

Analysis of Determinants of Liquidity Risk in Polish Banking Sector



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Abstract The purpose of this paper is to identify dependences between bank liquidity risk and selected group of internal determinants including levels of credit risk, capital ratio and profitability. The dependence study employed the estimation of correlation coefficient within two groups of banks forming the Polish banking sector, including commercial and cooperative banks. The research revealed the existence of correlation (statistically significant) between financial liquidity level and internal determinants across two groups of banks. However, there were various directions of correlation between liquidity risk and capital ratio evidenced for those two groups of Polish banks. The cooperative banking sector was diagnosed with the existence of strong positive dependence between liquidity and capital ratio, which may suggest the focus in those banks on increasing financial safety regardless the stage of economic cycle as well as on increasing the lending capacity of non-financial sector.

1 Introduction

The crisis and its negative consequences for financial systems and real economy caused the problem of banking systems liquidity risk become more explored research area. The crisis emphasized problems related to banking liquidity risk management (Jajuga 2009) from the level of individual financial institution on global scale and in particular to the issue of quantifying its level. This is primarily associated with the fact that liquidity risk is determined by a series of factors both of internal nature emerging from the classical formula of carrying out the function of financial intermediation as well as coming from macroeconomic effect in particular the market liquidity. The problem of identifying the determinants of bank liquidity risk was not the subject of wide scientific discourse until the outburst of sub-prime crisis. Consequences of the crisis focused the research on the problem of liquidity

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risk in the context of indicating the dependences between liquidity risk and the group of external determinants (GDP, inflation and the ratio of deposits to loans) and internal determinants, i.e. credit risk level or the profitability generated. Nevertheless, the results of the research are not homogeneous, in particular in relation to dependences between liquidity risk and profitability level (Wójcik-Mazur and Szajt 2015). Empirical research identifying the determinants of liquidity risk in Polish commercial banks was done by Vodovà (2013), however it was focused on commercial banks. Given the above, this paper is an attempt to indicate the dependences between the group of internal determinants and liquidity risk in both commercial banks and in the cooperative banking sector operating in Polish banking system. The characteristics of cooperative banks operation and in particular their local nature may result in different type of liquidity policy of those banks. This paper evaluates the existence of dependences between liquidity risk and credit risk level, profitability and the scope of capital ratio (calculated as the share of equity in total assets). Pearson correlation coefficients were used to diagnose those dependences, and they were estimated for the group of commercial and cooperative banks. Based on literature studies, following research hypotheses were formulated:

1. There is a positive linear correlation between liquidity risk and the profitability level of a bank operation, regardless of the type of the bank.
2. Credit risk level is negatively correlated with liquidity risk regardless of the group of banks.
3. Capital ratio is negatively correlated with a bank liquidity risk regardless of the type of the bank analyzed.

2 Liquidity Risk Measurement Methods

According to Basel Committee “liquidity is the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses” (Basel Committee 2008). It should be noted that liquidity risk is determined by both external factors and internal factors resulting from the nature and characteristics of given financial institution activities. Thus the literature of the subject commonly emphasizes that liquidity risk in commercial banks operation includes two crucial components—funding risk and market risk (Brunnermeier and Pedersen 2009; Nikolaou 2009; Vento and La Ganga 2009). Such specific nature of liquidity risk causes some problems with selecting measures for its analysis. This applies not only to empirical research but also to difficulties associated with the implementation of mandatory standards, on global scale, setting safety thresholds for maintaining liquidity reserves. Only in response to sub-prime crisis consequences Basel Committee introduced the obligation to evaluate liquidity measures in short and long-term, including: Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), respectively (Dziwok 2015; Zaleska 2016; Basel Committee, January 2013; Basel Committee, October 2014). According to Basel Committee the “objective of the LCR is to promote the short-term resilience of the liquidity risk profile

of banks". The LCR ratio should ensure that banks have an adequate amount of unencumbered high-quality liquid assets (HQLA). These assets can be converted easily and immediately in private markets into cash to meet their liquidity needs for a 30 calendar day liquidity stress scenario (Basel Committee, January 2013). The NSFR means that the amount of "available stable funding" should be equal to at least the amount of stable funding required. "Available stable funding" is the proper amount of capital and liabilities expected to over 1 year. The amount of stable funding required consists of various assets held by that institution and those of its off-balance sheet exposures. Their value and level are estimated by allowing for ASF factor, reflecting the funding stability level (Wójcik-Mazur 2012; Basel Committee, October 2014). The effect of the above measures on the banking sector operation in Poland was analyzed in particular by Marcinkowska et al. (2014), Dziwok (2015) and Niedziółka (2014).

The estimation of liquidity levels of individual banking institutions can employ three main measurement methods, including stock approaches, cash-flow and hybrid approaches (Vento and La Ganga 2009). The empirical research, related in particular to the identification of liquidity risk determinants and well as the determinants of effectiveness level estimation, is based on stock approach. The quantitative measurements of bank liquidity risk are being used most often. They include: balance sheet ratios, net cash capital position, maturity mismatches and funding ratios. Problem of calculating these measurements depends on cash-flow timing and its uncertainty level. For that reason space-time analyses treat declared cash flows as certain. Implied balance sheet measures allow for ratios of assets of different liquidity to total assets or selected funding sources including in particular deposits. The most often implied measures of liquidity level are equal to the ratio of liquid assets to total assets (Ferrouchi 2014; Ferrouchi 2014; Alper and Anbar 2011). In parallel those analyses also take into account the ratio of liquid assets to customer deposits and short-term funding (Vodová 2013; Grant 2012; Deléchat et al. 2012; Mehmet 2014; Maechler et al. 2007; Aspachs et al. 2005; Roman and Sargu 2015). A popular measure of liquidity risk is also the ratio reflecting the share of loans in total assets (Roman and Sargu 2015; Athanasoglu et al. 2006; Vodová 2011; Abreu and Mendes 2002; Rachdi 2013). Also noted should be the ratio that is widely used in conducted studies and reflects the relation between the value of loans granted and the level of deposits accepted. It enables the estimation of funding risk by indicating the values of stable funding sources, which are considered to be deposits mainly of non-financial sector (Marozva 2015; Bonfim and Kim 2017; Vodová 2011; Petria et al. 2015). Determinants of individual adopted various liquidity measures do not demonstrate the same directions of dependences and effect strength (Wójcik-Mazur and Szajt 2015). They are also dependent on the specifics of individual banking systems.

The basic element of liquidity risk estimation in cash flow approach is the liquidity gap calculation. Liquidity gap in relation to individual institutions should be based on the estimation of cash flows reflecting the actual inflows and outflows of funds that identify both balance sheet and off-balance sheet items in specific, precisely defined time periods. Many authors emphasize that estimating both funds

inflows and outflows should also allow for the process of their materialization which can be enhanced by the approach that takes into account future unexpected changes in cash flows (Matz and Neu 2007; Bessis 2009; Schmaltz 2009; Stopczyński 2016). Therefore it seems that such an approach is similar to the hybrid approach as hybrid approach consists of elements of cash flow and liquid assets approach. In this approach projected cash flows should include the calculation of stochastic cash flows (including those of undefined time profile) that can significantly change the liquidity position of the bank. Nevertheless statistical studies, in particular comparative analyses should be emphasized with the attempts to use balance sheet measures that in such an approach are about to reflect the „idea” of liquidity gap. Few studies undertake the attempts to calculate liquidity risk as liquidity gap that, however, the result of relations between balance sheet elements. In this approach it is treated as the difference between the value of loans granted reduced by the value of deposits accepted and the total value of assets (Chen et al. 2010; Wójcik-Mazur 2012). In the classical approach balance sheet measures or liquidity gap estimation can be used, that may relate both to individual financial institutions and to banking systems of individual countries.

3 Analysis of the Level of Correlation Between Liquidity Risk and Internal Determinants

Therefore, the basis for the research in the field of assessing the effect of liquidity risk determinants is the selection of a measure enabling that assessment. This paper analyzes the level of dependences between liquidity risk and the group of three internal determinants within the group of commercial and cooperative banks in 2009–2016. The source of information is financial data presented on a monthly basis by the Polish Financial Supervision Authority (KNF) for the sector of commercial and cooperative banks operating in Poland. Based on the literature studies, three classical formulas were selected as liquidity measures: loans to deposits ratio, liquid assets to total assets ratio and loans to total assets ratio. These ratio as proxies for liquidity risk are considered by many authors: Vodovà (2011), Bonfim and Kim (2012a, b), Sufian (2011), Kosmidou et al. (2006), Sheefeni (2015) and Roman and Sargu (2015).

When choosing the liquidity level measure from one of the three proposed above, the level of their mutual correlation was evaluated. Tables 1 and 2 present the level of

Table 1 Pearson correlation coefficient of liquidity measures for commercial banks at significance level $\alpha = 0.05$

	Loans/Deposit	Liquid assets/Total assets	Loans/Total assets
Loans/Deposit	1	-0.662358	0.564697
Liquid assets/Total assets		1	-0.774414
Loans/Total assets			1

Table 2 Pearson correlation coefficient of liquidity measures for cooperative banks at significance level $\alpha = 0.05$

	Loans/Deposit	Liquid assets/Total assets	Loans/Total assets
Loans/Deposit	1	-0.556951	0.6393642
Liquid assets/Total assets		1	-0.90794
Loans/Total assets			1

correlation coefficient between liquidity risk measures for the groups of commercial and cooperative banks, respectively. Data presented in Tables 1 and 2 indicate that the lowest level of correlation was observed for loans/deposits measure and loans/total assets measure for individual types of banks. Therefore it was assumed that the loans/deposits measure was the optimal ratio of liquidity risk for analyzed financial data.

Based on the literature studies and previous research (Wójcik-Mazur 2012; Wójcik-Mazur and Szajt 2015), determinants of liquidity risk include, as mentioned above, in particular credit risk level, return on equity and capital ratio. The value of above ratios were estimated from monthly data published by Polish Financial Supervision Authority (KNF) for the entire group of cooperative and commercial banks. The methodology for calculating the ratios were presented in Table 3.

In the existing empirical literature we can find broad area of research reflects the relationship between profitability in banking activity and group of internal determinants include liquidity risk. These studies have focused on commercial banks in different criteria based on cross-country evidence, country specific, size of banks etc. Many authors (Abreu and Mendes 2002; Kosmidou et al. 2005; Garcia-Herrero et al. 2009; Guru et al. 2002; Graham and Bordelean 2010; Al-Harbi 2017) find the evidence on the relationships between liquidity and profitability. Referring to the impact of bank liquidity is negatively related to the profitability of commercial banks. However Kosmidou et al. (2005) recognize that exists significant positive relationship between these determinants.

We examine the correlation between liquidity of banks and three internal determinants. Table 4 present the results of linear dependences between funding risk and indicated group of measures. Pearson correlation analysis revealed that all relations being analyzed are statistically significant, which suggests the existence of linear dependences between any of profitability ratio (ROE), credit risk level, capital ratio and financial liquidity level measured as funding risk.

Table 3 Internal determinants of liquidity risk

Name of measure	Construction	Source of data
ROE	Net profit/Equity	Polish Financial Supervision Authority (KNF)
Credit risk	Value of past due loans/ Gross loans	Polish Financial Supervision Authority (KNF)
Capital ratio	Equity/Total Assets	Polish Financial Supervision Authority (KNF)

Table 4 Pearson correlation coefficient of liquidity measures for commercial and cooperative banks

Name of measure	ROE	Credit risk	Capital ratio
Loans/deposits (commercial banks)	0.2523664	-0.681624	-0.546792
Loans/deposits (cooperative banks)	0.528535	-0.817615	0.8476575

The research indicates that levels of both operation profitability and credit risk are dependent on the value of maintained liquidity level for commercial banks group as well as for cooperative banks group.

When evaluating the dependence between funding risk and return on equity it is clearly visible that significantly stronger positive dependence occurs in cooperative banks sector. Therefore it seems that it is caused by the fact of maintaining liquidity reserves, which in the event of starting lending activity significantly increase interest revenues while not generating excessive additional increase of interest cost (hypothesis 1). That is because cooperative banks when funding increasing lending activity are not forced to obtain additional, more expensive funding sources originating from financial markets, as they maintain reserves in the form of deposits from non-financial sector. In the group of commercial banks the decrease in liquidity reserves results in increasing profitability ratios, however this dependence is much weaker. The increase in lending activity forces to obtain additional funding sources at a cost higher than from local wholesale market. For that reason the relation is positive but noticeably weaker.

General overview of empirical literature shows a positive relationship between liquidity and credit risk. This is shown by papers such as Diamond and Rajan (2005), Acharya and Viswanathan (2011), Gorton and Metrick (2012) and He and Xiong (2012). But Imbierowicz and Rauch (2014) find an evidence that there is no reliable relationship between liquidity risk and credit risk in banks.

In our paper while evaluating the relation between financial liquidity level and credit risk it should be noticed that there is a strong negative correlation both in commercial and cooperative banks groups (hypothesis 2). It probably results from the specific character of liquidity risk confirming its anticyclical nature (Wójcik-Mazur 2012). As emphasized in current research the significant increase in lending activity is realized by the banking sector in the event of the economic growth. At such circumstances the credit risk level is low and the potential growth of newly-started loans makes the ratio of past due loans to total receivables decrease. This negative correlation is much stronger in case of cooperative banks which are more responsive to economic situation and, as it seems, implement much more restrictive lending policy.

The measure demonstrating the relation between liquidity risk and capital ratio that reflects the ratio of equity share in total assets is observed for a strong correlation, however its direction is different in the discussed groups of banks (hypothesis 3). In commercial banks sector the funding risk level is negatively correlated with the

value of that ratio. It means that the increase in liquidity risk is accompanied by the decrease in the share of equity in total assets. The growth in lending activity results in the balance sheet total increase, but it is not accompanied by the proportional progress in equity. It may be caused by the fact that commercial banks are more focused on increasing profitability than on enhancing financial safety. The opposite situation takes place in cooperative banks sector. Those results are not consistent with the expected (hypothesis 3 negatively verified). It should be noticed that cooperative banks hold much higher liquidity buffer in comparison to commercial banks. They invest their free funds in associating banks and in debt instruments. Therefore it seems that the surplus funds held may form a source of newly-started loans, which does not have to be accompanied by a strong increase in deposits obtained from non-financial sector. Positive correlation between funding risk and the share of equity in total assets suggests that banks, when increasing the lending activity (still financed from liquidity surpluses), implement a conservative policy, simultaneously increasing the value of equity. However the policy aimed at the increase of the equity share may not only originate from the desire to enhance financial safety but also attempt to increase the lending potential, especially in the area of business activity financing by acquiring new customers that require more advanced products and in particular higher loans. As it may seem, external limits in relation to equity value in lending activity of particularly cooperative banks limit the possibilities of lending to non-financial sector. Increasing the equity is of key importance for the possibility of financing new ventures and acquiring new customers with higher credit needs, especially given the existing high liquidity buffer in the sector of cooperative banks.

4 Conclusions

The studies on correlation between the liquidity measure and the group of internal determinants evidenced the existing dependences in the sectors of commercial and cooperative banks. It should be noticed that based on financial data presented for cooperative and commercial banks it was possible to prove the existence of the correlation between liquidity risk and the return on equity, credit risk and capital ratio. The direction of diagnosed dependences was identical for ROE and for credit risk. However, the stronger dependences were observed in the group of cooperative banks. The opposite direction of correlation was found in cooperative banks segment in terms of the measure reflecting the relation of equity to total assets ratio and liquidity risk. Pearson correlation estimated revealed that cooperative banks, when decreasing their liquidity reserves, in parallel increase the value of equity, which may suggest that their policy is determined by capital requirement, but also in particular at increasing lending capacity.

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