors is negative. The impact of capital adequacy and the size of the bank is the same for Polish banks; moreover, the liquid asset ratio decreases during the period of the financial crisis and two years after the recession in Poland. Finally, liquidity of Slovak banks is positively influenced by the interest rate on loans and negatively influenced by capital adequacy in the previous year, bank profitability and the rate of unemployment.

Although the Visegrad countries have a lot in common, it is evident that different factors determined the liquid asset ratio in individual countries. The only factor that determines the liquid asset ratio in all analyzed countries is capital adequacy. However, the link between capital adequacy and bank liquidity differs among countries. In the Czech Republic, liquid banks are solvent, too, which is consistent with the risk absorption hypothesis. On the contrary, insolvent banks are more liquid in all other countries, which confirm the financial fragility-crowding out hypothesis. This finding raises interesting policy issues. While regulators may be able to make banks safer by imposing higher capital requirements, this benefit may be associated with a reduction of liquidity of Hungarian, Polish and Slovak banks.

The positive impact of the interest rate on loans (in Slovakia and in the entire group of V4) and interbank interest rate (in V4) is positive which signals the existence of the information asymmetry on these markets. Also the link between the size of the bank and its liquidity is the same for all countries where this factor was statistically significant: Hungary, Poland and the entire group of Visegrad countries. The direction of influence of some factors, such as

bank profitability or the growth rate of GDP differs among countries. Some other factors, such as the exchange rate, the existence of the financial crisis or the rate of unemployment was statistically significant only in one country. Inflation, interest margin and monetary policy interest rate have no statistically significant effect on the liquid asset ratio in any of the Visegrad countries.

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**Ing. Pavla Vodová, Ph.D.**

Silesian University in Opava

School of Business Administration in Karviná

Department of Finance

vodova@opf.slu.cz

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## Abstract

**LIQUID ASSETS IN BANKING: WHAT MATTERS IN THE VISEGRAD COUNTRIES?****Pavla Vodová**

*The recent financial crisis has shown that a liquidity risk plays an important role in the current developed financial system. Some Hungarian and Polish banks suffered liquidity problems, too. This paper therefore aims to describe development of liquid asset ratio and to find out determinants which affect their values in the Visegrad countries. The data cover the period from 2000 to 2011. Liquidity of Czech banks declined in 2000–2009 (due to higher lending activity and decrease of balances with central banks and other banks) but it has improved during last two years. Liquidity of Slovak banks has decreased in 2009 and 2010 due to impact of financial crisis on some economic sectors and due to changes in interbank market transactions. Very similar is the development of liquid asset ratio in Hungary and Poland where it has gone down during last five years due to important structural weaknesses such as very high loan-to-deposit ratio, high share of foreign debts, and negative net position in the interbank market. Furthermore, we focus on determinants of liquid asset ratio. Results of the panel data regression analysis showed that the liquid asset ratio is mostly influenced by the size of the bank, its capital adequacy and profitability. Also overall macroeconomic conditions, such as growth rate of gross domestic product, the existence of financial crisis, exchange rate or rate of unemployment and the development of interest rates (both on loans and interbank transaction) are important. Although the Visegrad countries have a lot in common, different factors determined liquid asset ratio in individual countries and also the direction of influence of some factors may differ.*

**Key Words:** liquid assets, panel data regression analysis, commercial banks, Visegrad countries.

**JEL Classification:** C23, G01, G21.