Determinants of Sensitivity of Czech Commercial Banks to the Bank Run

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Abstract
The aim of this paper is to find out the worst-case scenario for individual banks from the Czech banking sector and to find out determinants of their sensitivity to the bank run in the period from 2000 to 2014. We used a liquid asset ratio and a stressed value of this ratio to assess the sensitivity of banks to a bank run. This sensitivity strongly increased in the second half of the analyzed period. The ability of individual Czech banks to survive an unforeseen deposit withdrawal significantly differs. Two bank specific (profitability and liquidity of the bank) and two macroeconomic (interest rate on loans and unemployment rate) factors have the most important influence on the sensitivity of Czech banks to a possible bank run.

Keywords: bank run, liquid asset ratio, scenario analysis, panel data regression analysis
JEL codes: C23, G01, G21

1. Introduction

Liquidity risk can be defined as the risk that a bank, though solvent, either does not have enough financial resources to allow it to meet its obligation as they fall due, or can obtain such funds only at excessive costs (Vento and La Ganga, 2009). The insufficient liquidity of a bank may lead to a situation when the majority of depositors intend to withdraw their funds which will cause a bank run.

Czech banking sector experienced a bank run on – at that time the third-biggest bank – Investiční a Poštovní banka, in 2000 and on a number of small banks and credit unions in the nineties and at the beginning of the 21st century. Bank runs have also occurred in developed economies in recent years, for example, the run on the fifth-largest mortgage lender in the United Kingdom, Northern Rock, in September 2007.

Even if a potential bank run on Czech banks may be nowadays perceived as exceptional, extreme or simply unexpected, it is still a plausible event, therefore in accordance with the recommendation of the Basle Committee for Banking Supervision financial institutions should gauge their potential vulnerability to such events by conducting of stress tests (BIS, 2000). However, such stress testing could result in findings that the worst-case scenario for each bank in the banking sector is different. It could be therefore useful to investigate not only the level of bank sensitivity to the bank run, but also factors which affect this sensitivity.

The aim of this paper is therefore to find out the worst-case scenario for individual banks from the Czech banking sector and to find out determinants of their sensitivity to the bank run during the last fifteen years (i.e. in the period 2000 – 2014).

The paper is structured as follows. Next section gives theoretical background of bank liquidity and bank runs. Then we focus on methodology, data and results of the analysis. Last section captures concluding remarks.

2. Bank Liquidity and Bank Runs

Banks have been always plagued by the problem of bank runs. Freixas and Rochet (1997) define a bank run as a situation wherein depositors observe large withdrawals from their bank, fear bankruptcy and respond by withdrawing their own deposits. Withdrawals in excess of the current

expected demand for liquidity generate a negative externality for the bank experiencing the liquidity shortage, since they imply an increase in the bank's probability of failure.

Banks are vulnerable to runs that can lead to closure and liquidation because they issue liquid liabilities in the form of deposit contracts, but invest in illiquid assets in the form of loans. A banking panic then occurs when depositors at many or all of the banks in a region or a country attempt to withdraw their funds simultaneously (Allen and Gale, 1998).

The severity of the impact of a bank run on the banking sector and the whole economy depends mainly on the reaction of the depositors after the deposit withdrawal. According to Kaufman (1988), depositors have three choices as to what to do with their withdrawals: (i) they can redeposit their funds at another bank that is perceived to be safer; we call this a direct redeposit; (ii) they can purchase a security or real asset that is perceived to be safer (such as a treasury security), which is known as indirect redeposit; or (iii) they can hold the funds in cash outside the banking system, which will turn into a run on the banking system as a whole.

Bank runs can be prevented mainly by establishment of a functional deposit insurance scheme and by efficient liquidity risk management of individual banks.

3. Methodology and Data

First of all, we will evaluate the level of liquidity risk of each bank in the sample with the most commonly used liquidity ratio which is a liquid asset ratio. Liquid asset ratio (LAR) is the share of liquid assets in total assets (Equation 1).

$$LAR = \frac{liquid\ assets}{total\ assets} * 100(\%) \tag{1}$$

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. As we use the BankScope measure of liquid assets, the term liquid assets includes cash, government bonds, short-term claims on other banks (including certificates of deposit), and where appropriate the trading portfolio.

As a next step, we will simulate a run on a bank by the withdrawal of a certain volume of clients´ deposits. We simulate a 20% withdrawal of deposits; this haircut is applied on the total deposits not taking into account agreed maturities of different types of deposits. This is the way how to model an outflow of primary sources from the bank. This stress scenario is based on previous studies which are cited e.g. in Klepková Vodová (2015). To calculate the stressed value of the liquid asset ratio, we have to deduct the volume of withdrawn deposits, i.e. 20% of clients´ deposits, from liquid assets. Bank must use liquid assets to be able to repay deposits. At the same time, volume of total assets is also decreasing as a result of this operation. Equation 2 captures these modifications:

$$LAR_S = \frac{liquid\ assets - 0.2 * deposits}{total\ assets - 0.2 * deposits} * 100(\%) \tag{2}$$

After that, we will compare this stress value of the liquid asset ratio (LAR_S) to the baseline value of this ratio (LAR_B, i.e. LAR). The percentage change will be calculated according to the Equation 3. The results will show the magnitude of the relative changes between the stress and baseline values which will enable us to find out which bank is the most vulnerable. We will be also able to find out the worst-case scenario for each bank in the sample.

$$\Delta LAR = \frac{LAR_S - LAR_B}{LAR_B} * 100(\%) \tag{3}$$

Finally, in order to identify determinants which affect the worst-case scenario for Czech banks, we will use the panel data regression analysis (Equation 4).

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

where ΔD_{it} is the maximum deposit withdrawal for bank i in time t, X_{it} is vector of explanatory variables for bank i in time t, α is constant, β' is coefficient which represents the slope of variables, δ_i represents fixed effects in bank i, and ε_i means the error term. It is evident that the most important task is to choose the appropriate explanatory variables. Although liquidity problems of some banks during 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. This is especially true for determinants of bank sensitivity to any stress scenario. We can find some studies focusing on determinants of selected liquidity ratios. The literature review can be found e.g. in Vodová (2013). However, according to our knowledge, there is no empirical study focusing on determinants of bank vulnerability to a bank run. This paper therefore attempts to fill this gap.

The selection of explanatory variables is based on the studies cited in Vodová (2013). We considered whether the use of the particular variable makes economic sense in case of the Czech banking sector. We also considered which other factors could influence the sensitivity of banks to the bank run.

We can expect that the most vulnerable banks should be those banks whose amount of client deposits is not sufficient to finance their activities. Therefore they need to use other sources of funding. Vulnerable banks should also focus more on providing loans to non-bank customers; therefore they have a lower buffer of liquid assets. Liquidity is closely linked to profitability of banks. If banks prefer only to achieve maximum profitability, they provide relatively more loans to non-bank customers and they use more funds from the interbank market for the financing of their activities, which makes them much more vulnerable in case of crisis (which can be accompanied by, e.g. a bank run). On the contrary, the safest strategy is to hold a sufficient buffer of liquid assets (i.e. to have high value for the LAR ratio), to provide loans to non-bank customers reasonably and to finance lending activity mainly from client deposits. These ideas, together with findings of studies focusing on determinants of liquidity ratios, are reflected in the list of used variables (Table 1).

Table 1: Variables Definition

Variable	Source
CAP: the share of equity in total assets of the bank	BankScope
NPL: the share of non-performing loans in total volume of loans	BankScope
ROA: the share of net profit in total assets of the bank	BankScope
TOA: logarithm of total assets of the bank	BankScope
NITA: the share of net interbank position on total assets of the bank	BankScope
LODE: the share of loans in deposits of the bank	BankScope
LOTA: the share of loans in total assets of the bank	BankScope
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	CNB
IRM: difference between interest rate on loans and interest rate on deposits	CNB
MIR: monetary policy interest rate	CNB
UNE: unemployment rate	IMF

Source: author's processing

We considered seven bank specific factors and seven macroeconomic factors. We do not have an exact expectation of the impact of these factors on the bank sensitivity to the bank run as this is the first study investigating this problem.. The macroeconomic data were provided by the International Financial Statistics of the International Monetary Fund (IMF) and Czech National Bank (CNB). The bank specific data were obtained from the unconsolidated balance sheet and profit and loss data recorded in the database BankScope.

Table 2: Data Availability

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Total no. of banks	40	38	37	35	35	36	37	37	37	39	41	44	43	44	45
No. of obsv. b.	15	15	16	16	16	16	13	13	12	12	13	13	14	14	14
Share of as. (%)	59	68	74	74	74	72	75	75	66	68	68	75	69	72	74

Source: http://www.cnb.cz/cnb/STAT.ARADY_PKG.PARAMETRY_SESTAVY?p_sestuid=33049&p_strid=BAA&p_lang=CS

We used data over the period 2000 – 2014. Table 2 shows more details about the sample. In spite of the relatively small number of banks in the sample, the data set includes significant parts of the Czech banking sector (around 70% of total assets of the banking sector). Due to the homogeneity of the data set, we include only data from commercial banks. We abstract branches of foreign banks, mortgage banks, building societies and state banks with special purpose (like Českomoravská záruční a rozvojová banka, or Česká exportní banka). The panel is unbalanced as some of banks do not report or exists over the whole period of time.

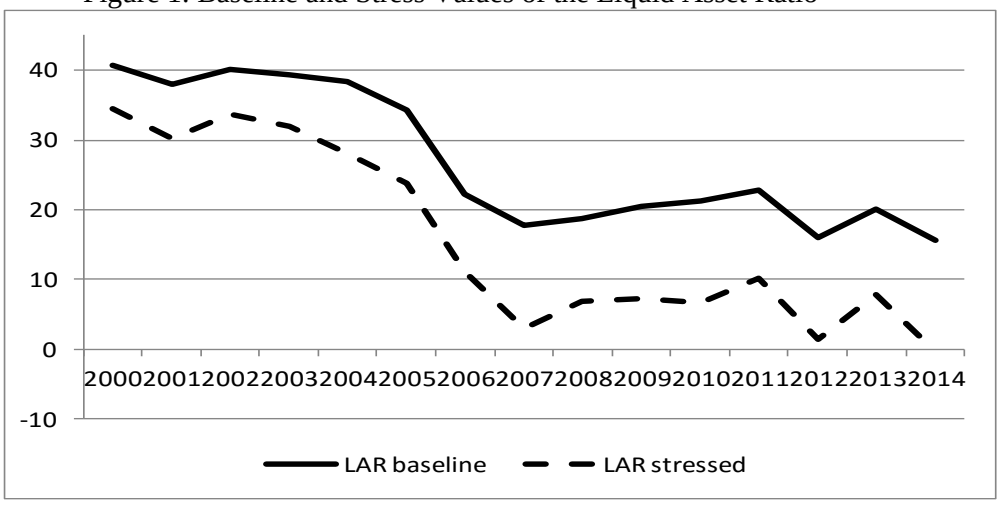
4. Results and Discussion

The first part of this section shows the median values of the baseline and the stress values of the liquid asset ratio and also worst-case scenario for each bank. The second part of this section focuses on factors which determine this scenario.

4.1 Scenario Analysis

The median values of the baseline and stress values of share of liquid assets in total assets (LAR) are presented in Figure 1.

Figure 1: Baseline and Stress Values of the Liquid Asset Ratio



Source: author´s calculations

As a higher value for this ratio means higher liquidity, it is evident that that bank liquidity in the Czech Republic has decrease during the analyzed period. Liquidity of Czech banks declined in 2000-2007, 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 (CNB, 2008). After a slight improvement of liquidity during 2008-2011, the liquidity further decreased in recent years. As the biggest part of liquid assets of

the Czech banking sector consists from government securities, it is evident that the development of liquid assets as a whole is strongly influenced by their volume held by banks (CNB, 2012 and 2014).

A lower stressed value for this ratio is a clear signal of a liquidity outflow. With the exception of 2014, median values of the stressed liquid asset ratio for Czech banks are positive for the whole analyzed period. This means that Czech banking sector as a whole should be well prepared for a bank run, simulated by a withdrawal of 20% of client´s deposits. Of course, individual banks in individual years could have problems with such crisis development; we can mention for example Equa bank in 2011-2014, Česká spořitelna in 2006-2008 and 2014, ČSOB in 2006-2008 and 2010, GE Money Bank in 2007-2009, J&T banka and Expobanka in 2012-2014, or Raiffeisenbank in 2010-2013.

Table 3: Average Decrease of the LAR Ratio (in %)

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
ΔLAR	9	20	20	27	30	44	56	85	77	63	76	65	137	104	95

Source: author´s calculations

Looking at the average impact of a bank run on the liquid asset ratio, we can see that, due to the bank run, the decrease of bank liquidity gradually increased during the years analyzed (see Table 3 for average values and Appendix for values for all banks in the sample). It is evident that the financial crisis increased the sensitivity of Czech banks to a possible bank run. However, it is quite surprising that banks would have been the most vulnerable two years ago. It seems that there exists a significant time lag between the emergence of the financial crisis and impacts of this crisis on financial stability of banks.

Table 4: Average Maximum Deposit Withdrawal in the Czech Banking Sector (in %)

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
ΔD	131	100	85	82	86	54	49	40	31	60	44	41	29	32	27

Source: author´s calculations

Our aim is also to find out the maximum volume of deposits that can be withdrawn from individual banks, i.e. to find out the worst-case scenario for each bank. The threshold volume of deposits was calculated assuming that the bank can use the whole volume of liquid assets to meet the demands for cash of depositors. The data in Table 4 shows the average maximum deposit withdrawal for Czech banking sector. The ability of individual banks to cover deposit withdrawals, i.e. what is the maximum deposit withdrawal (in percent of deposits) which the banks would be able to survive, can be found in Appendix.

As we can see, there are significant differences among banks. There exist banks that could only finance the withdrawal of less than 10% of deposits, such as Expobanka in 2012-2014, Raiffeisenbank in 2010 and UniCredit Bank in 2012-2013. If customers would like to reduce their deposits more, the existence of these banks would be threatened because of insufficient liquidity. On the contrary, at least in some years, the depositors of the following banks would be able to withdraw more than 50% of their deposits: Calyon bank, Citibank, Dresdner bank for the whole period, Airbank (in 2012-2013), Česká spořitelna (in 2000), ČSOB (in 2000, 2012-2013), eBanka (in 2000-2003, 2006-2007), Equa bank (in 2002-2007), Evropsko-ruská banka (in 2009-2011), Expobanka (in 2000-2006), Fio banka (in 2011-2014), GE Money Bank (in 2000-2003), HVB Bank (in 2001), J&T banka (in 2000), Komerční banka (in 2000, 2002-2005), Raiffeisenbank (in 2000-2005), Sberbank (in 2000-2001) and Živnostenská banka (in 2000-2003).

4.2 Panel Data Regression Analysis

To be able to find out which factors determine sensitivity of Czech banks to a bank run, we used an econometric package EViews 7. After tests of stationarity, normality and multicollinearity, we proceed with regression estimation. We estimated Equation 4. 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. The results are recorded in Table 5.

Table 5: Factors Affecting Bank Sensitivity to the Bank Run

Variable	Coefficient	Standard deviation
Constant	-1.852092*	0.324240
ROA (-2)	0.034600**	0.009717
LODE	-0.003867*	0.000626
IRL	0.214703*	0.045939
UNE(-1)	-0.104914*	0.023475
Adjusted R2	0.559081	
Durbin-Watson statistics	1.868249	
Total panel observation	172	

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

The explanatory power of the model is quite high. The sensitivity of Czech banks to the possible bank run, or, more preciously, the maximum deposit withdrawal for individual Czech banks, is determined mainly by two bank-specific and two macroeconomic factors.

Focusing on bank-specific factors, profitability and liquidity of the bank matter. The share of loans to deposits (LODE) is an indirect measure of bank liquidity. This ratio relates illiquid assets to liquid liabilities. The higher this ratio the less liquid the bank is. Values of this ratio lower than 100% mean that loans provided by the bank are fully financed from clients´ deposits. Values higher than 100% signal that bank needs also other source of funding such as interbank loans or funds from debt securities issuance. In terms of liquidity risk, banks should prefer lower value of this ratio as clients´ deposits are generally stable source of funding. Higher values indicate that the bank is more vulnerable, especially in case of market turbulence. The negative sign of the regression coefficient is consistent with the fact that the lower the values of the LODE ratio (and thus the higher the bank liquidity), the higher deposit withdrawal the bank is able to withstand. Such finding is fully logical.

The positive link between bank profitability measured by return on assets (ROA) and the ability of the bank to face a bank run may be a bit surprising. However, bank profitability is one of the key factors of financial stability of the bank. This variable is two years lagged which means that banks that were financial stable in the past are much more safer even in case of sudden deposit withdrawal.

Among macroeconomic factors, two variables are statistically significant: interest rate on loans (IRL) and the rate of unemployment (UNE). The interest rate on loans is probably connected with bank profitability. With higher interest rate on loans, the lending activity of the bank becomes more profitable. And with higher accumulated profit, the bank is more able to withstand any crisis development.

The unemployment rate is the last statistically significant variable. With increase of the rate of unemployment in previous year, bank customers are able to withdraw smaller part of their deposits. This variable can act as a proxy for general health of the economy. Therefore with increase of the rate of unemployment (and with worsening macroeconomic conditions in the past), banks are more vulnerable to possible bank runs.

Other variables (size of the bank, its capital adequacy, share of non-performing loans, share of net interbank position in total assets, share of loans in deposits, inflation rate, interbank interest rate, interest margin and monetary policy interest rate) have no statistically significant impact on sensitivity of Czech banks to the bank run.

We can compare our results only with findings of Vodová (2013) who analyzed determinants of liquid asset ratio in the Visegrad countries for the period from 2000 to 2011. When it comes to Czech banks, determinants of the holding of liquid assets are completely different from factors which influence the sensitivity of banks to potential bank run. However, as we can see, factors that affect sensitivity of banks to possible bank run have some connection to bank liquidity. This confirm us the fact that the ability of banks to withstand an unforeseen deposit withdrawal is strongly determined by the level of bank liquidity. Banks which have sufficient buffer of liquid assets are safer than other banks, mainly in periods of financial distress.

5. Conclusion

The aim of this paper was to find out the worst-case scenario for individual banks from the Czech banking sector and to find out determinants of their sensitivity to the bank run during the last fifteen years.

Liquidity of Czech banks measured by the liquid asset ratio has decreased during the analyzed period, mainly in 2000-2007; then it slightly improved in 2008-2011, and after that, bank liquidity further decreased in recent years. Such development is mostly influenced by the volume of government securities held by banks.

Stressed values of the liquid asset ratio indicated that Czech banks on average would be well prepared for a potential bank run. However, the impact of the stress scenario increased during analyzed period. The ability of individual banks to survive an unforeseen deposit withdrawal significantly differs.

The results of the panel data regression analysis showed that the sensitivity of Czech banks to the possible bank run, or, more preciously, the maximum deposit withdrawal for individual banks, is determined mainly by bank profitability, its liquidity (connected with lending activity), interest rate on loans and unemployment rate. We can conclude that the ability of banks to withstand an unforeseen deposit withdrawal is strongly determined by the level of bank liquidity. Banks which have sufficient buffer of liquid assets are safer than other banks, mainly in periods of financial distress.

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