DIPLOMA THESIS

“Credit and Liquidity Risk Management in Banking Services and Financial Products: Application on selected Case Study”

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UNIVERSITY OF THE AEGEAN
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DEPARTMENT OF FINANCIAL AND MANAGEMENT ENGINEERING

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…………………………  ………………………  ………………………

CHIOS, OCTOBER 2017
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Makridou Despina-Berta
Chios, 2017
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ABSTRACT

The current diploma thesis deals with the issue of risks in the banking sector and specifically with two major risks, the credit and liquidity risk. The purpose is to present how banks handle with the management of these risks in the day-to-day business and study the case of an existing bank, with real data and information, on how it deals with this issue. With the help of a little introduction the reader will be in the situation to understand the wide issue and impact of risks and why the research about the managing of such risks is significant for the banking sector, presenting the phenomenon of a real financial crisis. In the next chapter the reader has the chance to learn about key elements of the banking system, primarily giving the definition of money and lastly discussing the work of the regulatory authorities. Subsequently, introductory information about the general subject of risk management and its aspects is given, so that the reader is acquainted with. The next two chapters introduce the study of the management of credit risk and liquidity risk, where key tools and techniques for their identification, measurement and management are presented. Finally, the theoretical part of the thesis is applied on the case of the well-known Swiss bank UBS Group AG and is being studied according to real numbers, how an existing bank manages the credit and liquidity risk. Concluding the thesis, some inference about the subject and perspectives of possible further studies are given.

Keywords: Credit Risk, Liquidity Risk, Risk Management, Banking Sector, Banking services and products, Case study on UBS Group AG
1 Introduction

In the banking sector the word risk is equal to uncertainty. Uncertainty is the state of doubt about the future or the result of the decision taking. In such a situation of doubt, banks find themselves confronted with risk events that either have a positive or negative result. A positive result is desirable, a negative could be catastrophic if not confronted. A recent typical example is the global financial crisis of 2007-2008, which caused major problems to the financial and banking system.

It was the biggest shock that the banking system experienced since the last financial crisis in 1930 and was caused by an urgent demand for cash. It was a liquidity factor that drove the financial system to a systematic disaster. Most of the banks survived the disaster despite their big losses. In this, the emergency lending programs of the Central Banks helped and the efforts for regulating the liquidity risk. As we will see, regulatory requirements for the liquidity risk haven’t been established until the Basel III Accord in 2013 and after the shock experienced in the crisis. This was the biggest fail of the regulators.

The purpose of this study is to present how the impact of the liquidity risk on the banking institutions can be mitigated. We referred that the factor that caused the financial crisis was the excessive demand for cash and this indicates to lack of liquidity. This fact prepares us to understand that cash/money is the factor that causes the risks in the banking system, and it is also the factor that connects the risks and their impact.

For this reason, we will complement the study of the liquidity risk management with the one of the credit management. Moreover, these two types of risks are connected to each other, as banks give credits if they have available liquidity. In the end of the study, we will also present the issue of the management of these risks applied on a study of the case of an existing bank. But in the very beginning it is significant to present some basic information about the banking system.
2 Banking System

Our first attempt in this chapter is to present an integrated perspective of the Banking System and its components. This is a major step of the current thesis, because we are concerned on the banking risks and so it is important to firstly understand what a Bank is.

2.1 Concept of Banks

The first form of a modern bank arose from the need of the goldsmiths in 17th and 18th centuries to preserve the gold rods, once used as money; they then turned into bankers. The reason for this were two important developments: the discovery of deposits, and the unused reserves of gold bars. Traders always received transfer certificates of gold ownership for the gold bars they gave to goldsmiths and used them as a mean of payment, which were a form of the current banking checks. The value calculation of deposited gold bars and transfer certificates of gold ownership created the idea of deposits and the payment system. So, the large concentration number of unused gold bars in the safes of goldsmiths was the concept of today’s cash banking assets.\(^1\)

But what is money? Generally, money is anything accepted as payment for goods and services, usually used in the physical form of banknotes and coins. Its three main functions are: a mean of payment or exchange, a mean of storing value, and a unit of counting.\(^2\) Other common types of money being used except currency (banknotes, coins) are commodities (gold, metal, etc.), representative money (token coins, certificates etc.), fiat money, demand deposits, and electronic money (Bitcoin).

Usually currency, demand deposits and other types of deposits are referred to as financial instruments, amount of which is the available money supply for purchasing goods and services within a specific economy. Specific forms of

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financial instruments are also known as financial securities (stocks, bonds) which together with commodities, are tradable in financial markets. Financial markets attract funds from investors and channels them to corporations in need of financial liquidity for internal operations and growth achievement. This leads to a lender-borrower relation; this process can be supported by intermediaries. Such financial services are mainly provided by financial institutions. Financial institutions together with financial markets, financial instruments and financial services constitute the financial system where money, credit and finance are used as media of exchange between lenders, borrowers and investors. An indicative portrayal of a financial system is available on Figure 2.1

Within the various types of intermediaries, the main interest in the current thesis is on financial institutions, and more precisely on Banks. A Bank is therefore a financial institution that creates credit by accepting deposits from the public and provides liquidity to an economy. Of course, there are also many other services that banks provide. Other types of financial institutions include insurance companies, pension funds, mutual funds etc. which, together with a banking institution, compose a so-called financial group. The core of a financial system is always a banking system which consists of a Central Bank, commercial banks and specialized credit institutions. A more precise analysis of the banking system will follow.

2.2 Formal Organization of a Banking System

A simple example of a financial system concludes a banking system as the core and other various non-bank financial institutions. Such institutions could be a credit card management company, a leasing company, a fund management company, a real estate company, a stock company and an insurance company. Of course, many other system combinations are possible

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at a global scale. However, a banking system’s consistency are a Central Bank and other types of banks -usually Commercial Banks- in combination with specialized credit institutions.\(^6\)

Subsequently, a more detailed description of the three structures which constitute a banking system will be provided and, its role and contribution at a national level but also in the wider economy, will be explained.

![Diagram of a Financial System's typical structure](image)

**Figure 2.1** A Financial System’s typical structure *(Madhan Mohan: Indian Financial System)*

### 2.2.1 Central Bank

A (modern) Central Bank -also known as reserve bank or monetary authority- is a financial institution that generally has the authority of a nation’s money supply. Every nation has a Central Bank which can be completely and/or less

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independent from its nation's government or political interferences. It is also commonly said that this institution's goal is to pursue the public's and market's interests associated with the confidence in the currency, which is the foundation of the value of money.\textsuperscript{7}

Basically, the main role of a Central Bank has to do with three special functions. Firstly, it has the exclusive right to print and issue banknotes and coins of the national currency (legal tender). This is related with the second function, the implementation of the appropriate monetary and exchange rate policy. Through this monetary policy, the Central Bank, is able to control the nation's money supply and liquidity by managing base or interest rates. With those intervention rates, the Central Bank aims to achieve financial stability in the economy. The third function, refers to the supervisory actions the Central Bank takes over Commercial Banks and other financial institutions in order to regulate their reserve requirements and to prevent possible bank insolvencies or liquidity crises. To avoid such events, the Central Bank acts as a lender of last resort reducing thus the risks that Commercial Banks are facing. This could be translated as the liability to be the mean of settlement of all Commercial Banks debts.\textsuperscript{8}

The Central Banks genesis occurred in the nineteenth-century first in England after repeatedly liquidity crises in 1847, 1857 and 1866 that have shown the need of flexibility in the money supply.\textsuperscript{9} Although the Bank of England has been the origin of central banking and the base model for today's banks, it did not offer the three main functions of a modern central bank showed above. By that time, the core functions have been the responsibility for monetary stability, the domestic note-issuing monopoly (just in some cases) and, also the support for

financial stability. When years after, the nations started to form, this helped the modern central banks to create an own identity.\textsuperscript{10}

Nowadays the International Banking System includes more than 200 Central Banks all over the world, except from 8 countries that do not feature one. However, there are just few of them widely accepted as main banks and they are characterized by the term “Big Four”. The term was given to show that the banking industry is dominated by just four institutions. At an international base the term was given to the biggest Central Banks: The Federal Reserve (United States), The People’s Bank of China (China), The Bank of Japan (Japan) and The European Central Bank (European Union). Occasionally, The Bank of England (United Kingdom) is also included. Similarly, there are four main/largest banks in the most countries, and they are also referred to as “Big Four”.\textsuperscript{11} Table 2.1 shows the “Big Four” banks of some countries and internationally.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
\textbf{The “Big Four” Banks Internationally} & \\
\hline
\textbf{Country} & \textbf{Bank Name} \\
\hline
United States (USA) & The Federal Reserve \\
China & The People’s Bank of China \\
Japan & The Bank of Japan \\
European Union (EU) & The European Central Bank \\
\hline
\textbf{The “Big Four” Banks in several countries} & \\
\hline
\textbf{Country} & \textbf{Bank Name} \\
\hline
Australia & Commonwealth Bank of Australia \\
 & National Australia Bank \\
 & ANZ Banking Group \\
 & Westpac Banking Corporation \\
Canada & Royal Bank of Canada \\
 & Toronto-Dominion Bank \\
 & Bank of Nova Scotia \\
 & Bank of Montreal \\
\hline
\end{tabular}
\caption{The “Big Four” Banks internationally and by country}
\end{table}


\textsuperscript{11} Wikipedia. (2017), Big Four (banking), [Online]. Available from: https://en.wikipedia.org/wiki/Big_Four_(banking) [27 April 2017]
<table>
<thead>
<tr>
<th>Country</th>
<th>Bank Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Industrial and Commercial Bank of China</td>
</tr>
<tr>
<td></td>
<td>China Construction Bank</td>
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<tr>
<td></td>
<td>Agricultural Bank of China</td>
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<tr>
<td></td>
<td>Bank of China</td>
</tr>
<tr>
<td>France</td>
<td>BNP Paribas</td>
</tr>
<tr>
<td></td>
<td>Credit Agricole Group</td>
</tr>
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<td></td>
<td>Société Générale</td>
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<td></td>
<td>Groupe BPCE</td>
</tr>
<tr>
<td>Germany</td>
<td>Deutsche Bank AG</td>
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<td></td>
<td>Commerzbank AG</td>
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<tr>
<td></td>
<td>DZ Bank Group</td>
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<tr>
<td></td>
<td>KfW Group</td>
</tr>
<tr>
<td>Greece</td>
<td>National Bank of Greece (NBG)</td>
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<tr>
<td></td>
<td>Alpha Bank</td>
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<td></td>
<td>Eurobank Ergasias</td>
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<td></td>
<td>Piraeus Bank</td>
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<td></td>
<td>Unicredit SpA.</td>
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<td></td>
<td>Intesa Sanpaolo</td>
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<tr>
<td></td>
<td>Cassa Depositi e Prestiti</td>
</tr>
<tr>
<td></td>
<td>Banca Monte dei Paschi</td>
</tr>
<tr>
<td>Italy</td>
<td>Mitsubishi UFJ Financial Group</td>
</tr>
<tr>
<td></td>
<td>Japan Post Bank</td>
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<tr>
<td></td>
<td>Mizuho Financial Group</td>
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<tr>
<td></td>
<td>Sumitomo Mitsui Financial Group</td>
</tr>
<tr>
<td>South Africa</td>
<td>Standard Bank Group</td>
</tr>
<tr>
<td></td>
<td>FirstRand Ltd.</td>
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<td></td>
<td>Barclays Africa Group</td>
</tr>
<tr>
<td></td>
<td>Absa Bank Ltd.</td>
</tr>
<tr>
<td>Spain</td>
<td>Banco Santander</td>
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<td></td>
<td>BBVA</td>
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<td></td>
<td>Caixa Bank</td>
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<tr>
<td></td>
<td>Banco de Sabadell</td>
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<tr>
<td>Switzerland</td>
<td>UBS Group AG</td>
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<tr>
<td></td>
<td>Credit Suisse Group</td>
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<tr>
<td></td>
<td>Raiffeisen Switzerland</td>
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<tr>
<td></td>
<td>Zürcher Kantonalbank</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>HSBC Holdings</td>
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<tr>
<td></td>
<td>Barclays</td>
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<tr>
<td></td>
<td>Royal Bank of Scotland Group</td>
</tr>
<tr>
<td></td>
<td>Lloyds Banking Group</td>
</tr>
<tr>
<td>Country</td>
<td>Bank Name</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>United States</td>
<td>J.P. Morgan Chase &amp; Co.</td>
</tr>
<tr>
<td></td>
<td>Bank of America Corp.</td>
</tr>
<tr>
<td></td>
<td>Wells Fargo &amp; Co.</td>
</tr>
<tr>
<td></td>
<td>Citigroup</td>
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All the above banks -except the internationally “Big Four”- are Commercial Banks that constitute the second structure of the Banking System. As referred before, one of the Central Bank’s function is to supervise and control all the operations a Commercial Bank takes over. For this reason, it is necessary to make a presentation of these institutions too.

### 2.2.2 Commercial Bank

Commercial Banks – the main subject of research in the current thesis work- are the second structure of financial institution the banking system consists of. They also constitute the main form of banking institutions. A commercial bank’s financial activities have to do with almost all of the offered product and services categories in the financial and capital markets. Thus, social and economic stability can be ensured with the result of a sustainable growth of the economy.\(^{12}\)

Main function of commercial banking is the acceptance of deposits from its clients (public or corporations) on various types such as saving account deposits, demand deposits and others. On clients demand it is possible that these deposits are returned immediately to the customers or after a certain period. With the accepted deposits, the commercial bank is able to provide loans (money lending) in form of cash money, such as overdraft or instalment loan, or in form of documentary credits, such as Letter of Credit, Guarantees,

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Securities etc. Equally, important functions of a commercial bank are the issuing of bank drafts and cheques, the process of payments like internet banking or other payment methods, the cash management and treasury management, the private equity financing and the relationship building with other financial institutions. Many other secondary functions are performed, along with the above core products and services.\textsuperscript{13}

Of course, a bank’s scope has to do with the profit earnings occurring from the banks functions. In a state of equilibrium (balance sheet), the bank is obliged to pay an interest rate for the acceptance of deposits to its client, but it is also obliged to earn an interest rate from the loan takers. The profit earned is the so-called “spread” or “escart”, which is the difference between the interest rate from loans and that from deposits. Another source of profit are the extra fees earned from several banking activities or asset management and investment banking.\textsuperscript{14} However, this profit is not secured and can be easily minimized causing financial and operational problems to the bank, even a threat to its existence. For these reasons, a very important issue is the Risk Management which will be discussed in the next chapter.

Finally, it should be mentioned that this type of bank is a universal bank because of the participation in many kinds of banking activities. Another definition is a full-service financial firm. But a universal bank is both a commercial bank and an investment bank, and it provides other financial services such as insurance. Because of this, only large size banks are able to operate as universal banks. But there are banks that operate only as investment banks, especially in America (Goldman Sachs, Morgan Stanley), whilst there is no regulatory distinction in many other countries in Europe where there are a lot of universal banks (BNP Paribas, Société Générale, HSBC, Barclays, ING Bank, Bank of America, Citigroup, JP Morgan Chase, UBS, Credit Suisse etc.)\textsuperscript{15}

2.2.3 Other types of Banks

Another form of banks, the non-bank financial institutions, are the specialized credit institutions such as investment banks, insurance companies, mutual funds, pension funds, market brokerage, commodity traders etc. At the beginning of the financial crisis in 2007, they were named as “shadow banking system”. By this term, the whole set of the diverse non-bank institutions should be described.\(^\text{16}\)

These intermediaries are not banks as per the above definition because they do not have a full license for offering banking products and services like traditional banks do, or they are not supervised by a national or international banking regulatory agency (for example Basel Committee on Banking Supervision). They play a complementary role to the one of traditional banks by offering loans and other credit facilities but not accepting deposits from the public. According to the type of the non-bank intermediary, other offered services are retirement planning, underwriting stocks and shares, money market trading, wealth management provision etc. But it is remarkable to note that non-banking institutions have a positive impact on the stability of the financial system by protecting economies from financial shocks and helping them to recover by providing liquidity when the primary intermediaries are not able to.\(^\text{17}\)

In Figure 2.2 the total financial assets and the share of total financial assets of financial intermediaries from 2002 to 2014 are shown.


2.3 Related International Organizations

In order to have an integrated perspective on banks, it is useful to briefly refer to the international organizations which are directly or indirectly related to the banking system and banks.

- **Eurosystem**

The Eurosystem is an institution which is the monetary authority of the European Union member states (Eurozone) that have adopted a common currency, the Euro (€). It consists of the European Central Bank (ECB) and the 19 Eurozone member states’ National Banks (NCB).\(^{18}\)

Because of its independency, the European Central Bank and the National Banks are not supposed to take or seek instructions from external institutions and bodies or governments on tasks performing. As primary objective is the maintenance of the price stability in the Eurozone followed by the financial

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stability and integration. This is possible when ECB and NCB’s commonly contribute in order to achieve these objectives. As per Article 16 of the Statutes of the ECB, the latter has the exclusive right to issue the Euro banknotes and the Eurozone members states can issue Euro coins based on the authorized amount defined by the ECB. This is the reason of the monetary policy appliance of the ECB by the several National Banks. Among the previous objectives, other tasks of the Eurosystem are the conductions of the foreign exchange operations, the management and holding of the foreign reserves that Eurozone member states own, and the operation of the payment systems.\(^\text{19}\)

In addition, the Eurosystem contributes indirectly to the credit institutions’ supervision and financial systems’ stability by the related authorities.\(^\text{20}\)

**European System of Central Banks**

Conversely to Eurosystem, the European System of Central Banks (ESCB) is not the monetary authority of the Eurozone because it consists of the European Central Bank (ECB) and the National Central Banks (NCB) of the 28 member states of the European Union (EU), where 9 of them are non-Eurozone member states with the Euro (€) currency adoption.\(^\text{21}\)

While in the Eurosystem the decision-making processes are made by the Executive Board and the Governing Council (the decision-making bodies of the ECB), there is a third body existence for the EU member states which did not adopted the Euro currency and this is the General Council. In the General Council, except of the President and the Vice-President, also the National Central Banks’ governors of the 28 EU member states are comprised. The NCB’s, that are not in the Eurozone, are members of the ESCB with a special status. They conduct their respective monetary policies but are not allowed in any decision-making related to the monetary policy of the Eurozone. Because

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of this, the ESCB plays the role of the improver for the monetary and financial cooperation between the non-Eurozone member states and the Eurosystem.\textsuperscript{22}

- **Federal Reserve System**

  The central banking system of the United States is known as the Federal Reserve System or simply Fed. After several financial panics that occurred before 1913 it was necessary for the monetary system to be controlled. For this purpose, the Federal Reserve Act was implemented in 1913 and Fed was established.\textsuperscript{23}

  It is composed of the Federal Reserve Board or Board of Governors which is fully appointed by the President and the Federal Open Market Committee which is partially appointed by the President. The other members are twelve regional Federal Reserve Banks and other U.S. Private Banks, as well as several advisory councils. Because of these structures, the Fed is both public and private and functions as “independent within the government”.\textsuperscript{24}

  Apart from the initial purpose of the Fed’s creation, it functions mainly as Central Bank in the United States. So, it supervises and regulates the banking institutions, and has three main objectives: to maximize the employment, to stabilize the prices and to moderate long-term interest rates. Lastly, an important purpose is to strengthen the U.S. status in the world economy.\textsuperscript{25}

- **Bank for International Settlements**

  It is an international financial institution, founded in 1930 and based in Basel, Switzerland. It is considered as the “Bank for the Central Banks” that is


investing the funds of the countries which are members. Basically, it is a forum for central bankers and officials where the purpose is to cope with financial issues occurring in the banking system. There are 60-member central banks from countries internationally.26

The Bank for International Settlements (BIS) has the goal to preserve the monetary and financial stability for the central banks. Some of its missions are to foster the discussion and collaboration between the central banks, the collaboration with other authorities responsible for financial stability, to occur as the prime counterparty in central banks’ financial transactions, perform as an agent or trustee in international financial operations, and implement research and policy analysis on relevance issues that have to do with the monetary and financial stability.27

Moreover, the BIS plays indirectly a central role in banking supervision, by hosting the secretariat of the Basel Committee on Banking Supervision. In this context, the Basel Capital Accords in 1988, Basel II framework and Basel III framework have been established. However, we will deal with this issue in more detail at a later stage.28

• **International Monetary Fund**

The International Monetary Fund (IMF) is an international institution which has the central role in the global financial governance and constitutes of 189 countries. The institution was formed after the Bretton Woods Conference in 1944 with the goal to reconstruct the international payment system; it was formally created in 1945.29

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26 Bank for International Settlements. (2005), This is the biz, [Online]. Available from: https://www.bis.org/about/thisisthebiz.pdf [7 May 2017]
The primary mission of the organization is to obtain the stability of the international monetary system by lending to the countries with difficulties in the balance of payment, helping the members and by observing the economies of the member countries and the global economy. Through surveillance on the global economy and those of the members, the IMF can monitor the economic and financial policies by advising the member countries about policy adjustments and by emphasizing on the possible risks to stability. Finally, the lending process is carried out by providing loans to the member countries with payment problems. By this action, it is possible for these countries to rebuild the international reserves, stabilize the currencies, keep paying for imports and restore the economic growth.\textsuperscript{30}

- **World Bank**

  Another international financial institution is also the World Bank (WB) that includes the International Bank for Reconstruction and Development, and the International Development Association. These two institutions are part of the World Bank Group; together with three other institutions the World Bank constitutes a component of the Group. The World Bank Group is a part of the United Nations system.\textsuperscript{31}

  The two important goals of the World Bank are firstly the reduction of poverty and secondly the support of development. To reach these goals the institution provides loans to developing countries in order to support capital programs and investments in health, education, environment and other areas. Other offered services are policy advices, research and analysis, and technical assistance.\textsuperscript{32}

\textsuperscript{30}International Monetary Fund, (2017), About the IMF, [Online]. Available from: [http://www.imf.org/external/about.htm](http://www.imf.org/external/about.htm) [7 May 2017]


• **G-20**

The G-20 international forum, or Group of twenty, regards to the governments and Central Bank governors of the twenty major global economies. The twenty members consist of the leaders’ summit (leaders of 19 countries and the European Union) and the minister meetings (finance ministers and central bank governors of the 19 countries and the European Union). Except the European Union, the 19-member countries are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom and United States. Every year guests are participating: Spain, the Chair of Association of Southeast Asian Nations, two African countries and one country or more invited by the presidency. In addition, other participators are the Chairman of the International Monetary Fund (IMF), the President of the World Bank (WB), the International Monetary and Financial Committee (IMFC) and the Chairman of the Development Assistance Committee (DAC).

The purpose of this forum is the discussion and problem solving on issues in the global financial system such as economic growth, international trade and financial market regulation. Moreover, other themes of discussion are climate change, employment policy, development policy, technology, terrorism and other.

### 2.4 Regulation and Supervision

It is commonly known that the regulation is based on restrictions, requirements and guidelines that are necessary to be followed by the banks in order to avoid difficult situations and effects which could be the result of various financial actions and, also for protecting the bank’s creditors and guarantors. These ‘rules’ are imposed / proposed by the regulatory authorities that are responsible

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33 The Federal Government. (2017), Members and participants, [Online]. Available from: [https://www.g20.org/Webs/G20/EN/G20/Participants/participants_node.html](https://www.g20.org/Webs/G20/EN/G20/Participants/participants_node.html) [7 May 2017]

34 The Federal Government. (2017), Agenda, [Online]. Available from: [https://www.g20.org/Webs/G20/EN/G20/Agenda/agenda_node.html](https://www.g20.org/Webs/G20/EN/G20/Agenda/agenda_node.html) [7 May 2017]
for banks (government interventions), also known as supervisors.\textsuperscript{35} There are several regulation and supervision authorities worldwide at an international, national and local level.

Subsequently, it is informative to briefly represent the notion of “Too big to fail” which is an issue related to regulation and supervision and shows, through an example, that the latter is not always as fair and effective as believed. Through this, it can be understood how important Risk Management is for the banking sector and others in general. Also, it is useful to make a reference to the most significantly applied requirements for the banks (Basel Accord), because it will help for the better understanding of the banking risk management issue in the next chapters.

\textbf{2.4.1 The need of Regulation}

As referred before, banks as intermediaries provide financial services to the public and private sector or conduct transactions with other intermediaries. In order to do this, a bank must obtain a license from the regulatory and supervisory authorities. In this way, it is ensured that a bank is safe and efficient to the public and the wide economy. Supervisors, however, still keep monitoring the banks even after they granted a license and can intervene and sometimes retract the license if the institution does not comply with the regulations or there is an event of speculation and/or fraud. Moreover, because of the uncertainty occurring in the financial markets and the overall economy, banks are facing several types of risks that could cause major problems. Through regulation and supervision, it is possible to reduce these risks and prevent the financial instability.\textsuperscript{36}

License was the first of the three general principles of banking regulation. The second and most essential topic are the minimum requirements that banks have to follow in order to avoid exposes to several risks. Such requirements are


capital requirements, reserve requirements, credit rating requirements, reporting and disclosure requirements, exposures restrictions, corporate governance, activity and affiliation restrictions, and others. The last one has to do with the market discipline. According to this principle, banks should reveal financial information to the public (creditors, depositors, investors) so that they can be used for investment decision or assessment of the risk level. Additionally, this information also helps the regulators to control how healthy is the bank financially.\textsuperscript{37} These three principles are the three pillars of the Basel Accords, the most known and applied banking regulations. The Basel Accords are presented below in this part.

One of the most important goals for banking regulation is the deposits protection. Deposits are the main service that a bank provides to its customers and so depositors need to feel ensured about their funds and the solvency of the bank. Regulation, in this case, can reduce the deposits’ insurance costs and, also the moral hazard problems. Along to this, banking regulation aims also to the maintenance of the monetary and financial stability, where money as a mean of payment should be safe and so will be the transactions and the whole payment system. Another significant goal is the reduction of systemic risk, the risk that occurs from the impact of one banks’ system collapse to another bank or to the financial sector (domino effect).\textsuperscript{38} Efficiency and competitiveness in the financial system belongs also to the banking regulation goals. When a bank is competitive against other banks it is possible to obtain more customers and more gains by gradual improvements of their operations. This competitiveness increases the efficiency.\textsuperscript{39}

2.4.2 Too big to fail and Moral Hazard

Although this ‘protective acting’ by the supervisors, it is believed that regulation and supervision are not completely fair towards the banks. And this because, supervision has a monitoring cost. So, authorities can act more or less effective adjusted to the price banks are willing to pay or because of profit purposes. This issue is related to the “too big to fail” notion.

According to the definition “too big to fail”, certain financial institutions believe that their financial role in the economy is so important that an upcoming failure would be disastrous for the greater economic world, and because of this there must be a governmental support. This belief conceals great risks, because then the financial institutions are less careful in their risks controlling, thinking there will be always the government that protects them from failure. A consequence of this is the situation of moral hazard. Banks get in this situation when they think that they can take more excessive risks than they can handle, without worrying because someone else will take the cost of these risks on him. And they don’t worry because the governments let them believe that they will always provide them aid.

Such situations bring concerns to regulatory authorities. They have to decide whether they let a financial institution to fail, which may cause a great slack in the economy, or whether to save it by sending wrong messages to the markets (moral hazard). And here comes the question if supervision is always fair and effective. A possible answer can come through an example of a real event. During the credit crisis in 2007, a lot of financial institutions in the United States and Europe had the chance to get protected by the governments in order to avoid a big failure. However, the decision was taken to let Lehman Brothers fail in 2008. It is believed that after this action the credit crisis became even more bigger. This event was criticized and left intimations about the purpose and

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reasons of this decision by the US government, but also about how fair and effective supervisors eventually are.\textsuperscript{43}

2.4.3 The Basel Accord

The Basel Accord is a set of non-mandatory guidelines for the banking regulation. More specifically, it grew up after the need of risk-based standards for capital adequacy in the banks. This attempt was made by several nations’ contribution (G-10 Central Banks) with the monitor of the Basel Committee on Banking Supervisions, by the Bank for International Settlements (BIS) in 1988 in Basel, Switzerland.\textsuperscript{44} It has been the precursor to the risk management development.

- Basel I

Basel I (1988) was the first framework of the Basel Accord and was focused to credit risk and included the capital-based regulations which prescribed that risk losses should be quantified. This was possible with the help of the Cooke ratio (or risk-based capital ratio RBCR), a measure of the total credit exposure a bank can face. The Cooke ratio defined that banks should have a minimum capital level (capital requirement) of 8\% of their risk-weighted assets. A banks’ credit exposures can arise from the on-balance sheet assets or from the off-balance sheet assets which when added give the total risk-weighted assets.\textsuperscript{45}

The calculation of the capital ratio is based on this minimum capital level of 8\%, the risk weights of assets which were proposed by the regulatory and the exposure of the assets. In other words, the regulatory capital should be:

\[ \text{Capital} = 8\% \times \text{Risk weight} \times \text{Exposure} \] \textsuperscript{46}

In Table 2.2 the regulatory risk weights of asset classes are shown.

\begin{itemize}
\item \textsuperscript{43} Hull, J.C. 2015, ‘Basel I, Basel II, and Solvency II’, in Risk Management and Financial Institutions, 4\textsuperscript{th} edn., John Wiley & Sons, New Jersey, pp. 325-352
\item \textsuperscript{45} Guadalupi, D. 2013, ‘The ever-evolving Basel Accord’, in Retail Credit Risk Management, eds. Anolli, M., Becalli, E., Giordani, T., Palgrave Macmillan, Hampshire, pp. 13-58
\end{itemize}
### Table 2.2 Risk Weights for the On- and Off-Balance Sheet Items

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>On-Balance Sheet Item</th>
<th>Off-Balance Sheet Item</th>
<th>Risk Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Cash</td>
<td>• Commitments with an original maturity of up to one year, or which can be unconditionally cancelled at any time</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>• Claims:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) on central governments and central banks denominated in national currency and funded in that currency</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) on OECD, central governments and central banks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) collateralized by cash of OECD central-government securities or guaranteed by OECD central governments</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cash items in process of collection</td>
<td>• Short-term self-liquidating trade-related contingencies (such as documentary credits collateralized by the underlying shipments)</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>• Claims:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) on multilateral development banks (IBRD, IADB, AsDB, AtDB, EIB) and claims guaranteed by, or collateralized by securities issued by such banks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) on banks incorporated in the OECD and loans guaranteed by OECD incorporated banks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) on banks incorporated in countries outside the OECD with a residual maturity of up to one year and loans with a residual maturity of up to one year guaranteed by banks incorporated in countries outside the OECD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d) on non-domestic OECD public-sector entities, excluding central government, and loans guaranteed by such entities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loans fully secured by mortgage on residential property that is or will be occupied by the borrower or that is rented</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certain transaction-related contingent items (e.g. performance bonds, bid bonds, warranties and standby letters of credit related to particular transactions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note issuance facilities and revolving underwriting facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other commitments (e.g. formal standby facilities and credit lines) with an original maturity of over one year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All other assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital instruments issued by other banks (unless deducted from capital)</td>
</tr>
<tr>
<td>Real estate and other investments (including non-consolidated investment participations in other companies)</td>
</tr>
<tr>
<td>Premises, plant and equipment and other fixed assets</td>
</tr>
<tr>
<td>Claims:</td>
</tr>
<tr>
<td>a) on the private sector</td>
</tr>
<tr>
<td>b) on banks incorporated outside the OECD with a residual maturity of over one year</td>
</tr>
<tr>
<td>c) on central governments outside the OECD (unless denominated in national currency - and funded in that currency - see above)</td>
</tr>
<tr>
<td>d) on commercial companies owned by the public sector</td>
</tr>
</tbody>
</table>

| Direct credit substitutes, e.g. general guarantees of indebtedness (including standby letters of credit serving as financial guarantees for loans and securities) and acceptances (including endorsements with the character of acceptances) |
| Sale and repurchase agreements and asset sales with recourse, where the credit risk remains with the bank |
| Forward asset purchases, forward deposits and partly-paid shares and securities, which represent commitments with certain drawdown |

| 50% |
| 100% |
The capital requirement consists of the Tier 1 Capital and Tier 2 Capital components. The Tier 1 Capital includes the bank’s equity capital, in contrast to Tier 2 Capital which consists of the other elements of capital (hybrid capital). According to the requirement, the bank uses the Tier 1 Capital to avoid losses. This capital should always be greater than the losses so that the bank continues its business, but if it is less than the losses, then the bank is characterized as insolvent. If this happens and Tier 1 Capital is all used up, then Tier 2 Capital should be used to save the bank. In the worst case where Tier 2 Capital is not sufficient then the banks losses are covered up by the depositors’ money (public bailout). This scenario is the disaster of the bank. For this reason, it is required that Tier 1 Capital consists of the at least 50% of the total required capital, that is 4% of the risk-weighted assets. According to the Cooke ratio and to Tier 1 Capital ratio, banks are categorized into five risk categories where capital adequacy is measured. These can be seen on Table 2.3.

Nevertheless, Basel I showed some limitations in the proposed requirements such as the fact that it was not risk sensitive, it was only focused on credit risk and the asset classes in the same category showed obvious risk differences. Because of these issues, Basel I was modified in 1996 so that it also includes market risk, except from credit risk, which allowed banks to use their internal models for regulatory purposes, the most known value at risk (VaR) models. This modification was known as the “1996 Amendment” and was the step before the renewal of the framework, the Basel II.48

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### Table 2.3 Measurement of Bank’s Capital Adequacy

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Tier 1 Capital Ratio</th>
<th>Total Capital Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Well capitalized</td>
<td>≤ 6%</td>
<td>≤ 10%</td>
</tr>
<tr>
<td>2</td>
<td>Adequately capitalized</td>
<td>≤ 4%</td>
<td>≤ 8%</td>
</tr>
<tr>
<td>3</td>
<td>Undercapitalized</td>
<td>&gt;4%</td>
<td>&gt;8%</td>
</tr>
<tr>
<td>4</td>
<td>Significantly undercapitalized</td>
<td>&gt;3%</td>
<td>&gt;6%</td>
</tr>
<tr>
<td>5</td>
<td>Critically undercapitalized</td>
<td>&gt;2%</td>
<td>—</td>
</tr>
</tbody>
</table>


• **Basel II**

The revised framework of Basel Accord, namely Basel II, has been published in 2004, but implemented in 2007, and has been the result of the criticism on Basel I framework. It is remarkable that, while in Europe all sized banks were regulated under Basel II, in the United States the regulatory agencies allowed only to the “internationally active” and big banks to apply the new requirements.49

The new revision aimed for the requirements to be more risk sensitive, and so for the further improvement of the banks’ risk management. Now, it is based on three pillars. Pillar 1 consists of the minimum capital requirements for credit risk, same as in Basel I, where the requirement of the banks’ total capital to be 8% of the risk-weighted assets (RWA) remains the same, whereas the way of calculation for the minimum capital requirement is changing. Also, the calculation of market risk (after the 1996 Amendment) stays unchanged.

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including now a new calculation for the operational risk. So, the minimum capital requirement is a result of three banking risks: credit risk, market risk and operational risk.

\[
\text{Capital} = 8\% \times [\text{Credit risk RWA} + \text{Market risk RWA} + \text{Operational risk RWA}]^{50}
\]

According to the Basel Committee on Banking Supervision’s “The New Basel Capital Accord” Consultative Document (2001), as operational risk is defined as risk of losses occurring directly or indirectly because of inadequacy or failure on internal processes, or because of people and systems or external events. And, in the BCBS’s “Amendment to the Capital Accord to incorporate market risks” (1996), market risk is defined as the risk of losses arising from the changes in market prices and occurs in positions of the on- or off-balance sheet. The definition of credit risk will be presented in the corresponding chapter. Additionally, the new ways of calculating credit risk are through three approaches: the standardized approach, the foundation internal ratings-based approach (F-IRB) and the advanced internal ratings-based approach (A-IRB). The standardized approach is similarly used for the calculation of market and operational risk alongside to internal models.\(^{51}\)

The other two pillars, namely the supervisory review process and the market discipline play a supplementary role to pillar 1, especially pillar 2. According to pillar 2, supervisors are established to control if a bank adheres to the minimum capital requirements and to ensure that the latter keeps a higher level of capital than that of the minimum capital requirement. Moreover, it is expected that supervisors act interventional to bad conditions, at an early time. But, what is important to the supervisors’ role, is that they have to encourage banks to improve their risk management not only for the risks referred above, but also for other types of risks. Pillar 3, refers to the market discipline requirements

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which aim to improve the ability of market participants to estimate information of a banks risk profile (capital structures, risk exposures, risk management processes) and risk-based capital levels (capital adequacy). This aims to improve stability and manage risks in a better way.\textsuperscript{52}

The Basel II framework was also criticized and blamed to be responsible for the recession of the global financial crisis in 2008, although it has been revised to bring the financial stability. Some of the reasons for this failure were the freedom of the banks on the regulatory capital calculation by internal models with own estimates that might not have been realistic, or a weak risk management system which underestimated several significant risks, such as liquidity risk.\textsuperscript{53} Because of this event, Basel II has not been really implemented and since 2009 the Basel Committee on Banking Supervision showed several updates and the amendment of Basel II.5, trying to recondition the weakness in the banking sector, where in 2010 agreed on the new framework Basel III that would be introduced in 2013.\textsuperscript{54}

- **Basel III**

   After the increase of the capital requirements for the market risk in Basel II.5 framework, it was considered to be an increase of the capital requirements for credit risk also, and there was an immediate need for liquidity risk to be confronted. For this purpose, the Basel Committee on Banking Supervision introduced in 2013 the new framework Basel III in order to amend the deficiencies in the financial regulation that caused the global financial crisis of 2007-2008 and the financial instability and failure of the banks. Nevertheless, although Basel III was introduced in 2013 the fully implementation of the


framework has been extended to 2019, and until then only some of the frameworks’ aspects have been, and still today are, performed.55

The current recommendations according to the new Basel III framework aim to “strengthen” the capital and liquidity standards and also the regulation, supervision and the risk management in the banking sector. The first reform in Basel III has to do with the capitals’ definition. The total regulatory capital is the sum of the Tier 1 equity capital, the additional Tier 1 capital and the Tier 2 capital. The Tier 1 equity capital consists of share capital (common equity) and retained earnings, while the additional Tier 1 capital consists of instruments that are not included in common equity. On the contrary Tier 2 capital consists of debt with a minimum maturity of at least 5 years. The empowerment of the reformed framework can be observed at the increased capital requirements, where the total Tier 1 capital should now be the 6% of the risk-weighted assets counter to the Basel’s I and II 4%, while the total regulatory capital remains as before in at least 8%. Based to this, when a bank has a positive common equity capital this can absorb losses and it is characterized as “going-concern capital”. Additionally, when the banks’ common equity capital is negative and insufficient to absorb the losses, this should be done by the Tier 2 which is referred as “gone-concern capital”.56

As an insurance that no infringement on the minimum capital requirements occurs or a failure because of losses, the framework requires to keep a capital conservation buffer of a further Tier 1 equity capital amount of 2.5% on risk-weighted assets outside the stressed times. Alongside, another “safety measure” similar to the capital conservation buffer is the countercyclical buffer which aims to protect a bank from future potential losses likely to happen in an excess credit growth period. The implementation of the requirement is up to the national authorities and the buffer can be set to between 0% and 2.5% of the total risk-weighted assets and met with the Tier 1 equity capital. Both

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requirements were phased-in in 2016 and are expected be fully effective in 2019.57

Beside these requirements Basel III introduces the leverage ratio, a supplementary measure to the risk based capital requirements, which aims to amplify these requirements and prevent from an excessive build-up of leverage in the banking sector, as was so during the crisis period.58 The leverage ratio is the ratio of the capital measure over the exposure measure, where capital measure is the total Tier 1 capital and the exposure measure includes on-balance sheet exposures (all assets on the balance sheet), derivatives exposures, securities financing transaction exposures and off-balance sheet items (loan commitments, loan substitutes, acceptances, letters of credit etc.). During a testing period from 2013 to 2017 with data collection from banks about the application of the ratio, the Committee specifies a minimum Tier 1 leverage ratio of 3% and the official introduction will be in 2018.59

The new entry of the regulatory framework is a reflection of the observations during the crisis, which eventually was the main factor that caused a great damage in the banking sector. We talk about the liquidity risk that has not been under the attention of the past frameworks. The Basel Committee on Banking Supervision developed for this reason global minimum standards about the liquidity in banks, involving two liquidity ratios: the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The LCR is the ratio of the High-Quality Liquid Assets over the Net Cash Outflows in a 30-Day Period and is the ability of a bank to overcome a 30-day period of liquidity disruption. This ratio is required to be greater than 100%. Additionally, the NSFR is the ratio of the Amount of Stable Funding over the Required Amount of Stable Funding and focuses on the liquidity management of an over a 1-year period. NSFR is also

57 Basel Committee on Banking Supervision (2010), Basel III: A global regulatory framework for more resilient banks and banking systems, Bank for International Settlements, Basel
58 Basel Committee on Banking Supervision (2010), Basel III: A global regulatory framework for more resilient banks and banking systems, Bank for International Settlements, Basel
required by the Basel III to be over 100%. Both standards are scheduled to be implemented by 2018.60

Finally, the Basel III framework is also concerned about the impact the fact on the crisis had that the previous frameworks did not capture major on- and off-balance sheet risks and derivative related exposures. To amend this fact, the reformed framework is increasing the risk coverage of the capital for trading activities, securitizations, off-balance sheet exposures and counterparty credit exposures arising from derivatives. Also, it strengthens the risk management of counterparty credit exposures requiring the use of a stressed value-at-risk (VAR) capital measurement which helps in reducing procyclicality and systemic risk across the financial system.61

Concluding the issue of regulation and supervision someone could ask how trustful is the new Basel III framework is so that a possible upcoming crisis or sector collapse will be prevented. The answer is that nobody can ensure that the current requirements are strong enough to bring a macro-stability in the banking sector. No framework can eliminate risks occurring in the banks or promise no-failure, because uncertainty cannot be eliminated. And no guidance or regulation can be a substitute of a prudent banking risk management. The only way that a bank stays safe, adequate and solvent is through a qualitative risk management.62

61 Basel Committee on Banking Supervision (2010), Basel III: A global regulatory framework for more resilient banks and banking systems, Bank for International Settlements, Basel
3 Risk Management in Banking

In this Chapter, the definition of risk and the impact of risks in banking will be introduced. Because of this, we will examine several risks occurring in banking and present them in short. In addition, the significance of risk management in dealing with the consequences of the risks occurring in banking will be addressed through the representation of the risk management processes adopted by the banks. Moreover, there will be also a presentation of the basic risk management techniques used by the banks.

3.1 The need of Risk Management

In the previous chapter, we presented the important topic of regulation and supervision on financial institutions. As a continuation of this topic, it is necessary to develop the issue of risks occurring to banks and the vital importance of their management.

Firstly, it is important to understand what is defined as risk. Generally, risk expresses the uncertainty. But it is more understandable to say that risk is the probability of a negative event occurrence, such as potential losses (negative outcomes) owing to the uncertainty.63 Because of this uncertainty, risk cannot be avoided but managed in the most efficient way to cause less consequences. However, to be more precise, risk has two dimensions: the one of the uncertainty and the second of the impacts intensity.64 Banks do face risks due to various sources and factors. This is mostly because as financial institutions, banks are intermediaries and therefore provide financial services, where transactions between counterparties automatically pose risks. Also, one of the core businesses of a bank is investing, an activity that cannot be without risk. Moreover, risks occur at an operational level of a bank’s entity and existence. But the truth is that taking risks may result in increased profit margins (excess

63 Bessis, J. 2015, ‘Risks and risk management’, in Risk Management in Banking, John Wiley & Sons Ltd., Chichester, pp. 1-12
returns) for the bank. The point is not to take excessive risks that end up with negative consequences, but select those activities which offer higher returns.\textsuperscript{65}

In order to avoid possible negative consequences of the risk impact, financial institutions should mitigate risk exposures occurring in their businesses by measuring and managing them. Risk management is therefore the process (or sequence of activities) where managers use to identify and evaluate risks occurring in the bank’s business or the business decisions that are taken (which conduct to risk-adjusted returns) through continuous development of tools and techniques which set up the systems and the procedures for their management.\textsuperscript{66} This process, however, should be continuous in order to effectively evaluate its performance and not only protect the banks’ solvency but also protect the risk exposures of their clients.\textsuperscript{67}

As it will be shown thereafter, a banks’ solvency is just one of the issues that risk management deals with. Other significant issues are: risk analysis (where the identified risks are observed whether they correspond to the banks’ strategy), risk quantification (where risks are measured with the help of risk experienced data and assigned into categories of high or low risks), risk monitoring and reporting (where the risk profile is continuously monitored for unexpected changes). Additionally, investment and pricing decisions among with the property of the strategic advisor are also important issues of risk management. All these functions are part of a bank’s long-term strategy.\textsuperscript{68}

### 3.2 Risk Management Process

Risk management is both a qualitative and quantitative practice where expert knowledge and scientific techniques coexist for a successful result. Therefore, it is essential that a bank’s risk management department includes a well

experienced team with strong mathematical knowledge and computational technology background; this is an important factor in the risk management practice. There should also be a consecutive development of tools and techniques for the reinforcement of the managements’ framework. Additionally, another significant factor is the quality of data used in the process which is critical for the identification and measurement of risks.69 Finally, one more necessary factor is the formulation of the business policies and strategies that should be followed, alongside with employee ethics, communication and high standards in management.70 Having these factors ensured, a sound risk management is assured and the process can begin its continuous practice.

3.2.1 Enterprise Risk Management

Before proceeding to the presentation of the risk management process, it is useful to introduce the concept of Enterprise Risk Management or ERM. Usually, banks make mistakes in identifying and managing risks due to the tendency of grouping risks into silos. Many institutions believe that categorizing risks into silos with common characteristics (risk terminology, risk measures, reporting lines, systems, data, etc.) would be useful to organize an efficient risk management. However, this is only efficient when speaking about individual risks or individual business units. But as we know, banks are institutions of various business units and several activities in a whole, and each of them face one or more types of risks. So, this fact could be catastrophic for the bank if the risk managers are not able to communicate across the various silos and business units, because then they won’t be able to manage the important risks of the whole institution.71

The recent attempt to break down this tendency is called Enterprise (or enterprise-wide) Risk Management (ERM). ERM is a holistic approach to risk management, where an enterprise-wide assessment of risks is involved in order to facilitate a balanced decision making and the big-picture view of the enterprise-wide risks. This holistic approach is based on the bottom-up and top-down approaches in risk management. The top-down approach defines the institutions’ risk appetite overall and according to this, it is then able to define the risk limits in the various business units. Complementary, the bottom-up approach appraises whether the several risks occurring in the business units are consequent to the risk appetite. Both approaches are meaningful for the institution and so it is useful that both are applied, because the effective risk management gives the bank a competitive advantage compared to other banks.

An overall view of the Enterprise Risk Management framework can be seen in Figure 3.1

Figure 3.1 The ERM framework developed by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) (Executive Summary of Enterprise Risk Management – Integrated Framework, COSO, 2004)

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• Risk Appetite

Risk appetite refers to the amount of risk a bank is willing to accept in order to achieve its business plan and strategic objectives. Usually, the influence of risk appetite derives from the liquidity profile, the capital level, the liability structure and other elements which define the risk tolerance capacity of a bank. There are four formulations of risk appetite that a bank can adopt: high, moderate, low or balanced. The first one refers to banks that mostly prefer to do business in financial instruments, trading gold and futures and real estate finance. Contrariwise, the moderate risk appetite refers to banks with low capital, average risk management and risk control capabilities that mostly do business in loans and investments. The last formulation is about banks that prefer traditional activities and balanced business between risk and return. Finally, the risk appetite can vary from one business line to another and can be specified for each one of them or for the overall institution as a whole.74

• Risk Limits

Subsequently to the risk appetite, banks established also the risk limits. These are the upper bounds to the potential losses that may arise when risks materialize. For every activity, business unit and of course for the overall institution risk limits are set up as a first guideline for risk avoidance. Banks can define the merit of the risk limits according to the amount of capital losses that they can withstand. To achieve this, the overall risk limits can be defined as a percentage of the total owned funds and then distributed to market, credit, operational and residual risks. This distributed amount is not a random decision but results from measurement models, historical loss experiences or other data. It is also important to first limit up the needed amount to cover residual risks before proceeding to the other obvious risks, so that unexpected losses can be avoided. Finally, for each one category of risk, sub-limits can also be defined for every risk sub-category. The risk limits should be revised from year to year.

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following the changes in market variables and market volatility, and should be specified in the risk management policy document.\textsuperscript{75}

\subsection*{3.2.2 Risk Governance and Transparency}

Governance describes the actions, processes and structures that exercise authority, take decisions and implement them.\textsuperscript{76} Risk governance constitutes the appliance of the governance’s core principles to the context of risk and that of the risk-related decision making. According to the International Risk Governance Council (IRGC), actors, rules, conventions, processes and mechanisms are included in risk governance where their major concentration is about collection, analysis, communication and management decision taking of relevant risk information. Three components constitute the risk governance: risk assessment, risk management and risk communication. Risk assessment is about the scientific identification and exploration of the types, likelihoods and consequences of risks providing knowledge about possible events. Additionally, risk management is the tool for preventing, reducing or altering the consequences that result from the risk assessment. Finally, risk communication is the most important component as it is the mean of connection between expert judgement and public perceptions of risks, that helps the actors in their informed choices about the occurred risks.\textsuperscript{77} In Figure 3.2 the IRGC’s risk governance framework can be seen.

In the core principles of risk management also transparency is included together with governance, process and other elements. It is important that an analyst, an investor or the bank itself is able to understand and explain how the risk system works using data, specific models and assumptions as well as risk

\textsuperscript{75} Ghosh, A. 2012, ‘Risk management systems and processes’, in Managing Risks in Commercial and Retail Banking, John Wiley & Sons Ltd, Singapore, pp. 261-360
Generally, transparency is the state where investors have free access to required financial information of a company such as financial reports, price levels and market depth. Because of the free access on same information, all the market participants can take decisions of value and so transparency helps in reducing the price volatility.79

**Figure 3.2** The International Risk Governance Council’s (IRGC) risk governance framework. ([www.irgc.org](http://www.irgc.org))

### 3.2.3 Cyclical Process

The common steps of the risk management process are: 1) identification, 2) measurement and quantification, 3) management, 4) control, 5) monitor and report.80 However, these steps of the risk management process are not

standard and each bank has its own process according to its size and business activities. Each one of the steps are briefly represented below as a first attempt to understand the continuous process. Also, an indicative portrayal of a risk management process can be seen in Figure 3.3.

**Figure 3.3 The Risk Management Process**

**Framework Establishment:** Framework establishment can be described as the guidelines inflow of the risk management process. It is about the strategies, the plan and information that is used in the process in order to efficiently manage risks occurring in the banking business. As referred before, it is significant for the managers and the bank to establish the risk appetite and risk limits in the risk management process. Also, risk governance and transparency among other significant subjects are of importance, together with an ideal plan of the process steps and their content (techniques used, information used, etc.). Therefore, we add this step outside the cyclical process, as it constitutes an
entry of guidelines that are used for the further process, rather than a step of the continuous cycle.

- **Identification**

  In this first step of the process all potential risks occurring in the bank’s business are identified. Risk identification is about understanding the various risk types and their sources that are faced in the day-to-day business enterprise-wide. For an optimal identification and consequently for their best management, this step can be practiced as a three-stage process: by identifying the risk components, identifying the risk factors and lastly identifying the risk elements. Reaching the finer level of risk elements gives the bank the advantage to identify the possible higher level of risks and create the best strategy to manage them.\(^{81}\) The approaches used to identify risks are usually the bottom-up and top-down approaches as explained previously. The tools and techniques that help in the identification process of risks are among others brainstorming, interviewing, SWOT analysis, checklists, experienced observations, and others.\(^ {82}\)

- **Measurement and Quantification**

  After the successful identification of the risks’ occurring in the day-to-day business of banks, the next step of the process leads to their measurement and quantification. Through measurement tools and techniques, the impact of the risks can be estimated and ranked into ranking categories according to each risk’s intensity. More specifically, the likelihood and impact of each risk is quantified and according to this the risk is classified into the appropriate risk category (risk analysis). Subsequently, the risks are compared and prioritized to get managed, according to the frameworks’ establishment of the bank. This is known as risk evaluation, and constitutes a component of the risk

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assessment process. The most common model for measuring a risk’s likelihood is VaR (value at risk), which is mostly used for the measurement of the market risk and less often used for the measurement of the credit risk. However, not every risk can be measured with this model, as every risk provides its own challenges. Finally, the risk quantification ranks the identified risks according to their impact, intensity and likelihood into risk categories. A typical example are the credit ratings of credit risks. The risk analysis phase is also known as the division of a Quantitative and Qualitative Risk Analysis.

**Risk Assessment**: It refers to the part of the risk management process which constitutes of the risk identification, risk analysis and risk evaluation phases. The last two phases are part of the measurement and quantification step of the process. This part of the risk management process is of great importance as it is a critical step in dealing with banking risks. In Table 3.1 an illustration of its components is shown.

<table>
<thead>
<tr>
<th>Risk Assessment</th>
<th>Phase</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk Identification</td>
<td>find, describe, classify</td>
</tr>
<tr>
<td></td>
<td>Risk Analysis</td>
<td>quantify, classify</td>
</tr>
<tr>
<td></td>
<td>Risk Evaluation</td>
<td>Compare, prioritize</td>
</tr>
</tbody>
</table>

- **Management**
  
The next step of the risk management process, proceeds with the management of the identified risks occurring in the banking business. It is about the response of the bank against the threats that it is facing. In the risk evaluation phase, the risks are prioritized as of their grade of danger they cause
to the bank, and therefore the most dangerous of them are the ones that have to be treated at first.

The response of the bank against the threats can be implemented with four strategies: avoidance, reduction, transfer and acceptance. Risk avoidance is the strategy that a bank adopts when it considers not to perform activities that carry a great grade of risk. Risk reduction is about reducing the exposure of a bank or making changes in the business model and control system. Another strategy refers to the transfer of a part or the whole risk. Usually, the most common form of risk transfer used is insurance and derivatives. The last strategy, risk acceptance, refers to the acceptance of risks with a lower impact or well diversified portfolios. This strategy requires the increase of the risk appetite of a bank so that there is sufficient capital to cover the risk losses. The next phase, of a bank’s response to the risks that it is facing, is the evaluation (cost/benefit analysis) and implementation of the defined strategy which will be followed individually or in combination.83

• **Control**

In the risk control step, of the risk management process, the outcome of the previous step is examined i.e. to what extent it comes in line with the decision taken and the strategy chosen. If the results are not the desired ones, the cyclical process returns to the first step again, the risk identification, and it is controlled where and what mistakes have been made in the process. Otherwise, the process moves on to the last step where the outcomes and the risks are monitored and reported. The risk control can be performed daily, periodically or on a fixed basis to control if there should changes or updates be made in the risk management process.84

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• **Monitoring and Reporting**

The last step of the risk management process is monitoring and reporting of the outcomes of the whole process. The risks occurred in the banking business and the risks that may occur in the future should be under continuous observation, so that the risk management process is effective and the bank does not become insolvent or experience extreme losses. This is the outcome that banks and counterparties want to avoid and for this reason, continuous monitoring is of significant importance together with reporting of the outcomes, so that stakeholders have access to information about the state of a bank.⁸⁵

### 3.3 Risk Identification

Identifying risks is the first and most important step in risk management. Banks, as intermediaries with a wide occupational range, are imposed to various risks in their day-to-day business. Most of these risks are dangerous because they can cause significant losses to a bank and can drive to insolvency. Through the identification process a bank is able to get notified about the potential risks of which it is threatened, analyze and measure them, and eventually choose an effective way of their management.

We earlier represented risk as an expression of uncertainty which causes potential losses, in general. However, there are various sources and factors of risks causing difficulties to banks and therefore it is important to separate them into categories according to their type. This separation is helpful for us to understand the differences or similarities between risks, and also understand each individual risk, but it tends to create the pre-referred risk silos issue. Although, as showed before, this issue can be militated by adopting an enterprise-wide risk management process.

However, for the better understanding of the several types of risks we will though examine how risks are categorized and how they are grouped. The

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subject of the current study is risk management in financial institutions, and more precisely risk management in banks. Therefore, financial risks are of our interest.

**Financial Risk:** It refers to the ability of a bank to finance its debt by generating sufficient cash flows (in other words to ensure its financial leverage) in order to be able to meet its obligations. If a bank fails to meet its obligations then the loss that is inflicted is direct. The major categories of financial risks occurring in banks are credit risk, liquidity risk, market risk and operational risk, and they are also known as direct risks. Their impact can be measured through various techniques.

- **Credit Risk**

  Credit risk refers to the financial loss occurring from a borrower's or a counterparty's or a bond issuer's failure to fulfill its financial obligations on time and in accordance with the agreed contractual terms. This failure usually arises due to inability or unwillingness for payment, where the first situation is more commonly compared to the second one. The situation of payment's inability is related to states such as default, insolvency and bankruptcy. The main types of credit risk are default (or counterparty) risk, spread risk, downgrade (or migration) risk, recovery risk, country risk, pre-settlement risk and sovereign risk (the definitions of these risks will be given in chapter 4).

  Bank products and transactions always involve credit risk. These are loans, deposits, collaterals (accounts receivables, contingent claims, etc.), leases, repurchase agreements (repos), bonds, derivatives, and others. The most known bank product, deposits, involve credit risk and a wise protective measure

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against it is the assessment of the bank’s creditworthiness. Loans can be unsecured or secured, where in secured loans assets are set as collaterals for mortgage. In collaterals, the risk that is occurring is that the buyer makes a late payment or does not pay at all on his obligations. Leases are also a form of secured loans similar to collaterals. Credit risk is of course included in bonds, where there is the risk of non-payment, reduced payment or late payment of the bond’s coupon by the bond issuer.\textsuperscript{89} Repos are a form of secured loans where one counterparty is the seller of securities who wishes to borrow money paying the implied interest rate and repurchase the securities on a specified day, and the other counterparty is the lender who is willing to lend a loan but needs collateral against the risk of a non-repayment of the loan.\textsuperscript{90} Lastly, credit risk in credit derivatives refers to the potential loss of a bank due to the default of a counterparty to pay its derivative’s transaction obligations.\textsuperscript{91}

- **Liquidity Risk**

  Liquidity risk relates to liquidity. As liquidity is defined the availability of cash or other equivalent resources (assets), that allow the bank to make expected or unexpected, current or future payments or cover other obligations, when this is needed, so that the day-to-day business is effectively performed. Subsequently, liquidity risk is the risk of potential losses arising from the lack of cash resources, in other words it is the risk arising from the lack of liquidity. Therefore, it is a significant issue that a bank possibly faces and should be under surveillance and included in the risk management process.\textsuperscript{92}

  Liquidity risk comprises two types of liquidity, market liquidity risk and funding liquidity risk. The inability of a bank to convert financial assets into cash or

\textsuperscript{91} Ghosh, A. 2012, ‘Identification of credit risk’, in Managing Risks in Commercial and Retail Banking, John Wiley & Sons Ltd, Singapore, pp. 421-492
liquidate it to cover expected or unexpected obligations constitutes the market (or asset) liquidity risk.\textsuperscript{93} Alongside, funding (or liability) liquidity risk is the inability for access on unsecured funding sources to meet obligations without a cost. Sometimes it is noticed an incremental degree of risk which is termed as joint market/funding liquidity risk.\textsuperscript{94} Finally, it should be mentioned that this type of risk is rather a consequent risk, arising usually when credit and market risk occur.

- **Market Risk**

Market risk is defined as the risk where losses occur due to market movements of asset prices and have a negative impact on a banks’ positions. The factors that cause the change of asset prices are stock prices, volatility and correlation. But the major sources causing the market risk, the so called ‘risk factors’, are among others the interest rate risk, equity price risk, commodity price risk and foreign exchange risk.\textsuperscript{95}

Interest rate risk affects mostly investments because interest rates express a difference (yield spread) respective to a benchmark that is chosen or a reference rate such as government rate, LIBOR, etc. Credit quality (credit spread), liquidity (liquidity spread), maturity (term spread) or tax reasons (tax spread) are responsible for this difference. An example of the changes in interest rates are bonds with a fixed rate for a given time period, where the bond price falls when the interest rates arise and opposite. Equity price risk refers to the changes in stock prices over time due to volatility. Commodities are physical products, such as gold, metals, minerals, agricultural products and others, that are traded in the secondary market. Commodity price risk arises when uncertain future changes in market prices of commodities occur where the

prices are related to supply and demand.\textsuperscript{96} Finally, the foreign exchange risk arises from changes in international interest rates and imperfect correlations in changes of currency prices.\textsuperscript{97}

- **Operational Risk**

  It is the risk where potential losses may happen due to internal operational weaknesses such as inadequate systems, mismanagement, human error, fraud and faulty controls. Additionally, in the banking industry the operational risks also include natural and man-made catastrophes (earthquake, bank robbery, terrorism, etc.) which are known as external operational risks. As human errors are referred expected or unexpected events like inadequate knowledge or technical skills, pushing a wrong computer button, entering the wrong value as an input in a model or destroying a file. Fraud events (internal and external) occur when an employee or a trader intentionally falsifies or misrepresents risks coming from transactions or there is manipulation in information and data.\textsuperscript{98} The situation where systems (usually computer systems) are inadequate refers to failures in programs, hacking of networks and other similar events.\textsuperscript{99} Operational risk is a residual risk and is defined as any banks’ risk that is not a market or credit risk.\textsuperscript{100}

**Business Risk:** All the above risks are also business risks, which arise due to expected or unexpected financial events and cause the reduction of the bank’s intrinsic value.\textsuperscript{101} Another definition of business risk is that of the inability of a

\textsuperscript{100} Hull, J.C. 2015, ‘Operational risk’, in Risk Management and Financial Institutions, 4\textsuperscript{th} edn., John Wiley & Sons, New Jersey, pp. 479-497
\textsuperscript{101} Ghosh, A. 2012, ‘Business risk in banking’, in Managing Risks in Commercial and Retail Banking, John Wiley & Sons Ltd, Singapore, pp. 66-128
bank to profitably function, as a consequence of failure in covering its operational costs by generating sufficient revenue.\textsuperscript{102}

**Non-financial Risk:** This type of risk is related to operational challenges, misconduct, compliance failures or to technology, and opposite to financial risk which can also lead to profit the non-financial risk has only a downside with significant consequences.\textsuperscript{103} The affection of the non-financial risks is indirect and often unquantifiable and the impact can be assessed performing a scenario analysis. The major non-financial risks are control risk, reputation risk, legal risk and technology risk.\textsuperscript{104}

- **Control Risk**

  This type of risk refers to the inadequacy and failure of control against the enhancement of the operational risk and of the business’ risk volume and intensity control. Inadequacy in control relates to the inability of understanding the process of the entire business. Alongside, the looseness of the control team relates to the failure in control. Therefore, if the control system is not able to track in time disorders in operational areas, then the business risk will be higher.\textsuperscript{105}


\textsuperscript{104} Ghosh, A. 2012, ‘Business risk in banking’, in Managing Risks in Commercial and Retail Banking, John Wiley & Sons Ltd, Singapore, pp. 66-128

\textsuperscript{105} Ghosh, A. 2012, ‘Business risk in banking’, in Managing Risks in Commercial and Retail Banking, John Wiley & Sons Ltd, Singapore, pp. 66-128
• Legal Risk

Legal risk is the risk arising from the inability to comply with regulatory obligations or changes in regulations, accounting standards, etc. and to apply them, where this can lead to unexpected losses.106 This type of risk is related to operational and reputation risk.107

• Reputation Risk

Financial losses occurring due to the potential damage of a bank’s image and brand value (reputation) are referred as reputation risk. Reasons of this risk’s occurring could be because of employee’s behaviors, public’s confidence on banks’ solvency, abandonment of obligations, or other actions.108

• Technology Risk

Technology risk arises in banks when there is unsuitable or deficient technology used. The risk occurs in computer systems used in the day-to-day business and are part of the bank’s operations, data and reports, or information. Usually, it is detected in security breaches of the bank’s computer system or through unauthorized access.109

At this point of the chapter we will stop the study, as deepening in the subject of general risk measurement and management is not the actual aim of this diploma thesis.

4 Credit Risk Management

In the previous chapter we presented the subject of risk management in general and discussed about the processes that are usually followed, presenting each of them. In Chapter 4, our goal is to make a more thorough study specifically about the credit risk occurring in banking and its management. We will follow as much as possible the main steps of the general risk management process for an effective understanding.

4.1 Framework Establishment

Basel III regulations suggest to the banks to define and develop an appropriate framework that includes the necessary strategies, processes and policies for a sound and effective risk management. Their formulation is carried out through the establishment of the enterprise risk management which encompasses the significant issues of risk appetite and risk limits, and the risk governance that encompasses important policies, processes, structures, instruments and other issues.\textsuperscript{110}

However, this applies to the overall risk profile of the bank, but there are also credit risk strategies and policies that can be emanated from the overall organization context. More specifically, there is an integrated credit risk framework emanated from the overall risk framework of a bank. In this overall framework it should be defined which risks are occurring in the banking business and as well as their importance, as referred to in the previous chapter. Usually, banks holding a significant credit portfolio give to credit risk great importance, and therefore there should be an integrated credit risk framework included in the bank’s overall risk framework.\textsuperscript{111}

\textsuperscript{110} Hünseler, M. 2013, ‘Credit risk strategies’, in Credit Portfolio Management: A Practitioner’s Guide to the Active Management of Credit Risks, Palgrave Macmillan, Hampshire, pp. 18-44

\textsuperscript{111} Joseph, C. 2013, ‘Credit risk management’, in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 27-34
Important element of a sound credit risk framework constitutes the credit risk management team, which should be staffed with a pool of credit experts and specialists with relevant experience, knowledge and skills and of course a critical attitude towards the credit risk. The team should be supervised under a higher level of authority, namely by the Chief Credit Officer (CCO), who is in charge to ensure the pursuit of the goals of the credit risk framework. However, the CCO is also responsible for the effectiveness of the credit culture within the bank, an important element of the credit risk management. Credit culture is about the values and beliefs among the employees and is constituted by policies and procedures, as well as traditions, philosophies, communication, ethics and standards. All these components contribute a strong credit culture, which boosts the taking of effective and intelligent credit risk decisions.

An internal document, the credit risk policy, describes the target markets, economic activities, business lines, portfolio composition, exposure limits, loan restrictions, procedures for identifying, measuring, managing, controlling and monitoring types of credit risk, and other elements that a bank should concentrate on in a long-term perspective. Generally, the credit risk policy discloses the range of a bank’s risk-return trade-offs in its credit operations alongside with its credit risk appetite and credit risk limits. An important issue, is the maintenance of a periodical review of the credit risk policy document due to changes occurring in the economy, market conditions and business environment. As for the credit risk strategies, these constitute the high targets of the credit risk appetite that a bank poses. In other words, credit risk strategies are the definition of the place and the way that risk capital will be allocated within a portfolio to maximize the risk-adjusted return.

113 Joseph, C. 2013, ‘Credit risk management’, in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 27-34
Credit risk appetite is the statement of the type, amount, nature and range of credit risk and credit exposures that a bank is prepared to undertake in order to achieve its credit strategies. This statement defers of course from bank to bank, as it is a decision’s outcome of each bank separately.\textsuperscript{117} For a bank having a high credit risk appetite it means greater capital strength and additional capital raise ability, compared to other banks. After the specification of the credit risk appetite, the next step is the establishment of the credit risk limits for the planning of the bank’s capital amount and the avoidance of possible credit losses.\textsuperscript{118} The aim of establishing credit limits is for the control of the exposure’s amount in transaction activities with counterparties.\textsuperscript{119}

\textbf{4.2 Identification}

The definition of credit risk has already been given in the previous chapter, where there was a short presentation of each type of risk occurring in the banking business. In a continuation of the general risk identification of the risk management process and in our effort to follow its main steps, we will examine in the current chapter the identification of the several types of credit risks. Also, we will deal with the components and factors of the credit risk.

The factors that indicate potential losses from credit risk are default and exposure. Default refers to the state of a counterparty or an obligor who is unable to meet its contractual debt obligations. Default risk emerges from this state. Also, exposure constitutes the amount of the potential loss due to the default. According to this, the exposure risk is the risk of uncertainty about the loss of a future amount at an unknown time of default. For the measurement of these factors, the Basel regulations prescribe the use of the credit risk

\textsuperscript{117} Joseph, C. 2013, ‘Credit risk management’, in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 27-34
\textsuperscript{118} Ghosh, A. 2012, ‘Credit risk management’, in Managing Risks in Commercial and Retail Banking, John Wiley & Sons Ltd, Singapore, pp. 914-1042
components, which are the default probability (DP), the exposure at default (EAD) and the loss given default (LGD).\textsuperscript{120}

The three credit risk components are the result of the event of default but they interpret separately default loss and default likelihood. More specific, the default probability interprets the likelihood, and the other two measures interpret the loss. However, the outcome of the default event is the potential loss. This type of loss generated from default is characterized as an expected loss, opposite to other types of losses that are characterized as unexpected, and require the availability of the economic capital.\textsuperscript{121}

Another categorization of credit risk is that associated with the causes that trigger this risk. Credit risk is the impact of international, domestic or firm-specific complications. These are the outcome of the systematic (or uncontrollable) risk and the unsystematic (or controllable) risk. The latter risk usually affects only in a firm-specific way and not the entire economy or all enterprise businesses. To the contrary, the systematic risk affects the entire economy and enterprise businesses due to external forces. Finally, a last information which we have to bear in mind is that the study of the credit risk can be divided into the Single Borrower Credit Risk (Firm/Obligor Credit Risk) and the Portfolio Credit Risk. This is an important separation for the study of credit risk with regard to its better understanding and management.\textsuperscript{122}

At this point, it would be helpful to illustrate the above information concerning to the credit risk, in Figure 4.1 and Figure 4.2.

\textsuperscript{120} Bessis, J. 2015, ‘Credit risk’, in Risk Management in Banking, 4\textsuperscript{th} edn., John Wiley & Sons, Chichester, pp. 199-210
Figure 4.1 Factors and components of credit risk (Bluhm, C., Overbeck, L., Wagner, C. 2003, 'The basics of credit risk management', in An Introduction to Credit Risk Modeling, Chapman & Hall/CRC, Boca Raton, pp. 10-48)

Figure 4.2 Division and the major causes of credit risk (Joseph, C. 2013, 'Essentials of credit risk analysis', in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 15-25)
Credit risk can also be distinguished into two types according to its relevance. The first type, counterparty credit risk relates to loans and derivative transactions, opposite to the second type, the issuer credit risk, which is more related to bonds. However, derivative contracts are related to both types of credit risk. Also, the analysis of the counterparty credit risk is carried out for a long-time horizon and that of the issuer credit risk for a time horizon of a few days. ¹²³

The main types of risks, that credit risk comprises are:

- **Default (or counterparty) risk:**

  This is the risk that refers to the likelihood of the event that a counterparty is unable to make the required payments on its contractual obligations on time. The loss occurring from default can be partial or total.¹²⁴ The event of default can be measured by the default probability (DP), that shows the range to which a counterparty is likely to be able to meet its contractual obligations.¹²⁵ Counterparty risk is the risk that potential losses will occur to both parties of a contract when one of this party defaults on its obligations.¹²⁶

- **Spread risk:**

  The credit spread risk arises when potential changes of the spreads in the market occur, due to migrations across the credit states. The value difference between the return for risky assets and the risk-free rate is the credit spread.¹²⁷ The two components of credit spread are: a) jumps in the credit spread, where a rating change occurs (upgrade or downgrade) as a result of a possible positive or adverse information in the market, and b) credit spread volatility,

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which refers to continuous changes occurring in the credit spread and usually are market's appetite driven.\textsuperscript{128}

- **Downgrade (or migration) risk:**

  This is the risk connected to a deterioration in the counterparty's creditworthiness (credit standing). In other words, this refers to a downgrade action by the rating agencies (Moody’s, S&P, Fitch, etc.) and to the increase of the risk premium or the counterparty's credit spread.\textsuperscript{129}

- **Recovery risk:**

  Recovery risk refers to the uncertainty prospect of recovery after the occurrence of default, which recovery depends on the oldness of the debt and on any guarantee associated with transactions. Any occurred loss from recovery risk is known as the loss given default (LGD).\textsuperscript{130}

- **Country risk:**

  Country risk refers to the risk of default due to the inability of a counterparty or an obligor (a non-resident) to meet its payment obligations when cross-border restrictions (political and economic) prevent the availability and the conversion of a currency.\textsuperscript{131}

- **Pre-settlement risk:**

  The pre-settlement risk indicates the risk of potential losses occurring when a counterpart defaults before the maturity of the contract associated with a transaction (loan, bond, derivative product). This risk can exist over a long time,

\textsuperscript{130} Bessis, J. 2015, ‘Risks and risk management’, in Risk Management in Banking, 4\textsuperscript{th} edn., John Wiley & Sons, Chichester, pp. 1-12
usually starting already from the beginning of the contract until the settlement.\textsuperscript{132}

- **Sovereign risk:**

Sovereign risk is the risk when a government of a country becomes unwilling or unable or does not comply with its loan agreements during unstable political and economic times.\textsuperscript{133}

### 4.3 Measurement

In this step of the credit risk management process we will show some of the common used techniques and models for credit risk measurement. Because of the limitation of this thesis’ development, we will not proceed to the presentation of complex mathematical models that are used in credit risk measurement. This can be the subject of a future study as a continuation of this thesis.

Not all the techniques and models are absolute wrong or right and none of them is said to be the best one. Every model or technique has its strengths and weaknesses and it is up to each bank to decide which one to use and for which case or according to which customer’s profile.\textsuperscript{134} These models and techniques used are usually separated according to the study’ level of credit risk (firm/obligor or portfolio) and constitute an element of the quantitative and qualitative credit analysis.

#### 4.3.1 Firm/Obligor Credit Risk

**Credit analysis**

Lending money is one of the major activities of a bank together with deposits. This action is accompanied by risk as it is not always meant that obligors will

\textsuperscript{134} Allen, D.E. & Powell, R.J. 2011, ‘Credit risk measurement methodologies’, Proceedings of the 19\textsuperscript{th} International Congress on Modelling and Simulation, Perth, pp. 1464-1470
repay their loans. A method that banks use in order to remain safe and to provide successful transactions of money lending to counterparties is to assess their creditworthiness. In other words, this assessment is an evaluation of the obligor’s state and assignment of a credit rating before the money lending. But, this method is not a definitive solution against the emergence of the credit risk, as this can be expected or unexpected.\(^{135}\)

Usually, as obligors in this point are big or small companies and not individual customers of the bank. Thus, a credit analysis constitutes of various financial analysis techniques which use a company’s information sources as data. Such information sources are the financial statements (annual report and others) that provide the balance sheet, the profit and loss statement, the cash flow and other statements’ elements of the company.\(^{136}\) Other sources of information can also be industry analysis or competitive position statements, collateral analysis, credit history and management ability of the company.\(^{137}\)

The techniques that are used in the credit analysis are financial ratio analysis, trend analysis and strategic analysis. For the trend analysis, it is important that the financial analyst has access to financial information three to five years back in order to identify trends. As trends are considered debt, stock, share capitals, net worth and sales. However, this approach alone is not enough. A supplementary approach to balance sheet analysis, income analysis and trend analysis is the ratio analysis. Ratios are used to measure the financial performance, the financial standing (profitability, cash flow, leverage, liquidity) and the investment prospects of a company and help in understanding the financial state of the company, or sometimes compare it with other companies or industry averages.\(^{138}\) Financial ratios that are commonly used are operating performance, debt service coverage, financial leverage, liquidity and

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receivables ratios. The debt service coverage ratio is the typical measurement of the repayment ability of a company.\textsuperscript{139}

All these techniques help the credit analysts in evaluating the likelihoods of counterparties to meet their debt obligations. However, the elements that help them in taking credit decisions and in subjective judgement to assess the credit risk are the 5C’s. These are the character, capital, capacity, conditions and collateral of a company.\textsuperscript{140}

\textbf{Credit Scoring}

The credit scoring technique is a statistical credit risk measurement technique that evaluates a borrower’s creditworthiness by converting information, coming from credit history, into numerical expressions. These expressions (numbers) are usually added to form a credit score. This score is the probability of an obligor to repay his debt (default probability) and indicates its risk level.\textsuperscript{141} In other words, a credit score has two interpretations, the one of the probability of repayment and/or default and the one of a classification system that places the obligors into groups of ‘bad’ or ‘good’ credits according to the score.\textsuperscript{142}

The information that is used in credit scoring is a combination based on current and past data (credit history) such as financial ratios, profitability, leverage ratios and the size of a firm, or income, age and professional activities of an individual borrower. This information is known as the obligor’s credit standing.\textsuperscript{143} Credit scores range from 300 to 850 and depend on the credit

\textsuperscript{143} Bessis, J. 2015, ‘Scoring models and credit ratings’, in Risk Management in Banking, 4th edn., John Wiley & Sons, Chichester, pp. 221-236
scoring system that is used. In the USA, the most known credit scoring system is FICO score, opposite to Europe where there are various scoring systems.\textsuperscript{144} The FICO score system can be seen in Figure 4.3. According to a sound credit scoring model, a high score corresponds to low risk and a low score reflects high risk. This fact makes it a useful technique that banks use in order to successfully avoid risky customers. Credit scoring is usually used for reaching credit decisions about credit card applications and small credits (credit approval).\textsuperscript{145}

![Figure 4.3 The FICO credit score system (www.google.com)](image)

The most used credit scoring models are the linear probability model, the logit model, the probit model and the discriminant analysis model. These models are based on classification or regression methods\textsuperscript{146} replacing the human performance of a credit risk officer, who would estimate credit scores and reach a credit decision for each obligor according to experience, industry knowledge and personal know-how.\textsuperscript{147} A newer classificatory credit scoring model used is the Altman Z-score model for corporate borrowers.\textsuperscript{148}

Credit Ratings

Opposite to credit scoring, credit rating is a credit risk measurement technique that evaluates the borrower’s creditworthiness as a continuation of the credit analysis, and expresses this with a letter grade. A credit rating is a measure of a firm’s/obligor’s probability of default and it is designed to provide information about the credit quality.\textsuperscript{149}

There are two types of credit ratings, the external credit ratings and the internal credit ratings. The first type constitutes the assessment of an obligor’s creditworthiness by a third party. This is an external rating agency like Moody’s, Standard & Poor’s (S&P) and Fitch, which are the most known in the USA.\textsuperscript{150} On the other side, internal ratings of a bank are necessary as it is proposed in the Basel II Accord to estimate the probability of default through the internal rating based approach and moreover small and medium-sized banks may be unable to have access to external ratings.\textsuperscript{151}

As referred before, credit ratings are expressed by a letter. These letters constitute a scale of ratings, beginning from the best rating to the worst. External rating agencies use this way of rating. In Table 4.1 the rating scale systems of the external rating agencies (Moody’s, S&P, Fitch) are shown. The rating scale system begins with the best rating expressed as AAA or Aaa and continues descending to the worst rating expressed as C, and finally to D which characterizes the default state of an obligor.\textsuperscript{152}

However, credit ratings of obligors are not fixed and may change over time. Namely, there can be a change in the credit standing (credit quality) of an obligor that causes the deterioration of the creditworthiness. This deterioration is usually the result of a downgrade event in the rating scale and less often of

\textsuperscript{150} Joseph, C. 2013, ‘Credit rating and probability of default’, in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 161-173
an upgrade. Because of this, it is important for the banks and rating agencies to periodically review their ratings.\textsuperscript{153}

\textit{Table 4.1 The rating scale system of external rating agencies}

<table>
<thead>
<tr>
<th>Standard &amp; Poor’s</th>
<th>Moody's</th>
<th>Fitch</th>
<th>Credit Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>Aaa</td>
<td>AAA</td>
<td>Extremely Strong</td>
</tr>
<tr>
<td>AA, AA+, AA-</td>
<td>Aa1, Aa2, Aa3</td>
<td>AA, AA+, AA-</td>
<td>Very Strong</td>
</tr>
<tr>
<td>BBB, BBB+, BBB-</td>
<td>Baa1, Baa2, Baa3</td>
<td>BBB, BBB+, BBB-</td>
<td>Adequate</td>
</tr>
<tr>
<td>BB, BB+, BB-</td>
<td>Ba1, Ba2, Ba3</td>
<td>BB, BB+, BB-</td>
<td>Speculative</td>
</tr>
<tr>
<td>B, B+, B-</td>
<td>B1, B2, B3</td>
<td>B, B+, B-</td>
<td>High Speculative</td>
</tr>
<tr>
<td>CCC, CCC+, CCC-</td>
<td>Caa1, Caa2, Caa3</td>
<td>CCC, CCC+, CCC-</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>CC</td>
<td>Ca</td>
<td>CC</td>
<td>High Vulnerable</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>C</td>
<td>Extremely Vulnerable</td>
</tr>
<tr>
<td>SD</td>
<td>RD</td>
<td>RD</td>
<td>Selective, Restrictive, Default</td>
</tr>
<tr>
<td>D</td>
<td>D</td>
<td>D</td>
<td>Default</td>
</tr>
</tbody>
</table>


**Expected Loss**

As we know, banks make transactions and offer products and services only under the establishment of measures that promote their insurance against the losses (loss protection) and against the probability to be considered as insolvent. The ideal situation for a bank is when all its counterparties remain consistent with their obligations. But, we should keep in mind, that even a good customer could default sometime in meeting his obligations. For this reason,

\textsuperscript{153} Bessis, J. 2015, ‘Scoring models and credit ratings’, in Risk Management in Banking, 4\textsuperscript{th} edn., John Wiley & Sons, Chichester, pp. 221-236
banks have established the internal account expected loss reserve as a cushion against the losses occurring from defaulted loans. The reserve constitutes of the summary amount of the risk premiums charged for every loan\textsuperscript{154} and is subject of the credit pricing methodology.\textsuperscript{155}

So, this is a first measure against the expected losses that a bank knows it will face. The expected loss (EL) refers to a mean value, and specifically to the mean value of the loss. The loss of every obligor is defined from a probability of default (PD) given from the bank to its obligor, the exposure at default (EAD) and the loss given default (LGD):

\[ EL = E \left[ L \right] = PD \times EAD \times LGD \textsuperscript{156} \]

The probability of default (PD) is a very important element, as it is the estimation of how possible is it for an obligor to default; it follows a Bernoulli distribution with events 1 (default) or 0 (non-default). This estimation comes from two separate approaches: estimation from market data (equity prices, credit spreads, volatility and others) and estimation from ratings (based on past observations).\textsuperscript{157} In the latter approach the estimation of the default probability is made by internal methodologies of a bank or by external rating agencies (S&P, Moody's, Fitch).\textsuperscript{158} The external ratings are usually used as a benchmark for the bank to compare with its internal ratings.\textsuperscript{159}

Exposure at default (EAD) as the amount of exposure when an obligor defaults, consists of the outstanding (OUTST) and the commitments (COMM). The outstanding is the amount of exposure that the obligor has already drawn and at the time of his default the bank is exposed to the total amount of the

\textsuperscript{155} Joseph, C. 2013, ‘Credit rating and probability of default’, in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 161-173
\textsuperscript{159} Joseph, C. 2013, ‘Credit rating and probability of default’, in Advanced Credit Risk Analysis and Management, John Wiley & Sons, Chichester, pp. 161-173
outstanding. On the other side, commitments are the portion of exposure that the bank promised to lend to the obligor, and are divided into drawn and undrawn portions. According to historical default evidence, only the drawn portion of the commitment contributes to a loan’s loss when the obligor defaults. Therefore, the calculation of the exposure at default (EAD) is:

$$EAD = OUTST + \gamma \times COMM$$

where $\gamma$ is the expected amount of commitments that will be drawn before the default.$^{160}$

The last parameter of the expected loss, the loss given default (LGD), refers to the final amount of the loss that is occurring due to default. In other words, it refers to the severity of the loss after recovering actions$^{161}$ and is computed as:

$$LGD = 1 - RR \text{ (in %)}$$

where RR is the recovery rate.$^{162}$ This is the percentage of loss, due to default, that is recovered usually from collateral (securities, mortgages, guarantees).$^{163}$ And thus, because LGD and RR are complementary, the loss given default depends on the collateral’s quality and the claims’ seniority on the counterparty. Many of the banks do not own good internal data of recovery rates and use therefore external recovery data coming from the rating agencies.$^{164}$

**Unexpected Loss**

In addition to the expected losses occurring, there is also a need to hold a cushion against the unexpected losses. This amount should be greater than the

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average experienced losses according to history information. The unexpected loss is the standard deviation of the loss and is defined as:

$$ UL = \sigma_L = EAD \times \sqrt{V(LGD)} \times PD + LGD^2 \times PD \times (1 - PD) $$

### 4.3.2 Portfolio Credit Risk

**Expected and Unexpected Loss**

Previously, we presented the expected and unexpected loss for transactions that in the case of a portfolio composed of $N$ amount of loans for example, constitutes the summary of the individual loans. Therefore, the expected loss of a portfolio of $N$ loans is the sum of the expected loss of the individual loans and is defined as:

$$ EL_p = \sum_{i=1}^{N} E(L_i) = \sum_{i=1}^{N} PD \times EAD \times LGD $$

Same, the unexpected loss of a portfolio of $N$ loans is defined as:

$$ UL_p = \sigma_{L_p} = \sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} EAD_i \times EAD_j \times COV[LGD_i \times L_i, LGD_j \times L_j] } $$

**Economic Capital**

When the losses of a credit event exceed the amount of expected losses (EL) more than one standard deviation of the portfolio loss (when the cushion amount of UL is not enough), it is needed to quantify the risk capital in the concept of the economic capital. For a given level of confidence $\alpha$, the economic capital is defined as:

$$ E\text{C}_\alpha = q_\alpha - EL_p $$

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where \( q_\alpha \) is the \( \alpha \)-quantile of the portfolio.\(^{167}\) The unexpected loss (UL) is included in the amount of the economic capital, which is equal to one standard deviation of the losses. Also, the \( \alpha \)-quantile defines the absolute value at risk where \( VAR_{\alpha}^{abs} = q_\alpha \). The value at risk expresses the potential maximum absolute loss that can be realized on the probability level \( \alpha \).\(^{168}\) So, the economic capital can also be defined as:

\[
EC_\alpha = VAR_\alpha - EL_p
\]

All these risk metrics of the portfolio loss variable \( L_p \) compose the credit loss distribution of the variable. The loss distribution is an asymmetrical distribution/diagram and it is highly skewed. This reflects the fact that it is more concentrated toward small losses, where the probability for small losses is greater than the one for large losses. This is a characteristic of the lengthy tail on the side of losses which verifies the previous statement. For all these reasons, the loss distribution is a great element to reflect the underlying credit portfolio loss behavior.\(^{170}\) Figure 4.4 shows such a loss distribution.

![Figure 4.4 The credit loss distribution (Van Gestel, T., Baesens, B. 2009, ‘Portfolio models for credit risk’, in Credit Risk Management, Oxford University Press Inc., New York, pp. 273-343)](image)


4.4 Management

Financial institutions and especially banks use various methods to transfer and mitigate the credit risk. Such methods are the letters of credit and the guarantees, the collateralization method, the credit derivatives and the securitization among others. Even though, the credit derivatives and securitization were intensely criticized after the financial crisis of 2007, these tools are powerful methods for the transfer and mitigation of credit risk. We will make an informative presentation of the credit risk management methods as a completion of the study about the credit risks.\footnote{Koulafetis, P. 2017, ‘Credit risk transfer and mitigation’, in Modern Credit Risk Management: Theory and Practice, Palgrave Macmillan, London, pp. 187-206}

The Letter of Credits (LOC) are banking contracts which guarantee that a seller receives a full payment as long as the obligation of the buyer to send him the amount of the payment is met. This method is often used in international transactions where the seller is exposed to credit risk (the buyer may not meet his obligation) and to legal risk because of law jurisdictions. In other words, it is a guarantee of payment between two counterparties. The seller who is the beneficiary of the credit can demand a LOC from the seller who is the applicant of the credit.\footnote{Koulafetis, P. 2017, ‘Credit risk transfer and mitigation’, in Modern Credit Risk Management: Theory and Practice, Palgrave Macmillan, London, pp. 187-206}

In various transactions, such as real estate, securitization or counterparty risk, a great method for mitigating credit risk is the collateralization, as it can be used as a coverage of losses. An entity that holds the collateral should have the right to own and liquidate it when a counterparty default occurs. A low credit quality collateral also contains counterparty credit risk. If the collateral is strong positively correlated with the counterparty or the asset, then in a potential increase of credit exposure after the default of the counterparty or underlying of the asset, its value will decline.

Finally, another method of credit risk transfer is through the use of credit derivative instruments. They transfer the credit risk from one party to another,
which is related to an underlying entity or a portfolio of underlying entities. A widely used credit default for the hedging of credit risks is the Credit Default Swap (CDS). This is a single-name derivative contract between two counterparties, that provides credit protection against losses when the entity defaults. The buyer makes periodic payments to the seller and receives compensation when a default occurs.

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5 Liquidity Risk Management

Similar to the previous chapter, our aim in this chapter is to present the issue of liquidity risk and make a more thorough study. This is essential for the better understanding of liquidity risk and its management, but also for the completion of the current diploma thesis’ subject.

5.1 Framework

Liquidity risk’s framework is about the development of the liquidity risk culture through policies, examples, communication and training of the employees, according to their responsibilities. Except these, the framework should also include the bank’s risk appetite on liquidity risk and the procedures, controls and strategies that have to be followed. Decisions about the liquidity should be taken based on the information from the identification, measurement or assessment and monitoring of the liquidity risks. For a sound and effective liquidity risk management, it is important that the results from the assessment process are regularly reviewed and they ensure the compatibility with the risk appetite and risk limits set from the bank.\textsuperscript{175}

Responsibility about the compliance of the bank on the liquidity risk framework and, also the regulatory requirements has the Asset and Liability Committee (ALCO), which reports to the Board of Directors (BoD). Members of the Committee, with separate responsibilities on liquidity and funding management, are the Chief Executive Officer (CEO), the Chief Financial Officer (CFO), the Chief Risk Officer (CRO), the bank’s Treasurer and part of the Heads of the bank’s divisions or units. The report of the ALCO on the BoD includes recommendations on the appetite for funding liquidity risk, issuing long-term liabilities (such as bonds) and the maturity profile and composition of capital, among other.\textsuperscript{176}


5.2 Identification

As referred in chapter 3, liquidity is the availability of cash or other resources like assets that allow the bank to make payments or meet obligations in the day-to-day business. The lack of liquidity is the event which causes the occurrence of the liquidity risk in the banks. Such an event causes not only the bank failure, but also the instability of the financial system, according to supervisors. However, important to know is that liquidity risk is a consequential risk and is triggered by other risks and problems, like credit risk deterioration, market disruptions, operation risk and others.\textsuperscript{177}

Liquidity risk occurs in two types, the funding (or liability) liquidity risk and the market (or asset) liquidity risk. Their definition is already given in chapter 3. Funding resources are liabilities like short-term (commercial papers, short-term bank facilities, deposits, repurchase agreements and others) and long-term (long-term bonds, loans and others) debt facilities and off-balance sheet instruments (leases, derivatives and others). On the other hand, the financial assets that are liquidated into cash to prevent the liquidity risk are liquid assets (cash and marketable securities, receivables and inventories) and fixed assets.\textsuperscript{178} One more resource of liquidity for the banks are Central Banks, which act as lenders of last resort.

Funding liquidity risk is the result of an unexpected demand for liquidity due to unpredictable cash flows, unfavorable legal or regulatory judgments, mismanagement and negative perceptions or market actions. The lack of funding liquidity for the coverage of these factors automatically activates their coverage by assets. But in stressed times caused by such factors, the liquidation of assets or their post as collateral also trigger the asset liquidity risk. This is an indication that funding and asset liquidity risk are strictly linked to each other. Some other reasons which hinder the access on funding resources are credit rollover problems (downgrade), the lack of market access, commitment withdrawal and excessive concentrations in product, market or


\textsuperscript{178} Banks, E. 2005, ‘Sources of liquidity’, in Liquidity Risk: Managing Asset and Funding Risk, Palgrave Macmillan, Hampshire, pp. 36-59
lender funding. If a bank detects the existence of all or part of the mentioned issues it will surely face a proportion of economic loss, which along with the financial inflexibility lead to its financial distress.\textsuperscript{179}

Asset liquidity risk is also known as market liquidity risk because of the market value of assets that it is assigned to. Two sources of risk are associated with the market value: the uncertainty of asset returns (market risk) and the uncertainty of liquidity risk, which can be strongly correlated. This is the type of risk which most firms will face. In fact, risk exists in inadequate operating cash flows, in insufficient, unpredictable or expensive funding sources and in uncertain asset prices. Some of the factors that impact the asset liquidity are the asset substitution, the market structure, regulations, transaction costs and information availability, or the behavior and views of market participants. Also, the sources of risk, we referred to before, which impact the funding liquidity risk can be extended to provoke the asset liquidity risk. However, exogenous factors like lack of asset marketability, excessive concentrations and misvaluation in assets, constitute also the cause of liquidity problems. Finally, other endogenous factors that provoke problems, are the lack of unencumbered assets and the insufficient collaterals. Again, like in funding liquidity risk, the existence of these issues may be the reason of economic loss and financial distress in a bank.\textsuperscript{180}

\subsection*{5.3 Measurement}

The next step in the liquidity risk management process is the estimation of the risk exposures. The measurement of liquidity risk consists of a qualitative and a quantitative assessment, both equally important to address the issues referred in the identification step. The focus of the qualitative assessment is mostly on the availability of IT-system infrastructures, the application of management and control processes, and the existence or usage of a diversified market access for funding. Alongside, the quantitative assessment is


concerned on measurement techniques and models for the evaluation of the liquidity risk issues.\textsuperscript{181}

To estimate liquidity risk, banks apply two types of analysis: a balance sheet liquidity analysis and a maturity mismatch analysis (or cash flow gap analysis). Also, one of the most known measurement techniques is the calculation of liquidity ratios.\textsuperscript{182} These techniques are usually separated into short-term and long-term funding measurements.

**Balance sheet liquidity analysis**

In this approach the balance sheet items, namely the assets and the liabilities, are set into relation. On the assets side, the items can be characterized as liquid or illiquid (sticky) assets. Liabilities can be characterized as stable or volatile. According to this, the liquid assets should be founded by the volatile liabilities and opposite, the sticky assets should be founded by the stable liabilities.\textsuperscript{183} An exemplary balance sheet structure is shown in Table 5.1.

In the analysis, the money amount of the sticky assets (loans, receivables, investments and other assets) is compared to the total money amount of the stable funding liabilities (non-bank deposits, certified liabilities and equity), and the total money amount of the liquid assets (trading assets, reverse repos) is compared to the total money amount of the volatile funding liabilities (unsecured bank deposits, trading liabilities, repos, others). The amounts should be equal and not mismatch, otherwise there will be a funding problem with uncovered assets.\textsuperscript{184}


Table 5.1 An exemplary balance sheet structure

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sticky</strong></td>
<td>Non-bank deposits</td>
</tr>
<tr>
<td>Loans, receivables, investments, others</td>
<td>Certified liabilities</td>
</tr>
<tr>
<td><strong>Liquid</strong></td>
<td>Unsecured bank deposits, others</td>
</tr>
<tr>
<td>Trading assets</td>
<td>Trading liabilities</td>
</tr>
<tr>
<td>Reverse repos</td>
<td></td>
</tr>
</tbody>
</table>


Such an analysis is considered to be easy, because the only information source that is needed is the annual report of the bank. However, the approach is problematic as there are negative issues. The missing time dimension, the impact of accounting rules, the not-included off-balance sheet commitments and other, are some of these issues.\(^\text{185}\)

**Cash Flow Mismatch (Liquidity Gap Analysis)**

The cash flow or maturity mismatch approach, which is also known as the liquidity gap analysis, detects the gaps between the inflows and outflows of liquidity for given time lapses. According to these maturity gaps the bank is able

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to know how much liquidity should ensure in each time lapse.\textsuperscript{186} For this purpose, all the liquefiable balance sheet and off-balance sheet items and its liquidation cash flows are mapped to a cash flow (or maturity) ladder. The cash flow ladder constitutes a liquidity gap profile like the one shown in \textbf{Table 5.2 and Figure 5.1}, as an example of a hypothetical balance sheet.\textsuperscript{187}

The \textit{Balance} column shows the cash inflows and outflows, whereas the next columns show the different cash flow scenarios for each time lapse starting from the overnight (or intraday) time lapse up to this above ten years. The Net inflow for the overnight time lapse is also the Net cumulative inflow, in which is added the Net inflow of the next time lapse to result every time a new Net cumulative inflow. This constitutes the cover of the Net cumulative outflows and therefore the liquidity risk. Thereinafter, the same procedure is applied for the Net outflow and Net cumulative outflow, which are here illustrate as negative amounts.\textsuperscript{188}

The Net cumulative gap or the Net cumulative liquidity gap per time lapse is calculated as:

\begin{equation}
\text{Net cumulative liquidity gap} = \text{Net cumulative inflow} - \text{Net cumulative outflow}\end{equation}\textsuperscript{189}

If the liquidity gap is positive then the inflows can cover the outflows and there is an excessive resource that can be kept as a reserve for a future usage. Oppositely, if the liquidity gap is negative then the outflows exceed the inflows which shows a deficit, and is necessary for the bank to acquire immediate funding or use the existing reserves.

Table 5.2 A liquidity gap profile of a hypothetical balance sheet

<table>
<thead>
<tr>
<th>Balance</th>
<th>Gap profile</th>
<th>O/N</th>
<th>8D</th>
<th>14D</th>
<th>1M</th>
<th>3M</th>
<th>1Y</th>
<th>3Y</th>
<th>6Y</th>
<th>&gt;=10Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td></td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Unencumbered securities</td>
<td></td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Cont. inflow</td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Net inflow</td>
<td></td>
<td>38</td>
<td>11</td>
<td>10</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net cumulative inflow</td>
<td></td>
<td>38</td>
<td>49</td>
<td>59</td>
<td>67</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Loans</td>
<td></td>
<td>50</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Retail deposits</td>
<td></td>
<td>-40</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
</tr>
<tr>
<td>MM deposits &amp; CD</td>
<td></td>
<td>-50</td>
<td>-15</td>
<td>-15</td>
<td>-5</td>
<td>-7</td>
<td>-7</td>
<td>-7</td>
<td>-7</td>
<td>-7</td>
</tr>
<tr>
<td>Own funds</td>
<td></td>
<td>-30</td>
<td>0</td>
<td>-1</td>
<td>-2</td>
<td>-1</td>
<td>-1</td>
<td>-4</td>
<td>-7</td>
<td>-7</td>
</tr>
<tr>
<td>Cont. outflow</td>
<td></td>
<td>-10</td>
<td>-4</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>-1</td>
<td>-4</td>
<td>-7</td>
<td>-7</td>
</tr>
<tr>
<td>Net outflow</td>
<td></td>
<td>-21</td>
<td>-21</td>
<td>-16</td>
<td>-12</td>
<td>-4</td>
<td>-1</td>
<td>-1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Net cumulative outflow</td>
<td></td>
<td>-21</td>
<td>-42</td>
<td>-50</td>
<td>-66</td>
<td>-78</td>
<td>-82</td>
<td>-83</td>
<td>-84</td>
<td>-79</td>
</tr>
<tr>
<td>Net cumulative gap</td>
<td></td>
<td>17</td>
<td>7</td>
<td>9</td>
<td>1</td>
<td>-10</td>
<td>-12</td>
<td>-13</td>
<td>-14</td>
<td>-8</td>
</tr>
</tbody>
</table>


**Liquidity ratios**

In Basel III it is proposed that for the measurement of the liquidity risk, a bank should calculate the short-term liquidity coverage ratio (LCR) and the long-term net stable funding ratio (NSFR). The liquidity coverage ratio (LCR) is the ratio of a stock of high-quality assets over the net cash outflows of a 30-day time period. It indicates an element of forecasting as it is used by the banks to ensure the maintenance of an adequate level of liquefiable assets under scenarios of liquidity stress periods that supervisors specify. Banks should try to maintain the LCR always above 100% and recalculate it at least on a weekly basis. The mathematical formula of the LCR is:

\[
\text{Liquidity coverage ratio (LCR)} = \frac{\text{liquid assets available}}{\text{net cash outflows over 30 days}}
\]

The net stable funding ratio (NSFR) is the ratio for the stable funding over the next 12 months. It indicates the available amount of stable funding over the required amount of stable funding of a bank. Its goal is to address long-term liquidity mismatches. Banks use this ratio to ensure that assets are funded with at least a minimum amount of stable liabilities based on the liquidity characteristics of the assets over a one-year period and should try to maintain it above 100%. Its mathematical formula is:

\[
\text{Net stable funding ratio (NSFR)} = \frac{\text{available amount of stable funding}}{\text{required amount of stable funding}}
\]

Another useful ratio is the long-term funding ratio, which arises from the cash flow mismatch analysis and shows the share of assets with a specific maturity which are funded through liabilities of the same maturity. The result indicates...
the ability of the bank to compensate its obligations, which in other words means that it measures the liquidity of the bank.\textsuperscript{193} The ratio is defined as\textsuperscript{194}:

$$\text{Long-term funding ratio above } n \text{ years} = \frac{\text{sum of available funding liabilities above } n \text{ years}}{\text{sum of assets maturing above } n \text{ years}}$$

**Stress Tests**

In order to assess their liquidity positions and changes in the risk exposure, banks apply regularly stress tests, under the assumption of market conditions. This method also supports the strategic decision making, assesses the existence of adequate financial resources, valid processes, limits and IT systems.\textsuperscript{195}

Through liquidity stress testing it is observed if the liquidity management and control systems of a bank are capable of enduring market and economic shocks. Furthermore, the validity of the governance, the liquidity risk measurement methodologies and the control systems are inspected and the contingency funding and emergency plans are evaluated. The stress tests are complemented by the scenario analysis, where scenarios like shocks or changes in market parameters are tested to analyze how systems and limits in the bank react to changes or sudden facts.\textsuperscript{196}

**5.4 Management**

Unlike other types of risk, funding liquidity’s management actions are limited only on the contingency funding plans of a bank. The reason for this is the difficulty of the Treasury to reduce the frequency and the severity of events, to

transfer or transform the risk and of course to accept the risk. Accepting the risk would be an unsustainable proposition and the choice of hedging by transforming or transferring the funding liquidity risk is still to be fully developed.\footnote{Laycock, M. 2014, ‘Liquidity risk’, in Risk Management at the Top: A Guide to Risk and its Governance in Financial Institutions, Wiley & Sons, Chichester, pp. 215-234}

For this reason, banks use contingency funding plans for the measurement of the liquidity risk. A Contingency Funding Plan (CFP) includes the internal procedures about the managing of cash flow shortfalls in emergency situations. Also, it embodies assumptions about the behavior of liabilities, clients and regulators, and about liquidity values of assets and liquidity buffers. Additionally, it includes policies, action plans and procedures for managing liquidity stress events.\footnote{Soprano, A.A. 2015, ‘Control framework’, in Liquidity Management: A Funding Risk Handbook, John Wiley & Sons, Chichester, pp. 164-168}

Creating such a plan, a bank is able to respond to a possible liquidity crisis, by identifying liquidity sources that help it stay covered in liquidity stress events and ensure that these sources are sufficient to fund the operating costs and meet its commitments. However, in order to prevent operational difficulties that may occur in times of crisis the bank should regularly test the contingency funding plans, and especially the sources of liquidity that are listed. In this way, a potential exposure to reputation risk and the sending of wrong messages to the markets about the activation of the sources in stressed times is avoided.\footnote{Soprano, A.A. 2015, ‘Control framework’, in Liquidity Management: A Funding Risk Handbook, John Wiley & Sons, Chichester, pp. 164-168}
6 Case Study: UBS Group AG

6.1 Presentation of the Bank

The UBS Group AG is the result of the merger in 1998 between two leading Swiss banks, the Union Bank of Switzerland and the Swiss Bank Corporation (SBC). However, their initial activity goes back to the 19th century, where the history of the Union Bank of Switzerland began 155 years ago, in 1862. Today, the UBS Group AG is a globally successful financial institution, which offers financial and banking services to its clients.200

With a worldwide office presence in 52 countries, the UBS Group AG is active in all major financial centers and constitutes the leader of banks in Switzerland. The headquarters of the bank are located in Zurich, Switzerland. To accomplish the worldwide presence, UBS Group AG employs around 60'000 people in Switzerland, America, rest of Europe, Middle East and Africa, and Asia Pacific.201

Except its traditional private clients in Switzerland, UBS Group AG also provides solutions and financial advices to wealthy, corporate and institutional clients. This is feasible, as the operational structure of the bank constitutes of the Corporate Center and five divisions. These are Wealth Management and Wealth Management Americas, Personal and Corporate Banking, Asset Management and Investment Bank.202

UBS Group AG is the world’s largest global wealth manager as its strategy is focused on the leading wealth management business, and also on the senior universal bank in Switzerland. This is also reinforced by the Asset Management and the Investment Bank divisions. Moreover, UBS Group AG is focused on strong competitive position businesses in targeted markets, that are capital

efficient and with an attractive long-term structural growth or profitability outlook. Finally, the bank’s vision is its recognition for the creation of superior and sustainable value for its clients, employees and shareholders, together with the aspiration to stand out as a leader in the banking industry.

6.2 The Framework

In this sub-chapter we present the issue of the risk framework of the UBS Group AG. Because of the secrecy of internal information, we only have access to the overall risk framework in a more detailed structure and not specifically to the credit and liquidity risk frameworks. The latest are presented briefly in the annual report of the bank and we will focus on this information.

The risk governance framework of UBS Group AG performs three lines of defense: the Business Management, the Control Functions and the Group Internal Audit (GIA). The Business Management possesses its risk exposures and is obliged to manage these risks by effective processes and systems, internal controls and documented procedures. Its control weaknesses and inadequate processes are identified by supervisory control and review processes. The Control Functions provide independent supervision of risks, report directly to Group CEO, set risk limits and defend compliance with applicable laws and regulations. Lastly, the Group Internal Audit assesses the two referred defense lines and examines the overall effectiveness of governance, the risk management and the control environment.

As for the roles and responsibilities, for implementing the risk framework, the Group Executive Board (GEB) is responsible to control the risk profile of the Group and approve the key risk policies. The Group Chief Executive Officer (CEO) has the responsibility of the Group’s results, the risk authority over transactions, positions and exposures, and the allocation of portfolio limits, within the business divisions and Corporate Center units has. The Group Chief

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204 UBS AG. (2017), What we are aiming for-today and beyond, [Online]. Available from: https://www.ubs.com/content/dam/static/epaper/index.html?id=f1fa9bf8&page=15 [10 October 2017]
205 UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich
Risk Officer (CRO) has the responsibility of Risk Control, which includes the establishment of methodologies for the measurement and assessment of risk, the setting of risk limits, the development and operation of the appropriate risk control infrastructure and the validation of models used by the bank. The Group Chief Financial Officer (CFO) is responsible for the assessment and the transparency of the financial performance of the Group and the business divisions and, also the regulatory requirements and corporate governance standards. Additionally, the management of funding and liquidity risk concern the CFO among other responsibilities. The overall determination of risk principles, risk appetite and major portfolio limits of the Group are in responsibility of the Board of Directors (BoD), which allocate them to each business division and the units of the Corporate Center. Finally, the active management of risk exposures, the securing of the profit potential, the risk, the balance sheet and the capital usage are the responsibilities of the business division Presidents.

The risk appetite interprets the Group-wide level reflecting the risk types that UBS Group AG is willing to accept or purposed to avoid; it is inducted from the complement of qualitative and quantitative risk appetite statements. These constitute the foundation for the maintenance of a robust risk culture. Specifically, the qualitative statements aim to ensure the maintenance of the Group’s desired risk culture, and the quantitative risk appetite objectives aim to increase the resilience of the Group against adverse economic events (stress events). So, through these objectives, UBS Group AG aims to ensure that its desired risk capacity covers the total risk exposures when capital buffer, earnings, leverage, solvency, liquidity and funding are ensured.

Complementary to the risk appetite objectives, the risk limits set at the portfolio level monitor specific portfolios and identify potential risk concentrations as additional quantitative controls, applied across the Group. With the conjunction of the risk reports, the risk officers, senior management and the Board are informed about the performance of portfolios and the risk profiles. This information results from the risk measures across products and businesses, which indicate the amounts, types and sensitivities of the risks in portfolios and ensure the compliance with the defined risk limits.
Credit Risk Framework

UBS Group AG uses the estimates of probability of default, the exposure at default and the loss given default models for the measurement of the credit risk arising from the transactions with individual counterparties. The models used for the measurement of the portfolio credit risks in a Group-wide and business division level are the expected loss, the statistical loss and the stress loss. For both individual counterparties (and groups of related counterparties) and portfolios credit risk limits are established, that cover the banking and trading products and the settlement amounts. The Board of Directors approves the Risk Control authorities which are assigned to the Group Chief Executive Officer (CEO), the Group Chief Risk Officer (CRO) and to divisional Chief Risk Officers based on the amounts of the risk exposures and the internal credit ratings.

Liquidity Risk Framework

Responsible for the proposing, implementation, monitoring and execution of the liquidity and funding strategy of UBS Group AG is the Group Treasury, which is responsible for the adherence to policies, limits and targets. Group Treasury reports to the Group Asset and Liability Management Committee (ALCO) and the Risk Committee of the BoD about the Group’s overall liquidity and funding position (funding status and concentration risks). The overview of the liquidity and funding position of the bank enables the control of cash and collateral (high-quality liquid assets) and the access to wholesale cash markets. The measures employed to monitor the liquidity and funding positions under normal and stressed conditions, are stress scenarios for the internal stress models and external measures like the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). In order to maximize and sustain its business value and maintain an appropriate balance in the asset and liability structure, UBS Group AG sets limits and targets at the Group and the business division level, which are reviewed by the BoD, the Group ALCO, the Group CFO and the Group Treasurer, and consider the current and the projected strategy and the risk tolerance.
6.3 Risk Identification

According to the Annual Report 2016, the key risks that arise from the Group’s business activities are credit risk, market risk, operational risk, liquidity and funding risk, counterparty credit risk and structural FX risk. These risks arise in the five Business divisions and in the Corporate Center units. Specifically, credit risk occurs in every division and unit of the Corporate Center (except the Services unit), and liquidity and funding risk occur in the Group Asset & Liability Management unit of the Corporate Center.

Credit risks arise from transactions with individual counterparties or from portfolios. Such credit exposures occur in lending (corporate and mortgage loans), collateral, investing, trading liabilities and derivatives, retail business. Also, credit risks arise from risk concentrations. The exposures are categorized into exposures of banking products and these of traded products. Banking products are loans, undrawn guarantees and loan commitments, amounts due from banks and balances with central banks. The traded products include over-the-counter derivatives (OTC), exchange-traded derivatives (ETD) and securities financing transactions (SFTs), like borrowing and lending securities or repos and reverse repos agreements.

Unfortunately, in the Annual Report 2016 of UBS Group AG the sources of liquidity risk are not recorded. This case study is absolutely based on accurate information that strictly come out of the UBS Annual Report 2016 and for this reason we do not want to present false or similar information. However, we keep on our mind the general sources of liquidity risk that were presented in Chapter 5 of this thesis.

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UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich
6.4 Measurements

Credit Risk Models

For the measurement of the credit exposures to individual counterparties, transactions or portfolios, UBS Group AG uses the three generally accepted parameters: the probability of default (PD), the loss given default (LGD) and the exposure at default (EAD). The three parameters are the basis for many of the internal measures of credit risk and, also the input for the calculation of the regulatory capital under the internal ratings-based approach. The product of these parameters gives the expected loss (EL) of a credit exposure for counterparties, transactions or portfolios. Also, for the measurement of exposures in portfolios, UBS Group AG uses the statistical loss and stress loss models.

Credit losses are the variable cost that UBS AG faces for doing business; in order to quantify such future losses, it uses the Expected Loss (EL) statistical metric. This gives the average annual costs that are expected to result from deteriorated positions. Expected Loss can be calculated for an individual counterparty and the aggregation of all counterparties’ EL derives the portfolio expected credit losses. Credit risk can be quantified in all portfolios of UBS Group AG according to the Expected Loss (EL) and, also gives an input for the measurement of statistical loss and stress loss.

UBS Group AG uses PD ratings to measure credit risk, which result from market data and external rating agencies. An internal credit rating scale (Masterscale) is connected with these external ratings to ensure the consistent assessment of default probabilities across counterparties. The Masterscale expresses one-year default probabilities rates that range across the classes of ratings. Table 6.1 shows that for each external rating category, the average default rate is compared to the internal default probability bands of UBS Group AG. The estimates of loss given default (LGD) are supported by internal loss data and external information where available. For the estimation of exposure at default (EAD), UBS Group AG uses the information from its current

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207 UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich
exposures to the counterparty and the possible future development of the exposure.

**Table 6.1 The internal UBS rating scale and mapping of external ratings**

<table>
<thead>
<tr>
<th>Internal UBS rating</th>
<th>1-year PD range in %</th>
<th>Description</th>
<th>Moody’s Investors Service mapping</th>
<th>Standard &amp; Poor’s mapping</th>
<th>Fitch mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 and 1</td>
<td>0.00–0.02</td>
<td>Investment grade</td>
<td>Aaa</td>
<td>AAA</td>
<td>AAA</td>
</tr>
<tr>
<td>2</td>
<td>0.01–0.05</td>
<td>A1 to A3</td>
<td>AA+ to AA-</td>
<td>A+ to A –</td>
<td>A+ to A –</td>
</tr>
<tr>
<td>3</td>
<td>0.05–0.12</td>
<td>A1 to A3</td>
<td>AA+ to AA-</td>
<td>A+ to A –</td>
<td>A+ to A –</td>
</tr>
<tr>
<td>4</td>
<td>0.12–0.25</td>
<td>Baa1 to Baa2</td>
<td>BBB+ to BBB</td>
<td>BBB+ to BBB</td>
<td>BBB+ to BBB</td>
</tr>
<tr>
<td>5</td>
<td>0.25–0.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.50–3.00</td>
<td>Sub-investment grade</td>
<td>Ba1</td>
<td>BB+</td>
<td>BB+</td>
</tr>
<tr>
<td>7</td>
<td>0.80–1.30</td>
<td>Ba2</td>
<td>BB</td>
<td>B+</td>
<td>B+</td>
</tr>
<tr>
<td>8</td>
<td>1.30–2.10</td>
<td>Ba3</td>
<td>BB</td>
<td>B+</td>
<td>B+</td>
</tr>
<tr>
<td>9</td>
<td>2.10–3.50</td>
<td>B1</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>10</td>
<td>3.50–6.00</td>
<td>B2</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>11</td>
<td>6.00–10.00</td>
<td>B3</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>12</td>
<td>10.00–17.00</td>
<td>Caa</td>
<td>CCC</td>
<td>CCC</td>
<td>CCC</td>
</tr>
<tr>
<td>13</td>
<td>&gt;17</td>
<td>C to C</td>
<td>CC to C</td>
<td>CC to C</td>
<td>CC to C</td>
</tr>
</tbody>
</table>

**Source:** UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich.

Because of the need of internal historical data and information about the estimation of the parameters, we are not in a position to be able to calculate the expected loss (EL) of UBS Group AG for the year 2016. However, we will show the results of the Annual Report 2016 for the Credit exposure in **Table 6.2**.

To estimate the loss profile of each credit portfolio, UBS Group AG employs a statistical modeling approach (statistical loss) for over a one-year period and to a specified level of confidence, which constitutes a loss distribution (value at risk or VAR). The mean value of this distribution is the expected loss of the portfolios. A loss distribution is formed because of the statistical uncertainty, where the loss estimates deviate from the mean value. The outcome of this approach reflects all possible losses and each probability and so provides an indication of the risk level in the portfolio and how it will develop over time.
Complementary to the statistical loss approach, UBS Group AG also employs the stress loss approach, which is a scenario-based stress loss measure. With the stress tests the bank is able to monitor the potential impact of extreme events in the portfolios and apply limits if appropriate. The various stress scenarios used are tailored to the profile of each portfolio and vary in time horizon.

### Liquidity Risk Models

The first step in the liquidity risk measurement process is the analysis of the Balance Sheet, which is easy but not a perfect measurement model. However, it is a first outlook of the liquidity status in the bank. The total assets and the total liabilities and equity in the Group’s balance sheet of UBS Group AG as presented in the Annual Report 2016 according to the International Financial Reporting Standards (IFRS), are visible in Table 6.3 and Table 6.4.

As we can see, the total amounts of assets, liabilities and equity do not mismatch as both result on CHF 935 billion and is seemed that no funding problems occur as of the end of the year.
Table 6.3 UBS Group AG total balance sheet assets

<table>
<thead>
<tr>
<th>IFRS balance sheet assets</th>
<th>As of 31.12.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF billion</td>
<td></td>
</tr>
<tr>
<td>Cash and balances with central banks</td>
<td>107.8</td>
</tr>
<tr>
<td>Lending</td>
<td>319.5</td>
</tr>
<tr>
<td>Collateral trading(t)</td>
<td>81.4</td>
</tr>
<tr>
<td>Trading portfolio</td>
<td>96.6</td>
</tr>
<tr>
<td>Positive replacement values</td>
<td>158.4</td>
</tr>
<tr>
<td>Financial assets at FV/HTM(t)</td>
<td>90.3</td>
</tr>
<tr>
<td>Other assets(t)</td>
<td>81.1</td>
</tr>
<tr>
<td>Total IFRS assets</td>
<td>935.0</td>
</tr>
</tbody>
</table>

Source: UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich

Table 6.4 UBS Group AG total balance sheet liabilities and equity

<table>
<thead>
<tr>
<th>IFRS balance sheet liabilities and equity</th>
<th>As of 31.12.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF billion</td>
<td></td>
</tr>
<tr>
<td>Short-term borrowings(t)</td>
<td>36.8</td>
</tr>
<tr>
<td>Collateral trading(t)</td>
<td>9.4</td>
</tr>
<tr>
<td>Trading portfolio</td>
<td>22.8</td>
</tr>
<tr>
<td>Negative replacement values</td>
<td>153.8</td>
</tr>
<tr>
<td>Due to customers</td>
<td>423.7</td>
</tr>
<tr>
<td>Long-term debt issued(t)</td>
<td>132.5</td>
</tr>
<tr>
<td>Other liabilities(t)</td>
<td>101.7</td>
</tr>
<tr>
<td>Total IFRS liabilities</td>
<td>880.7</td>
</tr>
<tr>
<td>Share capital</td>
<td>0.4</td>
</tr>
<tr>
<td>Share premium</td>
<td>28.3</td>
</tr>
<tr>
<td>Treasury shares</td>
<td>(2.2)</td>
</tr>
<tr>
<td>Retained earnings</td>
<td>31.7</td>
</tr>
<tr>
<td>Other comprehensive income(t)</td>
<td>(4.5)</td>
</tr>
<tr>
<td>Total IFRS equity attributable to shareholders</td>
<td>53.6</td>
</tr>
<tr>
<td>IFRS equity attributable to non-controlling interests</td>
<td>0.7</td>
</tr>
<tr>
<td>Total IFRS equity</td>
<td>54.3</td>
</tr>
<tr>
<td>Total IFRS liabilities and equity</td>
<td>935.0</td>
</tr>
</tbody>
</table>

Source: UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich

In the Annual Report 2016 the Maturity analysis of assets and liabilities is also provided, as presented in Table 6.5.
Table 6.5 UBS Group AG maturity analysis of assets and liabilities

<table>
<thead>
<tr>
<th>CHF billion</th>
<th>Due within 1 month</th>
<th>Due between 1 and 3 months</th>
<th>Due between 3 and 6 months</th>
<th>Due between 6 and 9 months</th>
<th>Due between 9 and 12 months</th>
<th>Due between 1 year and 2 years</th>
<th>Due between 2 and 5 years</th>
<th>Due over 5 years</th>
<th>Perpetual/Not applicable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash and balances with central banks</td>
<td>107.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>107.8</td>
</tr>
<tr>
<td>Due from banks</td>
<td>11.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.2</td>
</tr>
<tr>
<td>Cash collateral on securities borrowed</td>
<td>15.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.1</td>
</tr>
<tr>
<td>Reverse repurchase agreements</td>
<td>36.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>66.2</td>
</tr>
<tr>
<td>Trading portfolio assets</td>
<td>96.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96.6</td>
</tr>
<tr>
<td>Positive replacement values</td>
<td>158.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>158.4</td>
</tr>
<tr>
<td>Cash collateral receivables on derivative instruments</td>
<td>26.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26.7</td>
</tr>
<tr>
<td>Loans</td>
<td>109.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>306.3</td>
</tr>
<tr>
<td>of which: residential mortgages</td>
<td>12.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>142.2</td>
</tr>
<tr>
<td>of which: commercial mortgages</td>
<td>2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.7</td>
</tr>
<tr>
<td>of which: Lombard loans</td>
<td>82.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>105.0</td>
</tr>
<tr>
<td>of which: other loans</td>
<td>11.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36.9</td>
</tr>
<tr>
<td>of which: securities</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
</tr>
<tr>
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<td>7.8</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>65.4</td>
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<td>Financial assets available for sale</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
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<td>6.6</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td>25.4</td>
</tr>
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<td>591.6</td>
<td>72.4</td>
<td>22.5</td>
<td>18.2</td>
<td>20.8</td>
<td>43.2</td>
<td>75.4</td>
<td>59.7</td>
<td>30.3</td>
<td>935.0</td>
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<td>72.4</td>
<td>25.4</td>
<td>23.5</td>
<td>15.4</td>
<td>31.8</td>
<td>75.8</td>
<td>54.9</td>
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<td>Due to customers</td>
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<td>2.5</td>
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<td>0.6</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>423.7</td>
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<td>14.6</td>
<td>4.6</td>
<td>3.4</td>
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<td>5.2</td>
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<td>Debt issued</td>
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<td>7.3</td>
<td>11.0</td>
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<td>9.5</td>
<td>19.7</td>
<td>29.4</td>
<td>7.8</td>
<td>103.6</td>
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<td></td>
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<td></td>
<td></td>
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<td>62.0</td>
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<tr>
<td>Total liabilities as of 31 December 2016</td>
<td>720.2</td>
<td>40.4</td>
<td>19.5</td>
<td>12.9</td>
<td>6.0</td>
<td>12.6</td>
<td>25.7</td>
<td>34.8</td>
<td>8.5</td>
<td>880.7</td>
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<td>Total liabilities as of 31 December 2015</td>
<td>720.4</td>
<td>46.0</td>
<td>22.6</td>
<td>8.6</td>
<td>3.6</td>
<td>17.7</td>
<td>28.8</td>
<td>32.3</td>
<td>5.4</td>
<td>885.5</td>
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<td><strong>Guarantees, commitments and forward starting transactions</strong></td>
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<td></td>
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<tr>
<td>Loan commitments</td>
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<td>0.0</td>
<td>0.0</td>
<td>54.4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>16.7</td>
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<tr>
<td>Reverse repurchase agreements</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.2</td>
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<td>Securities borrowing agreements</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>Total as of 31 December 2016</td>
<td>81.0</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>81.4</td>
</tr>
<tr>
<td>Total as of 31 December 2015</td>
<td>78.1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>78.7</td>
</tr>
</tbody>
</table>

Source: UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich
We can see that the total assets cover the total liabilities and there is a liquidity gap of CHF 135.7 billion, which can be kept as a reserve cushion.

Other measures used by UBS Group AG are the liquidity ratios LCR and NSFR which are proposed in the Basel III Accord as regulatory standards for the monitoring of the liquidity level and the funding stability. According to the Basel Committee on Banking Supervision, both the liquidity coverage ratio (LCR) and the net stable funding ratio are required to result of at least 100% by 2019. However, the Swiss Financial Market Supervisory Authority (FINMA) requires from UBS to maintain a minimum total Group LCR of 110%. The LCR and NSFR ratios of UBS Group AG can be seen in Table 6.6 and Table 6.7.

**Table 6.6 UBS Group AG Liquidity Coverage Ratio for 2016**

<table>
<thead>
<tr>
<th>High-quality liquid assets</th>
<th>Average 4Q16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash balances</td>
<td>102</td>
</tr>
<tr>
<td>Securities</td>
<td>94</td>
</tr>
<tr>
<td>of which: on-balance sheet</td>
<td>75</td>
</tr>
<tr>
<td>of which: off-balance sheet</td>
<td>18</td>
</tr>
<tr>
<td>Total high-quality liquid assets</td>
<td>196</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cash outflows</th>
<th>Cash inflows</th>
<th>Liquidity coverage ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail deposits and deposits from small business customers</td>
<td>26</td>
<td>117</td>
</tr>
<tr>
<td>Unsecured wholesale funding</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Secured wholesale funding</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Other cash outflows</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Total cash outflows</td>
<td>265</td>
<td></td>
</tr>
<tr>
<td>Secured lending</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Inflows from fully performing exposures</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Other cash inflows</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Total cash inflows</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>High-quality liquid assets</td>
<td>196</td>
<td></td>
</tr>
<tr>
<td>Net cash outflows</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>Liquidity coverage ratio (%)</td>
<td>132</td>
<td></td>
</tr>
</tbody>
</table>

*Source: UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich*
The results show that the LCR ratio at the end of the year is 132% and complies with both Basel III regulatory standard of at least 100% and the FINMA requirement of at least 110%. Also, the NSFR ratio complies with the Basel II regulatory standard as it is 116%.

UBS Group AG also performs stress testing to capture the optimal asset and liability structure, which under various scenarios allows the maintenance of an appropriate liquidity balance and funding position. Liquidity exposures are modeled under stress and acute scenario market conditions that include the consideration of the possible impact from stress events when entering the markets on all the business of the bank. In the stress scenario, potential stress effects across all markets, currencies and products are included. Oppositely, the acute scenario represents an extreme stress event which combines the market disruption with a firm-specific crisis.

6.5 Management

Credit Risk Management

The mitigation actions of UBS to actively manage credit risk in its portfolios are the taking of collateral against exposures and the utilization of credit hedging. The first action refers to lending by securing real estates as collateral. With the help of a credit scoring model, UBS Group AG takes credit decisions about the origination or modification of Swiss mortgage loans. The model

Source: UBS Group AG. 2016, Annual Report 2016, UBS AG, Zurich
calculates the affordability in relation to the gross income, and the loan-to-value ratio (LTV). For the calculation of affordability information like interest payments, minimum amortization requirements, potential property maintenance costs, or the level of rental income (properties expected to be rented out), is needed. The allowed LTV ratio for occupied properties is maximum 80%, opposite to vacation properties and luxury real estate with a LTV ratio of 60%. Also, for properties rented out the maximum LTV ratio ranges from 60% to 80%. UBS Group AG assigns values to each property that are based on the lowest values defined by internal value calculations, the purchase price and additional external values.

Another class of loans, where collateral is taken as securitization against exposures, is the Lombard lending. The collaterals include transferable securities (bonds, equities, approved structured products), guarantees and other forms. To derive the lending value, UBS Group AG applies haircuts (discounts) so that the collateral’s risk is reflected. For marketable securities, haircuts are calculated to cover a possible change of the market value over a given period and confidence level. The haircuts depend on the creditworthiness view of the counterparty.

In the management of the counterparty credit risk arising from traded products (OTC derivatives and SFTs from Investment Bank, Non-core and Legacy Portfolio and Group ALM), the effect of market movements on the exposure and any associated collateral until the time of closing out the positions are taken into account.

Finally, for credit hedging in the Investment Bank division and Non-core and Legacy Portfolio, UBS utilizes single-name credit default swaps (CDSs), credit index CDSs, bespoke protection and other instruments. These credit instruments reduce the concentrations of risk from specific counterparties, sectors or portfolios. Also, they reduce the profit or loss impact that occurs in credit valuation adjustments (CVA) in the case of counterparty credit risk.
**Liquidity Risk Management**

UBS Group AG manages its liquidity risks to maintain a sound liquidity position, so that it is able to meet all the liabilities when due and ensure time and financial flexibility when a firm-specific liquidity crisis occurs owing to a stressed market environment. Through this action the bank aims to avoid unacceptable losses or a sustained damage in its various businesses.

A contingency funding plan, supported by the liquidity crisis scenario analysis, is UBS’s liquidity management concept that covers various types of crisis events. The plan is about the assessment of contingent funding sources in a stressed environment, liquidity status indicators and metrics, and contingency procedures. In a crisis event, the bank protects its liquidity position by diversifying its funding. Also, all material, known and unknown cash flows, the level and availability of high-grade collateral for raising additional funding, are regularly assessed and tested. Finally, the contingent funding sources of UBS include the portfolio of its high-quality liquid assets (HQLA), liquidity facilities at several major central banks that are available and not utilized, and contingent reductions of liquid trading portfolio assets.
7 Conclusion

With this last chapter we complete the study of the credit and liquidity risk management in the banking sector and record some conclusions about this issue and also proposals of prospective future continuation of this study or alteration of the study variables.

Everyone thinks that banks have a powerful force in the financial environment and in our lives in general. But their major fear is an unexpected financial disaster as a consequence of mismanagement or wrong decision making. Such a scenario was confirmed in the global financial crisis of 2007-2008 which shaken the whole banking system. The conclusion resulting from this event is the question what went wrong. And a possible answer on this question is that we should not trust the risk management.

Regulators and supervisors are responsible to monitor the operations of the banks and also their financial stability, and to prevent bank default risk by monitoring and regulating its two major sources: liquidity risk and credit risk. They indirectly support the effort of the banks to stay solvent and financially healthy without problems. This action is obvious through all the regulatory requirements and standards they propose. Most of the banks try to stay consistent with these requirements and standards, because they believe that if they do so, nothing bad will happen. However, something gone bad in 2007.

Risk managers work hard in the day-to-day business of a bank to keep it safe or the less affected from the uncertainty of the risks. Uncertainty cannot disappear, it can be mitigated. This is the work of the risk managers, they are responsible to develop the best weapons against the uncertainty and the exposure of the risks. However, it will never be possible to anticipate all risks and their impacts.

This study was an introductive and informative step into the subject of risks and their management representing two of the major risks that banks face, the credit and liquidity risk, and producing a little research about the way an existing bank handles the management of these risks. We propose a future study, sequel to the one, where a presentation of a more quantitative and mathematical background of management methodologies would be interesting.
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