

# **University of Economics in Prague**

## **Faculty of Finance and Accounting**

Finance and Accounting



### **MASTER THESIS**

## **Liquidity management of commercial banks operating in Poland.**

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Academic Year: 2018/2019

### Declaration of Authorship

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## Acknowledgments

I would like to express my gratitude to my Thesis supervisor doc. Ing. Karel Brůna, Ph.D for his very helpful suggestions, comments as well as time spent on reviewing my Thesis.

## **Abstract**

This Thesis evaluated the level of liquidity risk and the tools used to minimize such risk in Polish commercial banks. The evaluation of the liquidity of banks in Poland consists of three parts. Firstly, the changes in funding gap, which is a measure of funding liquidity risk, in the period from 2003 to 2018 of commercial Polish banks was assessed. The main finding of this analysis was that the funding liquidity risk was significantly lower before the Global Financial Crisis than during any years since the crisis. Secondly, analysis of the liquidity ratios level since 2008 until 2018 was presented. The last part of the analysis demonstrated the analysis of linear regression of certain macroeconomic factors (unemployment, and inflation) and funding gap.

## **Keywords**

Liquidity risk analysis, Risk in banking sector,

Liquidity ratios, Funding Gap analysis

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## 1. Introduction

Banks play crucial role in the society and the economy as they provide funding for both firms and households, they facilitate deposits, cash settlements and manage risks. (Farag, Harland & Nixon, 2013). Having said that, stability of financial system is a necessary condition for a long term sustainable economic growth (NBP, 2018). Stability of financial system can be described as state in which it performs its functions effectively and continuedly even during unexpected and unfavorable events of a large scale and low probability of occurrence (Mishkin and Eakins, 2015). Stability of banking sector is regarded as especially important for the stability of the whole financial sector, as its assets account for majority of total assets of this sector (NBP, 2018). In order to maintain financial system stability, it is essential to monitor systemic risk occurring in banking sector as well as to take actions that eliminate or limit this type of risk (Mishkin and Eakins, 2015). We can distinguish four categories of risk that banks are exposed to: credit, liquidity, operational as well as market risk (Scannella, 2016). Growing uncertainty of financial markets and the financial crisis of 2007-2009 emphasized the need for banks to become more resilient to more difficult macroeconomic conditions (Zuk-Butkuvienė et al., 2014). We can identify a number of consequences of the crisis. First of all, crisis leads to liquidity shocks which refers to the situation of outflows of liquidity from banks to stable banking systems or to cash. What is more, crisis can result in frozen secondary market, making it impossible to trade assets as well as frozen supply of funding on the interbank market as well as from costumers' deposits (Mishkin and Eakins, 2015). Additionally, worsening credit portfolio leads to significant reduction of liquidity inflow. Mentioned consequences of the financial crisis have prompted regulators to reassess the financial risk assessment and management methods (Dziwok, 2015). The resilience of the banking industry greatly depends on the liquidity risk what has also been proven during the recent crisis. In the most basic words, liquidity of banks can be defined as their ability to meet their financial obligations on time (Klepková Vodová, 2016). Liquidity risk in banking refers to the possibility that the banks will not have enough cash or other liquid assets to meet the liquidity needs of their clients. Hence, banks' ability to efficiently manage their liquidity helps to ensure their undisturbed functioning and resilience (Handorf, 2015). Liquidity risk is



therefore regarded one of the most important financial risk of a bank (Jasienė et al., 2012). Loss of public trust which was the result of not managing effectively this type of risk has encouraged regulators to pay especially great attention to the liquidity of financial institutions (Mishkin and Eakins, 2015). Due to the evident relevance of liquidity risk, this paper will be concerned with the level and management of this type of risk in commercial banks in Poland. Liquidity risk has not been covered in much detail by the Basel I and Basel II Committee guidelines (Dziwok, 2015), however the consequences of the financial crisis has prompted the Basel Committee to focus on this type of risk in the Basel III, what will also be a part of discussion in this paper.

### **1.1.1. Aims and objectives**

Aim:

To evaluate liquidity risk level and examine the tools used to measure such risk in Polish commercial banks

Objectives:

- To compare the funding liquidity risk of the periods before and after the Global Financial Crisis by examining the changes in the funding gap between 2003 until 2018
- To assess the level of liquidity risk in the period after the Global Financial Crisis by examination of the liquidity ratios of Polish commercial banks in the period from 2008 until 2018.
- To present the linear regression analysis between inflation, and unemployment with funding gap.

### **1.1.2. Structure of the paper**

In the introduction part the research background as well as aims and objectives of the paper have been presented. In the literature section all relevant literature regarding risk in banking sector and liquidity risk will be reviewed. Following chapter will be concerned with the guidelines and recommendations of Basel Committee of Banking Supervision regarding liquidity risk. The subsequent chapter will present all the relevant for this study information about Polish regulatory and economic environment. Succeeding chapter will present the methodology used in the paper. Later will follow the chapter with the analysis that will consist of three parts; funding gap analysis, liquidity indicators analysis and lastly the analysis of the linear relationship between certain macroeconomic factors and funding gap. The last two chapters will present discussion of the findings and conclusion of the paper.

## 2. Literature review

### 2.1. Banking sector regulations

#### 2.1.1. Reasoning behind regulations of banks

The main goal of regulation of the banking sector is to correct so called market failure.

Explicitly, banking sector, if left without any regulations, would have low initiative to avoid risky but profitable for them behaviors. Great economic depression from the first half of the 20th century and its serious consequences for the whole economic sector prompted national governments to introduce regulations that could prevent another crisis (Malecki, 2014).

Another relevant justification of need for regulatory oversight is the hypothesis of Minsky's (1986) about financial instability. According to this hypothesis financial crisis is periodic in the economy, as the years of economic propensity and excess optimism encourage excessive accumulation of debt which in turn leads to economic crisis. As according to this hypothesis financial crisis is inevitable it is essential to have relevant and effective regulations in place in order to minimize the negative effects of financial crisis. This hypothesis was not very popular when it was first formulated, however after the financial crisis of 2007-2009 it started to be taken into account when preparing banking regulations (Dziwok, 2010). Preventing crisis in the banking sector is regarded as more important than in any other sector of the economy. There are few reasons why regulation of the banking sector is so crucial such as: cost to the external parties in an event of bank's bankruptcy, prevention of monopoly, and the threat of information asymmetry (Malecki, 2014). Marcinkowska (2010) have identified a number of subjects that are affected in an event of banks' failure;

Who is affected?	How is the subject affected?
Bank's shareholders	Loss of investment value
Private sector depositors	Partial or full loss of deposits
Private sector borrowers	Difficulty of obtaining funding as well as rise of funding cost

Banking sector	Risk of contagion as a result of loss of customer trust in banking institutions and funds withdrawal
Government/country wide losses	Cost of banks recapitalization, decrease in spending and investment as a lower lending capability
Businesses	Inability to obtain funding for investment

*Table 1 Subjects affected by bank's failure, Source: own work based on Marcinkowska (2010)*

To conclude, regulation of banking sector is extremely important as failure of financial institutions tends to negatively affect many areas of the economy and society. Despite all the reasoning behind regulations of banks it is important to acknowledge additional costs associated with such intervention in the functioning of this sector of economy such as negative impact on effectiveness and profitability (Malecki, 2014)

### **2.1.2. Methods and approaches to banks regulations**

Malecki (2014) has identified number of instruments used in regulation of banking sector, there are listed below:

- Establishing institutions supervising activities of banks
- Requirements for banking licenses
- Restriction of certain banking activities
- Limitation of risk taking by banks
- Introduction of detailed accounting standards in order to ensure transparency
- Setting up barriers against monopolistic practices

We can distinguish two basic approaches to banking sector regulations: micro-prudential and macro-prudential. Micro-prudential approach has been commonly used until the recent financial crisis. This approach focuses on the financial health and stability of individual institutions, what supposedly should result in stability of the whole financial sector (Malecki, 2014). Macro-prudential approach on the other hand focuses on ensuring stability of the banking sector as a whole in order to reduce systematic risk. According to this approach,

regulatory framework should be established firstly for the whole banking sector and only after that regulations should be tailored for different types of institutions separately. Such individual approach leads to different regulatory requirements for particular banks depending on the nature of their activity. What is more, regulations should be adjusted to current phase of the business as well as the financial cycle (Galati and Moessner, 2011)

### **2.1.3. Problem of moral hazard**

When discussing the regulations of banks, it is important to mention the problem of moral hazard that arises from the deposit insurance and lender of last resort provided by Central Bank that prevents banks runs in case of their liquidity problems. Because banks know they are “too big to fail” they can be tempted to keep the liquidity levels too low and invest the cash that would be otherwise held in case of higher level of withdraws by depositors (Bouwman, 2013). Therefore, the capital support provided by authorities in the event of liquidity problems of banks discourage banks from creating sufficient liquidity and can in fact increase liquidity risk. According to Calomiris et al. (2015), one of the solutions to this problem of moral hazard can be cash reserve requirements that would result in more prudent behavior of banks.

## **2.2. Liquidity of banks**

There are number of definitions of liquidity which refer to different aspects of banking industry liquidity. According to Chorafas (2002) liquidity is the ability of a bank to convert assets into cash at the fair price. Similarly, Pietrzyk (2007) stated that liquidity refers to the easiness of converting assets into cash with very limited loss on value. Both of these definitions relate to market liquidity, which is defined as the ease of trading the financial assets at the price approximate to their fundamental price. Another concept of liquidity, is the funding liquidity, which related to the ability of financial institutions to obtain funding (Marcinkowska, 2010). Regardless of exact definition, banks ensure their liquidity by the combination of two factors: ability to generate cash in case of cash outflows as well as by holding sufficient cash reserves as well as securities than can be easily converted to cash with minimal financial loss. It is regarded as crucial for banks managers to establish appropriate

procedures and tools in managing their liquidity level in order for them to prevent various issues that may result from insufficient liquidity (Marcinkowska, 2010). Having said that, management and evaluation of bank's financial liquidity is one of the most important and difficult responsibilities of the banks' managers. Liquidity of banks is required from the point of view of both borrowers and depositors. As keeping liquidity on high level is costly banks need to decide what is optimal level of it. Liquidity ratios as well as regulations are used to reduce risk taking by banks and ensure liquidity of banks. The aim of liquidity management is to reduce the risk of cashflow shortfalls in order to provide liquidity its customers. Even small delays in payments to the customers can drastically reduce their trust, what is more, constant deterioration of banks financial liquidity can lead to their bankruptcy (Gurgul, 2012). Scanella (2016) has stated that crisis of liquidity in banking sector is regarded and low probability but high impact event. It is important to acknowledge that maintaining high level of liquidity is usually at the expense of banks' profitability therefore it is one of the most important and difficult objectives of a bank to decide on the ratio of profitability and risk level (Jasienė et al., 2012). Banks wanting to enhance their profitability by reducing cash levels impose the risk of liquidity shortage.

### **2.2.1. Liquidity of a commercial bank**

Level of liquidity of a commercial bank is determined by the level of cash, securities in an account at the central bank as well as inflow of liquidity with the use of existing liquid assets as well as liquidity outflow due to liabilities payable (Pietryka, 2016). Liquidity of a bank is managed in a process of a bank granting a loan what in turn creates demand deposit, which are used by borrowers to make transactions. When a borrower performs transaction, a deposit is transferred out of a bank and when it happens in order to settle transaction between banks reserves must be transferred (Bianchi and Bigio, 2014). These central bank reserves are necessary in order to maintain liquidity as loans are usually not sold immediately. Lower level of reserves at the central bank increases the risk of a bank being short on reserves therefore increasing liquidity risk.

Liquidity of a commercial bank is a result of passive and active operations of a bank. Passive operations of banks relate to the processes resulting in accumulation of funds, active operations on the other hand involves placing/using of funding collected in passive operations (Pietryka, 2016). Examples of passive and active operations of banks are presented in a table below:

<b>Passive operations</b>	<b>Active operations</b>
Clients depositing cash	Clients withdrawing deposits
Loan repayments by clients	Loan issuance to the clients
Other banks depositing cash (Interbank deposits)	Depositing cash at other banks
Selling of securities	Buying of securities
Selling of currencies	Buying currencies
Issuance of own securities	Redemption of own securities
Borrowing from the central bank	Repayment of loans at central bank

*Table 2 Passive and active operations of a bank, Source: (Pietryka, 2016)*

It is important to acknowledge that liquidity of a bank is not a constant variable as is it determined by supply and demand of a bank for liquid reserve. Demand for liquid funds of a commercial banks is determined by two factors: required level of reserve at the current account as well as its own transaction needs (Pietryka, 2016). In respect to the reserves, there are two parts of it that need to be considered. First of all, minimum reserves required by central bank. Minimum reserves are the fraction of deposits that are held by banks at current accounts at a central bank. This minimum reserve requirement is determined by central banks in order for banks to hold sufficient cash on hand and avoid potential liquidity problems. Moreover, banks also hold reserves in excess of minimum reserves, however they do not have the initiative to hold high level of excess reserves as that usually compromises their profitability. In the periods of increased liquidity needs commercial banks must often obtain funds from other commercial banks with excess liquidity. Interbank lending is regarded as less favorable and riskier type of financing than clients' deposits (Bouwman, 2013).

### 2.2.2. Funding gap as a measure of liquidity risk

Liquidity of a bank is strongly influenced by the type of financing it uses. Customer deposits is regarded to be stable and relatively cheap source of funding. Interbank lending, on the other hand, is short-term type of funding, more expensive and is believed to be less stable. In Poland, the extent to which interbank deposit is used as a source of financing, is measured by funding gap (NBP, 2005). Funding gap indicates what portion of loans is financed with funding other than domestic costumer deposits (for instance, interbank lending). The higher funding gap is, the more banks are raising funds from other sources than costumers in order to close that gap, for instance with the use of loans from other financial institutions. As interbank lending is very often short-term lending, in an event of difficulties on the interbank market, banks may struggle to obtain new loans and as a consequence face increased liquidity risk (NBP, 2017). Negative funding gap means that a country's lending can be financed with domestic deposits what indicates comfortable liquidity position of a banking sector. On the other hand, positive funding gap indicates that some of the loans granted by banks are financed with the funding obtained from other source than costumer deposits (e.g. interbank deposits)

### 2.2.3. Factors influencing banks' liquidity

The liquidity of banks can be influenced by both external and internal factors as presented in the table below.

Internal factors	
Factor	How it affects liquidity
Structure and quality of assets	High quality assets with good liquidity can fund cash outflows for longer period (LCR ratio)
Structure of funding	Stable and predictable retail deposits will have better impact on liquidity than interbank lending



Economic and financial position of a bank	Positively correlated
Capital adequacy ratio (CAR)	Sufficient capital can absorb losses and prevent insolvency

Table 3 Internal factors affecting liquidity of banks, Source: (Distinguin, Roulet & Tarazi, 2013), (Shah, Khan, Shah & Tahir, 2018), (Miskin and Eakins, 2015)

External factors	
Factor	How it affects liquidity
Financial condition of bank costumers (related to GDP and unemployment)	E.g. rising unemployment leads to more loan defaults and negatively influences liquidity of banks
Stability of Financial System	Liquidity problems within the financial system negatively influence liquidity of individual banks
Monetary policy of central bank	Influences money supply in the economy so interest rates, inflation and employment
Fiscal policy	Expansionary fiscal policy increases demand for credit leading to lower liquidity
Level of political control	E.g. liberalization of regulations in terms of liquidity requirements may lead to lower level of liquidity

Table 4 External factors affecting liquidity of banks, Source: (Distinguin, Roulet & Tarazi, 2013), (Shah, Khan, Shah & Tahir, 2018), (Miskin and Eakins, 2015)

Scannella (2016) on the other hand distinguished sources of liquidity risk as: mismatch of assets and liabilities, fluctuations of financial markets and undesirable customer behavior.

### 2.3. Risk in Banking Sector

Before discussing the topic of risk in the banking sector it is important to define risk.

According to Jasienè et al. (2012) risk can be understood as a value of a probable unfortunate event and can be measured as a probability of unfavorable choice. In the simplest term we can say that risk refers to uncertainty about possible deviation from expected outcome

(Mishkin and Eakins, 2015). It is important to add that risk refers to the situation when the expected possible results are known, which is not the case with the uncertainty. Jasienė et al. (2012) have identified a number of risks that banks face: credit, market, liquidity, operational, concentration as well as other risk. There are however two types of risk that believed to be the most crucial for banking stability; credit and liquidity risk. Despite the fact that both credit and liquidity risk management/regulations deal with reducing risk of banks bankruptcy there is a significant difference between these two areas of regulations. The purpose of liquidity requirements is to manage the risk of withdrawal by ensuring that sufficient part of the banks' assets is held in the form of liquid assets and deposit at central bank (Klepková Vodová, 2016). Jasienė et al. (2012) has described two key aspects of liquidity risk as short-term risk related to cash flow as well as long-term risk which is linked to funding. Credit risk on the other hand is minimized by capital regulations as it is covered with sufficient equity. Despite this clear distinction between these two areas of regulation they do interact (Scannella, 2016): To summarize, liquidity risk, which will be the main focus of this study is linked to maturity transformation and funds transferring from depositors to creditors (Klepková Vodová, 2016). Liquidity risk management is so crucial as it ensures solvency of banks but it is important to acknowledge that it is not possible to separate liquidity risk from other risks that banks face as they are all strongly interconnected (Jasienė et al., 2012). For instance, both market as well as credit risk greatly influence liquidity risk. It is interconnected with market risk, because when investors in a market have difficulties to obtain funding for investment activities it will make it more difficult for banks to sell collateral leading as a consequence to possible liquidity difficulties. With credit risk, as increased credit risk leads to difficulties in obtaining funding from creditors decreasing consequently available liquidity.

### **2.3.1. Types of liquidity risk**

We can distinguish two types of liquidity risk: funding as well as trading (market) risk (Scannella, 2016).

### **2.3.1.1. Funding liquidity risk**

Funding risk is concerned with the possibility that the bank will not be able to handle both unexpected as well as expected outflows of cash and is associated with maturity transformation (Jasienė et al. (2012). Scanella (2016) have identified number of sources of funding liquidity risk sources:

- Risk of liquidity mismatching relates to the possibility that cash inflow will not match cash outflows in regards to either amount or maturity.
- Risk of liquidity contingency relates to the possibility that banks may need more liquidity than anticipated as a result of unexpected events
- Risk of margin call liquidity relates to the risks of higher than anticipated margin calls on markets of derivatives which result in higher outflows of cash
- Risk of intraday liquidity relates to the risk of not being able to cover intraday payments and collateral liabilities

Scanella (2016) has identified a number of approaches used to evaluate the influence of the funding liquidity risk on banks and these are as follows: cash flow approach, stock approach and hybrid approach.

#### **Stock based approach**

Stock based approach is a traditional way of assessing liquidity risk used by many banks.

This method is used to evaluate a bank's ability to handle liquidity shortages (their "Cash Capital Position") by dividing liabilities and assets into cashable assets (such assets that can be easily and quickly transformed into cash), off-balance sheet liabilities (e.g. wholesale funding and risky part of customer deposits) as well as volatile liabilities (Scanella, 2016).

The cash capital position is calculated as the part of easily marketable assets that is not absorbed by off-balance sheet and volatile liabilities. If this number is positive it is a good indication that bank would be able to handle volatile funding sources (Scanella, 2016). The meaning behind this approach is that it ensures well-structured balance sheet in regards to liquidity management, in a way that stable source of funding covers for not very liquid assets and volatile liabilities provide funding for assets that are easily marketable.

### Cash flow approach

Cash flow approach focuses on evaluating cumulative and marginal liquidity gap. Marginal gap is calculated by deducting cash outflows from cash inflows in particular time period.

Cumulative gap is the sum of marginal gaps from all the maturities. If the cumulative liquidity gap is higher than zero it indicates that expected cash outflows are big enough to cover cash inflows and the negative number means that there might be liquidity shortage as a result of not sufficient cash levels (Scanella, 2016).

#### **2.3.1.2. Trading or market liquidity risk**

The trading liquidity risk on the other hand refers to the price risk for the assets with significantly limited trading volume and it associated with the capability of financial market to limit the impact of transactions of a large scale on the price of asset (Scanella, 2016). When the financial market is not deep enough or the volume of trades is small banks may strongly influence price of financial assets when liquidating big amount of them. Financial instruments that can be liquidated or exchanged easily in the market are regarded to have good market liquidity and risk of market liquidity occurs when this condition is not met (Jasiené et al., 2012)

The sources of this type of risk may be both external and internal. External factors include for instance financial markets' characteristics and the internal factors include for example bank's portfolio structure or size (Scanella, 2016)

#### **2.3.2. Management of liquidity risk in banks**

According to (Klepková Vodová, 2016) liquidity risk of banks is the natural consequence of their main function of transforming deposits with short maturity into loans with significantly longer maturity making the liquidity management the most important part of banks' risk management. Growing innovation, complexity and globalization of financial markets as well as recent trend of banks of using funding from more volatile sources makes the liquidity risk management even more difficult and important (Scanella, 2016). In order for the banks to identify, control and reduce the risk related to risk they should have all relevant and

appropriate procedures in place (Scanella, 2016). Scanella (2016) has identified four steps of liquidity risk management of the banking sector as presented on the Figure 1 below.

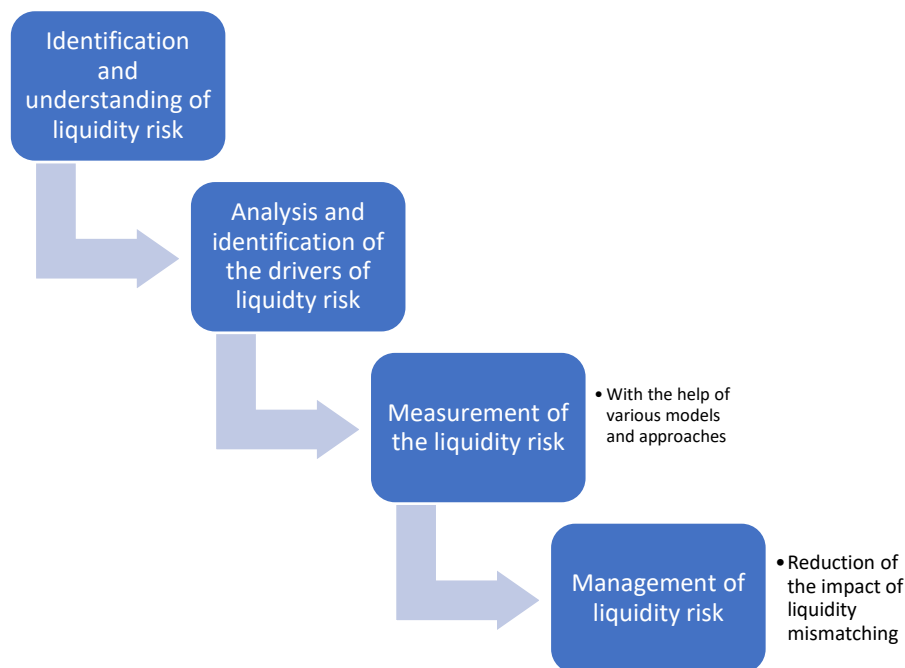


Figure 1 Steps in liquidity risk management, Source:(Scanella, 2016)

According to Scanella (2016) systematic approach to analysis of cash flow projections of both sides of the balance sheet is needed to effectively monitor liquidity of banks. Core objects based on which principles of liquidity risk management in the banking sector have been established by the Basel Committee are presented in the Figure 2 below.

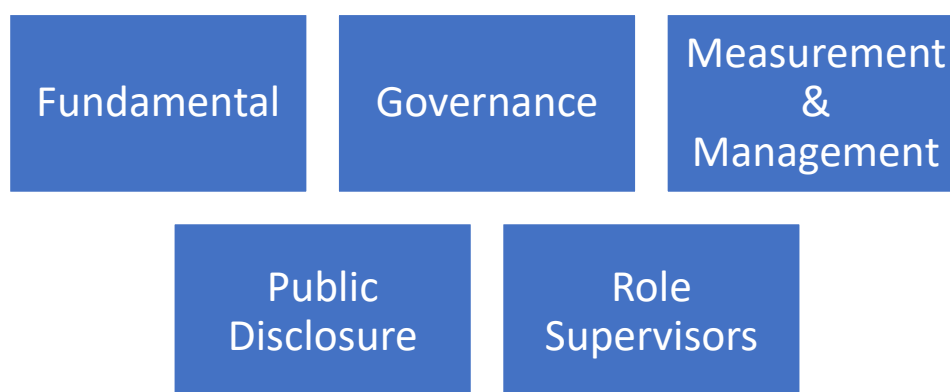


Figure 2 Core objects of liquidity risk management principles, Source: (Scanella, 2016)

### 2.3.2.1. *Liquidity ratios*

One of the tools used to assess financial liquidity of a bank is the use of liquidity ratios (Klepková Vodová, 2016).

Klepková Vodová (2016) have identified three liquidity ratios that are used the most frequently in banks: liquid asset ratio, loan to deposit ratio and net interbank position. The table below describes them in more detail.

Ratio	Formula	Description
Liquid asset ratio (LAR)	Liquid assets (e.g. Cash and government bonds)/total assets	Capacity of a bank to absorb liquidity shock (higher ratio indicates higher capacity; however, it can also indicate low efficiency)
Loan to deposit ratio (LOD)	Liquid assets/liquid liabilities	Ratio of over 100% indicates that loans are in addition to clients' deposits also financed with interbank loans. Clients' deposits are considered to be more stable source of funding than interbank loans, therefore the higher the ratio the lower the liquidity.
Net interbank position (NIP)	Liabilities due from banks minus liabilities due to bank	Due to lower stability of interbank lending as a source of funding, banks with negative ratio are more vulnerable and less liquid

Table 5 Liquidity ratios Retrieved from (Klepková Vodová, 2016)

### 2.3.3. Country specific factors that influence liquidity risk

As this paper focuses on liquidity risk management of one particular country, it is important to firstly establish how the country specific environment can influence the level of risk in banking sector. There are number of areas of which characteristics influence risk level and attitudes towards risk taking such as: regulatory framework of a country, macroeconomic conditions and cultural characteristics (Boubakri et al., 2017)

#### 2.3.3.1. Macroeconomic condition of a country

Trenca et al. (2015) have identified number of factors that are believed to influence banks' liquidity, which are presented with the explanation in the following table.

Factor	Direct influence	How it influences banks liquidity
Increase in GDP	Increased economic activity and in credit defaults	Decrease in bank's liquidity
Increase in inflation	Lower purchasing power of costumer, costumers need more money to pay for the same goods	Increased lending, which results in lower liquidity, <b>higher funding gap</b>
Increase in unemployment	Lower level of costumers' deposits and rise in the number of non-performing loans	<b>Increased funding gap</b> and lower liquidity of banks
Increase in public deficit	Increased bank loans	Drop in liquidity, increase in <b>funding gap</b>
Decrease in interest rates on deposits	Decrease in deposits	Increase in <b>funding gap</b> and increase in liquidity risk

Table 6 Macroeconomic factors influencing liquidity of banks, Source: Trenca et al. (2015) and NBP (2017)

Contractionary to the finding presented in the table, Ali and Daly (2010) have found that GDP increase causes the defaults on loans to decrease. They have also stated that short-term interest rates are also negatively correlated with number of loan defaults. Similarly, Jakubik

and Schmieder (2008) have found in their research that inflation, real interest rates and level of corporate indebtedness also can strongly impact loan defaults level and consequently liquidity of banks.

#### **2.3.3.2. Regulatory and political framework of a country**

According to Ashraf (2017) well-functioning and strong political environment is more likely to encourage stronger availability of information, which in turns lowers the risk of applicants with poor credit capabilities to receive a loan. The author has also stated that well-functioning legal environment of a country makes it easier for banking institutions to recover their bad loans. It is also important to acknowledge that political forces of a country that restrict or regulate activities of financial institutions that are considered riskier can also significantly reduce riskiness of these institutions Mansurov (2013). Table below presents methods used by governments to reduce risk taking by financial institutions:

<b>Method</b>	<b>Example</b>
Restricting high risk banking activities	Amount invested in foreign currency or real estates
Reducing risk-taking initiative	Increasing minimum capital requirements as a consequence banks with more own funds will be more reluctant to engage in risky activities

*Table 7 Methods to reduce risk taking by financial institutions, Source (Mansurov, 2013)*

#### **2.3.3.3. Cultural determinants**

The last aspect that can influence the risk taking and therefore liquidity risk of financial institutions is its cultural characteristics. Risk management is performed by people and their risk attitudes and behavior is strongly influenced by the culture of their country (Ashraf, Zheng and Arshad, 2016). Cultural environment is reflected especially in soft factors for instance in perception of what behavior is ethical and acceptable. The very accurate example here would be the fact that bankers sometimes could be tempted to act in a way that increases the profitability of the bank and therefore their bonuses however with no consideration to the liquidity and solvency of their institutions (Ashraf, Zheng and Arshad, 2016). What is more,



in relation to the previous paragraph, cultural characteristics also influence functioning of political and legal institutions.

### **3. Basel Committee of Banking Supervision**

#### **3.1. History and initial Basel recommendations**

Globalization of the financial sector and disturbances in banking sector and international currency created the need for the international harmonization of regulations of this area (Malecki, 2014). In an answer for this need in 1974 the Basel Committee on Banking Supervision initially called Committee on Banking Regulations and Supervisory Practices was founded (BIS, 2019). The Committee is an institution harmonizing regulations of banks on an international scale (Malecki, 2014). Basel Accords are set of capital as well as liquidity adequacy standards and recommendations that are practiced on the international scale to promote strong and resilient financial system globally (Sagner, 2010). Important fact that should be acknowledged is that the Basel Committee on Banking Supervision (BCBS) is not a regulatory institution therefore banks are not legally obliged to comply with their standards and recommendations (Marcinkowska, 2010). Their standards however have been implemented in many countries. The reason for this recommendation being adapted so widely is that they are a great tool helping to protect and prevent banks from big losses or bankruptcy and consequently protecting their costumers and the economy (Li et al., 2016). First two accords, Basel I and Basel II, introduced by Basel Committee were mostly concerned with the regulations of capital requirements (Bouwman, 2013). Basel II, which is said to be enhanced and improved version of Basel I accord, consists of three pillars designed to strengthen capital adequacy of banks. These pillars are the guidelines for banks on how to evaluate their capital needs by taking into account the risks of different classes of assets. This accord is also concerned with credit ratings so the minimum capital levels more accurately correspond to the actual risk level a bank is facing (Bessis, 2010)

#### **3.2. Basel III**

Despite the large number of risk management procedures and guidelines introduced by first two accords, very little attention has been given to the liquidity risk (Dziwok, 2015). As a consequence of the financial crisis of 2007-2009, The Basel Committee with Basel III accord introduced guidelines and recommendations that are designed to reduce liquidity risk of a

banking sector. Introduction of Basel III regulation was a direct consequence of the financial crisis of 2007-2009 and resulted in the following changes to the previous accords: stricter capital requirements and introduction of liquidity requirements, what was omitted in the previous versions of Basel recommendation.

Basel Committee with the new accord focused on the progression from the static to more dynamic approach to managing liquidity risk in banks. Banks now are not only required to have policy for liquidity management but also in order to reduce the effect of liquidity shocks they need to have contingency funding plan in place (Scannella, 2016). This new liquidity planning is supposed to provide more robust and clearer strategies for times of liquidity difficulties and is designed to help to choose between these strategies. The new plan also provides bank with the list of possible sources of funding in case of liquidity difficulties. The funding plan prepared for contingency difficulties describes the methods to assess different types of liquidity sources that can be used during liquidity difficulties (and the limits of these sources), improve ability of the financial institutions to handle different financial events, especially those that are not predictable (Scannella, 2016). This plan is designed to identify possible shortages of liquidity and to perform various scenarios stress test. It is important to acknowledge that assumptions of the plan are updated on a yearly basis in order to be the most accurate and relevant for the current economic conditions.

The functions of the contingency funding plan are presented on the Figure 3 below:

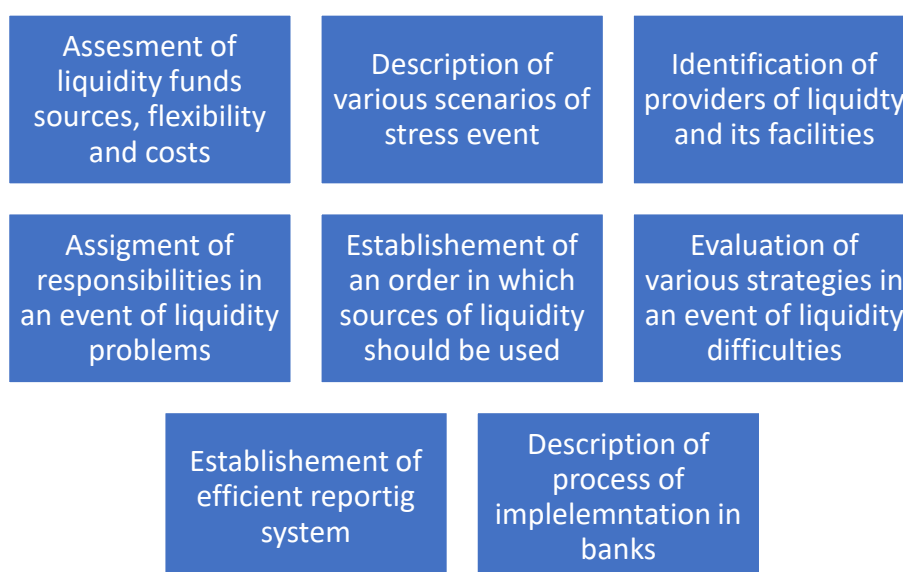


Figure 3 Functions of contingency funding plan, Source: (Scannella, 2016)

The original Basel III from December 2010 consists of two requirements regarding minimum liquidity that were designed to measure and monitor short- and long-term liquidity; LCR and NSFR standards (Bouwman, 2013), (Dziwok, 2015).

### **3.3. LCR standard**

The first indicator is called liquidity coverage ratio (LCR) and is concerned with the resilience of banks in the short run. It examines the banks' ability to survive one-month stress test scenario by using their liquid assets of high quality.

The liquidity coverage ratio requirement specifies that the stock of high-quality liquid assets should at least equal or exceed banks net cash outflow (NCOF) projection for the period of 30 days: (Bank for International Settlements, 2010).

High quality liquid assets are the assets that have a high probability of being converted quickly and easily into cash. High quality liquid assets include assets of Level 1 such as: cash, marketable securities which are backed by central banks as well as central banks reserves and Level 2A assets such as: particular government securities corporate debt securities as well as covered bond and Level 2B assets such as plain vanilla bonds (lower rated assets) and certain residential mortgage-backed securities. The regulation required that the assets of Level 2 (which are of lower liquidity than Level 1) cannot account for more than 40% of the bank's total HQLA and the Level 2B cannot be more than 15% of total HQLA stock (Bank for International Settlements, 2013). It is important to mention that when calculating LCR ratio, assets of level 1 are not discounted, assets of 2A level have 15% discount rate and 2B are discounted by 50%. The NCOF that is the denominator is calculated by deducting regulatory calculated expected inflow of cash from the total regulatory calculated expected outflow. When predicting inflows of cash, only those inflows from outstanding exposures that are performing fully and there is no expectation of default within the period of next 30 days should be included. It is important to acknowledge that there is a cap on expected inflow at 75% of expected outflows in order to prevent banks to rely only on

expected inflows to meet the required ratio level. Consequently, the banks are required to have High Quality Liquid Assets at the amount that equals minimum 25% of outflows (Bank for International Settlements, 2013). In order to calculate cash outflows outstanding liabilities and other commitments that are off-balance sheet need to be multiplied by the rate at which it is anticipated they will be drawn or run off in the stress scenario. In case of retail deposits run-off rates will differ depending on whether the deposits are considered stable (that is fully insured) or less stable. In case of stable deposits, the run-off rate is 3% or higher and in case of less stable deposits the rate is at least 10%. In case of unsecured wholesale funding the run-off rates are as follows. Funding that is provided by small business customers the rates are 5% then 10% and higher, in case of deposits that are generated by custody or clearing activities the run-off rate is 25% and the run-off rate for the deposits in cooperative banks network can be either 25% or 100% (Bank for International Settlements, 2013). For unsecured funding from non-financial corporates and sovereigns, PSEs, and central banks the rate can be either 20% or 40% and for unsecured funding from customers of legal entity the run-off rate is 100%. In order to maintain HQLA holdings on minimum required level total cash inflows must amount for at least 75% of expected cash outflows (Bank for International Settlements, 2013).

The LCR standard was gradually implemented in EU banks, in 2014 and 2015 the banks were required to maintain this ratio at 60 %, the requirement increased to 70% in 2016 and to 80% in 2017 and since 2018 banks are obliged to maintain the ratio of 100%.

### **3.4. NSFR standard**

The second ratio is referred to as net stable funding ratio (NSFR), as is concerned with promoting long-run resilience (Bank for International Settlements, 2010). The purpose of this ratio is for the banks to be able to survive longer period of wholesale funding markets closure as it creates initiatives to use higher portion of stable funding sources among banks (Bouwman, 2013). The reason behind introduction of this ratio is the fact that banks themselves do not have initiative to reduce high use of unstable funding sources. According to this requirements banks should be able to operate and survive with minimum level of

“stable funding” which is based on the liquidity levels of assets of specific banks. According to NBP (2018) the main purpose of introducing of the NSFR standard the European Union is to increase the use of stable funding sources and consequently mitigating the risk of funding.

Weights to balance sheet items are issued in the following way:

*Assets:* assigned weights depend on the following: maturity credit quality as well as liquidity profile.

*Liabilities:* assigned weights depend on their stability.

The NSFR ratio entails that available stable funding (ASF) of a bank must exceed the required amount of stable funding (RSF) which is calculated based on liquidity of assets as well as banks’ activities during the stress scenario that lasts for one year (Bank for International Settlements, 2010).

:

Stable funding consists of equity, liabilities and preferred stock with maturities of more than one year and various types of deposits with maturities shorter than one year.

The nominator (ASF) is established by assigning weight to the banks’ stable funding. Total value of bank’s ASF is part of its total capital and liabilities that is expected to stay with a bank for more than a year. ASF is determined based on the types of funding sources of a bank and their stability. Therefore, for example ASF factor of 100% is assigned to a funding source that is anticipated that will remain entirely available for the period longer than 1 year. On the other hand, ASF of 0% indicates that the funding source is completely not reliable.

The denominator (RSF) is the sum of assets as well as off-balance sheet activities multiplied by the RSF factor that is assigned to each particular type of assets or off-balance sheet activity. For instance, more liquid activities are assigned to lower factor of RCF as they require lower level of stable funding (Bank for International Settlements, 2013). For instance, a weight of 0% is assigned of cash as it is the asset with the highest possible liquidity. On the other hand, loans to corporates or central banks receive the weight of 50% and mortgages with certain risk weight are assigned the weight of 65%. Customers loans with maturity shorter than a year receive the weight as high as 85%.

### **3.5. Criticism of Basel III**

First of all, there are some drawbacks of both ratios. In case of LCR ratio the main issue is that it does not take into account differences and characteristics of different countries (Yar ,2019). LCR does not take into account banks' specifics which makes the indicator transparent but it also results in less reliable estimations. What is more, the formula is very simplified therefore it is impossible to be certain whether this "stress test" can really identify all possible problems with short-term liquidity. In case of NSFR the main issue is that the period of "stress test" was established to be one year. What is more, banks are against these new stricter regulations brought up by the Basel Committee (Yar ,2019. According to them, the new Basel recommendations are too strict and they will disturb effective functioning of banks making them less profitable and making it harder for the economy to access the funding and therefore limiting the economic growth (Malecki, 2014). Contrary to that opinion, some economists argue that the reforms proposed by Basel III are not radical enough and do not try to change defective structure of the banking sector. Namely, while the risk of banks bankruptcy is bared by public (as banks are regarded as "too big to fail"), their profits are private (Dziwok, 2015). According to these economists, without resolving this basic issue, it will not be possible to reduce the systemic risk of the banking sector.

## 4. Polish Context

In this chapter relevant information about Polish economy and Polish banking sector will be presented. Firstly, information about banking industry as well as macroeconomic conditions of recent period in Poland will be presented. Furthermore, the condition of banking sector in Poland after the global financial crisis will be described. Succeeding paragraph will be concerned with the methods of liquidity risk management in Poland and the comparison of these methods to the liquidity recommendations introduced by the Basel Committee.

### 4.1. Banking sector in Poland

Banking sector of Poland is one of the largest in the CEE area with strong own capital base of 209 billion PLN and improved capital indicators (KNF, 2018). In June 2018 Polish banking system consisted of 64 commercial banks, 14 of them with majority of domestic capital and 50 with majority of foreign capital as well as 550 cooperative banks (Stat.gov, 2018). Macro-prudential supervision in Poland lies within the scope of responsibility of the Financial Stability Committee (Komitet Stabilności Finansowej) consisting of Polish National Central Bank (Narodowy Bank Polski (NBP), the BFG (Bankowy Fundusz Gwarancyjny), Ministry of Finance and Financial System Authority (Komisja Nadzoru Finansowego, KNF) (EBF, 2018). The KNF has the responsibility of supervision and governance of the financial market. The Authority supervises the Polish banking sector, insurance market, capital market as well as all other types of finance related institutions (KNF, 2017).

Banking system in Poland is characterized by good capitalization as well as low level of financial leverage what translates into relatively strong resilience of banks (NBP, 2018). According to National Bank of Poland (NBP, 2018) the threats to stability of financial system in Poland are mainly external as uncertainty of economies linked economically to Poland can supposedly result in negative economic shocks and consequently slow down economic growth of the country. The condition of Polish economy is also strongly interconnected and influenced by the situation in the European Union. Structural characteristics of Polish financial system are conducive to its stability. It is believed that the risk of contagion in an event of financial distress of individual institutions is small due to limited interdependence of



various institutions. Cooperative banks sector is characterized by stability however it faces number of short as well as long term challenges. In most cases cooperative banks meet regulatory capital and liquidity requirements. Nevertheless, low effectiveness of business model result in limited profitability and low potential for long-term growth.

Economic growth in Poland in the first half of 2018 was at the high level of 5.2%. Main source of the economic growth was consumption demand which was supported by growing employment and salaries as well as growing customer confidence (NBP, 2018).

#### **4.2. Financial crisis of 2007-2009 in Poland**

As significant part of this study will be concerned with the period of and after the recent global financial crisis until last year therefore it is important to describe how Polish economy and banking sector have been affected by the crisis.

According to Strojwas (2010) in the years prior to the financial crisis activities of banking sector in Poland were focused mainly domestically therefore contagion of poor performing economies of different countries was limited. This was believed to be the main factor that allowed Poland to be the only European Union country that managed to avoid recession. The relatively good performance of Polish economy during the crisis also demonstrates the fact that none of the banks required help with the capitalization and most importantly none of the went bankrupt (Kruszka and Godziszewski, 2013). According to Borowiec (2013) during and after the crisis level of defaulted loans increased only by small amount as the loans and mortgages were only granted to credit worthy costumers as the credit verification process was strict and allowed to reject those applicants, that were likely to default. Despite the resilience of banks during these difficult times Polish economy did suffer from the crisis. The unemployment level rose significantly and there was much slower growth in economic activity compared to the years prior to the financial crisis (Kruszka and Godziszewski, 2013).

#### **4.3. Methods of liquidity risk management in Poland**

Banks in Poland are obliged to maintain financial liquidity to the level appropriate to their size and type of activity they perform (Prawo bankowe, § Nr 140). In order to achieve that

liquidity, they must comply with applicable regulations in regard to liquidity management with consideration of the influence of market conditions (KNF, 2007). According to KNF (2002) liquidity of banks can be described as ability of banks to meet their financial obligations on time and to obtain funding to finance unexpected deposit outflows. KNF (2002) distinguished five types of liquidity: instant liquidity (refers to the period of one day), current liquidity (period up to 7 days), short-term liquidity (period up to 30 days, medium-term liquidity (1-3 months) and long – term liquidity (3 months up to a year). Polish banking system has been using tools to monitor liquidity of particular financial institutions long before Basel III recommendations have been introduced. Polish Financial System Authority has issued separate legal act which describes the current liquidity indicators which must be at a certain level. These liquidity indicators have been introduced by the Polish Financial System Authority in June 2007 and have been in force since 2008 (Dziwok, 2015). Indicators give the information on how liabilities are covered with analogous in regards to maturity assets as well as the extent to which own funds minus capital requirements cover illiquid assets (Pietryka, 2016). The table below presents the description of types of assets and liabilities that are used to calculate the liquidity indicators

	<b>Assets</b>		<b>Liabilities</b>
A1	Primary liquidity reserves -used to secure the Bank's liquidity in the horizon of up to 7 days, allowing to generate liquidity at the expected price without deteriorating the market situation	P1	own funds less capital requirements for market risk, counterparty risk and delivery settlement
A2	Secondary liquidity reserves - securing the Bank's liquidity in time horizon between 7 to 30 days.	P2	External stable funds
A3	Other transactions concluded on the wholesale financial market	P3	Other liabilities on the wholesale financial market

A4	Assets with limited liquidity	P4	Other liabilities
A5	Illiquid assets	P5	External unstable funds

Table 8 Assets and liabilities types for calculation of the liquidity indicators, Source: (Pietryka, 2018)

Banks in Poland measure, monitor and report indicator of liquidity gap and various regulatory measures such as M2, M3 and M4 (Koleśnik, 2014). Mentioned liquidity gap indicator, which relates to short term liquidity, takes into account possibility crisis scenario occurrence such as for example excessive deposit outflows or inability to liquidate some of the assets as a result of external crisis (Dziwok, 2015). Liquidity gap should not be lower than zero (Pietryka, 2016). Other measures that has been in place since 2008 relate to short term liquidity (M2) as well as long term liquidity (M3 and M4). It is important to acknowledge that these liquidity risk standards in Poland did not constitute the implementation of any legal act of the European Union (Koleśnik, 2014). The table below presents liquidity indicators used by Polish banks since 2008 with the methods of their calculation. Items A and P presented in the formulas in the table below stand for real accounting values and their method of calculation was presented in table 9 above.

Liquidity indicator	Way of calculation	Minimum value
<b>Short-term liquidity</b>		
Liquidity gap (M1)	$(A1+A2)-P5$	0
Short-term liquidity indicator (M2)	$(A1+A2)/P5$	1
<b>Long-term liquidity</b>		
the ratio of coverage of illiquid assets with own funds (M3)	$P1/P5$	1
the ratio of coverage of illiquid assets and assets with limited liquidity with own funds and unstable external funds (M4)	$(P1+P2)/(A5+A4)$	1

Table 9 Methods of calculations of liquidity indicators, Source (Pietryka, 2016)

Polish liquidity regulations oblige Polish banks to manage liquidity risk in a way to ensure instant liquidity, current liquidity short-term liquidity, medium-term liquidity, long – term liquidity. (Koleśnik, 2014). These indicators differ depending on the size of a bank.

#### **4.3.1. Comparison of Polish liquidity indicators with Basel III**

Basel Committee as a result of the serious consequences of the recent global financial crisis, in the third stage of regulatory framework, introduced indicators allowing to measure the liquidity of financial institutions; LCR and NSFR ratios (Dziwok, 2015). These indicators have been detailly described in the chapters 3.3 and 3.4 of this paper. Until the LCR and NSFR requirements were in force, countries were allowed to use their own regulations in regards to financial institutions' liquidity of assets.

The first indicator LCR is the equivalent of mentioned earlier indicator M2 that has been used in Poland for over 10 years now (Dziwok, 2015). The table below presents the comparison made by Dziwok (2015) of LCR and the Polish equivalent of the ratio.

	<b>LCR</b>	<b>M2</b>
Scope of security	Given percentage of financing sources regarded as unstable should be covered by liquid assets	All financing sources that are regarded unstable should be covered with basic and additional liquidity reserve
Secured liabilities	Defined unstable liabilities	Possibility of own interpretation
Advantages	Transparency	Takes into account bank's and market's specifics
Disadvantages	Does not take into account bank's and market's specifics	Application of individual models makes comparison difficult or even impossible

*Table 10 Comparison of LCR and M2 indicators, Retrieved from (Dziwok, 2015) and (Koleśnik, 2014)*

Second indicator recommended by the Basel Committee is Net Stable Funding Ratio (NSFR). In Poland, banks used M3/M4 indicators which are the equivalent of NSFR. The table below presents comparison made by Dziwok (2015) of these indicators:

	<b>NSFR</b>	<b>M3/M4</b>
In force	Since 2018	Since July 2008
Scope of security	Focuses on maturity of assets and assignees to them parameters of stable funding coverage	All the assets should be covered with stable funding or own funds
Secured Liabilities	assigned weights for liabilities with maturities up to 1 year	Internal model of level of stable funding, accepted by the supervisory board
Advantages	Stable sources of funding account for 76-85% of assets requiring financing	Takes into account liquidity characteristic of a bank and market (consumer behaviour)

*Table 11 Comparison of NSFR and M3/M4 indicators, Source: (Dziwok, 2015) and (Koleśnik, 2014).*

In addition to the indicators as a part of liquidity management banks in Poland since 2007 are obliged to introduce following risk management procedures:

- Procedures to manage payment liquidity with clear assignment of competences and responsibilities
- Methods of identification, measurement and monitoring of payment liquidity
- Emergency planning to ensure undisturbed functioning with regards to maintaining payment liquidity in an event of emergency situations (Koleśnik, 2014).

## 5. Methodology

### 5.1. Source and type of data

This thesis was based solely on the secondary data, which is a type of data that has been already obtained in previous researches or published in another studies. The main reason for the choice of the secondary data over primary data is the feasibility and practicality of this method (Hammond & Wellington, 2013). Primary data is a type of data that is collected by the researcher themselves, what would not be possible for the type of data required in this study.

The main source of data for this thesis were “Financial Stability Reports”, or more precisely, the supplementary excel data spreadsheets that were additions to these reports, of the years from 2005 until 2018 published by the National Bank of Poland. This source of data is regarded to be reliable, accurate and sufficient for this type of analysis. Another great advantage of using the reports of national institutions is that they are easily available. Additional source of data were other types of data available at the National Bank of Poland website, such as data regarding inflation. In addition, data in respect to unemployment was obtained from Central Statistical Office of Poland website.

The initial intention was to gather the required information from the annual financial reports of individual commercial banks. However, after going through their reports and collecting the data I came to the conclusion that the information that was available is not sufficient to perform any analysis as different banks presented different types of information, some of them did not present the data needed for this analysis, for some of them types of data published was different every year etc. This inconsistency of reporting made it impossible to make any valuable conclusion on the data that was available.

Due to the nature of this thesis, only quantitative data will be used. The biggest advantage of using quantitative type of information is that it allows for precise comparison and analysis of data as well as for more objective results of the analysis, than it would be in case of using

qualitative data. However, the main reason for using the quantitative data is that what is being researched in this thesis could hardly be measured qualitatively.

## **5.2. Methods of data analysis and presentation**

Once the relevant data has been collected it is important to present and analyses it in a way that will give the most accurate and meaningful results. Data for the funding gap analysis as well as liquidity ratios analysis is presented in the graphs presenting changes over years in different liquidity measures. The visualization of information allows for a better understanding of it. For each presented set of information analysis and discussion is also presented. The last part of the analysis relates to the linear regression analysis between certain macroeconomic factors and funding gap. This method was used because modelling of past relationship can help to predict future behaviour (Seltmam, 2018). For instance, by understanding to what extent changes in inflation resulted in Funding Gap variations and having the inflation estimation it could be possible to predict Funding Gap (which is a measure of liquidity risk) in the next few years. Therefore, understanding this relationship can be used to estimate future liquidity risk of banks just by looking at the unemployment or inflation estimation. The p value (significance level) for this analysis has been set at the level of 0.05, therefore if the p value obtained in this analysis will be lower than this value  $p \leq 0.05$ , the result is regarded to be significant and if the p value be higher than 0.05 result will be rejected and regarded as not significant.

## **5.3. Limitations of the thesis**

One of the limitations of this thesis is that it uses for the analysis already existing measures and indicators of liquidity. The problem with this approach is that it may not capture the whole picture regarding the liquidity situations of the Polish banking industry. Although these indicators measure both short as well as long term liquidity, there might be some loop hole in this approach that may result in inability to identify problems with liquidity. Such potential faulty of these indicators is most likely to be discovered when liquidity problems arise despite indicators meeting the required standard. Further limitation is the fact that National Bank of Poland published the data based on the information banks provided

themselves, therefore there exists a threat that the numbers may differ from the actual values. Banks might be tempted to overestimate their liquidity positions; however, this scenario is rather unlikely.



## 6. Analysis and results

### 6.1. Funding gap analysis - Liquidity funding risk of the period before and after the Global Financial Crisis

As the regulatory liquidity measures (M1, M2, M3, M4) were introduced after the crisis it is not possible to compare liquidity risk from before 2007 with the use of such tools. However, since a few years before the crisis National Bank of Poland was publishing information regarding the funding gap of the Polish banking sector. Funding gap is believed to be a good indicator of liquidity funding risk and will allow for comparison of the liquidity risk of the period before and after the crisis. Negative funding gap indicates that loans granted have been fully financed by domestic deposits, positive value on the other hand, indicates that some portion of the extended loans has been financed with financial market sources of funding (NBP, 2007). The higher the funding gap, the higher perceived liquidity risk of banking sector. More detailed definition of funding gap was presented in chapter 2.2.2 of this Thesis. The figure 4 below represents changes in funding gap in years from 2003 until 2018.



Figure 4 Funding Gap of commercial banks in Poland in years 2003-2018, Source: own work based on data from Financial Stability Reports' and supplementary excel spreadsheets with data of National Bank of Poland available at <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>

#### 6.1.1. Years from 2003 to 2006

As presented on the above figure 4, funding gap of commercial banks sector in Poland was clearly negative until the year 2007, when it reached 1.11%. The negative gap that was

persistent in years from 2003 until the end of 2006 indicated that domestic lending was fully financed with domestic deposits and there was no need for other, less stable and more expensive sources of funding such as interbank lending. Therefore, it can be assumed that the liquidity position of the Polish banking sector prior to the financial crisis was favorable. This finding can explain the fact mentioned in the chapter 4.2 of this paper, that Polish banks during the crisis avoided liquidity problems. It can be assumed that stable liquidity position of Polish banks helped them to avoid liquidity difficulties related to the major and severe liquidity crisis on the global financial market that started in August of 2007.

### **6.1.2. Period of the Global Financial Crisis 2007 - 2008**

In 2007 the sector of Polish commercial banks experienced significant increase in the average funding gap, which in that year was already positive. This significant increase in funding gap can be explained as a result of the increase in the number of long-term loans (e.g. housing loans) in that year (number of long-term loans increased according to Financial Stability Report of 2007). In 2008 the trend of rising funding gap has continued. The reason why in 2008 the trend of rising funding gap continued might be the fact that banks that were pressured to increase their loans to customers (NBP, 2008) and they were searching for a way to finance this lending activities. Banks “closed the funding gap” with increased interbank lending from both Polish and foreign banks as well as with securities issuance (for the graphical representations of the increase of interbank lending see Appendix C).

### **6.1.3. Years after the crisis 2009 - 2010**

In the years from 2009 to 2010 sector of commercial banks in Poland has experienced continuous decrease of funding gap. Due to the crisis on global financial market and related to it deterioration of rating of financial strength of Polish banks (see appendix A), it was more difficult and expensive for them to obtain financing on the financial market. Therefore, many of the banks started following deposit strategy (see appendix B) and tried to attract more customer deposits – what resulted in the decrease of the average funding gap. It needs to be acknowledged that there were banks that followed foreign funding strategy and the liquidity risk that they faced was significantly higher (see appendix B).

#### 6.1.4. Years from 2011 until 2018

In 2011, due to increasing trend of deposits and loans from foreign banks (see appendix D) funding gap increased. In 2012 and 2013 funding gap was steadily decreasing. The main reason for that favorable change was increase in growth rate of deposits of non-financial sector (see Appendix E), which from the definition of funding gap, decreased it. From 2014 until 2016 the funding gap continued to decrease, which can be again attributed to continuing increase in deposits of non-financial sector. The figure below represents the proportion of different funding sources of the banks in EU in 2014.

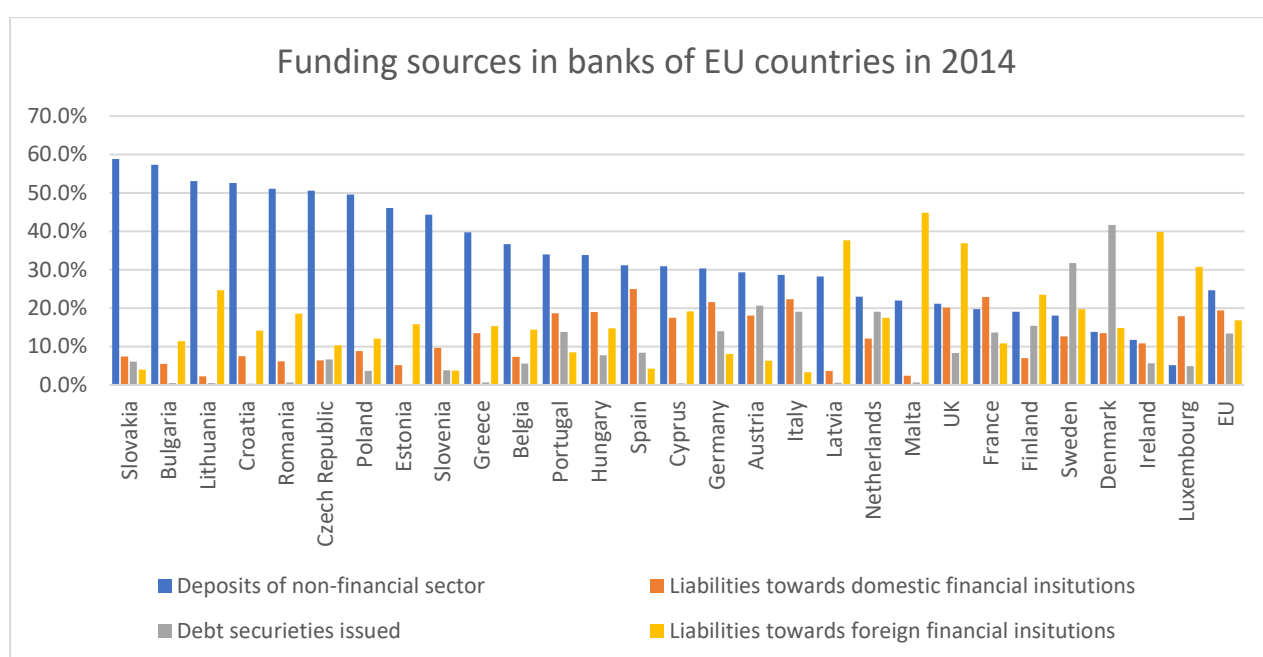


Figure 5 Funding sources in banks of EU countries in 2014, Source: Own graph based on the data from NBP (2015)

As it is evident from the figure 5 above that Polish banking sector in 2014 was 7<sup>th</sup> in the European Union in terms of portion of deposits of non-financial sector, which accounted for nearly almost 50% of all funding sources in that country.

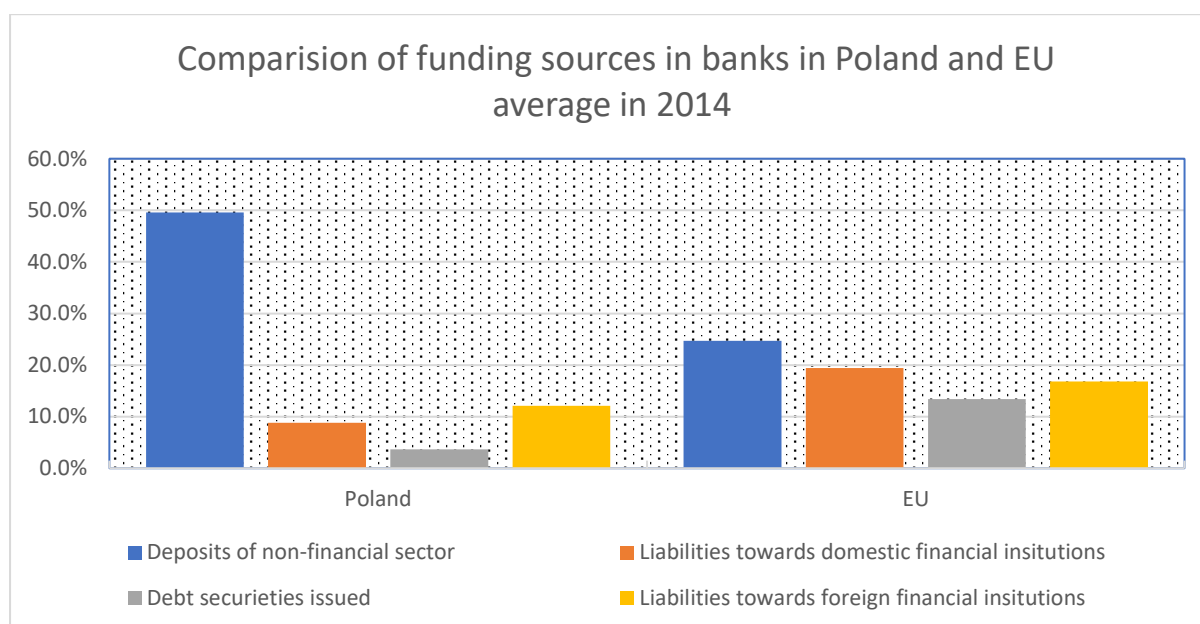


Figure 6 Comparison of funding sources in banks in Poland and EU average in 2014, Source: Own graph based on the data from NBP (2015)

Figure 6 above represents the comparison of funding sources of Polish banks to average of EU banks. It is evident from that figure that Polish banking sector in 2014 used more stable funding sources such as deposits or non-financial sector than banking sectors of other EU countries on average. Consequently, they needed less other, less stable sources of funding such as loans from domestic or foreign financial institutions. Therefore, it can be indicated that banks in Poland were on average more resilient to unfavorable conditions on foreign or domestic financial markets, therefore their funding liquidity risk was lower.

In 2017 and 2018 this trend reversed, the growth rate of deposits of non-financial sector decreased what consequently resulted in increase of funding gap (for the changes in growth rate of deposits see appendix F).

To summarize, despite the positive funding gap since the Global Financial Crisis, liquidity risk related to funding is considered limited and dependent on the stability of funding from the non-financial sector, which still is the major source of funding for commercial banks in Poland (see Appendix G)

#### **6.1.5. Possible issues with funding liquidity risk of Polish banks for the future**

Sector of commercial banks in Poland, despite the significant increase of funding gap when compared to the period prior to the financial crisis, is characterized by relatively stable liquidity position due to high share of highly fragmented households' deposits (see Appendix G). However, there exists a risk that the proportion of these stable deposit base will decrease due to low interest rates on deposits, which can discourage households from depositing money at banks and search for other, more profitable saving opportunities.

### **6.2. Analysis of liquidity risk based on the liquidity ratios**

As presented in the chapter 4.2 of this Thesis there exists a number of liquidity ratios that Polish commercial banks are obliged to comply with. Since 2008 banks in Poland were measuring and monitoring their short- and long-term liquidity with the use of four ratios (M1, M2, M3 and M4). In the recent years, with the new Basel accord, new regulatory measures have been introduced in addition to the ones that have been already in use. In this chapter, the liquidity position of Polish banks will be examined with the help of the ratios M2 and M4 for the period from 2008 until 2014 (due to limited availability of data for years after 2014) and LCR and NSFR ratios for the period since 2014 until 2018.

#### **6.2.1. Analysis of the M2 ratio**

The M2 liquidity measure has been in force in Poland since 2008. The method of its calculation is presented in the table 10 in chapter 4.2 of this paper. It is a measure of short-term liquidity and it requires from banks that all unstable funding sources should be covered with liquid assets. (Dziwok, 2015). The Figure 8 below represents the changes in M2 ratio level in years from 2008 until 2014.

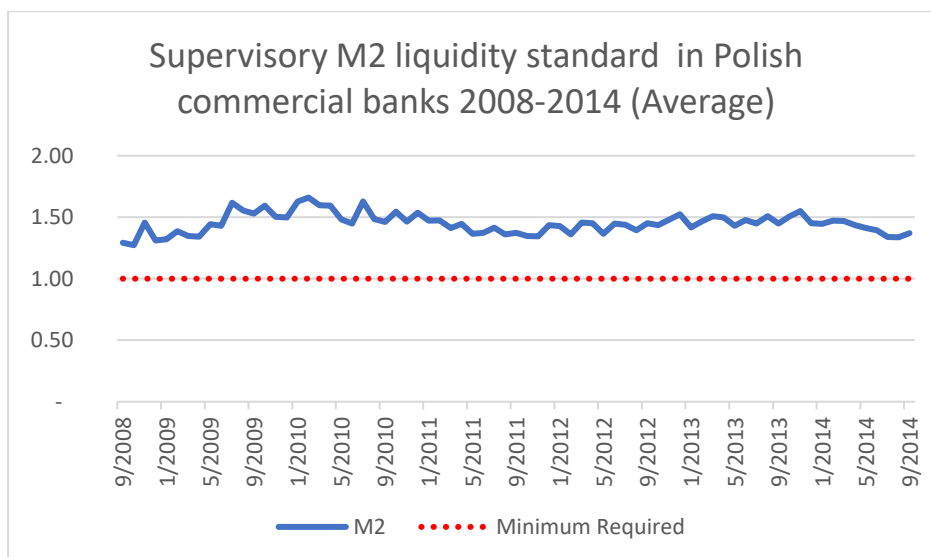


Figure 8 Source: Own work based on data from NBP (2011 and 2014)

As it is evident from the figure 8 Polish commercial banks were on average significantly exceeding the requirement in all of the periods of analysis that is since 2008 until 2014. This indicates that the short-term liquidity risk of commercial banks sector in Poland was limited as banks were holding enough liquid reserve to cover for all of the funding sources that were regarded unstable.

### 6.2.2. Analysis of the M4 ratio

The M4 measure of liquidity, similarly as M2, has been in force in Poland since 2008. M4 ratio measures long-term liquidity. The way of calculation of this ratio is presented in table 10 of chapter 4.2 of this paper. M4 ratio indicates what portion of illiquid assets and assets with limited liquidity is covered with both own funds as well as unstable external funds (Dziwok, 2015). Banks in order to meet the M4 standard are obliged to maintain this ratio at the level of at least 1 what translates into the situation when all illiquid or limited liquidity assets are covered with own and external funds. As presented on the figure 19 below, banks in Poland on average were meeting the required standard therefore indicating the long-term resilience of the banking sector in regards to liquidity.

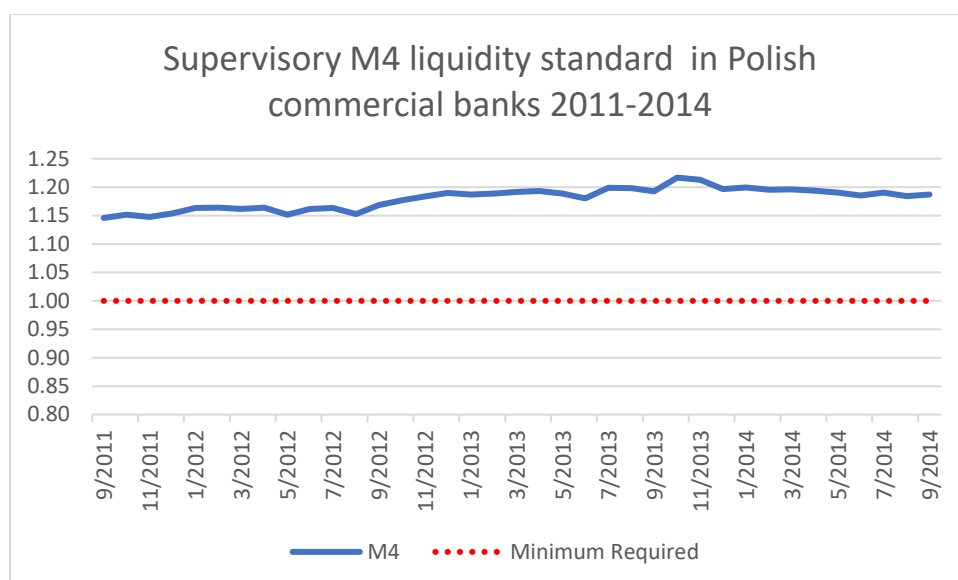


Figure 9 Source: Own work based on data from NBP ( 2014)

### 6.2.1. LCR Ratio

The Liquidity Coverage Ratio standard, which is a measure of short-term liquidity, specifies and requires from banks that the 30 days projection of net cash outflow (NCOF) should be covered with liquid assets of high quality (Dziwok, 2015). In order to meet the requirement of the first Indicator, banks must hold sufficient level of high-quality assets in a way that LCR (Liquidity Coverage Ratio) exceeds 100%, which is the required minimum. As a consequence, banks meeting the requirement are believed to cover 30 days' worth of liabilities in the event of the crisis. In Europe, there was a transition period which lasted from 2015 to 2018 which gradually prepared banks to meet the criterium (Dziwok, 2015). The method of calculation of was detailly explained in chapter 3.3. of this Thesis. The ratio tells what portion of projected cash outflow of one month is covered with high quality assets.

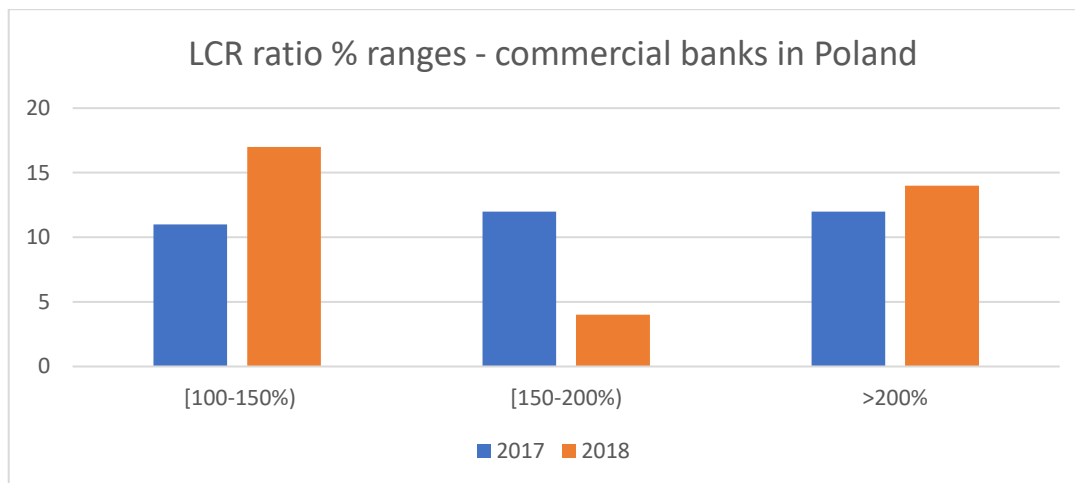


Figure 10 LCR ratio ranges of commercial banks in Poland 2017 and 2018, Source: Own work based on data from NBP (2018).

From the figure 10 it is evident that all commercial banks in Poland in 2017 and 2018 not only met the requirement but some of them even exceeded and achieved double the required ratio. This finding indicates that commercial banks in Poland hold sufficient stock of high liquid assets and that the short-term liquidity risk is very much limited.

### 6.2.2. NSFR ratio

The detailed description of Net Stable Funding Ratio was presented in chapters 3.2.2. and 4.2 of this paper. Just to explain it briefly, the aim of introduction of this ratio is to make sure banks maintain sufficient portion of stable funding in order to survive longer period of distress on financial markets (Bouwman, 2013). This chapter will present NSFR ratios level that were achieved by different types of commercial banks in Poland and whether they met the required minimum in the years since the standard has been introduced that is since 2015 until 2018.



The figure 5 below presents the minimum and medium NSFR ratio of universal banks in years 2015 – 2018.

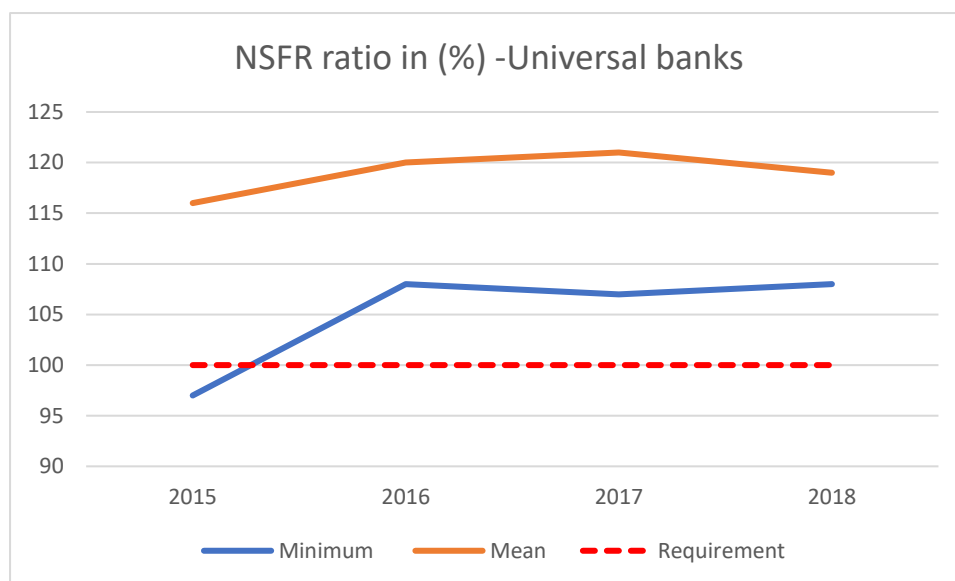


Figure 11 NSFR ratio in (%) -Universal banks 2015-2018, Source: Own work based on data from NBP (2018)

From the Figure 11 above it is evident that in 2015 minimum required was not met by all of the universal banks, however the average in the universal banks sector was significantly above the required level (around 116%). Since 2016 all of the universal banks in Poland were meeting the NSFR standard therefore it can be assumed that the long term liquidity position of these banks was favorable from the perspective of Basel recommendations.

The figure 12 also presents the minimum and medium NSFR ratio but for specialist banks.in years 2015 – 2018

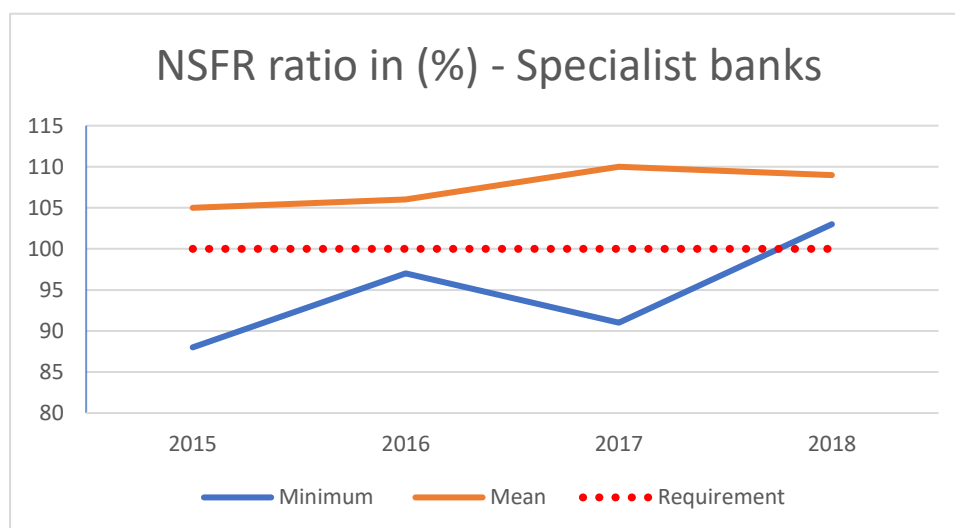


Figure 12 NSFR ratio in (%) -Specialist banks 2015-2018, Source: Own work based on data from NBP (2018)

From the figure 12 it is evident that until 2017 not all of the specialized banks met the required minimum, however the average was between 105-110%, therefore the average exceeded the minimum required. Minimum value below the required level in years from 2015 until 2017 suggests that the portion of stable funding sources in some of the specialist banks was not sufficient in respect to the liquidity of assets the banks were holding. In 2018 all specialist banks had the level of NSFR ratio above the required standard. This indicates that the long-term liquidity position from the perspective of Basel recommendations has improved in 2018 compared to previous years.

The figure 7 represents the minimum and medium NSFR ratio of mortgage banks.

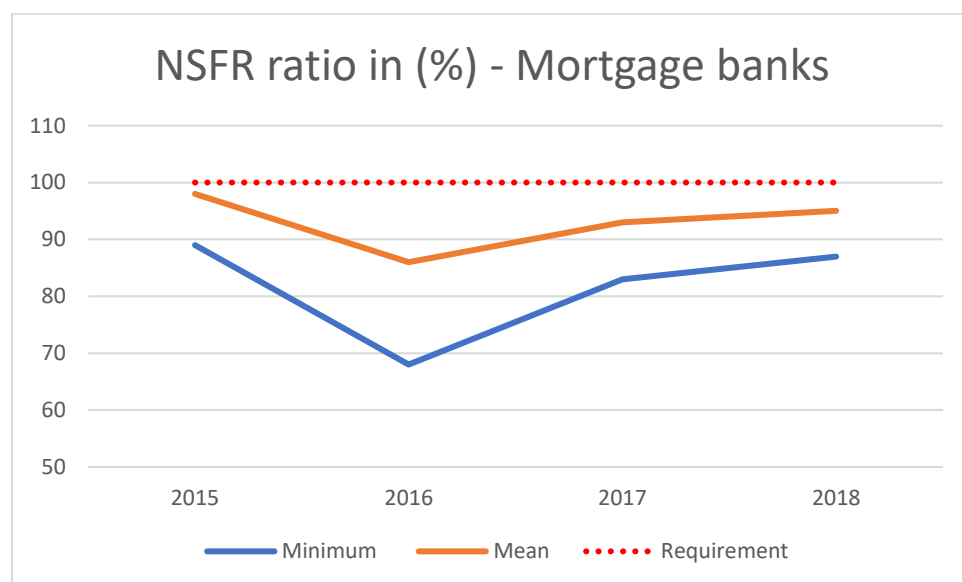


Figure 7 NSFR ratio in (%) -Specialist banks 2015-2018, Source: Own work based on data from NBP (2018)

From the figure 10 we can see that mortgage banks in Poland did not meet the required NSFR standard both in terms of minimum and average in all the years since the standard was introduced. However, it needs to be noted that the way NSFR is calculated does not take into account the nature of activities mortgage banks. Mortgage banks due to the nature of their business have very high ratio of housing loans with covered bonds to which RSF weight of 1 is assigned. This in turns leads to very high requirement of ASF (Available Stable Funding) making it very difficult for mortgage banks to meet the NSFR standard (NBP, 2018)

Therefore, despite the fact that mortgage banks do not meet the standard, this may not

actually indicate unfavorable liquidity position of these banks but rather inadequate measurement methods to the type of activities these banks perform.

### **6.2.3. Summary of liquidity ratios analysis and discussion**

Firstly, short- and long-term liquidity of commercial banks in years 2008 until 2014 was examined by the analysis of the level of M2 and M4 ratios. The finding was that the banks significantly exceeded the required standard therefore indicating liquidity reliance of commercial banking sector. However, it needs to be acknowledged that these measures are relatively simple ratios that only represent certain aspects of liquidity and may detect liquidity problems of bank. What is more, in case of M2 and M4 ratios, only data that was available was of average ratio of the whole commercial banking sector, therefore it made it impossible to identify whether there were cases of particular banks that did not meet the requirements and posed the risk to the liquidity of the whole banking sector.

In regards to LCR ratio all of the banks met the requirements indicating strong short-term liquidity position of the banks. It needs to be noted however, that the ratio is only simplified “stress test” and does not take into account specifics of banks. Therefore it might be the case that some of the banks that managed to achieve the required ratio may in fact face short term liquidity risk. In case of NSFR ratio both minimum and average values were analyzed. The main finding of this analysis was that in years before 2018 not all of the banks met the requirement suggesting poor liquidity position of some of the commercial banks. However, it needs to be noted that the standard is very new and in force only since 2018, therefore the data for the years prior to 2018 is only indicative as the banks were in the process of adoption of the standard. This assumption is confirmed by the evident improvement of NSFR ratio

level in all types of the commercial banks in 2018, the year in which the standard was actually in force.

**Appendix H** presents all the available ratios for particular commercial banks, the data was collected from their annual financial reports, however due to very limited availability of data it could not be used in this analysis.

### **6.3. Impact of certain macroeconomic factors on liquidity risk**

#### **6.3.1. Regression analysis of unemployment level and funding gap**

According to the presented literature regarding the factors influencing liquidity of banks (suchapter 2.3.3.1), rise in unemployment should result in less disposable income and decrease in costumers' deposits. From the definition of funding gap presented earlier in this Thesis decrease in costumers' deposits, other variables being constant, result in increase in funding gap. Therefore, increase in unemployment should logically lead to increase in funding gap. In order to measure this relationship, the linear regression analysis has been performed on the data of unemployment and Funding gap in years from 2003 until 2018. Linear regression line is the graphical representation of equation in the following form

$$Y_t = \alpha + \beta X_t + \epsilon_t$$

where X represents the explanatory variable (in this case unemployment) and Y represents the dependent variable, which in case of this analysis is Funding Gap and  $\epsilon_t$  in an error term (Seltmam, 2018). This linear regression measures what part of variations in Funding Gap is explained by the changes in unemployment. The p value for this analysis was 0.000432, which is below the significance level preset in the methodology part of this research (the p value was preset at 0.05) therefore indicating the result is significant and unemployment can be regarded as significant predictor of Funding Gap. Therefore the model is regarded to fit the data well. The table below represents the additional regression statistics of performed linear regression analysis.

<i>Regression Statistics</i>	
Multiple R	0.774055369
R Square	0.599161715
Adjusted R Square	0.570530409
Standard Error	0.120415527
Observations	16

Table 12 Regression Statistics – unemployment level and funding gap, Source: Own work

*Multiple R* presented in the table above represents the correlation coefficient. It indicates how strong is the linear relationship between funding gap and unemployment. Value of 1 would indicate perfect relationship and zero on the other hand would indicate no relationship at all (Seltman, 2018). Therefore, value of 0.77 indicates that the relationship between these two variables is strong. *R square* is so called coefficient of determination, and the value of 0.59 indicates that 59% of the variations in funding gap is explained by the unemployment variable. The figure 14 below is the graphical representation of the linear regression.

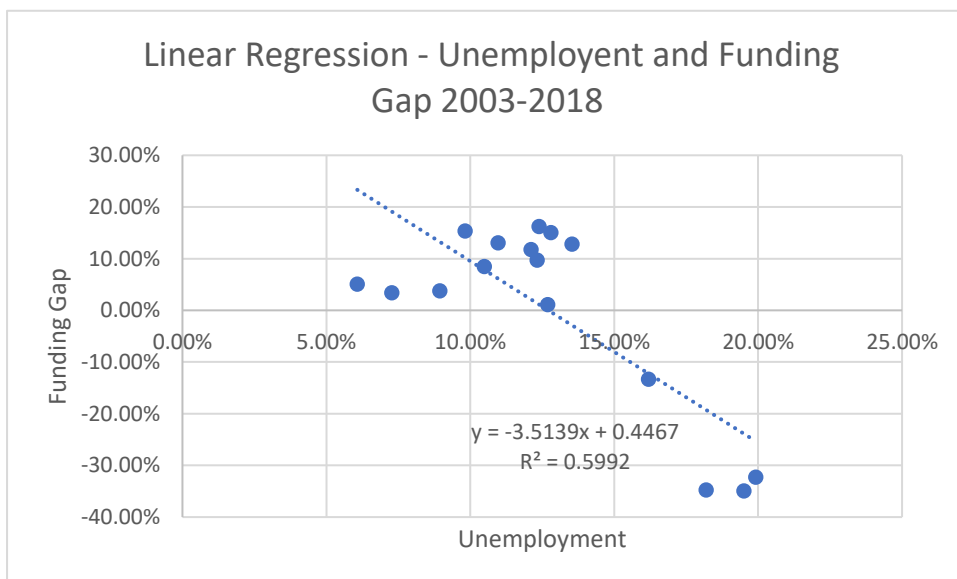


Figure 14 Linear regression between Unemployment and Funding Gap in Poland 2003-2018, Source: Own calculations based on data from NBP and Stat.gov (2018)

The linear equation is as follows

$$y = -3.5139x + 0.4467$$

where y is Funding Gap and x represent unemployment. The slope of the regression is negative (-3.51) what indicates that the funding gap decreases as unemployment increases.

Value 0.4467 in the equation is intercept, which is value funding gap when unemployment equals 0. The length of the distances of the blue data points from the line are referred to as “error terms” ( $\epsilon_t$  In equation), such errors exists due to the fact that explanatory variables can never predict dependent variables perfectly.

This finding is in contradiction with the findings from the previous research. Even though the relationship has been found to be significant between these two variables, it was found to be negative, which is the opposite of what was anticipated based on the literature review. The main possible explanation for this contractionary result is that there are many other factors influencing funding gap (such as interests’ rates on deposits, costs of obtaining funding in financial markets, funding strategy of banks, inflation or GDP growth) that could have influenced Funding Gap in another way. Another possible explanation for the different result from the previous research is that the previous studies were performed in different countries with different characteristics and the result presented in this Thesis only explains what is the relationship of these two factors in Polish banking sector, thus the difference in result.

### **6.3.2. The linear regression analysis between funding gap and inflation**

According to the reviewed literature review increase in level of prices in the economy (inflation) should result in increased funding gap of banks (the full explanation of this relationship is presented in the table 6 of the chapter 2.3.3.1 of this Thesis) .Due to increase in prices costumers would require more money to pay for the same products therefore that should lead to increase in lending, and other variables being constant, consequently increase in funding gap. In order to evaluate how the changes in inflation (explanatory variable) resulted in variations of funding gap (dependent variable) the linear regression analysis has been performed. Before presenting the results, it is important to note that the p value of this analysis was 0.68, which is higher than preset significance level thefore indicating that the model did not fit the data well and result cannot be regarded as significant. The results therefore should be rejected. The table 13 below presents the regression statistics of performed analysis.

Regression Statistics	
Multiple R	0.105042053
R Square	0.011033833
Adjusted R Square	-0.059606608
Standard Error	0.189142275
Observations	16

Table 13 Regression statistics inflation and funding gap, Source: Own work

Similarly, as in the previous analysis Multiple R represents the correlation between the two variables, the value of 0.105 indicates very weak correlation. Additionally, R Square value of 0.011 indicates that only 1.1% of variations in funding gap can be explained with the inflation.

The figure 15 below represents the linear regression of inflation and funding gap.

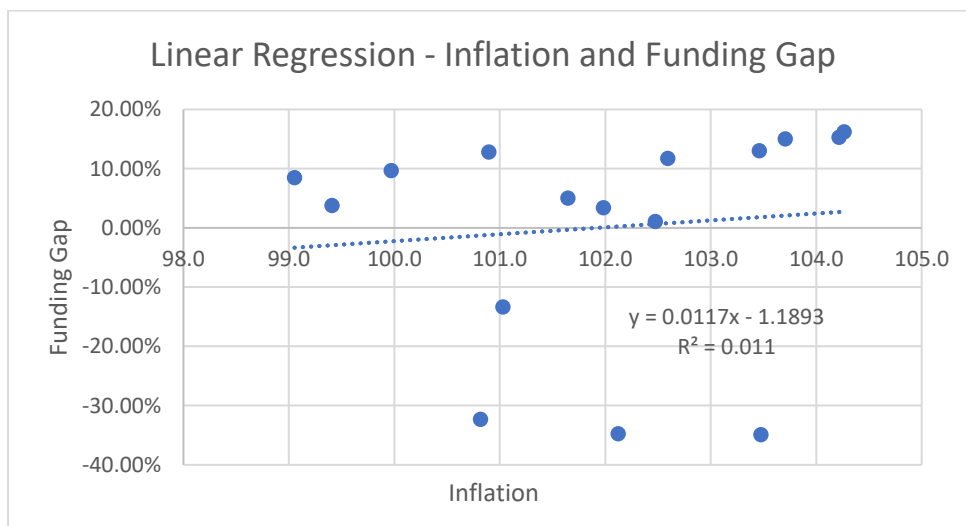


Figure 15 Correlation between Funding Gap of commercial banks and inflation in Poland 2003-2018, Source: Own calculation based on data from NBP (2018)

The equation of this linear regression is

$$y = 0.0117x - 1.1893,$$

similarly as in the previous case x is inflation (explanatory variable) and y represents Funding Gap (dependent variable). Positive slope is indicating that the increase in inflation results in increase in funding gap. However, the slope as well as the Multiple R variable is so small that is too insignificant to be able to make any valuable conclusion regarding the

relationship between these two variables. As mentioned earlier due to the p level being way above the present significance level, therefore the results are said to be insignificant.

### **6.3.3. Summary of linear regression analysis and discussion**

The purpose of performing linear regression analysis was to evaluate extent to which there exists a linear relationship between certain macroeconomic factor (unemployment or inflation) and Funding Gap and to examine whether those relationships are in line with that was stated in the previous researchers. Understanding these relationships is important as it can enable to forecast or predict the value of Funding Gap based on the predicted value of certain macroeconomic factor (unemployment and inflation). In case of unemployment and Funding Gap linear regression the p value was below the significance level indicating the result are significant. The relationship between these two was found to be strong, the value of Multiple R around 0.77, however the negative slope indicates negative correlation of these two variables. This finding means that increase in unemployment would result in decrease in a Funding Gap. This discovery can be useful for the future research for prediction of Funding Gap with the use of the data regarding expected unemployment in Poland. In the case of the second regression analysis that measured the linear relationship between inflation and Funding Gap, the p value was too high therefore the results had to be rejected.



## 7. Conclusion

This Thesis was concerned with the liquidity risk of Polish commercial banks. As defined earlier in this paper, there are two main definitions of liquidity: funding and market liquidity. Funding liquidity relates to the ability of banks to obtain funding and market liquidity to ease at which assets can be liquidated at the price that is close to their fundamental price.

According to Bouwman and Christa (2013) banks ensure liquidity in a number of ways: having sufficient liquid assets, being able to liquidate trading positions, holding deposits of retail and wholesale customers, being able to borrow funds at short notice and the last one borrowing from central bank. In very simple term, liquidity risk relates to the possibility that banks would not be able to meet their financial obligations on time (Marcinkowska, 2010).

The importance of liquidity risk management was understood after the severe consequences of the recent Global Financial Crisis, what prompted Basel Committee on Banking Supervision to introduce the new accord to help to monitor liquidity risk of banks. This Thesis presented all relevant concepts related to liquidity risk of the banking sector, relevance of banking regulations as well as methods and tools of liquidity banks regulations. The theoretical part has also presented various types of factors that influence risk of the banking sector as well as factors influencing specifically liquidity of banks. The 3<sup>rd</sup> chapter presented information about new Basel accord; the measures introduced by these standards as well as the possible issues related to using of these measures. Subsequent chapter presented all information about Poland that are believed to be relevant for this Thesis. Firstly, the information and Polish banking sector, its structure, functions and conditions were presented. Later subchapter explained the impact of the Global Financial Crisis on the Polish banking sector and Polish economy. Interesting conclusion of this chapter was that Poland was the only EU country that managed to avoid recession during and after the crisis, which is believed to be a result of prudent behavior and resilient banking sector (Strojwas, 2010). Finally, the regulatory liquidity measures used in Polish banks were presented with the detailed method of their calculation and meaning. The comparison of these measures to the ones introduced by the Basel Committee has also been presented.

The last chapter of this Thesis consisted of the analysis of liquidity risk with the help of various liquidity measures. Firstly, the changes in funding gap in the years from 2003 until 2018 was presented. The most important finding of this analysis was that before the Global Financial Crisis the funding gap was negative for many years, indicating strong liquidity position of the banks from the perspective of funding risk. During the crisis the trend has changed and since 2007 the funding gap was continuously positive. Subsequent analysis was related to the level of various liquidity ratios of the Polish commercial banks in the years from 2008 until 2018. The result of this analysis was that the banks were meeting the required standard, with the exception for NSFR ratio. However, the NSFR ratio was in force only since 2018 therefore analysis of this ratio in the years prior to 2018 is only indicative and does not indicate any noncompliance. The last analysis was the linear regression analysis of the relationship between unemployment with Funding gap and inflation with Funding Gap. The result was that there is a strong negative relationship between unemployment and Funding Gap, meaning that increase in unemployment results in decrease in Funding Gap. This result is of a great significance as it can be possibly used to predict future development of Funding Gap in Poland based on the expected unemployment rate. On the other hand, the p value of the linear regression analysis between inflation and Funding Gap was too high therefore the result cannot be regarded as significant.

To summarize, banking sector in Poland is characterized by stable financing structure with majority of deposits coming from non-financial depositors. The portion of different type of financing, such as issuing of debt, is still relatively small. In 2018 the LCR ratio of all commercial banks in Poland was above 100%. The Net Stable Funding Ratio was also above 100% in almost all commercial banks (the only exception for mortgage banks, however this is due to the nature of their business, what was mentioned in the analysis). The fact that the commercial banks in Poland were meeting the new Basel standards and the average ratios of these standards have been increasing since 2014 gives the positive outlook liquidity position of Polish banks in the future. However, it needs to be acknowledged that the analysis of liquidity based on the liquidity ratios has certain disadvantages as such ratios are regarded to

be only simplified “stress test” and therefore might not be able to detect all possible liquidity problems of banks.

## 8. List of References

- Ali, A., & Daly, K. (2010). Macroeconomic determinants of credit risk: Recent evidence from a cross country study. *International Review of Financial Analysis*, 19(3), 165-171. doi:10.1016/j.irfa.2010.03.001
- Ashraf, B. (2017). Political institutions and bank risk-taking behavior. *Journal of Financial Stability*, 29, pp.13-35.
- Ashraf, B. N., Zheng, C., & Arshad, S. (2016). Effects of national culture on bank risk-taking behavior. *Research in International Business and Finance*, 37, 309-326. doi:10.1016/j.ribaf.2016.01.015
- Bank for International Settlements (2010)., ' *Basel III: International framework for liquidity risk measurement, standards and monitoring* '
- Bank for International Settlements (2013a). ' *Basel III: The liquidity coverage ratio and liquidity risk monitoring tools*, ' January.
- Bank for International Settlements (2013b). ' *Report to G20 finance ministers and central bank governors on monitoring implementation of Basel III regulatory reform*, ' April.
- Bessis, J. (2010). *Risk management in banking. (3rd ed.)*. Chichester, UK: Wiley
- Bianchi, J., & Bigio, S. (2014). Banks, Liquidity Management and Monetary Policy. University of Wisconsin and NBER. doi:10.3386/w20490
- Boubakri, N., Mirzaei, A., & Samet, A. (2017). National culture and bank performance: Evidence from the recent financial crisis. *Journal of Financial Stability*, 29, 36-56. doi:10.1016/j.jfs.2017.02.003
- Bouwman, C., (2013). *Liquidity: How Banks Create It and How It Should Be Regulated The Oxford Handbook of Banking*, 2nd edition, A.N. Berger, P. Molyneux, and J.O.S. Wilson, eds, Forthcoming. Available at SSRN: <https://ssrn.com/abstract=2307727>
- Calomiris, C., Heider, F. and Hoerova, M. (2015). A Theory of Bank Liquidity Requirements. *SSRN Electronic Journal*, pp.14-39.
- Chorafas, D.,(2002) *Liabilities, Liquidity, and Cash Management: Balancing Financial Risk*, John Wiley & Sons Inc, New York.
- Distinguin, I., Roulet, C., & Tarazi, A. (2013). Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. *Journal of Banking & Finance*, 37(9), 3295–3317. doi: 10.1016/j.jbankfin.2013.04.027
- EBF (2018.). POLAND. Retrieved from <https://www.ebf.eu/poland/>
- European Banking Authority (2017). EBA REPORT ON LIQUIDITY MEASURES UNDER ARTICLE 509(1) OF THE CRR (Rep.). EBA.

Galati, G., Moessner, R., Macroprudential policy a literature review, "BIS Working Papers", February 2011, No. 337,

Gurgul G. (2012). Analiza płynności finansowej wybranych banków komercyjnych w latach 2008-2009, *Problemy Zarządzania, Finansów I Marketingu*, 27, 385-397. doi:10.18276/pzfm

Hammond, M., and Wellington, J. J. (2013). Research methods: The key concepts. London, UK: Routledge. doi:10.4324/9780203097625

Jakubik, P., & Schmieder, C. (2008). *Stress testing credit risk: Comparison of the Czech Republic and Germany*. Retrieved from: <http://www.bis.org/fsi/awp2008.pdf>

Jasienė, M., Martinavičius, J., Jasevičienė, F., & Krivkienė, G. (2012). Bank Liquidity Risk: Analysis And Estimates. *Business, Management and Education*, 10(2), 186-204. doi:10.3846/bme.2012.14

Klepková Vodová, P. (2016). Bank liquidity and profitability in the Polish banking sector. *Zeszyty Naukowe Wyższej Szkoły Finansów I Prawa W Bielsku-Białej*, (1), 19-33.

KNF (2002), *Rekomendacja P dotycząca monitorowania płynności finansowej banków*. Warszawa, s. 2

Koleśnik, J. (2014). Regulacyjne miary płynności w bankach jako dopełnienie miar adekwatności kapitałowej. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, (10(934), pp.81-91.

Kruszka, M., & Godziszewski, B. (2013). Wsparcie grupowe w procesie restrukturyzacji europejskich instytucji bankowych. *Unia Europejska.pl*, (4), 24-31.

Malecki, W. (2014). Regulacje sektora bankowego. *Prace I Materiały Instytutu Rozwoju Gospodarczego / Szkoła Główna Handlowa*, 94, 153-181.

Mansurov, A. K. (2013). Macroeconomic analysis of prudential instruments of bank risk management. *Studies on Russian Economic Development*, 24(1), 54-59. doi:10.1134/S1075700712060068

Minsky, H (1986), *Stabilizing an Unstable Economy*, Yale University Press, London

NBP (2005). Financial Stability Report 2005. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>

NBP (2006). Financial Stability Report 2006. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>

- NBP (2007). Financial Stability Report 2007. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2008). Financial Stability Report 2008. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2009). Financial Stability Report 2009. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2010). Financial Stability Report 2010. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2011). Financial Stability Report 2011. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2012). Financial Stability Report 2012. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2013). Financial Stability Report 2013. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2014). Financial Stability Report 2014. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2015). Financial Stability Report 2015. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2016). Financial Stability Report 2016. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2017). Financial Stability Report 2017. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- NBP (2018). Financial Stability Report 2018. Retrieved from <http://www.nbp.pl/homen.aspx?f=en/systemfinansowy/stabilnosc.html>
- Pietryka, I. (2016). *'Płynność sektora bankowego a skuteczność polityki pieniężnej Narodowego Banku Polskiego na tle Eurosystemu'* Torun: Polskie Towarzystwo Ekonomiczne Oddział w Toruniu. ISBN 978–83–65605–01–6
- Pietrzyk, G., Płynność banku komercyjnego, „*Gazeta Bankowa*”, 2007, 10–13.
- Prawo bankowe (1997). No 140, poz. 939, z późn. zm., art. 8
- Scannella, E. (2016). Theory and regulation of liquidity risk management in banking. *International Journal of Risk Assessment and Management*, 19(1/2), 4. doi:10.1504/ijram.2016.074433
- Seltman, H. (2018). Experimental Design and Analysis. [:http://www.stat.cmu.edu/~hseltman/309/Book/Book.pdf](http://www.stat.cmu.edu/~hseltman/309/Book/Book.pdf)

Shah, S. Q., Khan, I., Shah, S. S., & Tahir, M. (2018). Factors Affecting Liquidity of Banks: Empirical Evidence from the Banking Sector of Pakistan. *Colombo Business Journal*, 9(1), 01. doi:10.4038/cbj.v9i1.

stat.gov.pl. (2019). Stopa bezrobocia rejestrowanego w latach 1990-2019. [online] Available at: <https://stat.gov.pl/obszary-tematyczne/rynek-pracy/bezrobocie-rejestrowane/stopa-bezrobocia-rejestrowanego-w-latach-1990-2019,4,1.html>

Strojwas, M. (2010). The Polish banking system: hit by the crisis or merely by a cool breeze?. *Economic and financial Affairs of the European Commission.*, 7(2).

Trenca, I., Petria, N., & Corovei, E. A. (2015). Impact of Macroeconomic Variables upon the Banking System Liquidity. *Procedia Economics and Finance*, 32, 1170-1177. doi:10.1016/s2212-5671(15)01583-x

Yar, H. (2019). Basel III and Liquidity Risk - The shortcomings of the LCR and NSFR. Retrieved from <https://www.linkedin.com/pulse/basel-iii-liquidity-risk-shortcomings-lcr-nsfr-hakan-yar/>

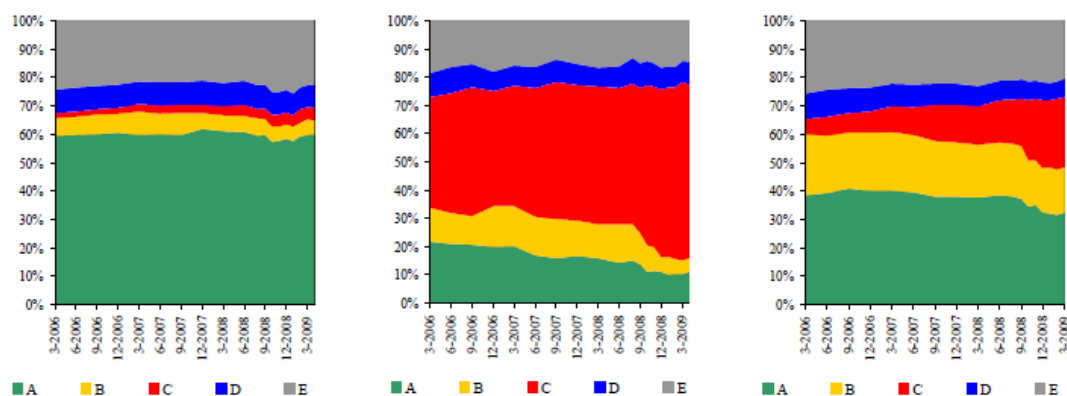
## 9. Appendices

**Table 3.7.** Ratings of Polish banks and their parent companies<sup>1</sup> by Moody's

	Financial strength rating	Long-term deposit rating	Outlook	Parent company	Parent company financial strength rating
Pekao	C (C)	A2 (A2)	NEG (POS)	UniCredit	C+ (B-)
PKO BP	C (C)	A2 (A2)	STA (STA)	n/a	n/a
ING Bank Śląski	D+ (D+)	A2 (A2)	STA (STA)	ING	B (B)
BRE Bank	D (D)	A2 (A2)	DNG (STA)	Commerzbank	C (C+)
BZWBK	C- (C-)	A2 (A2)	STA (STA)	AIB	B- (B-)
Bank Handlowy	C- (C-)	A2 (A2)	DNG (STA)	Citigroup	B (B)
Bank Millennium	D (D)	A3 (A3)	POS (POS)	BCP	C+ (C+)
Kredyt Bank	D (D)	A2 (A2)	STA (STA)	KBC	no rating
BGZ	D (D)	A2 (A2)	STA (STA)	Rabobank	B+ (B+)
Getin Bank	D (D)	Ba2 (Ba2)	STA (STA)	Getin Holding	no rating
BPH	D- (C-)	Baa2 (A3)	UPG (RUR)	GE	no rating
Lukas Bank	C- (C-)	A2 (A2)	DNG (STA)	Credit Agricole	B (B)
BRE Bank Hipoteczny	D- (D-)	A3 (A3)	DNG (STA)	Commerzbank	C (C+)

Appendix A, Ratings of Polish Banks, Source: Financial Stability Report 2008, National Bank of Poland

**Figure 3.26.** Structure of funding in banks applying deposit strategy (left-hand panel), foreign funding strategy (centre panel) and mixed strategy (right-hand panel)



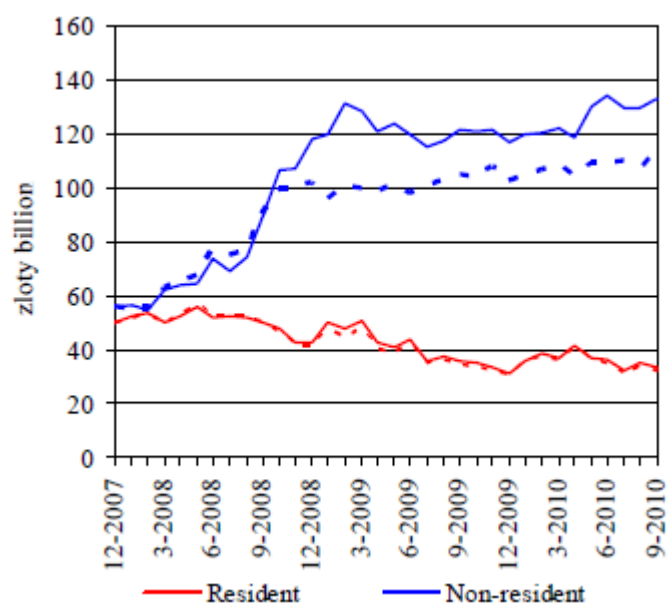
Legend: A - deposits of non-financial and the general government sector, B - liabilities towards financial entities-residents, C - liabilities towards financial entities-non-residents, D - capital, E - other liabilities.

Note: banks were classified into the particular groups on the basis of their funding structure at the end of March 2009

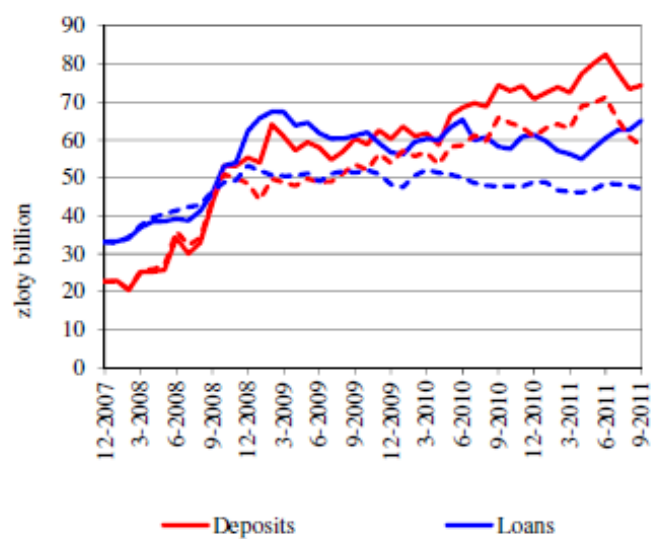
Appendix B Structure of funding in banks 2009, Source: (NBP, 2009)

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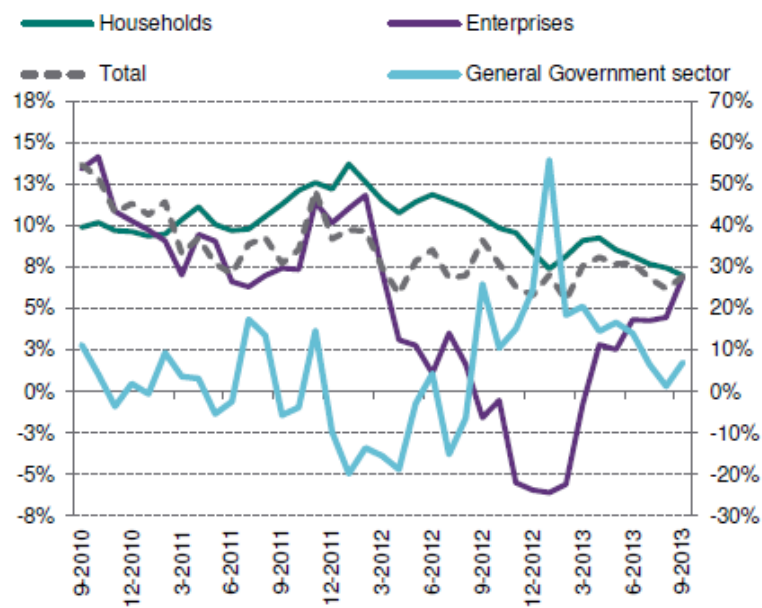




Appendix C Liabilities on domestic and foreign banks, Source: (NBP, 2010)



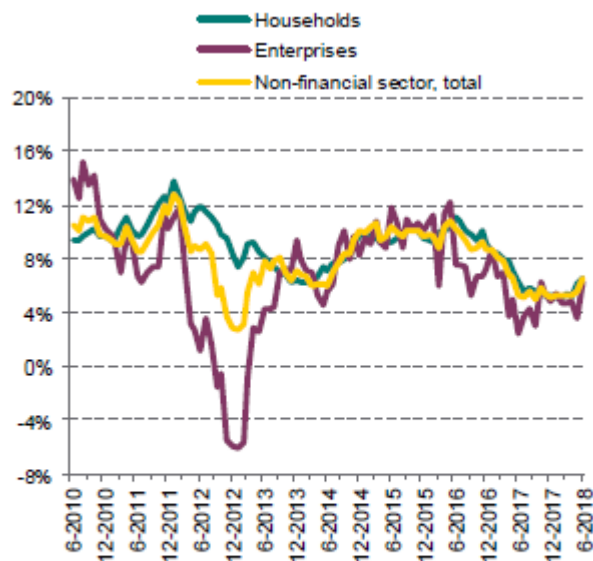
Appendix D Loans and deposits from foreign banks, Source: (NBP, 2011)



Notes: data after eliminating the impact of foreign exchange rate changes.

Source: NBP.

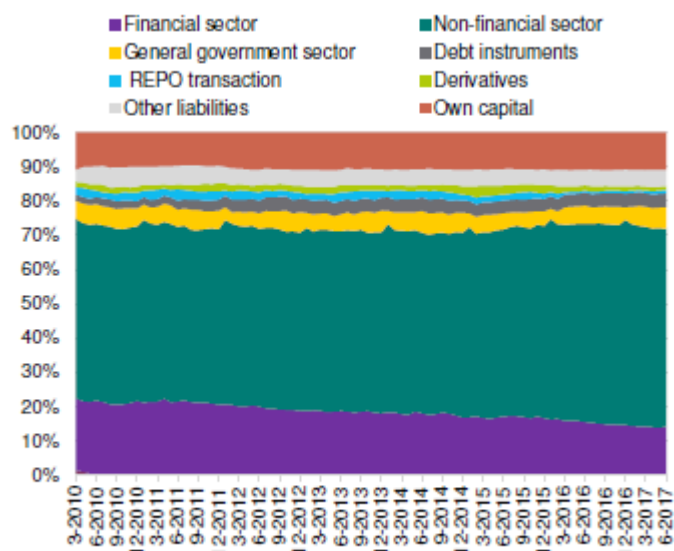
Appendix E Growth rate of deposits of the non-financial sector and general government sector, Source (NBP, 2013),



Note: Data for residents after excluding the impact of foreign exchange rate changes.

Source: NBP.

Appendix F Growth rate of non financial sector deposits, Source: NBP(2018)



Source: NBP.

Appendix G Funding structure of commercial banks in Poland 2010-2017, Source: NBP(2017)

LCR	Requirement	ING BSK	mBank	PKO Bank Polski	Bank Millenium	Allior Bank	Bank Pocztowy
2014	60%	176%	149%	132.7%	Not available	Not available	Not available
2015	60%	183%	144%	129.5%	Not available	Not available	131%
2016	70%	160%	200%	134.2%	122%	127%	148%
2017	80%	151%	165%	156%	150%	124%	207%
2018	100%	138%	190%	132%	195%	133%	242%
NSFR	Requirement	ING BSK	mBank	PKO Bank Polski	Bank Millenium	Allior Bank	Bank Pocztowy
2014	n/a	111%	Not available	Not available	Not available	Not available	Not available
2015	n/a	111%	Not available	Not available	Not available	Not available	Not available
2016	n/a	122%	Not available	Not available	Not available	Not available	Not available
2017	n/a	119%	Not available	113.9%	Not available	115%	Not available
2018	n/a	127%	Not available	117.7%	Not available	129%	Not available
M1	Requirement	ING BSK	mBank	PKO Bank Polski	Bank Millenium	Allior Bank	Bank Pocztowy
2008		Not available	Not available	Not available	Not available	Not available	Not available
2009		Not available	Not available	Not available	Not available	Not available	Not available
2010		Not available	Not available	Not available	Not available	Not available	Not available

2011		Not available	Not available	Not available	Not available	Not available	Not available
2012		Not available	Not available	Not available	Not available	Not available	Not available
2013		Not available	Not available	Not available	Not available	Not available	Not available
2014		Not available	12.302	Not available	Not available	Not available	Not available
2015		Not available	13.388	Not available	Not available	Not available	Not available
2016		Not available	15.117	Not available	Not available	Not available	Not available
2017		Not available	12.867	Not available	Not available	Not available	Not available
2018		Not available	Not avai	Not available	Not available	Not available	Not available
<b>M2</b>	<b>Requirement</b>	<b>ING BSK</b>	<b>mBank</b>	<b>PKO Bank Polski</b>	<b>Bank Millenium</b>	<b>Allior Bank</b>	<b>Bank Pocztowy</b>
2008	1	1.33	Not available	Not available	Not available	Not available	Not available
2009	1	1.43	Not available	Not available	Not available	Not available	Not available
2010	1	1.72	Not available	Not available	Not available	Not available	1.18
2011	1	1.25	Not available	Not available	Not available	Not available	1.51
2012	1	1.45	Not available	Not available	Not available	Not available	1.48
2013	1	Not available	Not available	Not available	Not available	Not available	1.31
2014	1	1.59	1.51	1.65	Not available	Not available	1.49
2015	1	1.57	1.47	1.65	1.53	Not available	1.60
2016	1	1.56	1.42	1.89	Not available	Not available	2.48
2017	1	1.4	1.35	Not available	Not available	Not available	Not available
2018	1	1.23	Not available	Not available	Not available	Not available	Not available
<b>M3</b>	<b>Requirement</b>	<b>ING BSK</b>	<b>mBank</b>	<b>PKO Bank Polski</b>	<b>Bank Millenium</b>	<b>Allior Bank</b>	<b>Bank Pocztowy</b>
2008	1	3.17	Not available	Not available	Not available	Not available	Not available
2009	1	3.71	Not available	Not available	Not available	Not available	Not available
2010	1	5.01	Not available	Not available	Not available	Not available	2.28
2011	1	5.45	Not available	Not available	Not available	Not available	4.09
2012	1	6.28	Not available	Not available	Not available	Not available	4.15
2013	1		Not available	Not available	Not available	Not available	2.88
2014	1	9.05	4.52	7.01	Not available	Not available	4.74
2015	1	10.68	4.68	9.87	4.72	Not available	4.85

2016	1	11.46	4.79	11.63	Not available		4.13
2017	1	13.73	4.52	13.92	Not available	5.09	4.43
2018	1	11.38	4.95	17.44	Not available	4.54	4.87
<b>M4</b>	<b>Requirement</b>	<b>ING BSK</b>	<b>mBank</b>	<b>PKO Bank Polski</b>	<b>Bank Millenium</b>	<b>Allior Bank</b>	<b>Bank Pocztowy</b>
2008	1	1.99	Not available	Not available	Not available	Not available	Not available
2009	1	1.80	Not available	Not available	Not available	Not available	Not available
2010	1	1.57	Not available	Not available	Not available	Not available	1.10
2011	1	1.36	Not available	Not available	Not available	Not available	1.13
2012	1	1.35	Not available	Not available	Not available	Not available	1.19
2013	1		Not available	Not available	Not available	Not available	1.13
2014	1	1.33	Not available	1.16	Not available	Not available	1.19
2015	1	1.31	1.33	1.15	1.11	Not available	1.16
2016	1	1.27	1.41	1.19	Not available	Not available	1.18
2017	1	1.19	1.39	1.19	Not available	1.15	1.34
2018	1	1.15	1.38	1.22	Not available	1.17	1.40

Appendix H, Various liquidity ratios of particular commercial banks in Poland, Source: Own work based on the data from Annual Reports from the particular banks.