Basel III: Beyond Compliance

An analysis of the current compliance level of the capital and liquidity requirements of Basel III in the European banking sector, and an assessment on how European banks can accommodate

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Abstract

The financial crisis of 2007-2008 proved that the banking sector was not sufficiently capitalized. Consequently, the Basel Committee of Banking Supervision developed Basel III that introduces several capital and liquidity requirements with the purpose of strengthening the stability of the banking sector. This thesis analyzes the current compliance levels of the capital and liquidity requirements of Basel III for the European banking sector, hereunder the risk-based capital requirements, the leverage ratio, the liquidity coverage ratio, and the net stable funding ratio. Moreover, the thesis provides recommendations for European banks on how to accommodate the capital and liquidity requirements.

Keywords

Basel I, Basel II, financial crisis of 2007-2008, Basel III, risk-based capital requirements, leverage ratio, liquidity coverage ratio, net stable funding ratio

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List of Acronyms

ABCP	Asset-backed commercial paper	HH	Household
ABS	Asset-backed security	HQLA	High quality liquid asset
AEG	Accounting Experts Group	IRB	Internal Rating Based
AMA	Advanced Measurement Approach	IRC	Incremental risk charge
ASF	Available stable funding	IUFI	Investments in unconsolidated financial institutions
A-IRB	Advanced-Internal Rating Based	LCR	Liquidity coverage ratio
AT1	Additional Tier 1	LGD	Loss given default
BCBS	Basel Committee of Banking Supervision	LR	Leverage ratio
BCG	Basel Consulting Group	LTV	Loan-to-value
BIA	Basic Indicator Approach	MA	Maturity adjustment
BIS	Bank for International Settlements	MBS	Mortgage-backed security
CCB	Capital conversion buffer	MMDA	Money market deposit account
CCF	Credit conversion factor	MSG	Macroprudential Supervision Group
CCyB	Countercyclical capital buffer	NINJA	No-income, no job or asset
CD	Certificate of deposit	NOW	Negotiable order of withdrawal account
CDO	Collateral debt obligation	NSFR	Net stable funding ratio
CDS	Credit default swap	OBS	Off-balance sheet
CEA	Credit equivalent amount	OECD	Organization of Economic Co-operation and Development
CET1	Common Equity Tier 1	PD	Probability of Default
CRA	Credit rating agency	PDG	Policy Development Group
CVA	Credit valuation adjustment	QE	Quantitative easing
DBPA	Defined benefit pension asset	QIS	Quantitative impact study
DDA	Demand deposit account	RAROCAR	Risk-adjusted return on capital at risk
DTA	Deferred tax asset	REA	Risk exposure amount
EAD	Exposure at default	ROA	Return on assets
EBA	European Banking Authority	ROE	Return on equity
ECB	European Central Bank	RSF	Required stable funding
EP	European Parliament	SA	Standardized Approach
ES	Expected shortfall	SIG	Supervision and Implementation Group
FSB	Financial Stability Board	SME	Small and medium enterprise
FTP	Funds transfer pricing	SPV	Special purpose vehicle
GHOS	Group of Governors and Heads of Supervision	VaR	Value-at-Risk
G-SIB	Global systematically important bank	WCDR	Worst case default rate

1 Introduction

Banks are credit intermediaries between borrowers and lenders, which enables the financing of investments. This means that banks are an essential building block for economic growth in society. However, when credit intermediaries take on too much risk, economic growth is unsustainable. This is evident from the numerous financial crises in history. Therefore, regulatory legislation and supervisory monitoring of the banking system are necessary mechanisms to maintain sustainable economic growth. The Basel Committee on Banking Supervision (BCBS) has a quintessential role in terms of banking regulation and supervision. BCBS aims to improve the resilience of the banking sector. Resilience implies that the banking sector must be capable of withstanding liquidity shocks arising from economic downturns and financial instability.

Since BCBS' first international banking regulation in 1975, The Basel Concordat, defining the governance structure of banking supervision in each country, BCBS has introduced a series of amendments and new regulatory frameworks. BCBS introduced the first Basel Accord in 1988, known as Basel I, which is an internationally standardized framework on capital adequacy. In 2004, BCBS launched Basel II that introduced several changes to the Basel I, however failed to improve the resilience of the banking system as banks were able to avoid the regulations by moving activities out of the balance sheet. This regulatory gap resulted in excessive leverage of short-term funding among banks, which backfired when the default rate of mortgages started to increase. Many banks were not able to rollover their short-term liabilities. Consequently, this led to a systemic liquidity shortage and credit losses known as the financial crisis of 2007-2008. In response, BCBS introduced a new regulatory framework in 2011 known as Basel III. Basel III changes both the quantity and quality of the risk-based capital requirements from Basel II in addition to introducing a non-risk based risk capital requirement. Furthermore, Basel III introduces two liquidity requirements (Mesnard et al. 2016).

This thesis analyzes the European banking sector's compliance level with the capital and liquidity requirements of Basel III, and how European banks can accommodate these requirements.

1.1 Problem Formulation

Banks need to comply with the capital and liquidity requirements of Basel III within a specific time frame. Some requirements are not fully implemented until 2019. The transition period allows banks to conduct the necessary actions to accommodate. The accommodation implies reconfigurations to the balance, which may differ in scale and complexity from bank to bank. Nonetheless, the increased capital and liquidity requirements imply higher cost of capital for the entire banking sector, which affects profitability. However, the European banks are not only under pressure from the capital and liquidity requirements, but also from historically low interest rate spreads due to an expansionary monetary policy in the Eurozone. In March 2015, the European Central Bank (ECB) launched extensive open-ended quantitative-easing (QE) program involving monthly bond purchases of €60bn until September

2016 with the purpose of keeping the inflation rate at 2% (European Parliament 2015a). In December 2016 ECB decided to continue the QE program until ultimo 2017 (ECB Press Conference 2016), holding the current lending rate at 0.00% and the depository rate at -0.40%. Consequently, the interest rate spread has diminished for European banks (Figure 2), which is the key driver of profitability for banks. Therefore, the European banking sector faces a serious challenge in accommodating the capital and liquidity requirements, while maintaining profitability. The problem is thus formulated as such:

What is the current compliance levels of the capital and liquidity requirements of Basel III for the European banking sector, hereunder the risk-based capital requirements, leverage ratio, liquidity coverage ratio, and net stable funding ratio, and how can the European banks accommodate the capital and liquidity requirements?

The thesis defines compliance level as the degree of which the European banks satisfy the regulatory requirements of the capital and liquidity framework of Basel III. The problem formulation is answered by firstly analyzing Basel I, Basel II, and Basel III comparatively from a capital and liquidity perspective. Subsequently, the thesis analyzes the current compliance levels of the European banking sector with respect to the capital and liquidity requirements of Basel III. The findings from the compliance level analysis are necessary to provide recommendations to European banks on how to accommodate the challenge of complying with the requirements while maintaining profitability. Finally, the thesis provides operational and strategic recommendations. The operational recommendations focus risk management, performance management, liquidity pricing management, and data management, while the strategic recommendations focus on restructuring of business model with respect to balance sheet reconfiguration, customer segmentation, and product offerings.

The thesis is of interest to both financial institutions, their equity holders, and banks' creditors and debtors, as it provides an understanding of the regulatory environment in the European banking sector in addition to how the regulations may affect European banks.

1.2 Methodology

This section provides insights to the methodological approach of answering the problem formulation, hereunder the underlying theories, method for data collection, and the epistemological and ontological considerations of the analyses.

Chapter 2 analyzes on the business model of a bank, hereunder liquidity risk management, asset-liability management, and capital management in addition to various banking-related risks. The underlying theories of these analyses are risk management and portfolio theory. Risk management theories such as term structure and liquidity preference theory are also embedded in the analyses of the Basel I, Basel II, Basel III, as one of BCBS' focus areas in the capital and liquidity frameworks is maturity. Moreover,

one of BCBS' revisions to Basel I was the replacement of value-at-risk calculation with expected shortfall calculation in the internal rating based approaches. The acknowledgement for fat tails in the loss probability distribution is embedded in extreme value theory. As for the analysis of the financial crisis of 2007-2008 in chapter 6, principles of macroeconomics and corporate finance constitute the primary theoretical basis. The recommendations in chapter 9 are primarily based on risk management theories, however the chapter draws upon other fields of literature such as resource-based view, knowledge-based view, theory of the firm, change management, and microeconomics.

In the analyses of the compliance levels of the European banking sector quantitative data is used. The data is primarily collected from the monitoring reports published by the European Banking Authority (EBA). The EBA reports include more than hundreds of European banks, implying a high degree of representativeness toward the European banking sector. Therefore, the thesis uses the reports instead of collecting and sampling financials from individual European banks. However, information is also collected from reports issued by financial institutions, academic scholars, and corporate bodies in the compliance level analyses and the recommendations of chapter 9. The thesis scrutinizes that information is collected from multiple sources to ensure triangulation. Triangulation implies a higher degree of validity of the collected information, and thereby a higher degree of reliability of the analytical findings (O'Donoghue & Punch 2003, p.78).

The analyses of the thesis rely on the epistemological consideration categorized as empirical realism, which implies in abstract terms that the conceptualization of reality is a way of acknowledging reality. In concrete terms, empirical realism implies that financial regulations are subject to change as the empirical basis, on which financial regulations are built, changes. The historical changes of the Basel Accords prove that the concept of reality is temporary, i.e. society and the economic context change. This implies that the current capital and liquidity framework of Basel III is subject to change, and therefore not the absolute truth. This epistemological consideration is shared by BCBS that emphasizes that the regulations on the banking system is under continuous review (BCBS 2017). Empirical realism is aligned with the ontological consideration of the thesis which is categorized as constructionism. In abstract terms, constructionism implies that social phenomena are continuously created by social actors. In concrete terms, this means the capital and liquidity requirements are continuously changed by social actors like BCBS. Furthermore, this implies that future Basel Accords will be developed as response to new contextual situations. Finally, the ontological consideration of constructionism presupposes that the conclusions of the thesis must be treated as contemporary conclusions. As for the recommendations in chapter 9, the thesis builds on inductive logic as the recommendations essentially work as theories developed from patterns of observations found in preceding chapters.

1.3 Delimitation

The goal of the thesis is to determine the current compliance levels of the capital and liquidity requirements of Basel III, and to provide operational and strategic recommendations for the European banks to accommodate the requirements. This section provides seven delimitations necessary for reaching this goal.

Firstly, the thesis focuses on traditional commercial banks with a business model that revolves around the financial intermediation between borrowers and lenders. This means that the scope of the thesis excludes other types of banks that provide services such as investment banking services, leasing or insurance. If not specified, *'bank'* implies *'commercial bank'* for the remainder of this thesis.

Secondly, the scope of the thesis excludes domestic regulations apart from the countercyclical capital buffer. Each country in Europe may have country-specific regulations toward domestic banks in addition to the capital and liquidity requirements of Basel III. The thesis will not assess the country-specific regulations, but limits the analyses and recommendations to cover the regulations of Basel III.

Thirdly, the scope of thesis excludes any analysis of the impact of Basel III on society and banking customers. The recommendations that are in scope may be utilized as preconceptual basis for understanding the impact on society and banking customers, however conducting such analysis is not the aim of the thesis.

Fourthly, the scope of thesis excludes idiosyncratic analyses and recommendations. The analysis of the compliance levels in chapter 8 is conducted on an aggregate level. Similarly, the recommendations in chapter 9 are not directed to individual banks. Moreover, it should be noted that the recommendations are merely proposals, and do not represent the perfect solution, as the optimal solution is contingent of idiosyncrasies of the bank.

Fifthly, the scope of the thesis excludes the regulations of Basel IV. The initial publication date for BCBS' fourth accord was set at ultimo 2016, however it was postponed. Due to uncertainty regarding the content of Basel IV in addition to the publication date, the thesis excludes the impact of Basel IV even though it may have a significant impact on the European banking sector.

Sixthly, the findings the compliance level analyses in chapter 8 are per medio 2016, which means that the problem formulation refers to medio 2016 when mentioning *current* compliance levels.

Finally, the analysis of the compliance levels in chapter 8 excludes any requirements of pillar 2 and pillar 3 in Basel II. The analysis focuses on the minimum capital and liquidity requirements of pillar 1.

1.4 Thesis Structure

The thesis consists of nine chapters from hereon.

Chapter 2 provides a theoretical and conceptual understanding of the business model of a commercial bank by describing the balance sheet of a bank in addition to banking risks and bank management.

Chapter 3 provides an understanding of the organizational structure of BCBS in addition to the governance structures and the implementation process of the Basel Accords.

Chapter 4 provides an analysis of Basel I hereunder its objectives, capital adequacy framework, and drawbacks. The purpose of this chapter is to gain understanding of the foundation of the regulatory capital requirements issued by BCBS, and to understand the motives for improving the regulations in Basel II.

Chapter 5 provides an analysis of Basel II hereunder its objectives, revisions to Basel I, and drawbacks. The insights of Basel II play a key role in understanding how the regulatory framework failed to prevent the financial crisis in 2007-2008.

Chapter 6 provides an analysis of the financial crisis of 2007-2008 with the purpose to show the drawbacks of Basel II and understand the motives for Basel III.

Chapter 7 provides an analysis of Basel III with the aim to understanding the amendments to capital framework of Basel II and the introduction of the liquidity framework. The insights of this chapter are the basis for conducting the analysis of the compliance levels of the European banking sector.

Chapter 8 provides an analysis of the current compliance levels of the European banking sector in relation to the capital minimum requirements, the leverage ratio, the liquidity coverage ratio, and the net stable funding ratio.

Chapter 9 provides operational and strategic recommendations for the European banks to accommodate the capital and liquidity requirements of Basel III.

Chapter 10 concludes the thesis.

2 Business Model of a Bank

The purpose of this chapter is to provide a conceptual and theoretical understanding of the business model of a commercial bank. To reach such understanding, the chapter firstly examines the balance sheet and off-balance sheet (OBS) items of a bank. Secondly, the chapter examines key concepts of bank management. Finally, the chapter examines significant banking risks. The insights of this chapter are necessary to understand the Basel Accords, and feeds into the recommendations in chapter 9.

The business model of a bank revolves around having a specific role in society. On a macroeconomic level, banks are the main conduit of the monetary policy of central banks, as central banks can control the money supply and the level of aggregate economic activity by changing the availability of credit and the interest rates towards banks within the economy (Koch & MacDonald 2003, p.41). On a microeconomic level, banks are the primary source of credit for individuals and corporations, and thus a key catalysator of industrialization and economic growth in many countries since the nineteenth century (Westerhuis 2016, pp.1–2). Banks take on this role by facilitating financial intermediation.

Financial intermediation entails the transfer of funds between two types of groups in the economy (Figure 1), namely depositors and borrowers of capital. Borrowers are deficit-spending individuals and institutions in need of funds as their current expenditures for consumption and investment exceed the current income, while depositors are surplus-spending individuals and institutions in need of investment or savings of surplus funds (Rose & Hudgins 2008, p.13).

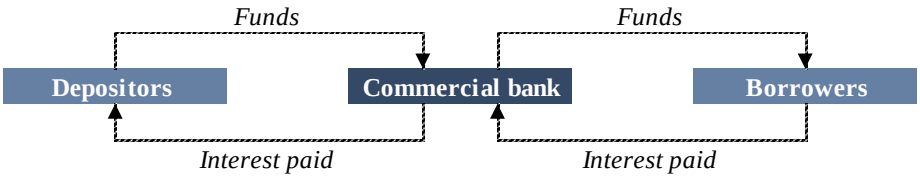


Figure 1: *Financial intermediation in a commercial bank*
Source*: Own creation*

Typically, the financial intermediation involves the facilitation of maturity transformation, implying that the financial intermediary transforms short-term liabilities into longer-term assets by e.g. issuing a loan from the funds of a pool of demand deposits (Allen & Saunders 2012, pp.1–14). Maturity transformation may generate a positive spread between yield on assets and expected funding costs, however it also entails liquidity risk, which is covered in section 2.2.

The economic prerequisites for intermediation are a positive spread between the expected yields on loans and the expected funding costs, and a positive correlation between these two (Rose & Hudgins 2008, p.13). A negative correlation implies that the expected funding costs would exceed the yields on loans, which would result in the financial intermediation being an unprofitable activity. In recent years, the ECB interest rate has declined significantly (Figure 2), implying that the term spread decreases as

yields on long-term assets decreases more than the decrease in short-term funding costs. Moreover, profitability on loans to sovereigns decrease, as the ECB interest spread has decreased.

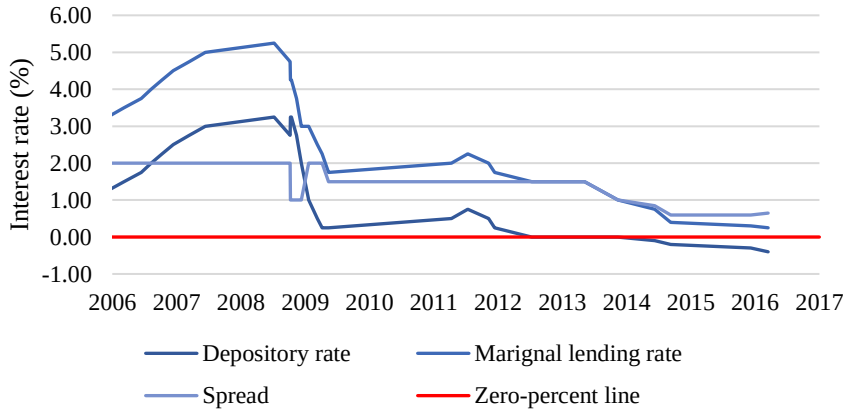


***Figure 2**: Key ECB interest rates and spread*
***Source**: Own creation based on data from ECB (Appendix 12.2)*

2.1 Balance Sheet

The following sections analyze the balance sheet of a bank, hereunder the typical assets, liabilities, and OBS items. The insights provide basis for understanding bank management and the risks of banking.

2.1.1 Assets

There are four main categories of assets on balance sheet of a bank including loans, investment securities of the open market, cash or cash equivalents and deposits held at other depository institutions, and miscellaneous assets (Rose & Hudgins 2008, p.130).

Loans often comprise the largest part of the total asset portfolio of a bank, and comes in multiple variations such as secured mortgage loans, household (HH) loans, agricultural loans, currency loans to individuals, corporates, and other institutions etc. (Koch & MacDonald 2003, p.99). Banks holds an allowance for loan losses (ALL), which is capital set a side in case of default on a loan. The size of the ALL is primarily determined by the credit risk of the counterparty.

Investment securities typically hold the second largest fraction of the total assets. Investment securities are divided into two main categories, namely securities available-for-sale, and bonds and notes (Rose & Hudgins 2008, p.133). The securities available-for-sale often include low yields, low risk, and high liquidity. High liquidity implies marketability without significant discounts. Because of the high liquidity, the funding cost is typically lower than for instance illiquid bonds.

Thirdly, cash, cash equivalents and deposits held in other financial institutions represent the primary reserve of a bank. The reserve functions as a liquidity cushion, protecting the bank from the inability to payback on liabilities. Banks can be subject to international and domestic requirements regarding the

size of the reserve. The minimum reserve requirement for European banks required by ECB is 1% of demand deposits, and re-evaluated every six week (ECB 2016).

Finally, banks typically hold fixed assets such as properties, plant, equipment, and investment in subsidiaries that are coined miscellaneous assets (Rose & Hudgins 2008, p.130).

2.1.2 Liabilities

There are two broad categories of liabilities, i.e. depository liabilities and non-depository liabilities. The main categories of depository liabilities are demand deposit accounts (DDA), negotiable order of withdrawal accounts (NOWs), money market deposit accounts (MMDA), and jumbo certificates of deposits (CD) also known as term deposits. Depository liabilities are the main source of funding for banks. The main categories of non-depository liabilities are purchased federal funds, security repurchase agreements (repos), bonds, and equity capital from shareholders (Koch & MacDonald 2003, pp.426–439; Rose & Hudgins 2008, pp.138–140).

DDAs are non-interest-bearing checking accounts. Traditionally, regulation required DDAs not to bear interest, however banks have circumvented the regulations by offering discount on other services, effectively providing a yield on the DDA (Rose & Hudgins 2008, p.138). Unlike DDAs, NOWs bear interest. Furthermore, banks typically price NOWs competitively to attract larger deposits.

MMDAs are used as an instrument for banks to compete with mutual funds offered by large brokerage firms in the money market. MMDAs bear higher interest rates compared to NOWs, however the checking privileges are typically limited. Depositors typically need to notice in advance before withdrawing the MMDA deposit.

Jumbo CDs typically involves larger deposit volumes than DDAs, NOWs, and MMDAs. Moreover, CDs have a fixed maturity and agreed yield-to-maturity. The longer the time to maturity, the more stable the funding source. However, the interest rate and liquidity premium paid to the depositor often correlate positively with the maturity, implying that stable funding is relatively costly. There are many variations of CDs including variable-rate-, callable-, zero-coupon-, and stock market indexed CDs (Koch & MacDonald 2003, pp.435–437).

Federal funds purchased are essentially unsecured short-term loans that are settled in immediately available funds, meaning that if a bank has excess reserves held at a federal reserve, the bank can sell the reserve to a third party. The third party purchases the federal funds, and books the funds as liabilities. Repos are secured by the government, and entail that both parties in the transaction are obliged to resell/buyback the federal funds at market value (Koch & MacDonald 2003, p.438).

Bonds offer banks funding for a longer period relative to repos. Bonds can be secured or unsecured. Secured bonds are also referred to as covered bonds, which are debt securities collateralized by a pool of assets. Covered bonds are typically used to fund mortgage loans.

Finally, equity capital is a liability that BCBS holds as an essential part of today's liquidity standards (BCBS 2011b), and consists of the funds from shareholders.

2.1.3 Off-balance Sheet Items

OBS items are exposures that are not recognized in the balance sheet, and include for instance certain loan commitments, letters of credit, operating leases, and derivatives. Derivatives include swaps, future and forward contracts, options, and guarantees used to hedge certain exposures or to secure payments. During the financial crisis of 2007-2008, banks moved activities off the balance to avoid capital charges on-balance items.

2.2 Liquidity Risk

Liquidity risk entails a risk of a negative liquidity gap in the maturity transformation within a period, and is the primary banking risk. As mentioned previously, maturity transformation entails using short-term liabilities to fund long-term assets. This implies a risk of maturity mismatch (Bessis 2010, pp.33–34). Maturity mismatch is the risk of not being able to satisfy the obligations within a contractual period. Maturity mismatch occurs when the cash and security flows from assets for a given period are not sufficient for covering the cash and security flows to debtholders of the bank in the same period. In event of maturity mismatch, banks risk becoming illiquid. Thus, banks are subject to liquidity risk through in the maturity transformation. In a maturity transformation process, liquidity risk exists on both the asset side and liability side of the balance sheet. Asset liquidity risk occurs when banks are unable to sell an asset in time to avoid losses or that the bank must recognize large impairment on assets (Allen & Saunders 2012). Liability liquidity risk, also referred to as funding liquidity risk, occurs when banks are unable to settle an obligation in time (Drehmann & Nikolaou 2010). Therefore, financial intermediation and maturity transformation necessitates that banks must manage both their assets and liabilities to minimize liquidity risk.

2.3 Bank Management

This section analyzes key aspects of bank management, hereunder asset management, liability management, liquidity risk management, and capital management. The insights are the basis for understanding the Basel Accords, and feed into the recommendations in chapter 9.

2.3.1 Asset Management

Asset management for banks have the same underlying principles as asset management for companies in other industries, i.e. obtaining the highest return possible at the lowest risk (Bodie et al. 2014). There

are four main strategies to manage assets (Mishkin & Stanley 2013, pp.448–449). Firstly, attract borrowers with low risk of default and a willingness to pay high interest rates. Secondly, purchase securities with the best risk-reward profile. Thirdly, minimize portfolio variance through diversification. Finally, ensure liquidity of assets.

As for attracting borrowers with low risk of default, banks conduct credit analyses. The methodology of the credit analysis that banks use varies depending on the type of counterparty. However, banks generally set up criteria on key financial parameters to sort out low-risk customers. For corporate customers, the parameters can be EBITDA/revenue, interest coverage ratio (EBITDA/interest payment), leverage (debt/equity), and quick ratio (current assets/current liabilities). For private customers, the parameters can be debt-to-income ratio, disposable income, and probability of future job securement. Banks use the credit risk assessment of the counterparty to price accordingly. This is the basis for any capital asset pricing model such that reward reflects risk.

As for purchasing securities with the best risk-reward profile, banks typically use measurements that captures return relative to the security's standard deviation of return, e.g. Sharpe Ratio that captures the average return adjusted for riskless per unit of volatility (Bodie et al. 2014). In addition to measuring return on risk, banks must also secure that the return on asset covers the cost of the capital set aside for the assets.

As for diversification of assets, banks attempt to mix asset so that the covariance between the assets is minimized. This is done by minimizing the correlation between assets in the portfolio. Ultimately, this means that the risk of their asset portfolio is reduced, and the Sharpe ratio is maximized.

As for ensuring a sufficient amount of liquid assets, banks can utilize the asset conversion strategy (Rose & Hudgins 2008, pp.351–352). The strategy entails storing liquidity in assets, primarily cash, government bonds, federal loans, and marketable securities, and selling these assets when liquidity is needed. The criteria for an asset conversion strategy are liquid assets, a market for these assets, stable prices on the assets, and opportunity to rebuild position of liquid assets (Rose & Hudgins 2008, p.352). However, the strategy can be costly in terms of commission and transaction costs.

2.3.2 Liability Management

There are four main liability management strategies, i.e. sell CDs, issue bonds, borrow federal funds, and hold excess reserves (Rose & Hudgins 2008, pp.208–209; Mishkin & Stanley 2013, pp.449–450). The aim of the strategies is to gain control over funding costs while ensuring availability of funds (Rose & Hudgins 2008, pp.208–209).

These liability management strategies are referred to as purchased liquidity management strategies (Rose & Hudgins 2008, p.352). The main advantage of the strategies is that banks can control the

funding volume intake through price, because the interest elasticity[1] for these funding sources is high (Koch & MacDonald 2003, pp.454–455). However, the strategies come with three significant disadvantages. Firstly, increasing prices is only feasible until the spread between asset yield and expected funding costs is positive. Secondly, the volatility of interest rates implies that the strategy can be costly (Rose & Hudgins 2008, p.353). Thirdly, funds in periods of systemic liquidity shortage may be unavailable or overpriced.

Therefore, banks may supplement the purchased liquidity management strategies with the asset conversion strategy mentioned in section 2.3.1 to ensure excess liquid asset reserves as protection for large deposit outflows (Mishkin & Stanley 2013, p.448).

2.3.3 Liquidity Risk Management

Liquidity risk management vary depending on the maturities of the assets and liabilities. Short-term liquidity management denotes the ability to manage the settlements with maturities under one year, while long-term liquidity management denotes the ability to manage settlements with maturities above one year (Roberto & Pierpaolo 2013). Therefore, liquidity risk management necessitates thorough estimations of future cash flows. The estimations must include the consideration of various economic and monetary scenarios, as banks are required to mitigate both normal and stressed conditions. The synthetization of macro-, meso- and microeconomic events with liquidity risk management is cumbersome, as the drivers of liquidity risk change.

An example of poor liquidity management was present during the financial crisis of 2007-2008. Many banks did not adjust their liquidity risk management practices to the contemporary drivers of liquidity risk. When assets started to default, many investors in the wholesale capital markets withdrew their funds. This meant that banks were forced to liquidate assets with large impairments to cover the liabilities. Some banks could not meet its obligations, resulting in illiquidity and the bank defaulting.

Liquidity risk can be reduced by diversifying funding sources. Thus, banks map the concentration of funding to identify potential liquidity risk from overreliance on one funding source. BCBS categorizes funding sources as significant if the funding source account for more than 1% of the bank's total balance sheet (BCBS 2013a, pp.48–49).

Moreover, banks can identify liquidity risk through contractual maturity mismatch identification, which enables banks to map the gaps between contractual cash and security flows from assets, liabilities and OBS activities for a defined period (BCBS 2013c, pp.46–47). The mapping shows how much liquidity is required in a contractual period if all outflows occurred at the earliest date possible. Thus, the

[1] Demand sensitivity to changes in interest rates

contractual maturity mismatch profile is used as an indicator of extensity of the maturity transformation within in a specific period, and thereby the need for or abundance of liquidity.

2.3.4 Capital Management

Capital denotes the funds contributed by the owners of the bank (Rose & Hudgins 2008, p.475). Banks must manage equity capital for two reasons. Firstly, to ensure that the bank has sufficient equity capital to prevent illiquidity in stressed periods. Secondly, to manage the return on equity (ROE).

Equation 1 shows the function for ROE as being the return on assets (ROA) multiplied by the equity multiplier (total assets over equity capital). This infers that increasing equity capital lowers the equity multiplier, and thereby reduces ROE. Oppositely, if the bank e.g. repurchases stocks to reduce equity capital, ROE increases.

$$\text{ROE} = \frac{\text{Assets}}{\text{Equity}} * \text{ROA} \qquad \textit{Equation 1}$$

The two reasons for managing equity capital creates an inevitable trade-off in which the bank must balance the ROE with capital adequacy. This trade-off is a recurrent theme in the thesis, and a pivotal point in the recommendation of chapter 9.

2.4 Banking Risks

The most important banking risk is liquidity risk, which was examined in section 2.2. However, the business model of a bank includes other significant types of risk. To understand the motives and content of the Basel Accords, it is key to understand these risk types. The subsequent sections conceptualize credit risk, market risk, operational risk, interest rate risk, legal and reputation risk, and systemic risk.

2.4.1 Credit Risk

Credit risk designates the probability of default (PD) of a counterparty on a payment obligation (Bessis 2010, p.28). When borrowers fail to settle their payments on a loan, the bank is unable to cover the funding costs of that loan. Therefore, the bank recognizes a loss on the income statement by adjusting for an impairment on the loan if the actual loss on the loan exceeds the expected loss. The impairment reduces net income, thus also capital (Rose & Hudgins 2008, p.477). Credit risks contain several important risk components, i.e. default risk, migration risk, exposure risk, loss given default, and counterparty risk (Bessis 2010, pp.28–33). Default risk entails the delay in payments, restructuring of debt obligation due to credit standing deterioration of the borrower, or bankruptcy. Migration risk denotes the risk of decline credit rating of the counterparty, which result in higher probability of default (Bessis 2010, p.29). Exposure risk measures the exposure amount subject to risk including accrued interest, i.e. the exposure at default (EAD). For instance, unutilized credit facilities and committed lines of credit do not have on-balance sheet exposure, but bears an exposure at risk in case credit utilization.

Loss given default (LGD) measures the probable loss in event of default. LGD is reduced if the loan is collateralized or backed with guarantees. Also, there are different recovery rates in event of default across asset type, industries, customer profiles, which implies that LGD varies a lot. Finally, credit risk includes counterparty risk, which relates to risk on derivative products such as swaps (Bessis 2010, p.30). Swaps entail a fixed, a floating leg, and a market value of zero at origination. If banks receive the floating leg, and the variable rate increases, the value of the swap for the bank increases. However, the probability of the customer not being able to pay the floating leg increases. The credit risk changes with movements in the derivative market, implying that there is an interaction between credit risk and market risk (Bessis 2010, p.30).

2.4.2 Market Risk

Market risk denotes the risk of deviations of the mark-to-market value of the trading portfolio due to market movements during the liquidation period (Bessis 2010, p.34). However, banks hedge against future negative changes in value of the instruments so that the market risk is minimized in the liquidation period. Market risk includes market liquidity risk and foreign exchange risk. The market liquidity risk includes a price risk on assets for which the trading volume is low or non-existent (Bessis 2010, p.34). Illiquid assets have higher risk of being sold at a discount in the liquidation period. However, illiquid assets tend to be have a liquidity premium embedded in the original price, but the uncertainty of illiquidity when traded remains. Foreign exchange risk, including translation risk, denotes the losses on asset price from changes in exchange rates when sold or converted into a base reference currency (Bessis 2010, p.35).

2.4.3 Operational Risk

Operational risk is "*the risk of loss resulting from inadequate or failed internal processes, people and system or from external events*" (BCBS 2006, p.144). The events could relate to breakdowns in IT stability, acts of fraud, force majeure, terrorism etc. (Gregoriou 2009, p.4; Rose & Hudgins 2008, p.477). The events are considered to affect revenue, operating cost, and the share price at occurrence. BCBS has attempted to combine the risk of each event into one integrated risk measurement, referred to as operational risk.

2.4.4 Interest Rate Risk

Interest rate risk denotes the probability that fluctuating interest rates result in appreciation or depreciation in the asset value and return on asset (Rose & Hudgins 2008, p.477). A decrease in asset value occurs if the spread between the asset yield and the expected funding cost is reduced. In addition to potential losses, interest rate risk includes opportunity costs. Opportunity costs occur when the cost on a fixed-rate debt obligation exceeds the market cost of the same debt amount and risk profile. This may happen if the variable rate decreases. Banks that focus on fixed pricing in their price structure can

reduce the interest rate risk stemming from variable rate assets, but are still prone to the risk of opportunity cost.

2.4.5 Legal and Reputational Risk

Legal and reputational risk denote the risk that lawsuits, adverse adjudgment, and negative publicity affect profitability and liquidity of the bank (Koch & MacDonald 2003, p.126). In the past years, banks have been under the media's scrutiny of improper behavior as for instance in the '*Panama papers*' case in which some banks advised clients on the topic of tax evasion.

2.4.6 Systemic Risk

Systemic risk denotes the risk that a default by one financial institution will create a cascading effect that turn into significant losses or defaults by other financial institutions (Hull 2015, p.258). This implies that one bankruptcy can lead to multiple bankruptcies and instability in the financial system. From a market perception, systemic risk can be identified and measured by the asset-return correlation among banks and the spread on credit default swaps (CDS), which represents market price of insurance against the failure of individual institutions to meet their debt obligations (BIS 2008, p.6). During the financial crisis of 2007-2008, the CDS spreads increased approximately 60 basis points for European banks, equivalent of a relative increase of 600%, while the average asset-return correlation for European banks increased from approximately 20 to 70 (BIS 2008, p.6).

3 BCBS and Implementation of the Basel Accords

The previous chapter analyzed the business model of a bank to provide the basis for understanding how the Basel Accords affect banks. This chapter analyzes BCBS and the implementation process of the Basel Accords.

BCBS was established by the central bank governors of the G10 countries (Appendix 12.3) in 1974 as a response to the *Bankhaus Herstatt failure*[2] with the aim to enhance financial stability by improving the banking supervision quality across the globe (BIS 2017c). BCBS has grown its membership from the G10 countries to 45 members across 28 legal jurisdictions today (Appendix 12.4). Today, BCBS' mandate is to improve the regulation and supervision of banks by being a global standard setter for regulation and by providing a forum for its members on supervisory matters (BIS 2017c). BCBS has published a series of international standards for bank regulations since 1974, including the Concordat in 1975, Basel I in 1988, Basel II in 2004, and Basel III in 2009 (Barfield 2011).

The organizational structure of BCBS comprises the Committee, the Chairman, five expert groups, and the Secretariat (Figure 3). The Committee includes 45 members, representing central banks and authorities with formal responsibility for banking supervision in addition to two seats for ECB and EU (Mesnard et al. 2016, p.2; BIS 2017a). The Chairman of BCBS presides over all BCBS meetings. The five expert groups consist of the Policy Development Group (PDG), the Supervision and Implementation Group (SIG), the Basel Consulting Group (BCG), the Macroprudential Supervision Group (MSG), and the Accounting Experts Group (AEG). PDG develops policies that promote a sound banking system, SIG ensures timely and effective implementation of BCBS standards, BCG facilitates fora for banking supervisory issues, MSG monitors the development of the banking sector, and AEG provides and supports sound international accounting and auditing standards and practices in relation to risk management (BIS 2017b). Finally, the Secretariat, run by BIS, facilitates all administrative tasks. BCBS is headquartered at Bank for International Settlements (BIS) in Basel, Switzerland.

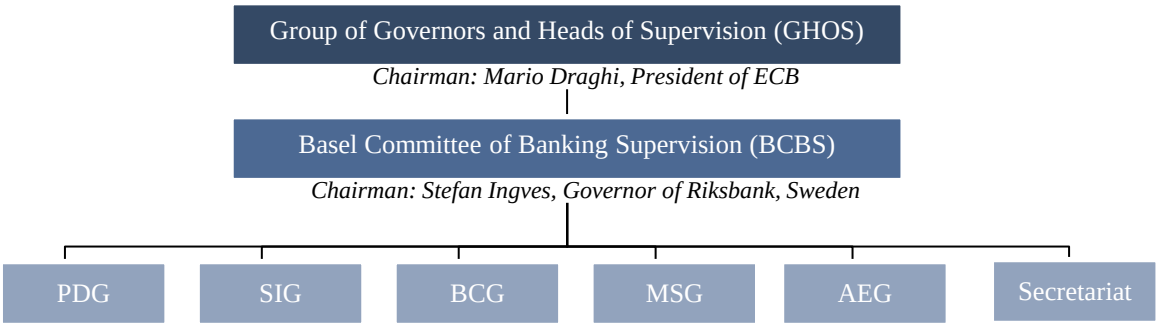


***Figure 3**: BCBS' organizational structure*
***Source**: Own creation based on information from (BIS 2017b)*

[2] The Bankhaus Herstatt failure entailed Herstatt bank's inability to deliver U.S. dollars to counterparties in process of liquidation, causing instability in the international currency markets (Kodres 1996).

BCBS reports to the Group of Governors and Heads of Supervision (GHOS). GHOS must approve all suggestions posed by BCBS, however the negotiation process between GHOS members can be long and complex as conflicts of interest may rise (European Parliament 2015b, p.19). GHOS consists of central bank governors and heads of supervision from BCBS' members. The members of GHOS are typically members of the G20 Finance Ministers, and the Financial Stability Board (FSB) (Barfield 2011, pp.5–6; Mesnard et al. 2016, p.2). The overlap between BCBS, GHOS, FSB, and G20 memberships implies that BCBS can be supported by multiple influential bodies.

BCBS does not possess any formal supranational authority (European Parliament 2015b, p.8). This implies that the Basel Accords are proposals. In EU, it is the European Parliament (EP) that transfers BCBS' proposals into EU law. The Basel Accords are transferred into the Capital Requirement Directives of EU. Finally, the EP directs the legislation to each BCBS member in EU. From here, the national parliament for each jurisdiction responsible for the implementation of the directives into the national banking system. Figure 4 provides an overview of the legislation process in EU.

***Figure 4**: BCBS' standard implementation process*
***Source**: Own creation based on information from (BIS 2016a; Finanstilsynet 2007)*

4 Basel I

This chapter analyzes Basel I with the purpose to gain understanding of the foundation of the regulatory capital requirements issued by BCBS and to understand the motives for Basel II.

4.1 Objectives

The underlying assumption for capital requirement regulations is that the private marketplace is unable to maintain financial stability without regulations, which is why regulatory capital requirements have changed considerably over the past last decades (Rose & Hudgins 2008, p.482; Mesnard et al. 2016).

This assumption is also the driver of Basel I. Basel I was introduced in 1988, and had three objectives. Firstly, to strengthen the stability of the international banking system by making sure that banks held sufficient capital to cover their risk in financially stressed periods. Secondly, to smooth competitive inequality among international banks by ensuring consistent application of regulatory standards. Finally, to improve transparency and comparability across banks (BCBS 1988; Mesnard et al. 2016).

BCBS aimed to reach these objectives by establishing a capital adequacy requirement under which banks are to hold capital equal to 8% of the risk-weighted assets[3] (Equation 2). The capital adequacy requirement is known as the *target standard ratio* (BCBS 1988, p.13). BCBS implemented the target standard ratio incrementally over a period of four and a half years, as the requirements entailed costly reconfiguration of balance sheet for some banks (Rose & Hudgins 2008, p.484).

$$\frac{\text{Qualifying capital}}{\text{Risk exposure amount}} \geq 8\% \qquad \textit{Equation 2}$$

To fully understand the capital adequacy framework of Basel I, it is necessary to examine both the numerator and the denominator of the target standard ratio. Therefore, the following sections analyze the constituents of qualifying capital, and the risk weights applied on assets and OBS exposures. Finally, section 4.4 analyzes the drawbacks of Basel I.

4.2 Qualifying Capital

Qualifying capital under Basel I is divided into two tiers, i.e. Tier 1 and Tier 2 capital (BCBS 1988). Tier 1 capital designates a bank's *core capital*, constituting broadly equity capital from issued and fully paid common stock and non-cumulative perpetual preferred stock, and disclosed reserves from post-tax retained earnings. For consolidated accounts, Tier 1 capital includes minority interest, and excludes goodwill. BCBS required that Tier 1 capital comprises at least 50% of a bank's total regulatory capital, equivalent of minimum 4% of the amount of risk-weighted assets (BCBS 1988, pp.3–4).

[3] Synonymous to risk exposure amount (REA)

Tier 2 capital designates a bank's *supplementary capital*, constituting undisclosed reserves from post-tax retained earnings, revaluation reserves, general loan-loss reserves on maximum 1.25% of risk-weighted assets, hybrid capital instruments, and subordinated term debt.

Despite BCBS admittedly recognizing the undisclosed reserve as the same intrinsic value as disclosed reserve, the capital category was excluded from Tier 1 to promote transparency (BCBS 1988, p.4). Revaluation reserves are equity reserves recognized at historic cost. If the market value exceed the book value, BCBS allowed for banks to recognize the difference between market value and book value contingent of an arbitrary discount factor of 55% (BCBS 1988, p.4). Hybrid debt capital instruments combine equity and debt capital, e.g. cumulative preference shares, perpetual subordinated (junior) debt, and mandatory convertible debt. The criteria for eligibility for these instruments are that instruments must be unsecured, subordinated and fully paid-up in addition to being loss-supporting and unredeemable without consent from supervisory authority (BCBS 1988, p.16). Finally, subordinated term debt includes conventional unsecured debt capital instruments with a maturity of minimum five years. BCBS applies a discount factor of 20% for each year of the last five years to maturity to reflect the diminishing value, and must be limited to maximum 50% of Tier 1 capital (BCBS 1988, p.16). Overall, Tier 2 capital must not exceed 100% of Tier 2 capital. Figure 5 shows an overview of the constituents of qualifying capital in addition to the restrictions to the target standard ratio.

Tier 1 capital	Tier 2 capital	Restrictions
• Fully paid common stock • Non-cumulative perpetual preferred stock • Published reserves from post-tax retained earnings • Minority interest	• Undisclosed reserves • Revaluation reserves (RR) • General loan-loss reserve (GLLR) • Hybrid capital instruments • Subordinated term debt (STD)	• $\frac{\text{Tier 1 + Tier 2}}{\text{REA}} \geq 8\%$ • $\frac{\text{Tier 1}}{\text{REA}} \geq 4\%$ • $\frac{\text{Tier 2}}{\text{Tier 1}} \leq 100\%$ • GLLR ≤ 1.25% of REA • RR= 55% * gains unrealized securities • STD ≤ 50% * Tier 1 capital

***Figure 5**: Overview of constituents of qualifying capital and restrictions in Basel I*
***Source**: Own creation based on information from (BCBS 1988)*

4.3 Risk Weights

For the denominator of the target standard ratio, BCBS introduces a risk weight system. The purpose of the risk weight system is to weigh the assets and OBS exposures of the bank according to the underlying credit risk of each asset class. Large risk weights imply risky assets, and large capital charge for the bank, and vice versa.

The risk weight system consists of five weights, i.e. 0%, 10%, 20%, 50%, and 100%. BCBS admits that the risk weight system includes broad-brush judgments, however argues that the simplicity of the

system enables cross-bank comparisons and eases implementation (BCBS 1988, p.8). The risk weight system is designed to solely reflect credit risk, despite various other risk types in banking as elaborated in section 2.4.

The 0%-weight applies to cash reserves, assets of counterparties with zero default risk, including claims on governments, central banks, banks within the organization of economic co-operation and development (OECD), and claims collateralized or guaranteed by such sovereign entities. The 10%-weight applies to commercial claims that are partially guaranteed by sovereign entities, and claims collateralized by cash. The 20%-weight applies to cash in process of collection, claims on banks and claims collateralized or guaranteed by banks with residual maturity of up to one year (BCBS 1988, p.18). The 50%-weight applies to mortgage-backed loans on residential property. Finally, the 100%-weight applies to claims on the corporate customers in the private sector and claims on non-OECD banks with residual maturity above one year, and all other assets (BCBS 1988, p.18). Figure 6 presents an overview of the risk weights.

Counterparties	**Sovereigns**	**Sovereigns** *(partially guaranteed)*	**Banks**	**Mortgages**	**Corporates**
Risk weight	0%	10%	20%	50%	100%

Figure 6: *Overview of risk weights and corresponding counterparties in Basel I*
Source*: Own creation inspired by and based on information from (BCBS 1988; Mesnard et al. 2016)*

As for risk assessment of OBS exposures, banks are to firstly use credit conversion factors (CCF) to calculate the credit equivalent amount (CEA), and then apply a risk weight on the CEA depending on the counterparty, maturity, and asset type as mentioned above (BCBS 1988, p.19). Figure 54 in Appendix 12.5 presents an overview of the CCFs and instruments.

As for calculating the CEA of derivatives, BCBS did not provide any specific guidelines in the original version of Basel I. However, amendments to Basel I were made in April 1998 in which CEA for derivatives is calculated in two different ways depending on whether the master agreement between the bank and the counterparty includes *bilateral netting* or not. Netting refers to a clause stating that if one party defaults on one the transaction with the counterparty, the party must default on all transactions (Hull 2015, pp.263–265). Appendix 12.6 shows the calculation of CEA for transactions with and without bilateral netting.

4.4 Drawbacks

This section elaborates on four main drawbacks of Basel I with the purpose of establishing an understanding for the creation of Basel II.

Firstly, the risk weight system only deals with credit risk (BCBS 1988, pp.8–9). Despite credit risk being the main risk type in banking, BCBS excludes other significant risk types such as market risk,

operational risk, interest rate risk, and liquidity risk. BCBS defines these risks as *investment risks*, but only states that banks should consider them (BCBS 1988, p.2).

Secondly, the risk weight system may be too simplistic. The credit risk for counterparties within the same risk weight category may vary significantly. For example, consider two different borrowers, each with a mortgage-backed loan on residential property with same maturity. One borrower has no job or education, and the other borrower is a highly-paid CEO in a profitable firm. The risk weight system assigns the same credit risk on the borrowers, when the probability of default may in fact be different. This incentivizes banks to hold assets with the highest risk-reward profile within each risk weight category to increase return on assets without decreasing the equity multiplier, and thereby increasing return on equity (Equation 1 in chapter 2).

Thirdly, Basel I lacked pro-cyclicality in the capital adequacy framework, meaning that the capital adequacy ratio of 8% may be sufficient in economic booms, but insufficient in economic contractions where credit risk may be higher.

Finally, Basel I was subject to arbitrary loopholes and large cliff effects that enabled banks to improve the regulatory capital adequacy. An example of regulatory arbitrage revolved around minority interests being categorized as Tier 1 capital (BCBS 1988, p.15). This enabled banks issue core capital by issuing notes out of a subsidiary that are less than wholly-owned (Barfield 2011, p.56). Another example of large cliff effects revolves around the risk weight gap on claims outside OECD countries. BCBS applies two different risk weights to claims on banks incorporated in nations outside the OECD depending on the residual maturity of the asset. If the residual maturity is above one year, the risk weight applied is 100%. If the residual maturity is below one year, the risk weight applied is 20% (BCBS 1988, pp.17–18). Thus, banks can increase their regulatory capital adequacy ratio by simply substituting the long-term claims with claims having a residual maturity below one year.

Moreover, Basel I include questionable categorizations of eligible capital. An example includes the categorization of revaluation reserves as Tier 2 capital. Revaluation reserves are in fact not be eligible as loss-absorbing capital. As mentioned in section 4.2, the revaluation reserves include unrealized gains on e.g. a premise as the asset is recorded as historic cost and not marked-to-market. If the reserves were to be used for absorbing financial losses, the underlying asset must be sold to realize the gain. However, in financial crises the realized gain may be reduced significantly, as liquidating premises in situations with financial distress typically includes large discounts (Barfield 2011, p.56).

5 Basel II

This chapter provides a comprehensive analysis of Basel II. Firstly, section 5.1 examines the objectives of Basel II. Secondly, section 5.2 analyzes the components of the minimum capital requirements under pillar 1. Thirdly, section 5.3 and 5.4 examine the proposed supervisory review process under pillar 2 and the disclosure requirements under pillar 3. Finally, section 5.5 analyzes the drawbacks of Basel II. The purpose of this chapter is to gain understanding of the ramifications in connection to the drawbacks of Basel I analyzed in the preceding chapter. The insights of Basel II play a key role in understanding the how the regulatory framework failed to prevent the financial crisis in 2007-2008.

Basel II was introduced in 2004. The framework of Basel II consist of three pillars. The first pillar primarily introduces changes to the criteria of qualifying capital, the introduction of capital charges for market and operational risk exposures, and new methodologies to compute the credit risk weights on assets. The second and third pillar focus on the adoption of stronger risk management practices by the entire banking sector through self-regulation and a set of disclosure requirements (Mesnard et al. 2016, p.3). Figure 7 shows an overview of the content of Basel II.

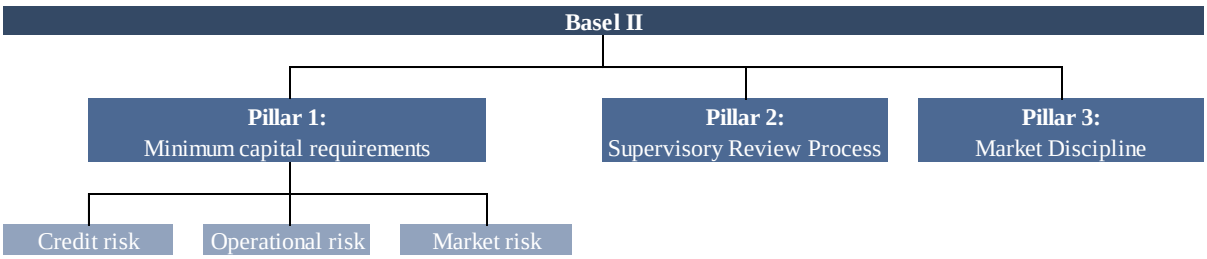


Figure 7: *Overview of the content of the Basel II*
Source*: Own creation based on the content of (BCBS 2006)*

5.1 Objectives

The opportunities to take advantages of the loopholes in Basel I incentivized banks to conduct regulatory capital arbitrage (Rose & Hudgins 2008, p.492). As mentioned in section 4.4, regulatory capital arbitrage allowed banks to increase profitability by reducing the amount of required capital. BCBS attempted to amend the drawbacks by publishing the Amendment in 1996. However, the Amendment was insufficient in amending all drawbacks, especially the drawbacks of assessing the credit risk based on five simple risk weights. Additional amendments were subsequently proposed, and the accumulation of proposed amendments led to the new framework of Basel II (BCBS 2006, pp.1–5).

Thus, the fundamental objective of Basel II is to further strengthen the stability of the banking sector simultaneously to ensuring the capital adequacy requirements did not create competitive inequality in the sector (BCBS 2006, p.2). The primary focus of Basel II is to ensure that the capital charge for an asset corresponds better with the actual risk exposure of that asset.

Each pillar of Basel II has an objective supporting the overall objective of Basel II. As for the first pillar, the objective is to reach a minimum capital adequacy level at 8% (Equation 3).

$$\frac{\text{Qualifying capital}}{\text{Risk exposure amount}} \geq 8\% \qquad \textit{Equation 3}$$

As for the second pillar, the objective is to encourage banks to improve the internal procedures for managing risk, monitoring risk exposure, and controlling risk exposure (BCBS 2004, pp.205–212). The objective of the third pillar is to encourage the banking sector to disclosure information on capital adequacy, risks, and risk management processes (BCBS 2004, p.226).

5.2 Pillar 1: Minimum Capital Requirement

This section analyzes what qualifies as eligible capital under Basel II, and the new methods to compute capital adequacy requirements for credit, operational, and market risk exposures.

5.2.1 Qualifying Capital

In comparison to Basel I, Basel II introduces two main changes to the constituents of qualifying capital (Barfield 2011, pp.54–55).

Firstly, Tier 3 capital is introduced. Tier 3 capital consists of short-term subordinated debt, and may be used at the discretion of the national authority by banks for the sole purpose of meeting the capital requirements. The main criteria for Tier 3 capital is that the subordinated debt is subject to a lock-in clause, which requires that payments of debt obligations are cancelled if the payments result in a capital adequacy level below the minimum requirement. Tier 3 capital is capped at 250% of bank's capital eligible to cover market risks (BCBS 2004, pp.16–17).

Secondly, changes to the deduction of goodwill is introduced. Under Basel II goodwill is deducted 50% from Tier 1 capital, and 50% from Tier 2 capital as opposed to 100% of total capital under Basel I. Thus, the relative demand for Tier 1 increases. Additionally, equity gains on sales on securitization exposures as excluded from Tier 1 capital (BCBS 2004, p.125).

Thirdly, Basel II allows for banks to hold subordinated term debt up to 50% of Tier 1 capital (BCBS 2006, p.14). Figure 8 shows an overview of the constituents of qualifying capital under Basel II.

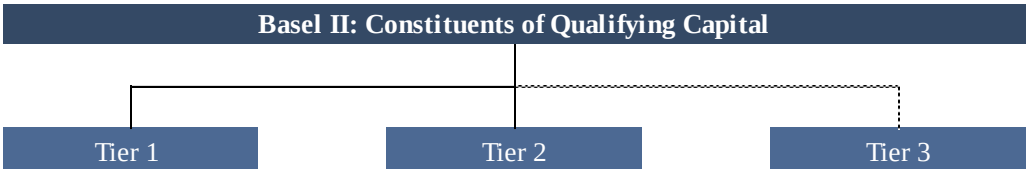


Figure 8: *The constituents of qualifying capital in Basel II*
Source*: Own creation based on information from (BCBS 2006)*

5.2.2 Capital Adequacy Requirement for Credit Risk

For the credit risk adjustment on assets and OBS exposures, Basel II allows for two methodologies that banks have the discretion of choosing between. The two methodologies are termed the Standardized Approach (SA), and the Internal Ratings-Based (IRB) Approach.

5.2.2.1 Standardized Approach

In the SA, capital charges are determined by a risk weight provided by BCBS, like in Basel I. However, in Basel II the risk weight is a function of the credit rating on the counterparty of the asset in addition to the type of counterparty (Figure 9). BCBS divides counterparties into five main categories, i.e. sovereigns, banks, and corporations, retail customers and mortgage claims for retail customers (BCBS 2006, pp.19–26). The category of banks is further subdivided into option 1 and option 2 at the discretion of the national authority. In option 1, banks within a country are assigned a risk weight one category less favorable than the risk weight assigned to sovereigns of the country (BCBS 2006, pp.21–22). In option 2, banks are assigned a risk weight based on the rating from a credit rating agency (CRA) officially recognized by the EBA. Furthermore, claims under option 2 with original maturities less than three months are given lower risk weights. High credit ratings imply low risk weight, thus low capital charges. The SA is used by banks that do not capacity to use the IRB Approach or banks that would not gain from conversion of credit risk computation methodology (Hull 2015, p.269). Figure 9 shows an overview of the risk weights for the SA. As for OBS exposures, the risk weight system of Basel I with CCFs is still valid (Figure 54 in Appendix 12.5).

Rating	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to BB-	B+ to B-	Below B-	Unrated
Sovereign	0%	20%	50%	100%	100%	150%	100%
Banks (Option 1)	20%	50%	100%	100%	100%	150%	100%
Banks (Option 2)	20%	50%	50%	100%	100%	150%	50%
Banks (Option 2 – Maturity < 3 months)	20%	20%	20%	50%	50%	150%	100%
Corporations	20%	50%	100%	100%	150%	150%	100%
Retail customers							75%
Retail customers (mortgage claims)							35%

Figure 9: Risk weights in the SA for credit risk capital Basel II
***Source**: Own creation based on information from (BCBS 2006)*

5.2.2.2 Internal Ratings-Based Approach

The IRB approach is an approach in which banks can use its own measures of PD, LGD, EAD, and effective maturity to calculate the capital charge of an asset or OBS item using formulas provided by BCBS (Equations 4-7). Unlike the Standardized Approach, the IRB approach is designed to ensure equal regulatory impact by providing the opportunity for banks to choose the risk management practices that suits the individual bank's operations. Therefore, the approach determines the risk exposure more accurately. Technically, the IRB approach grounds the capital charge on the value-at-risk (VaR) on an

exposure calculated using a one-year time horizon and a 99.9% confidence level and the expected loss on that exposure. Figure 10 illustrates with an example the concept behind the IRB approach.

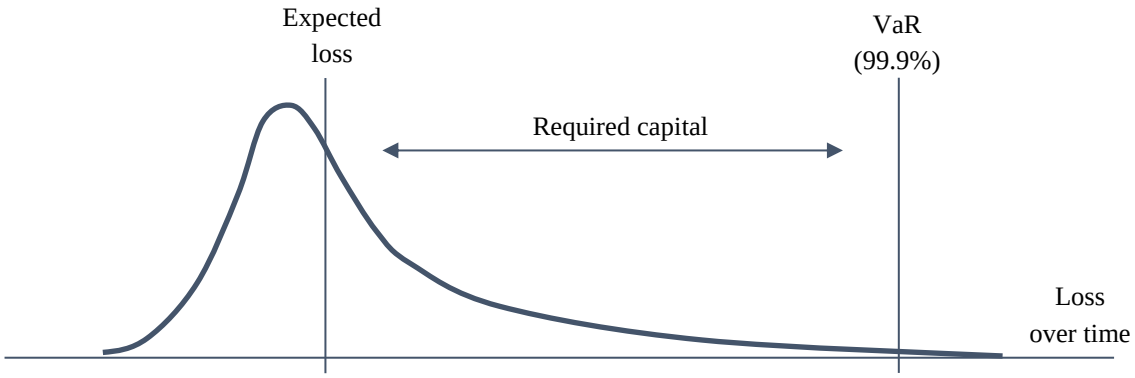


***Figure 10**: IRB Approach for credit risk capital: A loss probability distribution and capital charge*
***Source**: Own creation based on information from (BCBS 2006)*

The IRB approach contains different inputs depending on the nature of the counterparty. BCBS distinguishes between exposures on corporations, sovereigns, banks, residential mortgages, revolving credit lines for retail customers, and other times of retail exposure (BCBS 2006, pp.52–59). However, the capital charge for all exposures is expressed similarly using the following equation:

$$\sum_{i} EAD_i * LGD_i * (WCDR_i - PD_i) * MA_i \qquad \textit{Equation 4}$$

where WCDR denotes the worst-case default rate that we are 99.9% certain that will not be exceeded next year, and MA denotes maturity adjustment. WCDR runs a Gaussian copula model, which means that the VaR for an asset within a portfolio accounts for the probability of default for the other assets in the portfolio via the correlation coefficient, *R*. The portfolio consideration is an improvement to one of the Basel I drawbacks analyzed in section 4.4. The WCDR function is shown by the following equation:

$$WCDR = N\left[\frac{N^{-1}(PD) + \sqrt{R} * N^{-1}(0.999)}{\sqrt{1 - R}}\right] \qquad \textit{Equation 5}$$

The correlations coefficients are given in Figure 56 in Appendix 12.7. The maturity adjustment is designed by BCBS to increase the risk exposure for longer maturities given the following relation in which M denotes the residual maturity of the exposure:

$$MA = \frac{1 + (M - 2.5) * b}{1 - 1.5 * b} \qquad \textit{Equation 6}$$

where

$$b = [0.11852 - 0.05478 * ln(PD)]^2 \qquad \textit{Equation 7}$$

The risk exposure amount (REA) is calculated by multiplying a factor of 12.5, mathematically equivalent of a capital charge of 8%, with the capital requirement expressed in equation 4.

The IRB approach includes an extensive version referred to as the Advanced IRB (A-IRB) approach in which banks can be allowed to supply own estimates of all the above-mentioned components (summarized in Equation 4) instead of following the generic formulas provided by BCBS (BCBS 2006, p.52). To become eligible for the IRB or A-IRB approach, the bank must get approval from national authorities, and comply with minimum and disclosure requirements such as sound design of risk rating system, corporate governance structure, and validation of internal estimates (BCBS 2006, p.88).

5.2.2.3 Securitization Framework

In addition to capital adequacy requirements for credit risk exposures on assets, banks are also required to hold capital against the credit risk exposures under the securitizations of assets. BCBS requires that banks apply the securitization framework of Basel II in which banks can choose to follow a standardized approach or an IRB approach (BCBS 2006, p.120). Both traditional securitization and synthetic securitization of assets are subject to the capital requirements. Traditional securitization is a funding strategy in which banks repackage a pool of assets to create a security available to investors. Assets under traditional securitization typically involve mortgages, however any asset providing cash flows can be securitized. Synthetic securitization is a credit and/or capital hedge strategy in which banks buy credit protection on a portfolio of assets from investors, implying that the investor reimburses the bank for losses on the loans in the portfolio up to the amount invested. Under the standardized approach BCBS provides applicable risk weights shown in Figure 11, while the IRB approach involves the bank's own risk weighting system approved by national authority.

Rating	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to BB-	B+ and below or unrated
Risk Weight	20%	50%	100%	350%	Deduction

Figure 11: *Risk weights in the SA of the Securitization Framework for credit risk capital*
Source*: Own creation based on information from (BCBS 2006)*

5.2.3 Capital Adequacy Requirement for Market Risk

As mentioned in section 2.4.2, market risk denotes the risk of losses on assets and OBS items in the bank's trading book from market price volatility. The items subject to the capital requirement for market risk are interest related instruments and equities in the trading book in addition to foreign exchange and commodities (BCBS 2006, p.157). BCBS provides two options to compute the market risk, i.e. the Standardized Measurement Method, and the Internal Models Approach (BCBS 2006, pp.166–203).

5.2.3.1 The Standardized Measurement Method

The first method involves splitting market risk into two categories, *specific risk* and *general market risk* (BCBS 2006, p.166). The capital requirement for the specific risk is constructed to mitigate the risk of

losses from variables related to the issuer of the security. The capital charge for the specific risk is computed based on a standardized risk weight system designed by BCBS. The risk weight system components include credit ratings from EBA-recognized CRAs, residual maturity on the exposure, and the category of the counterparty. The risk weight ranges from 0.0% to 12.0% (BCBS 2006, p.167). A large risk weight implies high price sensitivity to specific risk factors; thus, a higher capital charge is required. The capital requirement for the general market risk is constructed to mitigate the risk of losses from changes in market interest rates. The capital charge is computed either based on the maturity or based on the duration[4] of the security in the trading book. In both methods, a risk weight applies to each category of maturity or duration, ranging from 0.0% to 12.5% (BCBS 2006, pp.170–171).

5.2.3.2 The Internal Models Approach

Like the IRB approach, the Internal Models Approach can be used by banks contingent of the approval of national authorities. The criteria are frequent and sound stress testing, sound corporate governance structure, and risk management practices. The Internal Models Approach is similar to the IRB models as capital charge is computed on the basis of a VaR estimate using a confidence interval of 99.9% (BCBS 2006, p.191).

5.2.4 Capital Adequacy Requirement for Operational Risk

As mention in section 2.4.3, operational risk denotes the risk of losses from internal failures. BCBS provides three options to estimate operational risk, i.e. the Basic Indicator Approach (BIA), the Standardized Approach (SA), and the Advanced Measurement Approach (AMA).

5.2.4.1 The Basic Indicator Approach

The capital charge under BIA is computed by multiplying an alpha-factor of 15% on the three-year average annual gross income, shown in Equation 8:

$$K_{BIA} = \frac{[\sum GI_{1..n} * \alpha]}{n} \qquad \textit{Equation 8}$$

BCBS defines gross income as the net interest income plus net non-interest income net of taxes. Only positive gross income and number of years in which income is positive are included in the computation (BCBS 2006, p.145), implying that gross losses on assets do not generate capital charge for operational risk. In contrary, a high level of gross income increases the capital charge for the operational risk.

5.2.4.2 The Standardized Approach

The capital charge under SA is computed by calculating the sum product of the gross income of eight business lines and the business line beta (BCBS 2006, pp.146–147). BCBS has defined the business

[4] Duration denotes the price sensitivity of changes in the interest rate

line categories and for each line assigned a beta factor that functions as a risk weight. The overview of beta factors is presented in Figure 12.

Business line	Beta factor
Corporate finance (β_1)	18%
Trading and sales (β_2)	18%
Retail banking (β_3)	12%
Commercial banking (β_4)	15%
Payment and settlement (β_5)	18%
Agency services (β_6)	15%
Asset management (β_7)	12%
Retail brokerage (β_8)	12%

Figure 12: *Beta factors under the SA for capital charges on operational risk exposures*
Source*: Own creation based on information from (BCBS 2006)*

5.2.4.3 The Advanced Measurement Approach

The capital charge under AMA is computed using internal models based on certain quantitative and qualitative requirements. The models must be approved by national authorities. The quantitative requirements involve a VaR based method with 99.9% confidence interval in additional to continuous data validation, scenario analyses and analyses of internal control factors, while the qualitative requirements involve a sound corporate governance structure and risk management system for operational risk, and sufficient resources for implementation in all business lines including control and audit functions (BCBS 2006, pp.147–156).

5.3 Pillar 2: Supervisory Review Process

The purpose of pillar 2 is to improve the supervisory review process by encouraging banks to follow four key guiding principles. The principles involve firstly having a process for determining capital adequacy. Secondly, banks should assess not only their capital adequacy level, but their monitoring processes as well. Thirdly, banks should aim for holding capital above the minimum requirement (Mesnard et al. 2016, p.3). Finally, banks should intervene in early stages of liquidity shortage to prevent capital to fall below the target standard ratio (BCBS 2006, pp.204–211; Hull 2015, p.278).

5.4 Pillar 3: Market Discipline

The purpose of pillar 3 is to improve the disclosure of banks' risk assessment procedures (Hull 2015, p.278). The disclosure requirements include quantitative and qualitative information on the bank's legal structure, capital structure, capital adequacy, structure of risk management functions, and risk exposures for credit, market, operational, and interest rate risk (BCBS 2006, pp.226–242).

5.5 Drawbacks

Even though Basel II provides significant improvements to Basel I, the accord is not perfect. This section elaborates on the five main drawbacks with the purpose of establishing a prior understanding of the financial crisis of 2007-2008 and the creation of Basel III.

Firstly, the inclusion of IRB and A-IRB approaches implies that banks can supply their own estimates of PD, LGD, and EAD. As mentioned in section 2.3.4, regulatory capital offsets profitability, inferring that shareholders and managers have the incentive to find opportunities to ease the capital requirements. This incentive may result in an underestimation of the risk exposures of the bank.

Secondly and in extension of the first drawback, the IRB and A-IRB approaches necessitate high competence levels at the supervisory units of the national authorities as each individual bank may try to circumvent the capital requirements (Rose & Hudgins 2008, p.496).

Thirdly, the computation for the capital charge on operational risk using the BIA or SA method builds on unrealistic assumptions. Under these methods, BCBS assumes positive a correlation between operational risk and gross income. This correlation is questionable. Operational risk mitigation could also be a source of higher gross income, implying a negative correlation.

Fourthly, the capital adequacy framework for market risk is inadequate as banks can decrease the capital charge by securitizing assets into securities with high credit ratings. The shift of exposures from the banking book to the trading book enabled banks to reduce the capital charge by relying solely at simple risk-weighting factors and external credit ratings. In connection, this implies that the securitization framework of Basel II may have relied excessively on the ratings from external CRAs. The excessive loophole for market risk transfer was the primary driver of the financial crisis in 2007-2008.

Finally, Basel II did not provide specific guidance on liquidity and solvency management. As the financial crisis started to occur, the need for liquidity increased. However, many banks had poor liquidity risk management practices, resulting in large discount on illiquid assets in absence of sufficient liquid assets.

6 The Financial Crisis of 2007-2008

This chapter analyzes of the financial crisis of 2007-2008. The purpose of the analysis is to illustrate the drawbacks of Basel II, and to understand the motives of Basel III.

It is important to note that the drawbacks of Basel II are not the only catalysts of the financial crisis of 2007-2008. The economic catalyst for the financial crisis of 2007-2008 was the U.S. housing bubble, also referred to as the subprime mortgage crisis (Baldvinsson et al. 2011, p.66). The housing bubble was driven by high economic growth with low volatility, low and stable inflation due to increasing globalization, lax credit policies, and low interest rates (Rangvid 2013, p.60). These factors led to a significant increase in housing prices and debt.

Another important catalyst of the financial crisis was the massive issuance of structured sub-prime mortgage bonds sold in the international capital market to a wide range of investors (Baldvinsson et al. 2011, p.66). Banks had huge risk exposures directly toward these structured financial instruments, and indirectly through guarantees.

Thus, the financial crisis of 2007-2008 was led by a series of economic and political factors, however exacerbated by financial factors in the banking sector caused by the regulatory inadequacy of Basel II. The following sections attempt to provide a thorough assessment of the catalysts of the crisis.

6.1 Low Interest Rates

Prior to the financial crisis of 2007-2008, the international macroeconomy was characterized as stable with a yearly GDP growth of 2-3% from 1980s (Rangvid 2013, p.61). The reasons for the economic stability were positive globalization effects and productivity-enhancing technologies. The increasing globalization implied increased imports from Asia, which resulted in increased focus to maintain low inflation, which in effect decreasing money market rates in Western countries (Figure 13).

***Figure 13**: 3-month money market rates from 1980 to 2012*
***Source**: (Rangvid 2013)*

The growing economy and low interest rates created large capital inflows to the equity capital markets. The large risk premia in equity capital markets, referred to as *irrational exuberance*[5], pushed the stock prices, especially IT stocks, which ultimately led to the dot com bubble in the late 1990s (Calverley 2009, p.57). At the burst of the bubble, the S&P 500 index declined more than 50% from 2000 to 2002, causing the U.S. Federal Reserve to cut the federal rate to 1% to combat a weak economy (Calverley 2009, p.68). Consequently, the mortgage rates decreased significantly (Figure 14 and 15).

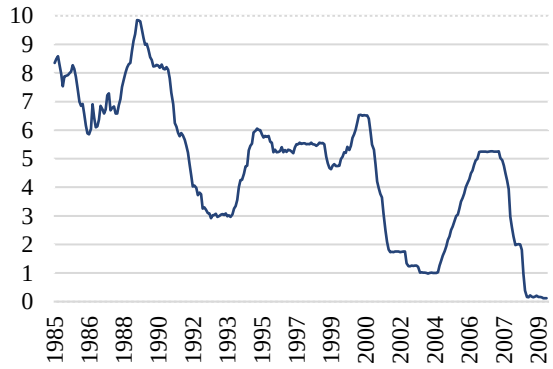


***Figure 14**: Effective Federal Funds Rate in U.S. (%)*
***Source**: Own creation with data from (FRED 2017)*

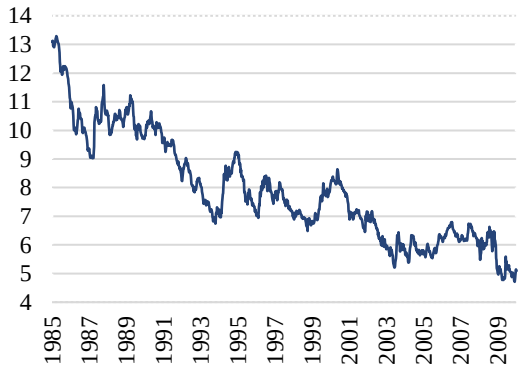


***Figure 15**: 30-year fixed mortgage rate in U.S. (%)*
***Source**: Own creation with data from (FRED 2017)*

The low interest rates increased the demand for housing, pushing housing prices upwards (Figure 17 in section 6.3). However, lax policies also contributed to the creation of the U.S. subprime mortgage crisis.

6.2 U.S. Government Subsidies

A second catalyst to the U.S. subprime mortgage crisis was the lax U.S. financial policies. The U.S. government subsidized the credit risk exposure in financing residential real estate (Calomiris 2008, pp.11–12). These subsidies resulted in a significant increase in subprime mortgages. Subprime mortgages are loans to borrowers with low credit rating and without transparent documentation of income (Federal Reserve Board 2008, p.1). Subprime borrowers are often referred to as NINJAs, implying that the individuals have no income, no job or assets (Brunnermeier 2008, p.1). Moreover, subprime mortgage loans are characterized by the loan-to-value (LTV) ratio being above 85%, implying that the property can be financed with little or no down payment (Baldvinsson et al. 2011, p.69). There were several ways in which the U.S. financial policies increased the credit growth. Firstly, mortgage interest expense was tax deductible. Secondly, the Federal Housing Agency accepted LTV levels up to 97%. Finally, government sponsored enterprises such as Fannie Mae and Freddie Mac[6] were forced to provide loans to subprime borrowers by purchasing risky mortgages from originating banks. In the end of 2003, 70% of mortgage debt were held or guaranteed by Fannie Mae and Freddie Mac (Calverley

[5] A term that Alan Greenspan used in 1996 to describe an investor's over-optimistic behavior toward stock price development during the dot com bubble.
[6] Fannie Mae and Freddie Mac are short for Federal National Mortgage Corporation and Federal Home Loan Mortgage Corporation, respectively. Both institutions were created by Congress to make mortgage loans affordable for subprime borrowers.

2009, p.104). The subsidies stimulated aggressive lending behavior among subprime borrowers, increasing the credit risk in the real estate market (Calomiris 2008, pp.11–12). Figure 16 shows the development of subprime mortgage debt relative to total mortgage debt.

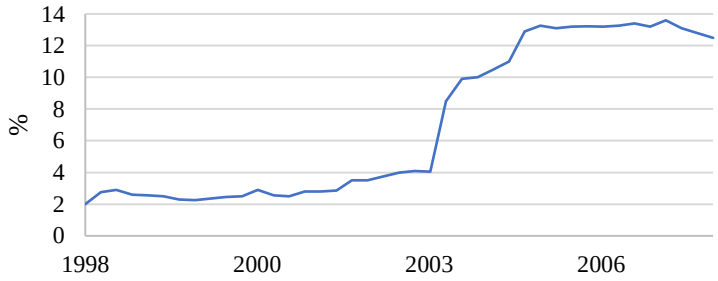


***Figure 16**: Subprime mortgage debt relative to total mortgage debt in US from 1998 to 2008*
***Source**: Own creation based on information from (Baldvinsson et al. 2011, p.70)*

6.3 Housing Prices

The low interest rates and lax governmental credit policies catalyzed the U.S housing prices. Figure 17 shows that the U.S. housing prices doubled in nominal terms from late 1990s to 2007.

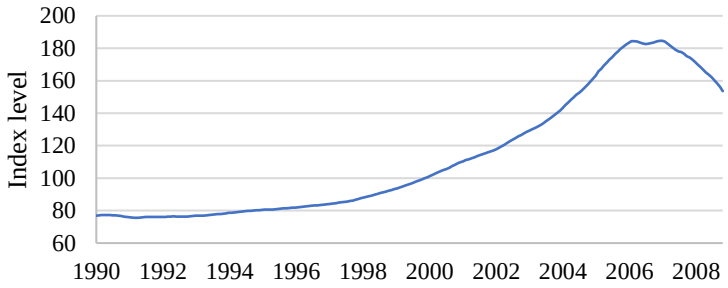


***Figure 17**: Index of U.S. real estate value from 1990 to 2008 (Index: January 2000)*
***Source**: Own creation based on data of S&P/Case-Shiller US National Home Price Index from (FRED 2017)*

Housing prices also increased internationally. As mentioned in section 6.1, the effect of globalization and the low interest rates generated a positive economic conjecture in U.S. as well as in Europe, resulting in increasing income levels and declining unemployment rate (Rangvid 2013, p.68). This resulted in the housing price development across nations in EU was positively correlated (Figure 18). The housing price increase affected the underlying economic growth through increased real estate investments and increased equity in existing mortgages translating into increased higher consumption levels. Especially Spain experienced an excessive construction rate from 1998 due to the Ley Del Suelo de España. Ley Del Suelo de España privatized state-owned land to promote growth through construction and cheap housing to the Spanish youth, however speculation and excessive subprime lending drove up the prices on the privatized real estates (Corrigan 2016).

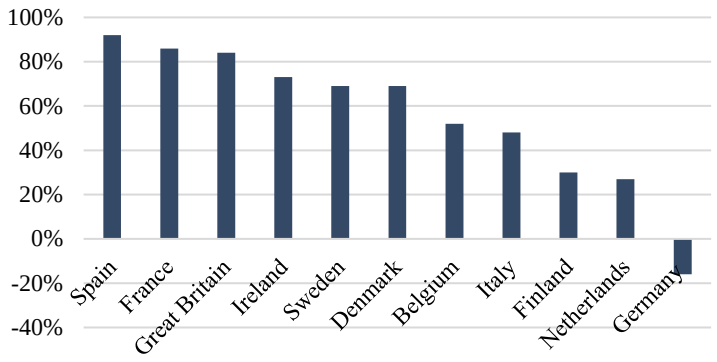


***Figure 18**: Real housing price development in selected European countries from 2000 to 2007*
***Source**: Own creation based on information from (Rangvid 2013, p.69)*

6.4 Securitization and Shadow Banking

In addition to the economic and political catalysts, the financial sector exacerbated the financial crisis by transferring risk exposures from the regulated banking system into a shadow banking system to minimize regulatory capital charges (Baldvinsson et al. 2011, p.66; Rangvid 2013, p.77).

According to the Financial Stability Board (2011 pp 1-3), a shadow banking system involves a system of credit intermediation outside the regular banking system in which prudential regulatory standards and supervisory oversight are not applied. The years up to the financial crisis of 2007-2008, the shadow banking system grew rapidly (Figure 19), driven by increased capital charges on the on-balance sheet activities of banks. By setting up special investment vehicles (SIV), banks conduit exposure from the balance sheet into the shadow banking system, thus, minimizing the capital charge on the on-balance exposures. Because the financial activities of SIVs were not accessible for the general public, regulators recognized SIVs as the same category as hedge fund, i.e. an entity of which regulators rely on the self-interest of sophisticated investors in relation to risk management (Sissoko 2009).

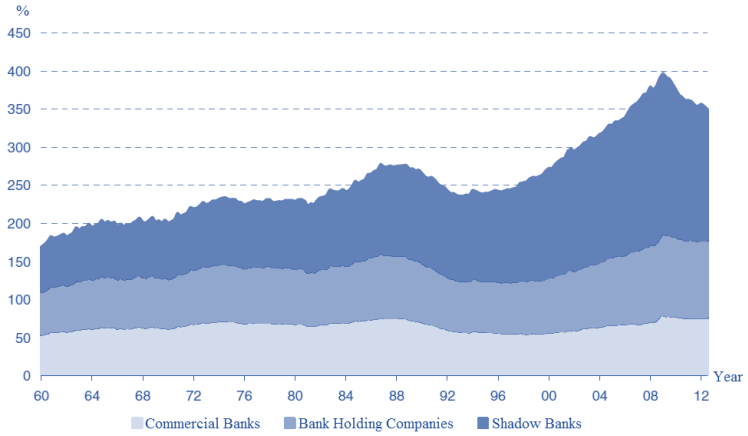


***Figure 19**: U.S. bank liabilities in percent of GDP: Increasing OBS exposure*
***Source**: Own creation based on information from (Rangvid 2013, p.77)*

Up to the financial crisis of 2007-2008, banks originated and distributed mortgage loans to the conduit (SIV) to move the exposure off the balance sheet, creating a new model for credit intermediation with the conduit as the central element. However, if the loan transferred from the sponsoring bank to the

conduit defaulted, the bank would lose creditability, and thereby lose the opportunity to place loans in other conduits[7] (Sissoko 2009). Therefore, banks started to transfer the mortgage loans to the conduit as an *implicit recourse sale*. An implicit recourse sale means that the bank guarantees for the cash flow of an asset to the SIV. While the accounting rules for a traditional recourse sale stated that the asset is not removed from the seller's balance sheet as the seller will take back the asset in case of counterparty default, the rules for an implicit recourse sale was unclear and allowed banks to remove the credit risk exposure from their balance sheet while still providing liquidity guarantees, i.e. a *liquidity put*, to the SIV in case of default (Sissoko 2009). Once the mortgage loans are distributed to the SIV, the process of securitization begins. The SIV pools the mortgage loans into portfolios of assets, decreasing the risk exposure significantly due to the diversification effect as explained in section 2.3.1. The portfolio of assets become debt obligation that serve as collateral for the structured asset-backed securities (ABS). There are various types of ABS. However, up to the financial crisis significant amounts of collateral debt obligations (CDO) and mortgage-backed securities (MBS) were issued (Figure 20).

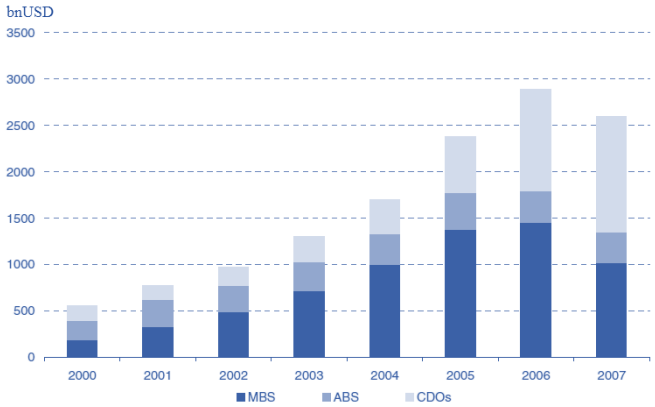
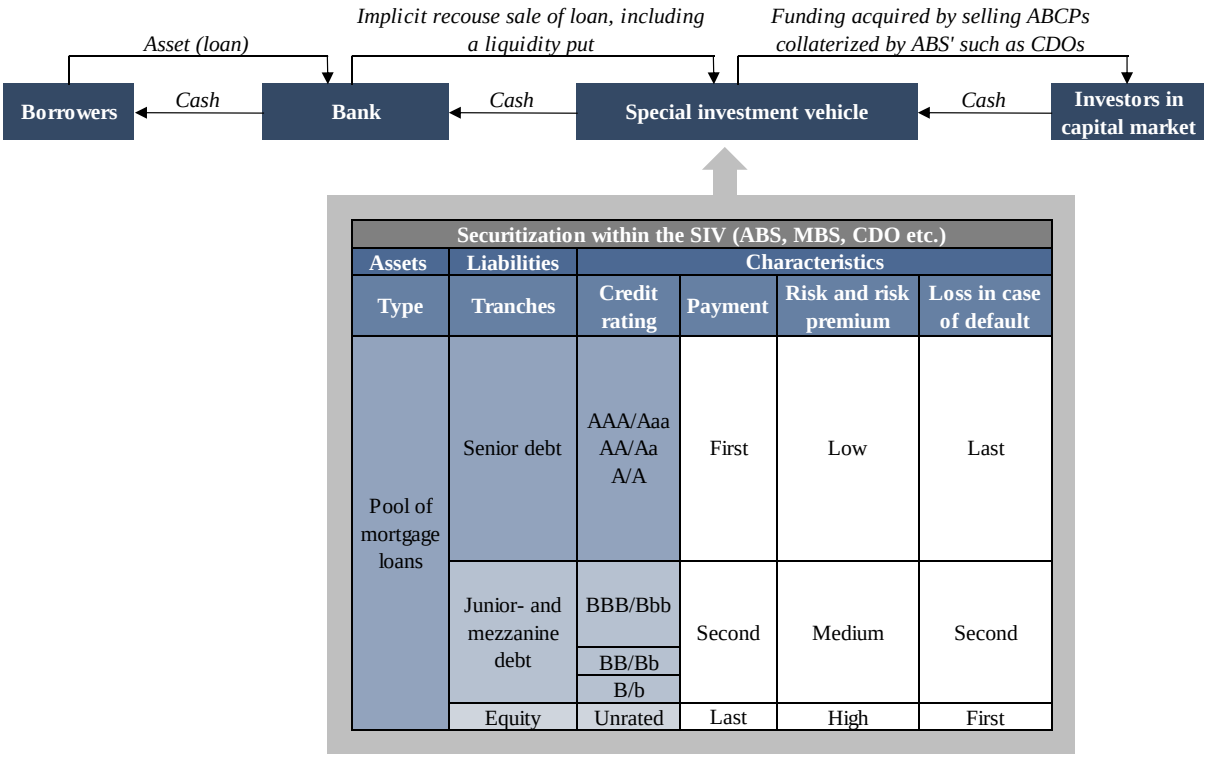


***Figure 20**: Issuance of structured credit obligations such as MBS, ABS, and CDOs*
***Source**: Own creation based on information from (Rangvid 2013, p.79)*

The SIV would split ABS into tranches with different risk and reward properties, and then sell the tranches to investors with according to the investor's risk preference. The safest tranche, senior debt obligations, receives payment before the other tranches, implying that the credit risk for investors on such asset is low. Consequently, the return is low. In contrary, the riskiest tranche, equity tranche, is impaired first if the underlying loans default, thus the credit risk is higher, and the return higher (Brunnermeier 2008, pp.3–4). The tranches were rated by external CRAs. The SIVs typically sell the ABSs by first securitizing them into asset-backed commercial papers (ABCPs). ABCPs is a short-term financial instrument. Thus, the payments on the loans from borrowers are redirected from the bank to the SIV, and further on to investors through the ABCPs. SIVs invest in the credit margin different between the asset yield and the cost of funding on ABCPs (Baldvinsson et al. 2011, p.71). Figure 21 shows the entire credit intermediation process using securitization in the shadow banking system.

[7] Conduits were designed so that multiple banks could transfer assets to the conduit.



Securitization within the SIV (ABS, MBS, CDO etc.)					
Assets	Liabilities	Characteristics			
Type	Tranches	Credit rating	Payment	Risk and risk premium	Loss in case of default
Pool of mortgage loans	Senior debt	AAA/Aaa AA/Aa A/A	First	Low	Last
	Junior- and mezzanine debt	BBB/Bbb	Second	Medium	Second
		BB/Bb			
		B/b			
	Equity	Unrated	Last	High	First

Figure 21: *The structure of securitization through a special investment vehicle*
Source*: Own creation*

Because ABCP had shorter maturity than the underlying financial assets, SIVs were subject to severe liquidity risk as their assets were funded with short-term debt in the wholesale capital market (Rangvid 2013, p.80).

6.5 The Collapse

In response to an accelerating inflation growth, the U.S. federal reserve and the Bank of England started tighten their monetary policies by increasing interest rates in the first half of 2004 (Calverley 2009, pp.68–70). Consequently, an increasing amount of the subprime mortgage loans with floating rates started to default (Figure 22).

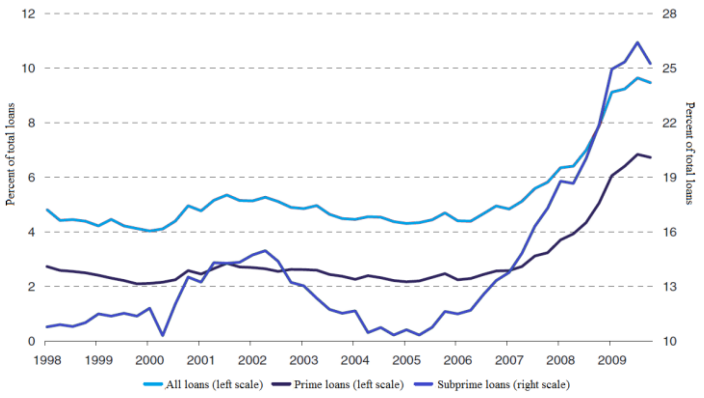


Figure 22*: Non-performing mortgage loans in U.S.*
Source*: Own creation based on (Rangvid 2013, p.85)*

The increase in non-performing loans led to delinquencies of MBS' and CDOs. Moreover, the CRAs started to give lower credit ratings to banks and SIVs (Brunnermeier 2008). The increased credit risk exposures meant that investors required higher risk premia on their investments on the structured financial assets issued by the SIVs, which led to significant increases in asset-spread (Figure 23).

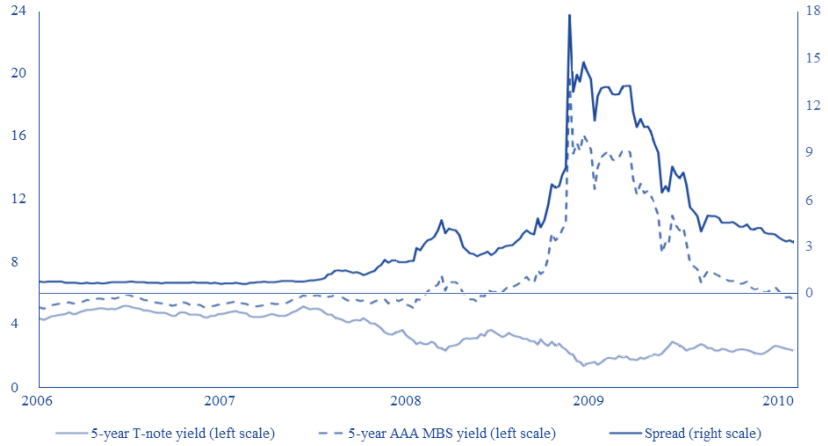


***Figure 23**: Asset spread between 5-year T-note and 5-year AAA MBS*
***Source**: (Guidolin & Tam 2010)*

The increasing amount of non-performing loans and increasing funding cost for SIVs resulted high liquidity risk for banks, and eventually significant losses on the MBS and CDOs. A series of loss announcements from large financial institutions followed. In medio 2007, two large hedge funds run by Bear Stearns announced a shut-down of the funds due to losses (Baldvinsson et al. 2011, p.74). Subsequently, IKB Deutsche Industriebank, the French bank BNP Paribas, and many other banks announced significant losses due to write-downs on their subprime investments. Mitigating actions were attempted during the period by ECB and the U.S. federal reserve. In august 2007, ECB injected €100 billion into the market as attempt to support the illiquid positions of many financial institutions. However, in fall 2007, the British bank Northern Rock defaulted follow by the Lehman Brothers' collapse in September 2008 (Baldvinsson et al. 2011, pp.71–76). The financial crisis spread systemically to the equity markets which experienced a plunge of more than 50% from medio 2007 to 2009 in both U.S. and EU (Rangvid 2013, p.90)

6.6 Regulatory Failures

Despite the economic and political catalysts for the financial crisis of 2007-2008, regulation on the banking sector was inadequately designed. The drawbacks of Basel II created several financial catalysts that exacerbated the crisis.

Firstly, Basel II relied on self-regulation which provided the opportunity for banks to make their own estimates of key risk measures through the IRB approach. Thus, banks may have been incentivized to find ways to lower capital charges, e.g. by using normal distribution for their VaR model as required instead of having fat tailed distribution and expected shortfall (ES) models. Moreover, the lack of capital

charge floors meant that banks could in theory become undercapitalized and remain compliant in relation the capital standards.

Secondly, SIVs were not under the same capital requirements as bank. This provided banks with the incentive to move exposures off the balance to minimize capital charges. Consequently, the risk exposures in the shadow banking system were not managed adequately.

Thirdly, the standardized approach in securitization framework allowed for a risk-weight of 20% on AAA/Aaa rated securities without regard for the actual credit risk on the counterparty of the underlying collateral. Because the framework relied excessively on credit ratings from CRAs, much of the responsibility of compliance toward capital standard were placed upon the CRAs. The financial innovation of structured products was not sufficiently transparent, which consequently meant that the CRAs underestimated the CDOs and MBS', and thereby providing over-optimistic credit ratings.

Fourthly, Basel II did not address liquidity risk explicitly. In the credit intermediation models of both the traditional banking system and the shadow banking system, there was a significant reliance on short-term funding, i.e. deposits and ABCPs respectively. In a systemic financial crisis, short-term funds are withdrawn or discontinued, resulting in an ability to rollover borrowings or continue to provide liquidity for borrowers. The illiquid assets are thus sold at large discount, implying significant losses. The lack of liquidity standards had severe systemic consequences.

Finally, the capital adequacy framework of Basel II did not accommodate the pro-cyclical nature of business cycles. In economic booms, the need for regulatory capital is lower due to lower credit risk. However, in economic recessions, the need for regulatory capital is higher as credit risk increases. With a relative static model for capital adequacy, capital adequacy in the banking sector will not follow the risk exposure developed driven by economic business cycles.

7 Basel III

The financial crisis of 2007-2008 proved the deficiencies of Basel II. Consequently, BCBS published Basel III in 2011 with the purpose to further improve the resilience in the banking system. Basel III builds upon the three pillars of Basel II. However, Basel III makes changes to the risk-based capital requirements, and introduces a non-risk based capital requirement in addition to two liquidity requirements. The non-risk based capital requirement is determined by the new leverage ratio (LR), and the liquidity requirements are determined by the new liquidity coverage ratio (LCR) and the new net stable funding ratio (NSFR). The subsequent sections analyze the capital and liquidity requirements of Basel III. The insights of this chapter provide the basis for compliance level analysis in chapter 8 and the recommendations in chapter 9.

7.1 Risk-based Capital Requirements

As for the risk-based capital requirements, Basel III introduces changes to the constituents of qualifying capital, two new capital buffers, and an additional capital charge for systematically important banks.

7.1.1 Qualifying Capital

The components of eligible capital consist of Tier 1 and Tier 2 capital (BCBS 2011b, p.12). Thus, Tier 3 capital from Basel II defined in chapter 5 is eliminated (Hull 2015, p.289). Moreover, Tier 1 is subdivided into Common Equity Tier 1 (CET1) and Additional Tier 1 (AT1). The purpose of the subdivision of Tier 1 capital is to eliminate the reliance of hybrid equity capital, which was eligible as Tier 1 capital in Basel II. As common equity and retained are the ultimate loss-absorbing type of capital, Basel III enables regulatory target setting for core capital (CET1).

CET1 consists mainly of common equity capital and retained earnings. However, other types of capital such as minority interest and CET1 capital held by subsidiaries also classify as CET1 capital under the fulfilment of certain criteria. BCBS poses 14 criteria for capital to be classified as CET1 (Appendix 12.8). An important criterium is that the capital represents the most subordinated claim.

AT1 consists mainly of hybrid equity instruments issued by the bank that fulfill 15 criteria set by BCBS (Appendix 12.9). Importantly, the instrument must be subordinate to general creditors of the bank, have a *bailout trigger*, and be perpetual. The bailout trigger implies that the instruments are converted to equity or written down in stressed periods, "*a trigger event*", so that the bank reduces the reliance of public rescue packages in event of default (BCBS 2011a). However, many of the instruments issued by banks are not perpetual, implying that most instruments fail to fulfill the fourth criterium (Barfield 2011, p.68).

Tier 2 capital is also subject to a set of criteria similar to the criteria for AT1 (Appendix 12.10). However, BCBS allows Tier 2 capital to have an original maturity of maximum five years. In addition, loan loss

provisions held against unidentified losses and freely available to meet losses qualify for inclusion in Tier 2 (BCBS 2011b, p.19). Tier 2 capital must also satisfy the criteria of bailout.

As for deduction of regulatory capital, Basel III requires banks to deduct the following from the amount of CET1 capital; goodwill, deferred tax assets, cash flow hedge reserves, shortfall of accrual provisions, equity increases from securitization transactions and fair value adjustments of liabilities, pension funds surpluses and investments in banks' own treasury stock (BCBS 2011b, pp.21–27).

The target standard ratio mentioned in section 5.1 has not changed from Basel II to Basel III, thus total eligible capital must be minimum 8.0% of REA. However, the minimum standards for the subcategories of eligible capital has changed. Basel II allowed for hybrid capital instruments to be 50% of Tier 1 capital, meaning that CET1 capital minimum standard under Basel II was effectively 2.0%. Basel III requires CET1 capital to be minimum 4.5% of REA, and total Tier 1 capital (including AT1) to be minimum 6.0% of REA. Figure 24 shows an overview of the minimum standards under Basel III in comparison to Basel II.

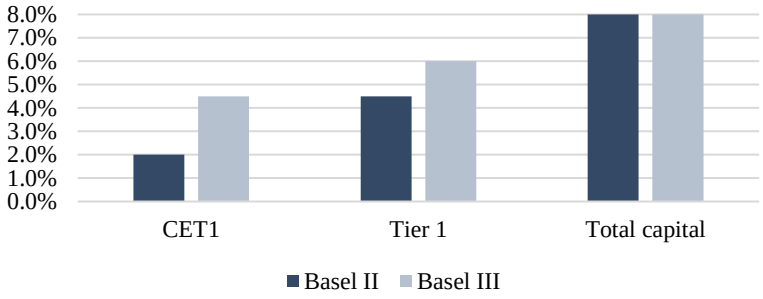


***Figure 24**: Minimum capital standards under Basel II and Basel III*
***Source**: Own creation*

7.1.2 Capital Buffers

In addition to the standard risk-based capital requirements, Basel III introduces two new capital buffers, i.e. the capital conservation buffer (CCB) and the countercyclical capital buffer (CCyB). The capital buffers aim to ensure liquidity cushions for stressed periods, thereby including pro-cyclicality in the capital framework. The capital charges related to CBB and CCyB are additional charges on top of the standard risk-based capital requirements. The following two sections analyze the two capital buffers.

7.1.2.1 Capital Conservation Buffer

CCB is designed to ensure that banks hold liquidity cushions in non-stressed periods. The buffer is to be drawn down in stressed periods, and rebuilt by reducing earnings dividends outside periods of stress (Hull 2015, p.291). In 2017, the capital charge related to CBB is 1.25% of REA, and will increase by 625 bps annually until reaching 2.5% in 2019. The capital eligible for the CCB is CET1 capital (BCBS 2011b, pp.54–57).

7.1.2.2 Countercyclical Buffer

The financial crisis of 2007-2008 proved that a downturn preceded by a period of excessive credit growth can lead to financial instability in the capital markets and the real economy. Economic recessions create vicious cycle in which the real economy and the capital markets affect each other negatively. CCyB aims to ensure that banks hold capital in conjunction with the macro-financial environment (BCBS 2011b, p.57). The implementation of CCyB is reserved to national authorities. BCBS advices national authorities to consider implementing the CCyB if the credit growth within a jurisdiction impose significant increase in systemic risk. National authorities are free to apply the capital charge related to CCyB on the exposure within their jurisdiction with a 12-month notice. The capital charge can be between zero and 2.5% of REA. The capital eligible for the CCyB is CET1 capital. As of primo March 2017, Sweden is the only nation with CCyB charge above 0.0% (BIS 2016b; Appendix 12.16). BCBS relies on the competence and judgement of national authorities, which can be criticized as nations can maintain a 0.0% CCyB charge to attract funds for stimulation of economic growth. Moreover, one can argue that BCBS places nations in a game theoretic situation in which the responsibility for mitigating systemic risk is passed on the neighbor country.

7.1.3 Global Systemically Important Banks

In addition to the minimum capital charges and the capital buffers, BCBS published a framework July 2013 in collaboration with FSB to assess and identify global systemically important banks (G-SIBs). G-SIBs are financial institutions whose financial failure negatively affects the financial system as well as the real economy, e.g. Lehman Brothers during the financial crisis of 2007-2008. The purpose of the framework is set higher loss absorbency requirements for G-SIBs by charging capital on top of the minimum requirements and the capital buffers (BCBS 2013b, pp.2–3). The methodology of the framework includes an indicator-based approach with twelve indicators that reflect the systemic importance of a bank. The indicators are bucketed into five broad categories, i.e. size, interconnectedness, lack of readily available substitutes, global activity, and complexity. (BCBS 2013b, pp.7–8). Figure 25 provides an overview of the content and the reasoning of why the indicators are used for identifying G-SIBs.

Category	Positive correlations
Size	Potential damage to financial markets and real economy ***vs*** balance sheet size
Interconnectedness	Systemic impact ***vs*** size of the network of contractual obligations
Substitutability	Systemic impact ***vs*** lack of substitutes for the bank's services
Global activity	Systemic impact ***vs*** number of jurisdictions that govern the bank's balance sheet due to costs and time for resolution
Complexity	Systemic impact ***vs*** the complexity of a bank's business, structural and operational functions due to costs and time for resolution

Figure 25*: FSB and BCBS' reasoning for the indicators in the G-SIB capital framework*
Source*: Own creation based on (BCBS 2013b)*

The indicators are weighed and computed into a total score, representing a bank's systemic importance. The scores range from one to five in which the capital charge of each bucket differs. The higher the score, the higher the systemic importance, and the higher the capital charge as shown in Figure 26. The capital eligible for the G-SIB capital charge is CET1 capital.

Bucket	Capital charge (CET1 in % of REA)
5	3.5
4	2.5
3	2.0
2	1.5
1	1.0

***Figure 26**: Capital charge for G-SIBs (CET1 in % of REA)*
***Source**: Own creation based on (BCBS 2013b)*

7.1.4 Implementation of Risk-based Capital Requirements

BCBS allows for a phase-in implementation for the risk-based capital requirements of Basel III. By primo 2019 the capital requirements are fully implemented. Figure 27 illustrates the decomposition of the capital charge for a G-SIB (bucket 4) bank with maximum CCyB charge as of primo 2019.

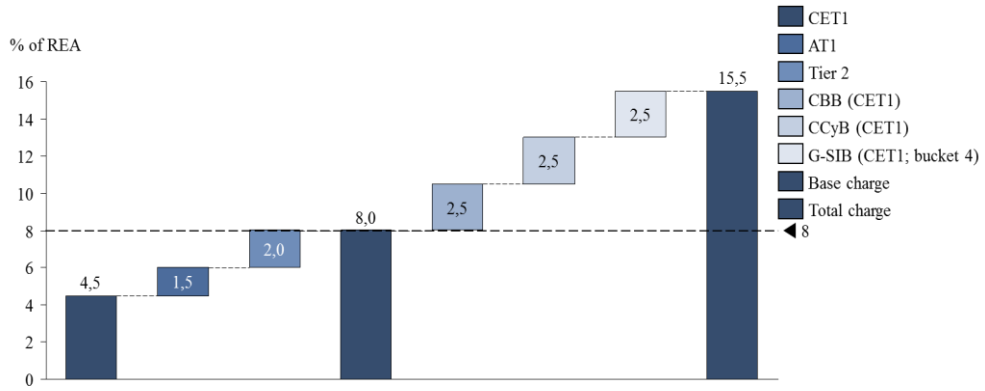


***Figure 27**: Capital charge decomposition for bucket 4 G-SIB per primo 2019*
***Source**: Own creation based on (BCBS 2011b; BCBS 2013b)*

The phase-in implementation is designed to provide banks the necessary time to be able to comply with the standards. For a bank with similar characteristics as described above, the capital charge increases 94% from 8.0% to 15.5% from the Basel II framework to the fully implemented Basel III framework in primo 2019 (Figure 28).

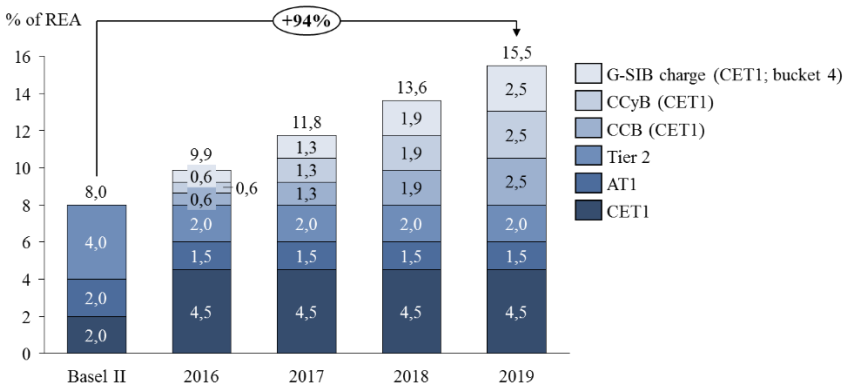


***Figure 28**: Capital charge development for bucket 4 bank (x-axis = primo anno)*
***Source**: Own creation based on (BCBS 2011b; BCBS 2013b)*

7.2 Risk Coverage

In addition to the raising the quality and quantity of the capital base, BCBS includes a section on risk coverage in Basel III to ensure that all material risks are captured in the capital framework (BCBS 2011b, p.29). In lieu of the financial crisis of 2007-2008, BCBS focuses primarily on risk embedded in securitizations, risk measuring in the trading book, and counterparty credit risk.

As for securitizations, BCBS requires that banks conduct more rigorous credit analyses of securitized assets rated by external CRAs. Thus, the securitization framework in Basel III has lower reliance on external ratings relatively to Basel II. In addition, in 2015 BCBS imposed a set of criteria known as the Simple, Transparent and Comparable criteria to promote simplicity of the securitization through heterogeneity of underlying assets, transparency to investors through sufficient information, and comparability through market disclosures (BCBS 2015b, p.3; Mesnard et al. 2016, pp.5–6).

As for risk measuring in the trading book, BCBS initially made changes to the VaR framework on risk measuring. BCBS introduced the a stressed VaR add-on to mitigate procyclicality. Stressed VaR uses the 10-day observation within a period of 250 days that shows the highest volatility. This has a flooring effect on capital requirements, as traditional VaR generates low VaR numbers and thus low capital requirements in periods with low volatility (Hull 2015, pp.289–290). Moreover, BCBS introduced an VaR based incremental risk charge (IRC) that would apply to default risk sensitive instruments on the trading book. Hence, IRC mitigates the regulatory arbitrage by transferring risk from banking book to trading book. However, in 2016 BCBS substituted the VaR framework with a measurement of the expected shortfall to be implemented in ultimo 2019 (Mesnard et al. 2016, p.5). ES does not assume normal probability distribution, but considers that the loss probability distribution for banks may have fat tails or other shapes. ES measures the expected loss conditional on the loss being greater than the X^{th} percentile of the loss distribution.

As for counterparty risk, BCBS introduced a credit valuation adjustment (CVA) risk framework (Mesnard et al. 2016, p.5). CVA is the difference between the risk-free portfolio and the portfolio value

adjusted for the default risk of the counterparty, thus CVA is equivalent of the market value of the counterparty credit risk (Barfield 2011, p.129). Therefore, CVA risk is the risk arising from a potential mark-to-market loss on a derivative for a bank due to a deterioration in a counterparty's creditworthiness. The primary aim of the framework is to ensure that all drivers of CVA risk are covered in the regulation in addition to provide consistency between the regulatory framework and accounting practices (BCBS 2015a, p.1). The framework includes multiple approaches to the computation of the capital requirement for CVA risk in which an IRB approach and a standardized approach are optional (Barfield 2011, p.129).

7.3 Leverage Ratio

As mentioned in chapter 6, the opportunity for regulatory arbitrage through creative securitization of assets prior to the financial crisis led to excessive leverage. As a response, BCBS introduces the LR. The LR acts as a supplementary requirement to the risk-based capital requirements, and aims to restrict excessive leverage (BCBS 2013c, p.1). Moreover, the LR aims to reduce model risk and measurement errors arising from IRB approaches to capital requirement computation (Barfield 2011, p.187).

BCBS refers to the LR as a non-risk based "backstop" measure, which effectively means that it provides a capital requirement independent of the underlying risk on the exposures. Instead, the capital charge is based on original exposure. The capital charges related to the LR is required on top of the risk-based capital requirements, capital buffers, and G-SIBs charges. The LR is expressed in Equation 9.

$$\text{Leverage ratio} = \frac{\text{Tier 1 capital}}{\text{Exposure measure}} \qquad \textit{Equation 9}$$

BCBS poses a minimum leverage ratio of 3% from primo 2018. Banks must meet the requirement with Tier 1 capital. The exposure measure is the sum of on-balance sheet exposure, derivative exposure, and OBS items. Netting, described in section 4.3, is not allowed (BCBS 2013c, p.2).

7.4 Liquidity Coverage Ratio

As explained in chapter 6, the financial crisis showed that stressed periods can result in systemic withdrawal of deposits. Banks with poor liquidity risk management systems during the crisis experienced excessive maturity mismatch between liabilities and assets. Moreover, banks that were unable to roll over their borrowings suffered from large impairment on their asset portfolio due to low market liquidity. As a response, BCBS introduces LCR. The ratio aims to promote short-term resilience of the liquidity risk of banks (BCBS 2013a, p.4). The ratio holds the sum of high quality liquid assets (HQLA) in the numerator, and total net cash outflows over the next 30 calendar days in the numerator (Equation 10). This implies that LCR ensures that banks have a 30-day liquidity buffer of liquid assets that are not prone to large impairments when liquidated. BCBS assumes that 30 calendar days are sufficient for banks to undertake remedial actions to mitigate immediate liquidity risk exposure. The

minimum requirement for LCR is set at 60% from primo 2015, and increases to 100% when fully implemented in primo 2019. The subsequent sections analyze the numerator and denominator of LCR.

$$\text{LCR} = \frac{\sum_{i=30} \text{HQLAs}}{\sum_{i=30} \text{Total net cash outflows over the next 30 calendar days}} \qquad \textit{Equation 10}$$

7.4.1 High Quality Liquid Assets

Assets eligible for the categorization of HQLA must firstly be unencumbered. This implies that there are no regulatory or contractual restrictions that prevent the bank from liquidating or transferring the asset (BCBS 2013a, p.7). Secondly, assets must not be held as collateral for other exposures. Thirdly, the monetization of the asset must be without significant impairment. Fourthly, the assets must have low legal, inflation, foreign exchange, and duration risk. Finally, the asset prices must be historically stable (BCBS 2013a, pp.7–12). BCBS divides HQLAs into two broad categories depending on the quality and liquidity of the assets. The categories are Level 1 and Level 2. Level 2 assets must not exceed 40% of total HQLAs. Level 2 includes two subcategories, i.e. Level 2A and Level 2B. Level 2B must not exceed 15% of total HQLAs. Each level comes with a haircut factor. The haircut factor denotes how much of the value of the asset can be included in the sum of HQLA. The larger the haircut factor, the lower the value can be used as regulatory short-term liquidity buffers in stressed periods. Figure 29 provides an overview of the asset categories and the haircut factors.

HQLAs	
Level 1 assets	**Haircut**
Coins and bank notes	0%
Marketable securities from sovereigns	
Central bank reserves	
Sovereign debt for non-0% risk-weighted sovereigns	
Level 2A assets	**Haircut**
Sovereigns qualifying for 20% risk weights on assets	15%
Corporate debt securities or covered bonds rated AA- or higher	
Level 2B assets	**Haircut**
MBS	25%
Corporate debt securities rated between A+ and BBB-	50%
Common equity shares	50%

Figure 29: *Categories of HQLA and corresponding haircut factors*
Source*: Own creation based on (BCBS 2013a)*

7.4.2 Total Net Cash Outflows

BCBS defines total net cash outflows as the total expected cash outflows net of total expected cash inflows in a time span of 30 successive calendar days (BCBS 2013a, p.20). BCBS has capped the total expected cash inflow to maximum 75% of total expected cash outflow to ensure that banks do not rely on cash inflows in stressed periods, but instead hold HQLAs as liquidity cushions. This implies that banks must hold a minimum amount of HQLAs equal to 25% of total cash outflows. The cash flows

are computed by applying a run-off factor defined by BCBS to each source of cash flow. The run-off factor on cash outflow reflects the stability of funding source. The stability of funding implies the expected amount of the exposure that will be drawn down in stressed periods. For example, term deposits with residual maturity greater than 30 days have a run-off factor of 0%, meaning banks do not need to hold HQLAs for that liability class. Demand deposits with residual maturity below 30 days have higher run-off factors, implying that BCBS expects that the depositors of such deposits are be more inclined to withdraw their funds. Thus, the higher the run-off factor, the lower the stability of funding and the higher the likelihood that the balance of that liability will be claimed by counterparties. Appendix 12.11 and 12.12 show the run-off rates on each asset and liability class.

7.5 Net Stable Funding Ratio

In addition to LCR, BCBS introduces NSFR as part of the liquidity framework. Whereas LCR aims to promote short-term liquidity by setting a minimum standard for liquidity within 30 days, NSFR aims to promote long-term stable sources of funding. Stable sources of funding reduce the funding risk of a bank, which in turn increases the probability of banks to uphold liquidity in yearlong periods despite liquidity shortage in capital markets (Roberto & Pierpaolo 2013, p.36). BCBS aims to reduce the reliance on unstable funding to prevent systemic bank runs and financial instability.

The ratio holds the sum of available stable funding (ASF) in the numerator, and the sum of required stable funding (RSF) in the denominator (Equation 11). This implies that the ratio measures the availability of stable funding relatively to the need of stable funding. Each asset, liability, and OBS item is assigned a factor to determine the amount of available stable funding or required stable funding. The factors are defined by BCBS. By primo 2018 banks must comply with a NSFR of 100% in any economic situation (BCBS 2010; BCBS 2014b).

$$\text{NSFR} = \frac{\sum \text{Available stable funding}}{\sum \text{Required stable funding}} \qquad \textit{Equation 11}$$

7.5.1 Available Stable Funding

The amount of available stable funding is determined by applying an ASF factor to all liabilities. BCBS defines the ASF factor based on the funding tenor, the funding type, and the counterparty. The ASF factor is multiplied with the carrying value of the liability, where carrying value represents the value recorded prior to regulatory adjustments (BCBS 2014b, pp.3–4).

BCBS divides funding sources into five broad categories with five different ASF factors, i.e. 100%, 95%, 90%, 50%, and 0%. The higher the ASF factor, the more stable the funding is. CET1, AT1, and Tier 2 capital in addition to term deposits and borrowings with residual maturities above one year are

eligible for a 100% ASF factor, mean that these funding sources are assumed to be stable in a longer time with financial stress.

The 95% ASF factor is assigned to stable demand deposits and term deposits with residual maturities below one year from small and medium enterprises (SMEs) and HHs, whereas the 90% ASF factor is assigned to unstable demand deposits and term deposits with residual maturities less than one year from SMEs and HHs. The difference between stable and unstable is that stable deposits are subject to deposit insurance schemes, whereas unstable deposits are not (BCBS 2013a, p.21). The amount of stable funding from demand deposits with a 95% ASF factor is only equal to the amount of funds covered by the insurance scheme[8].

The 50% ASF factor is assigned to deposits with residual maturities less than one year from non-financial corporate, sovereigns, and public sector entities in addition to funding from ABCPs and covered bonds held by central banks and financial institutions with residual maturities between six months and one year.

The 0% ASF factor is assigned to all other liabilities and equity without disclosed maturity. Appendix 12.13 provides an overview of all liabilities and equity capital with the corresponding ASF factor.

7.5.2 Required Stable Funding

The amount of required stable funding is determined by applying a RSF factor to all assets and OBS exposures. BCBS defines the RSF factor based on the asset type, asset tenor, asset marketability and propensity of asset roll over (BCBS 2014b, p.3).

BCBS divides assets into seven broad categories with five different RSF factors, i.e. 0%, 5%, 15%, 50%, 65%, 85%, and 100%. The 0% RSF factor is assigned to cash reserves and unencumbered loans with residual maturities less than six months, implying that the value of these assets are not at all likely to be impaired in stressed periods.

The 5% RSF factor is assigned to Level 1 assets, whereas the 15% RSF factor is assigned to Level 2A assets. The 50% RSF weight is assigned to Level 2B assets, including MBS' with credit rating of AA or higher. Moreover, HQLAs encumbered between six months and one year and all other loans with residual maturities less than one year receive a 50% RSF.

The 65% RSF factor is assigned to unencumbered residential mortgages with residual maturities less than one year and risk-weight less or equal to 35%. The 65% RSF factor on residential mortgages implies that there is a regulatory mismatch in the NSFR framework. The mismatch exists between the RSF factor of a residential mortgage and the ASF factor of a covered bond with same maturity. The

[8] For example Garantiformuen aka. Indskydergarantifonden in Denmark.

NSFR framework requires more stable funding for an asset than the asset-backed funding sources provides despite the same maturity.

The 85% RSF factor is assigned to unencumbered mortgages to corporates and non-mortgage loans to SMEs and HHs with residual maturities above one year. Finally, the 100% RSF factor is assigned to all unencumbered assets and OBS terms not classified as a HQLA, encumbered mortgages with residual maturities above one year, and derivatives (BCBS 2014b, pp.6–10). Appendix 12.14 provides an overview of all assets with the corresponding RSF factor.

7.6 Implementation of Minimum Standards

Figure 30 provides an overview of the levels and the phase-in implementation dates for the capital and liquidity requirements examined in section 7.1, 7.3, 7.4, and 7.5. By primo 2019 all requirements will be fully implemented.

Primo figures (% of REA)*	Minimum standards	2013	2014	2015	2016	2017	2018	2019
Capital	**CET1**	3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
	Tier 1	4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
	CCB				0.625%	1.25%	1.875%	2.5%
	CCYB				0.625%	1.25%	1.875%	2.5%
	G-SIB**				0.625%	1.25%	1.875%	2.5%
	Total CET1	3.5%	4.0%	4.5%	6.375%	8.25%	10.125%	12.0%
	Total capital	8.00%	8.00%	8.00%	9.875%	11.75%	13.625%	15.5%
	Leverage ratio***						3.0%	3.0%
Liquidity	**LCR**			60%	70%	80%	90%	100%
	NSFR****						100%	100%

Figure 30: *Implementation of minimum standards under Basel III*
Source*: Own creation based on (BCBS 2013a)*
**Leverage ratio is non-risk based, thus the ratio cannot be aggregated with the other measures*
*** Assuming a bucket 4 G-SIB*
****Leverage ratio will be migrated to pillar 1 as of primo 2018*
*****NSFR will be included as a minimum standard as of primo 2018*

8 Current Compliance Levels

This chapter analyzes the current compliance levels of the European banking in relation to the capital and liquidity requirements of Basel III, i.e. risk-based capital requirements, LR, LCR, and NSFR. However, the chapter firstly elucidates the data used in the analyses. The findings feed into the recommendations in chapter 9.

8.1 Data

The primary source of data used in the analysis is per medio 2016 and published by EBA in February 2017. Secondary sources of data used in the following sections are from BIS, EP and the Swedish central bank in addition to various corporations, institutions, and academic reports.

The EBA data is based on 164 banks in 17 EU member states (Appendix 12.15). The banks are divided into two broad categories, i.e. Group 1 and Group 2, based on size and international activity. Group 1 banks are internationally active and have more than €3 billion Tier 1 capital. Group 2 banks are subdivided into three clusters, i.e. Large, Medium, and Small. All clusters in Group 2 lack significant international activity, while the size-based grouping criteria vary from more than €3 billion, from €1.5 to €3 billion, and below €1.5 billion, respectively. There are 70 G-SIBs included in the sample (EBA 2017, pp.9–10).

The data of which the following analysis is based on is a significant representation of the European banking sector. Group 1 represents 94.1% of total REA for all banks with similar characteristics in the European Economic Area, while Group 2 represents 29.3% (EBA 2017, p.9). Furthermore, this means that that the analytical findings of this chapter are representative for the European banking sector.

8.2 Risk-Based Capital Requirements

This section analyzes the evolution of capital and REA from 2011 to medio 2016, the current capital ratios, and the capital shortfall of the European banking sector per medio 2016, respectively. Capital shortfall represents the amount of capital banks need to hold in addition to their existing capital holding to comply with the risk-based requirements.

From medio 2011 to medio 2016, CET1 ratios have increased from 6.5% to 12.6% for Group 1 banks, and from 6.9% to 13.5% for Group 2 banks, indicating that the European banks have initiated a capital build-up prior prematurely (Figure 31).

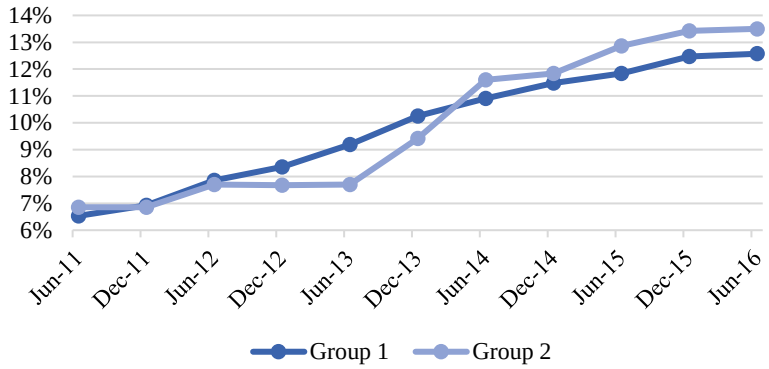


***Figure 31**: Evolution of CET1 ratios assuming full implementation capital requirements*
***Source**: Own creation based information from (EBA 2017)*

An increase in the CET1 ratio implies that either the CET1 capital holdings increase or that REA decreases. Figure 32 shows that CET1 holdings for Group 1 banks have increased more than 50%, while REA has decreased by 20% in the observation period. Thus, the main driver to the increase in CET1 ratio is the increase in CET1 holdings, of which retained earnings has increased the most, relatively (EBA 2016c, p.40). Figure 33 shows the REA development relative to total exposure, i.e. REA density. The declining REA density reflects lower risk weights on assets. This tendency has created a suspicion for "REA tweaking" among institutions[9], including the Swedish central bank who claims that the overall decrease in REA for large Swedish banks is mainly driven by the banks' influence on the estimates of PD, LGD, EAD, and maturity (Riksbank 2015, p.1). A study shows that the risk weight for inadequately capitalized banks decreases significantly upon IRB adoption (Mariathasan & Merrouche 2014). Yet, other studies show that the declining REA density is largely explained by changes to asset portfolio mix (Resti 2016, p.13). Nonetheless, the tendency implies that assets become less risky. This may increase the probability for additional regulation increases, e.g. floors in Basel IV or increased LR requirement.

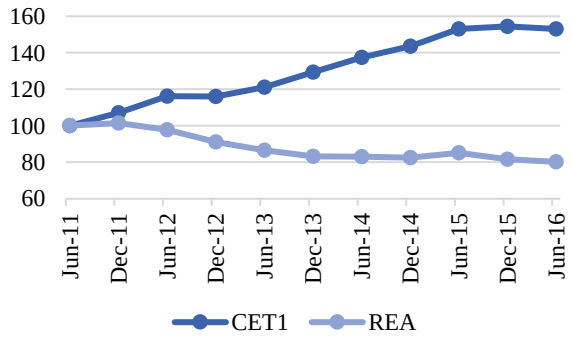


***Figure 32**: Index of the evolution of CET1 and REA for Group 1*
***Source**: Own creation based data from (EBA 2017)*

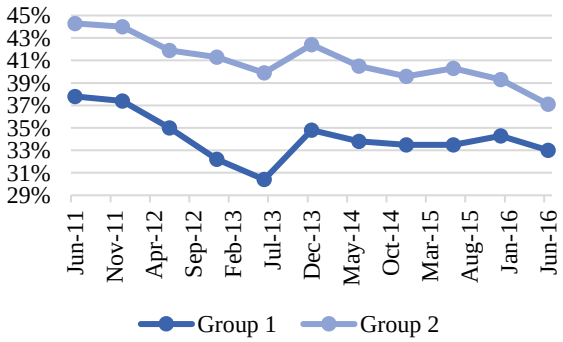


***Figure 33**: REA density evolution for European banks*
***Source**: Own creation based data from (EBA 2017)*

[9] Already in primo 2015, IRB exposure constituted almost 60% of total exposure in Europe (Resti 2016, p.10).

In summary, the increase in CET1 capital in addition to an overall decrease in REA result in higher CET1 capital ratios. Figure 34 illustrates the capital ratios for the European banking sector[10] per medio 2016. For all banks the CET1 ratio is 12.8%, Tier 1 ratio 13.5%, and the total capital ratio 16.1%. In terms of CET1, Group 2 banks are better capitalized than Group 1 banks and G-SIBs, while Group 1 banks and G-SIBs are better capitalized if AT1 and Tier 2 capital are also included. This implies that Group 1 banks and G-SIBs rely more on Tier 2 capital than Group 2 banks.

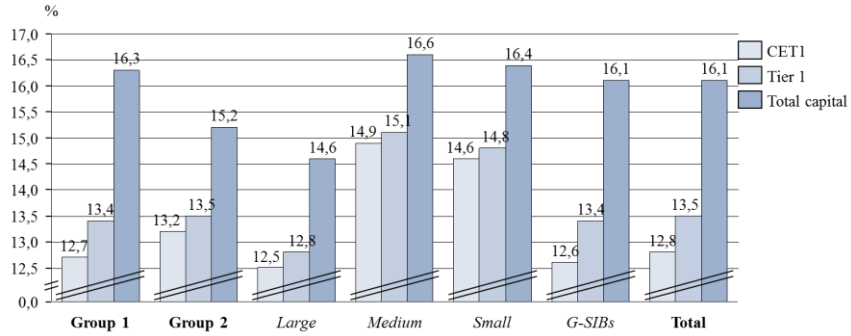
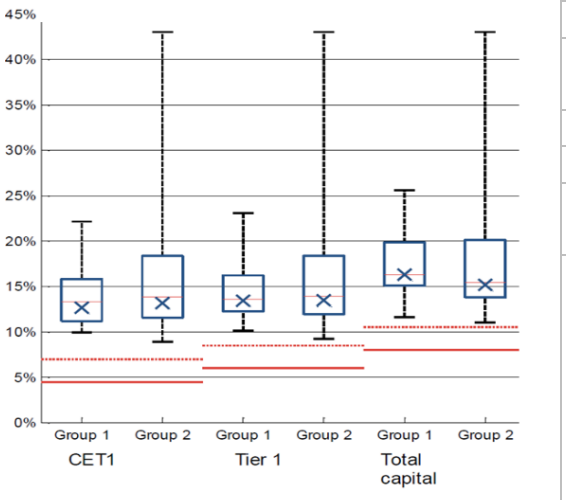


***Figure 34**: Current capital ratios (% of REA)*
***Source**: Own creation based information from (EBA 2017)*

As for the analysis of capital shortfall, it is assumed that the risk-based capital requirements are fully implemented. This implies that the capital shortfall is based on a total capital charge of 10.5%, the total base capital charge of 8% plus the CCB capital charge of 2.5%. Moreover, individual G-SIB capital charges are included. However, the CCyB capital charge is excluded, which is a limitation to the analysis. Given these requirement levels, approximately 95% of banks comply (Figure 35). However, due to the exclusion of the CCyB capital charge, the compliance level of the risk-based capital requirements may be slightly overstated. The CCyB capital charge is 0.0% in 21 of 27 jurisdictions, inferring that the effect of the limitation is rather small (Appendix 12.16)



Box plot	Explanation
Thick red line	Minimum requirement
Dashed line	Minimum requirement plus CCB
Thin red line	Median value
X	Mean
Blue box	25th and 75th percentile values
Black whiskers (vertical)	5th and 95th percentile values

***Figure 35**: Box plot statistics of capital ratios*
***Source**: (EBA 2017)*

[10] Represented by the 164 banks in the EBA report

Currently, the total capital shortfall comprises €2.1 billion. Figure 36 shows that no banking group is short of CET1 capital, and that majority of the shortfall is held by Group 1 banks or G-SIBs. As mentioned previously, it should be noted the fact that capital charge related to CCyB is excluded.

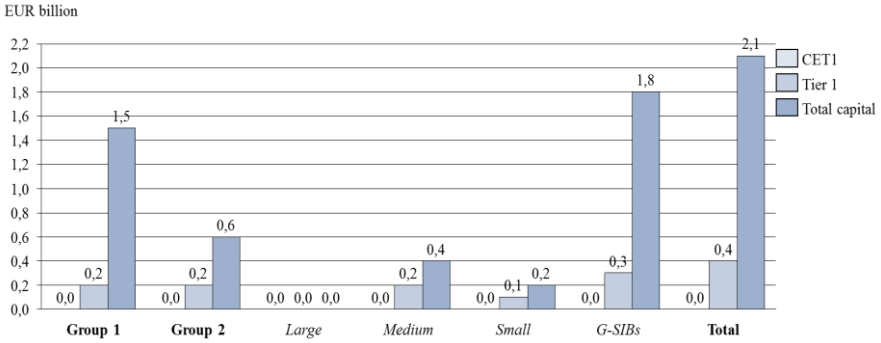


***Figure 36**: Capital shortfall per medio 2016 in relation to the risk-based capital requirements*
***Source**: Own creation based information from (EBA 2017)*

8.3 Leverage Ratio

This section analyzes the evolution of LR from medio 2011 to medio 2016, the capital shortfall per medio 2016, and the implications of the LR requirement for the European banking sector.

Figure 37 shows the LR development for Group 1 and Group 2 banks. Since ultimo 2013 both banking groups have on average been compliant with the LR requirement of minimum 3%.

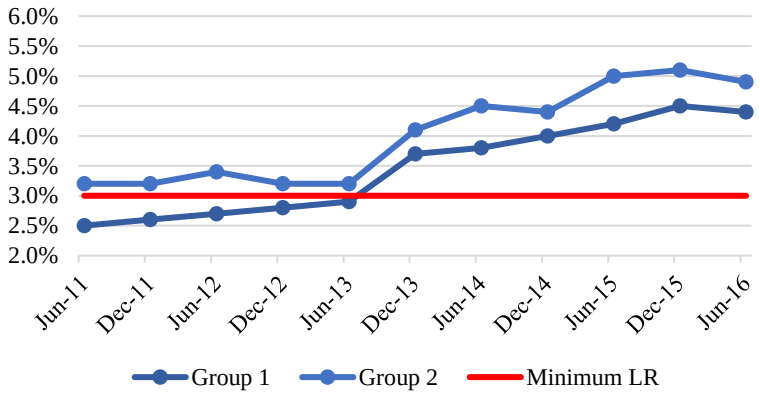


***Figure 37**: Leverage ratio evolution in the European banking sector*
***Source**: Own creation based on information from (EBA 2017)*

The main driver for the increase in LR is increased Tier 1 capital. Figure 32 in section 8.2 shows that REA drops from index 100 to 80 from medio 2011 to medio 2016 for Group 1, while Figure 33 shows that the REA density for Group 1 decreases from 44.3% to 37.1%. This implies that total exposure has decreased 4.5% from index 100 to index 95.5 for the sample of banks in the same period (See Equations 12-15 in Appendix 12.1). Thus, the main driver of the increase in leverage ratio is the 50% increase in CET1 capital as indicated in Figure 32.

Even though the European banking sector on average has a LR above 3%, some banks do not comply. The descriptive statistics in Appendix 12.19 show that the 95th quartile of all observations is below the 3% threshold, meaning that approx. 5% of all banks are still not complying with the LR requirement. These banks are short for a total of €3.0 billion Tier 1 capital as illustrated in Figure 38. Most of the capital shortfall lies with Medium and Small Group 2 banks. All Group 1 banks are compliant.

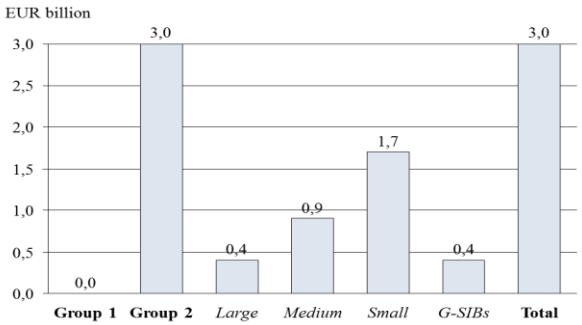


***Figure 38**: Capital shortfall per medio 2016 in relation to LR requirement of 3%*
***Source**: Own creation based on information from (EBA 2017)*

The LR requirement affects banks differently. LR prescribes a capital charge based on exposure rather than REA, which implies that low risk assets are charged the same as high risk assets. Therefore, the LR significantly affects banks with large exposures toward assets with low risk and low return such as sovereign claims[11]. The largest proportions of sovereign exposures are found with the Belgian, German, Luxembourgian, and Italian banking system (Schäfer et al. 2016). Despite the disadvantage for e.g. Belgian and German banks' high proportion of low-risk exposures, the Belgian banking system reached an average LR of 5.2% ultimo 2015, and is projected to reach 6.2% in 2019 (KPMG 2016), while 75% of the German banks reached a LR of above 6.7% in 2015 (Deutsche Bundesbank 2016). The non-risk property of LR creates an incentive for banks to seek out assets with higher credit risk.

8.4 Liquidity Coverage Ratio

This section analyzes the evolution of LCR and its components from medio 2011 to medio 2016 in addition to the LCR shortfall per medio 2016.

Figure 39 shows the LCR evolution for Group 1 and Group 2 banks. Group 2 banks reached the LCR requirement[12] in ultimo 2011, while Group 1 reach the LCR requirement in ultimo 2012. As per ultimo 2016, the LCR is on average 127% in Group 1 and 164% in Group 2.

[11] Sovereign exposure bears operational and market risk just like e.g. corporate exposures.
[12] Assuming full implementation, i.e. LCR ≥ 100%.

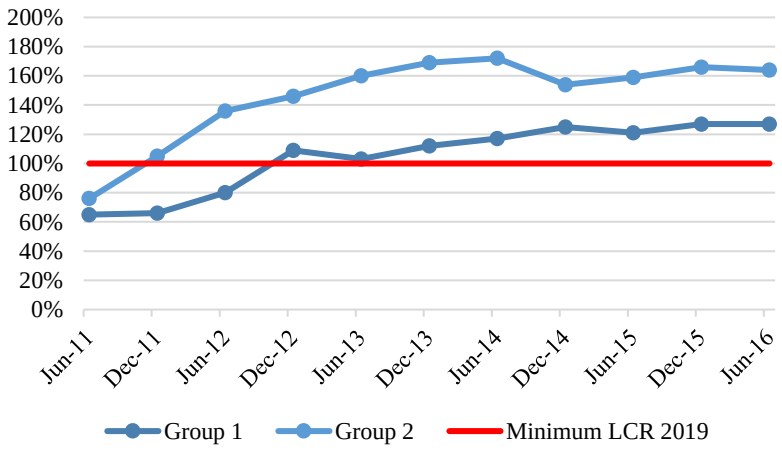


***Figure 39**: LCR evolution in the European banking sector*
***Source**: Own creation based on information from (EBA 2017)*

As mentioned in section 7.4, the three drivers of LCR are unencumbered HQLAs, cash outflows, and cash inflows. The main driver for the increase in LCR has been an increase in HQLAs, and the primary driver of the increase in HQLAs is the increase in level 1 assets, especially cash and central bank reserves (Figure 40). Cash and central bank reserves have increased 120% from medio 2011 to medio 2016, while the amount of Level 1 securities has increased 81%. Notably, we see Level 2A, hereunder sovereigns qualifying for 20% risk weights, corporate debt securities, and covered bonds with AA- rating or higher, decreasing 38%, while Level 2B assets have increased 7% from medio 2011. As for the denominator of LCR, the net cash outflows for European banks have been steady at the same level from 2011 to 2016 (EBA 2016d, p.36; EBA 2017, p.29).

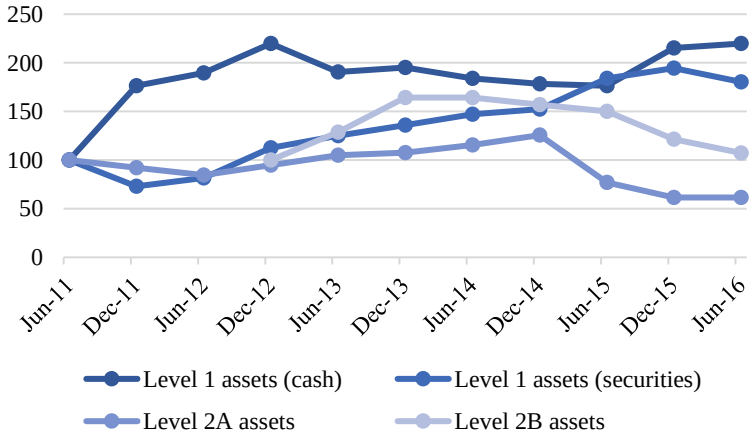


***Figure 40**: Evolution of all HQLA components in the European banking sector*
***Source**: Own creation based on information from (EBA 2017)*

Despite the high LCR levels on average, 7% of the Group 1 banks have a LCR between 70% and 100%, and less than 1 % of the Group 2 banks have a LCR below 100% (EBA 2017, p.31). However, considering that the 100% LCR requirement is due per 2019, the overall compliance level is rather

satisfactory. For the non-compliant banks the total LCR shortfall comprise €2.6 billion of which 85% of the shortfall is allocated at Group 1 banks (Figure 41).

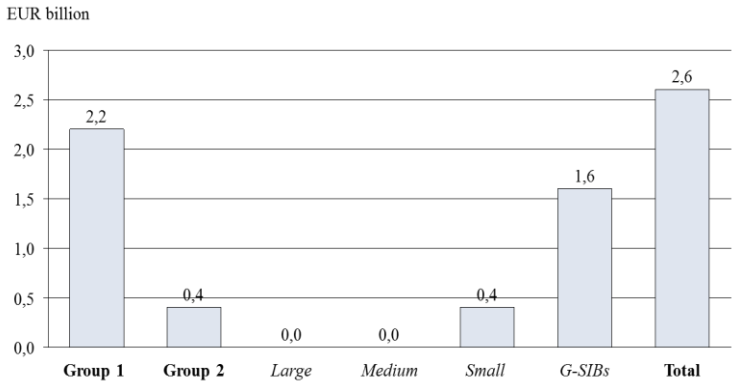


***Figure 41**: LCR shortfall per medio 2016 in the European banking sector*
***Source**: Own creation based on information from (EBA 2017)*

8.5 Net Stable Funding Ratio

This section analyzes the evolution of NSFR from medio 2011 to medio 2016 in addition to the NSFR shortfall per medio 2016.

Figure 42 shows the NSFR development for Group 1 and Group 2 banks. Group 2 banks reached on average the NSFR requirement[13] in medio 2012, while Group 1 reached the NSFR requirement in ultimo 2013. As per medio 2016, the NSFR are 107% in Group 1 and 114% in Group 2.

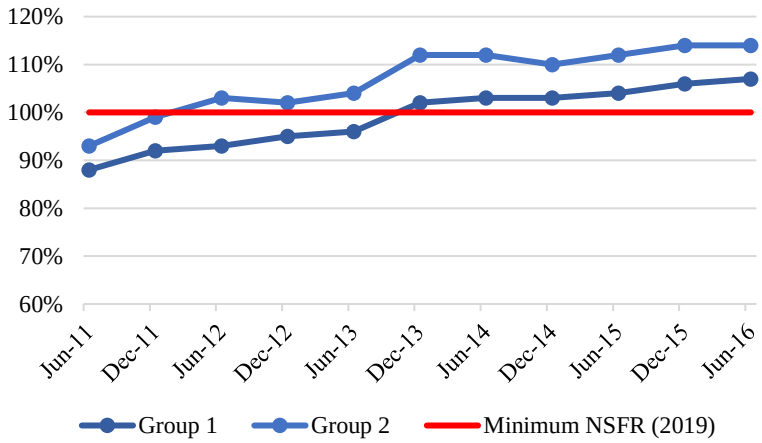


***Figure 42**: NSFR development in the European banking sector*
***Source**: Own creation based on information from (EBA 2017)*

As mentioned in section 7.5, there are two drivers of NSFR, i.e. ASF and RSF. The main driver for the increase in NSFR for Group 1 banks have mainly been an increase in ASF, meaning that more changes have been made to liabilities relative to assets. However, for Group 2 bank, NSFR compliance has been driven been a decrease in RSF, implying more changes to assets relative to liabilities (EBA 2016a, p.39).

[13] Assuming full implementation, i.e. NSFR ≥ 100%.

The NSFR level in medio 2016 means that the longer-term solvency of the European banking sector in on average stable. However, a rather large number of banks are not yet compliant[14] (Appendix 12.20). In Group 1, 3% of the banks have a NSFR below 85%, while 30% have a NSFR between 85% and 100%, leaving 67% of the banks with a NSFR above 100% (Figure 43). For Group 2 banks, 89% have a NSFR above 100%, while the rest have a NSFR between 85% and 100% (Figure 44).

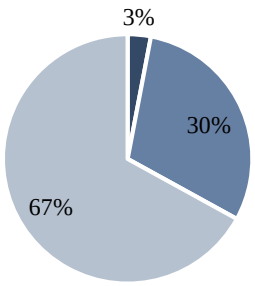


***Figure 43**: Composition of NSFR levels for Group 1*
***Source**: Own creation based on (EBA 2017)*

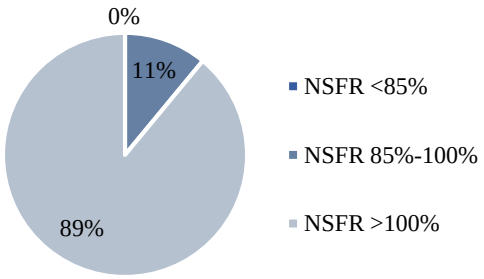


***Figure 44**: Composition of NSFR levels for Group 2*
***Source**: Own creation based on (EBA 2017)*

The total shortfall aggregates to €159 billion per medio 2016 of which 83% is allocated to Group 1 banks (Figure 45). The overall shortfall is equivalent of 4% of the total ASF[15] or 1.7% of total assets[16] (EBA 2017, p.33).

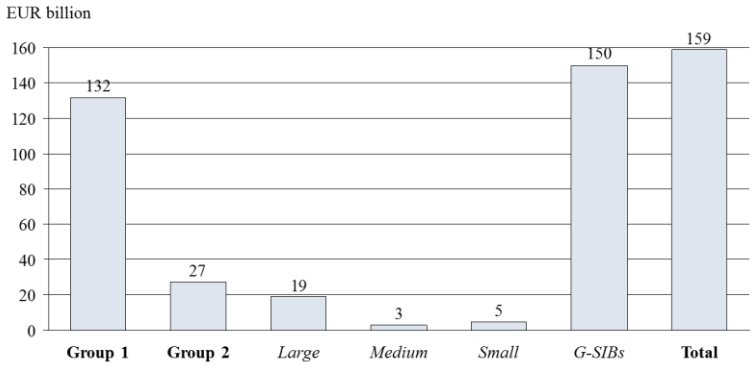


***Figure 45**: NSFR shortfall as per medio 2016 in the European banking sector*
***Source**: Own creation based on information from (EBA 2017)*

The NSFR requirements affect banks differently depending on the balance sheet components of the bank. Especially mortgage banks experience a great impact from the NSFR requirements as they rely on funding from covered bonds collateralized against a pool mortgage loans. In the NSFR framework, a mortgage loan with residual maturity above one year and funded by covered bonds receives a RSF factor of 100%. However, if mortgage loans are funded by senior unsecured bonds, the same mortgage loan is assigned a RSF factor of 65%, making covered bonds funding disadvantageous to unsecured

[14] Assuming full implementation, i.e. NSFR ≥ 100%.
[15] Total available stable funding comprises €4.0 trillion.
[16] Total assets comprise €9.1 trillion.

bonds (Appendix 12.14). The difference stems from the fact that BCBS defines mortgage loans as encumbered if the loans are used in an asset pool as collateral for issued covered bond, up to the exposure of the outstanding covered bonds, but unencumbered if the mortgage loan is not included in such pool.

Figure 46 shows that Denmark, Spain, France, and Sweden combined hold 63% of the total covered bonds outstanding in Europe per primo 2016, which comprised €1,724.18 billion. The main source of funding for mortgage loans in Denmark, Sweden, and Spain is through issuing covered bonds (Falch 2016, p.8; Sveriges Riksbank 2014, p.5; ECBC 2017, p.2017). The impact on the French mortgage system is smaller, as the majority of the residential mortgages are financed with the guaranteed loans (Fédération Bancaire Française 2015). The guarantee is effectively a mortgage, provided by insurance companies or financial institutions, however, in the NSFR framework, loans backed by a guarantee receives an 85% RSF where a mortgage loan receives a 65% RSF, despite the similarity in maturity (Appendix 12.14).

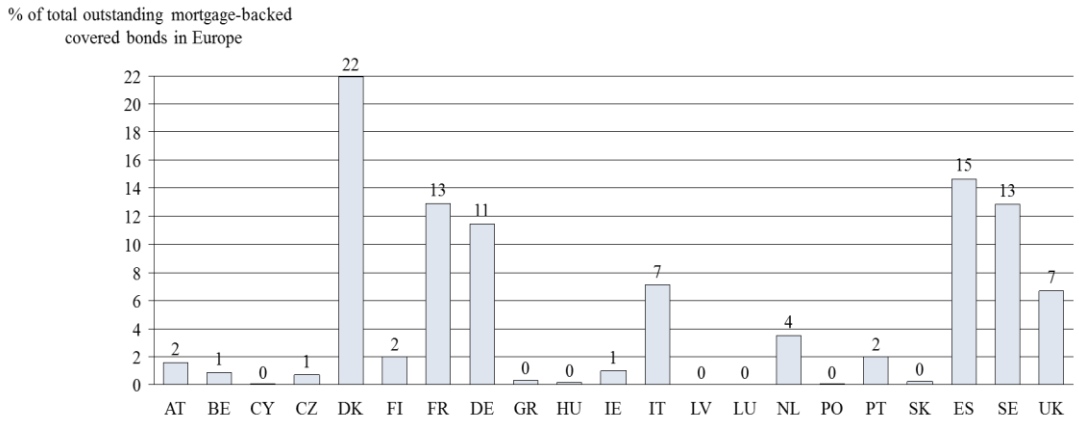


***Figure 46**: Share of total outstanding covered bonds in Europe per country (primo 2016)*
***Source**: Own creation based on information from (EMF 2016)*
***Comment**: See Appendix 12.17 for country abbreviations*

9 Recommendation

This chapter provides recommendations of how European banks can accommodate the capital and liquidity requirements. The recommendations are divided into two broad categories, i.e. operational recommendations and strategic recommendations. The operational recommendations focus the operational aspects of dealing with Basel III, while the strategic recommendations focus on how banks can restructure their business model with respect to balance sheet reconfiguration, customer segmentation, and product offerings.

The recommendations draw upon the conceptualization of a commercial bank's business model from chapter 2, the theoretical and technical concepts of Basel III in chapter 7, and the compliance analyses of chapter 8. Moreover, the recommendations attempt to focus on how to balance the trade-off between the regulatory requirements and profitability.

The recommendations are not only relevant for non-compliant banks, but are of value for already complaint banks. The actions of non-compliant banks alter the competition on certain products, customers, and funding sources, which can potentially affect profitability and capital and liquidity adequacy levels of compliant banks. Moreover, additional future regulations imply that currently compliant banks need to consider strategies for future compliance and profitability.

Finally, the recommendations are general guidelines for a traditional commercial bank, and thus do not take idiosyncratic factors into account. Moreover, the recommendations inevitably include trade-offs between the degree of regulatory compliance and profitability, which naturally implies that no perfect strategy exists as the trade-off is a matter of individual preferences in terms of business strategy developed between the board and management.

9.1 Operational Recommendations

This section provides recommendations on four identified key aspects of banks' operations that can help accommodate the capital and liquidity requirements. The aspects are risk management, performance management, liquidity pricing management, and data management (Figure 47).

***Figure 47**: Drivers of operational efficiency related to the accommodation of Basel III*
***Source**: Own creation*

9.1.1 Risk Management

The financial crisis of 2007-2008 proved that banks did not follow effective risk management practices. Consequently, profitability dropped significantly and regulatory authorities scrutinized even more on banks' risk management practices by imposing various requirements and guidelines as described in chapter 7. Studies show that efficient risk management can lead to not only effective risk measuring, but also reduced operating costs and positive customer experiences (Härle et al. 2016). Thus, the recommendation of an efficient risk management system is driven by two drivers, i.e. regulation and profitability. Banks need to develop a sustainable risk management system that captures banking risks as described in chapter 2, while contributing to profitability. Such risk management system requires three elements.

Firstly, it is necessary to establish a structural link between risk units and business units[17] as both units possess complementary information. Business units can confirm or adjust risk exposures identified by risk units, while the risk units can provide customers leads with respect to risk mitigation of value for both the bank and the customers. Thus, the collaboration can lead to reduced banking risk including model risk, customer experiences in addition to higher profitability through improved basis for strategic

[17] For example, the customer advisor.

and financial decisions. However, the prerequisite for such collaboration is effective knowledge sharing. Therefore, the collaboration must include systemic information-sharing processes to ensure the externalization of tacit knowledge and utilization of explicit knowledge[18] (Nonaka 1994, p.19; Osterloh & Frey 2000, p.539).

Secondly, efficient risk management requires clear risk governance and incentive structures in addition to operational procedures and culture-setting initiatives across all relevant units in the bank. Governance, incentive design, and culture are equally important as the technicalities of a risk management system, and contribute to the goal of reducing banking risks including model risk while optimizing profitability (Hendrikse 2003).

Finally, efficient risk management systems require high quality data and fast data delivery systems, which enables bank to minimize the risk of misinforming or past-due external reporting to regulators. Data management is elaborated upon in section 9.1.4.

9.1.2 Performance Management

A recent study on the top 50 banks in Europe reveals that efficient performance management is a key factor to withstand economic distress in addition to create value in the long run. Moreover, the study reveals that most banks use outdated measurements, and the measurements are inconsistent between the hierarchies of the bank (Wilpert et al. 2016). Therefore, the following recommendation focuses on an efficient performance management framework that consists of three key elements, i.e. education, target setting, and profitability governance.

In general, the recommended performance management system optimizes profitability by incorporating risk in the customer-related business decisions in daily operations. This way the bank ensures that the link between balance sheet, income statement, and capital and liquidity requirements are dealt with homogenously throughout all hierarchies of the bank.

In terms of education, banks need to educate relevant stakeholders, in particularly customer advisors, in the key components of Basel III for three reasons. First, by understanding the drivers of REA, the customer advisor can identify possibilities for reducing REA on an asset. Secondly, customer advisors will be able to incorporate REA in the pricing of assets to secure satisfactory operating profit and return on capital. Finally, customer advisors will be able to differentiate between profitable business possibilities and nonprofitable. It is recommended that an education program is supported by the management team in three ways. Firstly, the management team must clearly communicate the incentive of each stakeholder to partake in the change toward efficient performance management. Secondly, the management team must allow for stakeholder involvement in the education process. Finally, the

[18] Osterloh & Frey (2000) defines tacit knowledge as not easily transferred and explicit knowledge as transferrable, and Nonaka (1994) defines externalization as the transfer of tacit to explicit knowledge

management team must initiate culture-setting programs to move the mindset of the organization. The three elements of support reduce the risk of change resistance among stakeholders (Maurer 2009).

In terms of target setting, it is important that performance targets are linked to the components of the capital and liquidity framework of Basel III to ensure that assets yield a return that not only covers the cost of capital, but also contribute to the development of the bank's operations. For this it is recommended that banks use a performance measurement that measures the risk-adjusted return on capital at risk[19]. Specially, RAROCAR, expressed in Equation 16, is recommended.

$$\text{RAROCAR} = \frac{\text{(Income-cost-expected loss)*(1-tax rate)}}{\text{Economic capital}} \qquad \textit{Equation 16}$$

where economic capital equals REA multiplied by the capital charge of the bank.

By setting a hurdle rate that equals the required return on regulatory capital in addition to the operating costs, banks can measure if the asset yields a return that not only covers the capital charge on the asset but also business development costs. However, regulatory capital is not necessarily the same as actual capital, implying that banks also should set the RAROCAR hurdle rate to reflect a satisfactory ROE. The limitation of the RAROCAR is that it does not consider future or social contingencies. Future contingencies entail that the bank risks deselecting currently value-destroying assets that may become value-adding in the future. Social contingencies entail that the bank risks losing business with other customers because of a deselection of a specific customer. Thus, RAROCAR must not stand alone.

The performance target must be supported by a governance structure. A study shows that performance management frameworks are condemned to failure if the measurements are not governed (Wilpert et al. 2016). Thus, it is recommended that banks set up a specialized central unit responsible for approving or rejecting business cases below the hurdle rates based on future or social contingencies. This unit must be independent to avoid any conflict of interests (Hendrikse 2003).

Finally, effective performance management provides the possibility for banks to conduct effective internal reporting, which includes the ability to measure and report progress to business units in a timely manner. This provides the bank with an operational adaptability that may provide the benefit of identifying value-adding and value-destroying initiatives before competitors.

9.1.3 Liquidity Pricing Management

The recommendation related to liquidity pricing management includes to the development of a transparent funds transfer pricing (FTP) system. Studies show that effective FTP systems enable banks to optimize funding mix with respect to liquidity risk and funding costs (Pettersen et al. 2015, p.15; Ryan et al. 2016, p.1). Another study holds FTP as key component of cost-income allocation in

[19] Alternative performance measures include RAINCAR and EP described in Appendix 12.21.

performance measuring (Wilpert et al. 2016), which may often be neglected or treated exogenously. FTP entails the transfer of liquidity cost and income among business units. This means that the asset holders are charged a price for utilize the funds to purchase the asset. Oppositely, the providers of funds collect income from the receivers of funds. The price charged includes actual funding costs in addition to a liquidity premium. The liquidity premium is driven by maturity, and represents the spread between internal fixed rate and floating rate borrowing costs on the term structure. This means that funds from e.g. short-term deposit with floating rate charges a lower liquidity premium than long-term covered bonds with fixed rate. The importance of an efficient and transparent FTP system revolves around three elements. Firstly, it enables banks to incorporate funding costs in asset pricing more accurately. Secondly, it enables bank to reduce the risk of unnecessary high liquidity costs by optimizing the trade-off between funding costs and run-off rates on outflows and ASF factors related to LCR and NSFR. Finally, and relatedly, it enables banks to target the customer segments and transactions that have the highest RAROCAR.

9.1.4 Data Management

The prerequisite for effective risk management, performance management, and liquidity pricing management is efficient data management, which encompasses the accessibility of high quality data and effective IT systems to delivery data in time manner to all relevant units of the bank (Babczenko et al. 2015, p.1).

Low quality data and inefficient data delivery systems can have a significant impact on the capital adequacy and operating costs as risk managers cannot measure risks adequately, customer advisors cannot price asset correctly, treasury is unable to optimize funding costs, or external regulatory reporting is incorrect.

Moreover, high quality data and efficient delivery systems enable the management team to adjust in timely manner toward new regulations or economic changes, improving the agility of the bank. This necessitates that the data delivery systems are automated, so that manual interventions are reduced. Automated data processes enables rapidity in data deliveries, and can lead to timely decisions and superior customer experiences (Härle et al. 2016, p.6; Wilpert et al. 2016). Thus, high quality data and delivery systems are quintessential resources to ensure operational efficiencies in dealing with the requirements of Basel III.

Operational efficiency in terms of the four abovementioned management practices is a lever to not only comply with regulations but simultaneously create core competences and dynamic capability, which can lead to a competitive advantage (Prahalad & Hamel 1990; Teece & Pisano 1994).

9.2 Strategic Recommendation

This section provides recommendations on how banks can accommodate the capital and liquidity requirements of Basel III from a strategic perspective. The recommendations are divided into five broad categories (Figure 48).

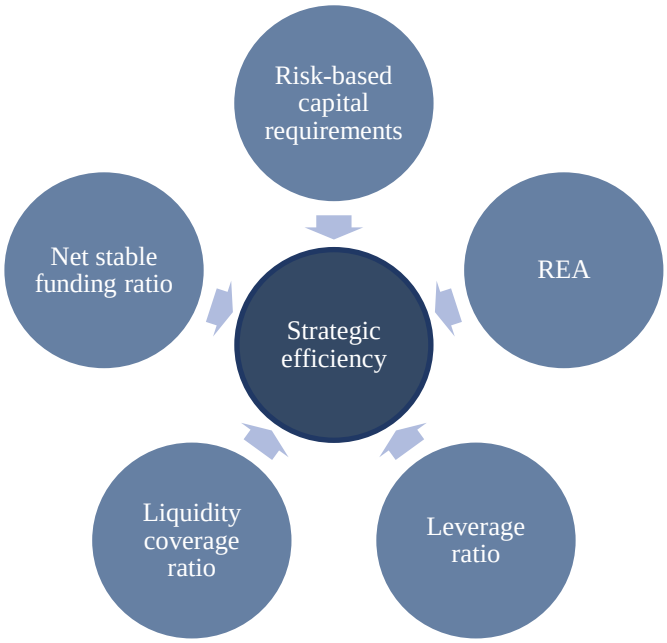


***Figure 48**: Drivers of strategic efficiency related to the accommodation of Basel III*
***Source**: Own creation*

9.2.1 Risk-based capital requirements

To improve the risk-based capital adequacy there are two broad strategic options, i.e. either increase the amount of eligible capital or reduce REA (Equation 17). This section presents recommendations on the first, while the next section presents recommendations on the latter.

$$\text{Capital adequacy} \uparrow = \frac{\text{Eligible capital} \uparrow}{\text{REA} \downarrow} \qquad \textit{Equation 17}$$

In terms of strategic opportunities related to increasing the amount of eligible capital, five sub-strategies are recommended. Firstly, banks should consider the opportunities for issuing new equity capital, hereunder initial public offerings for banks not yet publicly listed on stock exchanges or secondary equity offerings for banks already listed. Alternatively, banks can swap existing debt for newly issued equity through a debt-equity swap, effectively cancelling a portion of its obligation in return of an increase in equity capital. For this strategy to improve capital adequacy, banks must swap a category of debt that does not have the same regulatory eligibility as equity capital. Therefore, banks should consider subordinated debt with residual maturity lower than five years, as subordinated term debt capital is only fully eligible if termed above five years. However, a debt-equity swap may imply paying a premium for the equity depending on the risk-return profile of the debt offered.

Secondly, banks should structurally increase retained earnings. Retained earnings denotes the net earnings not paid out as dividends. However, the risk of this recommendation is the signaling effect and the clientele effect. The signaling effect implies that reduced dividends may be interpreted as the bank not being able to be profitable in the future. The clientele effect implies that investors with preference toward high dividends may no longer wish to hold the equity capital. If the clientele effect is substantial, the increased retained earnings may result in a depreciation of the equity value depending on the liquidity and price per share in the capital markets. Therefore, it is quintessential the management team to communicate a clear strategy to the capital markets with respect to the plans for higher profitability.

Thirdly, banks can reduce the minority interests that do not comply with the qualifying criteria of Basel III (Appendix 12.8). One criterium states that minority interests must be convertible into CET1 capital in occurrence of a *trigger effect*. The lack for such trigger clause implies that most minority interests are not eligible as Tier 2 capital. Therefore, it is recommended that banks buyout the minority interests without such clause or revise the clauses of those minority interests.

Fourthly, banks can improve their capital adequacy by increasing the amount of conventional unsecured subordinated term debt which includes capital instruments with a minimum original fixed term to maturity of over five years and limited life redeemable preference shares. Naturally, the subordination on debt implies higher risks for investors, which further implies higher funding costs for the bank. Likewise, limited callability on preference shares implies higher funding costs for banks due to high liquidity risk for investors. Thus, this recommendation has a clear trade-off with funding costs.

Fifthly, banks can improve their capital adequacy by reducing the amount of capital deductions such as deferred tax assets (DTAs), investments in unconsolidated financial institutions (IUFIs), defined benefit pension assets (DBPAs), and certain securitization exposures.

DTAs may arise for various reasons, including timing differences between tax rules and accounting practices, differences in tax base and accounting practices, and net-loss carry-forwards. DTAs arising from timing differences imply that banks that have an excessive amount of expected losses or other types of future expenses end-of-year that are taxed. Therefore, it is important that the effects of timing differences are optimized. This requires that banks improve calculations of expected losses in addition to align accounting practices with the tax rules. DTAs arising from net-loss carry forwards are more exogenous, thus no explicit recommendation is given on dealing with those.

Investments in unconsolidated financial institutions comprising of less than 10% of the equity of the institutions can also be a source of capital inadequacy if the investments do not satisfy the criteria of trigger effect as mentioned previously. Thus, banks can benefit from either incorporate a trigger clause in the investment or selling their shares in the institutions. The trigger clause would result in conversion to Tier 2 capital, while selling shares in the institution would result in conversion to CET1 capital.

DBPAs arise from surpluses in defined benefit pension plans offered to employees. It is required that DPBAs are deducted from eligible CET1 capital. Therefore, it is recommended that bank managers establish better coordination with the pension fund managers to secure that the withdraw of the DBPAs is maximized to increase CET1 capital.

For capital management of securitization exposures with a credit rating below BB-, BCBS allows for banks to choose between two options when adjusting for credit risk. The first option is to deduct the exposure from the amount of eligible capital. The second option is to treat the exposure as REA by applying a factor of 12.5 on the exposure. In theory, both options result in the same capital adequacy level as the 12.5 factor is the inverse of the 8% target standard ratio. However, for banks with additional risk-based capital charges, such as CCyB, CCB, and G-SIBs charges, the option of applying the 12.5 factor to adjust REA is disadvantageous as those bank's capital charge is above 8%. Thus, it is recommended that banks apply the deduction approach on these securitization exposures. Figure 49 summarizes the recommendations for capital efficiency.

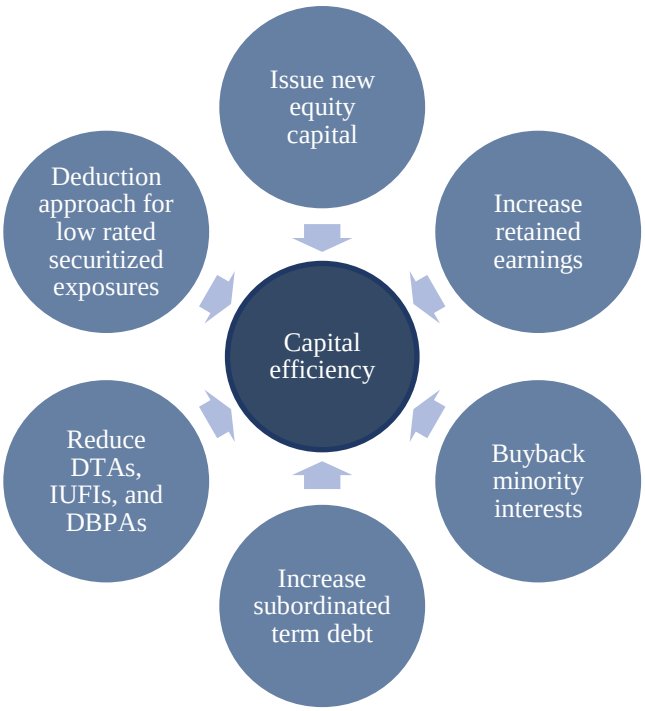


***Figure 49**: Recommendations to achieve capital efficiency*
***Source**: Own creation*

9.2.2 Risk Exposure Amount

This section presents four recommendations on how banks can optimize REA. The first recommendation relates to the bank's risk-weight approach, the second to its customer mix, the third to credit utilization, and the fourth to maturity management.

Firstly, banks should consider what risk-weighting approach for the computation of REA is most convenient and profitable for the bank. The benefit of using IRB relative to the standardized approach

is that the risk weights are calculated more accurately, implying that REA may either be larger or smaller when converting to IRB approach. If the overall REA of the bank decreases from using IRB, the bank saves capital by converting, which implies higher capital adequacy or/and improved profitability. However, the conversion toward IRB requires significant investments to enable the bank to conduct the PD and LGD estimations in addition to setting up processes for reporting and compliance. Thus, it is recommended that banks frequently conduct cost-benefit analyses on converting in addition to analyze possibilities for conversion such as mergers, acquisitions or collaboration that would reduce the conversion cost per exposure through scale economies.

In terms of customer mix, the recommendation revolves around finding and creating great customers. As for finding great customers, it is quintessential that banks have sufficient information as explained in section 9.1.4. The ability to drill down on PD, LGD, REA, EC, and RAROCAR for each customer and customer segment enables banks to systemically identify the customers that contribute the most to capital adequacy and profitability. For example, customers with Swedish and Norwegian exposures may be disadvantageous to hold due to the CCyB charge is 2% for Sweden as per 19th March 2017, and 2% for Norway per ultimo 2017 (Bank of England 2017). These exposures can be substituted with claims in jurisdictions with the CCyB is 0%.

As for creating great customers, it is quintessential that banks continuously attempt to improve the credit rating on counterparties through active management and business requirements. This applies for both banks with standardized approach and IRB approach. As for IRB banks, banks should consult corporate customers to increase key parameters for credit ratings such as the leverage ratio, quick ratio, EBITDA margin and return on invested capital. More, banks could proactively attempt to increase or improve the collateral and guarantees on the exposure for customers, e.g. guarantees from parent company. This would lower the PD and LGD on the counterparties, thus reduce REA for the bank. Finally, a key aspect of creating great customers is to maximize the credit utilization or price accordingly.

Unutilized credit facilities entail a great potential to reduce REA. As mentioned in section 5.2.2.1, the unutilized part of the credit facilities is converted to REA by a CCF, meaning that banks tie up capital regardless of the degree of utilization. However, cutting unutilized credit may cause customers to change banking affiliation. Therefore, it is recommended that banks monitor and analyze customers' liquidity patterns. This enables banks to customize the credit facility to the customer so the maximum credit amount of a credit facility follows the liquidity need of a customer. An example could be the agricultural farmer whose liquidity need during cold winter periods may be low, whereas the summer period may entail large expenses due to fertilization, harvest, and transport of products. Alternatively, it is recommended that banks price in accordance to a satisfactory RAROCAR on the unutilized part of the credit facility. This recommendation applies for both corporate and private banking.

In terms of maturity management, Equations 4 and 6 show that maturity increases REA, thus assets with shorter maturities generally have lower risk weights. Similarly, for IRB bank, maturity increases MA, which increases REA. Thus, it is recommended that banks focus on asset with shorter maturities. However, it should be noted that this recommendation involves a trade-off between capital adequacy and profitability. Maturity is also the primary driver for capital charges in the CVA framework for derivative exposures in the trading book. According to BCBS, if the derivative exposure includes a break clause with a specific date, the bank has the right to use the break clause date as the effective maturity instead of the original maturity of the exposure, which can significantly reduce REA. However, the clause would imply paying a premium to the counterparty for risk of terminating the transaction prematurely. Moreover, jurisdictions can set rules to prevent the effectuation of a break clause, which was the case for Sweden that set a maturity floor of 2.5 years in 2016 (Finansinspektionen 2016). Figure 50 summarizes the recommendations for REA efficiency.

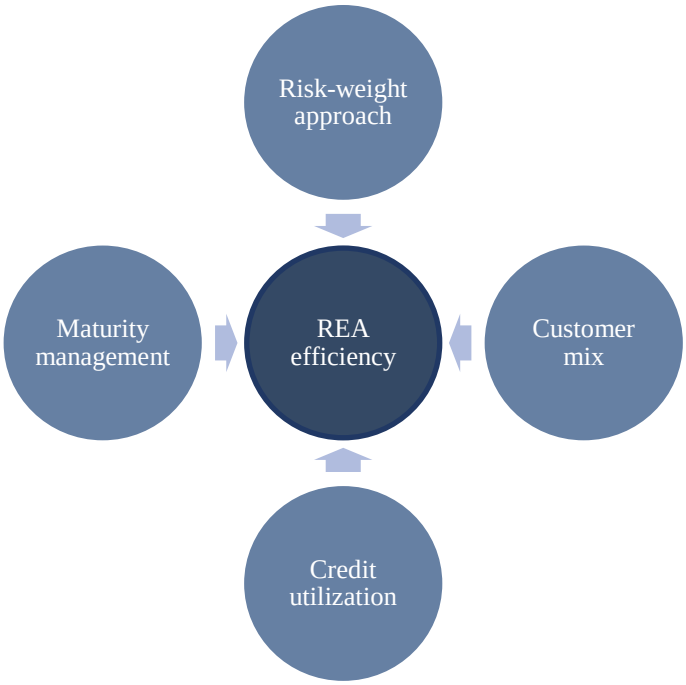


***Figure 50**: Recommendations to achieve REA efficiency*
***Source**: Own creation*

9.2.3 Leverage Ratio

While approximately 95% of the European banks comply with the current minimum as mentioned in section 8.3, the possibility that more banks will be non-compliant in the future is rather high. Several countries such as Netherlands (4% for G-SIBs) and Sweden (5% per ultimo 2018) have or will set the minimum requirement above 3%, while non-European countries such as US, Canada, Australia and Switzerland are setting the LR requirement between 4% and 5% (EBA 2016b, pp.73–74). Finally, BCBS and BIS also state that the 3% level has been a test, and that increasing the minimum requirement to 5% is under consideration (BCBS 2014a, pp.1–2; Bloomberg 2016). If the LR requirement is set at 5%, approximately 50% of the European banks will not comply based on data per medio 2016

(Appendix 12.19). Thus, the need for LR optimization is high despite a generally high compliance level currently. This section presents four recommendations on how banks can optimize LR.

Firstly, it is recommended that banks substitute low-risk assets with high-risk assets or reduce the exposure on low-risk assets to increase the return on the capital tied up by LR. For example, exposures on sovereign entities such as governments and municipalities are disadvantageous to hold with respect to LR. Therefore, it is recommended that banks reduce the amount of such exposure.

Secondly, banks should analyze the social contingencies such as the interdependencies with concomitant businesses related to its sovereign counterparties. If a municipality is closely linked to non-sovereign corporations, e.g. corporates that manage the municipality's water supply, road construction, construction plants etc., the bank must incorporate the capital adequacy and profitability of the entire group of customers into its business decisions. Lastly, banks with LCR below 100% should keep sovereign exposure with risk weight of 0% as such exposure qualifies as HQLAs. However, if the bank can find sources of Level 1 assets for LCR compliance, this strategy is irrelevant.

Thirdly, a potential increase of the minimum LR requirement to 5% will in theory increase the price on exposure for low-rated customers such as sovereigns due to increased funding costs for banks. This implies that in theory the general market price for sovereign exposure increases to a level of which the yield on the capital tied up is satisfactory. However, if the theoretical price movement does not occur, the profitability for banks on such exposure diminishes. Thus, it is crucial for banks to continuously compare the market price for different rating categories to create the basis for the optional strategic decision on what rating category should be pursued.

Finally, BCBS requires that the derivative exposure in the trading book is included in EAD with a 100% CCF. This implies that such exposure is relatively less attractive than banking book exposures. Thus, to reduce the capital charge related to the LR, it is recommended that banks reduce such exposure.

It should be noted that because LR is non-risk based, there is a direct trade-off between the risk-based capital requirements and LR. This means that a low-risk asset and a high-risk asset will require the same amount of capital to satisfy LR given the same exposure amount, whereas for the risk-based requirements the high-risk asset will tie up more capital. Therefore, the recommendations must be considered on a comprehensive basis including the strategic recommendations in section 9.2.2. Figure 51 summarizes the recommendations for LR efficiency.

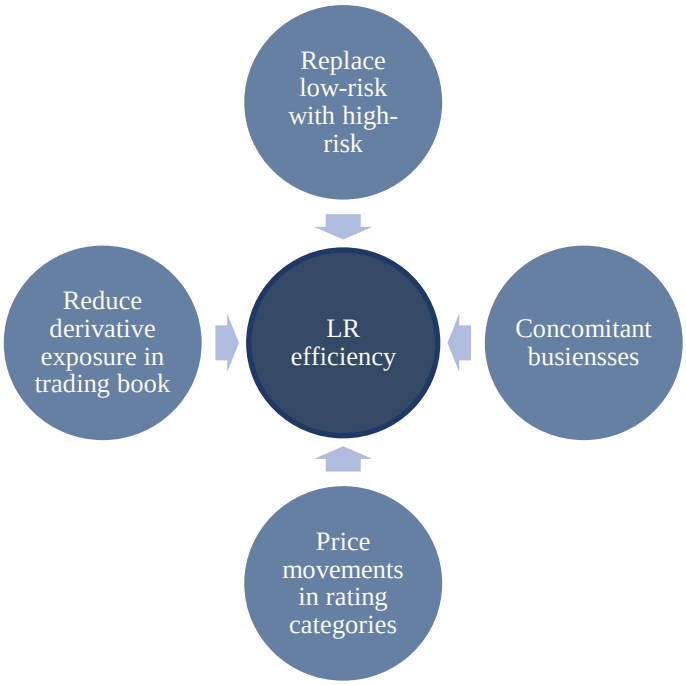


***Figure 51**: Recommendations to achieve LR efficiency*
***Source**: Own creation*

9.2.4 Liquidity Coverage Ratio

This section presents the recommendations on how banks can optimize LCR. As analyzed in section 8.4, the recent development in LCR is driven by the increase in HQLAs, especially Level 1 HQLAs. However, because optimal liquidity management matches the cash flows between assets and liabilities, the following recommendations are divided into two categories, i.e. assets and liabilities. Figure 52 presents an overview of the recommendations for LCR optimization.

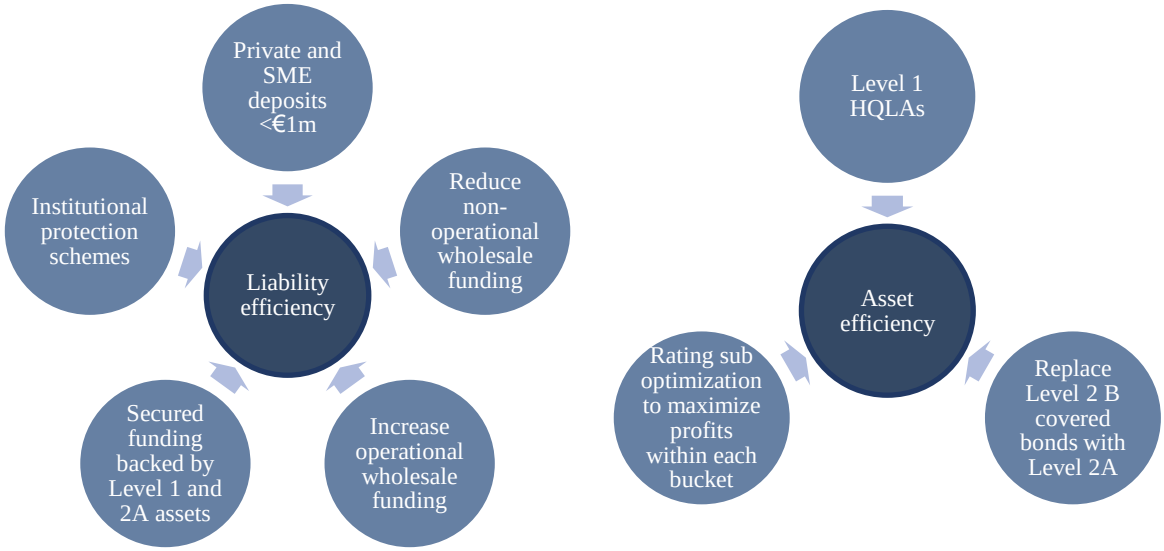


***Figure 52**: Recommendations to achieve LCR efficiency through liability and asset efficiency*
***Source**: Own creation*

As for liability efficiency in relation to LCR, the recommendations revolve around run-off rates applied by BCBS on the categories of funding. The run-off rates reflect the proportion of funding maturing in less than 30 days that will not rollover, i.e. the behavior of the funds providers in a period of stress. The higher run-off rate, the higher the probability that the funds will be withdrawn by the counterparty.

Firstly, it is recommended that banks attract more private customers and small corporate customers under depository insurance schemes because BCBS applies run-off rates between 3% and 10% to retail and unsecured wholesale funding with an aggregate depository volume of less than €1 million (BCBS 2013a, pp.20–24).

Secondly, it is recommended that banks reduce the non-operational unsecured wholesale funding not under insurance schemes such as demand deposits or short-term CDs as described in chapter 2. This type of funding was heavily leveraged prior the financial crisis of 2007-2008, and depositors providing these funds were also the first to run during the crisis (King 2013, pp.1–2). BCBS applies a run-off rate of 100% on this funding source.

Thirdly, banks should attempt to attract the unsecured wholesale deposits of operational purposes for the counterparty instead of non-operational deposits due to reduction in run-off rate from 100% to 25%. To ensure that the bank's relationship with the counterparty is in fact of operational purpose, BCBS requires that the clearing, custody or cash management services are subject to a legally binding agreement that would induce high switching costs for the counterparty to terminate within a 30 days' notice.

Fourthly, the run-off rates applied to secured funding depend on the type of collateral backing the transaction. The rates range from 0% to 100%, where funding backed by Level 1 assets or central banks receive 0%, whereas funding backed by Level 2A assets, e.g. high rated covered bonds and sovereigns with 20% risk weights, receive 15%. it is recommended that banks pursue secured funding backed by Level 1 and 2A assets, as the rate-off rates for 2B or other assets receive 25% to 100%, and may thus impose too high funding costs relative to unsecured funding due to the collateralization.

Fifthly, banks can reduce the run-off rate from 100% to 25% on deposits from other banks if the two parties have entered into an institutional protection scheme approved by regulators, which aims to protect those institutions by ensuring liquidity in case of bankruptcies (EUR-Lex 2013). This interbank deposit structure is efficient in terms of LCR, however it requires mutual due diligence of each member's risks and risk management practices. Therefore, this option may not be prioritized or feasible for some banks.

As for asset efficiency related to LCR, the recommendations revolve around the haircuts applied to the HQLA categories. Asset efficiency involves not only LCR compliance, but profitability optimization.

Firstly, banks should focus on Level 1 assets such as cash reserves, marketable securities and debt from sovereigns, and central bank reserves. It is recommended that banks prioritize and set a base level for cash reserves, so that in event of increased prices on external HQLAs, banks minimize the acquisition cost of such assets. Moreover, due to the low yield on Level 1 assets, it is recommended that banks manage the trade-off between compliance and profitability. This implies monitoring and determining a threshold of the amount of Level 1 assets, the banks can hold to maintain profitability, despite the haircuts on Level 2 assets.

Secondly, if banks should need assets with higher yields than Level 1 assets, it is preferential to focus on the corporate debt securities and covered bonds with rating of AA- or higher that are eligible as Level 2A assets. In comparison to debt securities and covered bonds with rating between A+ and BBB- with a haircut of 50%, the level 2A assets has a haircut of 15%. The haircut gap does not likely reflect the difference in yield on the assets. Therefore, it is recommended that banks increase the holdings of Level 2A assets.

Thirdly, due to BCBS' bucketing of ratings with relation to haircuts, differently rated bonds with different yields receive the same haircut given that they are in the same bucket, e.g. the Level 2B bucket. This means that there are possibilities for sub optimization. Therefore, it is recommended that banks should acquire the riskiest asset in each bucket to get the highest yield. However, this recommendation is depended that RAROCAR is highest for that asset.

9.2.5 Net Stable Funding Ratio

This section presents the recommendation on how banks can optimize NSFR. The recommendation is divided into two categories, i.e. liabilities and assets. As mentioned in section 7.5, the drivers of NSFR are ASF and RSF factors. The main driver for high ASF factors and low RSF factors is maturity, why the recommendation primarily focuses on maturity. Secondary, the recommendation revolves around specific regulatory differences between certain asset and liability classes, which banks can leverage on. Figure 53 presents an overview of the recommendation for NSFR optimization.

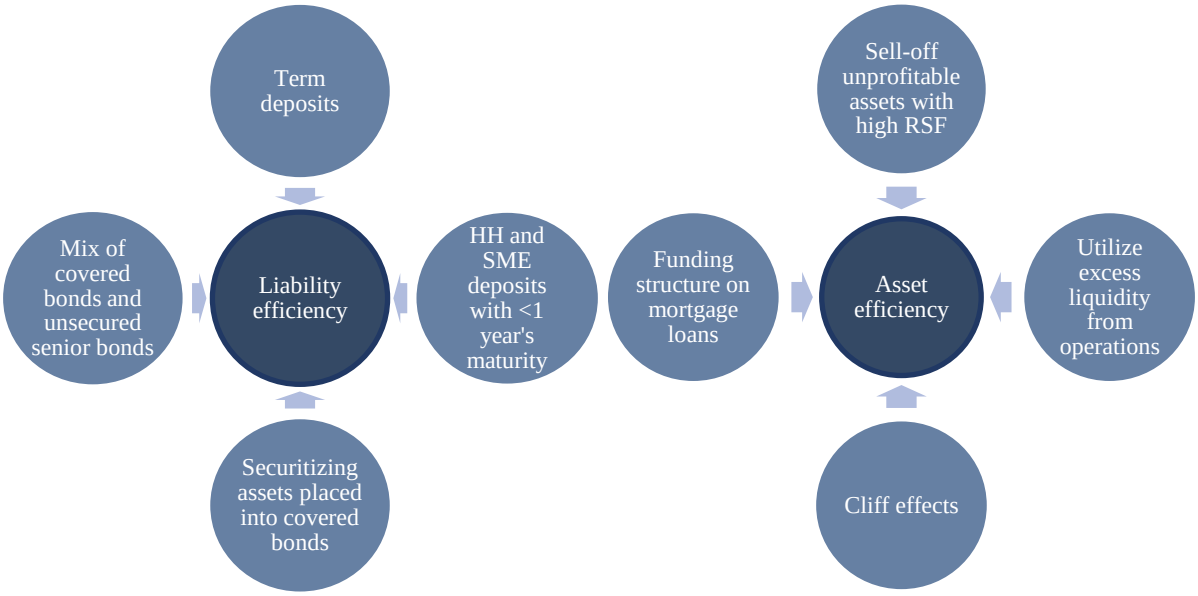


***Figure 53**: Recommendations to achieve NSFR efficiency through liability and asset efficiency*
***Source**: Own creation*

As for liability efficiency in relation to NSFR, the recommendations revolve around the ASF factors applied by BCBS on the categories of funding. The recommendations include four focus areas for banks improve NSFR whilst trading off as little profit as possible.

Firstly, it is recommended that banks increase the holdings of retail term deposits with residual maturities above one year. This funding source receives an ASF factor of 100% independent of the type of retail counterparty. If customers show reluctance to place funds in deposits due to low interest rates, banks can increase the depository interest rate. However, this is direct tradeoff on profitability. Alternatively, it is recommended that banks expand their term deposit offerings so that customers can choose between different types of deposits with different risk-reward functions, e.g. deposits with gearing towards an interbank rate or deposits that offset an interest-bearing amount on lending products.

Secondly, banks should focus on the retail deposits with residual maturities below one year from HHs and SMEs. The ASF factor applied for retail deposits with residual maturity below one year primarily depends on the counterparty. BCBS assigns 50% ASF factors on corporate deposits with residual maturity below one year despite a valid deposit insurance, while HH and SME deposits receive between 90% and 95% depending on the size and insurance as mentioned in section 7.5. Thus, it is recommended that banks attract HH and SME deposits. Moreover, this type of funding also generates low net cash outflow due to low run-off rates, which improves LCR by decreasing the denominator.

Thirdly, it is recommended that banks focus on issuing covered bonds with maturities above one year to get 100% ASF. This requires that the bank makes sure that all assets are securitized and placed into covered bonds. By securitizing all assets possible, the bank reduces its funding cost.

Finally, and as an alternative to funding from covered bonds for mortgage loans, banks can issue unsecured senior bonds with maturities above one year. Despite the higher cost of debt for unsecured funding, mortgage loans funded with unsecured funds receive a lower RSF, which increases NSFR. In practice, banks can for instance replace ten-year covered bonds with three-year unsecured bond at the same spread and the same ASF factor, assuming same funding costs on the bonds.

As for asset efficiency in relation to NSFR, the recommendations revolve around the RSF factors applied by BCBS on assets. The recommendations include four focus areas for banks to improve NSFR whilst trading off as little profit as possible.

Firstly, banks should sell off unprofitable assets with high RSF factors such as loans to customer segments with too high PD and LGD with residual maturity above one year. These assets may not contribute to a satisfactory RAROCAR nor to NSFR. The proceeds could be used to increase the holdings of unencumbered Level 1 and 2 assets that receive 0% to 15% RSF. Naturally, banks should not substitute all risky assets with low risk HQLAs due to the low yield, but for unprofitable risky assets with high RSF factors, the recommendation quickly improves NSFR.

Secondly, banks should minimize their own deposits utilized for operational purposes. Excess liquidity in operational accounts receives a 50% RSF factor in addition to low yields. Therefore, banks ensure optimal utilization of excess operational liquidity, by placing the cash in asset classes with a 0% RSF factor or higher yielding asset classes such as MBS' or corporate debt securities rated between A+ and BBB- that also receive 50% RSF factors.

Thirdly, banks should leverage on the cliff effects in the regulations. There are two significant cliff effects to consider. Firstly, mortgage loans with a residual maturity between six and twelve months receive a 65% RSF factor, while a corresponding covered bond with same maturity only receives a 50% ASF factor. When the residual maturity drops below six months the RSF factor remains at 65%, while the ASF factor on the bond drops to 0%. These large cliff effects imply that increasing the maturity to above one year optimizes NSFR as both the mortgage loan and the covered both receives 100% RSF and ASF factor, respectively. Another significant cliff effect revolves around to ratings on corporate debt securities, where we see that bonds with credit ratings below AA- receive 50% RSF factors, while bonds with ratings above AA- receive 15% (Appendix 12.14). Despite a slight difference in yields between an A- and AA- bond, the difference in funding costs from the NSFR requirement is significant. Thus, banks can optimize NSFR and profitability by holding A- bonds instead of AA- bonds. In general, banks should attempt to maximize the yield within each RSF category.

Finally, for banks with large proportion of their asset portfolio consisting of mortgage loans, it is recommended that banks consider the funding structure of the mortgage loans. As analyzed in section 8.5, mortgage loans with residual maturity above one year and funded by unsecured senior bonds

receive a 65% RSF factor, while the same loan funded by covered bonds receive 100%. If the spread between the funding cost of the unsecured bond and the yield on the mortgage loan is not negative, banks can consider changing funding structure to optimize NSFR. Alternatively, banks could attempt to use guarantees instead of mortgages, as in France, to reduce the RSF factor from 100% to 85% on a mortgage loan with maturity above one year.

10 Conclusion

The purpose of the thesis was to analyze the current compliance levels of the capital and liquidity requirements of Basel III for the European banking sector, and to provide recommendations for European banks on how to accommodate with the capital and liquidity requirements in a profitable manner. More specifically, the thesis analyzed the risk-based capital adequacy ratio, the leverage ratio, the liquidity coverage ratio, and the net stable funding ratio for the European banking sector, and provided both operational and strategic recommendations.

The compliance levels are analyzed as per medio 2016. As for the risk-based capital requirements, hereunder the target standard ratio, the capital buffers, and the G-SIBs charges, the capital shortfall is €2.1 billion. The analysis also found that the REA density for IRB banks is significantly smaller than for banks using the standardized approach to calculate risk weights on assets. As for the non-risk based leverage ratio requirement, the capital shortfall is €3.0 billion. The analysis also found relevant source of information suggesting that that the probability for the LR requirement will increase to above 3% is high in the future. As for the liquidity requirements, the European banking sector is short of €2.6 billion in relation to LCR, and €159 billion in relation to NSFR. The large shortfall in relation to NSFR is primarily caused by the rather harsh treatment of covered bonds as stable funding and the size of the mortgage markets in Europe.

The overall impact of the capital and liquidity requirements is an increase in funding costs for the European banks. Consequently, profitability must be optimized through operational efficiency and strategic efficiency. The thesis finds five drivers for operational efficiency hereunder risk management, performance management, liquidity pricing management, and data management. The main purpose for operational efficiency is for banks to be capable of linking the capital and liquidity requirements into the daily operations and business decisions through sustainable processes and sufficient data. As for strategic efficiency, the thesis finds various recommendations in relation to balance sheet reconfiguration, customer segmentation, and product offerings that enables bank to optimize the trade-off between capital and liquidity adequacy and profitability.

It should be noted that the recommendations are generic and aimed towards traditional commercial banks. The thesis did not consider idiosyncratic factors affecting individual banks.

11 Bibliography

Allen, L. & Saunders, A., 2012. *Risk Management in Banking* The Oxford.,

Babczenko, K. et al., 2015. *Devil in the data: How banks can improve data management*, PricewaterhouseCoopers. Available at: https://www.pwc.com/us/en/financial-services/publications/viewpoints/assets/improving-data-management.pdf.

Baldvinsson, C. et al., 2011. *Dansk Bankvæsen* 6th ed., København: Karnov Group Denmark A/S.

Bank of England, 2017. Countercyclical Capital Buffer (CCyB) rates. Available at: http://www.bankofengland.co.uk/financialstability/Pages/fpc/ccbrates.aspx [Accessed April 5, 2017].

Barfield, R., 2011. *A Practitioner's Guide to Basel III and Beyond* P. LLP, ed., London: Thomson Reuters UK Limited.

BCBS, 2010. *Basel III : International framework for liquidity risk measurement , standards and monitoring*, Bank for International Settlements. Available at: http://www.bis.org/publ/bcbs238.htm.

BCBS, 2011a. *Basel III definition of capital - Frequently asked questions*, Basel, Switzerland: Bank for International Settlements. Available at: http://www.bis.org/publ/bcbs198.pdf.

BCBS, 2014a. *Basel III leverage ratio framework and disclosure requirement*, Basel, Switzerland: Bank for International Settlements.

BCBS, 2011b. *Basel III: A global regulatory framework for more resilient banks and banking systems*, Bank for International Settlements. Available at: http://www.bis.org/publ/bcbs189.pdf.

BCBS, 2017. Basel III: international regulatory framework for banks. Available at: http://www.bis.org/bcbs/basel3.htm [Accessed April 4, 2017].

BCBS, 2013a. *Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools*, Bank for International Settlements.

BCBS, 2014b. *Basel III: The Net Stable Funding Ratio*, Bank for International Settlements. Available at: www.bis.org/bcbs/publ/d295.htm.

BCBS, 2015a. *Consultative Document - Review of the Credit Valuation Adjustment Risk Framework*, Bank for International Settlements.

BCBS, 2015b. *Criteria for identifying simple, transparent and comparable securitisations*, Basel, Switzerland: Bank for International Settlements & International Organization of Securities Commissions (IOSCO).

BCBS, 2013b. *Global systemically important banks: Updated assessment methodology and higher loss absorbency requirements*, Basel, Switzerland: Bank for International Settlements.

BCBS, 1988. *International Convergence of Capital Management and Capital Standards* The Basle .,

BCBS, 2006. *International Convergence of Capital Measurement and Capital Standards: A Revised Framework* June 2006., Bank for International Settlements.

BCBS, 2004. *International Convergence of Capital Measurement and Capital Standards: A Revised Framework* 2004th ed., Bank for International Settlements.

BCBS, 2013c. *Revised Basel III leverage ratio framework and disclosure requirements*,

Bessis, J., 2010. *Risk Management in Banking* Third edit., West Sussex: John Wiley & Sons, Ltd.

BIS, 2016a. Basel Committee Charter. , p.Bank for International Settlements. Available at: http://www.bis.org/bcbs/charter.htm [Accessed February 9, 2017].

BIS, 2017a. Basel Committee membership. , p.Bank for International Settlement. Available at: http://www.bis.org/bcbs/membership.htm [Accessed February 9, 2017].

BIS, 2017b. Basel Committee organisation and governance. , p.Bank for International Settlement. Available at: http://www.bis.org/bcbs/organ_and_gov.htm [Accessed February 9, 2017].

BIS, 2016b. Countercyclical capital buffer (CCyB). Available at: https://www.bis.org/bcbs/ccyb/ [Accessed March 6, 2017].

BIS, 2017c. History of the Basel Committee. , p.Bank for International Settlement. Available at: http://www.bis.org/bcbs/history.htm [Accessed February 9, 2017].

BIS, 2008. *International banking and financial market developments*, Basel, Switzerland: Bank for International Settlements.

Bloomberg, 2016. Europe's Banks Should Face 3% Minimum Leverage Ratio, EBA says. Available at: https://www.bloomberg.com/news/articles/2015-12-06/leverage-ratio-for-banks-can-be-raised-as-high-as-5-bis-says [Accessed April 6, 2017].

Bodie, Z., Kane, A. & Marcus, A.J., 2014. *Investments* 10th ed., McGraw-Hill Education.

Brunnermeier, M.K., 2008. Deciphering the Liquidity and Credit Crunch 2007- 08. , 23(Journal of Economic Perspectives), pp.77 – 100.

Calomiris, C.W., 2008. *The Subprime Turmoil: What's Old, What's New, and What's Next*,

Calverley, J.P., 2009. *When Bubbles Burst*, London: Nicholas Brealey.

Corrigan, E., 2016. Report: Spain's Housing Crisis. , p.Barcelona Metropolitan. Available at: http://www.barcelona-metropolitan.com/in-the-city/report-home-truths/ [Accessed February 24, 2017].

Deutsche Bundesbank, 2016. Risks in the German banking sector. Available at: https://www.bundesbank.de/Redaktion/EN/Dossier/Tasks/finanzstabilitaetsbericht_2015_1_2.html [Accessed March 19, 2017].

Drehmann, M. & Nikolaou, K., 2010. *Funding liquidity risk: definition and measurement*, Bank for International Settlements.

EBA, 2017. *CRD IV - CRR / Basel III Monitoring Exercise - Results Based on Data as of 30 June 2016*, London: European Banking Authority. Available at: http://www.eba.europa.eu.

EBA, 2016a. *CRD IV - CRR / Basel III Monitoring Exercise - Results Based on Data as of 31 December 2015*, London.

EBA, 2016b. *EBA report on the leverage ratio requirements under article 511 of the CRR*, London. Available at: https://www.eba.europa.eu/documents/10180/1360107/EBA-Op-2016-13+(Leverage+ratio+report).pdf.

EBA, 2016c. *Risk Assessment of the European Banking System*, Luxembourg.

EBA, 2016d. *The EBA Report on Liquidity Measures under Article 509(1) and the Review of the Phase-In of the Liquidity Coverage Requirement under Article 461(1) of the CRR*, London.

ECB, 2016. ... and what are minimum reserve requirements? *Eurosystem*. Available at: https://www.ecb.europa.eu/explainers/tell-me/html/minimum_reserve_req.en.html.

ECB Press Conference, 2016. Markets soar as ECB extends QE programme until December 2017 - as it happened. *ECB Press Conference 8 December 2016*, The Guardi. Available at: https://www.theguardian.com/business/live/2016/dec/08/ecb-stimulus-qe-draghi-italy-bank-rescue-business-live.

ECBC, 2017. Covered bonds framework. Available at: http://www.ecbc.eu/framework/freeCompare/add_filter_framework/23 [Accessed March 24, 2017].

EMF, 2016. *Hypostat 2016 A review of Europe's Mortgage and Housing Markets*,

EUR-Lex, 2013. *Regulation (EU) no. 575/2013 of the European Parliament and of the council on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012*, European Union: The European Parliament and the Council of fthe European Union. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32013R0575.

European Parliament, 2015a. The ECB ' s Expanded Asset Purchase Programme - Will quantitative easing revive the euro area economy ? , (February).

European Parliament, 2015b. *The European Union's Role in International Economic Fora Paper 5: The BCBS*, Directorate-General for Internal Policies: Policy Department A: Economic and Scientific Policy. Available at: http://www.europarl.europa.eu/RegData/etudes/IDAN/2015/542194/IPOL_IDA(2015)542194_EN.pdf.

Falch, C.E., 2016. *Danish Covered Bond Handbook - The handbook of the Danish covered bond market and issuers*, København.

Federal Reserve Board, 2008. *Subprime Mortgages: What, Where, and to Whom?*, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington D.C.

Fédération Bancaire Française, 2015. *French Banks and European Banking Reforms*, Paris. Available at: http://www.fbf.fr/.

Financial Stability Board, 2011. Shadow Banking: Strengthening Oversight and Regulation. , 27 October, p.Recommendations of the Financial Stability Board. Available at: http://www.fsb.org/wp-content/uploads/r_111027a.pdf?page_moved=1.

Finansinspektionen, 2016. New methods for banks' risk weights and capital requirements decided. Available at: http://www.fi.se/en/published/news/2016/new-methods-for-banks-risk-weights-and-capital-requirements-decided/ [Accessed April 5, 2017].

Finanstilsynet, 2007. Den danske EU-beslutningsprocedure. Available at: https://www.finanstilsynet.dk/Lovgivning/EU-lovsamling/EU-beslutningsprocedure/Den-danske-EU-beslutningsprocedure [Accessed February 9, 2017].

FRED, 2017. S&P/Case-Shiller U.S. National Home Price Index. Available at: https://fred.stlouisfed.org/series/CSUSHPISA#0 [Accessed April 18, 2017].

Gregoriou, G.N., 2009. *perational risk towards Basel III: best practices and issues in modeling, management and regulation*, New Jersey: John Wiley & Sons. Inc.

Guidolin, M. & Tam, Y.M., 2010. *A Yield Spread Perspective on the Great Financial Crisis: Break-Point Test Evidence*, St. Louis. Available at: https://research.stlouisfed.org/wp/2010/2010-026.pdf.

Härle, P., Havas, A. & Samandari, H., 2016. *The future of bank risk management*, McKinsey & Company.

Hendrikse, G., 2003. *Economics and Management of Organizations: Co-ordination, Motivation and Strategy*, McGraw-Hill Education.

Hull, J.C., 2015. *Risk Management and Financial Institutions* 4th ed., John Wiley & Sons, Ltd.

King, M.R., 2013. The Basel III Net Stable Funding Ratio and bank net interest margins. *Journal of Banking and Finance*, 37(11), pp.4144–4156. Available at: http://dx.doi.org/10.1016/j.jbankfin.2013.07.017.

Koch, T.W. & MacDonald, S.S., 2003. *Bank Management* 5th ed. J. W. Calhoun, ed., Mason, Ohio: South-Western, Thomson.

Kodres, L.E., 1996. *Foreign Exchange Markets: Structure and Systemic Risks*, Finance & Development.

KPMG, 2016. *The cumulative impact of regulation, taxes and a low interest rate environment: An impact analysis on the Belgian banking sector*, Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2016/07/ADV-brochure-Febelfin-Interactive_v5.pdf.

Mariathasan, M. & Merrouche, O., 2014. *The Manipulation of Basel Risk-Weights* Journal of.,

Maurer, R., 2009. *Introduction to Change without Migraines* Version 4., Maurer and Associates.

Mesnard, B., Margerit, A. & Magnus, M., 2016. Upgrading the Basel standards: from Basel III to Basel IV? , Directorat(Economic Governance Support Unit).

Mishkin, F. & Stanley, E., 2013. *Financial Markets and Institutions: Global Edition* Global edi., Pearson Education.

Nonaka, I., 1994. A Dynamic Theory Knowledge of Organizational Creation. *Organization Science*, 5(1), pp.14–37.

O'Donoghue, T. & Punch, K., 2003. *Qualitative Educational Research in Action: Doing and Reflecting*, Routledge.

Osterloh, M. & Frey, B.S., 2000. Motivation, Knowledge Transfer, and Organizational Forms. *Organization Science*, 11(5), pp.538–550.

Pettersen, B. et al., 2015. *Liquidity Coverage Ratio: Implications and a Pragmatic Approach to Implementation*, Accenture.

Prahalad, C.K. & Hamel, G., 1990. *The Core Competence of the Corporation* Harvard Bu.,

Rangvid, J., 2013. *DEN FINANSIELLE KRISE I DANMARK – årsager, konsekvenser og læring*, Rosendahls - Schultz Grafisk A/S. Available at: www.evm.dk.

Resti, A., 2016. *Banks' internal rating models - time for a change? The "system of floors" as proposed by the Basel Committee*, Directorate-General for Internal Policies: European Parliament.

Riksbank, S., 2015. *Capital requirements for the Major Swedish banks - the Riksbank's view*, Stockholm: Sveriges Riksbank. Available at: http://www.riksbank.se/Documents/Avdelningar/AFS/2015/prm_150703_eng.pdf.

Roberto, R. & Pierpaolo, F., 2013. *Liquidity Risk Management in Banks: Economic and Regulatory*

Issues, Springer.

Rose, P.S. & Hudgins, S.C., 2008. *Back Management & Financial Services* Seventh., New York: McGraw-Hill/Irwin.

Ryan, D. et al., 2016. *Interagency Funds Transfer Pricing guidance*, PricewaterhouseCoopers.

Schäfer, A. et al., 2016. *Removing Privileges for Banks' Sovereign Exposures - A Proposal* European E., Available at: http://european-economy.eu/2016-1/removing-privileges-for-banks-sovereign-exposures-a-proposal/.

Sissoko, C., 2009. *The parallel banking system: The regulation of ABCP* Synthetic ., Available at: https://syntheticassets.wordpress.com/2009/06/23/the-parallel-banking-system-2-of-3/ [Accessed February 26, 2017].

Sveriges Riksbank, 2014. *From A to Z: the Swedish mortgage market and its role in the financial system*, Stockholm.

Teece, D. & Pisano, G., 1994. *The dynamic capabilities of firms: An introduction* Industrial.,

Westerhuis, G., 2016. *Commercial Banking: Changing Interactions between Banking, Markets, Industry, and State* The Oxford.,

Wilpert, D.M. et al., 2016. *Rethinking performance management*, BANKINGHUB by zeb. Available at: https://www.bankinghub.eu/banking/finance-risk/rethinking-performance-management.

12 Appendix

12.1 List of Equations

Relation between ROE and ROA

$$\text{ROE} = \frac{\text{Assets}}{\text{Equity}} * \text{ROA} \qquad \textit{Equation 1}$$

Target standard ratio under Basel I

$$\frac{\text{Qualifying capital}}{\text{Risk exposure amount}} \geq 8\% \qquad \textit{Equation 2}$$

Target standard ratio under Basel II

$$\frac{\text{Qualifying capital}}{\text{Risk exposure amount}} \geq 8\% \qquad \textit{Equation 3}$$

Function of REA under IRB Approach for credit risk

$$\sum_{i} \text{EAD}_i * \text{LGD}_i * (\text{WCDR}_i - \text{PD}_i) * \text{MA}_i \qquad \textit{Equation 4}$$

Worst case default rate

$$\text{WCDR} = \text{N}\left[\frac{\text{N}^{-1}(\text{PD}) + \sqrt{R} * \text{N}^{-1}(0.999)}{\sqrt{1 - R}}\right] \qquad \textit{Equation 5}$$

Maturity adjustment

$$\text{MA} = \frac{1 + (\text{M} - 2.5) * b}{1 - 1.5 * b} \qquad \textit{Equation 6}$$

where

$$b = [0.11852 - 0.05478 * \ln(\text{PD})]^2 \qquad \textit{Equation 7}$$

Function for capital charge for operational risk under BIA

$$K_{\text{BIA}} = \frac{[\sum \text{GI}_{1..n} * \alpha]}{\text{n}} \qquad \textit{Equation 8}$$

Function of leverage ratio

$$\text{Leverage ratio} = \frac{\text{Tier 1 capital}}{\text{Exposure measure}} \qquad \textit{Equation 9}$$

Function of liquidity coverage ratio

$$\text{LCR} = \frac{\sum_{i=30} \text{HQLAs}}{\sum_{i=30} \text{Total net cash outflows over the next 30 calendar days}} \qquad \textit{Equation 10}$$

Function of net stable funding ratio

$$\text{NSFR} = \frac{\sum \text{Available stable funding}}{\sum \text{Required stable funding}} \qquad \textit{Equation 11}$$

Calculation of the development of total exposure from Chapter 8

$$\frac{\text{REA}_{2011}}{\text{Exposure}_{2011}} = 44.3\% \text{ and } \frac{\text{REA}_{2016}}{\text{Exposure}_{2016}} = 37.1\% \qquad \textit{Equation 12}$$

$$\frac{100}{\text{Exposure}_{2011}} = 44.3\% \text{ and } \frac{80}{\text{Exposure}_{2016}} = 37.1\% \qquad \textit{Equation 13}$$

$$= \quad \text{Exposure}_{2011} = 225.7 \text{ and } \text{Exposure}_{2016} = 215.6 \qquad \textit{Equation 14}$$

$$= \text{(indexed)} \quad \text{Exposure}_{2011} = 100 \text{ and } \text{Exposure}_{2016} = 95.5 \qquad \textit{Equation 15}$$

Risk-adjusted return on capital at risk

$$\text{RAROCAR} = \frac{\text{(Income-cost-expected loss)*(1-tax rate)}}{\text{Economic capital}} \qquad \textit{Equation 16}$$

Illustration of the relationship between the variables of the capital adequacy ratio

$$\text{Capital adequacy} \uparrow \; = \frac{\text{Eligible capital} \uparrow}{\text{REA} \downarrow} \qquad \textit{Equation 17}$$

Function of CEA in transactions with bilateral netting

$$\text{CEA} = \max\left(\sum_{i=1}^{K} V_i, 0\right) + (0.4 + 0.6*\text{NRR}) \sum_{i=1}^{K} a_i, L_i \qquad \textit{Equation 18}$$

Function of the net replacement ratio

$$\text{NRR} = \frac{\max(\sum_{i=1}^{K} V_i, 0)}{\sum_{i=1}^{K} \max(V_i, 0)} \qquad \textit{Equation 19}$$

Function of CEA in transactions without bilateral netting

$$\text{CEA} = \sum_{i=1}^{K} \max(V_i, 0) + \sum_{i=1}^{K} a_i, L_i \qquad \textit{Equation 20}$$

Risk-adjusted income on capital at risk

$$\text{RAINCAR} = \frac{\text{(Income-expected loss)*(1-tax rate)}}{\text{Economic capital}} \qquad \textit{Equation 21}$$

Economic Profit

EP = (income-cost-expected loss)*(1-tax) - (cost of capital*economic capital) *Equation 22*

12.2 Key ECB Interest Rates

(levels in percentages per annum; changes in percentage points)

With effect from: [1]	Deposit facility		Marginal lending facility	
	Level 1	Change 2	Level 6	Change 7
1999 1 Jan.	2.00	-	4.50	-
4 Jan. [2]	2.75	0.75	3.25	-1.25
22 Jan.	2.00	-0.75	4.50	1.25
9 Apr.	1.50	-0.50	3.50	-1.00
5 Nov.	2.00	0.50	4.00	0.50
2000 4 Feb.	2.25	0.25	4.25	0.25
17 Mar.	2.50	0.25	4.50	0.25
28 Apr.	2.75	0.25	4.75	0.25
9 June	3.25	0.50	5.25	0.50
28 June	3.25	...	5.25	...
3)	3.50	0.25	5.50	0.25
1 Sep.	3.75	0.25	5.75	0.25
6 Oct.				
2001 11 May	3.50	-0.25	5.50	-0.25
31 Aug.	3.25	-0.25	5.25	-0.25
18 Sep.	2.75	-0.50	4.75	-0.50
9 Nov.	2.25	-0.50	4.25	-0.50
2002 6 Dec.	1.75	-0.50	3.75	-0.50
2003 7 Mar.	1.50	-0.25	3.50	-0.25
6 June	1.00	-0.50	3.00	-0.50
2005 6 Dec.	1.25	0.25	3.25	0.25
2006 8 Mar.	1.50	0.25	3.50	0.25
15 June	1.75	0.25	3.75	0.25
9 Aug.	2.00	0.25	4.00	0.25
11 Oct.	2.25	0.25	4.25	0.25
13 Dec.	2.50	0.25	4.50	0.25
2007 14 Mar.	2.75	0.25	4.75	0.25
13 June	3.00	0.25	5.00	0.25
2008 9 July	3.25	0.25	5.25	0.25
8 Oct.	2.75	-0.50	4.75	-0.50
9 Oct. [4]	3.25	0.50	4.25	-0.50
15 Oct. [5]	3.25	...	4.25	...
12 Nov.	2.75	-0.50	3.75	-0.50
10 Dec.	2.00	-0.75	3.00	-0.75
2009 21 Jan.	1.00	-1.00	3.00	...
11 Mar.	0.50	-0.50	2.50	-0.50
8 Apr.	0.25	-0.25	2.25	-0.25
13 May	0.25	...	1 .75	-0.50
2011 13 Apr.	0.50	0.25	2.00	0.25
13 July	0.75	0.25	2.25	0.25
9 Nov.	0.50	-0.25	2.00	-0.25
14 Dec.	0.25	-0.25	1.75	-0.25
2012 11 July	0.00	-0.25	1.50	-0.25
2013 8 May	0.00	...	1.00	-0.50
13 Nov.	0.00	...	0.75	-0.25
2014 11 June	-0.10	-0.10	0.40	-0.35
10 Sep.	-0.20	-0.10	0.30	-0.10
2015 9 Dec.	-0.30	-0.10	0.30	...
2016 16 Mar.	-0.40	-0.10	0.25	-0.05

Source: ECB

1) From 1 January 1999 to 9 March 2004, the date refers to the deposit and marginal lending facilities. For main refinancing operations, changes in the rate are effective from the first operation following the date indicated. The change on 18 September 2001 was effective on that same day. From 10 March 2004 onwards, the date refers both to the deposit and marginal lending facilities and to the main refinancing operations (with changes effective from the first main refinancing operation following the Governing Council decision), unless otherwise indicated.

2) On 22 December 1998 the ECB announced that, as an exceptional measure between 4 and 21 January 1999, a narrow corridor of 50 basis points would be applied between the interest rates for the marginal lending facility and the deposit facility, aimed at facilitating the transition to the new monetary regime by market participants.

3) On 8 June 2000 the ECB announced that, starting from the operation to be settled on 28 June 2000, the main refinancing operations of the Eurosystem would be conducted as variable rate tenders. The minimum bid rate refers to the minimum interest rate at which counterparties may place their bids.

4) As of 9 October 2008 the ECB reduced the standing facilities corridor from 200 basis points to 100 basis points around the interest rate on the main refinancing operations. The standing facilities corridor was restored to 200 basis points as of 21 January 2009.

5) On 8 October 2008 the ECB announced that, starting from the operation to be settled on 15 October, the weekly main refinancing operations would be carried out through a fixed rate tender procedure with full allotment at the interest rate on the main refinancing operations. This change overrode the previous decision (made on the same day) to cut by 50 basis points the minimum bid rate on the main refinancing operations conducted as variable rate tender

12.3 List of G-10 Countries as of 1974

The G-10 is group of nations that entered the GAB agreement in 1962. The GAB agreement (General Arrangements to Borrow) is an agreement to support IMF's lending activities with additional funds

Countries:

1. Belgium
2. Canada
3. France
4. Germany
5. Italy
6. Japan
7. Netherlands
8. Sweden
9. United Kingdom
10. United State of America
11. Switzerland (entered in 1964)

12.4 Members of BCBS as of 9th February 2017

Members	
Country/jurisdiction	*Institutional representative*
Argentina	Central Bank of Argentina
Australia	Reserve Bank of Australia
	Australian Prudential Regulation Authority
Belgium	National Bank of Belgium
Brazil	Central Bank of Brazil
Canada	Bank of Canada
	Office of the Superintendent of Financial Institutions
China	People's Bank of China
	China Banking Regulatory Commission
European Union	European Central Bank
	European Central Bank Single Supervisory Mechanism
France	Bank of France
	Prudential Supervision and Resolution Authority
Germany	Deutsche Bundesbank
	Federal Financial Supervisory Authority (BaFin)
Hong Kong SAR	Hong Kong Monetary Authority
India	Reserve Bank of India
Indonesia	Bank Indonesia
	Indonesia Financial Services Authority
Italy	Bank of Italy
Japan	Bank of Japan
	Financial Services Agency
Korea	Bank of Korea
	Financial Supervisory Service
Luxembourg	Surveillance Commission for the Financial Sector
Mexico	Bank of Mexico
	Comisión Nacional Bancaria y de Valores
Netherlands	Netherlands Bank
Russia	Central Bank of the Russian Federation
Saudi Arabia	Saudi Arabian Monetary Agency
Singapore	Monetary Authority of Singapore
South Africa	South African Reserve Bank
Spain	Bank of Spain
Sweden	Sveriges Riksbank
	Finansinspektionen
Switzerland	Swiss National Bank
	Swiss Financial Market Supervisory Authority FINMA
Turkey	Central Bank of the Republic of Turkey
	Banking Regulation and Supervision Agency
United Kingdom	Bank of England
	Prudential Regulation Authority
United States	Board of Governors of the Federal Reserve System
	Federal Reserve Bank of New York
	Office of the Comptroller of the Currency
	Federal Deposit Insurance Corporation

Observers	
Country	*Institutional representative*
Chile	Central Bank of Chile
	Banking and Financial Institutions Supervisory Agency
Malaysia	Central Bank of Malaysia
United Arab Emirates	Central Bank of the United Arab Emirates

Supervisory groups, international agencies and other bodies
Bank for International Settlements
Basel Consultative Group
European Banking Authority
European Commission
International Monetary Fund

Secretariat
Bank for International Settlements

Source: Own creation based on (BIS 2017b)

12.5 Credit Conversion Factors for Off-balance Sheet Items

CCF	Off-balance sheet items
100%	Direct credit substitutes (e.g. standby letters of credit), repurchase agreements and asset sales with recourse where credit risk remains with the bank, and forward assets purchases
50%	Performance bonds, bid bonds and warranties, note issuance and revolving underwriting facilities, and other commitments with original maturity above one year (e.g. credit lines and standby facilities)
20%	Short-term self-liquidating trade-related contingencies (e.g. documentary credit collateralized by the underlying shipments)
0%	Credit lines and standby facilities with maturity up to one year or which cancellability

***Figure 54**: Overview of CFFs and the corresponding OBS instruments in Basel I*
***Source**: Own creation based on information from (BCBS 1988)*

12.6 Computation of Credit Equivalent Amount With and Without Netting

In transactions with bilateral netting, CEA is given by the following equation:

$$CEA = \max\left(\sum_{i=1}^{K} V_i, 0\right) + (0.4 + 0.6*NRR) \sum_{i=1}^{K} a_i, L_i \qquad \textit{Equation 18}$$

Where V_i is the current market value, L_i is the principal for the i^{th} transaction, a_i is the add-on factor presented in figure 55 and NRR is the net replacement ratio defined as

$$NRR = \frac{\max(\sum_{i=1}^{K} V_i, 0)}{\sum_{i=1}^{K} \max(V_i, 0)} \qquad \textit{Equation 19}$$

The constant notations in the Equation 18 are arbitrarily risk weights constructed by BCBS. Similarly, the add-on factors in addition to the add-on ratios are arbitrarily constructed by BCBS. Figure 55 shows the add-on factors for the over-the-counter (OTC) derivative such as equity index forward contract, currency swaps, and options.

Residual maturity	Interest rate	Exchange rate and gold	Equity	Precious metals except gold	Other commodities
< 1 year	0%	1.0%	6.0%	7.0%	10.0%
1 to 5 years	0.5%	5.0%	8.0%	7.0%	12.0%
> 5 years	1.5%	7.5%	10.0%	8.0%	15.0%

***Figure 55**: Add-on factors on OTC derivatives in Basel I*
***Source**: Own creation based on information from (BCBS 1988, updated in April 1998)*

In transactions without bilateral netting, CEA is given by the following equation:

$$CEA = \sum_{i=1}^{K} \max(V_i, 0) + \sum_{i=1}^{K} a_i, L_i \qquad \textit{Equation 20}$$

12.7 Copula correlation coefficients for calculation of WCDR for IRB banks

Counterparty of exposure	Copula correlation
Corporations, sovereigns and banks	$R = 0.12 * (1+ e^{-50 * PD})$
Residential mortgage	$R = 0.15$
Revolving credit lines for retail customers	$R = 0.04$
Other types of retail exposures	$R = 0.03 + 0.13 * e^{-35 * PD}$

***Figure 56**: Copula correlation coefficients for calculation of WCDR*
***Source**: Own creation based on information from (BCBS 2006)*

12.8 Criteria for Classification as Common Shares for Regulatory Capital Purposes

1.	Represents the most subordinated claim in liquidation of the bank.
2.	Entitled to a claim on the residual assets that is proportional with its share of issued capital, after all senior claims have been repaid in liquidation (ie has an unlimited and variable claim, not a fixed or capped claim).
3.	Principal is perpetual and never repaid outside of liquidation (setting aside discretionary repurchases or other means of effectively reducing capital in a discretionary manner that is allowable under relevant law).
4.	The bank does nothing to create an expectation at issuance that the instrument will be bought back, redeemed or cancelled nor do the statutory or contractual terms provide any feature which might give rise to such an expectation.
5.	Distributions are paid out of distributable items (retained earnings included). The level of distributions is not in any way tied or linked to the amount paid in at issuance and is not subject to a contractual cap (except to the extent that a bank is unable to pay distributions that exceed the level of distributable items).
6.	There are no circumstances under which the distributions are obligatory. Non payment is therefore not an event of default.
7.	Distributions are paid only after all legal and contractual obligations have been met and payments on more senior capital instruments have been made. This means that there are no preferential distributions, including in respect of other elements classified as the highest quality issued capital.
8.	It is the issued capital that takes the first and proportionately greatest share of any losses as they occur[13]. Within the highest quality capital, each instrument absorbs losses on a going concern basis proportionately and *pari passu* with all the others.
9.	The paid in amount is recognised as equity capital (ie not recognised as a liability) for determining balance sheet insolvency.
10.	The paid in amount is classified as equity under the relevant accounting standards.
11.	It is directly issued and paid-in and the bank can not directly or indirectly have funded the purchase of the instrument.

[12] The criteria also apply to non joint stock companies, such as mutuals, cooperatives or savings institutions, taking into account their specific constitution and legal structure. The application of the criteria should preserve the quality of the instruments by requiring that they are deemed fully equivalent to common shares in terms of their capital quality as regards loss absorption and do not possess features which could cause the condition of the bank to be weakened as a going concern during periods of market stress. Supervisors will exchange information on how they apply the criteria to non joint stock companies in order to ensure consistent implementation.

[13] In cases where capital instruments have a permanent write-down feature, this criterion is still deemed to be met by common shares.

12.	The paid in amount is neither secured nor covered by a guarantee of the issuer or related entity[14] or subject to any other arrangement that legally or economically enhances the seniority of the claim.
13.	It is only issued with the approval of the owners of the issuing bank, either given directly by the owners or, if permitted by applicable law, given by the Board of Directors or by other persons duly authorised by the owners.
14.	It is clearly and separately disclosed on the bank's balance sheet.

Source: (BCBS 2011b)

12.9 Criteria for Inclusion in Additional Tier 1 Capital

1.	Issued and paid-in
2.	Subordinated to depositors, general creditors and subordinated debt of the bank
3.	Is neither secured nor covered by a guarantee of the issuer or related entity or other arrangement that legally or economically enhances the seniority of the claim vis-à-vis bank creditors
4.	Is perpetual, ie there is no maturity date and there are no step-ups or other incentives to redeem
5.	May be callable at the initiative of the issuer only after a minimum of five years: a. To exercise a call option a bank must receive prior supervisory approval; and b. A bank must not do anything which creates an expectation that the call will be exercised; and c. Banks must not exercise a call unless: i. They replace the called instrument with capital of the same or better quality and the replacement of this capital is done at conditions which are sustainable for the income capacity of the bank[15]; or ii. The bank demonstrates that its capital position is well above the minimum capital requirements after the call option is exercised.[16]
6.	Any repayment of principal (eg through repurchase or redemption) must be with prior supervisory approval and banks should not assume or create market expectations that supervisory approval will be given
7.	Dividend/coupon discretion: a. the bank must have full discretion at all times to cancel distributions/payments[17] b. cancellation of discretionary payments must not be an event of default c. banks must have full access to cancelled payments to meet obligations as they fall due d. cancellation of distributions/payments must not impose restrictions on the bank except in relation to distributions to common stockholders.
8.	Dividends/coupons must be paid out of distributable items
9.	The instrument cannot have a credit sensitive dividend feature, that is a dividend/coupon that is reset periodically based in whole or in part on the banking organisation's credit standing.
10.	The instrument cannot contribute to liabilities exceeding assets if such a balance sheet test forms part of national insolvency law.

11.	Instruments classified as liabilities for accounting purposes must have principal loss absorption through either (i) conversion to common shares at an objective pre-specified trigger point or (ii) a write-down mechanism which allocates losses to the instrument at a pre-specified trigger point. The write-down will have the following effects: a. Reduce the claim of the instrument in liquidation; b. Reduce the amount re-paid when a call is exercised; and c. Partially or fully reduce coupon/dividend payments on the instrument.
12.	Neither the bank nor a related party over which the bank exercises control or significant influence can have purchased the instrument, nor can the bank directly or indirectly have funded the purchase of the instrument
13.	The instrument cannot have any features that hinder recapitalisation, such as provisions that require the issuer to compensate investors if a new instrument is issued at a lower price during a specified time frame
14.	If the instrument is not issued out of an operating entity or the holding company in the consolidated group (eg a special purpose vehicle – "SPV"), proceeds must be immediately available without limitation to an operating entity[18] or the holding company in the consolidated group in a form which meets or exceeds all of the other criteria for inclusion in Additional Tier 1 capital

Source: (BCBS 2011b)

The 15th requirement was announced separately in a press release on 13th January 2011, and states that the instrument must be convertible into CET1 or written down on the occurrence of a 'trigger event', unless this is already provided for in national laws and confirmed as such by a peer review of those laws (Barfield 2011, p.71).

12.10 Criteria for Inclusion in Tier 2 Capital

1.	Issued and paid-in
2.	Subordinated to depositors and general creditors of the bank
3.	Is neither secured nor covered by a guarantee of the issuer or related entity or other arrangement that legally or economically enhances the seniority of the claim vis-à-vis depositors and general bank creditors
4.	Maturity: a. minimum original maturity of at least five years b. recognition in regulatory capital in the remaining five years before maturity will be amortised on a straight line basis c. there are no step-ups or other incentives to redeem
5.	May be callable at the initiative of the issuer only after a minimum of five years: a. To exercise a call option a bank must receive prior supervisory approval; b. A bank must not do anything that creates an expectation that the call will be exercised;[19] and c. Banks must not exercise a call unless: i. They replace the called instrument with capital of the same or better quality and the replacement of this capital is done at conditions which are sustainable for the income capacity of the bank[20]; or ii. The bank demonstrates that its capital position is well above the minimum capital requirements after the call option is exercised.[21]
6.	The investor must have no rights to accelerate the repayment of future scheduled payments (coupon or principal), except in bankruptcy and liquidation.
7.	The instrument cannot have a credit sensitive dividend feature, that is a dividend/coupon that is reset periodically based in whole or in part on the banking organisation's credit standing.
8.	Neither the bank nor a related party over which the bank exercises control or significant influence can have purchased the instrument, nor can the bank directly or indirectly have funded the purchase of the instrument
9.	If the instrument is not issued out of an operating entity or the holding company in the consolidated group (eg a special purpose vehicle – "SPV"), proceeds must be immediately available without limitation to an operating entity[22] or the holding company in the consolidated group in a form which meets or exceeds all of the other criteria for inclusion in Tier 2 Capital

Source: (BCBS 2011b)

The 10th requirement was announced separately in a press release on 13th January 2011, and states that the instrument must be convertible into CET1 or written down on the occurrence of a 'trigger event', unless this is already provided for in national laws and confirmed as such by a peer review of those laws (Barfield 2011, p.74).

12.11 Run-off Rates on Cash Outflows

Cash Outflows	
A. Retail deposits:	
Demand deposits and term deposits (less than 30 days maturity) • Stable deposits (deposit insurance scheme meets additional criteria) • Stable deposits • Less stable retail deposits	 3% 5% 10%
Term deposits with residual maturity greater than 30 days	0%
B. Unsecured wholesale funding:	
Demand and term deposits (less than 30 days maturity) provided by small business customers: • Stable deposits • Less stable deposits	 5% 10%
Operational deposits generated by clearing, custody and cash management activities • Portion covered by deposit insurance	25% 5%
Cooperative banks in an institutional network (qualifying deposits with the centralised institution)	25%
Non-financial corporates, sovereigns, central banks, multilateral development banks, and PSEs • If the entire amount fully covered by deposit insurance scheme	 40% 20%
Other legal entity customers	100%
C. Secured funding:	
• Secured funding transactions with a central bank counterparty or backed by Level 1 assets with any counterparty. • Secured funding transactions backed by Level 2A assets, with any counterparty • Secured funding transactions backed by non-Level 1 or non-Level 2A assets, with domestic sovereigns, multilateral development banks, or domestic PSEs as a counterparty • Backed by RMBS eligible for inclusion in Level 2B • Backed by other Level 2B assets • All other secured funding transactions	0% 15% 25% 25% 50% 100%
D. Additional requirements:	
Liquidity needs (eg collateral calls) related to financing transactions, derivatives and other contracts	3 notch downgrade
Market valuation changes on derivatives transactions (largest absolute net 30-day collateral flows realised during the preceding 24 months)	Look back approach
Valuation changes on non-Level 1 posted collateral securing derivatives	20%
Excess collateral held by a bank related to derivative transactions that could contractually be called at any time by its counterparty	100%
Liquidity needs related to collateral contractually due from the reporting bank on derivatives transactions	100%

Increased liquidity needs related to derivative transactions that allow collateral substitution to non-HQLA assets	100%
ABCP, SIVs, conduits, SPVs, etc:	
• Liabilities from maturing ABCP, SIVs, SPVs, etc (applied to maturing amounts and returnable assets)	100%
• Asset Backed Securities (including covered bonds) applied to maturing amounts.	100%
Currently undrawn committed credit and liquidity facilities provided to:	
• retail and small business clients	5%
• non-financial corporates, sovereigns and central banks, multilateral development banks, and PSEs	10% for credit 30% for liquidity
• banks subject to prudential supervision	40%
• other financial institutions (include securities firms, insurance companies)	40% for credit 100% for liquidity
• other legal entity customers, credit and liquidity facilities	100%
Other contingent funding liabilities (such as guarantees, letters of credit, revocable credit and liquidity facilities, etc)	National discretion
• Trade finance	0-5%
• Customer short positions covered by other customers' collateral	50%
Any additional contractual outflows	100%
Net derivative cash outflows	100%
Any other contractual cash outflows	100%
Total cash outflows	

Source: (BCBS 2013a)

12.12 Run-off Rates on Cash Inflows

Cash Inflows	
Maturing secured lending transactions backed by the following collateral:	
Level 1 assets	0%
Level 2A assets	15%
Level 2B assets • Eligible RMBS • Other assets	 25% 50%
Margin lending backed by all other collateral	50%
All other assets	100%
Credit or liquidity facilities provided to the reporting bank	0%
Operational deposits held at other financial institutions (include deposits held at centralised institution of network of co-operative banks)	0%
Other inflows by counterparty: • Amounts to be received from retail counterparties • Amounts to be received from non-financial wholesale counterparties, from transactions other than those listed in above inflow categories • Amounts to be received from financial institutions and central banks, from transactions other than those listed in above inflow categories.	 50% 50% 100%
Net derivative cash inflows	100%
Other contractual cash inflows	National discretion
Total cash inflows	
Total net cash outflows = Total cash outflows minus min [total cash inflows, 75% of gross outflows]	
LCR = Stock of HQLA / Total net cash outflows	

Source: (BCBS 2013a)

12.13 Available Stable Funding Factors

Summary of Liability Categories and associated ASF factors

ASF factor	Components of ASF category
100%	• Total regulatory capital • Other capital instruments and liabilities with effective residual maturity of one year or more
95%	• Stable non-maturity (demand) deposits and term deposits with residual maturity of less than one year provided by retail and SME customers
90%	• Less stable non-maturity deposits and term deposits with residual maturity of less than one year provided by retail and SME customers
50%	• Funding with residual maturity of less than one year provided by non-financial corporate customers • Operational deposits • Funding with residual maturity of less than one year from sovereigns, public sector entities (PSEs), and multilateral and national development banks • Other funding with residual maturity of not less than six months and less than one year not included in the above categories, including funding provided by central banks and financial institutions
0%	• All other liabilities and equity not included in above categories, including liabilities without a stated maturity • Derivatives payable net of derivatives receivable if payables are greater than receivables

Source: (BCBS 2014b)

12.14 Required Stable Funding Factors

Summary of asset categories and associated RSF factors

RSF factor	Components of RSF category
0%	• Coins and banknotes • All central bank reserves • Unencumbered loans to banks subject to prudential supervision with residual maturities of less than six months
5%	• Unencumbered Level 1 assets, excluding coins, banknotes and central bank reserves
15%	• Unencumbered Level 2A assets
50%	• Unencumbered Level 2B assets • HQLA encumbered for a period of six months or more and less than one year • Loans to banks subject to prudential supervision with residual maturities six months or more and less than one year • Deposits held at other financial institutions for operational purposes • All other assets not included in the above categories with residual maturity of less than one year, including loans to non-bank financial institutions, loans to non-financial corporate clients, loans to retail and small business customers, and loans to sovereigns, central banks and PSEs
65%	• Unencumbered residential mortgages with a residual maturity of one year or more and with a risk weight of less than or equal to 35% • Other unencumbered loans not included in the above categories, excluding loans to financial institutions, with a residual maturity of one year or more and with a risk weight of less than or equal to 35% under the Standardised Approach
85%	• Other unencumbered performing loans with risk weights greater than 35% under the Standardised Approach and residual maturities of one year or more, excluding loans to financial institutions • Unencumbered securities that are not in default and do not qualify as HQLA including exchange-traded equities • Physical traded commodities, including gold
100%	• All assets that are encumbered for a period of one year or more • Derivatives receivable net of derivatives payable if receivables are greater than payables • All other assets not included in the above categories, including non-performing loans, loans to financial institutions with a residual maturity of one year or more, non-exchange-traded equities, fixed assets, pension assets, intangibles, deferred tax assets, retained interest, insurance assets, subsidiary interests, and defaulted securities

Source: (BCBS 2014b)

12.15 Overview of Banks per Country Included in the Compliance Level Analysis

Country	Group 1	Group 2				Total	Hereof G-SIBs/
			Large	Medium	Small		
Austria	2	7	1	2	4	9	5
Belgium	2	9	0	2	7	11	6
Denmark	1	2	1	0	1	3	3
France	5	2	1	0	1	7	6
Germany	7	32	5	5	22	39	9
Greece	4	0	0	0	0	4	4
Hungary	1	1	0	0	1	2	2
Ireland	3	5	0	3	2	8	2
Italy	2	21	6	8	7	23	3
Luxembourg	0	3	0	1	2	3	2
Malta	0	3	0	0	3	3	2
Netherlands	3	9	2	2	5	12	5
Norway	1	1	0	1	0	2	1
Poland	0	5	1	0	4	5	0
Portugal	2	3	0	1	2	5	4
Spain	2	9	7	2	0	11	6
Sweden	4	3	0	2	1	7	4
United Kingdom	5	5	1	3	1	10	6
Total	**44**	**120**	**25**	**32**	**63**	**164**	**70**

Source: (EBA 2017)

12.16 Countercyclical Capital Buffer Rates per Jurisdiction

Member jurisdictions			
Jurisdiction	Current CCyB		Table last updated
	Effective date	Add-on (per cent of REA)	
Argentina	01.04.2016	0.00%	31.03.2016
Australia	01.01.2016	0.00%	17.12.2015
Belgium	01.07.2016	0.00%	21.03.2016
Brazil	01.01.2016	0.00%	14.12.2015
Canada	n/a	n/a	19.10.2015
China	n/a	n/a	19.10.2015
France	30.12.2015	0.00%	30.12.2015
Germany	01.01.2016	0.00%	15.12.2015
Hong Kong SAR	01.01.2016	0.63%	14.01.2016
India	n/a	n/a	n/a
Indonesia	23.05.2016	0.00%	23.05.2016
Italy	01.01.2016	0.00%	30.12.2015
Japan	31.03.2016	0.00%	31.03.2016
Korea	31.03.2016	0.00%	31.03.2016
Luxembourg	01.07.2016	0.00%	29.03.2016
Mexico	07.04.2016	0.00%	07.04.2016
Netherlands	12.04.2016	0.00%	12.04.2016
Russia	01.06.2016	0.00%	01.06.2016
Saudi Arabia	01.01.2016	0.00%	28.02.2016
Singapore	n/a	n/a	30.11.2015
South Africa	01.01.2016	0.00%	28.10.2015
Spain	01.07.2016	0.00%	01.07.2016
Sweden	27.06.2016	1.50%	27.06.2016
Switzerland	16.02.2016	0.00%	16.02.2016
Turkey	01.01.2016	0.00%	24.12.2015
United Kingdom	05.07.2016	0.00%	05.07.2016
United States	21.12.2015	0.00%	10.01.2016

Non-member jurisdictions			
Jurisdiction	Current CCyB		Table last updated
	Effective date	Add-on (per cent of REA)	
Norway	30.06.2016	1.50%	19.10.2015

Source: (BIS 2016b)

12.17 Country Abbreviations

AL / Albania

AD / Andorra

AM / Armenia

AT / Austria

BY / Belarus

BE / Belgium

BA / Bosnia and Herzegovina

BG / Bulgaria

CH / Switzerland

CY / Cyprus

CZ / Czech Republic

DE / Germany

DK / Denmark

EE / Estonia

ES / Spain

FO / Faeroe Islands

FI / Finland

FR / France

GB / United Kingdom

GE / Georgia

GI / Gibraltar

GR / Greece

HU / Hungary

HR / Croatia

IE / Ireland

IS / Iceland

IT / Italy

LT / Lithuania

LU / Luxembourg

LV / Latvia

MC / Monaco

MK / Macedonia

MT / Malta

NO / Norway

NL / Netherlands

PO / Poland

PT / Portugal

RO / Romania

RU / Russian Federation

SE / Sweden

SI / Slovenia

SK / Slovakia

SM / San Marino

TR / Turkey

UA / Ukraine

VA / Vatican City State

12.18 Evolution of REA Density and Exposure for IRB Banks in Europe

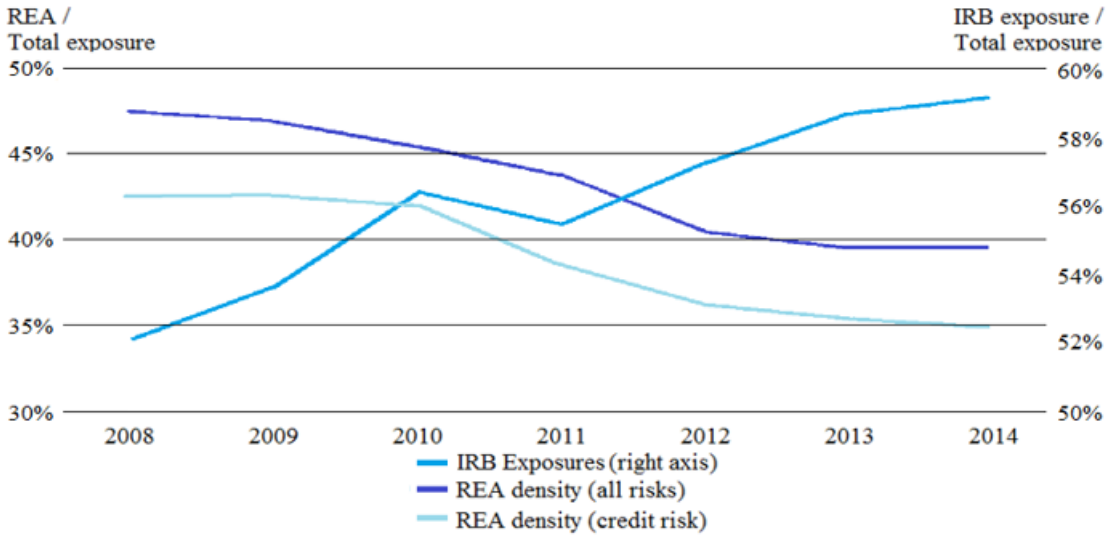
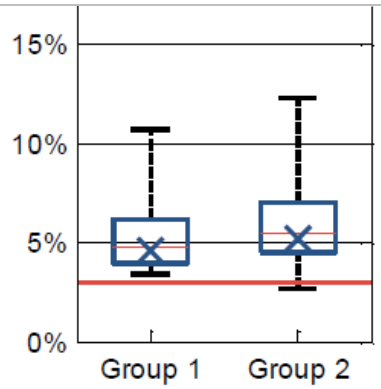


***Figure 57**: Exposure and REA density development for IRB banks in Europe*
***Source**: Own creation based information from (Resti 2016)*

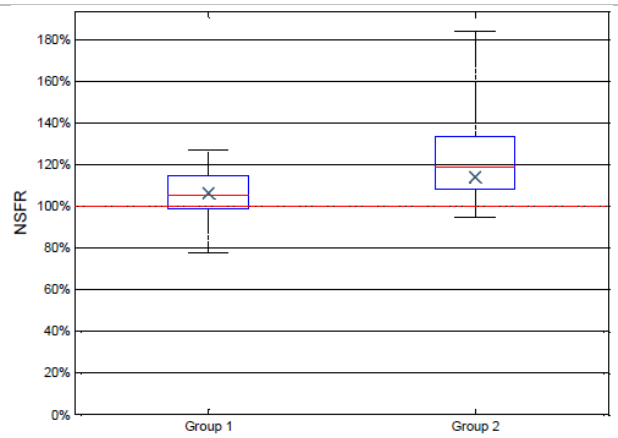
12.19 Descriptive Box Plot Statistics on Leverage Ratio



Box plot figure	Explanation
Thick red line	Minimum requirement
Thin red line	Median value
X	Mean
Blue box	25th and 75th percentile values
Black whiskers (vertical)	5th and 95th percentile values

***Figure 58**: Leverage ratio statistics and minimum leverage requirement*
***Source**: (EBA 2017)*

12.20 Descriptive Box Plot Statistics on Net Stable Funding Ratio



Box plot figure	Explanation
Thick red line	Minimum requirement
Thin red line	Median value
X	Mean
Blue box	25th and 75th percentile values
Black whiskers (vertical)	5th and 95th percentile values

***Figure 59**: NSFR statistics and minimum NSFR requirement*
***Source**: (EBA 2017)*

12.21 Evolution of HQLAs

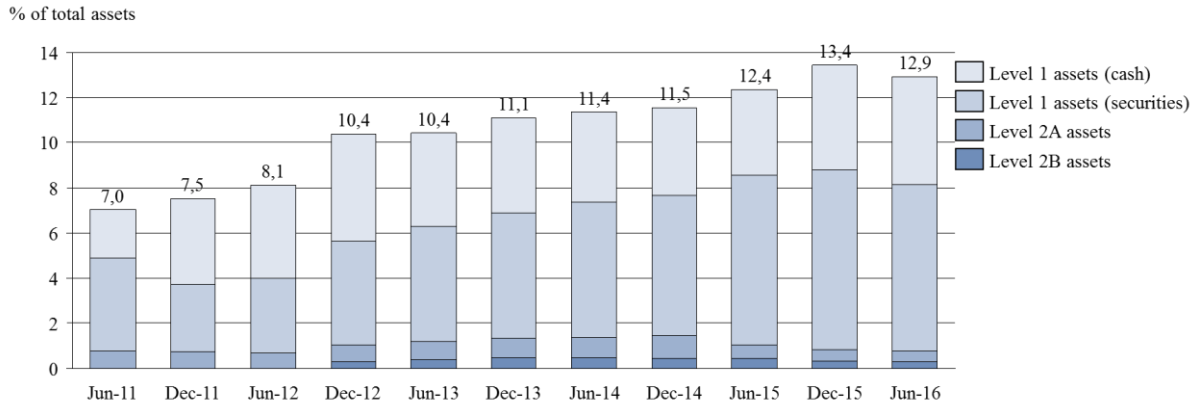


***Figure 60**: HQLA evolution – Group 1*
***Source**: Own creation based on (EBA 2017)*
Rounding errors may occur

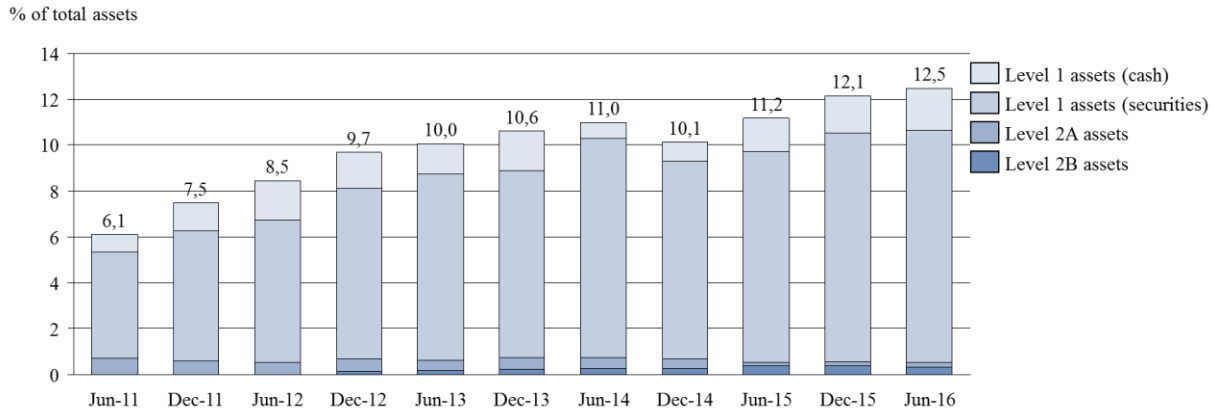


***Figure 61**: HQLA evolution – Group 2*
***Source**: Own creation based on (EBA 2017)*
Rounding errors may occur

12.22 Alternative Performance Measurement for RAROCAR

Recommended alternatives to RAROCAR are RAINCAR and Economic Profit[20].

RAINCAR denotes risk-adjusted income on capital at risk, and excludes operating costs.

$$\text{RAINCAR} = \frac{(\text{Income-expected loss})*(1\text{-tax rate})}{\text{Economic capital}} \qquad \textit{Equation 21}$$

By setting a hurdle rate that equals the required return on regulatory capital (e.g. 10%), banks can measure if the asset yields a return that covers the capital charge on the asset.

Economic Profit reflects RAROCAR in absolute terms. The advantage with Economic Profit is that captures the absolute value-add from an asset after returning cost of regulatory capital, which may be easier to comprehend for customer advisors as a negative Economic Profit reflects value-destroying businesses.

$$\text{EP} = (\text{income-cost-expected loss})*(1\text{-tax}) - (\text{cost of capital}*\text{economic capital}) \qquad \textit{Equation 22}$$

[20] Similar to economic value added (EVA)