UNIVERSITY OF LJUBLJANA
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MASTER'S THESIS

THE DETERMINANTS OF BANKS' LIQUIDITY BUFFERS IN SLOVENIA

Ljubljana, July 2018 MITJA LAVRIČ

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LIST OF ABBREVIATIONS

BAMC –Bank Assets Management Company

BCBS – Basel Committee on Banking Supervision

EURIBOR –Euro Interbank Offered Rate

GDP – Gross Domestic Product

GLTDF – Gross Loans to Deposits Flows

GMM – Generalised Methods of Moments

LCR – Liquidity Coverage Ratio

LOLR – Lender of Last Resort

NPL – Non-performing Loan

NSFR – Net Stable Funding Ratio

OLS – Ordinary Least Squares

SORS – Statistical Office of the Republic of Slovenia

INTRODUCTION

A bank's capital is the most important insurance, by which a bank absorbs any losses, thus maintaining the trust of depositors and investors. For this reason, until recently, policymakers focused primarily on formulating the capital regulation of banks as a way to protect overall financial stability. However, the global financial crisis, which began in mid-2007, revealed the crucial importance of another type of buffer, the so-called liquidity buffer, as many banks had difficulties in maintaining an adequate liquidity position. Due to inefficient liquidity risk management and inadequate liquidity of the financial system, financial institutions could not fulfil their contractual obligations. Central banks responded by injecting a large amount of liquidity into the financial system, but even with such a large amount of liquidity assistance many banks collapsed, demanded resolution or were forced to merge (BCBS, 2009a). These events raised a number of questions about liquidity risk and its regulation.

A sudden turnaround in market conditions in 2007 and 2008 showed how quickly liquidity can evaporate from the financial system, cause severe liquidity shortfalls in financial institutions and, as a result, lead to systemic contagion and financial instability. Many authors point out that the key features of the global financial crisis were insufficient liquidity buffers and a large mismatch in the maturity of assets and liabilities of financial institutions (e.g. BCBS, 2008; Brunnermeier, 2009; Acharya & Naqvi 2012; Acharya & Mora, 2015). Correspondingly, the Banking Committee on Banking Supervision (hereinafter: BCBS) introduced two international regulatory standards for liquidity risk supervision as a starting point for strengthening liquidity risk management. These standards establish minimum liquidity buffers for banks by requiring them to have a sufficient amount of high-quality liquid assets to promote short-term resiliency of banks to liquidity risk. The standards also encourage long-term resilience of banks to liquidity risk, with the requirement to finance their assets and off-balance sheet activities through stable sources of funding (BCBS, 2009b).

Due to the impaired market liquidity of financial assets during the global financial crisis, many financial institutions reduced liquidity creation and faced higher liquidity outflows (Laštůvková, 2017). Studies dealing with liquidity focus mainly on the effect the financial crisis has on the liquidity of banks or on the relationship between liquidity and financial stability or the real economy (e.g. Geršl & Komárková, 2009; Moore, 2009; Eroglu & Eroglu, 2011; Ellington, Florackis, & Milas, 2016). Prior to the outbreak of the global financial crisis, liquidity risk was mainly considered as a factor affecting the profitability of banks or as a factor of other risks, such as credit risk. However, after the global financial crisis, the authors paid more attention to the identification of key factors that affect the liquidity of banks (e.g. Bunda & Desquilbet, 2008; Dinger, 2009; Moore, 2009; Vodová, 2011, 2012, 2013; Bonfim & Kim, 2012; Wójcik-Mazur & Szajt, 2015; Laštůvková, 2016, 2017).

In the first half of 2017, the financial assets of the Slovenian financial system amounted to 137% of the gross domestic product (hereinafter: GDP). Monetary financial institutions account for 68.7% of total financial assets of the Slovenian financial system (Bank of Slovenia, 2017). Therefore, as Slovenian economy maintains a character of a highly bank-dependent economy, any changes in the liquidity stance of the banks affect directly the financing and liquidity conditions in the rest of the economy (Košak & Košak, 2016). Thus, banks in Slovenia should always hold a sufficient buffer of liquid assets in their balance sheet as self-insurance against liquidity risk.

Prior to the financial crisis, Slovenian banks funded their balance sheet growth by borrowing on the wholesale market. When the crisis started, a tremendous deleveraging pressure was imposed on the Slovenian banking system that resulted in significant reduction of wholesale funding. The outflow of foreign debt was compensated by government deposits placed in banks and by the extension of net borrowing at the European Central Bank. Nevertheless, the high-quality liquid assets of the Slovenian banks were reduced significantly from 2010 until the end of 2013. Because banks did not want to jeopardise their liquidity position further, they restricted the credit supply to the real economy (Košak & Košak, 2016).

Currently, there is a new trend in the Slovenian banking system. The share of demand deposits among all non-banking deposits is increasing persistently. More specifically, the share of demand deposits in total deposits went up from 33% to more than 70% between 2008 and 2017. Demand deposits, especially at levels as high as they are now, cannot be considered entirely as stable sources of funding for banks as they can be easily and quickly withdrawn (Bank of Slovenia, 2017). Due to the increase in the share of demand deposits, the maturity of the liabilities is reduced, while the maturity of loans is increasing, which increases the maturity mismatch of assets and liabilities. In these circumstances, it is possible to recognise the increased exposure of Slovenian banks to liquidity risk.

This master's thesis analyses the determinants of banks' liquidity buffers using a panel of 14 banks operating in Slovenia during 2000-2016. Our sample of banks accounts for 77% of banks in Slovenia and 90% of total assets of the Slovenian banking system at the end of 2017. Therefore, our sample is large enough to be considered representative for all banks in Slovenia. In addition, our long time-series captures crisis and non-crisis periods and thus coincides with a period of substantial adjustments made in the structure of assets and liabilities by banks operating in Slovenia. The goal of our research is to analyse how different bank-specific and macroeconomic factors affect the liquidity of banks in Slovenia.

We are interested in how bank-specific factors, such as bank size, bank's capital, profitability, credit risk and the spread between the loan interest rate and the deposit interest rate affect the liquidity of banks in Slovenia. In addition, we are also interested in how macroeconomic factors affect the liquidity buffers of banks. We are interested in how

the GDP and the short-term interest rate affect the liquidity of banks in Slovenia. Furthermore, given the importance of the difference between the ownership of the bank and its liquidity management, as well as the importance of domestic and foreign banks in the Slovenian banking system, we are interested in testing whether and how the determinants of liquidity buffers differ depending on the type of ownership of the bank (domestic vs. foreign). Following a review of the theoretical and empirical literature, we have set forth the following hypotheses:

H_1: Bank size negatively affects liquidity buffers.

H_2: Bank's capital negatively affects liquidity buffers.

H_3: Profitability negatively affects liquidity buffers.

H_4: Credit risk negatively affects liquidity buffers.

H_5: The interest rate spread negatively affects liquidity buffers.

H_6: Economic growth negatively affects liquidity buffers.

H_7: The short-term interest rate positively affects liquidity buffers.

H_8: The determinants of bank liquidity buffers differ according to the ownership of the bank.

The hypotheses are tested using panel data. We use a dynamic panel data model, which is characterised by the inclusion of lagged dependent variable. To avoid the problem of bias and inconsistent estimates owing to the correlation between the lagged dependent variable and the error term, we test the linear dynamic panel data estimation based on generalised methods of moments (hereinafter: GMM). Given our assumption of liquidity persistence, we used the system GMM estimator. However, in verifying the robustness of our estimates, we also used the difference GMM estimator and the fixed effects estimator among other things. We applied two diagnostics tests on GMM regressions. First, the Sargan test of the overidentifying restrictions. Second, the Arellano and Bond (1991) test for autocorrelation in residuals.

The master's thesis is organised as follows. Section 1 deals with the existing theoretical and empirical literature, which relates not only to liquidity determinants, but also provides a definition of liquidity risk, methods for measuring liquidity and deals with the main function of banks, their exposure to liquidity risk and the regulation of liquidity risk. Section 2 presents the data set, describes the estimation method and details the variables used and their expected impact on the liquidity of banks. Section 3 interprets the regression results, while section 4 provides a robustness check. In section 5 we draw out some policy implications. At the end, we conclude by summarizing the key findings.

1 LITERATURE REVIEW

In the literature review part, we first present literature that gives different definitions of liquidity and liquidity risk. We then describe various methods for measuring liquidity risk, followed by a brief overview of the literature dealing with the fundamental role of banks, their exposure to liquidity risk and the regulation of liquidity risk. In the end, we present a theory that directly focuses on banks' decision regarding investments in liquid assets and present some of the existing empirical studies and their findings.

1.1 Definition of liquidity

The BCBS defines **liquidity** as a bank's ability to finance the growth of assets and settle obligations to creditors at maturity without incurring any losses that could jeopardise the operations of the bank (BCBS, 2008, p. 1). Nikolaou (2009, p. 15) states that **liquidity risk** refers to the probability that the bank will become illiquid. The greater the probability of the bank becoming illiquid, the more it is exposed to liquidity risk. According to the BCBS (2008), liquidity risk can be broken down to two types of risks: **funding liquidity risk** and **market liquidity risk**. Nikolaou (2009) adds **central bank liquidity** to the general liquidity framework, whose task is to suspend the interconnectedness between market and funding liquidity.

The BCBS (2008, p. 1) defines **funding liquidity risk** as the risk that the bank will not to be able to efficiently settle all cash flows and collateral needs without affecting either current business or financial position of the bank. Drehman and Nikolaou (2009) indicate further that funding liquidity risk includes two elements: uncertain future cash inflows and outflows, and uncertain future prices of various sources that provide funding to banks. However, Brunnermeier and Pedersen (2007) also associate funding liquidity to traders, while Strahan (2008) associates it to investors, where funding liquidity is the ability of traders or investors to raise funds for their trading or investing purposes within a short period of time.

According to Nikolaou (2009, p. 14), **market liquidity risk** refers to the risk that a bank will not be able to trade or offset a position at a short notice without incurring losses. Alger and Alger (1999, p. 3) state that an asset is liquid if it can be sold immediately and without major losses. Usually, an asset is considered liquid if it has a short maturity and a perceived low risk (usually a government bond is considered a risk-free investment). Short-term assets are considered as less risky because their prices are less sensitive to the fluctuations of interest rates, therefore changes in the value of these assets do not significantly affect the bank's solvency. Typically, liquid assets of banks are excess liquidity reserves, cash, short-term interbank loans, and securities, such as government bonds and commercial paper.

Brunnermeier and Pedersen (2007) observe that interaction between market liquidity and funding liquidity can create phenomenon called liquidity spiral, especially in the presence of system-wide risk. As discussed by Brunnermeier and Pedersen (2007), funding liquidity shock can force the bank to sell its assets, which can lead to a decrease in the price of those assets, and consequently lower market liquidity of those assets, which then leads to a higher margin, thereby increasing funding liquidity risk.

The market (systemic) liquidity of financial assets is particularly important in terms of financial stability. As Allen and Gale (1998) discussed, the failure of a particular bank due to liquidity risk can be a useful mechanism that can restore financial health in certain parts of the financial system. However, systemic (market) liquidity risk can have serious repercussion for the financial system, as it can lead to a financial crisis affecting the real economy (Ferguson, Hartman, Panetta, & Portes, 2007; Hoggarth & Saporta, 2001; Ellington, Florackis, & Milas, 2017). Market liquidity is therefore the type of liquidity risk that instantly alerts policymakers, as pointed out by Nikolaou (2009).

1.2 Measurement of liquidity

Liquidity risk arises from a withdrawal of funding sources or because of a new demand for loans and the need to meet those demands, either by borrowing funds or by liquidating assets. Therefore, the bank's liquidity risk managers must measure the liquidity position of the bank on a daily basis in order to be able to implement adequate liquidity planning for potential liquidity needs and avoid the situation of becoming illiquid, while maintaining adequate returns for shareholders.

According to Saunders and Cornett (2008), liquidity planning is an important element in measuring liquidity risk. It starts with the delineation of managerial responsibilities. Then, the providers of funds are separated from those that are most likely to withdraw (the most unstable funding sources), and a pattern of possible withdrawals is provided. Liquidity plan should identify the size of potential withdrawals over various horizons (e.g. one week, one quarter, etc.). Besides, it should list all alternative funding sources that a bank can use to meet those withdrawals (e.g. loans from other banks or from the central bank). Liquidity plan should also provide internal limits on bank branches' or subsidiaries' borrowings as well as limits for acceptable interest rate to pay for each funding source (e.g. for central bank borrowings, certificates of deposits or issuance of bonds). From a liquidity plan, it should be evident which assets are available for disposal in case of deposits or other funding sources withdrawals. The bank's asset-liability management committee usually develops a liquidity plan. As point out by Saunders and Cornett (2008), liquidity plan allows the bank's managers to make borrowing decisions prior to the emergence of liquidity problems. These decisions can then lower the costs of funds and minimise excess liquidity reserves (reserves that are above the required minimum) and so minimise the opportunity costs of those excesses.

As reported by Saunders and Cornett (2008), another important tool to measure potential liquidity needs of a bank is the net liquidity statement. In the net liquidity statement, all uses of liquidity (e.g. borrowed funds, central bank borrowing, etc.) are subtracted from the sources of liquidity (e.g. liquid assets, excess cash reserves, etc.). When the net liquidity position of a bank is positive all the uses of liquidity are completely covered by the sources of liquidity. On the other hand, when the net liquidity position is negative, a bank does not fully cover used liquidity with sources of liquidity.

Saunders and Cornett (2008) note that the liquidity risk of the bank can also be measured by comparing certain balance sheet features among banks of similar size and also from the same geographic region. This approach of measuring liquidity is called the stock approach or static approach of liquidity measurement, as it uses the bank's balance sheet ratios to identify the liquidity position of a bank. These ratios are often: liquid assets to total assets, liquid assets to total deposits or to deposits of the non-banking sector and other short-term funding, loans to deposits, borrowed funds to total assets, loan commitments to total assets, etc. Of course, it is also important to compare the structure of bank funding, as banks with a large share of stable liabilities (e.g. core retail deposits) are less vulnerable to the outflow of funding sources.

According to Laštůvková (2017), studies analysing the determinants of liquidity either use balance sheet features (stock approach) or they use the method of liquidity creation (dynamic approach) based on the work of Berger and Bouwman (2009) or Deep and Schaefer (2004). Alternatively, Cucinelli (2013) uses the liquidity ratios that were developed by the BCBS to measure liquidity risk on the side of the dependent variable. The dynamic approach of Berger and Bouwman (2009) divides all balance sheet and off-balance sheet items in terms of liquidity into liquid, semi-liquid and illiquid (determined upon by category of the given item and its maturity) and assigns them weights in order to obtain four possible measurements of liquidity creation. For example, Horvath, Seidler and Weill (2012) or Pana, Park and Query (2010) are the authors using the Berger and Bouwman (2009) method of measuring liquidity.

The dynamic approach of Deep and Schaefer (2004), which is called the liquidity transformation gap (LT gap), measures liquidity by subtracting liquid liabilities from liquid assets and the obtained difference is then weighted by the total value of assets. Deep and Schaefer (2004) divide assets and liabilities in terms of liquidity but only into liquid and illiquid. Their measurement of liquidity assesses the net "excess" of liquidity. The ratio of the LT gap can range between - 1 and 1. When a bank has no "excess" liquidity (when the value of liquid assets is the same as the value of liabilities) its LT gap equals zero. For some authors the dynamic approach of Berger and Bouwman (2009) or Deep and Schaefer (2004) gives a better estimate of liquidity risk than the approach based on static liquidity indicators derived from the bank's balance sheet.

Nevertheless, empirical studies mostly use balance sheet features (stock approach) when identifying determinants that influence the liquidity of banks. The most common indicator of liquidity measurement on the side of the dependent variable is the ratio between liquid assets and total assets (e.g. Bund & Desquilbet, 2008; Deléchat, Henao, Muthoora, & Vtyurina, 2012; Vodova, 2011, 2012, 2013). Another commonly used indicator in empirical research is the ratio between liquid assets and deposits or its extension, which includes short-term funding or other types of funding in the denominator (e.g. Munteanu, 2012; Vodova, 2011, 2012, 2013; Mehmed; 2014). The higher the ratio of these indicators, the greater the ability of the bank to absorb funding liquidity shock and thus the less vulnerable it is to funding liquidity risk. On the other hand, some studies employ the ratio of loans to total assets (e.g. Demirgűc-Kunt & Huizinga, 1999) or the ratio between loans and customer deposits (e.g. Bonfim & Kim, 2012) to assess the liquidity risk of a bank. However, a high ratio of these indicators indicate that the bank is more vulnerable and exposed to liquidity risk.

As part of Basel III, the BCBS developed the liquidity coverage ratio (hereinafter: LCR) and the net stable funding ratio (hereinafter: NSFR) to assess the liquidity position of a bank. The LCR aims to ensure that banks have enough high-quality liquid assets, which can be easily and immediately converted into cash, to meet the liquidity stress scenario lasting 30 calendar days (BCBS, 2013). Its goal is to improve the banks' resilience to short-term liquidity risk. The second liquidity regulation tool, the NSFR, requires from banks that they have a stable funding structure with respect to the composition of their assets and off-balance sheet exposures (BCBS, 2014). Its goal is to improve the stability of the funding structure of banks. Such liquidity regulation of banks seems appropriate for strengthening liquidity risk management and financial stability, as we have seen that the solvency requirements are not enough to protect the banking system against liquidity risk.

Prior to the implementation of international standards for measuring liquidity risk, each country had its own method of measuring the liquidity risk of a particular bank and the liquidity of the banking system. The central bank of Slovenia, for example, regulates liquidity risk by requiring from banks that their first-bucket liquidity ratio – ratio referred as KL1, which classifies financial assets and liabilities by residual maturity of up to 30 days – be maintained above one. If banks fail to comply with the regulation, they must report reasons for non-compliance. The second-bucket liquidity ratio – ratio referred as KL2, which classifies financial assets and liabilities by residual maturity of up to 180 days – is for informational purposes only. Bank of Slovenia also measures the stock of liquid assets relative to total assets in the so-called secondary liquidity indicator. The secondary liquidity indicator treats foreign marketable securities rated BBB or higher and Slovenian government securities as liquid assets. The Bank of Slovenia does not set minimum requirements for the secondary liquidity indicator, but uses it for information purposes.

In June 2014, the Bank of Slovenia developed and introduced a liquidity requirement called gross loans to deposits flows (hereinafter: GLTDF). It prescribed banks with a

positive annual growth of deposits to have a positive growth of loans to the non-banking sector. The rationale of the GLDF was to boost banks' intermediation activity, support credit to the economy and strengthen the ability of banks to repay their depositors. In October 2017, the Bank of Slovenia adopted the decision to introduce GLTDF requirement and first-bucket liquidity ratio requirement as the non-binding macroprudential recommendations. This decision was based on the positive developments of liquidity of the Slovenian banking system. Namely, due to the stabilization of the loan-to-deposit ratio and thus the funding structure of banks, the existing high stock of liquid assets, and the implementation of international regulatory standards that require that national liquidity requirements become merely recommendations. Nevertheless, by maintaining liquidity requirements as recommendations, the Bank Slovenia emphasized the need to monitor the stability of funding structure and to monitor liquidity risk management due to the existing high share of demand deposits in the balance sheet of banks.

1.3 The traditional role of banks, exposure to liquidity risk and its regulation

The traditional function of banks is to accept deposits from savers and grant loans to borrowers. While providing the necessary liquidity to borrowers (e.g. by providing borrowers the possibility of financing their investments or consumption needs), banks offer deposits to savers which represent liquid claims to the bank, and allow depositors to withdraw their savings to optimise their consumption expenditure. With this function banks convert short-term liquid liabilities (e.g. deposits from savers) into long-term loans, which are usually illiquid (cannot be sold immediately without major losses). By transforming maturities from short-term to long-term, banks create liquidity (Bryant, 1980; Diamond & Dybvig, 1983).

Liquidity creation is recognised as one of the most important function provided by banks and an essential component for the functioning of the economy. This is especially emphasized and well elaborated in the theoretical literature that deals with bank liquidity creation, where the specific role of banks in the process of creating liquidity is to hold illiquid assets while providing liquidity to the economy (e.g. Bryant, 1980; Diamond & Dybvig, 1983; Diamond & Rajan, 2001a). However, it is also pointed out that liquidity creation relies on the discrepancy in the maturity of the bank’s assets and liabilities, which makes banks inherently vulnerable and exposed to liquidity risk.

The follow-up papers, extending the models of Bryant (1980) and Diamond and Dybvig (1983), accentuate the point that liquid liabilities (e.g. liquid demand deposits) have compelling incentive implications for bank managers (e.g. Calomiris & Kahn, 1991; Diamond & Rajan, 2001b; Kim, Kristiansen, & Voje, 2005). Calomiris and Kahn (1991) and Kim, Kristiansen and Voje (2005) emphasize that depositors, as well as borrowers, have incentives to monitor banks and their risk exposure, and their ability to liquidate their deposits (cause a bank run) is what concerns the bank managers and is disciplining them.

Calomiris and Kahn (1991) emphasize that the use of liquid liabilities (e.g. demandable debt) overcomes many agency problems because it creates the right incentives for bank managers.

Deposits have been the main source of funding for banks for many years, but banks have eventually gained access to other sources of funding. Especially before the financial crisis banks strongly relied on the interbank market. This way, additional to the classical bank runs, banks became exposed to market freezes or sudden depletion of funds on the interbank market, during which banks may lose funding irrespective of the quality of their credit portfolio, as discussed by Brunnermeier (2009), Borio (2010) or Huang and Ratnovski (2011). In addition, according to Drehmann and Nikolaou (2009), the increased dependence of banks on interbank funding has considerably strengthened the link between funding liquidity risk and market liquidity risk, and as shown by Brunnermeier and Pedersen (2007), market liquidity and funding liquidity can be mutually reinforcing each other and generate liquidity spirals.

Diamond and Rajan (2001a, 2001b) raised the question if financial fragility (the possibility of a bank run) is actually a desirable state for banks since its existence provides bank managers the right incentives. Furthermore, Diamond and Rajan (2001b) emphasize that bank regulation, such as minimum capital requirements, should be avoided because it could impair liquidity creation. However, inherent vulnerability of banks to funding liquidity risk due to the function of transforming maturities from short-term to long-term is the predominant reason for bank regulation and the establishment of national deposit insurance systems. Llewellyn (1999) also emphasizes that it is necessary to regulate individual bank and strengthen its stability because strong interbank linkages can worsen the impact of one bank's failure and jeopardise financial stability.

According to some authors (e.g. Acharya, Shin, & Yorulmazer, 2001; Allen & Gale 2004a; Tirole, 2011; BCBS, 2013) banks can reduce maturity transformation gap in the balance sheet by holding a buffer of liquid assets. However, there are costs associated with investing in low-yielding liquid assets. Namely, holding a certain share of assets in the most liquid forms is expensive for banks, as liquid assets are associated with lower returns compared to illiquid assets (e.g. loans). Moreover, as Bonfim and Kim (2012) point out, holding a buffer of liquid assets can be inefficient for banks, as it limits their ability to supply credit to borrowers. Therefore, banks are constantly faced with the task of avoiding a situation in which they would become illiquid, and at the same time ensuring adequate returns to shareholders.

Although banks have some incentives to have a certain share of their assets in the most liquid forms, they will never have enough liquid assets to completely protect themselves from a sudden stop or dry-up of funds in the wholesale markets or against a bank run. Therefore, as pointed out by Acharya, Shin, & Yorulmazer (2011) or Holmström and Tirole (2001), regulation become necessary to mitigate some of the liquidity risk.

Robitaille (2011) points out that mandatory reserve requirements that banks must have in the form of cash or deposits with the central bank in order to cover particular deposit liabilities were traditionally one of the main tool used by central banks to reduce liquidity risk. However, reserve requirements also play an important role in the implementation of monetary policy, as the reserve rate set by the central bank affects the money supply.

Diamond and Dybvig (1983) were among the first to show how explicit deposit insurance designed to protect the depositors of the bank can sustain bank run, thereby reducing liquidity risk and maintaining financial stability. On the other hand, Bruche and Suarez (2010), Ioannidou and Penas (2010) or Martin (2006) discuss how insurance of bank liabilities can create wrong incentives for bank managers and can lead to moral hazard, and that liability insurance is only efficient in reducing the probability of bank runs and is not sufficient to reduce all liquidity related risks. In a recent paper, Calomiris and Jaremski (2016) underline that empirical evidence supports the political approach (private interest motivation) in the creation and expansion of deposit insurance systems. Calomiris and Jaremski (2016) find that liability insurance has often been associated with an increase rather than a reduction in systemic risk due to the removal of market discipline.

Brunnermeier, Crockett, Goodhard, Persaud and Shin (2009) expressed the idea of a further increase in capital requirements to integrate also liquidity risk, but Ratnovski (2013) emphasizes that funding liquidity risk is associated to asymmetric information on banks' solvency and increasing capital requirements, without reducing the problem of asymmetric information, would not reduce liquidity risk. To avoid systemic crisis and maintain financial stability, Perotti and Suarez (2009) propose a mandatory liquidity insurance mechanism based on the compulsory liquidity charge paid to the regulator, the premium being dependent on the extent of maturity mismatch of assets and liabilities. However, many authors argue that the most important insurance against funding liquidity shock is a buffer of liquid assets, and therefore emphasize the usefulness of imposing minimum requirements on the amount of high-quality liquid assets (e.g. Acharya, Shin, & Yorulmazer, 2011; Allen & Gale, 2004a and 2004b; Rochet & Vives, 2004; Tirole, 2011; BCBS, 2013). On the other hand, Wagner (2007) shows that a high share of liquid assets in banks' balance sheet can induce risk-taking.

1.4 Determinants of banks' liquidity buffers – theory and empirical findings

We emphasized that banks provide liquidity to borrowers by offering loans and at the same time, they offer liquid deposits to savers so they can optimise their consumption needs. When the excessive number of depositors decides to withdraw their deposits, the bank must liquidate part of its assets. If the bank does not have sufficient liquidity to cover the outflow of funding, the liquidation of assets can lead to a loss of value and a lack of liquidity can quickly lead to a solvency problem. As emphasized, many authors point out that the best insurance for banks against such a liquidity crisis is that they have a sufficient

amount of high-quality liquid assets (e.g. Allen & Gale, 2004a, 2004b; Rochet & Vives, 2004; Acharya, Shin, & Yorulmazer, 2011; Tirole, 2011; BCBS, 2013). An overview of theoretical and empirical literature suggests that determinants that influence the liquidity of banks can be divided into four categories. These are i) opportunity costs of owning liquid assets and the volatility of funding sources and the volatility of their prices, ii) bank characteristics, iii) macroeconomic environment, and iv) moral hazard incentives caused by safety nets (e.g. deposit insurance) and the availability of the central bank assistance. In this section, we present the theoretical and empirical findings that relate to factors that influence the liquidity of banks.

1.4.1 Opportunity cost and volatility of funding sources and their prices

Most of the theories that focus on the bank's decision on the amount of liquid assets it will have, predict that liquid assets of banks will decrease when the opportunity cost of owning liquid assets increase. For example, "liquid assets as a buffer" theory that was initiated by Edgeworth (1888) and later developed by Porter (1961) and Kane and Malkiel (1965), predict that banks invest in liquid assets mainly for precautionary reasons. "Liquid asset as a buffer" theory also predict that banks will increase the amount of liquid assets when refinancing cost increase (if the penalty rate in the model is treated as the refinancing cost). The empirical implications of the theoretical model provided by Freixas and Rochet (1997, p. 228), which deal with the "liquid asset as a buffer" theory, are that the amount of liquid assets held by banks are reduced when the opportunity cost of investment in liquid assets increases.

The model also predicts that the bank's liquid assets increase when the intensity and probability of a liquidity shock increase (due to the volatility of funding sources) and when the refinancing costs increase (e.g. the discount rate charged by a central bank or the interest rate on interbank loans). The model considers the difference in the return (yield) on loans and securities (treated as liquid assets) as the opportunity cost of owning liquid assets (securities) instead of loans. However, in order to measure the difference in returns and thus the opportunity cost, the expected return on loans and securities would be needed. Therefore, empirical studies measure the opportunity cost of owning liquid assets instead of loans with a net interest margin or with the spread between the loan interest rate and the deposit interest rate.

Deléchat, Henao, Muthoora and Vtyurina (2012) find that liquidity buffers of banks from the Central America region have a negative correlation with the net interest margin. Aspachs, Nier and Tiesset (2005) find the same result for domestic banks in the United Kingdom, but for foreign banks, the interest rate margin has an opposite effect on liquidity. The authors explain that a positive effect could reflect transfers of liquidity from the parent bank when interest rate margins in the United Kingdom are high. Valla, Seas-Escorbiac

and Tiesset (2006) report a negative correlation between the net interest margin and the liquidity of the French banking system.

Agénor, Aizenman and Hoffmaister (2004) report that the excess liquidity reserves of Thai banks are increasing as external funding costs increase (measured by the interest rate charged by the central bank). Munteanu (2012) finds a positive correlation between the cost of funding (measured with the ratio between total interest expense and total liabilities) and the liquidity of the Romanian banking system. Roman and Sargu (2014) find the same result for banks in Bulgaria, but they measure the costs of funding with interest expense relative to total deposits. In assessing the effect of the financial crisis on the liquidity creation of banks, Moore (2009) concludes that liquidity of banks from Latin America and the Caribbean tends to be negatively linked to the volatility of the cash to deposit ratio.

Vodová (2013) notes that due to the increase in market interest rates, lending activity becomes more attractive and, consequently, the banks reduce the amount of liquid assets. An empirical study of the Hungarian banking system provided by Vodová (2013) confirms the negative relationship between the short-term interest rates and the liquidity of banks. However, in the empirical study of the Czech banking system provided by Vodová (2011), a positive link was established between the interbank interest rate and the liquidity of banks, which means that a higher interbank interest rate encourages banks to invest more on the interbank market. An empirical study carried out by Trenca, Petria, Mutu and Corovei (2012) on a sample of 30 commercial banks from seven Central and Eastern Europe countries (including Slovenia) analyses the impact of the interest rate spread between the loan interest rate and the deposit interest rate on the liquidity of banks and, contrary to expectations, find that the interest rate spread has a positive impact on the liquidity of banks.

1.4.2 Bank characteristics

The above "liquid assets as a buffer" theory does not recognise the liabilities side of the balance sheet as a potential liquidity source for banks. Liability source in that case is implicitly presented through the penalty rate, which is considered as exogenous and independent of the required amount of liquid assets relative to reserves (in case of a liquidity shock), the cost of accumulating liabilities is assumed exogenous and banks do not have limited access to these liabilities. Poole (1968) was one of the first to recognise liabilities as an important source of liquidity for banks and adds interbank market as a potential liquidity source. However, the assumption of the model provided by Pool (1968) is the perfect elasticity of the supply of funds on the interbank market, but more recent literature claims that banks do not have unlimited access to external funding (e.g. to interbank advances), and explains why not (e.g. Holmström & Tirole, 1998; Lucas & McDonald, 1992 or Kiyotaki & Moore, 2008).

Holmström and Tirole (1998), Lucas and McDonald (1992) and Kiyotaki and Moore (2008) show that due to market imperfections resulting from asymmetric information, due to either moral hazard or adverse selection, banks cannot raise an unlimited amount of external funding. The model offered by Holmström and Tirole (1998) analyse the effects of moral hazard on the ability of companies (or banks) to raise external funding. Holmström and Tirole (1998) conclude that due to moral hazard incentives (e.g. due to misallocated resources because of wrong manager incentives) banks, at an interim stage, cannot raise the full amount of required extra funding (which they might need because of a liquidity shock) for their desired long-term investment through external funding sources. Therefore, in order to avoid the problem of limited access to external sources of funding, financially constrained banks are encouraged to invest in liquid assets.

Lucas and McDonald (1992) and Kiyotaki and Moore (2008) argue that the ability of banks to raise external funding depends on private information on the quality of their investments. Since external funding is considered as uninsured and sensitive to private information on the quality of the bank's assets, banks with better asset quality have the incentive to display the quality of their assets, so that they do not have to pay the same interest rate for external funding as weak banks (banks with lower asset quality). The authors point out that banks can signal their riskiness and hence the quality of their assets by investing in liquid assets. However, the cost of investments in liquid assets is different for banks with good asset quality than it is for banks with poor asset quality. Namely, banks with lower asset quality can survive only if they receive high enough yield on their future investments (e.g. loans).

Therefore, the opportunity cost of investing in low-yielding liquid assets for weak banks is higher than for good banks, as banks with good asset quality can survive even if the yield on future investments is low. This follows from the fact that banks with lower asset quality should require a high average return per unit invested, while good banks can have lower average return on their investments in order to survive. Accordingly, the good banks can afford to show the quality of their assets by investing in liquid assets and are encouraged to actually do so, because under certain conditions it is profitable for them, due to lower costs of obtaining external funding. The model provided by Lucas and McDonald (1992) envisages that banks with better asset quality should invest more in liquid assets than weak banks, given the level of deposits and the distribution of possible withdrawals of funding sources.

Most of the above-discussed models emphasize there are several characteristics of banks that affect their ability to obtain external funding sources. For example, it is expected that the size of the bank will have a positive impact on banks' ability to obtain new sources of funding, as smaller banks have difficulties in accessing the capital market. In addition, banks that are more profitable will have fewer difficulties in acquiring new capital and are therefore less financially constrained, and consequently need to invest less in liquid assets. The ownership of the bank may also affect banks' ability to obtain funding sources. As

underlined by Freixas and Holthausen (2005), public and foreign banks should be less financially constrained in comparison to private and domestic banks, as public banks may have an implicit guarantee, while foreign banks may have access to support from headquarters. Deléchat, Henao, Muthoora and Vtyurina (2012) note that the ownership of the bank might interact with other explanatory variables in the regression model. For example, Aspachs, Nier and Tiesset (2005) report that the availability of a domestic lender of last resort (hereinafter: LOLR) affect the liquidity of domestic banks, while it does not affect the liquidity of foreign banks.

Using the three-period model, Almedia, Campello and Weisbach (2004) analyse whether a decision on the possession of liquid assets differs between financially constrained companies that can raise the required amount of capital only up to the amount of their eligible underlying assets and financially unconstrained companies. Their results show that for non-constrained companies, the amount of cash held between period one and two is irrelevant. On the other hand, companies that have financial difficulties and cannot obtain an unlimited amount of capital through external sources manage their liquidity more actively by retaining some of the cash inflows (earnings) in order to increase the ability to finance future investment opportunities when they occur. Almedia, Campello and Weisbach (2004) use the Tobin's Q to proxy future investment opportunities and receive significant and positive coefficients on cash flow and Tobin's Q. Almedia, Campello and Weisbach (2004) interpret this result as evidence in favour of financial constraints.

Following the findings of Almedia, Campello and Weisbach (2004), on a sample of banks from the United Kingdom, Aspachs, Nier and Tiesset (2005) analyse whether a similar relationship (between future investment opportunities and cash flows, and the liquidity) applies to banks. Aspachs, Nier and Tiesset (2005) obtain positive and statistically significant coefficients on bank earnings (cash flows) and Tobin's Q. The results suggest that banks in the United Kingdom behave in a way consistent with the model of Almedia, Campello and Weisbach (2004). Namely, the liquidity of banks in the United Kingdom is increasing as the current earnings increase and when the future lending opportunities, measured with Tobin's Q, are increasing. Aspachs, Nier and Tiesset (2005) interpret this result as evidence that banks are financially constrained because they store liquidity when current earnings are high and when future investment opportunities become favourable.

Deléchat, Henao, Muthoora and Vtyurina (2012) find that the banks' demand for precautionary liquidity in Central America is related to the size of the bank, profitability, capitalisation and financial development. They also find that, on average, foreign banks have less liquid assets and note that this could reflect the fact that foreign banks have access to emergency lines from the parent bank. On a sample of 1080 listed and non-listed euro area banks, Cucinelli (2013) analyses the relationship between liquidity risk, measured with the LCR and the NSFR, and some bank-specific variables. Her results indicate that bigger banks are more exposed to short-term liquidity risk (e.g. have lower LCR), while banks that are better capitalised have less exposure to long-term liquidity risk

(e.g. have higher NSFR). Furthermore, banks that are more specialised on lending activities have more vulnerable funding structure (e.g. have lower NSFR).

Roman and Sargu (2015), which analyse the relationship between certain bank characteristics and the liquidity of commercial banks from the Central and Eastern Europe, find that the total capital ratio, the ratio of impaired loans to total loans and the return on average equity have the most influence on the overall liquidity level of banks. The impact of these variables is positive in some cases and negative in others, depending on the local particularities of the macroeconomic environment.

Wójcik-Mazur and Szajt (2015) analyse the effect of some microeconomic factors and some and macroeconomic factors on the liquidity of banks. In their analysis, the sample of banks is separated into two groups. In the first group are banks operating in the countries of the so-called old European Union (Austria, Belgium, Germany, Denmark, Spain, Finland, France, the United Kingdom, Greece, Ireland, Italy and Portugal), while in the second group are banks operating in the countries of the so-called new European Union (Bulgaria, the Czech Republic, Hungary, Slovenia, Poland, Romania, and Slovakia). Wójcik-Mazur and Szajt (2015) find that factors of liquidity risk differ among old European Union and new European Union countries. However, some factors were detected that affect liquidity regardless of the country group. These are margin volume, credit risk, and the size of the engagement in the interbank market.

1.4.3 Macroeconomic fundamentals

The macroeconomic environment is an important external and uncontrollable factor that influences the banks' decision regarding the amount of liquid assets they will have. This is because cyclical fluctuations of macroeconomic factors (such as economic growth, market interest rates, inflation, etc.) affect the creditworthiness of businesses and consumers, and consequently, the quality of the credit portfolio of banks. When the credit portfolio of the bank deteriorates, the exact value of the bank's assets becomes unknown, which makes the bank's net worth and its capital adequacy unclear. This, according to literature, affects the ability of banks to obtain external funding (acquire liquidity), while increasing the probability of funding sources withdrawal and thus also affecting banks' decision on the amount of liquid assets that they will have.

Alger (1999) and Bhattacharya and Gale (1987), for example, analyse the interbank market as a potential liquidity source for banks, and its role in the distribution of liquidity in the financial system, and present two different potential sources that affect the functioning of the interbank market and underline its imperfection. Bhattacharya and Gale (1987) assume that information on the amount of liquid assets held by banks is not easily observable. Since the bank's liquidity is not known to other banks, a free-rider problem may arise, which means that some banks under-invest in liquid assets so that in the event of a liquidity

shock there is an aggregate lack of liquidity in the financial system. The authors suggest the reserve requirement as one of the ways to mitigate this interbank market imperfection.

The model presented by Alger (1999) presupposes that private information on the amount of liquid assets held by banks is visible, but banks have private information on their net worth. As the increased credit risk can cause the interbank market to freeze due to the adverse selection problem (due of the unknown value of banks), banks have inventive to store liquidity, which quaintly is determined before banks know if they are solvent or not. Therefore, if banks expect that the interbank market will freeze, they accumulate a sufficient amount of liquid assets in order to protect themselves against the possible withdrawal of funding sources and mitigate the negative impact of the expected limited or completely frozen access to external funding. The model provided by Alger (1999) also carries implications for the liquidity fluctuations with respect to the economic cycle. It assumes that the probability of an interbank market freeze is greater during the economic downturn, which means that the relative share of liquid assets in the balance sheet of the banks should increase when they expect a recession.

The theory, which takes into account the role of supply and demand factors of deposits and credits, and has implications in terms of cyclical liquidity developments, considers bank liquid assets as a residual. Accordingly, as explained by Bester and Hellwig (1987) and Stiglitz and Weiss (1981), due to moral hazard or adverse selection problems there may be credit rationing, meaning that there is no interest rate at which the market for credit clears. Under the adverse selection case, it is assumed that, when the interest rate on loans is increased, riskier borrowers want to obtain a new loan, which as pointed out by Alger and Alger (1999) potentially implies a non-monotonic credit supply. If the supply and demand functions do not meet, credit is rationed. The implications of the theory given by Stiglitz and Weiss (1981) and Bester and Hellwig (1987) are that banks should increase liquid assets when the probability of default by borrower's increase (given the level of deposits), which could be expected during the economic downturn.

Aspachs, Nier and Tiesset (2005) also note that the liquidity of the balance sheet of banks depends on the scope of access to external funding. They point out that limited access to external funding can lead to the fact that banks' liquidity buffers are moving in contrast to the economic cycle. In other words, limited access to external funding opens up the possibility that liquidity buffers of banks are moving counter-cyclically[1]. Their empirical analysis confirms this hypothesis, as it concludes that the liquidity buffers of banks in the United Kingdom have a negative relationship with the growth of the GDP. Deléchat, Henao, Muthoora and Vtyurina (2012) also point out that the bank's demand for liquid assets is counter-cyclical if capital markets are imperfect, which means that banks decide to accumulate liquid assets before or during the economic downturn, and they reduce them

[1] Pro-cyclical and counter-cyclical are the terms used in economics to describe how an economic quantity or variable is related to the general economic trend, where the former means that an economic variable is positively correlated with the overall state of the economy, while the latter means the opposite.

in periods of economic growth when the opportunities for lending and the loan demand are higher. They emphasize that this means that liquidity buffers of banks are negatively linked to the fluctuations of macroeconomic factors, such as real GDP growth (hereinafter: GDP), credit cycle, output gap, inflation rate and policy interest rates.

On the other hand, Valla, Saes-Escorbiac and Tiesset (2006) argue that the conditions for accumulation of liquidity are better in times of economic growth. They say that banks store liquid assets in economic downturn mainly due to the precautionary reasons. Berrospide (2013) provides evidence that during the global financial crisis, American commercial banks have accumulated liquid assets for a precautionary reason, as he finds that banks held more liquid assets in anticipation of future expected losses. On the other hand, analysing the effect of a financial crisis on the creation of liquidity of banks, Moore (2009), using a sample of Latin America and Caribbean countries, observe that liquidity tends to fall on average by around 8 percentage points during a crisis. On the other hand, about a year and a half after the crisis, liquidity tends to increase on average by 17 percentage points. Moore (2009) concludes that liquidity is negatively linked to the business cycle and interest rates. Furthermore, Moore (2009) advocates that cyclical downturn should lower banks' expected transactions demand for money and lead to a decrease in liquid assets held by banks.

Pyle (1971) and Hart and Jaffe (1974) treat assets and liabilities of a bank as securities. The entire bank can therefore be viewed as a portfolio of securities. Accordingly, a "portfolio management theory" may be used for the management of bank's assets and liabilities. The model offered by Freixas and Rochet (1997, p. 236) illustrates the main ideas and Alger and Alger (1999) provide the empirical implications of this model. When the volatility of interest rates increases, which can happen with a market turnaround or at the onset of a crisis, banks should reduce the relative amount of loans and increase their investments in liquid assets (Alger & Alger, 1999).

Trenca, Petria and Corovei (2015) analyse the impact of several macroeconomic factors on the liquidity of banks from countries that were recently affected by adverse economic and financial conditions (Greece, Portugal, Spain, Italy, Croatia and Cyprus). They find that inflation rate, public deficit, unemployment rate, and GDP negatively affect bank liquidity. Moreover, inflation rate and liquidity in the previous period had the most significant impact on bank liquidity, while GDP growth rate had the least significant impact.

According to our knowledge, a study that analyses the effect of bank-specific factors and macroeconomic conditions on the liquidity of banks in Slovenia has not yet been carried out with the exception of a study by Laštůvkoá (2017), which differs from our study in many ways. For example, our empirical analysis utilizes static balance sheet ratios for the dependent variable, while the empirical analysis of Laštůvkoá (2017) uses flows, such as positive flow (representing the creation of liquidity), negative flow (representing the outflow of liquidity), net change, and total allocation (e.g. the activity in the banking

system). For the independent variables, Laštůvkoá (2017) use the size of the bank, the amount of loans and deposits, earnings and capital of the bank.

Results of empirical analysis of Laštůvkoá (2017) show that internal factors (size of the bank, the amount of loans and deposits, earnings and bank's capital) have the greatest impact on the creation of liquidity (on a positive flow). On the other hand, external factors have the greatest impact on the outflow of liquidity (on a negative flow). Laštůvkoá (2017) made the following conclusions for the Slovenian banking system: The creation of liquidity increases (banks increase a buffer of liquid assets) when banks acquire new customer deposits, when they increase capital and when the ratio between loans and deposits increases. The creation of liquidity (banks decrease a buffer of liquid assets) decreases with rising earnings and rising share of loans, but rising share of loans and bank size also lead to liquidity outflow.

1.4.4 Moral hazard and safety nets

There are various mechanisms that banks can use to protect themselves against liquidity shock. Many authors point out that the interbank market is the most important source of liquidity for banks since it can optimize the allocation of liquidity in the financial system in the absence of information asymmetries. Consequently, banks are not faced with the inefficiency of excessive investments in liquid assets, as they can rely on the interbank market in order to gain liquidity if, due to the liquidity shock, they need more liquid assets to cover the outflows of sources of funding than they may actually have. However, as pointed out by Bhattacharya and Gale (1987) and Alger (1999), due to asymmetric information (e.g. due to unobservable information about the quality of banks' assets or the amount of liquid assets), the interbank market might not work perfectly in all market conditions.

Due to the imperfections of the interbank market, the central bank usually acts as a LOLR to provide emergency liquidity assistance to certain financial institutions or to ensure aggregate liquidity when there is a system-wide lack of liquidity. However, as Repullo (2005) demonstrates, the availability of the financial safety net (the possibility of obtaining emergency liquidity assistance) may actually have undesirable effects. Namely, it can influence banks' decisions regarding the level of risk they take and on the amount of liquid assets they will hold. Repullo (2005) reports that the choice of banks regarding the level of risk they will take is not related to the availability of emergency aid. However, the presence of a LOLR reduces the incentive of banks to hold liquid assets. Therefore, the share of liquid assets in the balance sheet of banks is reduced by the introduction of a LOLR.

Aspachs, Nier and Tiesset (2005) analyse how the presence of a LOLR affects the liquidity buffers of banks from the United Kingdom. They find that the greater the probability of a potential liquidity support from the central bank, the less the banks will invest in liquid

assets. Gonzalez-Eiras (2003) analyses the effect of the Repo Agreement, which was implemented in 1996, and increased the ability of the central bank to provide emergency liquidity assistance, on the liquidity position of Argentinean banks. He finds that after the entry into force of the Repo Agreement, the banks reduced the share of liquid assets by approximately 6.7 percentage points. Both empirical studies reached conclusions in accordance with the theoretical model offered by Repullo (2005).

Today, many governments have established national deposit insurance schemes to avoid panic bank runs. However, liability insurance, as emphasized by many authors (e.g. Bruche & Saurez, 2010; Ioannidou & Penas, 2010; Martin, 2006) is not sufficient to prevent liquidity risk and can actually lead to moral hazard. Using data from 61 countries, Demirgűc-Kunt and Detagriache (2002) find that explicit deposit insurance actually increases the probability of a banking crisis. Calomiris and Jaremski (2016) also note that the formulation of deposit insurance is associated with an increase rather than a reduction in systemic risk since the introduction of liability insurance eliminates market discipline. Indeed, Merton (1997) shows that deposit insurance should lead banks to maximize risk.

Using data from nearly 7000 banks from 30 countries that are part of the Organisation for Economic Co-operation and Development, Bonner, Lelyveld and Zymek (2015) find that in the absence of liquidity regulation the determinants of banks' liquidity buffers are a combination of bank-specific (business model, earnings, deposit holdings, size) and country-specific factors (disclosure requirements, concentration of the banking sector). However, they note that while most of banks' incentives are replaced by a liquidity regulation, the bank's disclosure requirements and the size of the bank remain significant factors affecting the liquidity of banks.

2 DATA AND EMPIRICAL ANALYSIS

In our analysis, we study how the size of banks' liquidity buffers might be influenced by bank characteristics and by macroeconomic factors. In our econometric model, we use five bank-specific variables and two macroeconomic variables, which in the literature (e.g. Aspachs, Nier, & Tiesset, 2005; Bunda & Desquilbet, 2008; Bonfim & Kim, 2012; Dinger 2009; Deléchat, Henao, Muthoora, & Vtyurina, 2012) were shown to be important in determining the size of banks' liquidity buffers. We also analyse if the factors that influence the liquidity buffers of banks differ according to the ownership of the bank. The econometric tests were carried out using the dynamic panel data method, estimated by the system GMM estimator. The bank’s liquidity buffer is measured by the ratio of liquid assets to total assets. It is assumed that this ratio provides important insight into the bank’s absorption capacity of funding liquidity risk and is therefore used in many empirical studies (e.g. Aspachs, Nier, & Tiesset, 2005; Bunda & Desquilbet, 2008; Vodová, 2011, 2012, 2013; Deléchat, Henao, Muthoora, & Vtyurina, 2012; Bonfim & Kim, 2012).

2.1 Sample of the study

Our empirical analysis concentrates on the Slovenian banking sector. There are currently 17 banks operating in Slovenia. Among them, there are eight domestically owned banks, seven foreign banks and two foreign bank branches. Due to insufficient data, foreign bank branches are excluded from the analysis. The analysis also excludes the Slovenian Export and Development Bank due to its unique business model. In addition, banks that ceased to exist (such as Probanka, d. d. and Factor banka, d. d., which were liquidated in 2013) are excluded from the analysis. Thus, our sample shown in Table 1 consists of 14 banks, which accounts for 77% of banks in Slovenia and 90% of the balance sheet total of the Slovenian banking sector. The sample is therefore large enough to be considered representative for all banks in Slovenia. We selected annual time series between 2000 and 2016, covering the pre-crisis period, the crisis period and the post-crisis period, thus capturing the period of substantial adjustments made to the balance sheet structure of banks in Slovenia.

Table 1: Sample of the study

Bank	Ownership
NOVA LJUBLJANSKA BANKA D. D., LJUBLJANA	Domestic
NOVA KREDITNA BANKA MARIBOR D. D.	Domestic
ABANKA D. D.	Domestic
GORENJSKA BANKA D.D., KRANJ	Domestic
DEŽELNA BANKA SLOVENIJE D. D.	Domestic
DELAVSKA HRANILNICA D. D., LJUBLJANA	Domestic
HRANILNICA VIPAVA D. D.	Domestic
HRANILNICA LON D. D., KRANJ	Domestic
ADDIKO BANK D. D.	Foreign
INTESA SANPAOLO D. D.	Foreign
UNICREDIT BANK SLOVENIJA D. D.	Foreign
SBERBANK BANK D. D.	Foreign
SKB BANK D. D., LJUBLJANA	Foreign
SPARKASSE BANK D. D.	Foreign

Source: own work.

During the selected analysis period, there were several mergers and acquisitions. In order to limit the impact of mergers and acquisitions on the historical data series, we aggregated data prior to a merger using backward static consolidation. In the sample period there was also a change in bank ownership, namely, a big domestic bank (Nova KB Maribor d. d.) was sold to the investment management fund Apollo and the European Bank for Reconstruction and Development. Consequently, the process of the transfer of shares and the subscription for ownership interest was also implemented and Nova KB Maribor d. d. became a bank under foreign ownership. Because we also analysed the differences of liquidity determinants between domestic banks and foreign banks, it should be noted that Nova KB Maribor d. d. was treated as a domestic bank during the whole sample period, although it actually became a foreign-owned bank in the first half of 2016.

Slovenian government has recapitalized five banks and implemented a capital increase of EUR 3.2 billion, thus increasing the capital adequacy of the largest Slovenian banks. At the same time, non-performing claims were transferred from the banking system to the Bank Assets Management Company (hereinafter: BAMC). In return, recapitalised banks received government bonds. In our research, we reviewed these extraordinary measures and important balance sheet changes of domestic banks by imposing a dummy variable. In particular, a dummy variable was used for recapitalised banks, namely, Nova Ljubljanska banka d. d. and Nova KB Maribor d. d. after Q4 of 2013 and for Abanka d. d. after Q3 of 2014.

2.2 Data and descriptive statistics

Bank-specific data are derived from the statistical database of the Bank of Slovenia. Macroeconomic data are obtained from the Statistical Office of the Republic of Slovenia (thereinafter: SORS) and the Eurostat database. We use the STATA 14 statistical program for statistical data processing. Descriptive statistics of variables for all banks in the sample are shown in Table 2, and separately for domestic banks in Table 3 and for foreign banks in Table 4.

After looking at the data a few quick conclusions can be drawn. As for the first liquidity indicator (liquid assets to total assets), we can observe that the average value for domestic banks (see Table 3) is much higher than that of foreign banks (see Table 4). This is partly because small domestic savings banks exhibit a high share of liquid assets in total balance sheet, which is why the maximum value in the sample is 84.2% (see Table 2). However, after removing savings banks from the sample of domestic banks, foreign banks nevertheless had lower average values of liquid assets to total assets, which indicate that on average, foreign banks hold less liquid assets. As for the second liquidity indicator (liquid assets to deposits of the non-banking sector), which we used to test the robustness of our model, we can notice that on average, foreign banks have a better coverage of deposits with liquid assets than domestic banks (see Table 3 and Table 4). However, the average

value for both types of banks is similar. The greater coverage of deposits with liquid assets of foreign banks can be because foreign banks have fewer non-banking sector deposits than domestic banks among sources of funding.

Shareholder equity seems not to differ much with respect to the average value, however, foreign banks, at some point, had lower minimum value of equity in total balance sheet (see Table 4). Relatively high maximum values of equity to total assets coincide to the period after the crisis when some of the domestic banks were recapitalised by the government (see Table 2). Credit risk, measured with the ratio of non-performing loans to all loans, was more intense with domestic banks as its highest value is 33.8% (see Table 3) compared to foreign banks, where the highest value is 22.3% (see Table 4).

With regard to interest rate spread, it appears that domestic banks were able to create a larger spread between the loan interest rate and the deposit interest rate (see Table 3). This can be attributed to different business models of domestic and foreign banks, where foreign banks focus mostly on safer and more transparent companies and are financing themselves internally (through headquarters) or on wholesale markets.

In the period before the crisis, the Slovenian economy achieved a very high growth rate that exceeded the growth rate of the European Union. Exports of goods and services were the most important factor contributing to high economic growth, followed by investments in the construction of structures and transport equipment (Bank of Slovenia, 2007). Subsequently, after the turmoil on the financial markets that lead to the global financial crisis, the GDP growth of the Slovenian economy dropped significantly. Interest rates (3-month EURIBOR) reached the highest level in the pre-crisis period, and the lowest level of interest rates corresponds to the last year of our analysis.

Table 2: Descriptive statistics for all banks in the sample from 2000-2016

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Liquid assets to total assets (%)	232	34.70	16.09	3.25	84.26
Liquid assets to deposits (%)	232	56.65	22.72	3.84	147.49
Bank size (1,000,000 €)	232	1,367.40	2,918.00	12.57	15,511.41
Equity to total assets (%)	232	9.05	3.65	2.08	23.28
Return on average equity (%)	232	1.65	27.94	-249.42	31.45
NPL over all loans (%)	232	6.30	6.35	0.04	33.79
Interest rate spread (%)	167	2.65	0.74	1.01	6.00
Annual real GDP growth (%)	238	2.15	3.35	-7.80	6.94
3-month EURIBOR (%)	238	2.00	1.72	-0.31	5.03

Source: own work.

Table 3: Descriptive statistics for domestic banks from 2000-2016

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Liquid assets to total assets (%)	136	41.75	15.41	3.25	84.26
Liquid assets to deposits (%)	136	57.89	18.17	3.84	94.69
Bank size (1,000,000 €)	136	929.29	3,669.38	12.57	15,511.41
Equity to total assets (%)	136	8.94	4.24	4.31	23.28
Return on average equity (%)	136	1.46	34.09	-249.42	31.45
NPL over all loans (%)	136	6.59	7.43	0.15	33.79
Interest rate spread (%)	96	2.86	0.75	1.57	6.00
Annual real GDP growth (%)	136	2.15	3.35	-7.80	6.94
3-month EURIBOR (%)	136	2.00	1.72	-0.31	5.03

Source: own work.

Table 4: Descriptive statistics for foreign banks from 2000-2016

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Liquid assets to total assets (%)	96	24.63	10.87	3.53	46.58
Liquid assets to deposits (%)	96	54.89	27.93	13.23	147.49
Bank size (1,000,000 €)	96	1,514.17	853.68	97.95	3,267.37
Equity to total assets (%)	96	9.21	2.59	2.08	21.59
Return on average equity (%)	96	1.92	14.68	-67.04	26.61
NPL over all loans (%)	96	5.90	4.36	0.04	22.34
Interest rate spread (%)	71	2.26	0.55	1.01	3.78
Annual real GDP growth (%)	102	2.15	3.35	-7.80	6.94
3-month EURIBOR (%)	102	2.00	1.72	-0.31	5.03

Source: own work.

2.3 Method of estimation of the empirical model

For the empirical analysis, we used the panel data. The panel data takes into account both time series and cross-section data, which results in an increase in the number of available observations. In our instance, we have 16 years of data across 14 banks, so we have 224 observations. Therefore, we have repeated observations on the same cross-section observed for several time periods. Based on the number of observations, we can have a balanced or an unbalanced panel. A balanced panel has an observation for each unit of observation in time series, while in an unbalanced panel the observations are missing (Gujarati & Porter,

2009). Since we do not have an observation for every unit of observation in our time series, we are dealing with an unbalanced panel.

Klevmarken (1989) and Hsiao (2003) list several benefits of panel data. Notably, with panel data, we have better control over omitted variable bias (the unobserved effects), which can result from not controlling individual heterogeneity. In addition, the inclusion of a cross-sectional dimension adds a lot of variability in adding more informative data. In short, the great advantage of panel data is increased precision in estimation.

Using panel data, several banks operating in Slovenia were evaluated using the dynamic panel data model (a model containing a lagged dependent variable) that can lead to a number of econometric challenges. As described in Bond (2002), the ordinary least squares (hereinafter: OLS) estimator is inconsistent due to the presence of a correlation between the lagged dependent variable ($y_{i,t-1}$) and the individual specific effect (δ_i), which is also present if we increase the sample (Volk & Trefalt, 2014). A similar problem arises when assessing the model with random effects (RE) estimator, which like the OLS, does not remove the unobserved effect.

A fixed effect (FE) estimator, or within estimator, eliminates this source of endogeneity by subtracting the individual means for each bank, thus enabling the control of unobserved effects. This way the time-invariant individual specific effect (δ_i) is removed from the transformed equation. However, endogeneity remains because the within-transformed lagged dependent variable is correlated with the within-transformed error term (Volk & Trefalt, 2014). The presence of this type of correlation violates one of the basic rules of classical regression models, since the independent variable must not be correlated with the error of the regression model, as this can cause bias in the estimates of the coefficients.

To avoid the problem of bias and inconsistent estimates owing to a correlation between the lagged dependent variable and the error term, we tested the linear dynamic panel data estimation based on GMM. The GMM method was developed by Hansen (1982), who showed that the method of moments can be generalised and then used in testing of econometric models. In general, two GMM estimators are in use: the difference GMM estimator developed by Arellano and Bond (1991), and the system GMM estimator, described in Arellano and Bover (1995) and implemented in Blundell and Bond (1998).

Arellano and Bond (1991) obtain a consistent GMM estimator using lagged levels as instruments in the transformation of the first differences. This way, the problems of autocorrelation and endogeneity are better controlled by removing fixed effects in the error and using lagged explanatory variables as instrumental (Baltagi, 2014; Roodman, 2006). However, Blundell and Bond (1998) note that lagged level instruments can become weak when the autoregressive process becomes too persistent.

Therefore, Blundell and Bond (1998) develop an approach based on Arellano and Bover (1995) where in addition to the moment conditions of lagged levels as instruments of the

differenced equation, they also include moments conditions in which lagged differences are used as an instrument for the level equation. Such a transformation combines differentiated instruments into the system as well as instruments in levels: where in contrast to the difference GMM estimator, the variables in the equation with levels are instrumented by their own first differentials.

The system GMM estimator is designed for small T and large N (which is not our case since we have T=16 and N=14) and does not require specific assumptions in the distribution of data. With the system GMM estimator, we obtain also higher estimates of lagged coefficients because this estimator is not characterised by downward bias as in the dynamic GMM estimator (Roodman, 2006). Furthermore, according to Roodman (2006), both estimators (system GMM and difference GMM) can overcome the problems of endogeneity, autocorrelation, unobserved heterogeneity, and liquidity persistence.

Given our assumption of liquidity persistence, we prefer to use the system GMM estimator, which helps to overcome the weak instrument problem and results in improvements of estimates (Blundell & Bond, 1998; Roodman, 2006). However, in verifying the robustness of our estimates, we also used the difference GMM estimator and the fixed effects estimator among other things. We applied two diagnostic tests on GMM regression. First, the Sargan test of the overidentifying restrictions, which tests for the validity of instruments. Second, the Arellano and Bond (1991) test for autocorrelation in residuals.

2.3.1 Model specification

In our baseline specification we test the effect of bank-specific variables and macroeconomic conditions on the whole sample of banks. The baseline model specification can be seen in equation (1):

$$\pi_{i,t} = c + \alpha\pi_{i,t-1} + \sum_{j=1}^{j} \beta_j X_{i,t-1}^{j} + \sum_{m=1}^{m} \beta_m X_t^m + \delta_i + \mu_{i,t} \qquad (1)$$

Where the dependent variable (π_{it}), measures the liquidity buffer, which is measured by the ratio of liquid assets to total assets, for the bank i in year t. The model also includes the lag of dependent variable ($\pi_{i\,t-1}$) and constant (c). X_{it-1}^{j} is a vector of explanatory variables that are bank-specific and X_t^m is a vector of macroeconomic explanatory variables. Macroeconomic variables are defined as exogenous, while bank-specific variables are defined as endogenous and, consequently, their values are applied with a lag in order to eliminate or reduce endogeneity. The model also includes fixed effects (δ_i) and the error term ($\mu_{i,t}$).

Since we were also interested if ownership matters, we tested the effect of bank-specific and macroeconomic variables on the liquidity of domestic and foreign banks separately. To

test this hypothesis, we ran regressions for domestic and foreign banks separately, as according to literature ownership of the bank may influence liquidity decisions.

$$\pi_{i,t} = c + \alpha\pi_{i,t-1} + \sum_{j=1}^{j} \beta_j X_{i,t-1}^{j} + \sum_{m=1}^{m} \beta_m X_t^m + \delta_i + \mu_{i,t} + ownership\ dummy\ variable \quad (2)$$

Table 5 shows the correlation matrix between variables. The correlation tells us the linear relationship between variables, with -1 being a complete negative correlation, and +1 a complete positive correlation. The closer to those values, the stronger the correlation between the variables and values around zero mean that there is a weak link between variables (Robertson & McCloskey, 2002).

Table 5: Correlation Matrix

	L1	**TOA**	**CAP**	**ROAE**	**NPL**	**SPREAD**	**GDP**	**IR**
L1	1.000							
TOA	-0.096	1.000						
CAP	0.028	0.023	1.000					
ROAE	0.046	-0.195	0.087	1.000				
NPL	-0.114	0.231	0.132	-0.545	1.000			
SPREAD	-0.076	0.168	-0.039	-0.004	0.103	1.000		
GDP	0.150	0.107	0.082	0.246	-0.220	-0.106	1.000	
IR	0.066	-0.087	0.036	0.296	-0.487	-0.281	0.572	1.000

Source: own work.

From Table 5, we can see that the most strongly correlated variable with the dependent variable is the variable real GDP with a correlation coefficient of 0.15. Correlation is also relatively low among all other variables and is above -/+ 0.5 only between real GDP and short-term interest rate and between the share of non-performing loans and the return on average equity. Consequently, it can be concluded that the correlation between the variables is low and that there is no multi-collinearity problem.

2.3.2 Assumptions and restrictions

Assumptions

- It is assumed that systemic factors have an equal contribution to bank liquidity.
- It is assumed that market liquidity of assets is the same for all banks in the sample.

- It is assumed that the relative share of liquid assets is an appropriate indicator to measure the bank's absorption capacity of the funding liquidity risk.
- It is assumed that the sample is large enough to be representative of all banks in Slovenia.

Restrictions

- Due to insufficient data, foreign bank branches are excluded from the analysis.
- The analysis also excludes the Slovenian Export and Development Bank due to its unique business model.

2.4 Description of variables and hypotheses of the study

There are several empirical studies that have studied the determinants that influence the liquidity of banks. Some of them are focused on individual countries, such as the United Kingdom (Aspachs, Nier, & Tiesset, 2005), the Czech Republic (Vodová, 2011), Poland (Vodová, 2012), Romania (Munteanu, 2012), Hungary (Vodová, 2013), Bosnia and Herzegovina (Mehmed, 2014), Serbia (Račić, Stanišić, & Stanić, 2016) and Slovenia (Laštůvková, 2017). Other empirical studies included several countries in the analysis (Bunda & Desquilbet, 2008; Shen, Chen, Kao, & Yeh, 2018; Moore, 2009; Deléchat, Henao, Muthoora, & Vtyurina, 2012; Bonfim & Kim, 2012; Roman & Sargu, 2015; Bonner, Lelyveld, & Zymek, 2015; Cucinelli, 2013; Trenca, Petria, & Corovei, 2015; Wójcik-Mazur & Szajt, 2015). Most of these studies divide the determinants of banks' liquidity buffers into bank-specific and macroeconomic and on the level of the banking sector (e.g. market concentration). Among empirical research, independent variables differ slightly, but they all cover similar risks and factors that affect liquidity. Differences occur mainly in the indicators for the various risks that the authors use. For example, the asset quality of a bank is measured by the ratio of non-performing loans to total assets or with the loan-loss reserve ratio. Another example would be profitability, as it can be measured by return on average equity, return on average assets or with the net interest margin. However, authors also use net interest margin or the spread between the loan interest rate and the deposit interest rate as a proxy for the opportunity cost of holding liquid assets. Studies have also a rather heterogeneous approach when choosing a dependent variable.

2.4.1 The dependent variable

A buffer of liquid assets is the most secure way by which banks can mitigate the funding liquidity risk. In this respect, the ratio of liquid assets to total assets provides an important insight into bank's liquidity risk absorption capacity and is widely used as a dependent variable in other empirical research (e.g. Aspachs, Nier, & Tiesset, 2005; Bunda &

Desquilbet, 2008; Vodová, 2011, 2012, 2013; Deléchat, Henao, Muthoora, & Vtyurina, 2012; Bonfim & Kim, 2012). As equation (3) shows, a buffer of liquid assets can be calculated by dividing liquid assets by the total assets.

$$L1 = \frac{Liquid\ assets}{Total\ assets} * 100 \quad (3)$$

In examining the robustness of our model, we replace the initial indicator of liquidity with the ratio of liquid assets to deposits of the non-banking sector. This indicator and its modifications in the denominator (e.g. total deposits, client deposits, or short-term deposits) are also commonly used as a dependent variable in other empirical research. This ratio is more focused on the bank's sensitivity to selected types of funding, in our case, deposits of non-banking sector. Equation (4) shows this ratio can be calculated by dividing liquid assets by the deposits of the non-banking sector.

$$L2 = \frac{Liquid\ assets}{Deposits\ of\ the\ non{-}banking\ sector} * 100 \quad (4)$$

Liquid assets are composed of cash, financial assets held for trading (derivatives, government debt securities held for trading, and shares and participating interests), and loans and advances to banks.

2.4.2 Independent variables

When defining independent variables, we followed previous research and divided the determinants that affect bank liquidity buffers into bank-specific and macroeconomic ones. In the models, we used those independent variables that in previous research proved to be effective in assessing the impact on banks' liquidity and were therefore often used in empirical analyses.

2.4.2.1 Bank-specific variables

Bank-specific characteristics mainly depend on the objectives and consequently on the actions of the bank's management. Bank-specific variables typically include bank size, capitalisation, profitability and credit risk. These variables and risks vary considerably between banks and are dependent on the ability of bank managers, as well as on the responsibilities of bank owners.

Bank size. Titman and Wessels (1998) observe that larger companies hold less liquid assets because they are more diversified and are therefore less likely to experience financial distress. Faulkender (2003) confirms this, as he concludes that smaller companies with no credit rating, with better investment opportunities and riskier cash flows hold larger amount of liquid assets. Furthermore, Opler, Pinkowitz, Stulz and Williamson (1999) observe that larger companies with better credit ratings and better access to the capital

market hold less liquid assets. These observations apply also to banks. Namely, Dietrich, Hess and Wanzenried (2014) note that larger banks have smaller amounts of liquid assets in their balance sheet because they rely more on the capital market and thus manage their liquidity needs. Bonner, Lelyveld and Zymek (2015) note that larger banks can have less volatile cash flows and can have better access to other sources of funding, and thus hold less liquid assets. Contrarily, Berger and Bouwman (2009) note that smaller banks tend to focus more on traditional banking activities with low risk-weighted investments and stable cash flows and therefore hold less liquid assets.

Liquidity holdings of large banks are also connected with the "too-big-to-fail" theory, which predicts that due to an implicit guarantee, larger banks have lower funding costs and can invest in riskier assets (Iannotta, Nocera, & Sironi, 2007). Furthermore, due to their systemic importance, systemically important banks may respond to moral hazard incentives, leading to excessive risk exposure. In fact, Repullo (2005) and Aspachs, Nier and Tiesset (2005) show that the probability of receiving liquidity support from the central bank reduces the incentives of banks to maintain a sufficient amount of liquid assets. However, Bonner, Lelyveld and Zymek (2015) note that supervisors and regulators can pay more attention to systemically important banks, and consequently require greater disclosure of information or even require higher liquidity requirements due to their systemic importance.

Empirical studies that examine the impact of the bank's size on its liquidity offer different results. Kashyap and Stein (1997) and Kashyap, Rajan and Stein (2002) find significant differences in the amount of liquid assets held by small and large banks. They observe that smaller banks have more liquid assets because of the constraints in accessing the capital market. For smaller Eastern European banks, Dinger (2009) finds the same results. Deléchat, Henao, Muthoora and Vtyurina (2012) also find that smaller banks in Central America region have less liquid assets compared to larger banks. Račić, Stanišić and Stanić (2015) find that the size of the bank has a negative impact on the liquidity of banks in Serbia, while it has a positive impact on the liquidity of Czech banks. On the other hand, Lucchetta (2007) and Bonfim and Kim (2012) find a positive relationship between the size of the bank and liquidity, while Aspachs, Nier and Tiesset (2005) do not find a significant effect of bank size on liquidity.

Based on the theoretical and empirical developments regarding the relationship between the size of the bank and its liquidity, we expect a negative relationship between these two variables and therefore we formulate the following hypothesis:

H_1: *Bank size negatively affects liquidity buffers.*

As in other empirical studies (e.g. Bonfim & Kim, 2012; Vodová, 2011; Bonner, Lelyveld, & Zymek, 2015) we measure the size of a bank with the natural logarithm of total assets to proxy for bank's total assets and to proxy size.

Capitalisation. The influence of the bank's capital on its liquidity is ambiguous. In theoretical literature two opposing views exist. The first, the so-called "crowding out of deposits" hypothesis that anticipates that the bank's capital negatively affects its liquidity (e.g. Gorton & Winton, 2000) and another so-called "risk absorbing hypothesis", which predicts that the bank's capital positively affects its liquidity (e.g. Allen & Gale, 2004a, 2004b; Repullo, 2004). Empirical studies therefore provide mixed results.

Bunda and Desquilbet (2008) find significant and positive relationship between the capitalisation of banks (measured with the ratio between shareholder equity and total assets) and all three liquidity indicators that the authors used in their study. On the other hand, Angora and Roulet (2011) find that the relationship between the bank's capital and liquidity risk (measured with the LCR and the NSFR) tends to be negative. Deléchat, Henao, Muthoora and Vtyurina (2012) obtain the same results for banks in Central America and underline that better capitalised banks tend to hold less liquid assets because they have better access to the capital market.

On a sample of banks operating in a number of countries of Central and Eastern European countries, Roman and Sargu (2015) confirm the negative relationship between the bank's capital and its liquidity. Authors explain that shareholders who are emplacing a high amount of shareholder equity may pressure bank managers to increase profitability. Bank managers are then forced to transform some liquid assets into higher-yielding assets, such as loans or other long-term investments. For the Chinese banking system, Lei and Song (2013) report a negative relationship between the bank's capital and its liquidity. They emphasize that this relationship is weaker for foreign banks and that domestic banks are mostly owned or controlled by the government, so they have less capital than foreign banks to protect against potential risks. Berger and Bouwman (2009) point out that the relationship between the bank's capital and its liquidity varies greatly depending on the type and size of the bank.

Using the aforementioned theoretical and empirical developments, we expect a negative relationship between the capital and the liquidity of the bank and therefore we formulate the following hypothesis:

H_2: *Bank's capital negatively affects liquidity buffers.*

As in other empirical studies (e.g. Aspachs, Nier, & Tiesset, 2005; Dinger, 2009; Bonfim & Kim, 2012; Roman & Sargu, 2015) we measure capitalisation of the bank by the ratio of shareholder equity to total assets.

Profitability. In general, liquidity is considered as a counterweight to profitability. Owolabi, Obiakor and Okwu (2011) provide a discussion on the trade-off between profitability and liquidity. The relationship between liquidity (risk) and bank profitability is a well-researched question (e.g. Bourke, 1989; Molyneux & Thornton, 1992; Banerjee, Ahtik, & Schipper, 2005; Shen, Chen, Kao, & Yeh, 2018; Tomec & Jagrič, 2017).

Theoretical considerations suggest a positive relationship between liquidity (risk) and bank profitability. Since liquid assets typically have relatively low returns, they are imposing opportunity costs on banks. The opportunity cost represents the foregone return from loans or other illiquid and higher-yielding investments (Molyneux & Thornton, 1992). On the other hand, Bourke (1989) points out that a bank with more liquid assets is less exposed to liquidity risk and therefore benefit from a superior perception on the capital market, which reduces its funding costs and increases profitability. Nevertheless, these studies analyse the relationship between liquidity risk and profitability and not the other way around.

Many authors (e.g. Kashyap & Stein, 1997; Kashyap, Rajan, & Stein, 2002; Almedia, Campello, & Weisbach, 2004; Aspachs, Nier, & Tiesset, 2005) note that financially constrained banks have more liquid assets in their balance sheet, which means that banks that are more profitable have less liquid assets because they have fewer problems in raising new funds and obtaining liquidity from the market. On the other hand, Roman and Sargu (2015) emphasize that banks that are more profitable have more liquid assets because additional returns (earnings) of banks are not always distributed in the first year when they are received, which leads to an increase in the retained earnings of a bank, and thus to a positive impact on the stock of liquid assets. Contrary, losses negatively affect retained earnings and consequently available liquidity. In addition, shareholders of a less profitable bank may force managers of the bank to find profitable investments, which are usually less liquid and riskier, with higher expected return, leading to a reduction in the amount of liquid assets.

Based on the theoretical and empirical developments, we expect a negative relationship between profitability and the liquidity of the banks, and therefore we formulate the following hypothesis:

H_3: *Profitability has a negative impact on liquidity buffers.*

There are several ways to measure the profitability of a bank. Empirical studies typically measure the performance of banks with the return on average assets, return on average equity and net interest margin. To measure the bank's profitability, we use the return on average equity, as in some other empirical studies (e.g. Vodová, 2011; Roman & Sargu, 2015; Mehmed, 2014).

Credit risk. The most common indicator of credit risk is the quality of the credit portfolio, which is usually measured by the ratio of non-performing loans to all loans or by the ratio of loan loss provisions to total loans. The Monti-Klein model and its extensions (e.g. Prisman, Slovin, & Sushka, 1986) envisages that borrower defaults may lead to withdrawal of funding sources and lower profitability. Furthermore, borrower defaults may reduce the amount of liquid assets available to the bank, due to a reduction in cash inflows, which increases liquidity risk (Dermine, 1986). Therefore, credit risk and bank liquidity buffers should exhibit a negative relationship.

Studies that are more recent support a negative relationship between credit risk and bank liquidity (e.g. Acharya & Viswanathan, 2011; Gorton & Metrick, 2012; He & Xiong, 2012). These studies argue that if a bank finance too many distressed economic projects it will have a hard time meeting the depositor's demand for cash. If the value of those assets further deteriorates, more depositors will claim back their deposits, which leads to a higher liquidity risk (implicitly lower liquidity buffers) through the channel of depositor demand. Furthermore, as pointed out by Gorton and Metrick (2012), the perceived credit risk at a given bank can also lead to a significant increase in funding costs and funding haircuts in the interbank market. Gorton and Metrick (2012) show that the expected increase in credit risk in a given bank can lead to a liquidity risk.

However, some authors (e.g. Wanger, 2007; Cai & Thakor, 2008; Gatev, Schuermann, & Strahan, 2009; Acharya, Shin, & Yorulmazer, 2011; Acharya & Naqvi, 2012) support a positive relationship between credit risk and liquidity of the bank. The disadvantage of these studies is that they focus on specific aspects of liquidity, such as certain assets or deposits and specific credit risk features, namely loan commitments. Berrospide (2013), for example, argues that loan loss reserves (an indicator of potential credit losses) contribute to the increased holdings of liquid assets. Vodová (2011) notes that banks may offset higher credit risk with cautious risk management. Therefore, when the credit risk of a particular bank increases in order to preserve the confidence of investors and depositors, it increases the amount of liquid assets. More recently, Ghosh (2015) observe that the rising level of non-performing loans leads to a greater liquidity and profitability risk.

Taking into account the above considerations, we expect a negative relationship between credit risk and the liquidity of the bank and therefore we formulate the following hypothesis:

H_4: *Credit risk has a negative impact on liquidity buffers.*

To measure credit risk, we use the ratio of non-performing loans over all loans as in Mehmed (2014), Vodová (2011, 2012), Cucinelli (2013) and Roman and Sargu (2015).

Opportunity cost. We pointed out that most of the theories that focus on the banks' decision on the amount of liquid assets it will have, predict that liquid assets of banks are reduced when the opportunity cost of owning liquid assets increases. In our study, we measure the opportunity costs of owning liquid assets instead of loans with the spread between the loan interest rate and the deposit interest rate. Therefore, we expect a negative relationship between the interest rate spread and the liquidity of the bank and therefore formulate the following hypothesis:

H_5: *The interest rate spread has a negative effect on liquidity buffers.*

Ownership. According to the literature, the ownership of the bank affects the bank's precautionary demand for liquidity. Freixas and Holthausen (2005), for example, emphasize that foreign and public banks should be less financially constrained in

comparison to private and domestic banks, because public banks can have an implicit guarantee and foreign banks are supported by a parent bank (have access to support form headquarters).

Furthermore, as reported by Deléchat, Henao, Muthoora and Vtyurina (2012), bank ownership may not have direct influence but may interact with other explanatory variables. Aspachs, Nier and Tiesset (2005), for example, report that the availability of domestic LOLR affects liquidity buffers of domestic banks, while it does not affect the liquidity of foreign banks. In addition, liquidity buffers of foreign banks tend to react less to changes in the domestic policy rate[2] and changes in the GDP growth. Aspachs, Nier and Tiesset (2005) interpret this result as evidence that foreign banks are subject to a rather different constraint than domestic banks. Detagriache, Gupta and Tressel (2008) underline that foreign banks are more prudent and tend to lend to less risky borrowers in contrast to domestic banks. Dinger (2009) finds that, on average, foreign banks have less liquid assets. In these studies, it is emphasized that foreign banks are subject to a different set of constraints and are expected to be less financially constrained than domestic banks.

Considering that the Slovenian banking system has a number of foreign banks, we are interested in testing whether and how the determinants of liquidity buffers differ depending on the ownership of the bank (domestic vs. foreign). Therefore, we formulate the following hypothesis:

H_6: *The determinants of bank liquidity buffers differ according to the ownership of the bank.*

2.4.2.2 Macroeconomic variables

Another group of factors that can affect the liquidity of banks are macroeconomic conditions. This is because cyclical fluctuations of macroeconomic factors (such as economic growth, market interest rates, inflation, etc.) affect the creditworthiness of businesses and consumers, and consequently, the quality of the credit portfolio of banks. A number of studies have empirically analysed the various macroeconomic factors affecting the liquidity buffers of banks (e.g. Bonfim & Kim, 2012; Aspachs, Nier, & Tiesset, 2005; Valla, Saes-Escorbiac, & Tiesset, 2006; Moore, 2009; Trenca, Petria, & Corovei, 2015). These studies often point to economic growth (business cycle) and short-term interest rates as the main macroeconomic factors affecting the liquidity of banks.

Economic growth. The model provided by Alger (1999), which analyses the banks' decision to hold liquid assets when the interbank market is characterised by credit risk, has implications also in terms of economic cycles. It assumes that the probability of an interbank market freeze is greater during the economic downturn, which means that, the

[2] Less relevant when the owner of the foreign bank is from the euro area.

relative share of liquid assets of banks should increase when they expect a recession. Stiglitz and Weiss (1981) and Bester and Hellwig (1987) illustrate how adverse selection or moral hazard can lead to credit rationing. The implications of the theory provided by Stiglitz and Weiss (1981) and Bester and Hellwig (1987) are that banks increase liquid assets when the probability of default by borrower's increase, which could be expected during the economic downturn.

Aspachs, Nier and Tiesset (2005) also note that the liquidity of the balance sheet of banks depends on the scope of access to external funding. They point out that limited access to external funding can lead to the fact that banks' liquidity buffers are moving in contrast to the economic cycle. In other words, limited access to external funding opens up the possibility that liquidity buffers of banks are moving counter-cyclically[3]. Their empirical analysis confirms this hypothesis, as it concludes that the liquidity buffers of banks in the United Kingdom have a negative relationship with the growth of the GDP.

Deléchat, Henao, Muthoora and Vtyurina (2012) agree that if capital markets are indeed incomplete, the bank's demand for liquid assets is counter-cyclical, which means that banks decide to accumulate liquid assets before or during the economic downturn, and they reduce them in periods of economic growth when the opportunities for lending and loan demand are higher. These arguments suggest that that liquidity buffers of banks are negatively linked to the fluctuations of macroeconomic factors, such as real GDP growth, credit cycle, output gap, inflation rate and policy interest rates. Dinger (2009) also finds that the liquidity buffers of banks in Eastern Europe are negatively linked to GDP growth. Wójcik-Mazur and Szajt (2015) also confirm the counter-cyclical behaviour of liquidity buffers, as their results show that GDP growth negatively affects the liquidity of both new and old members of the European Union. Berrospide (2013) has empirically tested whether American commercial banks hoarded liquidity due to the precautionary motive hypothesis during the recent financial crisis and found evidence to substantiate this hypothesis.

Some authors find a positive relationship between GDP growth and bank liquidity (e.g. Valla, Seas-Escorbiac, & Tiesset, 2006; Bunda & Desquilbet, 2008; Moore, 2009). Valla, Seas-Escorbiac and Tiesset (2006), for example, support a positive relationship between GDP growth and liquidity of banks, as they say banks' willingness to create liquidity is encouraged by better economic conditions. They emphasize that the conditions for accumulating liquid assets are more suitable during the period of economic growth, and that the creation of liquidity in times of economic growth is easier than during the economic downturn, when the accumulation of liquidity is motivated mainly due to the precautionary principle. Valla, Seas-Escorbiac and Tiesset (2006) report a negative correlation between the net interest margin and the liquidity of the French banking system.

[3] Pro-cyclical and counter-cyclical are the terms used in economics to describe how an economic quantity or variable is related to the general economic trend, where the former means that an economic variable is positively correlated with the overall state of the economy, while the latter means the opposite.

We are interested in testing the hypothesis that liquidity buffers of banks in Slovenia are counter-cyclical, so that liquidity during periods of economic expansion is low, while it is high in periods of economic downturn. Therefore, we formulate the following hypothesis:

H$_7$: *Economic growth negatively affects liquidity buffers.*

Economic growth is measured by the annual real growth rate of GDP, which is often used to measure the business cycle.

Short-term interest rate. Interest rates are linked to the objectives of monetary policy aimed at stimulating or reducing economic activity, and should therefore affect the liquidity of banks. Fielding and Shortland (2005) note that a higher policy interest rate increases borrowing costs with the central banks and therefore encourages banks to have more liquid assets. Pilbeam (2005) agrees that higher short-term interest rates encourage banks to invest more in short-term money instruments, thereby improving their liquidity position. The empirical implications of the model offered by Freixas and Rochet (1997, p. 228) are that banks increase the amount of liquid assets when the penalty rate increases (e.g. the discount rate charged by the central bank). However, in their model, penalty rate can have different interpretations.

Agénor, Aizenman and Hoffmaister (2004) report that the excess liquidity reserves of Thai banks are increasing as the external funding costs increase (measured by the interest rate charged by the central bank). Vodová (2013) notes that due to the increase in market interest rates, lending activity becomes more attractive and, consequently, the banks reduce the amount of liquid assets. An empirical study of the Hungarian banking system provided by Vodová (2013) confirms the negative relationship between short-term interest rates and the liquidity of banks. However, in the empirical study of the Czech banking system provided by Vodová (2011), a positive link was established between interbank interest rate and the liquidity of banks, which means that a higher interbank interest rate encourages banks to invest more on the interbank market. Vodová (2011) explains that the interest rate on interbank deposits is not the main factor affecting banks' decision to hold liquid assets in the form of interbank deposits.

Lucchetta (2007) analyses the impact of changes in interest rates on banks' interbank lending decisions. Across European countries, Lucchetta (2007) finds that the monetary policy interest rate (considered a risk-free interest rate) has a negative impact on the liquidity of banks and has a negative impact on the banks' decision to lend on the interbank market. However, Lucchetta (2007) finds that the interbank interest rate positively influences the banks' decision to lend on the interbank market. Wójcik-Mazur and Szajt (2015) find that for old European Union members, rising interest rates encourages banks to participate in the money market, while for the new European Union members an increase in interest rate for the unsecured market of overnight deposits does not correspond to an overall increase in the banks' liquid assets.

We test the hypothesis that higher interbank interest rate, proxied by the short-term interest rate (3-month EURIBOR) positively affects banks' liquidity buffers.

H_8: *The short-term interest rate positively affects liquidity buffers.*

A summary of variables and their expected impact on the liquidity of banks is presented in Table 6.

Table 6: Summary of variables and their expected impact on the liquidity of banks

Variables	Expected sign	Description	Source
Dependent variables			
Liquidity indicator 1	Liquid assets to total assets, in %		Bank of Slovenia
Liquidity indicator 2	Liquid assets to deposits of the non-banking sector, in %		Bank of Slovenia
Bank-specific independent variables			
Size	-	Logarithm of total assets of a bank	Bank of Slovenia
Capitalisation	-	Shareholder equity to total assets, in %	Bank of Slovenia
Profitability	-	Return on average equity (ROAE), in %	Bank of Slovenia
Credit Risk	-	Classified claims in D or E credit grades (non-performing loans) to all loans, in %	Bank of Slovenia
Spread	-	The difference between the loan interest rate and the deposit interest rate, in %	Bank of Slovenia
Macroeconomic independent variables			
GDP	-	Annual real GDP growth, in %	SORS
IR	+	3-month EURIBOR[4], in %	Eurostat
Dummy variable			
Bank ownership	+/-	Dichotomous variable (1 for domestic; 0 for foreign)	Bank of Slovenia

Source: Own work.

[4] The Euro Interbank Offered Rate (Euribor) is a reference rate calculated as the average interest rate at which a large number of euro area banks offer unsecured loans with different maturities to one another, whereby, in our case, the loans have a maturity of 3 months.

3 INTERPRETATION OF EMPIRICAL RESULTS

Empirical results are presented in two parts. In the first part, we interpret the impact of bank-specific and macroeconomic factors on the liquidity of all banks in the sample. In the second part, we interpret the regression estimates performed separately for domestic and foreign banks. We used the method of the dynamic panel model and the system GMM estimator. To control for possible heteroscedasticity, we use robust standard errors. The empirical results are shown in Table 7.

Table 7: Blundell-Bond System GMM Estimator

Explanatory Variables	**Whole sample**	**Domestic Banks**	**Foreign Banks**
Lag_{-1} Liquidity Ratio 1	0.8080*** (0.0520)	0.8593*** (0.0316)	0.7131*** (0.0364)
Lag_{-1} Size	-1.6429*** (0.5662)	-0.8007* (0.4988)	-0.9340 (1.5176)
Lag_{-1} Capital	0.3220 (0.2653)	-0.1098 (0.3552)	1.0275*** (0.0768)
Lag_{-1} Profitability	-0.0129 (0.0151)	0.0094 (0.0125)	0.0483 (0.0054)
Lag_{-1} Credit Risk	0.1616 (0.1585)	0.1357 (0.2156)	0.1052* (0.0630)
Lag_{-1} Interest Rate Spread	-1.4217*** (0.2519)	-1.1467*** (0.2772)	-2.5336*** (0.8654)
Annual real GDP growth	-0.4507*** (0.1489)	-0.5459*** (0.1510)	0.0108 (0.1839)
3-month EURIBOR	0.1224 (0.4488)	0.8609** (0.4092)	-1.0130 (0.6341)
Constant	28.0492*** (8.4520)	17.9769** (8.7217)	15.8646 (21.8646)
No. of observations	218	128	90
No. of banks	14	8	6
AB test AR(1) (p-value)	0.0123	0.0087	0.0461
AB test AR(2) (p-value)	0.4775	0.7745	0.3552
Sargan test (p-value)	0.0165	0.1480	0.1370
Robust standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1			
AB test AR(1) and AR(2) refer to the Arellano-Bond test; p-values in parentheses.			

Source: own work.

3.1 Baseline specification

As we anticipated and in line with the results of similar empirical studies, we find that liquidity buffers of banks in Slovenia are persistent, which is in line with the view that banks are striving for an optimal or desired amount of precautionary liquidity reserves. However, as we learned in the examination of theoretical literature, this result can be attributed to possible existing structural obstacles to credit or to the credit rationing of banks that can lead banks to invest more in low-yielding liquid assets.

In accordance with expectations, we find that the size of a bank has a negative impact on the liquidity of banks. The bank size coefficient is negative and statistically significant. This result is in line with the expectation that banks' liquidity buffers are diminishing with the size of the bank and in line with the view that larger banks have less liquid assets compared to smaller banks, as they have greater ability to access the capital market and receive liquidity from it when this is necessary. The literature also envisages that systematically important banks have incentives for moral hazard, which means that larger banks are prone to take on more risk, as they expect support from the central bank or the state when problems arise because of their systemic importance in the financial system.

As expected and as foreseen by most of the theoretical literature that deals with banks' decision regarding the investments in liquid assets, the interest rate spread between the loan interest rate and the deposit interest rate – considered as a proxy for measuring the opportunity cost associated with investments in liquid assets – has a negative impact on the liquidity buffers of banks. The result suggests that liquid assets of banks will be reduced due to increased opportunity costs, when the interest rate spread between the loan interest rate and the deposit interest rate will increase. The result is consistent with the "liquid assets as a buffer" theory, which predicts that banks should decrease investments in liquid assets when the opportunity cost of investment in liquid assets increase.

In the entire sample of Slovenian banks, the impact of the annual growth rate of the GDP is negative and statistically significant. This result is in line with our expectations, and in line with the assumptions of theoretical literature that in times of higher economic growth, banks are reducing inventories of liquid assets and increasing them in times of negative economic growth. This means that the demand of Slovenian banks for liquidity is counter-cyclical. The result is consistent with the theory given by Stiglitz and Weiss (1981) and Bester and Hellwig (1987) which suggest that banks increase liquid assets when the probability of default by borrower's increase, which could be expected during the economic downturn. Alger (1999) also notes that the probability of an interbank market freeze is greater during the economic downturn, which means that the relative share of liquid assets of banks should increase when they expect a recession.

Given the entire sample of banks, it turns out that profitability, capital ratio, credit risk, and short-term interest rate do not have a statistically significant effect on the liquidity of banks

in Slovenia. We also tested whether the factors and their impact on liquidity buffers of banks change when we divide the sample of banks into domestic and foreign banks, as according to the literature, the ownership of a bank can influence liquidity decisions. The results are presented in the next section.

3.2 Bank ownership

Empirical results show that liquidity is persistent both for domestic and foreign banks, with the effect being more pronounced with domestic banks. The interest rate spread between the loan interest rate and the deposit interest rate has a negative impact on the liquidity buffers of both domestic and foreign banks. However, the size of the effect is more than half lower for domestic banks. On the other hand, the results show that profitability does not affect the liquidity of either domestic or foreign banks. Nevertheless, there are differences in the impact of other explanatory variables, which confirms the hypothesis that the factors that influence the liquidity of banks differ in terms of to the ownership of the bank.

The bank's capital and the quality of the credit portfolio (credit risk) affect the liquidity of foreign banks, but do not affect the liquidity buffers of domestic banks. The results show that foreign banks with more capital and lower quality of the credit portfolio are more cautious in managing liquidity risk. For foreign banks, capital is treated as an absorber of risk, which means that higher values of capital lead to higher liquidity buffers (e.g. banks have a lower liquidity outflow), which is in accordance with the "risk absorption hypothesis". As intuition suggests, better capitalised banks have more at stake so they invest more in liquid assets for precautionary reasons. The credit risk coefficient, which measures the quality of the credit portfolio is positive and statistically significant, which suggests that foreign banks increase liquid assets when the credit portfolio deteriorates. This may also reflect liquidity transfers from the centre of the banking group and can be a sign of sound liquidity risk management of foreign banks.

Furthermore, we find that the size of the bank has a negative effect on the liquidity of domestic banks, but does not affect the liquidity of foreign banks. As mentioned earlier, larger banks may be prone to take on more risk, as they expect support from the central bank or the state due to their systemic importance in the financial system. This prediction is even more valid for larger domestic banks as they have stronger political connections and support than foreign banks. In addition, depositors can assume that domestic banks are safer than foreign banks, precisely because of the expectations that the government will support them, which domestic banks can recognise and consequently underestimate the possibility of a bank run, and therefore invest less in liquid assets.

Economic growth negatively affects only the liquidity of domestic banks, with the annual growth of the GDP being negative and statistically significant for domestic banks, while for foreign banks it is positive but statistically insignificant. It appears that only domestic

banks reduce the stock of liquid assets during economic growth. The reason for the different effect of economic growth on the liquidity of banks may be that borrowers borrow more from domestic banks during economic expansion, while during a recession they turn to foreign banks, as the ability of foreign banks to provide loans during recession may be better.

In fact, several studies (e.g. Bonin, Hasan, & Wachtel, 2005; Clarke, Cull, Maria, & Suzana, 2005; Detagriache, Gupta, & Tressel, 2008) note that foreign banks lend mostly to safer and more transparent customers, and in the event of an economic downturn, credit risk with foreign banks is less intense compared to domestic banks. Consequently, the ability of foreign banks to provide loans during the recession can be better than with domestic banks. Descriptive statistics also showed that through the sample period, foreign banks exhibited lower levels of non-performing loans to total loans than domestic banks. The reason for the different effect of economic growth on the liquidity of banks can also be because the structure of funding of domestic banks and foreign banks varies considerably and, according to numerous literature, foreign banks may have different limitations in obtaining new sources of funds than domestic banks.

Last but not least, the short-term interest rate has a statistically significant and positive effect on the liquidity buffers of domestic banks, while at the same time it has a negative effect on the liquidity of foreign banks, but the impact of the short-term interest rate on the liquidity of foreign banks is statistically insignificant. A higher short-term interest rate seems to encourage domestic banks to invest more in money markets, thereby increasing their liquidity. Differences in the effect of the short-term interest rate on the liquidity of domestic and foreign banks can be attributed to the different structure of the liquid asset portfolio or to the different liquidity management strategies of domestic and foreign banks. Nevertheless, such conclusions require further, more detailed analysis and are beyond the scope of our study. Our results are in line with some other studies (e.g. Agénor, Aizenman, & Hoffmaister, 2004; Vodová, 2011; Lucchetta, 2007; Wójcik-Mazur & Szajt, 2015), which also find that higher interbank rate encourages banks to invest more in the interbank market, thereby increasing their liquidity.

4 ROBUSTNESS CHECK

The robustness of the dynamic panel model and system GMM estimator was tested with additional regression estimates. Initially, we examined the impact of the outliers on regression estimates. Furthermore, we tested the dynamic panel data model with a difference GMM estimator, which in addition to the system GMM estimator, is often used in empirical research that attempts to identify the determinants of bank liquidity. The fixed effects estimator is another method that we used to check the robustness of our results. We also replaced our initial dependent variable with the ratio of liquid assets to deposits the of non-banking sector, which is also often used in other empirical analyses. Finally, in order

to verify if our model is feasible, we performed two diagnostic tests: The Sargan test of the overidentifying restriction and the Arellano-Bond test to detect autocorrelation of errors.

4.1 Outliers

Since outliers can cause serious problems in statistical analysis, we firstly tested the possible influence of outliers on regression estimates, whereby we deleted the values of explanatory variables that are below or above 1st and 99th percentile. This procedure has limited our variables to the 1st and 99th percentile. Comparison of regression estimates shows very similar statistical significance and economic impact of explanatory variables on banks' liquidity in Slovenia. As a matter of fact, all explanatory variables show the same coefficients as our baseline model specification, so we omit the presentation of the results. From the results, we can conclude that our initial findings were not driven by outliers.

4.2 Arellano-Bond difference GMM estimator

The robustness of our model was also tested with the Arellano-Bond difference GMM estimator. The results are given in Table 8. We can observe that the signs of the coefficients of statistically significant explanatory variables (bank size, interest rate spread, and annual real GDP growth rate) are the same as with the Blundell-Bond estimator (see Table 7). However, the magnitude of the impact changes. In particular, the size of a bank has a much greater negative impact on liquidity buffers.

Table 8: Arellano-Bond Difference GMM Estimator

Explanatory Variables	All Banks
Lag_{-1} Liquidity Ratio 1	0.6508*** (0.0781)
Lag_{-1} Size	-6.2535*** (2.3542)
Lag_{-1} Capital	-0.0735 (0.3363)
Lag_{-1} Profitability	0.0127 (0.0090)
Lag_{-1} Credit Risk	0.1073 (0.1561)
Lag_{-1} Interest Rate Spread	-0.5226** (0.2407)
Annual real GDP growth	-0.3216*** (0.1072)
3-month EURIBOR	-0.4119 (0.3607)

table continues

Table 8: Arellano-Bond Difference GMM Estimator (cont.)

Explanatory Variables	**All Banks**
Constant	99.5682*** (36.7679)
No. of observations	204
No. of banks	14
AB test AR(1) (p-value)	0.0358
AB test AR(2) (p-value)	0.5441
Sargan test (p-value)	0.1199
Robust standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1	
AB test AR(1) and AR(2) refer to the Arellano-Bond test; p-values in parentheses	

Source: own work.

4.3 Liquid assets to deposits as a dependent variable

In this model specification we replaced our initial dependent variable with the ratio of liquid assets to deposits of the non-banking sector. The results are generally in line with our initial model, but some differences do appear. The results are given in Table 9.

We find that liquidity buffers of banks are persistent. This effect is again more pronounced for domestic banks. The bank size coefficient is negative and statistically significant, which means that larger banks hold less liquid assets also relative to customer deposits. The effect of the interest rate spread between the loan interest rate and the deposit interest rate remains negative. Profitability, which was statistically insignificant in determining the level of liquid assets to total assets, is now statistically significant for the whole sample of banks and for domestic banks.

The profitability coefficient is positive, which implies that more profitable banks will have greater coverage of customer deposits with liquid assets. As indicated in the literature, the managers of the bank might not distribute the entire earnings of the bank in the first year it is received, which leads to an increase in the retained earnings of banks, thereby positively affecting their liquidity. Interestingly, the impact of the credit risk on the liquidity of foreign banks is no longer positive but becomes negative which implies that when the credit risk increases, foreign banks reduce the coverage of non-bank deposits with liquid assets.

Table 9: Blundell-Bond System GMM Estimator with different dependent variable

Explanatory variables	**Coefficient**		
Liquid assets / deposits of the non-banking sector	**All banks**	**Domestic Banks**	**Foreign Banks**
Lag_{-1} Liquidity Ratio 2	0.8154*** (0.1171)	0.9462*** (0.0745)	0.6619*** (0.1403)
Lag_{-1} Size	-4.2868* (2.3832)	-0.7477 (0.8377)	-2.5938 (7.0522)
Lag_{-1} Capital	-0.5253 (0.4544)	-0.4445 (0.6371)	0.0307 (0.5287)
Lag_{-1} Profitability	0.0609** (0.0251)	0.0486*** (0.0186)	0.2073 (0.1403)
Lag_{-1} Credit Risk	-0.1415 (0.3015)	0.0713 (0.3434)	-1.6491* (0.8678)
Lag_{-1} Interest Rate Spread	-3.0430*** (1.0933)	-1.6279*** (0.3645)	-7.0416** (3.1222)
Annual real GDP growth	-0.4136 (0.3353)	-0.8560*** (0.2402)	0.9051*** (0.3452)
3-month EURIBOR	0.9161 (2.4107)	1.5377** (0.7383)	-2.3544 (3.9237)
Constant	87.2366 (31.6519)	17.4422 (9.0702)	77.4394 (95.6021)
No. of observations	218	128	90
No. of banks	14	8	6
AB test AR(1) (p-value)	0.0335	0.0307	0.0335
AB test AR(2) (p-value)	0.4444	0.7579	0.4768
Sargan test (p-value)	0.0000	0.1134	0.0145
Robust standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1			
AB test AR(1) and AR(2) refer to the Arellano-Bond test; p-values in parentheses			

Source: own work.

The annual growth rate of GDP has a negative and statistically significant effect on the liquidity buffers of domestic banks. This confirms that the liquidity buffers of domestic banks behave counter-cyclical, but this is not the case with the liquidity buffers of foreign banks. In other words, domestic banks reduce liquid assets (relative to customer deposits as well as relative to total assets) during economic expansion and increase the amount of liquid assets when they expect a recession. On the other hand, the annual growth rate of GDP has a positive and statistically significant impact on the liquidity buffers of foreign

banks. It seems that in time of economic upturn, the appetite of foreign banks to create liquidity increases. Indeed, some authors argue that the conditions for accumulating liquidity are better in times of economic growth. They say that during the economic crisis banks keep liquid assets mainly due to precautionary reasons. Last but not least, as in the previous models, the short-term interest rate has a statistically significant and positive effect on the liquidity buffers of domestic banks, while at the same time, it has a negative effect on the liquidity of foreign banks, but the effect of the short-term interest rate on the liquidity of foreign banks is statistically insignificant. Differences in the effect of the short-term interest rate on the liquidity of domestic and foreign banks can be attributed to the different structure of the liquid asset portfolio or to the different liquidity management strategies of domestic and foreign banks.

4.4 Fixed effects estimator

The robustness of our model was also tested with the fixed effects model. The results are presented in Table 10. The results obtained with the fixed effect estimator confirm some of our initial findings. Namely, liquidity is persistent with the effect being more pronounced for domestic banks. Capital positively affects liquidity buffers of foreign banks, while the interest rate spread negatively affects liquidity buffers of domestic and foreign banks. The effect of the interest rate spread is again more pronounced for foreign banks. As with other models, the real annual GDP growth rate has a negative effect on the liquidity of domestic banks, while the short-term interest rate has an opposite effect. In this model, the effect of the short-term interest rate on the liquidity of foreign banks becomes statistically significant. Foreign banks appear to reduce the stock of liquid assets when the short-term interest rate increase.

Table 10: Fixed effects model

Explanatory variables	**Coefficient**		
Liquid assets / total assets	**All banks**	**Domestic Banks**	**Foreign Banks**
Lag_{-1} Liquidity Ratio 1	0.8605*** (0.0403)	0.8814*** (0.0420)	0.6834*** (0.0578)
Lag_{-1} Size	0.0717 (1.0008)	0.6485 (1.9895)	0.0981 (1.0372)
Lag_{-1} Capital	0.2099 (0.1927)	-0.2680 (0.2314)	0.4468** (0.1633)
Lag_{-1} Profitability	-0.0035 (0.1567)	0.0075 (0.0130)	-0.0216 (0.0528)
Lag_{-1} Credit Risk	0.2007* (0.0961)	0.1666 (0.1145)	0.2185 (0.1544)
Lag_{-1} Interest Rate Spread	-1.4622*** (0.4754)	-1.4364** (0.5187)	-2.7457*** (0.6061)

table continues

Table 10: Fixed effects model (cont.)

Explanatory variables	**Coefficient**		
Liquid assets / total assets	**All banks**	**Domestic Banks**	**Foreign Banks**
Annual real GDP growth	-0.3142** (0.1418)	-0.4886*** (0.1968)	-0.0535 (0.1385)
3-month EURIBOR	-0.0822 (0.3575)	0.9247* (0.4610)	-0.7108* (0.3499)
Constant	4.1189 (14.3174)	-0.8066 (26.4266)	6.7805 (15.8588)
No. of observations	218	128	90
No. of banks	14	8	6
Standard errors in parentheses *** p<0.01, **p<0.05, *p<0.1			

Source: own work.

4.5 Model diagnostics

We applied two diagnostic tests on GMM regressions. First, the Sargan test, which is a statistical test used to testing overidentifying restrictions in a statistical model. A joint null hypothesis is that the instruments are valid (e.g. uncorrelated with the error term). If we reject the null hypothesis the instruments do not satisfy the orthogonality conditions. If this is the case, we should reconsider our model or our instruments, unless we can attribute the rejection of the null hypothesis to heteroscedasticity in the data-generating process. Second, the Arellano-Bond test for serial correlation. The first-order serial correlation AR(1) is expected due to the lagged dependent variable and should not be a problem. We look for second-order serial correlation AR(2) in differences. A rejection of the null hypothesis indicates autocorrelation in residuals.

For the baseline specification (see Table 7) the results show that at 1% significance level, we cannot reject the null hypothesis of the Sargan test, which implies that our instruments satisfy the orthogonality condition. The results of the Arellano-Bond test for serial correlation also show that we cannot reject the null hypothesis, which implies that there is no serial autocorrelation. Therefore, we can conclude that our model is feasible. The robustness of the regression results was first tested with the Arellano-Bond difference GMM estimator. Diagnostic tests show (see Table 8) that we cannot reject the null hypothesis of the Sargan test. With the Arellano-Bond test for serial correlation we also failed to detect serial autocorrelation.

When performing a robustness check, among other things, we also used different dependent variable. With the Arellano-Bond test for serial correlation we failed to detect serial autocorrelation. However, for the whole sample (see Table 9) we reject the null hypothesis of the Sargan test which implies that the instruments do not satisfy orthogonality conditions. Therefore, overidentifying moment conditions are not valid. This means that we should reconsider our model or our instruments unless we can attribute the rejection of the null hypothesis to heteroscedasticity in the data-generating process. Nonetheless, since this was only a robustness check we can conclude that our results are robust.

5 POLICY IMPLICATIONS

Empirical results show that the size of a bank has a negative effect on the liquidity of domestic banks, but does not affect the liquidity of foreign banks. Consequently, supervisors should closely monitor large domestic banks, which might respond to moral hazard incentives due to their systemic importance in the financial system.

The interest rate spread between the loan interest rate and the deposit interest rate – considered as a proxy for measuring the opportunity cost associated with investments in liquid assets – has a negative impact on the liquidity buffers of banks. The result suggests that the banks' liquid assets will be reduced due to increased opportunity costs, when the interest rate spread between the loan interest rate and the deposit interest rate will increase. This finding is presumably particularly important for banks that finance most of their assets through retail deposits, since the increase in the market interest rates is usually first passed through to bank lending rates and slowly to deposit rates, which means that these banks would have a higher opportunity cost of holding liquid assets instead of loans. Therefore, in a rising market interest rate environment, supervisors should pay attention to banks that finance most of their assets with retail deposits, as they are expected to be encouraged to reduce liquid assets.

Another important finding is that liquidity buffers of domestic banks are counter-cyclical. Domestic banks appear to reduce the amount of liquid assets during periods of strong economic growth and accumulate them during periods of economic downturn. Therefore, a liquidity requirement imposed on the Slovenian banking system is likely to be tight in economic expansion and to be slack during recession, possibly limiting lending activity of domestic banks during economic expansion. However, this only applies to domestic banks, as we find that liquidity buffers of foreign banks do not behave counter-cyclical. Literature suggests that counter-cyclical movement of liquidity buffers can be linked to financing constraints at the individual bank level.[5] In addition, the counter-cyclicality of liquidity

[5] See Aspachs, Nier, & Tiesset (2005) or Almeida, Campello, & Weisbach (2004).

reserves can limit the effectiveness of monetary policy when it seeks to allocate liquidity to the financial system in order to stimulate the economy from recession.[6]

Lastly, we find supporting evidence that the determinants of liquidity buffers differ according to bank ownership, perhaps indicating that foreign banks manage their liquidity centrally through a group-internal capital market. The concern may be that potential liquidity problems that might arise at the parent bank will quickly be transferred to bank branches and, as a result, lead to liquidity shortages in the host country. Furthermore, foreign banks may be subject to different financial constraints when managing their liquidity.[7] With respect to policy implications, it is difficult to offer some solid conclusions from this evidence.

CONCLUSION

In this master's thesis, we analysed how bank-specific factors and macroeconomic conditions affect the liquidity buffers of banks in Slovenia. We selected five bank-specific variables and two macroeconomic ones, which in the literature have proven to be important in determining banks' liquidity buffers. The sample included 14 banks currently operating in Slovenia. We selected annual time series between 2000 and 2016. We also divided our sample of banks in terms of ownership in order to test whether the liquidity determinants differ according to the ownership of the bank. The econometric tests were carried out using a dynamic panel data method, using the Blundell and Bond (1998) system GMM estimator.

Robustness tests have shown that our results are robust to different model specifications. By removing variables that are below or above 1st and 99th percentile, we tested whether the results of the baseline model are driven by outliers and found that this was not the case. We performed the Arellano-Bond difference GMM estimator and changed the initial dependent variable with an alternative. This model gave us similar results as the baseline model specification. The fixed effects model also confirmed some of the key findings. In addition, the diagnostic tests carried out with the Sargan test and the Arellano-Bond test confirm that our model is feasible. Empirical results enabled us to make the following conclusions.

Liquidity buffers of banks in Slovenia are persistent with the effect being more pronounced with domestic banks. This result is in line with the view that banks are striving for an optimal or desired amount of precautionary liquidity reserves. However, this may be due to credit rationing of banks or due to possible existing structural obstacles to credit. The interest rate spread between the loan interest rate and the deposit interest rate has a negative impact on the liquidity of both domestic and foreign banks. The result is consistent with the "liquid assets as a buffer" theory, which predict that banks reduce their

[6] See Deléchat, Henao, Muthoora, & Vtyurina (2012).
[7] See Dinger (2009); Aspachs, Nier, & Tiesset (2005) or Freixas & Holthausen (2005).

investments in liquid assets when the opportunity cost of investments in liquid assets increase.

There are several bank-specific factors that influence the liquidity of banks in Slovenia, which have a different impact on the liquidity buffers of domestic and foreign banks. Namely, liquidity buffers of domestic banks are decreasing with the size of the bank, while we could not find the same evidence for foreign banks. Credit risk positively affect the liquidity of foreign banks but do not affect the liquidity buffers of domestic banks. This result suggests that foreign banks with lower quality of the credit portfolio are more cautious in managing liquidity risk.

For foreign banks, capital is treated as an absorber of risk, which means that higher values of capital lead to higher liquidity buffers (e.g. banks have a lower liquidity outflow), which is in accordance with the "risk absorption hypothesis". As intuition suggests, better capitalised banks have more at stake so they invest more in liquid assets for precautionary reasons. However, the capital does not affect the liquidity of domestic banks. It turns out that profitability does not affect the liquidity of either domestic or foreign banks.

We have identified several differences in the effects of macroeconomic conditions on liquidity buffer banks. Namely, liquidity buffers of domestic banks behave counter-cyclical. In other words, domestic banks reduce liquid assets during economic expansion and accumulate them during recession, which implies that the demand of domestic banks for liquidity is counter-cyclical. On the other hand, economic growth does not affect the liquidity buffers of foreign banks. However, in the model where we used a different dependent variable, the effect of economic growth on the liquidity of foreign banks was positive and statistically significant, which implies that foreign banks increase liquid assets relative to customer deposits during the economic growth.

We found that the short-term interest rate positively affects the liquidity of domestic banks. It seems that higher short-term interest rates encourage domestic banks to engage more in the interbank market, thereby increasing their liquidity. For foreign banks, it turns out that the short-term interest rate has a negative impact on liquidity. Actually, the effect in most models was statistically insignificant, but when we used the fixed effect model, the effect of the short-term interest rate became statistically significant. This implies that foreign banks reduce liquid assets when the short-term interest rate increases.

Based on the obtained results we also offered some policy implications. First, because the effect of size on the bank's liquidity is negative only for domestic banks, supervisors should monitor large domestic banks that could respond to moral hazard incentives due to their systemic important in the financial system. Secondly, banks that finance most of their assets with retail deposits, could have high opportunity cost when market interest rates start to increase, as the increase in market interest rates is usually first passed through to bank lending rates and slowly to deposit rates. This means that banks that finance most of their

assets with deposits would have a higher opportunity cost of holding liquid assets instead of loans. Therefore, supervisors should pay attention to banks that finance most of their assets with deposits, as they will have the incentive to reduce the relative share of liquid assets due to high opportunity cost.

Third, given that the liquidity buffers of domestic banks are inversely related to the economic cycle, it is expected that the liquidity requirement for the Slovenian banking system will be tight in economic expansion and will be weak during the recession, which could limit domestic bank lending during robust economic growth. In addition, the counter-cyclicality of liquidity buffers can limit the effectiveness of monetary policy when it seeks to allocate liquidity into the financial system in order to stimulate the economy from recession. Lastly, we find supporting evidence that the determinants of liquidity buffers differ according to the ownership of the bank, perhaps indicating that foreign banks manage their liquidity centrally through a group-internal capital market. Concern for supervisors may be that liquidity problems that arise at the parent bank get quickly transferred to bank branches and consequently lead to a lack of liquidity in the host country.

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APPENDIX

Appendix: Povzetek (Summary in Slovene language)

Kapital banke je najpomembnejše zavarovanje, s katerim banka absorbira morebitne izgube, s tem pa ohranja zaupanje vlagateljev in deponentov. Zato so se do nedavnega, oblikovalci politik osredotočili predvsem na oblikovanje kapitalske ureditve bank, kot načina za zaščito finančne stabilnosti. Vendar je svetovna finančna kriza, ki se je začela sredi leta 2007, poudarila pomen druge vrste blažilnika, tako imenovanega likvidnostnega blažilnika, saj so se v času krize številne banke borile za ohranjanje ustrezne likvidnostne pozicije. Zaradi neučinkovitega upravljanja likvidnostnega tveganja, finančne institucije niso bile sposobne izpolniti svojih pogodbenih obveznosti. Da bi ohranili finančno stabilnost, so se centralne banke odzvale z zagotavljanjem likvidnostne podpore, a tudi z zelo obsežno likvidnostno podporo so mnoge banke popadle (BCBS, 2009a). Ti dogodki so izpostavili številna vprašanja glede likvidnostnega tveganja in zadostnosti obstoječih likvidnostnih zahtev.

Pred začetkom svetovne finančne krize so se študije osredotočale predvsem na povezavo med likvidnostjo in finančno stabilnostjo ali povezavo med likvidnostjo in finančno krizo ter realnim gospodarstvom. Likvidnostno tveganje se je pogosto obravnavalo kot dejavnik drugih tveganj, kot je kreditno tveganje ali kot dejavnik, ki vpliva na dobičkonosnost banke. Vendar pa so po svetovni finančni krizi avtorji preusmerili pozornost na opredelitev ključnih dejavnikov, ki vplivajo na likvidnost bank. Večina raziskav je determinante oziroma pojasnjevalne spremenljivke opredelila na bančno-specifične in makroekonomske. Med raziskavami se uporabljene neodvisne spremenljivke nekoliko razlikujejo, vendar zajamejo podobna tveganja in dejavnike, ki vplivajo na likvidnost bank. V raziskavah so prav tako zajeta različna časovna obdobja (krizno, ne-krizno ali oboje).

V magistrskem delu smo analizirali dejavnike, ki vplivajo na likvidnost bank s pomočjo panela 14-ih bank, ki poslujejo v Sloveniji v obdobju 2000-2016. Tuje bančne podružnice so bile zaradi nezadostnih podatkov izvzete iz analize. Analiza prav tako izključuje Slovensko izvozno in razvojno banko zaradi njenega edinstvenega poslovnega modela. Poleg tega so iz analize izvzete banke, ki so bile likvidirane (npr. Probanka, d.d. in Factor banka d.d., ki sta bili leta 2013 likvidirani). V vzorec je bilo tako zajetih 77% bank v Sloveniji oziroma 90% bilančne vsote slovenskega bančnega sistema konec leta 2017. Sklepamo lahko, da je naš vzorec reprezentativen za celoten slovenski bančni sistem. Cilj empirične raziskave je bil analizirati, kako bančno-specifični dejavniki in makroekonomski dejavniki vplivajo na likvidnostne blažilnike bank v Sloveniji.

Uporabili smo pet bančno-specifičnih spremenljivk: velikost banke, kapitalizacijo, dobičkonosnost, kvaliteto kreditnega portfelja ter obrestno razliko med posojili in depoziti. Za makroekonomske dejavnike smo vzeli letno rast bruto domačega proizvoda in kratkoročno obrestno mero (3 mesečni EURIBOR). Vzorec bank smo razdelili tudi na domače in tuje banke ter preverili, če se faktorji, ki vplivajo na likvidnostne blažilnike bank, razlikujejo glede na lastništvo banke. Vir podatkov za bančno specifične

spremenljivke je podatkovna baza Banke Slovenije, pri čemer smo uporabili letne bilančne podatke bank. Vir makroekonomskih podatkov je statistična baza Eurostat in Statistični urad Republike Slovenije.

Hipoteze smo testirali z uporabo panelnih podatkov s tem pa smo lahko ocenili več bank v daljšem časovnem obdobju. Uporabili smo dinamični model panelnih podatkov za katerega je značilno, da v model vključuje odloženo vrednost odvisne spremenljivke (v našem primeru vrednost likvidnosti v predhodnem letu). Zaradi predpostavke, da je likvidnost obstojna smo uporabili sistemsko GMM cenilko, saj se lahko diferenčna GMM cenilka izkaže za šibkejšo cenilko ob morebitni prisotnosti korelacije med odloženo in trenutno vrednostjo potencialno endogene spremenljivke. Kljub temu smo pri preverjanju robustnosti modela smo med drugimi uporabili tudi diferenčno GMM cenilko in cenilko fiksnih učinkov. Za preverjanje konsistentnosti cenilke GMM smo izvedli Sarganov test, ki testira prekomerne identifikacije omejitev in Arellano-Bond test, ki testira morebitno prisotnost avtokorelacije.

Empirični rezultati so pokazali, da so likvidnostni blažilniki bank obstojni, kar je v skladu s stališčem, da si banke prizadevajo za optimalno oziroma želeno količino previdnostnih likvidnostnih rezerv. Vendar pa je po mnenju literature to ugotovitev mogoče pripisati tudi racionalizaciji kreditov s strani bank oziroma morebitnih obstoječih strukturnih ovirah pri odobravanju kreditov, ki lahko vodijo do višje ravni likvidnih sredstev pri bankah. Na celotnem vzorcu bank je koeficient velikosti banke negativen in statistično značilen. Rezultat je v skladu s pričakovanjem, da se likvidnostni blažilniki bank zmanjšujejo z velikostjo banke in v skladu s stališčem, da imajo večje banke manj likvidnih sredstev v primerjavi z manjšimi bankami, saj imajo boljšo možnost dostopa do kapitalskega trga in pridobijo likvidnost, kadar je to potrebno. Literatura tudi predvideva, da imajo velike banke spodbude za moralno tveganje, kar pomeni, da so večje banke nagnjene k prevzemanju večjega tveganja, saj pričakujejo podporo centralne banke ali države zaradi njihovega sistemskega pomena v finančnem sistemu. V skladu s pričakovanji, obrestna razlika med posojilno obrestno mero in depozitno obrestno mero, ki se smatra kot približek za merjenje oportunitetnih stroškov povezanih z vlaganjem v likvidna sredstva namesto v posojila, negativno vpliva na likvidnostne blažilnike bank.

Na celotnem vzorcu slovenskih bank je koeficient letne rasti bruto domačega proizvoda negativen in statistično značilen. Pridobljeni rezultat je v skladu s pričakovanji, da banke v obdobju gospodarske rasti zmanjšajo zaloge likvidnih sredstev ter jih povečajo v recesiji. To pomeni, da je povpraševanje bank po likvidnih sredstvih proticiklično, saj banke med gospodarskim upadom nakopičijo likvidna sredstva, ki jih nato prodajo v obdobju gospodarske rasti in ob povečanem povpraševanju po posojilih. Izkazalo se je, da dobičkonosnost, višina kapitala, delež slabih posojil ter kratkoročna obrestna mera nimajo statistično pomembnega vpliva na likvidnostne blažilnike bank v Sloveniji.

Preverili smo tudi, če se dejavniki ter njihov vpliv na likvidnostne blažilnike bank razlikujejo glede na lastništvo banke, saj lahko po navedbah literature, lastništvo banke vpliva na likvidnostne odločitve. Empirični rezultati so pokazali, da je likvidnost obstojna tako za domače kot tudi za tuje banke, s tem da je ta vpliv bolj izrazit pri domačih bankah. Obrestna razlika med posojilno obrestno mero in depozitno obrestno mero negativno vpliva na likvidnostne blažilnike domačih in tujih bank. Vendar pa je velikost učinka za več kot polovico manjši pri domačih bankah. Po drugi strani pa so rezultati pokazali, da dobičkonosnost ne vpliva na likvidnost domačih ali tujih bank. Vendar pa obstajajo razlike v vplivu drugih pojasnjevalnih spremenljivk, kar potrjuje našo hipotezo, da se dejavniki, ki vplivajo na likvidnost bank, razlikujejo glede na lastništvo banke.

Kapital banke in kvaliteta kreditnega portfelja vplivata na likvidnost tujih bank, vendar ne vplivata na likvidnostne blažilnike domačih bank. Rezultati kažejo, da so tuje banke z več kapitala in slabšo kvaliteto kreditnega portfelja bolj previdne pri obvladovanju likvidnostnega tveganja. Koeficient kreditnega tveganja, ki meri kakovost kreditnega portfelja, je pozitiven in statistično pomemben, kar nakazuje, da tuje banke povečujejo likvidna sredstva, ko se kreditni portfelj slabša . To lahko odraža tudi prenos likvidnosti iz središča bančne skupine in je lahko znak preudarne politike tujih bank pri upravljanja s tveganji.

Poleg tega smo ugotovili, da velikost banke negativno vpliva na likvidnost domačih bank, vendar ne vpliva na likvidnost tujih bank. Kot smo že omenili, so lahko večje banke bolj nagnjene k prevzemanju večjega tveganja, ker zaradi svojega sistemskega pomena v finančnem sistemu pričakujejo podporo centralne banke ali države ob pojavu resnejših problemov. Ta predpostavka še bolj veljavna za velike domače banke, saj imajo močnejše politične povezave in podporo kot tuje banke. Poleg tega, lahko deponenti pričakujejo, da so domače banke varnejše od tujih, prav zaradi pričakovanj, da jih bo država podprla, kar lahko domače banke prepoznajo in posledično podcenjujejo možnost navala na banke in imajo zato v bilanci stanja manj likvidnih sredstev.

Gospodarska rast negativno vpliva le na likvidnost domačih bank, saj je koeficient letne rasti bruto domačega proizvoda negativen in statistično pomemben le za domače banke, medtem ko je pri tujih bankah pozitiven, vendar statistično nepomemben. Zdi se, da samo domače banke zmanjšujejo zaloge likvidnih sredstev med gospodarsko rastjo. Razlog za drugačen vpliv gospodarske rasti na likvidnost bank je lahko ta, da se posojilojemalci med gospodarsko rastjo zadolžujejo več pri domačih bankah, medtem ko se v primeru gospodarske krize obrnejo na tuje banke, ker je lahko zmožnost tujih bank, da zagotavljajo med recesijo višja. Pravzaprav je že več študij ugotovilo, da tuje banke posojajo predvsem varnejšim in preglednejšim strankam, zato je v primeru gospodarskega upada kreditno tveganje pri tujih bankah manj intenzivno v primerjavi z domačimi bankami.

Ugotavljamo, da ima kratkoročna obrestna mera statistično pomemben in pozitiven vpliv na likvidnostne blažilnike domačih bank, hkrati pa negativno vpliva na likvidnost tujih

bank, vendar je vpliv kratkoročne obrestne mere na likvidnost tujih banke statistično nepomemben. Zdi se, da višja kratkoročna obrestna mera spodbuja domače banke, da vlagajo več v denarne trge ter tako povečajo svojo likvidnost. Razlike v vplivu kratkoročne obrestne mere na likvidnost domačih in tujih bank je mogoče pripisati različni strukturi portfelja likvidnih sredstev oziroma različni strategiji upravljanja likvidnosti domačih in tujih bank. Kljub temu pa takšne ugotovitve zahtevajo nadaljnjo podrobnejšo analizo in bile presegajo obseg naše študije.

Sarganov test potrjuje pravilno specifikacijo modela in veljavnost izbranih instrumentov. Prav tako s cenilko Arellano-Bond nismo zasledili prisotnosti avtokorelacije. Robustnost dinamičnega modela panelnih podatkov in sistemske cenilke GMM smo testirali z dodatnimi regresijskimi ocenami. Sprva smo ugotavljali vpliv osamelcev na regresijske ocene, pri čemer smo izločili vse vrednosti pojasnjevalnih spremenljivk, ki se nahajajo pod prvim in nad devetindevetdesetim percentilom. S tem smo izločili vpliv osamelcev, ki zajemajo ekstremne vrednosti pod 1 in nad 99 percentilom. Primerjava regresijskih ocen nam je pokazala zelo podobno statistično značilnost in vrednost koeficientov. Ekonomski vpliv pojasnjevalnih spremenljivk tako ostaja enak ocenjenim vplivom v osnovni cenilki (sistemska cenilka GMM brez izločenih ekstremnih vrednosti), kar potrjuje robustnost regresijskih ocen tudi ob izločitvi vpliva osamelcev.

Nadalje smo testirali robustnost dinamičnega modela panelnih podatkov in sistemske cenilke GMM s cenilko Arellano-Bond (dinamična cenilka GMM), ki se v literaturi poleg sistemske cenilke GMM pogosto uporablja za testiranje dinamične metode panelnih podatkov. Uporabili smo enake specifikacije modela kot pri sistemski GMM cenilki, z enim odlogom odvisne spremenljivke in istim številom instrumentov. Pri uporabi cenilke Arellano-Bond ni prisotnih večjih razlik v primerjavi s sistemsko cenilko GMM. Ekonomski vpliv statistično značilnih pojasnjevalnih spremenljivk ostaja enak ocenjenim vplivom v osnovni cenilki. Spremeni se le velikost vpliva. Zlasti velikost banke ima pri dinamični cenilki GMM veliko večji negativni vpliv na likvidnostne blažilnike bank. Ker med modeloma ni prisotnih večjih razlik lahko zaključimo, da je sistemska cenilka GMM robustna. Sarganov test potrjuje pravilno specifikacijo in veljavnost instrumentov. Prav tako s cenilko Arellano-Bond nismo zasledili prisotnosti avtokorelacije.

Robustnost sistemske cenilke GMM smo preverili še z zamenjavo odvisne spremenljivke, pri čemer smo razmerje likvidnih sredstev glede na celotno bilanco stanja zamenjali z razmerjem likvidnih sredstev glede na depozite nebančnega sektorja. S spremembo odvisne spremenljivke pri testiranju vpliva bančno-specifičnih in makroekonomskih dejavnikov na likvidnost bank lahko zaznamo nekaj sprememb. Dobičkonosnost, ki se je izkazala kot nepomembna pri ocenjevanju vpliva na likvidnost bank, postane statistično značilna na celotnem vzorcu bank ter pri domačih bankah. Koeficient dobičkonosnosti (ROAE) postane pozitiven, kar pomeni, da imajo bolj dobičkonosne banke, več likvidnih sredstev glede na depozite nebančnega sektorja. Vpliv kreditnega tveganja na likvidnost tujih bank ni več pozitiven, temveč postane negativen. Teorija pravi, da se ob pojavu

neplačila kredita in poslabšanju kreditnega portfelja, poveča likvidnostno tveganje (zmanjšajo se zaloge likvidnih sredstev) zaradi oslabljenih denarnih pritokov ter povečanih zahtevkov za izplačilo depozitov.

Zanimivo, vpliv gospodarske rasti na likvidnost tujih bank postane pozitiven in statistično značilen, kar pomeni, da se apetit tujih bank po ustvarjanju likvidnosti poveča z boljšimi gospodarskimi razmerami. To ugotovitev podpira tudi nekatera literatura, ki pravi, da so pogoji za ustvarjanje likvidnosti boljši v obdobju gospodarske rasti kakor v obdobju gospodarskega upada, ko banke kopičijo likvidna sredstva predvsem zaradi previdnostnih razlogov. Ekonomski vpliv ostalih spremenljivk ostaja enak kot pri izvirni specifikaciji modela. Rezultati Sarganovega testa so pokazali, da v celotnem vzorcu bank in pri vzorcu tujih bank, test zavrne ničelno domnevo o veljavnosti instrumentov. V tem primeru je potrebno ponovno razmisliti o ustreznosti modela oziroma instrumentov, razen če zavrnitve ne prepišemo heteroskedastičnosti v procesu zbiranja podatkov. Pri tem je potrebno poudariti občutljivost in druge pomanjkljivosti Sarganovega testa, ki se pojavijo pri večjem številu momentov oziroma instrumentov.

Nenazadnje, smo testirali robustnost dinamičnega modela panelnih podatkov še z modelom fiksnih učinkov, ki ga nekateri avtorji uporabijo pri iskanju determinant likvidnosti, kljub njegovim številnim omejitvam. Pridobljeni rezultati potrjujejo naše izvirne ugotovitve. Do sprememb pride le pri vplivu kratkoročne obrestne mere na likvidnost tujih bank. V tem modelu ostane ekonomski vpliv kratkoročne obrestne mere negativen, toda postane statistično značilen. Zdi se, da ob povišanju kratkoročne obrestne mere tuje banke zmanjšajo zaloge likvidnih sredstev, medtem ko jih domače banke povečajo. Kot že rečeno, razlike v učinku kratkoročne obrestne mere na likvidnost domačih in tujih bank je mogoče pripisati različni strukturi portfelja likvidnih sredstev oziroma različni strategiji upravljanja likvidnosti domačih in tujih bank.

Na podlagi dobljenih podatkov smo ponudili tudi nekaj predlogov za oblikovalce politik. Prvič, ker je učinek velikosti banke negativen le za domače banke, morajo nadzorniki pozorno spremljati velike domače banke, ki bi se lahko odzvale na spodbude za moralno tveganje. Drugič, banke, ki večino svojih sredstev financirajo z depoziti, bi lahko imele visoke oportunitetne stroške, ko se bodo tržne obrestne mere začele zviševati, ker se zvišanje tržnih obrestnih mer običajno najprej prenese na posojilne obrestne mere in počasi na depozitne obrestne mere, kar pomeni da se obrestna razlika poveča s tem pa tudi oportunitetni strošek posedovanja likvidnih sredstev. Zato morajo nadzorniki pozornost nameniti bankam, ki večina svojih sredstev financirajo z depozit, saj bodo spodbujene k zniževanju deleža likvidnih sredstev zaradi visokih oportunitetnih stroškov. Tretjič, glede na to da se likvidnostni blažilniki domačih bank gibljejo proticiklično, je mogoče pričakovati, da bo med gospodarsko rastjo likvidnostna zahteva, uvedena za slovenski bančni sistem, omejevala posojilno aktivnost predvsem domačih bank. Poleg tega lahko proticikličnost likvidnostnih rezerv omejuje učinkovitost monetarne politike. Nenazadnje najdemo tudi dokaze, da se dejavniki, ki vplivajo na likvidnostne blažilnike razlikujejo

glede na lastništvo banke, kar lahko pomeni, da tuje banke upravljajo svojo likvidnost preko matičnih bank. Zaskrbljenost je lahko ta, da se morebitne likvidnostne težave, ki bi se lahko pojavile pri matični banki, hitro prelijejo v podružnice bank in posledično povzročijo pomanjkanje likvidnosti v državi gostiteljici.