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Models for Stress Testing Czech Banks´ Liquidity Risk

Zlatuše Komárková, Adam Geršl, and Luboš Komárek*

Abstract

We provide a macro stress-testing model for banks' market and funding liquidity risks with a survival period of one and three months. The model takes into account the impact of both bank-specific and market-wide scenarios and considers both the first- and second-round effects of shocks. The testing model has three phases; (i) the formation of a balance-sheet liquidity shortfall, (ii) the reaction by banks, and (iii) the feedback effects of shocks. During each phase we re-count the liquidity buffer and examine whether banks hold a sufficiently large amount of liquid assets to be able to survive the liquidity tension in their balance sheets. An application to Czech banks illustrates which bank business models are sensitive to liquidity tensions. Overall, we confirm that the Czech banking system is resilient to a scenario mimicking the international liquidity crisis of 2008–2009.

JEL Codes: G12, G19, G21.

Keywords: Banking, financial stability, liquidity risk, stress testing.

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Nontechnical Summary

The recent financial crisis has shown how important a role liquidity risk plays in the current developed financial system and has highlighted a pre-crisis lack of sound liquidity risk management in financial institutions. During the very short crisis period, idiosyncratic liquidity risk became systemic through direct and/or indirect linkages within the financial system. Financial institutions themselves were not able to fight this systemic risk effectively. The functioning of the global financial system was very often seriously disrupted. The relevant authorities took some measures to mitigate the negative impacts of systemic liquidity risk as part of their crisis management programs. However, there was a need to develop prudential tools for protecting the financial system against similar negative liquidity events. These prudential tools include liquidity stress testing.

The presented liquidity stress-testing model is a new instrument that the CNB uses for simulating the negative impact of market and funding liquidity shocks on the Czech banking system. Considering the available literature concerning liquidity, liquidity risk, and liquidity risk stress testing, we incorporated a basic recommended assumption into the model – direct and indirect financial sector systemic linkages. We mainly followed the Dutch liquidity stress-tester framework (van den End, 2008), adjusting it slightly to the needs of the Czech banking sector (a system with a liquidity surplus). The Czech framework focuses on the mechanics and possible dynamics of a bank's market-banking liquidity relationship under stress.

The CNB's model considers the impact of both idiosyncratic and market-wide scenarios in three logically interlinked phases: (i) the formation of a balance-sheet liquidity shortfall as the first-round effect of shocks, (ii) the reaction by banks, and (iii) the feedback effects of shocks, including reputational and systemic risks. With each step we re-count the liquidity buffer and examine whether or not the tested banks hold a sufficiently large amount of liquid assets to be able to survive the liquidity tension in their balance sheets. Our empirical analysis is based on an October 2011 data set for 23 reporting Czech banks operating in the Czech Republic in 2011 (excluding branches and subsidiaries of foreign banks). The data reports include on- and off-balance-sheet items for all the Czech banks tested, with a rather detailed breakdown per item. The data are available on a monthly basis and the test was run for scenario horizons of one month and three months without any parameter changes.

The initial parameters of the scenario are designed firstly by assuming a liquidity shortfall and a decline in the value of banks' tradable portfolios due to uncertainty about asset valuations, which is caused by the drying-up of market liquidity, and secondly by assuming a decline in the value of non-tradable assets if a bank liquidates them prematurely. Some additional market specifications concerning the impossibility of raising any funding are also considered: no net additional intra-group funding (where applicable) is available, and no additional intrabank funding or securities issuance is available. The impaired market conditions in the scenario are triggered regardless of whether or not a bank is active in the market, and the values of marketable assets are cut according to these conditions. Only sales of non-tradable assets (often illiquid ones) are conditional on the reactions of the bank holding the particular non-tradable assets. The two conditions of the scenario – bank runs and a reduction in the value of assets sold before maturity –

are linked to the results of the credit and market risk stress tests published in CNB (2011). The underlying intuition is that banks that incurred accounting losses in the stress scenarios face a greater outflow of liquidity than profitable banks. In sales of illiquid assets, account is taken of the quality of the bank's assets as measured by the credit portfolio risk costs.

The model outcomes showed that the Czech banking system as a whole seems to be stable and liquid enough. As Czech banks stand more or less on a conservative business model (without large activity in the capital or money market), the impact of the first round of shocks was more significant than the second round. Most Czech banks have a sufficient liquidity buffer to be able to withstand a potential liquidity stress on their balance sheets. However, a few of the banks tested lost over 100% of their initial liquidity buffer, which means that they were not able to cover a further increase in claims with their own funds and were forced to sell illiquid assets.

The proposed framework can be readily applied to other banking systems, and its great advantage is the simplicity with which it can be applied. Its disadvantage is that it is based on reporting data which are usually not publicly available. The test does not represent a redemptive prudential tool for detection of accumulated excessive liquidity risk within the financial system, but it can be used by a prudential supervisory authority as a suitable alternative to existing tools (the Liquidity Coverage Ratio and Net Stable Funding Ratio – BIS, 2010).

1. Introduction

The global financial crisis beginning in 2007 illustrated the importance of including liquidity risk within stress-testing frameworks, especially when the US bank Lehman Brothers went bankrupt in the fall of 2008 and many US and European banks were hit by severe idiosyncratic funding shocks. Since then the banking sector has been affected by a liquidity crisis and some central banks have had to take unconventional measures to provide funding to solvent but illiquid banks. The severity of the global financial crisis reminds us how important it is to investigate banks' liquidity risks. Therefore, the CNB has increasingly focused on analyzing the liquidity situation of Czech banks.

The concept of liquidity has been analyzed in a vast amount of literature. In this paper, we follow the classification presented in Geršl and Komárková (2009) and differentiate between balance-sheet (or funding) liquidity and market liquidity, acknowledging their mutual interaction and reinforcing effects. Banks usually hold a liquidity buffer containing highly-liquid securities to meet outstanding obligations at a reasonable cost (balance-sheet liquidity). For this to be possible, markets must be able to accomplish trades of a given volume of securities without significantly affecting their prices (market liquidity). Assets may be liquid at some stage but may suffer significant haircuts and/or valuation uncertainty at other points in time. Thus, the ability to raise cash (banks' funding risk) is strongly linked to the ability to convert assets into cash at a given price (market liquidity). Additionally, because the relationship between market and funding liquidity is two-sided, there is the potential for a feedback effect, and a liquidity shock to a single institution can spread further and lead to a downward liquidity spiral.[1]

Moreover, we also differentiate between liquidity (of any kind) and liquidity risk. Liquidity is essentially a binary concept, as an institution or market either is or is not liquid at any particular point in time. On the other hand, liquidity risk – defined as the possibility that an institution or market will become illiquid – is a continuous variable measured over a specific time horizon.

The balance-sheet liquidity of banks can be analyzed in three main ways. First, one can focus on monitoring and assessing the evolution of balance-sheet ratios such as the ratio of liquid assets to total assets, the customer-funding gap, the deposit-to-loan ratio, and the ratio of wholesale funding to total funding, or the degree of maturity mismatch in the balance sheet. Second, market-based indicators can be interpreted as reflecting balance-sheet liquidity tensions. These can include market prices (liquidity risk premia in market rates) and the institution's market behavior, for example in bidding in the central bank's open market operations (Drehmann and Nikolaou, 2009; Geršl and Komárková, 2009). Finally, liquidity stress testing can be used to quantify the impact of liquidity stress on individual banks or the banking system as a whole.

This paper focuses on liquidity stress testing, acknowledging the complexity of the liquidity concept to quantify liquidity risk using simple balance-sheet measures and the relatively shallow financial markets to be able to fully exhaust market-based indicators. The CNB has been developing its liquidity stress-testing model since 2007. It focuses on the mechanics and possible dynamics of a bank's market-banking liquidity relationship under stress. The recent crisis

[1] A situation in which falling asset prices generate pressures on less sound banks, leading to deposit withdrawals and the need to liquidate additional assets, causing further falls in asset prices.

revealed that the deepening symbiosis between banks and financial markets has led to a more efficient allocation of savings through the financial system on the one hand, but also to greater dependence of banks on market liquidity on the other hand (Praet and Herzberg, 2008). With this greater dependence on financial markets, and more specifically on short-term funding, banks have become more vulnerable to all the factors that form or affect market liquidity. This feature, combined with insufficiently large bank liquidity reserves, contributed to the severity of the recent crisis (Riksbank, 2010). The CNB's model covers both the market and funding liquidity risk of banks and also takes into account the first- and second-round (i.e. feedback) effects of shocks, the latter including idiosyncratic (reputational) and systemic (collective reaction) risks.

The structure of the paper is as follows. Section 2 discusses the related literature. Section 3 briefly describes the liquidity situation in the Czech banking system. Section 4 is devoted to the methodology of liquidity stress testing. Section 5 presents model simulations for Czech banks. Section 6 concludes.

2. Related Literature

To investigate the determinants of liquidity risk in Czech banks' balance sheets and measure the impact of liquidity shocks on the Czech banking system as a whole, we draw on the literature on liquidity, liquidity risk, and the market-banking liquidity relationship under normal and stress conditions, as well as on the literature on methods for measuring the impact of liquidity risks, for example liquidity risk stress-testing models, especially with feedback effects.

Several papers investigate liquidity, liquidity risk, and the market-banking liquidity relationship within the financial system. Nikolaou (2009) introduces various types of liquidity (funding, market, and monetary) and explains the strong, complex, and dynamic linkages among them. 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 remain strong, but become propagation channels of liquidity risk in the financial system, leading to a vicious circle. Similarly, Adrian and Shin (2009) and Praet and Herzberg (2008) provide the theoretical and practical foundations for banks' market-banking liquidity relationship under stress – the mark-to-market effects on banks' balance sheets, which lead to a downward liquidity spiral in asset prices and contagious defaults of banks through market linkages. A well-known model that links asset market liquidity and traders' funding liquidity is provided by Brunnermeier and Pedersen (2009). They show that under certain conditions market and funding liquidity are mutually reinforcing and lead to liquidity spirals. They also empirically document the features that market liquidity can suddenly dry up, has commonality across securities, is related to volatility, is subject to "flight to quality", and co-moves with the market. Some other papers (e.g. Cifuentes et al., 2005; Nier et al., 2008; IMF, 2009), besides contagion via changes in asset prices, consider another channel through which liquidity risk can be transferred – direct exposures among financial institutions. Liedorp et al. (2010) test interconnectedness in the interbank market as a channel through which banks affect each others' riskiness. They show that interbank funding exposures to other banks in the system exhibit significant spill-over coefficients. Interlinkages within the financial system are nothing fundamentally new, but the current crisis has highlighted how systemic linkages can arise not just from banks' solvency concerns but also from a credit event or liquidity squeeze throughout the banking system via direct linkages in the interbank market (ECB 2009; IMF 2009).

The above literature focusing on liquidity and liquidity risks shows that interactions between funding liquidity risk and market liquidity, especially in periods of crisis, and the associated downward liquidity spiral are fundamental features that have to be taken into account in order to assess the impact of liquidity events. At the same time, it draws attention to direct financial sector systemic linkages. This implies that the development of an appropriate and effective liquidity risk stress-testing model should take into account both direct and indirect financial sector systemic linkages. Our liquidity stress-testing model presented in this working paper takes into account both the basic forms in which liquidity risk can materialize, that is, market liquidity risk and funding liquidity risk, and their interaction with each other (the indirect contagion effect). The direct contagion effect (network effect) is not directly included in the model. Nevertheless, a drying-up of liquidity in the money market caused by liquidity hoarding and by a high level of counterparty risk forms part of the scenario for the first round of liquidity shocks applied.

This paper is also related to the literature on stress-testing models. Our approach is consistent with the stress-testing literature relating bank runs to extreme market episodes in which liquidity withdrawals are linked to banks' solvency risk. We follow Van den End's liquidity stress-tester framework (Van den End, 2008). Van den End's model, based on re-counting of liquidity buffers after the impacts of several kinds of shocks, combines both the market and funding liquidity risks of banks, with feedbacks between them driving the second-round effects of market disturbances on banks. Banks' responses are assumed to be triggered by a decline in the liquidity buffer. In this model, the second-round (feedback) effects of shocks are mechanically determined by the number and size of reacting banks and the similarity of reactions. However, our framework is different in some elemental parts. Firstly, Van den End's model comprises a combined stock and cash flow approach, whereas due to a lack of reporting data our framework considers only the stock of liquid assets. Secondly, while the shocks in the first-round effects of the Dutch model are designed in the case of liquid assets as haircuts, our framework takes into account both the reduced value of assets on the one hand and the increased amount of loans on the other hand (both of which increase the financing needs). Lastly, further differences relate to the assumption regarding banks' reactions and the trigger for those reactions. The Dutch model assumes that the responses of banks are triggered if the decline in the liquidity buffer after the first round of effects breaches a predefined threshold. The reactions are assumed to take the form of sales of tradable securities, the issuance of additional securities, or the substitution of some assets or liabilities with other items. The Czech approach does not allow any increase in the liability side of banks' balance sheet even if banks react. The trigger for the reactions in our framework is much simpler. Czech banks are assumed to react when they run out of cash and receivables from the central bank. The differences in the approaches stem largely from differences between the financial systems of these two countries (see section 3).

Besides the Dutch model we were also inspired by the liquidity stress-testing framework presented by Wong and Hui (2009). The authors developed a stress-testing framework to assess liquidity risk of banks, where liquidity and default risks can stem from the crystallization of market risk arising from a prolonged period of negative asset price shocks. They took into account three channels through which asset price shocks are transformed into banks' liquidity risk: (i) mark-to-market losses increase banks' default risk and induce deposit outflows, (ii) the ability to generate liquidity from asset sales evaporates due to the shocks, and (iii) due to more stressful financial environments the likelihood of drawdowns on banks' irrevocable commitments increases. They linked deposit withdrawals to the probability of default of the particular bank. In our framework we linked withdrawals to the profitability of the particular bank. We made this substitution because profitability and probability of default are closely correlated and profitability is plainly available. IMF (2011) also presented a stress-testing framework for liquidity risk as a standard solvency stress test with an innovation in the form of an added systemic liquidity component. Similarly to our model the IMF stress test models two channels for a systemic liquidity event – a frozen interbank money market due to higher counterparty and default risks or liquidity hoarding by banks and investors, and a fire sale of assets. As in our model, the feedback effect is simulated by an attempt by banks to meet immediate obligations by selling assets, which affects the market liquidity of the assets, further tightening funding liquidity (through higher withdrawal rates).

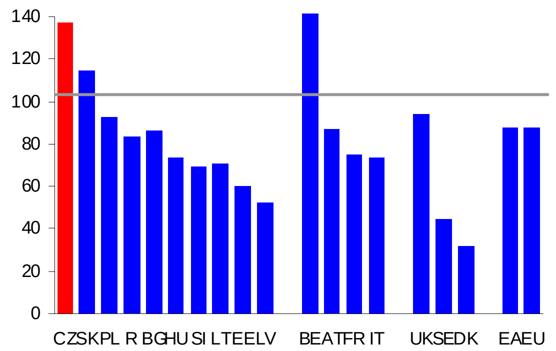
This study contributes to the literature in two aspects. Firstly, few empirical studies incorporate the interaction of risks into a liquidity risk stress-testing framework, especially in the case of countries with banking sectors similar to the Czech one (see section 3). Secondly, our framework could serve as a complementary tool to the two liquidity standards proposed by the new regulatory framework – the Liquidity Coverage Ratio and the Net Stable Funding Ratio (BIS, 2010). The proposed framework can be readily applied to other banking systems, and its great advantage is the simplicity with which it can be applied. Its disadvantage is that it is based on reporting data which are usually not publicly available. However, they are usually available as aggregated over the entire financial system.

3. The Liquidity Situation of the Czech Banking System

The Czech banking system features relatively high liquidity. The ratio of deposits to loans is one of the highest in the EU (Figure 1) and banks hold the rest of their assets mainly in the form of government bonds, short-term interbank deposits, and deposits in the central bank (Figure 2). Thus, the Czech National Bank absorbs rather than provides liquidity to the banking system.

Figure 1: Deposit-to-Loan Ratio for Selected EU Countries

(end-2010; %)

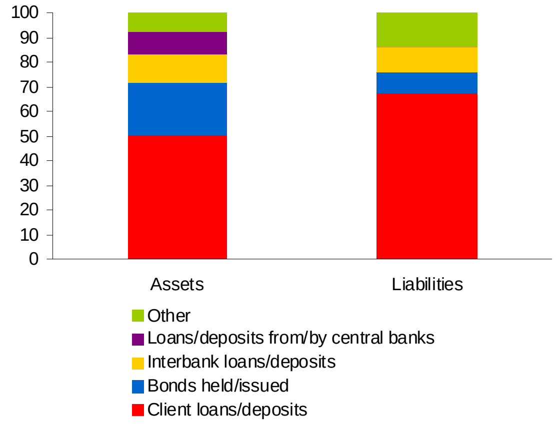


Note: EA = euro area; EU = average for all EU countries

Source: ECB

Figure 2: Structure of Banking Sector Assets and Liabilities

(% of total assets/liabilities; end-2010)

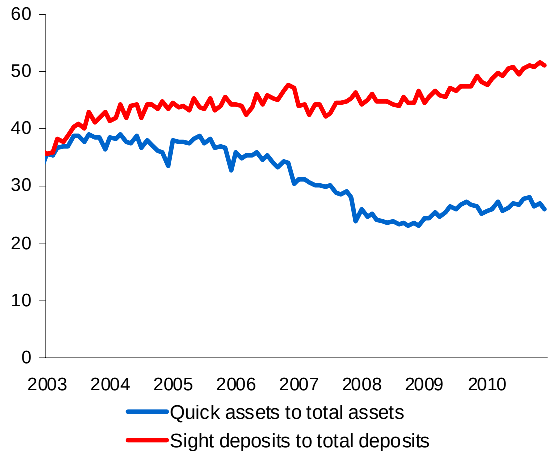


Source: CNB

The ratio of liquid assets (quick assets) to total assets had been declining since 2003, but stabilized at between 25% and 30% during the crisis period 2008–2010 (Figure 3). In parallel, the ratio of sight deposits to total deposits increased.

Figure 3: Quick Assets and Sight Deposits

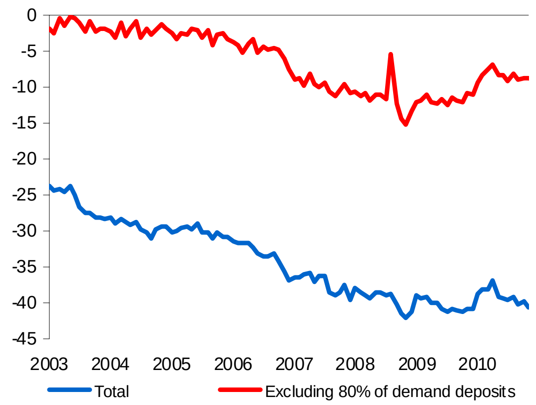
(%)



Source: CNB

Figure 4: Asset and Liability Maturity Mismatch in the Banking Sector

(% of assets; cumulative 3M net balance-sheet position)



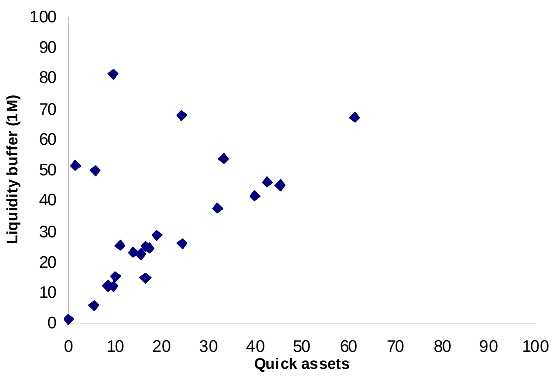
Source: CNB

Depositors' preference for liquidity together with continuous financial deepening via provision of long-term credit (mortgages, corporate loans) has been reflected in an increase in the maturity mismatch in the Czech banking sector. The 3M net balance-sheet position has declined into negative territory despite the exclusion of 80% of demand deposits, which can be assessed as very stable (Figure 4).

It should be mentioned that the liquid (quick) assets in Figure 3 do not fully correspond to the liquidity buffers used in the simulations in section 4, as the latter also include claims on banks with maturity of up to one month or three months, depending on the horizon of the test (quick assets include only O/N claims on banks). For example, the ratio of quick assets to total assets as of end-September 2011 totaled 31.8% for the four largest banks, while the liquidity buffer of the same group of banks used in the stress-testing model amounted to 36% for the one-month horizon and 39% for the three-month horizon. Figures 5 and 6 plot the liquidity buffers against quick assets (both as a percentage of total assets). While for most banks these indicators coincide, there are several banks that have much a larger difference between quick assets and liquidity buffers due to a large amount of interbank deposits.

Figure 5: Quick Assets and Liquidity Buffers Used in Stress Tests (1-Month Horizon)

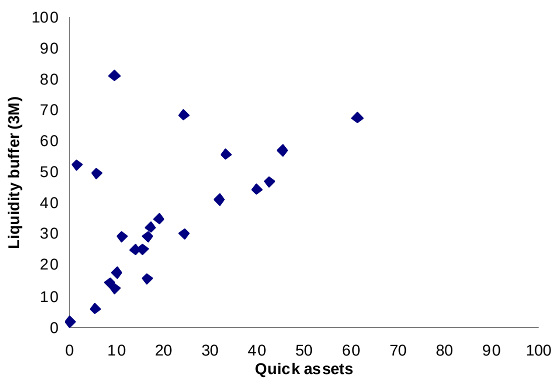
(% of assets)



Source: CNB

Figure 6: Quick Assets and Liquidity Buffers Used in Stress Tests (3-Month Horizon)

(% of assets)



Source: CNB

Building societies make up a specific segment of the Czech banking sector. These institutions focus on collecting deposits under specific and legally regulated building savings plans and use the funds to grant housing loans. By design, the liquidity risk of these institutions should be mitigated by the relatively long maturity of their liabilities (usually 5 to 6-year savings contracts where the minimum period of the term deposit is 5 or 6 years) matched to long-term assets (the housing loans arising from these contracts). However, past developments have aggravated liquidity risk in this segment, as most of the savings contracts have now run beyond the minimum number of years and are thus redeemable at notice of three months. At the same time, building societies have lower liquidity ratios (CNB, 2011). While a run on these institutions is highly improbable given the good terms at which deposits are remunerated (usually relatively high interest rates, until recently also exempt from tax, plus a state subsidy of between CZK 3,000 and

CZK 4,500 a year, although this is planned to be reduced to around CZK 2,000), it might still be relevant to analyze in detail the resilience of these institutions to possible sudden liquidity shocks such as deposit withdrawals.

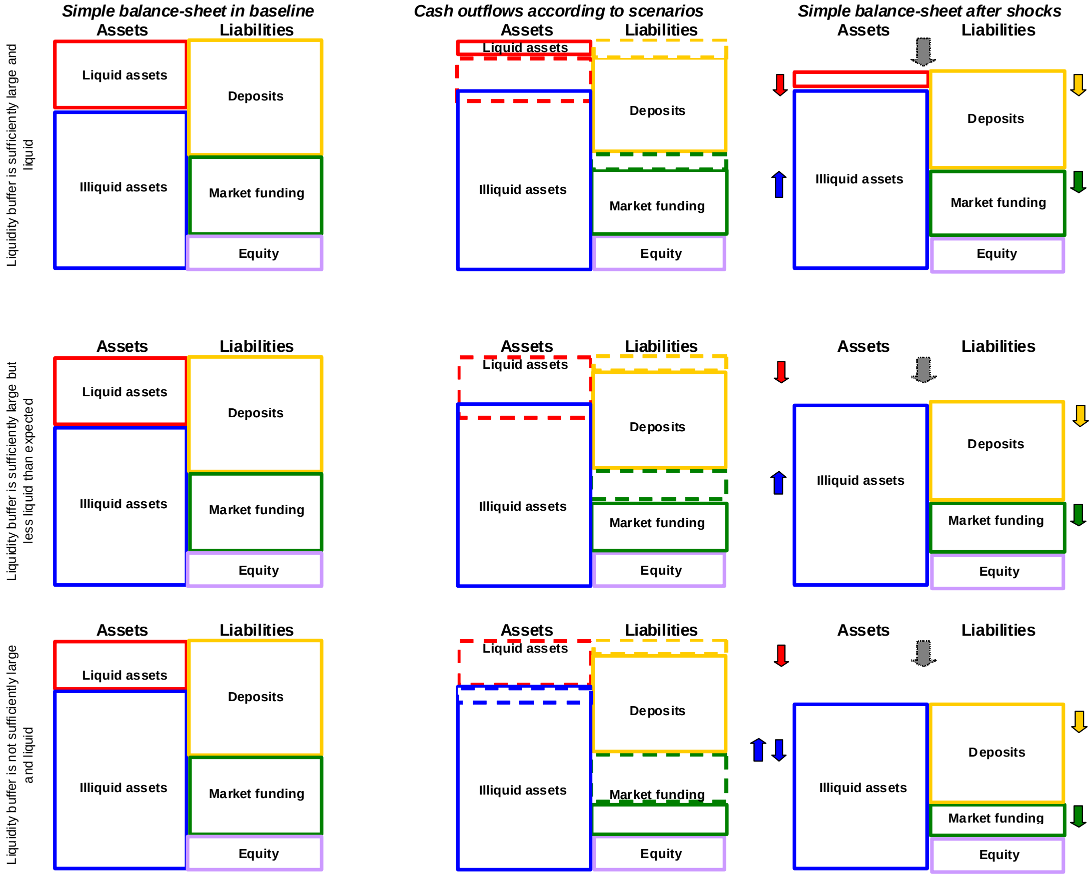
4. Empirical Methodology

The model is based on a top-down approach and is run using bank-level data. It captures both liquid assets and liabilities in the banks' balance sheets and includes on-balance-sheet items as well as selected off-balance-sheet ones. Unfortunately, due to a lack of data, the model uses only stock variables and does not include predictions about cash inflows and outflows that are related to standard banking business.

In its simplest form, the CNB's liquidity stress-testing model examines banks' liquidity buffer in relation to stressed cash outflows. The model assumes that banks normally have a liquidity reserve consisting of liquid securities or cash (the red square in Figure 7) to cope with unexpected cash outflows. Unexpected cash outflows can in general arise due to: (i) a loss of confidence in a bank, so that refinancing problems arise when the securities issued by the bank mature (the green square), (ii) turbulence causing markets that banks are dependent on for their funding to stop functioning (also the green square), (iii) private customers wishing to withdraw their deposits for some reason (the yellow square), or (iv) companies using a credit facility to an unexpectedly large extent (the blue square; drawdown of credit lines). The main aim of the model is to examine if banks' liquidity reserves are sufficiently large and liquid.

In general, three impact examples can occur in the model (Figure 7). In the first example, the bank would score higher in the test because it has a large proportion of liquidity reserves, i.e., a sufficiently large and liquid asset buffer for meeting its liquidity needs, whereas in the third example not only does the bank hold an insufficiently large liquidity buffer, but also the assets included are probably not liquid enough to cover all the bank's commitments (cash outflows exceed the buffer). The second case is the full exhaustion of liquidity reserves.

Figure 7: Three Different Impact Examples



Note: Cash outflows; funding sources = deposits + market funding + equity; liquid assets = cash, receivables from the central bank, bonds issued by governments or central banks, claims due within 1 month (or 3 months, including on demand); illiquid assets = total assets – liquid assets.

Source: Authors according to Sveriges Riksbank (2010)

The model assumes three subsequent steps that are logically interlinked: (i) the formation of a balance-sheet liquidity shortfall, (ii) the reaction by banks, and (iii) the feedback effects of shocks. With each step we re-count the liquidity asset buffer (at the beginning, after the first round of shocks, and after the second round of shocks) and examine whether the banks hold a sufficiently large amount of liquid assets to be able to survive the liquidity tension in their balance sheets. Otherwise, the liquidity shocks would be accompanied by declines in their businesses (loans and investments).

4.1 The Formation of the Balance-Sheet Liquidity Shortfall

In the first step, it is assumed that a sound banking system with a given liquidity buffer (in normal market conditions) is hit by a liquidity shock that includes bank runs and falling prices of securities holdings and simultaneously is not acquitted of the duty to meet obligations negotiated prior to the shock (the drawdown of credit lines). The model is based on the simple assumption that a bank is able to provide liquidity on demand to depositors as well as to borrowers via credit if it holds a sufficiently large amount of liquid assets that can be quickly transformed into cash without a loss of value.

In a financial crisis, financial market conditions usually deteriorate and for businesses, households, and other economic entities it becomes much more difficult to borrow funds to cover their day-to-day operations. The deterioration in market conditions can be caused by losses incurred by market investors. Investors, who are constantly searching for yields and thus supplying funds to the financial markets, can suddenly lose confidence and change their beliefs about the risks or uncertainty in the economy as a result of pessimistic expectations. Consequently, they withdraw funds from the markets and try to invest them in safer assets, such as high-quality government bonds (flight to quality) and/or bank deposits. Financial markets suffering from a lack of funds and liquidity are no longer able to provide market-based sources of funding and shut borrowers out. Borrowers thus turn to banks, drawing down credit lines established with banks in the pre-crisis period. Banks serve as natural backup providers of liquidity that combine deposit-taking with loan commitments.

Deposit outflows. It is believed that funds flow into banks during market stress because banks are viewed as safe havens (in comparison to other institutions, such as mutual funds or direct market instruments) owing to government guarantees on deposits. However, (i) not all deposits are under the deposit insurance limit, and deposits over the limit are not explicitly guaranteed in the event of a bank failure, (ii) there are fixed costs to extracting deposits from banks that fail, and (iii) depositors may worry that the deposit insurance fund will not be large enough in the event of a bank failure (Mora, 2010), especially if the government itself suffers from a loss of confidence. Thus, despite the existence of a deposit insurance scheme, there might be bank runs.

The bank's loan portfolio increases. As discussed above, borrowers shut out of financial markets are in need of funds. As they try to avoid the disruptions and their own liquidation, they turn to banks for liquidity by drawing on credit lines that will serve as insurance for borrowers who suddenly find themselves liquidity-constrained. If banks honor these commitments (credit lines), the amount drawn down is moved from the bank's off-balance sheet into its balance sheet and the bank's loan portfolio increases.

Besides an increase in bank lending driven by the drawdown of credit lines we assume that during the first phase of the liquidity crisis banks continue to provide traditional, at least secured loans (e.g. mortgages) to continue to safeguard their income from credit business and to mitigate the loss of confidence. The reason for including this assumption is that banks' business depends on confidence in soundness. At times of market tension, banks can be viewed as "persuading" depositors and/or credit markets that they are exceptionally sound and there is no doubt about the quality of their assets. In addition, in the first phase of the crisis it is very difficult for any financial market participants, including banks, to estimate the extent and duration of the crisis. It is thus very likely that banks will try to keep their market shares even though they are suffering from balance-sheet tensions.

To provide liquidity on demand (to depositors and/or borrowers), especially at times of impaired market function, banks must hold a liquidity buffer. Such assets are costly to hold because they do not provide a high return compared with alternative uses of funds. Therefore, banks try to avoid holding a large amount of unnecessary low-return liquid assets. According to Kashyap et al. (2002), banks can hold the liquidity buffer at lower cost if the need for liquidity by depositors is not strongly correlated with the need for liquidity by borrowers. In other words, depositors are unlikely to withdraw funds from their accounts at the same time that firms are tapping bank credit lines. In fact, many studies have shown that during past episodes of market stress, the funds that investors pulled out of markets flowed primarily into the banking sector (Saidenberg et al., 1999; Gatev et al., 2009; Kashyap et al., 2002), but this argument has broken down in the current crisis. The results presented by Mora (2010) show that during the 2007–2009 crisis banks most vulnerable to liquidity drawdowns did not have bigger deposit inflows and had to rely more on other sources of borrowing (such as securities issuance or wholesale funding, which are excluded from our scenario – see below) and liquid assets to fund used commitments.[2]

Our scenario is based on the consideration described above. For each bank in the test, we first calculate the initial liquidity buffer LB_0

$$LB_0 = \sum_{i=1}^{5} I_{Bi} \ , \qquad (1)$$

where i is a particular balance-sheet item, B is a particular bank, and I are items made up of liquid assets: (1) cash, (2) claims on the central bank, (3) bonds issued by the government or the central bank, and (4) other claims due within a particular time horizon.[3]

The first round of shocks has two dimensions. The first, a liquidity shortfall (R_1), is created by the higher credit supply and demand and is determined by

$$R_1 = L * p + C * c + D * r \ , \qquad (2)$$

where L represents the bank's loan portfolio as the sum of all claims (excluding claims on the central bank) and p is the monthly rate of increase in the loan portfolio; C represents the total credit lines in off-balance sheets and parameter c is the rate of drawdown of committed credit lines; and D represents deposits and r is the deposit withdrawal rate.

The second dimension of the first round of shocks is a decline in the value of liquid assets held in banks' balance sheets, owing to the impaired market liquidity resulting from increased uncertainty regarding the market value of some instruments (such as government bonds). This effectively decreases the available liquidity buffer LB_0 to LB_{0a}:

$$LB_{0a} = \sum_{i=1}^{5} I_{Bi} * h_i \ , \qquad (3)$$

where h_i is the haircut for the individual liquid assets. The decrease is also applied to instruments that are classified as held to maturity, which are normally not marked to market. Thus, the overall

[2] There are several reasons for banks not to hold adequate amounts of liquid assets (Banque de France, 2008): (i) liquidity is costly, (ii) liquidity shortages are very low probability events, (iii) there is a perception that central banks will step in and provide liquidity support if and when it is needed (the moral hazard argument).

[3] The model is flexible as regards the setting of the scenario horizon. It is usual to set the scenario horizon at one month, but it could be extended (to three months, for example; see section 4).

liquidity gap that should be closed is the sum of the liquidity shortfall and the difference between the initial and available liquidity buffer ($R_1 + \Delta LB$).

After these two initial shocks, the next step is to compare the size of the liquidity shortfall generated (R_1) with the available liquidity asset buffer (LB_{0a}):

$$\frac{LB_{0a}}{R_1} \geq 1 . \tag{4}$$

If the above condition is met, the bank survives the first round of shocks just with liquid assets. Such banks gradually start liquidating their liquid assets to close the liquidity shortfall. Other banks that do not fulfill condition (4) must also liquidate less liquid or illiquid assets. Such liquidation is usually very costly because less liquid and illiquid assets are very often subject to large haircuts. This is because less liquid assets, such as the retail or corporate loan portfolio, are rarely traded. Due to their uniqueness it could be difficult to find a market for these items and to determine what their fair value might be. To compensate for this uncertainty and illiquidity, the model assumes large haircuts compared to liquid assets.

4.2 The Reaction by Banks

Banks liquidating available assets determine the second step of the model, called the "reaction by banks." By reacting, banks obtain proceeds that can be used to close the liquidity gap. The higher liquidity supply and demand and the decline in value of some assets lead to a situation where all banks react somehow. However, while some banks will only reduce their claims on the central bank and cash, other banks have to sell their available assets in the financial markets. The stress test assumes that due to the simultaneous disturbances to the functioning of money and credit markets, banks are shut out of their main funding source (e.g. a rise in banks' credit spreads leading to reduced wholesale refinancing) and an increase in banks' liabilities in the model is thus excluded. The only permitted method banks can use is the liquidation of assets.

In general, the banks' reaction is expressed by

$$\sum_{j=1}^{n} I_{Bj} * p_{1j} \geq R_1 \qquad \wedge \qquad R_1 \geq 0 , \tag{5}$$

where j is the number of available assets liquidated to fund the liquidity shortfall. It is assumed that for their reaction banks first use assets included in the liquidity asset buffer (I_B, where $I_B \subset I_{B,j}$) and subsequently other available assets. We believe that banks rank asset items according to their market liquidity, e.g. assets included in the liquidity buffer (in the following order: cash, claims on the central bank, claims on demand, claims due within a horizon, bonds issued by the domestic government or central bank, bonds issued by other governments) and other assets (other bonds, equity instruments, claims with maturities over a horizon, other assets; see Appendix 1 for an example).

The banks' response will reduce the impact of the first-round shocks on their balance-sheet liquidity. However, it will simultaneously increase the reputational risk of each responding bank and systemic risk through the simultaneous response of the banks on the financial markets.

A bank's reputational risk consists of signaling its liquidity problems. Banks do not usually like offering over-the-odds (a premium) for borrowing in the market as this could advertise their weakness, known as the stigma effect (Goodhart, 2008). Thus, banks that react too much might be offered worse prices for their assets, being hit by an increase in reputational risk. This is similar to the stigma issue for borrowing from central banks. Armantier et al. (2010) provided empirical evidence for the existence, magnitude, and economic impact of the stigma associated with discount window liquidity provision by the Federal Reserve. They found, inter alia, that during the height of the 2007–2010 crisis the day after borrowing from the discount window, banks faced higher borrowing rates as they suffered from a special stigma premium.

As to the systemic risk, an idiosyncratic liquidity shock[4] concerning a single bank can very quickly spread to others through the high degree of market and balance-sheet interconnectedness. In order to generate the required cash, a single bank has to sell assets, which may start weighing on prices. Other market participants who have followed similar trading strategies may also begin selling, but this may be widely anticipated by the rest of the market, which has little incentive in being on the buying side. As a result, liquidity providers close their positions, waiting for the inventory to be wound down and triggering sharp falls in prices of instruments (Praet and Herzberg, 2008). A similar episode is simulated in the model as excessive one-sided pressure from banks on the financial market (e.g. all banks want to sell bonds), which leads to an additional decline in market liquidity and thus an additional decrease in the market value of liquidated assets.

The increase in these two risks feeds back to banks' balance sheets (as a further decline in asset prices and deposit withdrawals), constituting a feedback effect.

4.3 The Feedback Effects of Shocks

The third step of the model involves calculation of the second round of shocks stemming from the market reaction of banks to the first round of shocks. Both the possible systemic risk and the reputational risk have a feedback impact on the liquidity buffers and other market assets through additional haircuts ($p_{2,j}$, or, for reacting banks, $p_{3,j}$) and on liabilities through additional deposit withdrawals. The non-reacting banks are affected only by systemic risk through additional haircuts, which is expressed by

$$R_2 = \left[\left(\sum_{j=1}^{n} I_{Bj} * p_{1j} \right) - R_1 \right] * \left(p_{2j} - p_{1j} \right), \tag{6}$$

where R_2 is the second round of shocks. Our model, like that of Van den End (2008), additionally assumes that the impact of the market stress on the banks' balance sheet is larger if (i) more banks react in the markets *(Σq)*, (ii) the reactions on the markets are more similar *(ΣLIB,j)*, and (iii) the reacting bank is larger.

The depth and liquidity of financial markets also plays a relevant role. In the case of asset liquidation on deeper and liquid markets (such as government bond markets) the feedback impact

[4] Such as losses in a particular activity, a hedge that has gone wrong, or operational problems leading to higher demand for cash (Brunnermeier and Pedersen, 2009).

is smaller than in the case of liquidation on illiquid and shallow markets. The market conditions (market liquidity) are expressed by a state variable *s* that is derived from standardized distributions of risk aversion indicators expressed by the implied stock price volatility and corporate bond spreads (Van den End, 2008). Normal market conditions are reflected by $-1 \leq s \leq 1$ and market frictions (a less than perfectly liquid market) by $s = 3$, i.e., the higher is *s*, the stronger are the effects of the number and the similarity of banks' reactions. Haircuts relevant for non-reacting banks (if there are any) are determined by

$$p_{2j} = p_{1j} * \left(\sum_B q \hat{} \left(1 + \sum_B LI_{Bj} / \sum_j \sum_B LI_{Bj} \right) * s \right) / \sum_B q \,, \tag{7}$$

where Σq is the number of reacting banks, ΣLI is the amount of a particular asset liquidated by all reacting banks in the particular market, and $\Sigma\Sigma LI$ is the total amount of liquidated assets in all the markets.

A bank that reacts in order to fund its liquidity shortfall faces both a reputational risk and a systemic risk, whereas an irresponsive bank faces "only" the systemic risk. Therefore, the impact of the second round of shocks must be stronger for responsive banks. The reputational risk is expressed by the market conditions *(s)* because especially in stressed markets the signaling effect of reactions will adversely feed back to the reacting bank. The reputational risk is determined by

$$p_{3j} = p_{2j} * \sqrt{s} \,, \tag{8}$$

and can be manifested either in additional haircuts on assets or in withdrawals of deposits. In the current version of the model, we assume only additional haircuts on assets, which are higher for reacting banks than for non-reacting banks. While one could argue that when selling assets all banks face the same (market) price, we assume that there is a certain intraday (or – in the setup of the model – intra-month) dynamic where banks that react need to sell within a day regardless of the intraday price movement. So, while reacting banks suffer by selling at the lowest prices in the market, as they need to sell and thus drive the market price down, other banks just revalue their assets using the closing price, which is assumed to normalize back after the reacting banks have sold, although not fully to the initial levels.

As regards deposits, it is true that banks that are severely hit by liquidity shocks and need to react in the markets may face a stigma effect and may experience second-round deposit withdrawals. Nevertheless, we assume that the reacting banks can mitigate some of the withdrawal risk by offering better retail deposit rates, thereby effectively stabilizing the deposit base of the first round of shocks. However, we intend to develop the model further to allow second-round deposit withdrawals in future research.

According to the new assumption, equation (6) can be modified for reacting banks as

$$R_3 = \left[\left(\sum_{j=1}^{n} I_{Bj} * p_{1j} \right) - R_1 \right] * \left(p_{3j} - p_{1j} \right). \tag{9}$$

The impact of the two rounds of shocks depends on the predefined scenario and the banks' types of business model as reflected by the balance-sheet and maturity structures. The model scores high those banks that are funded at long maturities and have assets that are easy to sell. Ceteris paribus, the model scores low those banks that are funded at short maturities (wholesale funding) and have a lot of illiquid assets (loans to the private sector) that are difficult to sell.

It is obvious that the model has some limits and does not present a full picture of a bank's liquidity risk. First, it does not take fully into account the business model and confidence in the bank, for example, which usually play a significant role in financial market trading. Second, interbank contagion via direct interbank borrowing and possible contagion via domino effects are also not captured. Third, only stock variables are used for the simulations, disregarding the expected inflows and outflows of funds, as these are not available via standard bank reporting to the central bank.

However, the test complies with the basic conditions of sufficient liquidity risk management: a bank should not have too large a difference between the maturities of assets and liabilities and should not hold too many illiquid assets in relation to unstable (volatile) liabilities. This evidence is confirmed by the outcomes of a test carried out in Czech banks (see Section 5).

5. Application of the Model to the Czech Banking System

5.1 Data

The model is applied to Czech banking sector data provided by the supervisory liquidity report from the Czech National Bank. The data is a cross-section of balance-sheet information (volume, maturity profile of items, and type of assets and liabilities) for 23 banks operating in the Czech Republic in 2011 (excluding branches and subsidiaries of foreign banks). The data are available on a monthly basis and include on- and off-balance-sheet items. The model assumes as a baseline unweighted assets and liabilities with values equal to 100%, meaning that haircuts or withdrawals equal zero. The basic balance-sheet data on the banks are given in Appendix 1. The items presented in the Appendix are expressed for the entire Czech banking sector in gross amounts, but the stress test is run on each bank separately.

Our selected sample of tested banks also includes building societies. As a significant share of the sector's funding consists of term deposits redeemable at notice of three months (see section 3), building societies are more sensitive to the scenario horizon of three months compared to the rest of the banks, which are more sensitive to a shorter time horizon. Therefore, we run the stress test for scenario horizons of one month and three months without any parameter changes. The model is run using October 2011 data.

The shocks applied, which are partly deterministic and partly stochastic, are a mixture of idiosyncratic and market-wide liquidity events. They affect the banks through declining liquidity values of liquid assets and reduced cash inflows. Liabilities can be affected in the stress scenario through calls on contingent liquidity lines, withdrawals of deposits, and a drying-up of wholesale funding. The level of the runoff coefficients (weights) applied to the assets and liabilities of the Czech banking sector is mainly based on best practice, on the available historical experience, or on data collected from the Czech banking sector or from abroad. The determination of the runoff coefficients in this manner represents a disadvantage. This is because there is still no sufficient quantity of data available from liquidity crises, and because private liquidity is cyclical around an increasing trend with a high endogenous component during a leveraging phase that can disappear during a deleveraging phase. These dynamics of private liquidity and its international spillover make it more difficult to estimate and set the parameters of the runoff rates. To mitigate this disadvantage we adopted a conservative approach when applying the stress weights in this test – on the one hand we applied strong shocks, and on the other we adopted severe assumptions motivated by the liquidity events during the current crisis (see Table 3).

We are aware that the Czech banking system is in a different liquidity situation than most banking systems in the EU. The Czech banking sector has surplus liquidity, while in many developed countries of the EU the banking system is in a deficit liquidity situation. Nevertheless, even when banks have surplus liquidity which they deposit in the central bank, they can still face liquidity shocks in terms of a sudden and large withdrawal of deposits or activation of credit lines. Thus, the liquidity shocks tested in the Czech banking system are those to which Czech banks are sensitive, i.e., they relate mainly to retail segments rather than to wholesale segments.

5.2 Stress-Testing Scenario

This section describes the model outcomes by simulating the recent financial crisis in its advanced stage, which is a combination of impaired financial market stability, including distrust in the credit markets, and slowed-down domestic and foreign economic growth. The liquidity and funding stress test scenario examines how Czech banks would withstand a shortfall in funding and demands for liquidity with limited access to external funding, including from their parent banks, within two separate horizons of one month and three months, and with medium-disturbed markets ($s = 1.5$).

In the first instance we calculated the initial liquidity buffer for each bank according to equation (1) determined by cash, claims on central banks, claims on demand, claims due within one month or within three months, and securities issued by governments or central banks. The unweighted initial liquidity buffer of the whole Czech banking sector is on average approximately 34% of total banking sector assets in the case of the one-month horizon and 37% in the case of the three-month horizon (see Table 1). Czech banks mainly hold government securities in their liquidity reserves (around 40%).

Table 1: Composition of Czech Banks' Liquidity Buffers

(in %)

The one month horizon	MIN	$Q_{0.25}$	MEDIAN	MEAN	$Q_{0.75}$	MAX
CASH	0.00	0.01	0.62	1.67	2.89	7.24
CLAIMS ON CEB	1.02	5.94	19.35	21.16	29.68	66.52
CLAIMS ON DEMAND	0.00	0.30	1.43	3.35	4.27	19.85
CLAIMS DUE WITHIN A MONTH	1.23	14.87	23.31	33.74	40.86	98.48
BONDS ISSUED BY GOVERNMENTS	0.00	24.73	43.07	40.09	56.03	93.05
BONDS ISSUED BY CENTRAL BANKS	0.00	0.00	0.00	0.00	0.00	0.00
LIQUIDITY BUFFER/TOTAL ASSETS	1.25	18.85	25.95	33.82	47.93	81.27
The three month horizon						
CASH	0.00	0.01	0.64	1.55	2.48	6.64
CLAIMS ON CEB	0.78	5.55	16.58	17.16	22.16	50.27
CLAIMS ON DEMAND	0.00	0.31	1.47	3.07	4.39	15.63
CLAIMS DUE WITHIN THREE MONTHS	4.86	22.92	36.61	42.11	49.81	99.03
BONDS ISSUED BY GOVERNMENTS	0.00	22.23	38.96	36.12	49.20	86.52
BONDS ISSUED BY CENTRAL BANKS	0.00	0.00	0.00	0.00	0.00	0.00
LIQUIDITY BUFFER/TOTAL ASSETS	1.95	21.51	32.37	36.63	51.16	81.27

Source: CNB, authors

The composition of the liquidity buffer also varies from bank to bank (see Table 2). While some banks hold a large proportion of their liquidity buffer in government bonds, other banks hold it in the form of short-term claims, mainly vis-à-vis the central bank. The former are more vulnerable to sovereign credit risk and the latter to counterparty risk if the claims are vis-à-vis other commercial banks.

Table 2: Composition of Liquidity Buffers According to Bank Size

(in %, unweighted average for the sector)

The one month horizon	Large banks	Medium-sized banks	Small banks	Building societies
CASH	3.46	1.95	1.60	0.00
CLAIMS ON CEB	27.41	24.53	24.73	6.38
CLAIMS ON DEMAND	1.47	3.05	6.37	0.37
CLAIMS DUE WITHIN A MONTH	21.83	38.35	46.14	17.88
BONDS ISSUED BY GOVERNMENTS	45.83	32.12	21.15	75.37
BONDS ISSUED BY CENTRAL BANKS	0.00	0.00	0.00	0.00
LIQUIDITY BUFFER/TOTAL ASSETS	33.63	33.40	42.09	21.22
The three month horizon				
CASH	3.06	1.72	1.65	0.00
CLAIMS ON CEB	24.79	22.47	16.37	5.77
CLAIMS ON DEMAND	1.30	2.69	6.36	0.34
CLAIMS DUE WITHIN THREE MONTHS	29.63	43.93	59.80	25.13
BONDS ISSUED BY GOVERNMENTS	41.21	29.19	15.82	68.76
BONDS ISSUED BY CENTRAL BANKS	0.00	0.00	0.00	0.00
LIQUIDITY BUFFER/TOTAL ASSETS	37.10	35.49	45.58	23.31

Source: CNB, authors

The initial parameters of the scenario are designed firstly by assuming a liquidity shortfall and a decline in the value of banks' tradable portfolios due to uncertainty about asset valuations, which is caused by the drying-up of market liquidity, and secondly by assuming a decline in the value of non-tradable assets if a bank liquidates them prematurely. The liquidity shortfall is determined by

(i) deposit withdrawals[5] (including on demand) amounting on average to 11% of total deposits due within a horizon (one month or three months), (ii) drawdown of committed credit lines amounting to 10%, and, due to the assumption that the financial crisis is at an advanced stage, (iii) growth in the (initially zero) nominal stock of credit (see Table 3).

Table 3: Scenario Type and Shock Size

Scenario type	Runoff rates
Bank run (average for banks, in %)	11
Drawdown of credit facilities (credit lines, % of volume)	10
Share of short-term claims on banks that will become unavailable (%)	50
Share of short-term claims on other clients that will become unavailable (%)	20
Reduction in value of government bonds eligible as collateral in CNB liquidity-providing operations (%)	20
Reduction in value of other securities (%)	40
Reduction in value of assets sold before maturity (average for banks, in %)	50

Source: authors

The market conditions are determined as follows: (iv) liquidity dries up in the money market, as 50% of interbank claims on demand and claims due within one month (or three months) are unavailable, (v) 20% of other claims on demand and claims due within one month (or three months) are unavailable, (vi) government bonds and other securities (non-eligible) suffer a 40% loss in value ("haircut"), (vii) any asset (not securities) liquidated prematurely suffers a 50% loss in value, (viii) 20% of assets previously eligible for central bank rediscounting become ineligible. Some additional market specifications concerning the impossibility of raising any funding are also considered: (ix) no net additional intra-group funding (where applicable) is available, and (x) no additional intra-bank funding or securities issuance is available. The impaired market conditions in the scenario are triggered regardless of whether or not a bank is active in the market, and the values of marketable assets are cut according to these conditions. Only sales of non-tradable assets (often illiquid ones) are conditional on the reactions of the bank holding the particular non-tradable assets.

The two conditions of the scenario – bank runs and a reduction in the value of assets sold before maturity – are linked to the results of the credit and market risk stress tests published in CNB (2011), (see Table 4). The underlying intuition is that banks that incurred accounting losses in the stress scenarios face a greater outflow of liquidity than profitable banks. In sales of illiquid assets, account is taken of the quality of the bank's assets as measured by the credit portfolio risk costs.

[5] The withdrawn deposits are assumed not to be returned to the banking system, but to be held as cash or other safe haven investments (such as gold).

Table 4: Dependence of Selected Liquidity Shocks on Estimated Bank Balance-Sheet Indicators in the Stress Tests

Estimated RoA in 2011 (%)	Bank run
<-2%	15%
-2% – -1%	13%
-1% – 0%	11%
0% – 1%	9%
1% – 2%	7%
> 2%	5%
Estimated risk costs 2011 (%)	**Reduction in value of assets sold before maturity**
<1%	25%
1% – 2%	45%
2% – 3%	55%
> 3%	65%

Source: CNB, Financial Stability Report 2010/2011

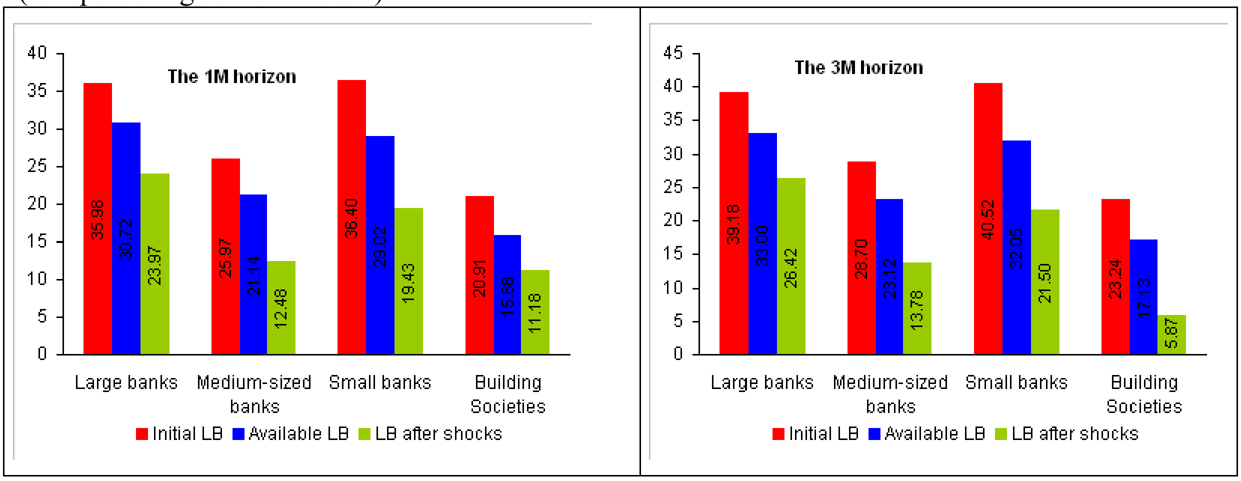
The shocks applied are in most cases deterministic and only the two shocks linked to the credit and market risk stress test are stochastic. However, all these shocks can be stochastic and simulated using the Monte Carlo method, for example (van den End, 2008). The liquidity shocks can also be more integrated with solvency stress testing, an issue to be explored in future research.

5.3 Results

After the application of the first round of shocks the liquidity buffer fell from an average of 30% of total assets for the one-month horizon and 33% for the three-month horizon (see the red columns in Figure 8) to 17% for both horizons (see the green columns in the same figures).

Figure 8: Liquidity Buffers before and after the Effects of the Scenario

(as a percentage of total assets)



Source: CNB, authors

However, the initial liquidity buffers reflect the high level of quick assets held by the Czech banking sector (over 20%); in the long term building societies hold the lowest level. The adverse shocks affected medium-sized banks the most, followed in descending order by building societies, small banks, and large banks. Nevertheless, the categories of medium-sized banks and small banks include banks with very specific business models. If we take such banks out of the tested sample, medium-sized and small banks record similar outcomes as large banks and their liquidity buffers would decline by less than one third. The composition of medium-sized banks' liquidity buffers differs from that of large banks. While large banks' liquidity buffers consist mainly of Czech government bonds (50%), medium-sized and small banks hold their buffers mostly in the form of short-term claims on other banks.

In this test large banks came out well. However, in the event of a scenario similar to the Greek debt crisis, where the haircuts on Czech government bonds would be much bigger, the large banks would probably not score very well.

The simulated liquidity events affected building societies the most, with a greater adverse impact in the case of the three-month horizon. For this horizon, two building societies would fully exhaust their buffers and would have to sell other less liquid assets from their portfolios. This is because Czech building societies are more sensitive to withdrawals of deposits with maturities of three months or longer (see Section 3).

The other general reason for the above outcomes is that the banks which score high in the model typically have larger liquidity reserves than the rest. Banks that are amply funded by longer-term deposits, particularly if those deposits come from households and small firms, also experience a smaller outflow, since this source of funding has historically been relatively stable. Banks that are less dependent on wholesale market funding also have a smaller outflow, since they have fewer securities that mature with one month of the stress test than other banks.

6. Conclusion

The presented stress-testing model is a new instrument that the CNB uses for simulating the negative impact of market and funding liquidity shocks on the banking system. The methodology of the model is based mainly on the model of van den End (2008). It handles both sides of the on- and off-balance sheet and takes into account feedback effects derived from the collective behavior of banks trading on financial markets and also the influence of reputational risk.

In this paper the model was applied to data on 23 Czech banks, which were divided into four basic categories – small, medium-sized, and large banks, and building societies. The scenario used for the testing was designed to mimic the liquidity crisis of 2008–2009. The model outcomes showed that the Czech banking system as a whole seems to be stable and liquid enough. As the Czech banks stand more or less on a conservative business model (without large activity in the capital or money market), the impact of the first round of shocks was more significant than the second round. Most Czech banks have a sufficient liquidity buffer to be able to withstand a potential liquidity stress on their balance sheets. However, a few of the banks tested lost over 100% of their initial liquidity buffer, which means that they were not able to cover a further increase in claims with their own funds and were forced to sell illiquid assets.

The CNB liquidity risk testing model provides a suitable tool for evaluating the importance of various risk factors for banks' liquidity positions in different scenarios. While the current CNB model is already relatively advanced, we nevertheless plan further improvements. These would focus mainly on including the domino effect using a matrix of interbank market exposures, on the dynamics of the individual shocks over time (effectively introducing third- and higher-round effects), and on the endogenization of some of the shocks.

Moreover, as liquidity issues are coming to the forefront of regulators' attention given the new Basel III regulation on liquidity, further work will be devoted to recalibrating the model along the new Basel III metrics, i.e., the net stable funding ratio and the liquidity coverage ratio.

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Appendix

Table 1: Banking Sector Balance Sheet and Impacts of Shocks (in CZK thousands)

Assets	**Baseline**	**Shocks**
On-balance sheet items		
Banknotes and coins	34 594 657	
Receivables from central banks	339 745 859	
Receivables from banks	400 710 514	
on demand	15 832 512	(↓) unavailable short term claims and (↑) credit lines
up to one month (excl. on demand)	42 004 908	″
over one month and up to three months	20 188 806	(↓) unavailable short term claims (3M scenario) and (↑) credit lines
over three months	322 684 288	(↑) credit lines
Receivables from government	57 629 323	
on demand	126 328	(↓) unavailable short term claims and (↑) credit lines
up to one month (excl. on demand)	6 275 776	″
over one month and up to three months	3 016 324	(↓) unavailable short term claims (3M scenario) and (↑) credit lines
over three months	48 210 895	(↑) credit lines
Receivables from other clients	1 732 941 200	
on demand	9 158 229	(↓) unavailable short term claims and (↑) credit lines
up to one month (excl. on demand)	188 130 640	″
over one month and up to three months	90 421 172	(↓) unavailable short term claims (3M scenario) and (↑) credit lines
over three months	1 445 231 159	(↑) credit lines
Other receivables	11 979 791	(↑) credit lines
Debt instruments	918 627 733	
issued by central banks	0	(↓) reduction in value
issued by Czech government	574 862 798	″
issued by other governments	84 117 909	″
other debt instruments	259 647 026	″
Other securities	9 303 983	″
Other assets	240 350 582	
Off-balance sheet items		
Committed credit facilities	500 576 458	(↓) drawdown of credit facilities
Liabilities		
Deposits on demand: received from	1 520 933 634	(↓) withdrawal rate and (↑) no additional funding
banks	33 527 368	″
government	191 928 942	″
other clients	1 295 477 324	″
Deposits up to one month (excl. on demand)	588 886 663	″
Deposits over one month and up to three months	373 218 660	(↓) withdrawal rate (3M scenario) and (↑) no additional funding
Deposits over three months	990 201 768	
Other liabilities (incl. capital)	272 642 918	(↑) no additional funding

Note: The table contains data for 23 tested banks.
Source: CNB

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