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Faculty of Business Administration & Economics
Graduate Division

The Impact of Bank Liquidity on the Lebanese Banks' Risk Taking Behavior

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of the Master of Science in Financial Risk Management (MS-FRM)

NDU-Lebanon

2016

Approval Certificate

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17/01/2017

DECLARATION

I hereby declare that this Thesis is entirely my own work and that it has not been submitted as an exercise for a degree at any other University.

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ABSTRACT

Purpose – This paper aims at investigating the impact of bank liquidity on the risk-taking behavior of the Lebanese commercial banks.

Methodology – To achieve this objective, this study considers the impact of seven variables, namely, liquidity, size, capital, profitability, loan ratio, efficiency and revenue diversification by using a panel data of audited financial statement of Lebanese commercial banks for the period from 2008 to 2015. Three models were tested depending on the definition of risk and eight hypotheses were investigated using the fixed effect model.

Findings – Empirical results show that a high level of liquidity tends to increase the bank total risk but decrease the bank lending risk. Bank's risk is positively affected by the bank capital, size and loan ratio, but negatively affected by the bank profitability, revenue diversification and efficiency.

Research limitations – The small sample size with the presence of outliers could have affected the quality of the study's output.

Practical Implications – The findings of this study have implications for bank regulators advocating greater liquidity and capital requirement for banks under Basel III.

Originality – This study has delivered some insights on the determinant factors of the bank risk-taking behavior in the Lebanese banking system, a topic which is not well studied in Lebanon.

Keywords – Bank, Liquidity, Risk, Lebanon, Capital, Size, Fixed effect model

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ACKNOWLEDGMENTS

I would like to express my gratitude to my supervisor Dr. Rim El Khoury for the useful comments and engagement through the learning process of this master thesis. She consistently allowed this paper to be my own work, but directed me in the right direction whenever she thought I need it. I would also like to thank Dr. Hassan Hamadi, my thesis reader, for his support and guidance. Without his passionate participation, this thesis could not have been successfully conducted.

I would also like to thank my loved ones, who have supported me throughout the entire process, by helping me achieving what I have done and keeping me harmonious. I will be grateful forever for your support.

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Chapter 1
Introduction

1.1. Background

The banking system is one of the most important financial intermediaries in the economy of Lebanon given the absence of capital markets. In spite of the economic and social difficulties, banks continue to be one of the main pillars of Lebanon economy, through transferring funds from people who have excess of funds to those with productive investment opportunities. Given the importance of banks in the economy, and in order to ensure the stability in the financial market, banks should be efficient and safe. Thus, a careful risk assessment is important on macro and micro levels. Farag, Harland, & Nixon (2013, p.201) states that "bank capital, and a bank's liquidity position are concepts that are central to understanding what banks do, the risks they take and how best those risks should be mitigated." According to Elliott (2014), the most essential safety buffer for a bank is its capital as it covers substantial losses. However, financial crisis has shown the importance of the liquidity as a second safety buffer. Ly (2015) stated in his article that the liquidity risk and the dependency on the short range funding were the main reasons behind the failure of large banks such as Lehman Brothers and Northern Rock. Furthermore, Hong, Huang and Wu (2014) have shown in their article that the liquidity risk is an essential contributor to banks' failures in 2009-2010 as a result of the financial crisis in 2007-2008. Additionally, Haan and Willem (2012) state that the collapse of the financial system in 2008 could be attributed to a bad bank's liquidity management, which could give rise to market and funding liquidity risk, resulting in a major catastrophe in the whole financial system.

As a response to the worldwide financial crunch, in 2009, the Basel Committee on banking supervision had issued a vigorous framework related to the liquidity risk, 'Principles for Sound Liquidity Risk Management and Supervision' (Basel Committee on banking supervision, 2009). It had introduced regulations to control bank's liquidity gap through two financial ratios, mainly the Liquidity Coverage ratio (that captures the capacity of banks to survive a 30-day period after a shortfall in liquidity) and the Net Stable Funding Ratio (that captures the long term stable sources of funding) (Hull, 2012).

Banks started to increase their liquid assets in order to avoid liquidity shortfall that might lead to bank run (Khan, Scheule & Wu, 2015).

However, it is uncertain the positive response of those regulations imposed by Basel III on bank's lending risk and on bank's total risk. Therefore, determining the impact of liquidity on bank risk behavior is an important issue for a stable financial system. Acharya and Naqvi (2012) states in their article that the lending process tends to be aggressive when banks have an excess liquidity. Khan et al. (2015) have also found in their research that a high level of liquidity creates an agency problem that persuades managers to relax the lending standards by setting a discount rate lower than the one that maximizes the bank's profit. Moreover, Altunbas, Carbo, Gardener and Molyneux (2007) affirm that liquid banks tend to take more risk than the illiquid ones. Thus, it is important to study the impact of liquidity on bank risk taking behavior, in order to ensure a stable financial system and then a stable economy.

1.2. Need for the study

The global financial crisis starting from the summer of 2007 is considered to be the worst financial crisis since the Great Depression of 1930. Large financial institutions collapsed, banks were bailed by governments, stock markets declined, key businesses failed, and consumer wealth declined. There was a downturn in the economy activity. This global financial crisis was manifested as a liquidity crisis. Thus, many scholars and officials have realized that managing bank liquidity risk is as important as capital or solvency risk management. With respect to liquidity management, the Bank for International Settlement (BIS) published a consultative paper in June 2008 entitled 'Sound Liquidity Risk Management and Supervision' (Basel Committee on Banking Supervision, 2008); Financial Services Authority (FSA) introduced a new liquidity regime in October 2009 (FSA, 2009); International Monetary Fund (IMF) reviewed its stress test experience in 2008; Bank of England had focused on managing funding liquidity risk since 2008 (Aikman, Alessandri, Eklund, Gai, Kapadia, Martin, Mora, Sterne & Willison 2009), and the European Central Bank (ECB) provided a new measurement of funding liquidity risk in 2009 (Drehmann & Nikolaou, 2009). This topic is very hot nowadays as the Basel

Committee is implementing the new standards for bank liquidity. However, the impact of increasing bank liquidity on the banks' activities, mainly risk is not yet known.

In the case of Lebanon, the banking industry is the key sector in the economy since it dominates the financial system by being the major providers of credit to businesses and individuals. Lebanon is one of the few nations that were able to maintain growth since the financial crisis of 2007, due to the fact that the Lebanese banking sector is already operating with a high level of liquidity (Salem, Shaheen, Abi Habib & Azhari, 2012). Given the vital role played by the Lebanese banks in promoting economic growth, this study aims to study the impact of liquidity on Lebanese banks' risks. In particular, there is a paucity of empirical studies in Lebanon addressing the relationship between liquidity and bank risk. Thus, this thesis attempts to address this gap by empirically investigating the impact of liquidity on the financial stability of banks in Lebanon.

1.3. Purpose of this Study

The specific objectives of this thesis are:

1. To ascertain the impact of liquidity on the lending risk behavior and total risk of the Lebanese banking industry.
2. To examine the influence of banks' capital and size on the liquidity and bank risk relation.

1.4. Organization of the Study

The rest of the paper is organized as follows. Chapter 2 gives a general background about banks and more specifically the Lebanese banking sector as well explains the importance of bank liquidity. Chapter 3 discusses the data, variables, scope and sample size of the research; it also formulates the hypotheses and explains the reasons behind choosing the appropriate research methodology. Subsequently, chapter 4 explains the research methodology and presents the finding of the results. Finally, chapter 5 displays the conclusions that have been drawn from the results of the study and provides recommendations for future analysis.

Chapter 2
Literature Review

This chapter introduces banks in general and the Lebanese banking sector in specific, followed by liquidity, its definitions, its measurements, and its impact on bank risk. The first part will commence by defining a bank, its function and types. The second part will continue with a brief history about the Lebanese banking sector, its characteristics, and its situation after the crisis of 2008. The third part will discuss banks' liquidity and liquidity risk including regulations and measurements. The fourth part will focus on reviewing the relevant theoretical and empirical literature on the importance of bank liquidity and its impact on bank risk behavior. This review of the literature will help in establishing the framework and formulating the research hypotheses for this study.

2.1. Banks in General

2.1.1. Definition and History of Banks

The word "bank" is dated more than a hundred years ago and is derived from an Italian world "banco", which refers to the worktable used by Florentine bankers to execute their transactions (Russell, 1916). Lawson (1850, p.1) stated in his book: "Among the instruments of civilization which, ingenuity and industry of man have given to his species, not one has been so completely characterized by the potency of effect and universality of application as money". Money started with the religious temple of the ancient world, where people deposit their money and borrow in the form of materials such as grains and animals (Bucka & Buckova, 2011). When humans started to realize how much precious metals such as gold and silver are valuable, they started to appreciate those metals. In this way, the bartering of grains and animals became an exchange of gold and silver and it was prized according to the weight of the stone (Lawson, 1850). Eventually, money was first published in the form of coinage by the Chinese civilization, where coins became the mean of exchange. Nonetheless, the Romans had created a separate building specialized for coin exchanges and a safe place for the deposits of coins, which is the bank nowadays. With the cycle of Julius Ceaser, a Roman statesman in that century, the banking system had seen the biggest shift of power according to the

relationship between the creditors and debtors. This is where the creation of the banking institution had taken place (Davies & Julian Hodge, 2002). Thus, the banking institutions became a separate sector in the economy functioning according to certain roles, where it will be discussed in the next section.

2.1.2. Role of Banks

The traditional function of a bank is to receive deposits and channels these deposits into loans for different customers. Nowadays, the functions of most of the banks had enlarged to cover investment banking activities (Hull, 2012).

Banks are the major sources of fund for businesses and individuals, thus they are considered as important part of the economy. According to Allen and Cartelli (2008), the roles of banks can be classified as follows:

1. Bank-based system plays a role in the growth of the economy.
2. Banks contribute in the corporate governance by playing the role of the delegated monitor of the corporation, which eliminates the agency problem.
3. Banks provide risk sharing for the risks that cannot be diversified. For example, investors holding their assets in a bank are protected from the risk faced if they hold their assets in equities.

Most importantly, banks play a critical key in promoting the economic growth of each country since no growth could be attained unless savings are well channeled into investments. Monnin and Jokipii (2010) found in their paper that there is a positive relationship between banking sector stability and real output growth. In addition, Fohlin (1998) states in her article that banks influence the money supply through deposits lent to clients who are willing to invest. Furthermore, Ariccia, Detragiache and Rajan (2004) had shown in their study that a crash in the banking system negatively affects the economy of the country. Hull (2012) mentioned the effect of the global financial crises of 2008, where the economies of the United States and international countries had crashed down as the effect of the banking crises. For Lebanon, which is the focus of this study, it is well shown the importance of the banking sector in boosting the Lebanese economy.

2.1.3. Types of Banks

The banking system is classified into various categories or types that differ according to their roles, such as commercial banks, investment banks, cooperative banks, specialized banks, and central banks.

1. Commercial banks

Commercial banks can be further categorized as retail banking or wholesale banking. While the retail banking provides the basic financial services for individual or small businesses such as small deposits or small loans, the wholesale banking provides financial services for larger clients such as fund managers, corporations and other financial institutions, for example, overdraft or huge amounts of deposits. Furthermore, commercial banks can also be divided as public and private banks. In the public sector banks, the government held the majority of the bank stakes, while in the private sector banks, the majority of the stakes are held by individuals (Hull, 2012).

2. Investment banks

Investment banks assist corporations and government in raising debt and equity by originating, underwriting and placing securities to investors. The arrangement between the investment banker and the corporation can be classified into various types. It can be a private placement, where the securities are sold to a small number of large institutional investors, or through a public offering, where any investor can buy the security issued (Hull, 2012).

3. Cooperative banks

According to the International Cooperative Alliance Statement, a cooperative bank is defined as an association of a group of people who join together to serve a common interest under a democratically controlled system. It differs from stockholder banks in their values, goals and governance. For instance, it is based on ethical values such as equality, unity, democracy, self and social responsibility (International Cooperative Banking Association, 2016)

4. Specialized banks

Specialized banks are banks that support business in a specialized area of activity. For example, agriculture banks provide services only for agricultural purpose (Ionescu, 2012).

5. Central Banks

Central banks guide and regulate the banking system of the nation; they work as a government banker to maintain deposits and loans for banks. They also monitor the monetary and credit policies of the banks. More importantly, central banks are responsible for the issuance and supervision of the country's currency (Archer & Boehm, 2013).

2.1.4. Risks Facing Banks

Banks are exposed to financial instability. In fact, bank collapses are not rare, nor limited to certain geographic areas. The consequences of banks' financial distress are disruptive to the economy, with significant impact. Some of the risks faced by the banking system are classified as follows:

- Major Risks:

1. Credit risk: It is the greatest risk that banks face. It is defined as the risk that the counterparty defaults to pay his/her obligations. It is also known as performance risk, counterparty risk and default risk (Hull, 2012).
2. Market risk: It arises from the trading transactions made by the bank. It is defined as the probability that the instruments used in the trading book of the bank will decrease in value (Hull, 2012).

   Within these two types of risks, there are:

a. Systemic risk: It is the probability of the failure of the whole banking system rather than the failure of one financial institution. The latest example of this risk was the financial crisis of 2008, which showed a high correlation between a breakdown in one bank and the failure of the whole banking system (Kaufman & Scott, 2003).
b. Capital Risk: It is the probability that the bank does not have enough capital to confront the risks it takes. Generally, it is measured by the capital adequacy ratio,

defined as the capital required by the bank as a percentage of its risk weighted credit exposure. This ratio protects the banks' depositors in case of breakdown by the bank (Hull, 2012).

c. Interest rate Risk: It is defined as the exposure faced by the bank due to adverse movements in interest rates (Hull, 2012). More specifically, according to Basel Committee on Banking Supervision (2015b, p.3) "interest rate risk in the banking book refers to the current or prospective risk to the bank's capital and earnings arising from adverse movements in interest rates that affect the institution's banking book positions".

3. Operational risk: It is the risk that a bank faces due to breakdowns in internal or external factors that negatively affect the operations of the bank (Hull, 2012).
4. Liquidity risk: It is referred as the probability that the bank will not have enough cash to meet its short term obligations (Hull, 2012). The financial crises have shown the importance of the liquidity risk that lead to the failure of many banks in the financial crises of 2008 such as Lehman Brothers and Northern Rock Banks. Due to its importance, this risk will be elaborated later on in this thesis.

- Other Risks (Falls under Credit and Market risk):

2.2. Lebanese banking Sector

2.2.1. History of the Lebanese Banking Sector

During the French mandate, foreign financial institutions were leading the banking sector in Lebanon. Their role was to drive Lebanon's foreign trade, leaving the domestic financial transactions to the local financial institutions that were operating at a limited capital and limited activities such as short-term bills of exchange, loans and advances in the form of current accounts. After the independence of Lebanon in 1943, the Ministry of finance started to supervise the banking system according to the Code of Commerce, which was specialized in commercial businesses rather than financial institutions. In 1963, the banking sector began to flourish with the establishment of Banque du Liban (BDL), which introduced the Code of Money and Credit to monitor in an effective way the financial system. This sector had shifted from the dominance of foreign banks to the command of the local banks. As a matter of fact, more than 40 domestic banks entered the banking market in that period, in addition to 13 new foreign banks. Nowadays, as of

2016, the Lebanese banking sector includes 69 banks, classified as follows (About Banque du Liban, 2016):

- 31 Lebanese Commercial Banks
- 6 Lebanese Commercial Banks with Arab Controls
- 7 Arab Commercial Banks
- 4 Foreign Commercial Banks
- 5 Islamic Commercial Banks
- 14 Lebanese Investment Banks
- 2 Lebanese Investment Banks with Arab Controls

All banks and financial institutions fall under the jurisdiction of the Bank of Lebanon (BDL), which is the bank regulatory authority. In fact, the progress realized by the Lebanese banking sector is attributed to the strong bank regulation and supervision undertaken by BDL. Currently, the Lebanese banking sector is financially sound and stable and it is the key role in the Lebanese economy. Banks dominate the financial system of the country and are the major providers of credit to individuals and businesses.

2.2.2. Regulations of the Lebanese Banking Sector

Strong bank regulations are one of the factors that contribute to the growth of the Lebanese banking sector. The Banking Control Commission (BCC), established in 1967 by Banque du Liban (BDL), is defined as the banking regulatory authority, responsible for supervising the banking sector and ensuring its compliance with different financial institutions regulations (Lebanese Banking Sector, 2015). There are many regulations controlling the banking sector, but the focus is on the ones related to risk and liquidity.

1. Capital Adequacy Requirements

According to Basel III regulations, banks are compelled to maintain the following capital adequacy ratio at the end of 2018 (Basel Committee on Banking Supervision, 2010):

- Common Equity Capital Ratio: This ratio must be at least 4.5% of risk weighted assets all times.
- Total Tier 1 Capital Ratio: This ratio must be at least 6% of risk weighted assets.

- Total Capital Ratio: This ratio includes tier one and tier two and must be at least 8% of risk weighted assets.

Tier 1 capital includes the share capital of the bank and its retained earnings and exclude intangibles and deferred tax assets. As for Tier 2 capital, it includes debt that is subordinated to depositors with an original maturity of five years.

2. Lending requirements

The lending activities that banks should pursue for a single entity are classified as follows (Lebanese Banking Sector, 2015; Salame, 2013):

- Facilities lent for Lebanese clients or other clients rated A+ should not exceed 20% of the banks' equity (Tier 1).
- Facilities lent for other foreign clients should not exceed 10% of the banks' equity.
- Total facilities lent should not exceed 50% of the banks' equity for customers rated BBB and 25% for the ones rated less than BBB.
- Total facilities lent for foreign countries cannot exceed four times the bank's equity and total facilities lent for countries rated less than BBB cannot exceed 100% of the bank's equity.
- Facilities lent to non-housing loans granted in Lebanese pound should not exceed 60% of its value.

  Facilities lent to housing loans under the Protocol signed with the Public Housing Institution should not exceed 80% of its value.

3. Investment Requirements

The percentage of investing is based on the type of investment. For example, banks are allowed to finance 50% of a debt initiated from foreign clients and they can invest up to 25% of their equity in structured investment products but after receiving BDL approval. On top of that, the central bank can approve derivatives use only for hedging purposes.

4. Liquidity Requirements

Banks are obliged to hold 25% of their Lebanese pounds (LBP) demand deposits and 15% of their LBP term liabilities as required reserves. Furthermore, they are required to

hold at least 10% of their deposits in foreign currencies and at least 15% of their remunerated foreign currencies liabilities as liquid assets. In addition, the bank is required to hold 40% of its equity as liquid assets.

5. Other Regulations

In addition to all previous regulations, Lebanese banks follow the Basel Committee regulations according to the loan details and internal policies and procedures.

2.2.3. Main Characteristics of the Lebanese Banking Sector

The Lebanese banking sector is the key of commerce, financial trading and investments growth in Lebanon. It was behind the evolution of Beirut to be an important financial center that supported and guaranteed the Lebanese economy. In addition to being strongly regulated, the Lebanese banking sector encompasses certain characteristics that helped it in moving abroad. It is known in its liberal economic system, where there are no restrictions on foreign investments or capital movement but still being well controlled by the Lebanese Secrecy law economy. The latter regulates all banks established in Lebanon as well their branches established abroad. It obliges all employees exposed to banking activities to conceal any information related to a client such as names, assets and holdings from any individual or even judicial authority. Such information is released in some cases such as bankruptcy, lawsuits between banks and client or when the client gives the authorization. Due to this secrecy law, the Lebanese market is threatened by money laundering through illegal operations. Consequently, the Association of Banks in Lebanon had set a regulation to limit this issue under the name of Due Diligence Convention (About Banque du Liban, 2016).

Moreover, the Lebanese banking sector has expanded to the Arab countries, Gulf region, Europe, Africa and the United States through its branches, affiliated companies, subsidiaries, sister banks and representative offices worldwide. Currently, the major Lebanese banks that represent approximately 86% of the banking sector, are present in more than 30 countries in the MENA region, such as United Arab Emirates, Saudi Arabia, Egypt and Africa (such as Nigeria, Congo and many others). Their operations abroad have reached 17% of their total assets, low enough so it will not increase the risk

of the Lebanese banking sector in case of international crises (Lebanese Banking Sector, 2015).

Furthermore, the Lebanese banking sector had introduced the joint accounts in 1961, which consist of accounts opened in the name of more than one person and can be used by any one of them without the approval of the others. This facility had attracted the Arab funding that facilitated the opening of the Lebanese banks in the MENA region (About Banque du Liban, 2016). In addition, the Lebanese banks provide traditional and modern services of which the ATM, card services, electronic banking, in addition to retail, private, corporate, Islamic banking, brokerage, consulting and insurance services (Lebanese Banking Sector, 2015).

2.2.4. Summary of the Lebanese Banking Activities in 2015

According to Nahas (2000), the Lebanese banking system had the ability to manage the need of the Lebanese economy during and after the war. As well, the banking sector is a dominant sector in the Lebanese economy due to the high ratio of money to GDP. According to Bank Audi report (2015) the Lebanese banking sector had observed a slowdown growth between 2014 and 2015. The percentage increase in total assets of banks operating in Lebanon had decreased from 6.6% in 2014 to 5.9% in 2015 which reflects the slowdown in the Lebanese economy. This slowdown is mainly due to deposits which are the main source of funds for the Lebanese banks (representing 81.5% of the total balance sheet of banks in 2015). The total deposits growth rate has decreased from 6% in 2014 to 5% in 2015. As well, the percentage change in the lending activities has diminished from 7.4% to 6.5%. Thus, the Lebanese market had faced a lower growth in its overall market activities which led the economy to slow down during 2015.

Table 2.1 summarizes the main items of the banking activities as of 2015.

Total Assets (in millions of L.B.)	**280,378,536**
Total Deposits (in millions of L.B.P.)	**233,588,888**
Total Credits to Private Sectors (in millions of L.B.P.)	**81,743,663**

Table 1:Summary of the Lebanese Banking Sector

(Source: History and Structure, 2015)

2.2.5. Lebanese Banking Sector after the Financial Crisis of 2008

For the past fifty years, the Lebanese banking sector had witnessed major crises in military, security, political, financial and economic aspects. Nonetheless, it proved its ability to survive those shocks and the financial system was immune from any level of strictness crises (Lebanese Banking Sector, 2015). For example, Lebanon was not affected by the last global financial crisis in 2008 which was considered as the worst financial crisis after the great depression in 1930. The crisis began in the United States with a bubble in the house prices, where the prices raised sharply due to the relaxation in the lending standards. This climb in prices reached a point where it started to edge down due to defaults in mortgages that led to a crash in the asset backed securities (which are based on those mortgages). This crash had created a contagion effect between the US financial institutions which led the whole financial system to crash down, and which affected all other sectors in the economy (Hull, 2012). This crisis was spread over the world and it had affected almost every country in the planet. Yet, the Lebanese banking sector was able to immune itself from the effect of this crisis and even it was able to score an 8% growth during that period. This is due to the regulatory system imposed by the central bank that can be summarized as follows (Markets Insights Division, n. d.):

1. The lending requirements by the central bank enforced the Lebanese banks to lend up to 70% of their deposits compared to 100% in some international banks.
2. The Lebanese banking sector was barely depending on the inter-bank rate, due to the high reserve requirements, while international banks were excessively depending on the inter-bank rate.

3. The central bank was stabilizing the Lebanese currency for over 15 years.
4. Speculations and risky investments were banned.

2.3. Liquidity and Liquidity Risk

2.3.1. Liquidity: Definition and Types

It is difficult to measure liquidity and liquidity risk without a proper definition of both terms. Since the recent financial crisis, the concept of liquidity has become the main focus for regulators, financial institutions and academics. Nevertheless, there is no uniform definition of liquidity.

Crockett (2008, p.14) stated in his article that "Liquidity is easier to recognize than to define". Liquidity can be understood as the cash realized immediately from the sale of an asset. Liquid assets are referred to those that can be transformed into cash in a short period of time at a small cost. At the same time, Elliott (2014) defined liquidity as the ability of the financial institution to realize cash when needed which can be through cash or marketable securities held by the bank or through reserves kept at the central bank.

Conversely, a distinction is to be made between liquidity and solvency of a bank. While the former is defined as the ability of the bank to meet its short term obligations as they become due, the latter refers to its ability to bear its activity into the future (Hull, 2012). Nevertheless, long term obligations might also affect the bank's liquidity condition during a crisis because those obligations might mature before the crash crunch passes. In this case, the bank will need additional funds to meet those obligations. In case of its inability to provide those funds, the bank will be forced to sell its loans at a discount, thus incurring substantial losses (Elliott, 2014).

Since liquidity is a vague concept and its meaning can vary considerably, this thesis will focus on the following main types of liquidity: market liquidity, funding liquidity, accounting liquidity and central bank liquidity.

2.3.1.1. Market Liquidity

Market liquidity is defined as the speed degree to which securities can be bought and sold in the market without incurring unacceptable losses (Elliott, 2015). Hence, market liquidity is based on the ability to trade securities, which can be characterized by three

major elements: volume, time and transaction costs. Those three elements are considered to be the factors that allow a security to be sold anytime and easily during the trading hours while experiencing a minimum loss (Nikolaou, 2009). Moreover, according to Nikolaou (2009), the properties of market liquidity can be summarized as follows:

- There is a positive covariance between stock liquidity and market liquidity
- There is a negative relation between the price of assets and liquidity
- Liquidity is interconnected throughout the whole market.

2.3.1.2. Funding Liquidity

According to Basel Committee on Banking supervision (Basel Committee on Banking Supervision, 2008), funding liquidity is defined as the ability of the bank to meet its short term obligations as they become due without incurring losses. Nikolaou (2009) stated in his article that the International Monetary Fund (IMF) defines the funding liquidity as the capacity of solvent banks to make due payments in a short period of time. Hence, it is significant to highlight the funding sources of banks. Firstly, the most common source is depositors, who provide cash for the bank. Secondly, the market is a well-known source, where banks can sell assets or engender liquidity through securitization. Thirdly, banks can access liquidity through interbank market, which is considered as the most important source for banks. Lastly, banks can fund liquidity through central bank. However, funding liquidity should be distinguished from funding liquidity risk that will be discussed in the following section (Drehmann & Nikolaou, 2009).

2.3.1.3. Accounting Liquidity

Accounting liquidity can be measured through certain liquidity ratios that will test the ability of the bank to pay off its short term obligations. Those ratios are the current ratio and the quick ratio (Saleem & Rehman, 2011).

First, the current ratio is defined as current assets divided by current liabilities. It measures the ability of the bank to covers its short term obligations by its short term assets. Second, the quick ratio is defined as cash and equivalent plus short term investments plus account receivables divided by current liabilities. This ratio measures

the ability of the bank to meet its current liabilities through its most liquid assets. The higher these two ratios, the higher the ability of the bank to meet its current liabilities.

2.3.1.4. Central Bank Liquidity

The central bank, being the originator of the monetary base, is considered as a provider of liquidity for the financial system. Hence, the central bank uses the monetary policy tools to increase or decrease the money supply in the market in order to affect the liquidity in the money market. The central bank liquidity is measured as the flow of the monetary base from the central bank to the banking system. Table 2.2 summarizes the components of a central bank balance sheet. From the assets side and as its role in supplying liquidity, the central bank conducts open market operations (OMO), which include sale and purchases of government securities. These governmental debt instruments are repurchased on a regular basis by the central bank to inject liquidity in the financial system. From the liabilities side, the autonomous factors are factors which are not controlled by the monetary policy such as bank notes, government deposits, net foreign assets and some other factors. The reserves are the balances of the required and excess reserves kept by the financial institutions at the central bank. Therefore, in order to meet the requirements of the central bank, an aggregate liquidity deficit will be created throughout the financial system that will force the central bank to refinance the market liquidity. Thus, being the source of the liquidity in a financial system, the central bank will supply the market through its open market operations that are considered to be its assets. Hence, we can conclude that the central bank needs to supply liquidity up to an amount equal to the sum of its autonomous factors and reserves (Nikolaou, 2009).

ASSETS	LIABILITIES
Open Market Operations	Net Autonomous Factors
	Reserves

Table 2: The Balance Sheet of the Central Bank

(Source: Nikolaou, 2009)

2.3.2. Liquidity Risk: Definition and Types

After defining liquidity, this part will move to liquidity risk. Before the last financial crisis, regulators used to focus on the capital requirements of the financial institutions. However, it turned out that a deficiency in the capital level of the financial institutions was not the reasons behind the crisis. Indeed, liquidity risk was the cause behind those failures (Hull, 2012). Ly (2015) stated that liquidity risk was a major cause of the majority of the financial crises faced internationally. It was the reason behind the failure of large banks such as Lehman Brother and Northern Rock. Moreover, Hong et al. (2014) had shown in their article that the liquidity risk is an essential contributor to the bank's failures in 2009-2010 after the financial crisis of 2007-2008.

Naveira, Martin, Cascales, Vidales and Acosta (2012) defined liquidity risk as the possibility of suffering losses due to insufficient liquid funds to meet the short term obligations and the probability of liquidating the asset at a lower price within a short time period. Furthermore, according to Banks (as cited in Driga, 2012), liquidity risk is defined as the economic loss occurring from the inability of the bank to fund its short term obligations at an economically reasonable level.

In fact, the mismatching between banks' assets and liabilities- known as maturity mismatching can lead to a liquidity risk problem. In general, the bank funds long term loans with short term deposits. Thus, the bank might be unable to meet its short term deposits as they become due because its long term loans did not yet mature. The bank will be forced to provide its short term depositors with their capital in addition to the interest earned regardless of whether its long term liabilities matured or not. In this manner, maturity transformation activity exposes the bank to two other major risks: interest rate risk and credit risk. First of all, the bank will be exposed to interest rate changes due to the difference between the maturities of its assets and its liabilities. Hence, in case of an increase in interest rates, the interest paid on the bank's short term deposits will increase, while the interest received on its long term loans will remain the same, resulting in a lower interest rate spread and a lower net interest income. Second of all, there is a possibility that the bank cannot secure that its long term borrowers can provide long term funding which can be raised from anticipated and unanticipated risks driven by market distress, systemic risk and counterparty failures. Hence, the bank will no

longer have a growth in its investment which will make the liquidity risk a complex of operational risks (Hull, 2012).

Similar to the liquidity, the focus will be on the following main types: Market liquidity risk, funding liquidity risk and central bank liquidity risk.

2.3.2.1. Market Liquidity Risk

Tian (2009) defines market liquidity risk as the loss suffered when financial institutions or participants want to trade their assets or to liquidate their positions at an unfair price in a short period of time. Vento and La Ganga (2009) defined market liquidity risk as the risk faced by financial institutions or participants that are unable to trade or liquidate their positions without having a reasonable effect on the market price due to the market disruption. Nikolaou (2009) stated that market liquidity risk has a tendency to compound market risk (a decrease in an asset price due to changes in market aspects) due to the fact that when it is hard to find a buyer for an illiquid asset, the price of the asset will decrease, thus increasing the market risk. Nevertheless, market liquidity risk has some negative consequences on the whole financial market. It can lead to financial crises by disrupting the financial stability and damaging the allocation of capital which eventually will affect the whole economy of the country (Nikolaou, 2009). Given the importance of this type of risk on the financial stability, it is this type of risk that provides an immediate warning to policy makers.

2.3.2.2. Funding liquidity Risk

Drehmann and Nikolaou (2009) defined funding liquidity risk as the possibility of the bank to become unable to settle its obligations over a given period of time. According to Vento and La Ganga (2009), funding liquidity risk is defined as the inability of the financial institution to maintain its equilibrium between cash inflows and outflows or its ability to maintain this equilibrium only by incurring unacceptable losses over a short time period. Furthermore, funding liquidity risk is dependent on the market liquidity in the sense that funding liquidity risk is exposed to shocks from instability in the market. Hence, when the market is illiquid, the bank will be unable to meet its short term obligations due to the inability of liquidating the required assets to fund those obligations.

Therefore, the funding process of the bank is depending on the market conditions (Drehman & Nikolaou, 2009). The linkage between market and funding liquidity risk had been supported theoretically (Brunnemeier & Pedersen, 2008) and empirically (Drehmann & Nikolaou, 2009).

2.3.2.3. Central Bank Liquidity Risk

The central bank liquidity is defined as the inability of the central bank to perform its role in supplying the market liquidity requirements and in insuring the financial stability. According to Nikolaou (2009), this kind of risk is unlikely to happen in developed economies since the central bank is an extension of the government which means that it is a risk-free association that can always, through its market operations, supply liquidity to maintain the market equilibrium. Thus, the central bank, which is the last resort, is considered to be an essential part in hedging liquidity problem in the financial market through its daily net liquidity demand. Net liquid demand is defined as the liquidity needed by the banking system to meet the obligations when they fall due (Drehmann & Nikolaou, 2009).

2.3.3. Sources of Liquidity Risk in Banks

In order to quantify and manage liquidity risk, the sources of this risk should be identified. According to Rochet (2008), there are mainly four sources of liquidity risk. First, on the liability side, depositors are considered to be the main source of liquidity and liquidity risk. This can be explained by the uncertain amount of deposit withdrawals which construct the main liabilities of the bank (Rochet, 2008). Similarly, Allen (2014) stated in his article that consumer deposits are considered to be the liquidity insurance for the bank. However, once they are withdrawn, they can raise a liquidity risk that might lead to a failure. Second, from the asset side, the uncertainty on the volume of loans that will be requested in the future is another source of liquidity risk. Indeed, the bank can reject those requests in case of shortage of liquidity, but this will raise an opportunity loss of profit from those loans. In addition, rejecting new loans requests will be harmful for the economy as well because banks are the unique finance tools for small and medium size enterprises which are considered to be an important part of the private sector. Third, off-

balance sheet operations such as credit lines, derivatives and other commitments are another source of liquidity risk in banks (Rochet, 2008). Finally, the last source of liquidity risk comes from large interbank payments, for which the central bank facilitates the use of real time gross settlement (RTGS), which is the transfer of funds between banks in real time without a waiting period. RTGSs, which are highly liquid, function properly only if banks have enough collateral to back up their credit lines. Hence, large value payments might create a shortage in the bank's liquidity (Rocket, 2008). Additionally, Allen and Gale (as cited in Derham & Nikolaou, 2009) stated that a shortage in liquidity will lead to a higher interbank rate because the demand on those credits will increase. Therefore, the bank will suffer liquidity risk due to higher rates for funding liquidity in the secondary market (interbank rates).

According to Matz (2011) factors that may cause a liquidity crisis are classified as either endogenous or exogenous. Endogenous factors are related to the firm specific factors such as poor management, whereas exogenous factors are related to the whole financing system, or country rating downgrades. The results are endogenous and exogenous liquidity crises. While endogenous crisis is referred to bank specific crisis, the exogenous crisis is known as systemic crisis.

2.3.3.1. Bank Specific Liquidity Crisis

Bank specific liquidity crisis is related to the failure of the bank due to internal mismanagement in the liquidity risk. For, instance, banks with accurate liquidity risk management face lower exposures threats. According to Koch and Macdonald (as cited in Hong & Wu, 2013), banks with higher liquidity ratios and lower dependency on wholesale funding will face lower liquidity risk than those depending much on the wholesale funding. Other reasons might lead to this risk such as reputation risk as a result of a sudden loss of confidence in the bank which in turn leads to large cash withdrawals. Even though bank-specific liquidity risk is a major threat for the bank, Hong and Wu (2013) found in their research that the cause behind the financial crisis of 2008-2009 was the systemic liquidity risk rather than the bank-specific liquidity risk.

2.3.3.2. Systemic Liquidity Crisis

Exogenous crisis known as the systemic crisis is related to the whole financing system, which means a contagion effect is created in the banking system. Kaufman and Scott (2003) defined systemic risk as "the risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components, and is evidenced by co-movements among most or all parts". From the liquidity point of view, Allen and Gale (2000) stated that a small liquidity shock in one bank could affect the whole banking system. However, although a bank can immune itself from the non-systemic liquidity risk (firm-specific risk) by enhancing the liquidity risk management, it cannot immune itself from the systemic liquidity disruption because the latter is out of the control of the bank itself. This can be shown in the financial crisis of 2008-2009 where 60% of the banks failed due to this channel (Hong and Wu, 2013). Hence, the source of liquidity risk in some financial institutions is the risk attributed to the whole banking system.

2.3.4. Liquidity Risk Management Principles

The ability of the bank to meet its deposits withdrawals, loans requests and other cash outflows are the indicators of the bank's soundness. Hence, if the institution fails to meet those requirements, a lack of confidentiality will be developed which will lessen the bank operations and may lead to the failure of the bank. Furthermore, a liquidity crisis in one bank might have a systemic consequence by affecting the whole banking system as it happened during the financial crisis of 2008. Therefore, adopting a liquidity risk management is an essential part in drafting liquidity policy to ensure the success of each financial institution as well as the success of the whole financial system. The process will require quantifying, measuring, monitoring and controlling liquidity exposure in every financial institution through the supervision of Basel committee.

For the liquidity management to be effective, it is important to divide liquidity risk into different time horizons, each requiring a unique management approach. The short term liquidity management focuses on a time horizon of one year and requires an intra-day monitoring. The long term/structural liquidity management requires a comprehensive balance sheet management. Both managements are addressed by Basel Committee.

Regulations through Central bank and Basel committee is one to measure and manage liquidity risk, but there are other tools such as internal stress tests and cash flow based gap analysis. Internal stress tries to identify possible payment difficulties related to the bank liquidity, while the cash flow based gap analysis combines all current and expected cash inflows and outflows to identify any potential liquidity shortages. This part will focus only on the regulatory development to manage this type of risk.

2.3.4.1. Regulation of Commercial Banks' Liquidity by the Central Bank

In general, there is a trade-off between the costs and benefits of holding liquidity to determine how much liquid assets should the bank have. Banks should be liquid enough to meet depositors' withdrawals. However, banks can borrow at the discount window which provides them with a lower cost opportunity. Since the cost of borrowing from the discount window is higher than the low return received on cash and marketable securities, banks are more likely to invest their liquid assets rather than holding them. Moreover, banks tend to lower their liquidity level due to the insurance offered on the deposits. Consequently, the central bank introduced some regulations to reduce this moral hazard problem by imposing a minimum cash-asset reserve. According to Bouwman (2013), the reserve requirements were propelled in the United States at a national level with the National Bank Act in 1863. The latter was introduced to the financial system in order to create a stable national banking system as a way to resolve the financial crisis that emerged due to the American Civil War in 1861-1865. At the beginning, this Act required 25% reserve on bank notes (bank note is a negotiable instrument, known as a promissory note issued by the bank and payable on demand) and deposits for banks located in large cities and 15% for those located outside those cities. In the late of 19th and early 20th centuries, panics in banks proved that those reserve requirements were not a safeguard for the banking system (Calomiris & Gorton, 1991). As a result, the Federal Reserve Bank (The central bank in the United States) was created in 1913 to provide stability, safety and flexibility for the banking system by being the lender of the last resort. In 1980, the congress introduced the Depository Institutions Deregulation and Monetary Control Act (Feinman, 1993). This act was amended over

time to end up with the following reserve requirements that are imposed on all the depository institutions (Bouwman, 2013, p.10):

- The first USD 12.4 million deposits are exempted from reserve requirements.
- Deposits between USD 12.4 million and USD 79.5 million are subject to 3% as reserve requirements.
- The rest of the deposits are subject to 10% reserve requirements.

As for the Lebanese central bank, it follows the same procedures as for the Fed with the following percentages (Lebanese Banking Sector, 2015):

- 25% of their LBP demand deposits are required to be held as reserve
- 15% of their LBP term liabilities are required to be held as reserve
- 10% of their foreign currency liabilities should be liquid assets and at least 15% of these foreign currency should be foreign currency deposits.
- 40% of bank's equity must be denominated in LBP as liquid assets

Before the financial crisis of 2008, banks focused only on capital requirements. Then, there was a shift toward liquidity, and the Basel Committee raised the voice by calling for liquidity regulations to be implemented worldwide.

2.3.4.2. Basel Accord Development and Liquidity Requirements

After the breakdown of the Bretton Woods system in 1973 that led to the failure of many banks due to large foreign currency losses, a new committee, known as Basel Committee on Banking Supervision, was introduced by the G10 countries (Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom and the United States) in 1974, to enhance the financial stability in the financial market by imposing requirements on the banking system. The first requirement for liquidity risk was published in 1992, in a document entitled "A framework for managing and measuring liquidity risk" (Basel Committee on Banking Supervision, 1992). This document was updated in February 2000 within "Sound practices for managing liquidity in banking organizations" (Basel Committee on Banking Supervision, 2000).

Before the financial crisis of 2008, the main focus of the Basel committee was to ensure that banks had sufficient capital to meet up their risks. However, it turned out that liquidity risk was a major driven for the financial crisis and the failure of many large banks such as Lehman Brothers in the United States and Northern Rock in the United Kingdom. In response to this, the Basel Committee updated its requirements for liquidity risk management in 2008 in a paper entitled "Sound Liquidity risk management and supervision" (Basel Committee on Banking Supervision, 2008). This document was made of seventeen principles divided into 5 areas of focus, which are (1) Fundamental principle for the management and supervision of liquidity risk; (2) Governance of liquidity risk management; (3) Measurement and management of liquidity risk; (4) Public disclosure; and (5) The role of supervisors.

In 2010, "Basel III: International framework for liquidity risk measurement, standards and monitoring" was published followed by "Basel III: A global regulatory framework for more resident banks and banking systems" in 2011. Since then, many updates were released, such as "Basel III: The liquidity coverage ratio and liquidity risk monitoring tools" in January 2013 and "Basel III: The net stable funding ratio" in October 2014; (Basel Committee on Banking Supervision, 2015a, p.4). Appendix A provides a list of all documents related to liquidity, which are published by Basel Committee.

Basel III, which is an evolvement for Basel I, had enhanced certain requirements to control some critical issues faced during the last financial crisis. Imposing certain liquidity requirements on the banks will regulate the need of emergency liquidity assistance when banks face a liquidity shortage and will minimize the government responsibilities to bailout large banks during crisis.
Thus, Basel III introduced two main ratios that measure the ability of the banks to survive liquidity pressures, which will be discussed in details in the next section.

2.3.5. Liquidity Ratios

As mentioned before, Basel Committee published in 2010 the "Basel III: International framework for liquidity risk measurement, standards and monitoring" in order to increase the resistance of banks to liquidity shocks. The main two ratios introduced by Basel

Committee are liquidity coverage ratio (LCR) and net stable funding ratio (NSFR). The first objective is to promote the resilience of the liquidity profile of banks over a shorter term horizon by ensuring that banks have sufficient high quality liquidity asset to survive a stress scenario over 30 calendar days and LCR has been developed to achieve this objective. The second objective is to promote the long term resilience by ensuring that banks have more stable source of funding and NSFR has been developed for this purpose. While LCR applies to short term liquidity management, NSFR is related to long term structural liquidity management.

2.3.5.1. Liquidity Coverage Ratio (LCR)

Global Financial Stability Report (2011) stated that liquidity coverage ratio (LCR) was established to enhance the bank's ability to handle short term liquidity disturbance. Basel Committee on banking supervision (2013, p.7) stated that the aim behind LCR is to "promote the short-term resilience of the liquidity risk profile of banks". Concisely, LCR ensures that the bank is able to meet its short term obligations immediately through the conversion of its high-quality liquid assets (HQLA) in the market within a 30-day period. This will be reached by forcing banks to hold sufficient liquid assets, referred to high quality assets that will be the insurance for any short term liquidity outflow. Thus, LCR will assure that the bank will be able to absorb financial and economic shocks (Bank for International Settlement, 2013). This ratio is calculated as follows:

$$LCR = \frac{High\ Quality\ Liquid\ Assets\ (HQLA)}{Net\ Cash\ Outflows\ in\ a\ 30-day\ Period}$$

Basel requires the ratio to be greater than 100% in order for the bank to meet its short term obligations.

High Quality Liquid Assets (HQLA)

The HQLA are those assets that can be liquidated at any time or at least within a short period of time (30 days) without incurring significant losses. According to Basel Committee on Banking Supervision (2010), the characteristics of high liquid assets can be summarized as follows:

- The asset should be assigned by Basel as zero risk weight

- The asset should be highly liquid in deep markets
- The asset is traded frequently without a having a spread between bid and ask prices.

HQLA are classified into two categories. Level 1 category is referred to the most liquid assets such as cash, central bank reserves and some marketable securities. Level 2 category is classified into two sections. The first section is 2A assets that include certain government securities, corporate debt securities and covered bonds. The second section is 2B assets which include residential mortgage backed securities, lower rated corporate bonds, and some equities (Basel Committee on Banking Supervision, 2013).

Table 3 presents the different assets classes and how they are counted toward their liquidity buffer (Basel Committee on Banking Supervision, 2013):

<table>
<tr><td colspan="4">Stock of High-quality Liquid Assets</td></tr>
<tr><td colspan="3">Level 1 assets:
- Cash, Sovereign, Central banks and public sector
- Domestic sovereign debt for non-0% risk weighted sovereigns</td><td>100%</td></tr>
<tr><td>Level 2A assets:
- Sovereign central bank + PSE assets qualifying 20% risk weighting
- Qualifying corporate/covered bonds rated AA- or higher</td><td>85%</td><td>Level 2B assets:
- Qualifying RMBS
- Certain qualifying corporate debt securities and common equity shares</td><td>75%
50%</td></tr>
</table>

Table 3: Stock of High-Quality Liquid Assets

(Source: Basel Committee on Banking Supervision, 2013)

Net cash outflows in a 30-day period

The net cash outflows are defined as the total cash outflows minus the total cash inflows in a specified stress situation for a 30-day period of time (Basel III: The liquidity Coverage Ratio and liquidity risk monitoring tools, 2013).

The outstanding balances that mature in 30-day stress scenario are multiplied by their inflow rate (shown in Table 4). The expected cash outflows are calculated through the multiplications of outstanding balances of various categories by the rates assigned to each one at which they are expected to run out. As for the expected cash inflows, they are similarly calculated through the multiplication of outstanding balances of various categories by the rates at which they are expected to flow up to a total cap of 75% of total expected cash outflows (Basel Committee on Banking Supervision, 2013).

a. Cash Outflows

First of all, a distinction should be made between stable and less stable items. Stable Items are those items that are backed by a deposit insurance or a public guarantee. Such items have a lower run-off rate than the unsecured ones. Moreover, run off rates of the secured funds depend on the riskiness of the backed asset or the counterparty. Hence, the higher the insurance risk, the higher the run-off rate. The run-off rate can be summarized as follows (See Table 2.4) (Basel Committee on Banking Supervision, 2013):

- Funds secured by the central bank have an outflow rate equal to zero.
- Funds linked with other counterparties have an outflow rate equal to 15% for level 1 or 2A assets and higher for other assets.
- Derivatives business has an outflow rate equal to 100%.

b. Cash Inflows

Contractual inflows with interest payments are the only ones incorporated in the calculation, while reliant outflows are not. This is why the credit and liquidity facilities are not considered to be generators for cash inflows. Contractual receivables are used by multiplying them with their allocated inflow rates. In addition, the secured lending with a short period of maturity (30-day) are allocated to inflow rated depending on their backed collateral and counterparties as follows:

- Level 1 asset insurances are considered to roll over so their inflow rate is zero
- Other collaterals have inflow rates up to 100%.
- Non-financial wholesale and retail counterparties allocates a 50% inflow rate

- Financial institutions and central banks allocated a 100% inflow rate

Table 2.4 summarizes the cash inflows and outflows rates of the net cash outflows.

According to Basel Committee on Banking Supervision (2010), the LCR was planned to be implemented completely from 2015 on. However, there were some concerns regarding the negative implications of LCR on the lending procedures in part and on the economy as a whole. Therefore, the Basel Committee on Banking Supervision (2013) decided to start at 60% of LCR in 2015, to be raised 10% every year. However, some banks had started the early implementation of LCR (Watt, 2013).

Net Cash Outflows Under Stress			
Cash Outflow Rates		**Cash Inflow Rates**	
- Stable Deposits	3-5%	-Maturing Secured Backed by:	
- Less Stable Deposits	10%	o Level 1 assets	0%
- Term Deposits maturity >30 days	0%	o Level 2A assets	15%
- Certain Operational Deposits	5-25%	o Level 2B assets	25-50%
- Other Unsecured Wholesale funding	25-100%	- Amounts Receivable:	
		o Retail Customers	50%
- Secured Funding Level 1 assets	0%	o Wholesale	50%
- Secured Funding Level 2 assets	15-50%	o Financial Institutions	100%
- Other Secured Funding	100%	- Other Cash Inflows	0-100%
- Other Cash Outflows	0-100%		

Table 4: Composition of inflows and outflows rates

(Source: Basel Committee on Banking Supervision, 2013)

2.3.5.2. Net Stable Funding Ratio (NSFR)

Basel has introduced another liquidity measurement known as the Net Funding Ratio (NSFR) that measures the liquidity management of the bank for a one-year period rather than one-month period. Basel regulation obliges the bank to maintain a stable funding management of its assets and off-balance sheet items in order to minimize its likelihood to fail due to a disruption in its liquidity position. The aim behind NSFR is to encourage

the bank to manage its funding across on and off-balance sheet items rather than to depend only on short term funding, with the goal of promoting the stability in the bank funding profile. In brief, the objective of NSFR is to lessen future funding pressure by pushing the bank to fund its operations with suitably stable sources of funding (Basel Committee on Banking Supervision, 2014).

The ratio is calculated as follows:

$$NSFR = \frac{Amount\ of\ Stable\ Funding}{Required\ Amount\ of\ Stable\ Funding}$$

This ratio should be greater than 100%, so the amount of stable funding is higher than the required one.

Amount of Stable Funding (ASF)

It measures the stability of the bank's funding sources. It is calculated through the multiplication of each group of funding such as capital, retail deposits and sale deposits by its ASF factors, which reflects the stability of each liabilities and equity groups. For example, an ASF factor of 100% is given to regulatory capital with a maturity of more than one year. On the other hand, short term funding receives a factor of 0%, encouraging banks to reduce short term wholesale funding.

Required Stable Funding (RSF)

As for the required amount of stable funding (RSF), it is based on liquidity risk of the bank's assets and exposures (Bank for International Settlements, 2014). It is computed through the multiplication of the bank's assets and off-balance sheet items by its RSF factors that reflect the permanence of each assets category (Hull, 2012). High liquid assets are assigned a 0% factor, and the harder is to liquidate an asset, the higher is the RSF factor.

The ASF and RSF factors are settled after the financial crisis faced by the market in 2008, and more specifically as a result for the funding liquidity risk. Those ASF and RSF factors are listed in Table 5 and 6.

ASF Factors	Category
100%	• Total regulatory capital • Preferred stock and borrowing with a maturity greater than a one year period.
90%	• Stable demand and term deposits with a maturity less than one year given by retail and small businesses.
80%	• Less Stable demand and term deposits with a maturity less than one year given by retail and small businesses.
50%	• Wholesale demand and term deposits with a maturity less than one year given by non-financial institutions, sovereigns, central banks and public sector units.
0%	• All other liabilities and equities.

Table 5:ASF Factors for Net Stable Funding Ratio

(Source: Hull, 2012, p.293)

RSF Factors	Category
0%	• Cash • Short term securities, loans to financial entities for a maturity less than one year.
5%	• Marketable securities with maturity greater than one year with a 0% risk weight.
20%	• Corporate bonds with a maturity greater than one year and rated AA- or higher.
50%	• Equity securities, gold and bonds rated A+ to A-
65%	• Residential mortgages
85%	• Loans to retail and small businesses with maturity less than one year period.
100%	• All other assets.

Table 6:RSF factors for Net Stable Funding Ratio

(Source: Hull, 2012, p.294)

2.4. Impact of Bank Liquidity on Bank's Risk

2.4.1. Theoretical Framework

According to Handorf (2014), the banking system in some regions faced bank crisis every 10 to 15 years. Countries are incurring significant fiscal costs in order to bail out failed banks and central banks are suffering monetary exposures because banks ended up by borrowing from them. Thereby, in case of failures, the financial sector might not be able to rescue all banks, which will lead to the failure of the whole financial system. This part will focus on the review of relevant theoretical literature on the influence of liquidity on bank risk behavior.

2.4.1.1. Impact of Liquidity on Bank Risk

A high level of liquidity can be interpreted as a big pile of cash that has a negative signal on the institution. The positive relationship between liquidity and bank risk can be explained by two main theoretical frameworks, mainly the agency theory and the free cash flow hypothesis.

Agency Problem

Agency problem is defined as the conflicts of interest arising from the separation between principals (shareholders/owners) and agents (managers). Since managers are only agents, they might not apply the same effort required for shareholders' wealth maximization, or they may misuse the assets or waste some corporate resources (Shleifer & Vishny, 1997). Thus, the separation of ownership from the management can lead to manager taking actions that maximize their benefits instead of shareholders' wealth (Jensen & Meckling, 1976). To be more precise, agency problem is defined as "the welfare of one party, termed the principal, depends upon actions taken by another party, termed the agent. The problem lies in motivating the agent to act in the principal's interest rather than simply in the agent's own interest" (Armour, Hansmann & Kraakman, 2009, p.2).

This theory emphasizes the positive link between liquidity and risk. Acharya and Naqvi (2012) stated in their article that when banks have high level of liquidity, their managers tend to take more risk by fiercely lowering the lending standards for the purpose of increasing the volume of loans. This behavior is due to the fact that manager's

compensations are based most of the time on the volume of loans. To increase loan volume, managers are also encouraged to reduce the rate on loan, a rate lower than the one that maximizes shareholders' wealth. Since auditing to investigate managers' lending decisions is only performed in case of liquidity deficit, excess liquidity will make managers overconfident that their lending practices will not be investigated (Agenor & Aynaoui, 2009, and Berger & Bouwman, 2009). Moreover, Cao and Illing (2008) stated that liquidity gives insurance against aggregate risk which will encourage banks to overinvest in risky activities for higher return. Khan et al. (2015) affirmed in their article that agency problem may tempt managers to set loan rates lower than the rate that maximizes shareholders' profit for the purpose of increasing loan volume.

Furthermore, and based on the principal-agent theory, Cheng, Hong and Scheinkman (2015) explained that managers working in riskier firms require higher compensation since they face higher uncertainty. Thus, to achieve this higher compensation, risk averse managers are given more freedom and flexibility in setting aggressive lending strategies when there is an excess of liquidity.

Free Cash Flow Theory

A free cash flow is defined as the "cash flow in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital" (Jensen, 1986, p.112).

According to Jensen (1986), the access of managers to a free cash flow will induce them to waste shareholders' money through organizational inefficiencies, such as a renovation for their offices or through investing at below the cost of capital. Furthermore, the increase of excess liquidity will drive managers to enlarge the bank riskiness through an aggressive lending which will lead to a decrease in the value of the firm.

2.4.1.2. Impact of Liquidity on the Probability of Default

Karminsky and Kostrov (2014) defined the probability of default as the likelihood of a bank to fail for a certain period of time. This failure is attributed to the bad financial performance of the bank and its inability to meet its due debt. More precisely, the

probability of default can be measured as the percentage of the bank loans to default for a given period of time (Jouault & Featherstone, 2006).

According to Wagner (2007), the increase in asset liquidity is measured by the low discount rate on loan sales, while bank risk is measured by the probability of default. In normal times, the increase in asset liquidity does not have any effect on the stability of the bank, which means it does not have any effect on the probability of default. However, during financial crisis, a lower discount rate on loan sales reduces bank's stability, thus increasing the probability of default. Thus, he concluded by stating that the impact of asset liquidity on bank risk depends on the economic conditions. An increase in bank liquidity will increase bank risk, only during crisis. Besides, "when asset liquidity becomes large, capital requirements become a less effective instrument for ensuring stability. This is because the losses from the sale or the liquidation of assets in a banking closure become then small, making banking closure less of a threat for bank owners" (Wagner, 2007, p.123).

More so, according to Berger and Bouwman (2009), bank liquidity creation activity is positively coupled with bank's risk exposure. Hence, the greater the liquidity created, the greater the probability of losses, for the reason that banks create liquidity through selling long-term loans which are generally associated with more risk than investing in short-term government bonds when seeking to lessen the liquidity creation activity. In addition, Berger and Bouwman (2009) reports that liquidity creation does not only elevate the bank exposure to risk, but also it tends to be high prior to financial crises.

According to Fungacova, Turk and Weill (2015), a shortage or and excess in liquidity creation can be harmful for the bank's stability. First of all, a shortage in the bank liquidity creation may be associated with a higher probability of failure, for the reason that the raison d'être of banks is liquidity creation for the economy, therefore a shortage in this function will lead to a trouble. Banks with a low liquidity creation rely more on the volatile non-deposit long-term sources of funds instead of core funding, which increase the bank's exposure to sudden reduction in access to funding and therefore to a higher probability of failure. Second of all, as liquidity shortage can be damaging for the bank, high liquidity creation may also have severe implications on the bank's survival.

According to Diamond and Rajan (2001), bank liquidity creation is a major driver for the fragility of the financial system, noting that bank failures are more likely to happen when banks have a high level of liquidity creation. This is explained due to the fact that high liquidity creation forces bank to dispose their illiquid assets in order to meet the depositors' demand, therefore, increasing the probability of failures when assets become insufficient to meet banks' commitments.

2.4.1.3. External Factors affecting the relationship between Liquidity and Risk

There are some external factors that might affect the relationship between level of liquidity and bank risk, which could either strengthen or weaken this relationship.

Bank Capital and Bank Risk

Capital, being the difference between bank's assets and liabilities, is a cushion tool for unforeseen losses. In order for the bank to remain solvent, assets should exceed liabilities, and in order for the bank to withstand risk, capital should be high. Regulators are imposing certain minimum capital requirements to allow banks to absorb losses in case of failure. However, higher capital requirements for banks do not always lead to safer and stable banks.

Capital and liquidity are different but related concepts. Each one plays an important role in the function of the bank's viability and solvency. Distinguin, Roulet and Tarazi (2013) noted in their article that banks facing lower liquidity do not strengthen their solvency standards. They actually lessen their Tier 1 and Tier 2 capital when they face lower liquidity. However, according to Diamond and Raja (2001), the relationship between bank capital and bank liquidity creation is explained through two distinct effects: the financial fragility structure and the crowding-out effect. First, according to the financial fragility structure, the bank operates by collecting funds from depositors and lending them to borrowers. By monitoring the borrowers, the bank tends to have access to private information, which creates an agency problem by giving advantage for the bank to extort rents from its depositors by requiring a greater share of the loan income. As a result, depositors will become reluctant to deposit their money in the bank. Accordingly, the bank must gain the depositor's trust through a contract between the two parties which

gives the depositors the right to run on the bank in case of withhold effort. Therefore, the financial fragility hypothesis favors the liquidity creation in the bank through increasing the fund collected from depositors. In contrast, the presence of high level of capital tends to lessen the financial fragility and heighten the haggling power of the bank, which hinders the credibility of the bank. Therefore, the higher the capital, the lower the liquidity creation. As for the crowding out hypothesis, banks consider deposits as more effective hedge for agents than the bank equity investments. Actually, deposits are more insured and withdrawable at par value. However, bank capital has a stochastic value that depends on the state of the bank fundamentals and the liquidity of the stock exchange. Therefore, under-capitalized banks face larger challenges to provide funds, which push them to hold more liquid assets. Well-capitalized banks tend to hold lower liquidity by shifting the investors' funds from being liquid to illiquid. Thus, according to the fragility-crowding out hypothesis, capital and liquidity are negatively related. In contrast, Berger and Bouwman (2009) expand the risk absorption hypothesis, which states that higher capital enhances the ability of the bank to create liquidity. Liquidity creation increases the bank's exposure due to the fact that banks with higher liquidity creation tend to lose more when they are forced to sell illiquid assets in order to satisfy the liquidity needs of customers.

However, Koehn and Santomero (1980), Kim and Santomero (1988) and Gonzalez (2005) state that the implementation of the new capital requirement restricts the risk-return edge of the bank through forcing the bank to reduce their leverage. This might encourage the bank to reconsider their portfolio risk assets by increasing their risk taking behavior for the purpose of increasing their return. Furthermore, banks will tend to take on more profitable high risk loans in order to increase the value of equity (Blum, 1999). Therefore, the increase in capital requirements might have a negative effect on the risk taking behavior of the bank.

Nonetheless, Repullo (2005) states that an increase in the capital ratio of the bank causes a decrease in the bank liquidity. Higher capital implies higher losses for the bank in case of default, therefore, lower incentives for risk-taking. Moreover, Kochubey and Kowalczyk (2014) conducted the same research and found that there is "a negative coordination between bank risk and liquidity, which suggests that banks lower their

riskiness by increasing their liquidity position and increase risk-taking by lowering their capital" (p.17).

Moreover, according to Calem and Rob (1996), there is a U-shaped relation between capital and bank risk. This relationship implies that overcapitalized and undercapitalized banks are riskier than banks with intermediate levels of capital. Overcapitalized banks tend to increase their risk-taking behavior with an increase in the capital requirements. Undercapitalized banks are willing to take on higher level of risk because they can easily transfer the costs in case of default. However, an increase in the capital standards has a moderate effect on the risk taking behavior of intermediate capital level banks.

Bank Size and Bank Risk

It is expected that the bank size has an influence on the bank risk-taking behavior. On one hand, and according to Demsetz, Saidenberg and Strahan (1997), large banks tend to have a higher ability to enlarge their investments which allow them to diversify their portfolio investments in a way to be less risky in terms of specific risk. Smaller banks do not have the necessitated funds to broaden their horizons in order to minimize their risk-taking. Therefore, larger banks tend to be less risky than smaller ones. This inverse relationship between size and earning volatility has been supported by Haan and Poghosyan (2011) especially during the financial crisis. For instance, large banks tend to be more diversified than smaller banks, resulting in lower risk and return.

On the other hand, 'too big to fail' theory posits a positive relationship between risk and size. 'Too big to fail' is defined as a bank "that is perceived to require either or both special enhanced government regulation to discourage failure while alive and/or special resolution regime that does not have the insolvent firm resolved through the usual resolution processes that apply to other banks, at least with respect to allocating losses, when dead" (Kaufman, 2014, p.214). During the crisis of 1984, the government of the United States did not allow the failure of its eleven largest banks. Ever since, many concerns were raised regarding the 'too big to fail' hypotheses which gave incentives for largest bank to take additional risk. Hence, as a result of the 'too big to fail' hypothesis, investors will be willing to invest in large banks at a discount, which will trigger those banks to invest in riskier portfolios (Afonso, Santos & Traina, 2014). Moreover,

Wilmarth (2010) stated that the largest important financial institutions take the government help as granted and thus they engage in riskier activities.

Furthermore, the financial fragility crowding out and risk absorption hypotheses can explain the importance of the size in determining the relationship between capital and liquidity. First, the risk absorption hypothesis states that a positive relationship between capital and liquidity is more applicable for large banks. This hypothesis conceives that liquidity creation enriches the likelihood of losses for the bank, hence, the bank capital becomes more likely to absorb losses. Larger banks are more related to this hypothesis due to the fact that they are more exposed to regulators' examinations and market discipline. Henceforth, the risk absorption hypothesis predicts that higher capital enhances the ability of large banks to create more liquidity. Hence, a higher liquidity creation increases large bank's exposure to risk (Allen & Gale, 2004). Second, the financial crowding out hypothesis states that a negative relationship between capital and liquidity is more applicable for smaller banks due to the fact that smaller banks tend to raise more local funds than large banks (Fungacova, Weill & Zhou, 2010). A financial crowding hypothesis asserts that higher capital ratio crowd out deposits, thus reducing liquidity creation. Hence, a lower liquidity creation minimizes the bank's exposure to risk for smaller banks (Diamond & Rajan, 2001).

2.4.1.4. Liquidity and Asset Price Bubble

According to Hull (2012), asset price bubble can be described as a cycle where prices expand very fast above their fundamental prices until a point where a contraction in the market occurs leading to a decrease in the price. Indeed, the fundamental price of an asset is measured as the present value of its future cash flows and the price at which it is sold in the infinite future. Hence, a bubble is referred to the deviation of the asset price from its fundamental level (Semirumi & Reza, 2012).

According to Acharya and Naqvi (2012), bank's liquidity increases in the presence of risky macroeconomics situations due to the fact that investors in the economy prefer to save their money in form of deposits instead of making direct investments. As banks become flush with liquidity, managers tend to relax the lending standards in order to

increase the lending behavior, which leads to a credit boom and therefore to an asset price bubbles and may reach to a next crisis in the end.

2.4.2. Empirical Framework

2.4.2.1. Impact of Liquidity on Bank Risk

The aim of this research is to investigate the impact of bank liquidity on the bank risk taking behavior. Many previous theories and models have been attempted to examine this relationship through conducting regression analysis on different samples, which will be summarized as follows:

Altunbas et al. (2007) examine the relationship between capital, liquidity, risk and efficiency of European banks. The sample chosen for this research cross around 15 European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and UK) for a period between 1992 and 2000. The modeling framework adopted to estimate the relationship between bank risk and efficiency is based on Zellner's Seemingly Unrelated Regression approach (SUR). This approach allows for simultaneity between banks' risk, capital, liquidity and efficiency while controlling important other bank and country specific factors. The system of equations estimated include three models, including indicators of banking system liquidity, efficiency, return on capital and risk. The first model examines the banking sector risk by using the loan-loss reserves levels as a proxy for banking risk as dependent variable. The second model examines the bank capital levels, where capital is the dependent variable. And finally, the third model examines the determinants of bank cost inefficiency by using it as dependent variable. In addition, a variety of bank-specific and country-specific variables that explain the variation in European banks risk, capital and inefficiency are included to the regression analysis. The ending results on the European banks shows that changes in risk and capital as well the changes in capital and inefficiency are positively related. Hence, banks that are riskier and inefficient seem to hold more capital than the ones that are less risky. Therefore, there is a positive relationship between bank capital level and bank risk. As well, changes in risk and inefficiency are negatively related, signifying that more efficient banks tend to take on more risk. In addition, it appears there is a positive relationship between liquidity and

risk as banks with higher liquidity tend to have higher reserves levels. To end up, the results of this research suggest that banks with higher capital, liquidity and better efficiency tend to take on more risk.

Fungacova, Ariss and Weill (2013) examines the effect of liquidity creation level on the failure of Russian banks. The database used is based on an unbalanced panel of 33,000 quarter observations for the period crossing between 2000 and 2007. In order to gauge the effect of different levels of liquidity on the probability of bank failures, the authors conduct a panel logit model under the random effect assumption in order to capture the effect of both excessive liquidity creation and shortage in liquidity creation. The dependent variable is presented as a dummy variable, where it is equal to 1 if the bank's license is withdrawn and equal to 0 otherwise. The bank's license is withdrawn when the bank is no longer viable, which means the bank is failing. In addition, a variety of bank-specific and country-specific variables that explain the effect of liquidity creation level of the failure of Russian banks are included in the regression analysis. The result is that the excessive liquidity creation can be counterproductive for the bank. Liquidity creation above a certain threshold increases the probability of bank failure, which might lead eventually to the disappearance of the financial institution and even a reduction the volume of liquidity creation in the financial system.

Hong et al. (2014) examine the relationship between the new liquidity risk measures (liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR)) and U.S. commercial bank failures. The database is based on quarterly data set that includes 334,365 bank-quarter observations for a period crossing from 2001 to 2011. When examining the link between liquidity risk measures and bank failure, a binary performance variable was used to indicate whether a bank fail within the next 12 months. A lagged variable is created to capture this effect; it is equal to 1 when the bank fails within the next 12 months (flagged as bad), 0 otherwise (flagged as good). The authors applied a dynamic discrete-time hazard model, in which the bank failure hazard consist of two major components. The first component is the solvency component which consists of the first eight variables used in the Moody's RiskCalc model (the capital ratio, return on assets, net interest margin, loan mix (sum of commercial and industry loans and

commercial real estate loans to total assets ratio), OREO ratio (other real estate owned total assets ratio), size, consumer loan charge-off ratio, and commercial loan charge-off ratio). The second component is the liquidity risk component, which is the single bank-specific liquidity risk measure in the Moody's RiskCalc model. The risk component is measure by the TED spread (spread of the three-month LIBOR over the three-month treasury rate), liquidity coverage ratio and net stable funding ratio. The results show that liquidity risk affects the bank system in an idiosyncratic and systemic way. The probability of failure of the U.S commercial banks is negatively related with the NSFR (a measure of funding stability) but positively related with the LCR (a measure of asset liquidity). Therefore, high funding stability lessens the bank probability of failure, nonetheless, high liquidity increases the probability of bank failure.

Combola, Ho and Huang (2015) examine the impact of leverage and liquidity on the behavior of earnings and capital management of U.S. commercial banks. The study employs data from 124 active U.S. commercial banks with 1890 observations for the period crossing from 1999 to 2013. In order to examine the effect of leverage and liquidity on the banks' earnings and capital management, three leverage ratios including Tier 1 capital ratio, total capital ratio, equity ratio and two liquidity ratios including liquid assets over deposits and short-term funding and liquid assets over total assets were used. As for the measures of earnings and capital management, the loan loss provision(LLP), the net charge-off (NCO) and the abnormal loan loss provision (AbLLP) were regressed. In addition, a variety of control variables that explain the impact of leverage and liquidity on the earning behavior of banks were added to the regression analysis. The findings of this research indicate in the first place that banks tend to increase their capital, liquid assets and earnings management behavior after a financial crisis. In second place, the earnings measures have a positive relationship with leverage ratios, but a negative relationship with liquidity ratios. Banks with low liquidity rate tend to engage more in earnings and capital management behavior than banks with high liquidity when liquidity increases.

Khan et al. (2015) examine the impact of bank liquidity on U.S. bank risk-taking behavior. The sample used in this research analysis is based on a quarterly data consisting

of 166,567 bank-quarters for unique 4,749 U.S. bank Holding Companies for the period crossing from 1986 Q4 to 2014 Q4. In order to capture the impact of bank liquidity on the risk-taking behavior of banks, a panel data regression with heteroscedasticity robust standard errors was used. The empirical model consists of the dependent variable, which measures the bank risk and the explanatory variables consisting of bank characteristics and country-specifics, which may influence the risk-taking behavior of the bank. The bank risk is measured through five different ways; the net interest income (NII), the non-performing assets (NPA), the loan loss provision (LLP), the risk weighted assets (RWA) and the Z-score. As for liquidity, it is measured through total deposits over total assets. The empirical evidence shows that more liquid banks tend to take on more risk. The results show that an increase in bank deposits reduces net interest income (increases banks risk). Similarly, an increase in deposits increases the loan loss provision and risk-weighted assets, indicating that a high level of liquidity triggers banks risk. Moreover, an increase in bank deposits reduces the z-score and capital buffers, which reflects that a higher level of liquidity makes banks riskier.

2.4.2.2. Impact of Liquidity on Profitability

Bank profitability measures how well the bank generates revenues from its capital. It shows the overall performance of the bank over a period of time, and it is used as a comparative tool across the banking industry at the same time. Indeed, the bank performance is diagnosed by the stability and the profitability of the bank. The stability denotes the risk factors of the bank and the profitability denotes the financial return of the bank. For a better understanding of the relationship between risk and return, several studies tried to investigate it, however, there is no consensus upon this topic. While some studies found a significant positive relationship between these two variables, other studies found a negative relationship.

Starting with the positive relationship between liquidity and bank performance, Bourke (1989) studied the performance of banks in Europe, North America and Australia and reviewed the determinants of their profitability. The results point that the liquidity ratios measured by loan to assets, loan to deposits and cash rations have a positive effect on the profitability of the bank.

In the same line, Dietrich and Wanzenried (2011) studied the determinants of the profitability of Switzerland banks before and during the crisis. The results found that a growth in the loan volume (lower liquidity) tend to have a positive effect on the bank profitability, which clarify the negative effect of liquidity on the profitability of the bank. Moreover, banks that severely depends on interest income are considered to be less profitable banks than those who diversify their interest income.

In contrast, Molyneux and Thornton (1992) reviewed the profitability determinants of European banks for the period between 1986 and 1989. They found a negative relationship between liquidity ratios and bank profitability, with a weak effect of liquidity on profitability as liquidity represents a cost to the bank.

Furthermore, Kosmidou, Tanna and Pasiouras (2012) studied the impact of bank-specific characteristics, macroeconomic situations and the financial market structure of UK commercial banks for the period between 1995 and 2002. The results point that the net interest margin, as a measure of bank profitability, tends to be negatively related to liquidity indicators. However, this relationship can be affected by external factors such as inflation, macroeconomic policies and economic growth. Furthermore, Kosmidou (2008) studied the determinants of the Greek banks' performance during the EU financial integration. The research points that internal characteristics of banks such as liquidity is negatively associated with the return on assets, hence, with the profitability of the bank. However, this relationship turns to be positive and insignificant when macroeconomic factors and other financial structure are taken into consideration.

Bordeleau and Graham (2010) investigated the impact of liquid assets holdings on the profitability of U. S. and Canadian banks. The sample chosen include 55 U. S. banks holding companies (BHC) and 10 Canadian banks for the period crossing from Q1 1997 to Q4 2009. The model applied in this research analysis is based on a panel two-step GMM procedure with bank and time fixed effects. The econometric framework regresses the dependent variable, banks profitability, against a non-linear expression of relative liquid asset holding, in addition to a set of explanatory variables that explain the relationship between liquid assets holdings and bank profitability. The ending result shows that bank profitability improves as liquid assets increase up to a point, where

further liquidity lessens the banks' profitability. This result is consistent with the notion that funding markets reward banks for holding liquid assets, but at some point this reward is settled down by the opportunity cost of holding such low-yielding assets. Therefore, the conclusion is a non-linear relationship between the level of liquidity and profitability of the bank, i.e. the profitability of banks with moderate level of liquidity is higher than those with a higher level of liquidity and those with a lower level of liquidity. This is the result of the presence of the opportunity cost of investing that excess liquidity in high return investments rather than holding it as a liquid asset.
In addition, Handorf (2014) states that a high level of liquidity negatively affects the net interest margin, which means that the bank will incur lower interest income from short term debt and will pay higher interest expenses on long term deposits. As a result, ROA and ROE will be much lower.

Ly (2015) examines the relationship between liquidity risk, regulation, supervisions and bank performance. The sample chosen in this research analysis consists of 4114 banks from 23 countries from the European Union with the exception of Estonia, Latvia, Malta and Slovakia for the period crossing from 2001 till 2011. This paper employs a panel regression method, the random effect model, where the net interest margin is considered as the dependent variable measuring bank performance. In addition, some explanatory variables representing bank specific characteristics, industry level characteristics and country specific characteristics were included. The regression analysis shows a negative relationship between liquidity ratio and the bank performance, indicating that banks with high level of liquid assets are unlikely to earn higher profits due to the opportunity cost of holding low-yielding assets. As for the bank size, income diversification, efficiency in expense management, GDP and foreign ownership, they have a negative relationship with the bank performance, while capital strength and composition of assets and liabilities are positively related to interest margins. Regarding the capital regulations, official supervision and restrictions on banks' activities shows a positive relationship with the bank performance while deposit insurance and private monitoring practices shows a negative relationship with the bank performance.

Chapter 3
Methodology

The purpose of this research is to investigate the effect of liquidity on the bank risk. Thus, this chapter presents the research design, the research questions and hypotheses, data collection, and the methodology used to address the formulated research questions.

3.1. Research Approach

Leedy and Ormrod (2001) defines research as the mean used to collect, analyze and interpret data needed in order to highlight a certain phenomenon. The research process defines the objectives, manages data used and interprets the findings in a systematic manner. Hence, researchers must choose the right research methodology in order to obtain efficient findings (Williams, 2007).

Bryman (1988) states that the decision to choose the right research instrument is based on its appropriateness to answer the research questions. However, there are three approaches to conduct a research; quantitative, qualitative and mixed methods. The choice behind choosing between those three approaches is based on the type of data needed to answer the research questions (Williams, 2007).

The quantitative research is defined as a social research that uses empirical statements (Cohen, Manion & Morrison, 2000). It is a descriptive statement about what is going in the real world rather than what must be the case. Besides, Marshall (1996, p.522) states that "the aim of the quantitative research method is to test pre-determined hypotheses and produce generalizable results". The methodology used in this approach focuses on obtaining market data by means of number and statistics. The main advantage behind conducting a quantitative approach is that data is examined critically and in a reliable way. Nonetheless, the main disadvantage of this research methodology is that there is no human perception nor beliefs interaction (Choy, 2014).

The second approach is the qualitative approach, which is used when the research does not know what to expect. The qualitative approach is similar to the quantitative one from the perspective that both are based on empirical investigations. However, it analyses

information from human perspective and generates case studies rather than numerical data (Williams, 2007). The main advantage of this approach is that it allows researchers to view a homogeneous exploration as well a diverse and representative cross section of the community. However, there are many drawbacks for the qualitative methodology. Firstly, the process is time consuming and secondly, the research is deeply involved in the data examination, which gives the researcher a subjective assessment of the study (Choy, 2014).

Caracelli states that "a mixed method study is one that plan-fully juxtaposes or combines methods of different types (qualitative and quantitate) to provide a more elaborated understanding of the phenomenon of interest (including its context) and as well, to gain greater confidence in the conclusions generated by the evaluation study" (as cited in Johnson, Onwuegbuzie & Turner, 2007, p.119). The combination of both quantitative and qualitative data provides the research with a more complete understanding of the research issue than either method might provide alone. The quantitative method covers a broad survey of the research in order to generalize the results to the whole community and the qualitative method runs an open-ended interview in order to have a detailed view from the participants that will clarify the quantitative survey results (Creswell, 2014).

In our study, the quantitative research will be the appropriate method to be used, since our research examines an experimental research that will test the accuracy of a theory through determining the effect of the independent variables on the dependent one. Therefore, a statistical measurement will be deduced from a numerical data focusing on the effect of liquidity on the bank risk. The target community of this study is the commercial banks operating in Lebanon.

3.2. Research Questions and Hypotheses

The purpose of this thesis is to analyze the impact of bank liquidity on the bank risk taking from the perspective of the Lebanese banks. This finding is critical given that Basel III had currently increased the bank liquidity requirements, thus it is important to know whether these requirements will minimize bank's risk or not. Therefore, the research questions of this study will be summarized as follows:

1- What is the impact of liquidity on lending behavior of banks?
2- What is the impact of liquidity on the total risk of banks?

Henceforth, hypotheses will be formulated in order to study the relationship between liquidity and bank risk taking. A hypothesis is one of the fundamental tools for research in any kind of examination. Cherry (2016) defines a hypothesis as a testable estimation about the relationship between two variables or more. Typically, a hypothesis test involves two competing hypotheses: the null hypothesis (H_0) which is given the benefit of doubt and the alternative hypothesis (H_1) which is given the burden of proof. Hence, a hypothesis test observes the significance of the available data supporting H_1.
However, there are two possibilities of drawing incorrect results as follows (Glasserman, 2001):

- Type one error results when we reject the null hypothesis when it is true.
- Type two error results when we accept the null hypothesis when the alternative hypothesis is true.

Thus, one of the conventions for statistical hypothesis testing is the p-value method which will be adopted in this research. The p-value approach measures the compatibility of the research data with H_0, so it refers to the possibility of having an effect at least as extreme as the one in the research data in case of a true null hypothesis. Thus, a high p-value refers to a true null hypothesis and a low p-value refers to a false null hypothesis. Furthermore, the p-value is compared to a level of significance (alpha), which is the critical region. Hence, the latter stipulates the acceptable risk of type one error that refers to a rejection of the null hypothesis when it is true. Henceforth, the typical value chosen for alpha is 5% (Frost, 2014) so a p-value lower than 5% allows to reject the null hypothesis (Thisted, 2010, p.5). In general, researchers lessen the significance level to 1% in cases they are not willing to accept higher risk in their assessment. In this research, an alpha of 5% will be used to test the impact of liquidity on the bank risk taking.

The null hypothesis in this thesis states that there is no relationship between liquidity and bank risk behavior and the alternative hypothesis states that there is a relationship between the level of liquidity and bank risk. Consequently, the hypotheses used in this research are as follows:

H_0 : There is no relationship between liquidity and bank risk

H_1 : There is a relationship between liquidity and bank risk

Accordingly, this hypothesis will be divided into sub-hypothesis which will examine the relationship between liquidity and bank taking risk depending on how risk will be defined, which will be discussed later on.

3.3. Data and Variables

3.3.1. Data and its Sources

Data can be classified as either primary or secondary data. The primary data is defined as the data collected by the researcher for the purpose of solving a specific research problem. Basically, it is a first-hand data that was not collected by anyone else. The secondary data is defined as the data collected by someone other than the researcher himself/herself, either from published or unpublished sources. Secondary data is used by the researcher to present an evidence or to back-up a certain argument (Hox & Boeije, 2005). This thesis will use secondary data, consisting of published documents such as banks' annual reports.

This study will focus only on commercial Lebanese banks. Annual bank specific data will be gathered from Bankscope that entails the financial statements of all Lebanese banks needed. However, in case of missing data, it will be filled using the online website of each bank in order to make sure of the accuracy of the research results. The selection of the period conducted in this research will be based on the latest period provided by Bankscope database, going 7 years backward. Investment banking and Islamic banking will be excluded from this study, and commercial banks without at least five consecutive financial reports or without unconsolidated reports will be excluded (Beck, Onweugbuzie & Turner 2013). The final sample size includes 21 banks for a period of 7 years as follows:

- Bank Audi
- Bank Blom
- Fransabank

- Byblos Bank
- SGBL
- Bank of Beirut
- Bankmed
- Banque Libano-Francaise
- Credit Libanais
- BLC Bank
- IBL Bank
- Credit Bank
- Bank Bemo
- Lebanon & Gulf Bank
- MEAB
- Emirates Lebanon Bank
- HSBC Bank Middle East
- Federal Bank of Lebanon
- Bank de L'industrie et du Travail
- Ahli International Bank
- CSC Bank

3.3.2. Variables

According to Patel (2009), a variable is defined as a feature that must vary from one element of analysis to another one. To be more precise, it is a characteristic that varies upward or downward over time, or a concept that changes in each situation. However, there are several ways to classify variables; one of them is through the classification of dependent and independent variables. The dependent variable is defined as the variable that depends on the variation of another variable. It is the variable that the researcher wishes to elucidate its variation (Patel, 2009).

As for the independent variable, it is defined as the presumed source in an experimental study. It is the concept that explains the variations in the dependent variable. Therefore,

the independent variables, also known as the explanatory variables are the predecessors while the dependent variable is the successor (Patel, 2009).

3.3.2.1. Dependent Variables

Since this study aims to investigate the impact of liquidity on bank risk behavior, the dependent variable will be represented by bank's risk. "A risk is a potential for a loss. The loss is the realization of that negative potential. A risk is running across a busy street blindfolded. A loss is getting hit by a car while doing that" (Strachnyi, 2012, p.27). Hereafter, Galati (2003) defines risk as a situation in which there exists an exposure to adversity or a probability that the actual outcome on an investment will be lesser that the expected one. There are various types of risks such as credit risk, liquidity risk, interest rate risk, and capital risk. Although bank risk can be measured in many different ways, the focus of this thesis will be on credit risk and on the overall riskiness of banks.

Bank Lending Risk

Pyle (1997) defined lending risk or credit risk as the potential that a bank's borrower will fail to meet its obligations according to the terms agreed on. However, there is no single way to measure this risk. In this thesis, credit risk will be measured in two ways. First, according to Acharya and Naqvi (2012), a low bank lending rate indicates an aggressive lending, thus leading to bank risk. Thus, a low net interest income divided by total loans can be used as a proxy for this risk, whereby net interest income is defined as interest income minus interest expenses. Second, loan loss provisions can be also considered as a measure to this risk, where a higher loan loss provisions indicates that banks are taking more risk.

Overall Bank

The bank overall risk will be measured as the risk weighted assets to total assets ratio, similar to previous studies (Hussain & Hassan (2004); Zribi & Boujelbene, 2011; Brunoa, Nocerab & Restic, 2014). According to Hull (2012), the total risk weighted assets for on-balance sheet is calculated through the multiplication of the weight assigned for each category in reference to Basel to the principal amount of the item. As for the off-balance

sheet items it is expressed as a credit equivalent amount, which is the principal that is considered to have the same credit risk.

In summary, bank risk will be measured as the ratio of net interest income to total loans, loan loss provision to total loans and risk weighted assets density. However, since lower net interest income implies higher risk, while higher loan loss provision ratio and higher risk weighted assets density signal higher risk, and to facilitate a more consistent interpretation, the values for net interest income will be multiplied by -1 so that a higher value for all bank risk measures indicates higher risk.

3.3.2.2. Independent Variables

The independent variables will be divided into the independent test variable and the independent control variables. The test variable is the bank liquidity while the control variables include bank characteristics which are commonly adopted in the literature as potential determinants of bank risk.

Independent Test Variable: Bank Liquidity

Crockett (2008) defined liquidity as the cash realized immediately from the sale of an asset. Liquid assets are referred to those that can be transformed into cash in a short period of time at a negligible loss, such as government bills and marketable securities. At the same time, Elliott (2014) stated that liquidity is not only the direct cash held by the bank or accounts held at the Federal Reserve and other central banks, but it also includes other assets that can be easily transformed into cash.

There are concerns that high liquidity can lead to higher risk. To maintain a high liquidity ratio, banks earn less interest income but they still pay higher interest expenses. Thus, liquidity regulation can adversely affect bank profitability and push banks to increase their risk (Handorf, 2014).

Liquidity is the key variable in our analysis since the thesis' objective is to see the impact of a high level of liquidity on bank undertaking of riskier activities. Yet, there is no consensus on how liquidity is measured. Bank liquidity could be measured as total deposits over total assets. Deposits endogenously determine bank liquidity reserves

(Acharya & Naqvi, 2012). However, this thesis will adopt Altunbas et al. (2007) and Ly (2015) way of measuring liquidity, whereby liquidity is measured as the ratio of liquid assets to total assets.

The higher the liquidity, the higher the bank's ability to absorb losses. However, banks with high liquidity are not profitable since liquid assets provide lower income, therefore, banks might undertake riskier activities to generate higher income.

H1: Higher bank liquidity leads to higher bank lending risk.

Independent Control Variables

These variables are bank specific characteristics that are included either because they are commonly used as a main determinant of bank risk or because they might have an effect on the relationship between bank liquidity and bank risk. These variables are bank capital, bank size, ROA, loans ratio, and deposits ratio (Casu, Clare, Sarkisyan & Thomas 2011; Shrieves & Dahl, 1992; Rime, 2000; Lee & Hsieh, 2013).

Bank Capital

Elliott (2010, p.2) defined bank capital as "the portion of the value of a bank's assets that is not legally required to be repaid to anyone". Capital is considered as a cushion against losses, thus, Basel Committee had set a minimum capital requirement to ensure the stability of banks. On one side, banks with a high level of capital are able to take more risk without falling below the required regulatory capital. They are also induced to take more risks since higher capital requirements reduce bank's profits (Gonzalez, 2005). On the other side, some studies have argued that capital regulation encourages banks to reduce bank risk in order to meet capital requirement or in order to avoid falling below minimum capital requirements, so the implementation of capital adequacy requirements could reduce risk taking behavior of commercial banks (Furlong & Keeley, 1989; Repullo, 2005; Konishi & Yasuda, 2004). In order to meet higher capital ratios, banks try to reduce high risk assets (Hyun & Rhee, 2011). Other researchers found a U-shape relationship between capital and bank risk, where undercapitalized banks reduce their risk as capital increases, while well-capitalized banks increase their risk as capital

increases (Calem & Rob, 1996). In light of these findings, we expect that well-capitalized banks are more willing to take risks than less capitalized banks.
In this thesis, capital is measured by the capital adequacy ratio, calculated as the summation of Tier 1 and Tier 2 capital over the risk weighted assets (Fatima, 2014). Alternatively, capital could be measured as equity divided by total assets, whereby a higher ratio indicates higher capital or as debt over total equity which indicates how much the bank is using debt to finance its assets (Estrella, Park & Peristiani, 2000).

Banks with higher capital and liquidity levels are willing to take on more risks, since higher equity is considered as a safeguard that absorbs losses in shocks situations.

H2: Well-capitalized banks take more risks in response to higher bank liquidity

Bank Size

The size of bank is considered as a major factor that might have an effect on the bank lending risk and total risk. Some researchers found that an increase in bank risk reduces risk since larger banks have more opportunity to diversify (Demsetz et al., 1997). Similarly, Boyd and Runkle (1993) found that larger banks tend to have smaller volatility of asset return, thus conveying lower risk. However, other researchers have found that large banks tend to take on more risk due to the 'too big to fail' theory. According to Panzera and Rossi (2011), large institutions tend to increase their risk taking behavior, as they exploit the implicit guarantee offered by the government in case of failure. Furthermore, Brewer and Jagtiani (2013) state that large banks benefit from uninsured funding and lower regulatory costs on their banking activities by increasing their risk taking behavior. Since the financial crisis of 2008, the Basel Committee on Banking Supervision had established certain indicators to specify if the bank is big enough to be globally important. However, the Federal Deposit Insurance Corporation (2012) used the asset-size as the indicator to measure the bank size through specifying $ 1 billion as a benchmark to separate larger banks from smaller banks. In this thesis, bank size will be measured as the natural logarithm of total assets. Based on the previous discussion in the literature review, bank size is expected to have a positive relationship on the effect of

liquidity on bank's risk since larger banks tend to take on more risk due to the too big to fail theory.

H3: Larger banks take more risk in response of higher liquidity

Profitability

Profitability is one of the banks' characteristics that might have an effect on the bank risk behavior (Casu et al., 2011; Laeven & Levine, 2009). Obviously, banks with a poor profitability tend to invest more in riskier activities in order to increase their return. In addition, Jensen and Meckling (1976) mention that more profitable banks tend to have lower risk-taking incentives than lower profitable banks. In contrast, Martynova, Ratnovski and Vlahu (2015) found in their research that a high level of profitability allows banks to borrow and invest in riskier investments on a larger scale. In general, banks operate in correspondence to a fixed core business. They tend to increase their risk by investing in side risky activities in conjunction with a profitable core business. According to Doehring (2001), the return on equity is a financial ratio used to measure profitability. Thus ROE ratio, defined as net income divided by total equity, will be used in our research to measure bank profitability.

H4: There is a negative relationship between return on equity and bank risk.

Loan ratio

Loans are categorized as the major items on a bank's balance sheet and the source of the largest flow of revenue income. However, loans are also considered to be the least liquid assets items and the major source of credit and liquidity risk for the bank (Saunders & Cornett, 2016). In this study, the loan ratio, measured as net loans to total assets, will be used in order to capture the bank's exposures to loans' default. According to the World Council of Credit Union (2002), the net loans to total assets ratio is a quantitative analysis used to measure the percentage amount of the banks' assets that are invested in loans. Taillard (2012) states that banks with high level of loan ratio indicates that those banks are investing their deposits in form of interest-bearing loans in order to generate more income. Many studies have found a positive relationship with loan ratio and banking

problems, where a higher ratio increases NPL and insolvency (Blasko & Sinkey, 2006). Therefore, the higher the ratio, the higher the risk.

H5: There is a positive relationship between loan ratio and bank risk.

Efficiency Ratio

Banks' efficiency is a key financial measure used to value the bank's ability to turn resources into revenue. It gives a clear view of how efficiently the bank is being run (Money Week, 2013). Recent studies had used the cost to income ratio as a proxy for efficiency, where a high ratio indicates a lower efficiency (Ghosh, Narian & Sahoo 2003). This ratio is considered to be a popular measure due to its easiness and simplicity to estimate. Tripe (1998) defines the cost to income ratio as the operating expenses (non-interest costs which are administrative and fixed costs) divided by the operating income (net interest income and non-interest income). The ratio does not include bad and doubtful debt expenses due to the fact that those expenses reflects the quality of previous decisions and not the current performance of the bank. Henceforth, it focuses more on the banks' operating expenses, since, a rise in the ratio means that costs are rising at higher rate than income (Money Week, 2013).

According to Hess and Francis (2004) and Money Week (2013), there is an inverse relationship between efficiency ratio and bank's risk. A high cost to income ratio indicates low efficiency, which is positively associated with an increase in NPL, bad management, poor skills in credit scoring and monitoring, thus leading to a higher risk (Berger & DeYoung, 1997).

H6: There is a positive relationship between cost to income ratio and bank risk.

Revenue Diversification

Demsetz et al. (1997) defined diversification as a tool used in order to reduce the return variance of a portfolio consisting of financial assets. Revenue diversification is one of the banks' characteristics that might have an effect on the bank risk behavior. There are various activities that provide non-interest income such as fees, commissions, and trading. The greater the proportion of these activities in a bank's portfolio, the greater is

the diversification. According to Diamond (1984), diversification helps to reduce all types of risks. Odesanmi and Wolfe (2007) found a positive relationship between revenue diversification and bank stability, due to the fact that revenue diversification lengthens the distance to default. However, some authors found that diversification might encourage banks to take more risks. Banks will offset the risk reduction benefits of revenue diversification by rising risk taking in other areas. De Jonghe (2010) found that traditional banking activities are less risky, so diversified banks will tend to exhibit higher risk. This positive relationship between revenue diversification and risk was supposed by many studies (Demirguc-Kunt & Huizinga, 2010; Stiroh, 2004). In this study, Herfindahl Hirschmann Index will be used to calculate revenue diversification, which is defined as follows (Odesanmi & Wolfe, 2007):

$$RVD = \left(\frac{NON}{NETOP}\right)^2 + \left(\frac{NET}{NETOP}\right)^2$$

Where:

NON represents the non-interest income, which is the sum of net commission fees, net trading loss or profit and other non-interest income.

NET represents the net-interest income, or interest income minus interest expenses

NETOP represents the net operating revenue = (NON+NET)

The maximum of HHI being 1 represents the lowest level of income diversification. Thus, the higher the HHI is, the lower the diversification is.

H7: There is a negative relationship between revenue diversification and bank risk.

Crisis

According to Claessens and Kose (2013), a financial crisis is caused by one or more phenomena such as severe disruptions in financial intermediation and the supply of external financial to various branches in the economy, changes in credit volume and asset prices or even large scale problems in the balance sheet of highly significant financial institutions or firms etc... In addition, Bordo et al. (as cited in Cecchetti, Kohler & Upper,

2009, p.9) defines a banking crisis as a period of "financial stress resulting in the erosion of most or all aggregate banking system capital". Financial crises have large economic cost; it contributes to the build-up of risk by many institutions in the period preceding the crisis (Altunbas, Manganelli & Marques-Ibanez, 2011). As well, Claessens and Kose (2013) states that there are many recessions associated with financial crises; indeed, the average duration connected to a financial crisis is six quarters, which is double the duration associated with a normal recession. The financial crisis of 2008 is captured by creating a dummy variable, which is equal to one for the years greater than 2009 and zero otherwise.

H8: There is a positive relationship between a financial crisis and bank risk.

3.4. Technique of Data Analysis

"The data analysis is the process of bringing order, structure and meaning to the mass of collected data" (Marshall & Rossman, 1990, p.111). The data analysis techniques adopted in this research are the descriptive statistics, correlation techniques and the regression analysis. First of all, the descriptive analysis is a method used to transform the available data into a form that will make it easy to interpret and understand (Bluman, 2014).

Second of all, the correlation analysis is a technique used to determine how strongly two variables are related. It reveals itself when there is a linear relationship between two variables in a dataset. Pearson Product-Moment Correlation Coefficient measures the correlation between the independent and the dependent variables as well the correlation between two independent variables. The value resulted from Pearson correlation ranges between -1 to 1. A value of -1 shows a perfect negative correlation, which means that if one variable gets bigger, the other variable will get smaller. A value of 1 represents a perfect positive correlation, which means that if one variable gets bigger, the other variable will get bigger as well. The closer the value to the extreme, the closer the relationship between the two variables tested. However, a value equal to zero means that there is no correlation observed, hence, there is no linear relationship in the data being analyzed (Stockwell, 2008). Pearson's correlation coefficient is denoted by r and is defined as follows:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2}}.$$

Third of all, a regression analysis is a statistical tool used to investigate the nature of the relationship between a single variable known as the dependent variable and with one or more variables known as the independent variables, to see if it is a positive or negative, linear or non-linear relationship. A regression can be categorized into three different categories; the simple regression, the multiple regression and the multivariate multiple regression. First, a simple regression analysis analyzes the variation of one dependent variable with one independent variable. Second, a multiple regression analyzes the relationship between one dependent variable and multiple independent variables. Finally, a multivariate multiple regression analyzes the variation in more than one dependent variable with multiple independent variables (Faraway, 2002). In our research, a multiple regression analysis will be conducted, namely the fixed effect model.

3.4.1. The Model

The panel data, also known as longitudinal or cross-sectional time-series data, is a database in which the behavior of entities are perceived through time. The best use of this database is when the outcome variable might depend on the independent variables that are not observable but correlated with the observed independent variables. When those omitted variables are constant through time, panel data will estimate the effect of the observable independent variables (Schmidheiny, 2015). A panel data is considered to have the scopes of both database: time-series and cross-sections. Hence, "by combing cross-sectional and time-series data, one can increase the number of degrees of freedom, and with it the power of the test, by employing information on the dynamic behavior of a large number of entities at the same time" (Brooks, 2008, pp528). By combining time-series and cross-sectional database, the additional variation introduced can also help to moderate the presence of multicollinearity issues that may arise if the database is modelled individually (Brooks, 2008). Thus, the general form of the panel data can be denoted as follows:

$$Y = \propto + \beta X_{i,t} + e_{i,t}$$

Y represents the dependent variable, which is the bank risk or bank lending risk

X represents the independent variables in the model

e represents the disturbance term

$\propto$ is a constant term

β represents the regression coefficient of the explanatory variables

i and t represents the cross-sectional and time-series dimensions respectively

Henceforth, according to the above model and based on the explanatory variables chosen, this study will use the following econometric model:

$$Risk_{i,t} = \propto + \beta_1 LIQ_{i,t-1} + \beta_2 CV_{i,t} + TD_{i,t} + e_{i,t}$$

Where Risk = Bank risk or Bank lending risk

LIQ = Liquidity ratio

CV = Control variables

TD = Time dummies

The dependent variable, Lending Risk, is measured as loan loss provision over total loans and net interest income over total loans. The bank total risk is measured by the risk weighted asset density.

The independent test variable, LIQ, is the liquidity measure for bank i, in year t-1. A lagged relationship between liquidity and bank risk is assumed since liquidity increases the risk in the next period.

The independent control variables are bank characteristics for bank i, in year t. These variables are the capital adequacy ratio (CAP), the natural logarithm of total assets (SZ), return on equity (PROF), total loans to total assets (LR), cost to income ratio (EFF), and HHI index (RED). Moreover, a dummy variable related to the crisis (CD) should be included in order to capture the effect of the financial crisis of 2008.

Time specific effects are captured by introducing time dummies (TD). The latter is important to control macroeconomic effects over time. Thus, the final model is as follows

$$Risk_{i,t} = \alpha + \beta_1 LIQ_{i,t-1} + \beta_2 CAP_{i,t} + \beta_3 SZ_{i,t} + \beta_4 PROF_{i,t} + \beta_5 LR_{i,t} + \beta_6 EFF_{i,t} + \beta_7 RED_{i,t} + \beta_8 CD_{i,t} + TD_{i,t} + e_{i,t}$$

Furthermore, we extend the model in order to test the relationship between liquidity and bank risk for banks with high capital buffers and with large banks by generating test dummies to be interacted with Liquidity. HIGH is a dummy variable equals to one in case of banks with a high capital level and zero otherwise, while BIG is a dummy variable equals to one for large banks, and zero otherwise. The HIGH capitalized banks are the ones having a value of capital adequacy ratio in the top 25 percentile, and BIG banks are the ones that their size is in the top 25 percentile. Thus, the model will be extended as follows:

$$Risk_{i,t} = \propto + \beta_1 LIQ_{i,t-1} + \beta_2 Testdummy_{i,t} + \beta_3 LIQ_{i,t-1} \times Testdummy + \beta_3 CV_{i,t} + TD_{i,t} + e_{i,t}$$

3.4.2. CLRM Assumptions

Before conducting the regression analysis, the first part of the process involves checking if the data used can actually be analyzed using the multiple regression. Therefore, the Classical Linear Regression Model (CLRM) assumptions should be tested and they are: (1) zero mean, (2) unit root test, (3) homoscedasticity, (4) serial correlation, (5) normality, and (6) multicollinearity tests. All computations were produced using STATA software.

3.4.2.1. Assumption 1: The errors have zero mean (E(e) = 0)

The first assumption required for a valid analysis is that the average of the errors should be equal to zero. However, this assumption is never violated if a constant term is included in the regression analysis (Brooks, 2008). Therefore, since the model used in this research incudes a constant term, this assumption was not violated.

3.4.2.2. Assumption 2: Unit-Root test (Stationary test)

The stationary of a series suggests that all moments of the process are constant over time such as the mean, variance, and autocorrelation. A stationary process is one whose probability distribution is stable over time. A non-stationary process is a stochastic process that fails to satisfy these requirements, in that its mean is changing over time, even if its variance and covariance are not. The presence of non-stationary series can intensely impact its behavior i.e. the presence of shocks could have an infinite effect for non-stationarity series (Nielsen, 2005). Stationary time series tests are used to examine if the probability distribution is stable over time (Wooldridge, 2002). In this thesis, Fisher test proposed by Maddala and Wu (1999), which uses the p-value from unit root tests for each cross-section i will be used to test stationary. The formula of the test is denoted as follows:

$$P = -2\sum_{i=1}^{N} log\pi_i$$

Where π_i is equal to the p-value from the ith-test.

The test is asymptotically chi-square distributed with 2 N degrees of freedom. An advantage of this test that it handles an unbalance panel. Moreover, the Fisher test can be applied through two tests: Dickey-Fuller test or the Philips Perron test. First, the Dickey-Fuller tests for the existence of unit root of the dependent variable y_t that represents all variables in a natural logarithmic form at time t. The unit root test determines if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. The test is conducted on the coefficient of y_{t-1} in the regression. If the coefficient is significantly less than zero, then the y tested does not have a unit root (Wooldridge, 2005). Second, the Philips-Perron test (PP) (named after Peter Philips and Pierre Perron) is another unit root test that is used in a time series analysis to test the null hypothesis that a time series is integrated of order 1 and does not have a linear trend, with or without intercept terms. The Philips-Perron test is considered to be a non-parametric unit root test that is modified so that serial correlation does not have an effect on the asymptotic distribution. In this thesis, the Dickey-fuller test will be used in order to

determine the stationarity of the variables. Hence, the p-value given by the test should be less than 0.05 in order to reject the null hypothesis which states that all panels contain unit root.

3.4.2.3. Assumption 3: Serial Correlation

One assumption in a regression analysis is that the error terms are independent from one another, which means they are uncorrelated. If not, a serial correlation problem exists, suggesting that the errors in a period influences the error in future periods. There are two different types of serial correlation; the first-order serial correlation and the positive serial correlation. Firstly, the first-order serial correlation occurs when the error terms in one-time period are directly correlated with the error terms in the following time period. Secondly, the positive serial correlation occurs when the error terms in one period are positively correlated with the error terms in the next time period. A statistical test known as the Durbin-Waston method denoted by DW can be used in order to examine the serial correlation assumption. However, the Durbin-Waston test can only be used for time series data (Williams, 2015). Since this research involves a panel data rather than a time series data, Wooldridge method will be used to test serial correlation. It is considered to be an attractive test since it requires few assumptions and it is easy to implement. The Wooldridge test begins by estimating the parameters through regressing the dependent and the independent variables and finding the residuals. Then, it uses the residuals from a regression in first-differences variables on their lags and tests if the coefficient on the lagged residuals is equal to -5, which refers to the absence of a serial correlation (Drukker, 2003).

3.4.2.4. Assumption 4: The Homoscedasticity Test

Furthermore, the assumption of homoscedasticity requires a constant variance of the errors. However, if the variance is not constant, the error terms are said to be heteroskedastic (which means "differing variance"). Heteroskedastic is generally detected either through a visual inspection or through a statistical test. To begin with the visual inspection, it is hard to observe the actual values of the error term, that is why a

test is needed to examine the residuals in order to see if they show a pattern consistent with a non-constant variance (Williams, 2015).

A test that can be used to detect heteroscedasticity is known as the Breusch-Pagan test which is named after Trevor Breusch and Adrian Pagan. It is useful to test whether the error variances are a multiplicative function of one or more variables or they are all equal. The generalized residuals, which are obtained through dividing the regression sum of squares (RSS) by N, are regressed on all the explanatory variables (m) that are suspected of causing heteroscedasticity problem. The error sum of squares (ESS) divided by 2 will follow a chi-square distribution with an m-1 degree of freedom. Consequently, the null hypothesis is rejected when the findings are significant, hence, violating the homoscedasticity assumption (Garson, 2012).

Furthermore, another statistical test known as the white test will be used to test the Heteroscedasticity problem. It is considered to be a special case of the Breusch-Pagan test, where it involves regressing the squared residuals on all explanatory variables plus the cross-products and squares of the explanatory variables and find the R^2 value. Then, the resulting R^2 will be multiplied by N, giving a statistic with a chi-square distribution and a t degree of freedom. If the null hypothesis, which refers to the absence of heteroscedasticity problem, is rejected, then homoscedasticity assumption is considered to be violated (Garson, 2012).

3.4.2.5. Assumption 5: The Normality Test

The normality test is used to determine whether the data set is well modeled by a normal distribution or not. A normal distribution takes the form of a symmetric bell-shaped curve with a mean of zero and a standard deviation of one. There are many normality tests that can be used such as Skewness-Kurtosis tests (Ghasemi & Zahediasl, 2012). The Skew refers to the tilt of the distribution; it measures the symmetry of the distribution, which means the extent to which the distribution is not symmetric around its mean. Kurtosis refers the peakeness of the distribution; it measures how fat is the tail of the distribution. However, a normal distribution is neither skewed to the left or to the right and it has a coefficient of kurtosis equal to three or excess Kurtosis equal to zero (Brooks, 2008).

In this study, another test known as Bera-Jarque statistic will be used to test normality by testing whether the coefficient of skewness and excess kurtosis are jointly zero. If the residuals are normally distributed, then the Bera-Jarque statistic would not be significant. Hence, the p-value given by the test should be greater than am alpha of 0.05 to support the null hypothesis of presence of normal distribution (Brooks, 2008).

3.4.2.6. Assumption 6: The Multicollinearity Test

Another assumption is that the independent variables are not correlated with one another. If there is no correlation among the independent variables, it is said to be orthogonal. However, if those independent variables were not orthogonal to another, a multicollinearity problem occurs, indicating a high degree of correlation among the explanatory variables. Multicollinarity is categorized into two types; a perfect multicollinearity and a near multicollinearity. Firstly, the perfect multicollinearity occurs when there is an exact relationship between two or more independent variables. Secondly, a near multicollinearity occurs when there is a non-negligible, but not perfect relationship between those variables (Brooks, 2008). The existence of multicollinearity between explanatory variables is tested by calculating the Variance Inflation Factor (VIF), which measures how much the variance of the estimated coefficients is inflated by the presence of correlation among the explanatory variables in the model. The VIF is calculated as follows:

$$VIF = \frac{1}{(1 - R2)}$$

A value of VIF equals to one refers to no correlation among the explanatory variables estimated, and hence the variance is not inflated. The general rule states that a VIF greater than four requires further examination and a VIF greater than ten is a sign of a high multicollinearity (Akinwande, Dikko & Samson, 2015). In this study, the multicollinearity will be also tested through Pearson correlation between the explanatory variables. The Pearson correlation factor is a measure of the intensity of the linear relationship between the explanatory variables. A correlation below 0.7 shows that

multicollinearity is not a serious problem in the regression conducted (Anderson, Sweeney & Williams 2008).

3.5. Conclusion

This chapter starts by describing the quantitative method that will be used in this thesis, since this research examines an experimental research that will test the accuracy of a theory. The sample chosen focuses on Lebanese commercial banks for a period of seven years.

Since the objective of this research is to study the relationship between the bank liquidity and bank risk taking behavior, the dependent variable is represented by bank's total and lending risk. The total risk is measured by the risk weighted asset density and the lending risk is measured by the loan loss provision ratio and the net interest income ratio. As for the explanatory variables that are included in the regression model, they are divided into the dependent test variable and the independent control variables. The test variable is the bank liquidity while the control variables are the bank capital, size, profitability, loan ratio, efficiency, revenue diversification, and crisis.

Finally, the research analysis will be conducted through a multiple regression analysis. Thus, this chapter will explain the six Classical Linear Regression Model (CLRM) assumptions that will be tested in the next chapter.

Chapter 4
Empirical Results

This chapter presents the empirical results of the study. First, it summarizes the descriptive analysis of the variables. Second, it tests the regression assumptions. Finally, it discusses and analyzes the regression results. The goal is to determine the effect of liquidity on the bank risk behavior.

4.1. Descriptive Statistics

Table 7 provides the descriptive statistics for 21 banks covering a period of 8 years from 2008 to 2015. Descriptive Statistics include the mean, the standard deviation, the minimum, and the maximum for the dependent and the independent variables. It is important to mention that the top and bottom 5% of all observations for all variables have been winsorized to reduce the influence of the outliers.

Variables	Obs	Mean	SD	Min	Max
RWAD	168	0.5931	0.2621	0.1845	1.4411
LLP	168	0.0064	0.0131	0.0001	0.0975
NII	168	0.0749	0.0782	0.0176	0.5628
LIQ_{t-1}	168	0.2517	0.1383	0.0872	0.7326
CAP	168	0.1342	0.0498	0.0813	0.3291
SZ	168	14.855	1.5598	12.02	17.55
PROF	168	0.1158	0.1013	0.0013	0.7573
LR	168	0.3055	0.1217	0.0605	0.6069
EFF	168	0.5687	0.1698	0.3503	1.1489
RED	168	0.5906	0.1059	0.3954	0.8777

Table 7:Descriptive Statistics

(Source: STATA)

According to Table 7, the number of observations for each variable extracted from Bankscope is equal to 168 observations. The size and RWAD reports the highest standard deviation as compared to other variables, revealing that these variables have more significant variance than the others.

The total risk was measured through the risk weighted assets density (RWAD), which capture the bank's average risk weight. It reports a mean equal to 0.5931 and a standard deviation of 0.2621, which shows that banks differ in their total risk exposure.

Furthermore, the gap between the minimum value, which equal to 0.1845, and the maximum value, which is equal to 1.4411, illustrates the high risk variation among the Lebanese banks.

The bank lending risk was measured through the loan loss provision over total loans (LLP) and through the net interest income over total loans (NII). First of all, a high value of LLP indicates higher risk. The results report a mean of 0.0064 and a standard deviation of 0.0131, which shows that the Lebanese banks are not considered to be high risky. The minimum value was 0.0001 whereas the maximum value was 0.0975, which illustrate that the riskiest Lebanese bank is not so risky in their lending. Second of all, a low value of NII indicates higher risk. The results report a mean of 0.0749, higher than the mean of LLP, which exemplify the same conclusion that Lebanese banks are not considered to be high risky in their lending. The minimum value was 0.0176 whereas the maximum value was 0.5628, and a standard deviation of 0.07828.

Furthermore, the average value of $LIQ_{i,t-1}$ measured by liquid assets over total assets was 0.2517, which means that 25.17 percent of the total assets are liquid assets. According to Angora and Roulet (2011), the higher the ratio, the more liquid a bank is considered to be. The minimum value reported was 0.0862 whereas the maximum value was 0.7512, indicating a high dispersion among Lebanese banks.

Regarding the capital ratio of banks, it was measured through the capital adequacy ratio. The statistics results show a mean of 0.1342 which is higher than the minimum capital adequacy ratio of 8% that banks must maintain. The minimum value was 0.0813 whereas the maximum value was 0.3291. As for the standard deviation, the results report a value of 0.0498. The high level of capital ratio supports the strict regulation imposed by the central bank of Lebanon, forcing all banks to maintain an adequate level of capital. Moreover, the natural logarithm of the total assets which was used as a proxy for the bank size reports a standard deviation of 1.5598, which reveal the variation around the mean of 14.855. The maximum value was 17.55 while the minimum value was 12.02. This shows that there is a disparity in the size of the Lebanese banks.

Profitability is measured by the return on equity. The average profitability reports a value of 0.1158, which means that for each USD 1000 investment in the equity of those banks, there was a USD 115.8 return. The maximum value of PROF reported was 0.7573 whereas the minimum value was 0.0013, indicating that Lebanese banks differ substantially in their profitability. This result is not surprising since Lebanese banks differ in their capital ratio, which affects profitability. Moreover, the standard deviation of the ROE was 0.1013 which indicates that there is around 10 percent variation form the mean.

Regarding the loan ratio, it is used to measure the percentage amount of the banks' assets that are invested in loans. Therefore, the higher the ratio, the higher the lending behavior. The results report a mean of 0.3055 and a standard deviation of 0.1217, indicating that Lebanese banks have an average of 30.55 percent of their total assets invested in loans which vary about 12.17% around the mean. The minimum value reported was 0.0605 whereas the maximum value was 0.6069, which shows that some Lebanese banks invest more than their half of total assets in loans.

In addition, the cost to income ratio was used as a proxy for efficiency, where a high ratio indicates a lower efficiency. The results report a mean of 0.5687 with a standard deviation of 0.1698, which shows that the Lebanese banks are not that efficient. The minimum value reported was 0.3503 whereas the maximum value was 1.1489. Hence, many Lebanese banks are not operating in an efficient way due to high cost to income ratio.

Finally, the revenue diversification reported an average value of 0.5906, which shows that Lebanese banks are diversified. The minimum value was 0.3954 whereas the maximum value was 0.8777 with a standard deviation equal to 0.1059, which shows the variation about diversification among the Lebanese banks.

4.2. Tests for the Classical Linear Regression Model (CLRM) Assumptions

In order to maintain the robustness of the regressed results of this thesis, the classical linear regression model (CLRM) assumptions must be tested. Accordingly, there are six

CLRM assumptions that will be tested, which are the following: (1) errors have a mean of zero, (2) stationarity, (3) serial correlation, (4) homoscedasticity, (5) normality and (6) multicollinearity. According to Brooks (2008), all these assumptions need to be satisfied. Nevertheless, any violation in one of the assumptions means that there is a pattern of data that has been not included in the model, and other models could be a better fit for this data.

4.2.1. Assumption 1: The errors have a zero mean

According to Brooks (2008), this assumption is not violated if a constant term is included in the regression. Thus, since the regression model used in this study includes a constant term, the errors of this regression have a zero mean.

4.2.2. Assumption 2: Stationarity of Unit Root Test

An important assumption for a panel data technique is that the data must be stationary. The property of a stationary process is that the mean, variance and autocorrelation are constant over time. According to Brooks (2008), a nonstationary data could lead to spurious regression. Hence, when two variables are trending over time, a regression of one on the other could report a high R^2 even if the two variables are totally unrelated. Therefore, if standard regression techniques are applied on nonstationary data, the regression might look good but might be valueless. Furthermore, the t-ratios will not follow a t-distribution, i.e. the hypothesis tests about the regression parameters cannot be validly accepted. In this study, we are going to use the Fisher test as suggested by Maddala and Wu (1999). The Fisher test using the Dickey-fuller test will be used in order to test the stationarity of the variables.

Fisher-type unit-root test based on Dickey-Fuller test Ho: All panels contain unit roots H1: At least one panel is			
Variables	**Lags**	**Chi-squared**	**P-value**
RWAD	0	313.4599	0.0000
LLP	0	100.3232	0.0000
NII	0	198.2258	0.0000
$LIQ_{i,t-1}$	0	324.2280	0.0000
CAP	0	361.5602	0.0000
SZ	0	259.9398	0.0000
PROF	0	155.8902	0.0000
LR	0	180.0937	0.0000
EFF	0	127.4088	0.0000
RED	0	138.0313	0.0000

Table 8:Fisher-type unit-root test based on Dickey-Fuller test

(Source STATA)

Under the Dickey-Fuller test, the null hypothesis is that all panels contain unit roots. Table 8 indicates that all the variables are stationary since their P-values are below 0.05; thus rejecting the null hypothesis.

4.2.3. Assumption 3: Serial Correlation Test

The third assumption is whether errors are serially correlated, or linearly dependent of one another, suggesting that the errors in a period influence the errors in future periods. Since it is a panel data rather than a time series data, the Wooldridge test will be used to test autocorrelation for three different regressions, depending on the definition of the dependent variable. The first regression measures bank total risk by RWA density, and the second and third regressions measure bank lending risk by loan loss provision over total loans, and net interest income over total loans, respectively.

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation

RWAD		**LLP/TL**		**NII/TL**	
F(1, 20)	10.296	F(1, 20)	6.667	F(1, 20)	8.588
Prob > F	0.0044	Prob > F	0.0178	Prob > F	0.0083

Table 9: Wooldridge test

(Source: STATA)

The null hypothesis was rejected in the three regressions, since the p-value is lower than the significance level of 0.05. Hence, serial correlation exists in the three regressions. However, according to Torres-Reyna (2007), serial correlation is considered to be a problem for macro panels with a T greater than 20-30 years and not for micro panels with few years. Since we are dealing with a micro panel data for which the time dimension T (8 years) is largely less important than the individual dimension N (20 banks), serial correlation should not be considered as a problem.

4.2.4. Assumption 4: Homoscedasticity Test

Homoscedasticity assumption requires a constant variance of the errors. However, if the errors have a non-constant variance, the error term is said to be heteroskedastic which violates the homoscedasticity assumption. In this study, the Breusch Pagan and white tests will be used to test for the existence of heteroscedasticity across the range of explanatory variables. Those two tests will be conducted on three different dependent variables, RWA density, loan loss provision over total loans, and net interest income over total loans.

For Bank Risk (RWAD)			
Breusch-Pagan Test		**White's test**	
Ho: Constant variance		**Ho: homoskedasticity** **Ha: unrestricted heteroskedasticity**	
chi2	8.99	**chi2**	128.52
P-value	0.0027	**P-value**	0.000
For Bank Lending risk (LLP/TL)			
Breusch-Pagan Test		**White's test**	
Ho: Constant variance		**Ho: homoskedasticity** **Ha: unrestricted heteroskedasticity**	
chi2	294.32	**chi2**	110.51
P-value	0.000	**P-value**	0.000
Bank Lending risk (NII/TL)			
Breusch-Pagan Test		**White's test**	
Ho: Constant variance		**Ho: homoskedasticity** **Ha: unrestricted heteroskedasticity**	
chi2	192.61	**chi2**	139.77
P-value	0.000	**P-value**	0.000

Table 10: Breusch Pagan Test and White test

(Source: STATA)

Both tests shown in Table 10 indicate that the null hypothesis is rejected for the three regressions, since the p-values are lower than 0.05. This means that there is a heteroscedasticity problem in this study. Therefore, in order to solve heteroscedasticity issue, the regression analysis will be adjusted using the robust standard errors (Zumbach, 2011).

4.2.5. Assumption 5: Normality Test

The normality of the error distribution assumes that the errors are normally distributed. In order to test if the residuals are normally distributed or not, the Jarque- Bera statistic test will be used. If the residuals are normally distributed, the statistic would not be significant. Thus, the p-value should be greater than 5% to support the null hypothesis of normal distribution (Brooks, 2008). The test will be applied on the three different regression differing by the definition of the dependent variable.

Jarque Bera test					
Skewness/Kurtosis tests for Normality For bank risk (RWAD)					
Variable	**Obs**	**Pr(Skewness)**	**Pr(Kurtosis)**	**adj chi2(2)**	**Prob>chi2**
Residuals	168	0.0000	0. 0248	18.44	0.0001
Jarque Bera test					
Skewness/Kurtosis tests for Normality For bank lending risk(LLP)					
Variable	**Obs**	**Pr(Skewness)**	**Pr(Kurtosis)**	**adj chi2(2)**	**Prob>chi2**
Residuals	168	0.000	0.000	.	0.000
Jarque Bera test					
Skewness/Kurtosis tests for Normality For bank lending risk (NII)					
Variable	**Obs**	**Pr(Skewness)**	**Pr(Kurtosis)**	**adj chi2(2)**	**Prob>chi2**
Residuals	168	0.000	0.000	.	0.000

Table 11: Jarque Bera Test

(Source: STATA)

Results reported in the three previous regressions show a p-value lower than 0.05, which means that the null hypothesis is rejected and the residuals are not normally distributed. However, according to Dielman (2005), the assumption of having normally distributed

residuals is not always essential while running a regression estimate. Furthermore, Gelman and Hill (2007) state that a least squares method will provide a fit linear model and estimate the parameters of the model without assuming a normal distribution.

4.2.6. Multicollinearity Test

This assumption of multicollinearity states that the independent variables are not correlated with one another; they are said to be orthogonal to one another. However, a high degree of correlation among the independent variables will be a violation of the CLRM assumption, leading to a multicollinearity problem. Therefore, this high correlation may explain a great deal of the dependent variable, without contributing significantly to the model (Brooks, 2008). The existence of multicollinearity between the independent variables can be tested by Pearson correlation and Variance Inflation Factor (VIF). The first test is a useful technique to test for multicollinearity of explanatory variables by investigating the relationship between bivariate variables (Wooldridge, 2002).

	RWAD	LLP	NII	$LIQ_{i,t-1}$	CAP	SZ	PROF	LR	EFF	REV
RWAD	1.000									
LLP	0.020	1.000								
NII	0.472	0.397	1.000							
$LIQ_{i,t-1}$	0.314	0.064	0.409	1.000						
CAP	0.091	-0.08	0.480	0.179	1.000					
SZ	-0.005	-0.12	-0.24	0.028	-0.062	1.000				
PROF	0.068	0.022	0.277	0.136	-0.061	0.109	1.000			
LR	0.103	-0.08	-0.45	-0.14	-0.216	0.174	0.007	1.000		
EFF	0.146	0.007	0.014	0.055	0.157	-0.37	-0.287	0.306	1.000	
RED	0.163	0.148	0.270	0.066	0.299	-0.12	0.049	0.004	0.477	1.000

Table 12: Pearson Correlation Test of explanatory variables

(Source STATA)

According to Anderson et al. (2008), Pearson correlation factor is a measure of the intensity of the linear relationship between the independent variables. A correlation below 0.7 shows that multicollinearity is not a serious problem in the regression

conducted. Therefore, as shown in Table 12, all the correlation results are below 0.7, which indicates that multicollinearity is not a potential problem in this regression. In order to further check this matter, the variance inflation factors (VIF) for the independent variables will be computed where a VIF greater than 10 indicates the possibility of multicollinearity problem.

Variables	VIF	Tolerance
$LIQ_{i,t-1}$	1.11	0.904156
CAP	1.20	0.832307
SZ	1.37	0.731749
PROF	1.23	0.814364
LR	1.47	0.682367
EFF	2.27	0.441427
RED	1.53	0.652932
Mean VIF	1.45	

Table 13: Variance Inflation Factor (VIF) of the explanatory variables

(Source STATA)

Therefore, as we can see in Table 13, the mean of VIF was 1.45, which is much lower than the limit of 10. The VIF for individual variables was also very low. Hence, the explanatory variables included in this regression are not substantially correlated with each other.

4.3. Regression Results

The model used aims to investigate the relationship between bank liquidity and bank risk behavior, measured by bank total risk (RWAD) and bank lending risk (LLP/TL and NII/TL) by including six control variables with eight year observations.

4.3.1. FEM vs REM

There are two types of panel estimator approaches that can be applied in financial research, namely, the fixed effect models (FEM) and the random effects models (REM). In order to check which, one is more reliable estimate for this study, a test of over identification restrictions between fixed and random effects (Xtoverid) was used and the results for the three regressions are reported in Table 14.

Xtoverid Test		
For Bank Risk (RWAD)	**For Bank Lending Risk (LLP/TL)**	**For Bank Lending Risk (NII/TL)**
• Prob>chi2 = 0.000	• Prob>chi2 = 0.000	• Prob>chi2 = 0.000

Table 14: Xtoverid test of three regressions

(Source: STATA)

The null hypothesis is the same for the three tests. For the bank total risk and bank lending risk, the p-value is less than 0.05, which means that the fixed effect model is the preferred method regardless of the dependent variables.

Hence, Table 15 summarizes the appropriate model to be used in the three regressions.

Regression	Model
For bank risk (Δ log of z-score)	FEM
For bank lending risk (NII/TL)	FEM
For bank lending risk (LLP/TL)	FEM

Table 15: Summary of Regression Analysis Models

(Source STATA)

4.3.2. Presentation of findings

Empirical findings related to the relationship between liquidity and bank risk taking behavior is presented for three different regressions. These regressions differ according to the definition of the bank risk.

By comparing the results for the three cases, the findings revealed that Case I was the efficient method estimating the regression results, with the highest regression fit of 50.51 percent. However, Case II has a lower regression fit than Case I (adjusted R-square = 44.38 percent), but a larger number of significant explanatory variables than Case I, and the highest F value of 123.10. As for case III, it has the lowest regression fit of 36.75 percent but the same number of significant explanatory variables as Case I.

	Bank Total Risk (RWAD)		Bank Lending Risk (NII/TL)		Bank Lending Risk (LLP/TL)	
	Case I		**Case II**		**Case III**	
Risk	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
$LIQ_{i,t-1}$	0.6285	0.050*	-0.9492	0.040*	-0.0295	0.001*
CAP	-1.4045	0.023*	-0.3460	0.000*	0.0106	0.621
SZ	0.4392	0.434	0.0056	0.546	0.0038	0.021*
PROF	0.7652	0.094	-0.1568	0.199	-0.0678	0.023*
LR	0.9590	0.578	0.1105	0.029*	-0.0165	0.378
EFF	0.4740	0.014*	-0.0628	0.324	-0.0092	0.417
RED	0.5151	0.123	-0.1830	0.032*	0.04576	0.130
Crisis	0.0177	0.757	0.0207	0.253	0.01074	0.045*
Regression	• Number of obs = 168 • F (13,20) = 23.54 • Prob > F = 0.0000 • Adj R^2 = 0.5051		• Number of obs = 168 • F (12,20) = 123.01 • Prob > F = 0.0000 • Adj R^2 = 0.4438		• Number of obs = 168 • F (13,20) = 17.10 • Prob > F = 0.0000 • Adj R^2 = 0.3675	

** indicates significant at 5% significance level*

Table 16:Regression analysis results

(Source STATA)

4.3.3. Analysis of Findings

This section interprets the main findings of the three regressions presented in Table 4.10. It is important to mention that a reduction in the net interest income ratio (Case II) implies higher bank lending risk, while an increase in the risk weighted assets density (Case I) and in loan loss provision (Case III) implies higher bank total risk. To facilitate comparison, we have multiplied the value of net interest income ratio by -1, so that a higher value of all dependent variables indicates a higher risk.

4.3.3.1. Liquidity and Overall Risk of Banks

Table 4.10, Case I shows that liquidity is significant, with a positive coefficient, indicating that as liquidity increases, bank risk increases, consistent with Acharya and Naqvi's (2012) theoretical argument. Therefore, high liquidity is positively related to bank's total risk, clearly accepting the first hypothesis H_1.

4.3.3.2. Liquidity and Lending Risk of Banks

Cases II and III in Table 4.10 examine the effect of bank liquidity on the lending risk of bank as measured by net interest income divided by total loans, and by loan loss provision divided by total loans. Results suggest a negative relationship between liquidity and bank lending risk as measured by NII/Tl (Case II) and LLP/TL (Case III), significant at 5%. Thus, liquidity was found to be a significant determinant of bank lending risk. The sign of the coefficient is inconsistent with the Acharya and Naqvi (2012)'s hypothesis that banks tend to reduce their lending rate in response to a higher liquidity level. The results suggest that high liquidity has the potential to reduce bank lending risk, rejecting the first hypothesis H_1.

4.3.3.3. Control Variables and Bank Risk

Capital Ratio

Capital ratio was found to be a significant determinant of bank risk taking behavior in Case I and II. The sign of the coefficient is not consistent with Gonzalez (2005)'s hypothesis that more capitalized banks tend to take more risk. The negative relationship between bank capital and bank risk taking behavior clearly rejects the second hypothesis H_2. However, this relationship is consistent with Furlong and Keeley (1989)'s hypothesis that capital regulation reduces bank risk. According to Furlong and Keeley, shareholders are seen as holders of a call option on the bank with unlimited profits but limited losses. Thus, shareholders tend to increase the value of their option in the absence of the regulations through lessening the level of capital and increasing the level of risk. Therefore, the presence of regulations could minimize this moral hazard problem through ensuring that shareholders are able to absorb part of the losses. Thus, banks with low level of capital tend to increase their risk in order to increase their profitability, and consequently their capital level.

The results that banks having higher equity are less risky support Repullo (2005) finding that bank risk taking is negatively related to capital requirements, and Konishi and Yasuda (2004) who found that the implementation of capital adequacy requirements had reduced risk taking by commercial banks.

Size

The bank size was found to be statistically significant determinant of bank risk taking behavior only in Case III. The sign of the coefficient is inconsistent with Boyd and Runkle (1993)'s hypothesis that larger banks tend to have smaller volatility of asset return, thus conveying lower risk. The positive relationship between bank size and bank lending risk clearly accepts the third hypothesis H_3, consistent with the 'too big to fail' theory. According to this theory, the failure of a large financial institution would impose significant losses to other financial institutions, and would impede the functioning of the financial system. Thus, the government will not let these banks fail, and will provide support in case of failure (Wilmarth, 2010). Thus, the 'too-big-to-fail' status will give large banks a competitive advantage and incentives to take on additional risk.

Profitability

Profitability was found to be statistically significant determinant of bank risk taking behavior only in Case III. The sign of the coefficient is consistent with Jensen and Meckling (1976)'s hypothesis that more profitable banks tend to have lower risk-taking incentives than lower profitable banks. There is a negative relationship between the bank profitability and bank lending risk (Case III), clearly accepting the fourth hypothesis H_4.

Loan Ratio

Loan ratio was found to be significant only in Case II. The sign of the coefficient is consistent with Blasko and Sinkey (2006)'s hypothesis that high level of loan ratio increases NPL and insolvency. There is a positive relationship between the loan ratio and bank lending risk (Case II), clearly accepting the fifth hypothesis H_5.

Efficiency Ratio

Efficiency ratio was found to be an important determinant of bank risk taking behavior in Case I. The sign of the coefficient is consistent with Ghosh et al. (2003)'s hypothesis that a low cost to income ratio indicates higher efficiency, which is positively related to better skills and credit scoring, thus leading to a lower risk. There is a positive

relationship between bank inefficiency and bank total risk (Case I), clearly accepting the six hypothesis H_6.

Revenue Diversification

Revenue diversification was found to be statistically significant determinant of bank risk taking behavior in Case II. The sign of the coefficient is consistent with Diamond (1984)'s hypothesis that revenue diversification reduces all type of risks. As long as the revenue streams from different activities are less than perfectly correlated, revenue diversification should offer banks opportunities to reduce their risks by lowering the volatility of their revenues and profits. This negative relationship is consistent with Berger, Demsetz, and Strahan (1999), Barth, Caprio, and Levine (2004), Stiroh and Rumble (2006) who found that diversification of income through non-traditional activities is positively associated with bank stability. Thus, this negative relationship between revenue diversification and bank lending risk clearly accepts the seventh hypothesis H_7.

Crisis

Crisis was found to be statistically significant determinant of bank risk taking behavior only in Case III. The sign of the coefficient is consistent with Altunbas et al. (2011)'s hypothesis that financial crises contributes to the build-up of risk by many institutions. There is a positive relationship between a financial crisis and bank risk taking behavior, accepting the eighth hypothesis H_8.

Table 17 summarizes the results obtained and compares them to the expectations formulated in chapter 3.

Variables	Expectation	Actual Results	Statistical Significance test
$LIQ_{i,t-1}$	+	+/-	Significant
CAP	+	-	Significant
SZ	+	+	Significant
PROF	-	-	Significant
LR	+	+	Significant
EFF	+	+	Significant
RED	-	-	Significant

Table 17: Comparison of the Test Result with the Expectation

4.3.4. Banks with High Capital Buffer

Table 18 reports the effect of bank capital buffers on the relation between liquidity and risk taking behavior. A dummy variable HIGH is created, which takes the value of 1 for high capitalized banks, 0 otherwise. High capitalized banks are banks in the top 25th percentile, thus having a value of capital adequacy ratio greater than 14.735 percent. The interaction variable (Highliq) refers to the interaction between the dummy variable (High) and the liquidity variable.

	Bank Total Risk (RWAD)		**Bank Lending Risk (NII/TL)**		**Bank Lending Risk (LLP/TL)**	
	Case I		**Case II**		**Case III**	
Risk	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
$LIQ_{i,t-1}$	0.0972	0.585	-0.020	0.655	-0.0235	0.070
High	-0.300	0.000*	0.0288	0.288	0.0042	0.151
Highliq	0.780	0.006*	-0.1979	0.101	-0.010	0.449
SZ	0.0839	0.063	0.0031	0.705	0.0035	0.044*
PROF	0.6816	0.094	-0.1736	0.190	-0.0676	0.019*
LR	-0.0849	0.626	0.1306	0.041*	-0.0146	0.444
EFF	0.5416	0.002*	-0.0859	0.196	-0.1065	0.350
RED	0.397	0.273	-0.2058	0.017*	0.0465	0.109
Crisis	0.0623	0.253	-0.0187	0.311	0.0105	0.057*
Regression	• Number of obs = 168 • F (14,20) = 46.24 • Prob > F = 0.0000 • Adj R^2 = 0.5190		• Number of obs = 168 • F (14,20) = 14.13 • Prob > F = 0.0000 • Adj R^2 = 0.4322		• Number of obs = 168 • F (14,20) = 22.36 • Prob > F = 0.0000 • Adj R^2 = 0.3715	

** indicates significant at 5% significance level*

Table 18: Liquidity and Bank Risk in Banks with High Capital Buffers

(Source STATA)

The interactive variable between high capital buffer and liquidity is significantly related to risk weighted asset density at the 5% significance level. Banks with higher capital buffer carry higher risk taking behavior as measured by risk weighted assets than banks with lower capital buffer when they are flushed with liquidity as evidenced by the positive relationship between Highliq and bank risk weighted asset density. Therefore, the results are consistent with Gonzalez (2005)'s hypothesis argument that higher capital requirement induce banks to take on more risk, clearly accepting the second hypothesis

H_2, which states that well-capitalized banks take more risks in response to higher bank liquidity. The result suggests that highly capitalized banks tend to take less risk in the absence of liquidity and more risk when they are liquid. However, the liquidity interacted with the capitalization is insignificant in Case II and Case III, indicating that liquidity does not affect the relationship between capital and bank lending risk.

4.3.5. Big Banks

Table 19 reports the impact of size on the relationship between liquidity and bank risk taking behavior. A dummy variable, Big, is introduced, which takes the value of 1 for large banks (large banks are the ones in the top 25th percentile or having the natural logarithm of assets greater than 16.23) and zero otherwise. As for Bigliq, it is the interactive term resulting from multiplying the dummy variable with the liquidity variable.

	Bank Total Risk (RWAD)		**Bank Lending Risk (NII/TL)**		**Bank Lending Risk (LLP/TL)**	
	Case I		**Case II**		**Case III**	
Risk	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
$LIQ_{i,t-1}$	0.6754	0.017*	-0.087	0.027*	-0.029	0.005*
Big	-0.0138	0.889	-0.0140	0.481	-0.005	0.310
Bigliq	0.0850	0.828	0.0501	0.507	0.0394	0.049*
CAP	-1.4558	0.022*	-0.356	0.000	0.0103	0.585
PROF	0.8037	0.080	-0.154	0.188	-0.066	0.028*
LR	0.2567	0.253	0.139	0.088	0.0007	0.964
EFF	0.4511	0.035*	-0.068	0.311	-0.007	0.506
RED	0.5866	0.037*	-0.173	0.023*	0.05	0.076
Crisis	0.0060	0.920	-0.0220	0.257	0.010	0.056*
Regression	• Number of obs = 168 • F (14,20) = 1136 • Prob > F = 0.0000 • Adj R-squared = 0.4945		• Number of obs = 168 • F (14,20) = 157.63 • Prob > F = 0.0000 • Adj R-squared = 0.4424		• Number of obs = 168 • F (14,20) = 25.10 • Prob > F = 0.0000 • Adj R-squared = 0.3726	

** indicates significant at 5% significance level*

Table 19: Liquidity and Bank Risk in Large banks

(Source STATA)

The interactive variable between big banks and liquidity is significantly related to loan loss provision at the 5% significance level. The interactive variable between bank

liquidity and big bank dummy is positively related to the bank lending risk measured by the loan loss provision at the 5 % level of significance, indicating that higher liquidity in larger banks leads to less stability than smaller banks. This is consisting with our previous result, which states that large and liquid banks benefit from being too big to fail through enlarging their risk taking behavior in order to increase their return (Wilmarth, 2010), clearly accepting the third hypothesis H_3.

4.3.6. Conclusion

After testing the classical linear regression model (CLRM) assumptions, an over identification restriction test (Xtoverid) was conducted to choose between the fixed effect model and the random effect model. The results provided evidence in favor of the fixed effect model. Subsequently, the fixed effect model with robust standard errors (to control for heteroscedasticity) was estimated for three dependent variables; namely risk weighted assets density, the net interest income ratio and the loan loss provision ratio. The results show that a high level of liquidity tends to increase the bank total risk but decrease the bank lending risk. It also shows that well-capitalized banks are riskier than lower capitalized banks only when they are liquid. The size of the bank is positively related to the bank risk taking behavior, supporting the too big to fail theory. Furthermore, bank profitability has a negative impact of the bank risk taking behavior suggesting the need to take on new risk in order to upsurge the profits. Moreover, the bank loan ratio is positively related to the bank risk taking behavior, where a higher ratio increases the NPL and insolvency of the bank, leading to higher risk. Additionally, a low efficiency as measured by a high cost to income ratio leads to a higher risk. Finally, the last variable is the revenue diversification variable, which is negatively related to the bank risk taking behavior since well diversified portfolios minimize the risk.

Chapter 5
Conclusion and Recommendations

The aim of this chapter is to summarize the findings, answer the research questions and further develop the analysis from the previous chapter. Subsequently, limitations will be discussed followed by implications. Finally, recommendations as well as suggestions for further research will be addressed.

5.1. Conclusion

This research attempts to analyze the impact of bank liquidity on bank risk taking behavior from the lending perspective of the Lebanese commercial banks and from the total risk perspective. Therefore, the research questions were:

1. *What is the impact of liquidity on lending behavior of the bank?*
2. *What is the impact of liquidity on the total risk of the bank?*

In order to answer the previous research questions, a fixed effect model regression was conducted on a sample consisting of twenty-one Lebanese banks. The study is crossed over a period of eight years from 2008 to 2015. The dependent variable is defined in three ways, the risk weighted assets ratio as a measure of total risk; the loan loss provision ratio and net interest income ratio as a measure of lending risk. The bank specific factors included in this study are seven: the bank liquidity, size, capital, profitability, loan ratio, efficiency and revenue diversification. Crisis and time dummies are also included. The analytical techniques used were the descriptive statistics and the regression analysis which provided the estimate for the model. The estimates were used to analyze the relationship between the dependent and the independent variables. Some of the results obtained comply with the existing theories and previous studies, while some results had an unexpected outcome. Three models were estimated and eight hypotheses were tested. The following conclusions can be deduced from the findings of the study.

The results obtained depends on how risk is measured. There is a positive relationship between the bank liquidity and bank total risk, which is consistent with Acharya and Naqvi (2012)'s theoretical argument that high level of liquidity boost banks to increase

their risk taking behavior. The main empirical implication of this model is that excessive liquidity induces risk-taking behavior from the part of bank managers, which is related to the agency problem. Furthermore, the access of managers to free cash flow motivates them to enlarge the bank riskiness. However, there is a negative relationship between the bank liquidity and bank lending risk, which is not consistent with our first hypothesis H_1. Therefore, the presence of high liquidity in the Lebanese banks tends to minimize the bank risk taking behavior from the lending perspective.

Moreover, while testing the impact of other factors on bank risk behavior, we concluded that some variables are significant with bank total risk while others are significant with bank lending behavior. The results indicate that less profitable banks tend to have higher risk-lending incentive than higher profitable banks, due to the fact that banks with a poor profitability tend to invest more in riskier activities in order to enlarge their revenues. As well, revenue diversification is negatively related to the bank risk-lending behavior, since diversification helps to reduce all type of risks. However, the loan ratio is positively related to the bank lending behavior, since a high level of loan ratio increases NPL and insolvency. Additionally, more efficient banks tend to have a lower risk-taking behavior than less efficient banks. This is due to the fact that efficiency is positively associated with a beneficial management and good skills in credit scoring, thus leading to a lower risk-taking behavior. Moreover, the financial crisis contributes to the build-up of risk by financial institutions in the period preceding the crisis.

In addition, extensions to the models were made in order to test the effect of bank capital and size on the relationship between liquidity and bank risk taking behavior. First of all, the liquidity interacted with the capitalization is significant only with the bank total risk, indicating that well capitalized liquid is riskier than lower liquid capitalized banks, which is consistent with Gonzalez (2005)'s hypothesis argument that higher capital requirement induces banks to take on more risk. Second of all, the liquidity interacted with the size is significant with bank lending risk, indicating that a higher liquidity in larger banks leads to less stability than smaller banks by increasing their risk taking behavior. This is consistent with Wilmarth (2010)'s hypothesis that large banks benefit from being too big

to fail through enlarging their risk taking behavior for the purpose of enlarging their return.

5.2. Limitations of the Results

The analysis conducted in this study suffers from serious limitations that will be mentioned below.

Firstly, the small sample size (limited to 21 banks) and the limited resources available may affect the qualities of the results. Generally, statistical tests require a larger sample size in order to assure the accuracy of the estimated data.

Secondly, due to the presence of outliers in the sample chosen, the top and bottom 5% of all observations for all variables have been winsorized, which might reduce the accuracy of the regression results.

Thirdly, six bank control variables were included in the research, which are the most commonly factors used in previous studies. However, it is possible that other factors might have a greater impact on the relationship between bank liquidity and its risk-taking behavior than the ones included in the research.

Fourthly, economic variables were supposed to be included in the model regression in order to catch the effect of the economic situation on the Lebanese bank risk-taking behavior.

5.3. Implications

While banks around the globe suffered from severe crisis due to liquidity issues, the Lebanese financial system remains liquid and well-stocked with cash deposits. However, little, if any, empirical studies were conducted on the effects of high liquidity on the risk taking behavior of the Lebanese banking sector; thus this study has many implications for the participants.

Firstly, researchers could use this study as a base for further studies. Throughout the research process, we have described all the stages and assumptions in order to make sure that other researchers are able to replicate our results. The database used in this research

follows a quantitative method which we have prudently described from where and how it was used. Additionally, the methodological assumptions and models are explained in a precise and detailed way.

Secondly, this study will provide some directions to the front-runner of the Lebanese banking sector, which is the central bank of Lebanon, and the risk management of Lebanese banks. It will enlighten the procedures needed in order to reduce the risk of the Lebanese banking system.

Thirdly, this research explores the avenues of further research on the impact of liquidity in the banking system. Hence, this study might be a helpful tool to study the effect of Basel III requirements on the bank risk taking behavior.

5.4. Recommendations

The following recommendations and suggested future research are derived from this thesis.

First, including economic variables in the regression analysis is a potential extension of the current research analysis.

Second, the risk managers' point of view toward the effect of liquidity on the bank risk taking behavior were not covered in this thesis, which could be explored by future researchers.

Third, the regression analysis could be run using a method other than the fixed effect model, like the Two-Stage Least Squares model.

Fourth, future studies can look at the effect of the liquidity on the risk taking behavior of the banks in the MENA region.

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Appendix A

Table 20: Basel Committee- Liquidity Reports

Date	Title
Sep, 1992	A Framework for Measuring and Managing Liquidity
Feb, 2000	Sound Practices for Managing Liquidity in Banking Organizations
May, 2006	The Management of Liquidity Risk in Financial Groups
Feb, 2008	Liquidity Risk: Management and Supervisory Challenges
Jun, 2008	Principles for Sound Liquidity Risk Management and Supervision – Consultative Document
Sep, 2008	Principles for Sound Liquidity Risk management and Supervision – Final Document
Dec, 2009	Strengthening the Resilience of the Banking Sector – Consultative Document
Dec, 2009	International Framework for Liquidity Risk Measurement, Standards and Monitoring – Consultative Document
Aug, 2010	An Assessment of the Long-term Economic Impact of Stronger Capital and Liquidity Requirements
Oct, 2010	The Basel Committee's Response to the Financial Crisis: Report to the G20
Dec, 2010	Results to the Comprehensive Quantitative Impact Study
Dec, 2010	Basel III: International Framework for Liquidity Risk Measurement, Standards and Monitoring

Dec, 2010	Basel III: A Global Regulatory Framework for more Resilient Banks and Banking Systems
Jun, 2011	Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems – Revised Version June 2011
Jul, 2011	Basel III Framework for Liquidity – Frequently Asked Questions
Apr, 2012	Results of the Basel III Monitoring Exercise as of 30 June 2011
Jul, 2012	Monitoring Indicators for Intraday Liquidity Management – Consultative Document
Sep, 2012	Results of Basel III Monitoring Exercise as of 31 December 2011
Jan, 2013	Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools
Mar, 2013	Results of the Basel III Monitoring Exercise as of 30 June 2012
Apr, 2013	Monitoring Tools for Intraday Liquidity Management – Final Document
Jul, 2013	Liquidity Coverage Ratio Disclosures Standards – Consultative Document
Sep, 2013	Results of the Basel III Monitoring Exercise as of 31 December 2012
Jan, 2014	Basel III: The Net Stable Funding Ratio – Consultative Document
Jan, 2014	Liquidity Coverage Ratio Disclosure Standards – Final Document
Jan, 2014	Guidance for Supervisors on Market-Based Indicators of Liquidity
Jan, 2014	The Liquidity Coverage Ratio and Restricted-use Committed Liquidity Facilities

Mar, 2014	Results of the Basel III Monitoring Exercise as of 30 June 2013
Apr, 2014	Frequently Asked Questions on Basel III's January 2013 Liquidity Coverage Ratio
Oct, 2014	Basel III: The net stable Funding Ratio
Dec, 2014	Net Stable Funding Ratio Disclosure standards – Consultative Document
Jun, 2015	Net Stable Funding Ratio Disclosure Standards
Sep, 2015	Basel III Monitoring Report
Jan, 2016	Minimum Capital Requirements for Market Risk
Mar, 2016	Basel III Monitoring Report
Mar, 2016	Pillar 3 Disclosure Requirements – Consolidated and Enhancement Framework – Consultative Document
Jul, 2016	Basel III – The Net Stable Funding Ratio: Frequently Asked Questions
Sep, 2016	Basel III Monitoring Report
Sep, 2016	Regulatory Consistency Assessment Programmed (RCAP) – Assessment of Basel III LCR Regulations
Sep, 2016	Regulatory Consistency Assessment Programmed (RCAP) – Assessment of Basel III LCR Regulations

(Source: Basel Committee on Banking Supervision, 2016)