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The differences in regulatory capital requirements for the banking and insurance industry regarding Dutch mortgages

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October 23, 2014

[Public version]

A study that compares the regulatory capital requirements under the first pillar on behalf of investing in Dutch mortgages for the banking and insurance industry.

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Preface

During the last six months, I have written this thesis at the ABN AMRO Bank N.V. in order to obtain my master's degree in Industrial Engineering and Management at the University of Twente. I am thankful that the ABN AMRO Bank N.V. offered me the opportunity to conduct the thesis at their company which has resulted in a better understanding of the banking industry, the regulations for financial institutions, mortgages and securitizations. For this, I would like to thank several people.

First, I would like to thank Robert-Jan Reitsma for the enthusiastic support which helped me to improve this thesis and to get a better understanding of the banks' business and financial institutions in general. Second, I would like to thank Berend Roorda and Toon de Bakker, my supervisors from the University of Twente, for providing feedback during our meetings. Furthermore, thanks to Mark Geubbels for providing feedback on my writing, thanks to Karim Bensaid for providing information from the credit risk department and thanks to the colleagues of the balance sheet department for the support and social interaction.

Finally, I would like to thank Aranka, family and friends for their support which helped me to successfully complete my study.

Edo van de Burgwal

Management Summary

The Dutch mortgage market is changing. Insurers increased their activity in providing mortgages and the regulation frameworks for the banking and insurance industry have changed during the last decade. Therefore, the discussion about the level playing field between insurers and banks has increased. This study contributes to this discussion by answering the research question: *Are there differences in the regulatory capital requirements for banks and insurers for the product Dutch mortgages?*

To answer this question, the relevant parts of the regulations Basel III and Solvency II are described and applied to the XX mortgage portfolio of ABN AMRO Bank N.V. Due to the available data, this study is restricted to the regulatory capital requirements of the first pillar. As hypothesis, it is assumed that there are differences in the regulatory capital requirement. Therefore, this study also examines the questions: What are the differences in the regulatory capital requirements for banks and insurers? Which characteristics of the mortgage have an effect on these differences? Are these differences reflected in the interest rates that banks and insurers set for the customer?

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Whereas the differences in the capital requirements are in favour for insurers for the lower Loan-to-Foreclosure-Values and fixed interest rate periods, the analysis of the interest rate indicates that insurers seems to have a higher focus on higher Loan-to-Foreclosure-Values and longer fixed interest rate periods.

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Abbreviations

AT1	Additional Tier-1
ABN	ABN AMRO Bank N.V.
BCBS	Basel Committee on Banking Supervision
BIS	Bank of International Settlements
BSCR	Basic solvency capital requirement
CET1	Common Equity Tier-1
CRD	Capital Requirements Directive
DNB	Dutch National Bank
EAD	Exposure at default
EC	European Commission
EIOPA	European Insurance and Occupational Pension Authority
EU	European Union
GDP	Gross domestic product
IRB	Internal ratings based
LGD	Loss given default
LtFV	Loan-to-Foreclosure-Value
LtMV	Loan-to-Market-Value
MCR	Minimum capital requirement
NHG	Nationale Hypotheek Garantie
NSC	Notional solvency criterion
PD	Probability of Default
QIS	Quantitative Impact Study
RoE	Return on Equity
RWA	Risk-weighted assets
SCR	Solvency capital requirement
SCR_{def}	Solvency capital requirement regarding counterparty default risk
$SCR_{def,2}$	Solvency capital requirement regarding counterparty default risk type 2
SIB	Systematically important bank
VaR	Value-at-Risk
WACC	Weighted average cost of capital

1 Introduction

The core business of banks and insurers is different; banks operate as financial intermediaries that link the capital of customers with a surplus to those with a shortage, whereas insurers indemnify customers in case a predefined event happens (Al-Darwish, Hafeman, Impavido, Kemp, & O'Malley, 2011). As a result, both industries have their own regulatory regimes.

After the financial crisis, these regulatory frameworks have changed to increase the financial market stability with adequate and consistent capital standards (Laas & Siegel, 2014). The regulation framework for the banking industry shifted from Basel II to Basel III in 2013 and Basel III will be fully effective as of 2019. At the same time, the insurance regulation has changed to Solvency II, which will come into force as of 2016.

Since these regulatory frameworks are built for two different industries, both regulations compute the regulatory capital requirements with different methods. These regulatory capital requirements are set to ensure that financial institutions are prudently managed (Laas & Siegel, 2014).

The new regulations started the discussion about the level playing field for banks and insurers. See for example the speech *same risk, same rules, same capital* of Leo de Boer, Director Verbond van Verzekeraars (Verbond van Verzekeraars, 2014), who argues that insurers have to hold more capital for wealth accumulation products. If the level playing field does not hold, it means that products of the same type with the same amount of risk have a different capital charge under both regulations. Consequently, this would give one industry a competitive advantage with respect to the other.

During the last years, the insurance industry started to invest more in the mortgage market directly, which is attractive for them due to the long term investment focus of insurers (NVM, 2014). ABN AMRO Bank N.V. (ABN) would like to know if this is caused by differences in the regulatory capital requirements that apply to mortgages under Basel III and Solvency II. Therefore, the following research question will be answered during this study:

Are there differences in the regulatory capital requirements for banks and insurers for the product Dutch mortgages?

The hypothesis is that there are differences in the regulatory capital requirements, since both industries have a different business model. Therefore, this study also examines the following:

1. What are the differences in the regulatory capital requirements for banks and insurers?
2. Which characteristics of the mortgage have an effect on these differences?
3. Are these differences reflected in the interest rates that banks and insurers set for the customer?

To present these findings, an overview of the Dutch mortgage market and the active providers will be given in Chapter 2. After this, Chapter 3 describes the regulatory capital requirements calculation under Basel III and Solvency II. These methods will be used for a numerical comparison of the capital requirements for the XX mortgage portfolio in Chapter 4. Finally, if these differences are reflected in the interest rates is analysed in Chapter 5.

Although an extensive amount of literature can be found on Basel III and Solvency II separately, the number of studies comparing Basel III with Solvency II is limited. There are some articles, such as *A comparative assesment of Basel II/III and Solvency II* (Gatzert & Wesker, 2011), *Possible Unintended Consequences of Basel III and Solvency II* (Al-Darwish et al, 2011) and *Solvency II and Basel III* (Zähres, 2011) which show the differences and similarities of the frameworks, but they all argue that it is hard to draw conclusions due to a lack of empirical evidence.

While those articles have a lack of empirical evidence, the article *Basel Accords versus Solvency II: Regulatory Adequacy and Consistency under the Postcrisis Capital Standards* (2014) includes an empirical research. It shows that the regulatory capital requirements for Solvency II are higher with 10.82% compared to the 8.79% that holds for systematically important banks (SIB) under Basel III. However, these numbers are based upon a stylized portfolio and are not specific for the Dutch market. Therefore, this study contributes to the literature by comparing the regulatory capital requirements based upon a real mortgage portfolio that contains Dutch mortgages only.

Delimitation

This study compares only the regulatory capital requirements of the first pillar which relate to Dutch mortgages.

2 The Dutch mortgage market

2.1 The Dutch mortgage market in numbers

Almost 4.3 million Dutch households owned a house on January 1, 2013, from which 83% had financed (a part) of their house with a mortgage (CBS, 2014). The total outstanding exposure was EUR 653 bln and EUR 637 bln at the end of respectively 2012 and 2013 (DNB, 2014a).

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The corresponding market shares are presented in Figure 2.1. This figure shows that the total market share of insurers – Achmea, AEGON, ASR and Delta Lloyd – is rising. The increase is mainly caused by the large increase in production of AEGON and Delta Lloyd, which are insurers with a long-term investment focus due to their supply of pensions and life insurances.

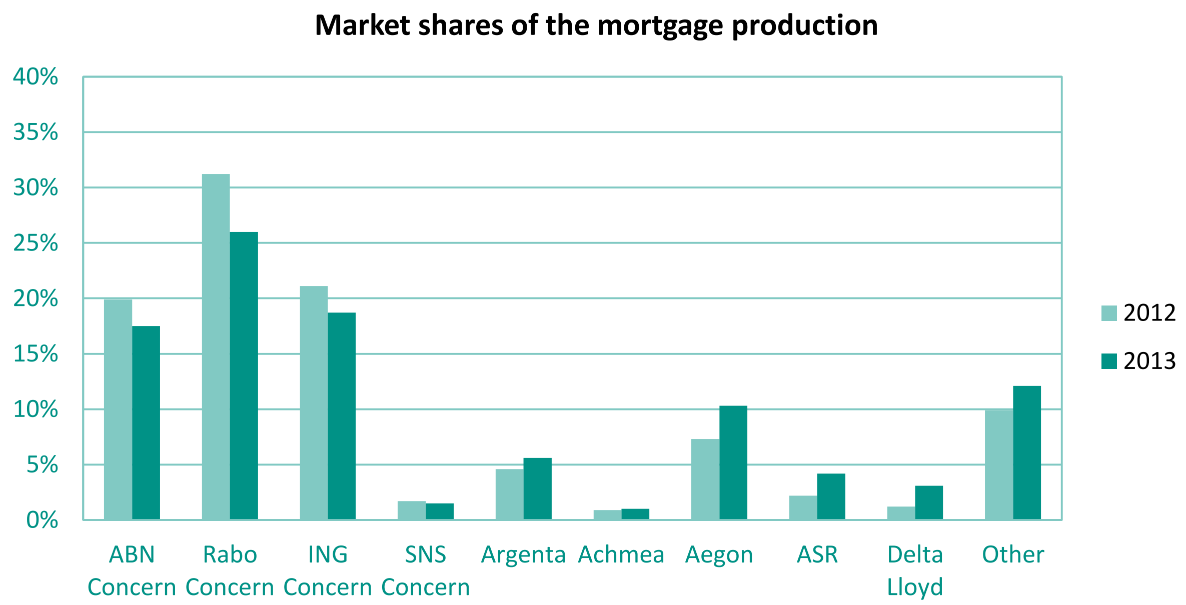

Figure 2.1 The mortgage production market shares in 2012 and 2013 (AAHG, 2014)

The decline in the mortgage production is caused by the financial crisis. Due to the financial crisis, the inflation corrected house prices dropped around 4% per year between 2008 and 2012 in the Netherlands (CBS, 2013). As a consequence of this price drop, approximately 1.1 million of the households had a Loan-to-Market-Value (LtMV) of more than 100% in 2012 and approximately 1.4 million in 2013 (CBS, 2014); i.e. the market value of their house is lower than the outstanding mortgage loan. Therefore, households are moving less and early repayment is stimulated so that the total outstanding mortgage exposure declines. Furthermore, originators apply stricter lending criteria for the issuance of new mortgages as agreed in the code of conduct mortgage finance 2011 (Dutch: gedragscode hypothecaire financieringen) (Homefinance.nl, n.d.).

In the Netherlands there is a unique feature that guarantees the repayment of the remaining debt in the event that the borrower is not able to fulfil the payment obligations due to a divorce, disability, unemployment or death. This is the so called Nationale Hypotheek Garantie (NHG). To receive the guarantee, a one-time fee of 1% has to be paid and the mortgage cannot exceed EUR 265,000 as of 1 July 2014 (NHG, n.d.). Mortgage providers assume that mortgages with NHG are less risky, such that the interest rate is up to 0.6% lower than a mortgage without the guarantee (NHG, n.d.). At the end of December 2013, almost 1.1 million mortgages were issued under NHG with a total outstanding exposure of EUR 164 bln (Stichting Waarborgfonds Eigen Woningen, 2014).

2.2 The mortgage providers

Some companies that are mentioned in Figure 2.1 are active in both the banking and insurance industry and thus they have legal entities that report under Basel and Solvency. Therefore, the annual reports of these providers are analysed to check under which entity the mortgages are provided and to which regulation they report. The findings are shown in Appendix A and the most important findings are summarised below:

- The Dutch system banks – ABN, ING Bank, Rabobank and SNS REAAL – hold their mortgages on the banking book and compute the regulatory capital requirements regarding credit risk via the advanced internal ratings based (IRB) approach;
- Argenta is a bank and insurance combination based in Belgium, which also provides mortgages on the Dutch market. The mortgages are issued from their banking entity which shifter recently from the standardized approach to the foundation IRB approach;
- Achmea, AEGON, Delta Lloyd, Nationale-Nederlanden and ASR core business is in the insurance industry. Although the insurance business is their core business all these companies, except ASR, have a separate legal entity that is operating as a bank and does provide their mortgages. It should be noted, however, that Achmea, AEGON and Nationale-Nederlanden sell parts of their mortgage portfolio to legal entities that apply the Solvency regulation. This is also noticed by the Dutch National Bank (DNB) who

argues that insurers have become more active as a provider of mortgage loans through banking subsidiaries (Z24, 2014b);

- Furthermore, Nationale Nederlanden Levensverzekering N.V. argues that it is interesting to invest in mortgages for an insurer on page 113 of their annual report: "*Residential mortgages are a common investment class for Dutch insurance companies, since their illiquidity provides a good match to the illiquidity of insurance liabilities. Mortgages provide a good risk-reward profile at current spreads and the risk is deemed manageable even if default losses are expected to rise.*"

3 The regulations

Both Basel III and Solvency II are based upon a three-pillar structure. The first pillar states the minimum capital requirements, the second pillar sets additional capital requirements for risks that are not covered in the first pillar and the third pillar specifies standards for the public disclosure of regulatory information (Gatzert & Wesker, 2011). This study is restricted to the first pillar, since the second pillar is specified for each company individually and the capital requirements are not affected by the public disclosure requirements of the third pillar. The capital requirements for banking and insurance industry are described in Section 3.1 and 3.2 and the capital requirements are theoretically compared in Section 3.3.

3.1 Capital requirements for the banking industry

The Basel Committee on Banking Supervision (BCBS) develops the regulatory guidelines for the banking industry that are known as Basel Accords (BIS, 2013). However, these accords do not hold the status of law and are therefore transformed into a Capital Requirements Directive (CRD) by the European Commission (EC) in order to be part of European law. Basel III is the most recent accord and is transformed into CRD IV (European Parliament, 2013).

Once the Basel guidelines are transformed into the CRD, national authorities have to transform the CRD so that it fits into their national legislation. In the Netherlands, this is the responsibility of the DNB. The national implementation of Basel III started in January 2013 and will be fully effective as of January 2019 (BIS, 2011).

The purpose of Basel III is to ensure that banks can absorb shocks arising from financial and economic stress. Therefore, regulatory capital requirements are set to make sure that the financial institutions are prudently managed. The capital that has to be held is divided into Common Equity Tier-1 (CET1), Additional Tier-1 (AT1) and Tier-2 capital. See page 12-18 of *Basel III: A global regulatory framework for more resilient banks and banking systems for the definitions* (BIS, 2011) for the definitions of these types of capital.

To compute the regulatory capital requirements regarding mortgages under Basel III the next four steps have to be executed:

1. Compute the risk-weight in euros for the credit and operational risk;
2. Multiply the risk-weight with the capital adequacy ratio (also known as BIS-ratio);

3. Compute and add the capital add-ons of pillar 2[1];
4. Compute the leverage ratio across the entire portfolio of the bank.

These steps are explained in the Sections 3.1.1-3.1.3. A schematically overview of Basel III is presented in Appendix B.

3.1.1 Risk-weighted assets calculation

The first pillar of Basel III classifies four categories of risks; concentration, credit, market and operational. The risk-weight has to be computed for each risk class individually and the total risk-weight is the sum of these risk-weights.

Residential mortgages are only exposed to credit risk and operational risk if they comply with the following definition (§231, BIS, 2005b): *"Residential mortgage loans (including first and subsequent liens, term loans and revolving home equity lines of credit) are eligible for retail treatment regardless of exposure size so long as the credit is extended to an individual that is an owner-occupier of the property (with the understanding that supervisors exercise reasonable flexibility regarding buildings containing only a few rental units - otherwise they are treated as corporate)."*

Credit risk-weight

The credit risk-weight of residential mortgages can be computed using the standardized approach or the IRB approach. Both approaches make a distinction between performing and defaulted loans, where a mortgage is defined to be in default when the repayments are past due for more than 90 days *(BIS, 2005b)*.

Standardized approach

The standardized approach is the most basic method to compute the risk-weight. The outstanding exposure of performing residential mortgages is multiplied with 35% (§72, BIS, 2005b) and for defaults with 100% (§78, BIS, 2005b).

IRB approach

The IRB approach allows banks to assign a specific risk-weight to each loan and client. The credit risk-weight for performing loans is than computed with the following formulas (§328, BIS, 2005b):

[1] This study is restricted to the first pillar and therefore this step will be neglected.

$$K = LGD \cdot N\left(\sqrt{\frac{1}{1-R}}G(PD) + \sqrt{\frac{R}{1-R}}G(0.999)\right) - LGD \cdot PD$$

$$RWA = K * 12.5 * EAD$$

Where R is the correlation coefficient which is set at 0.15 for mortgages; K the capital requirement; N(x) the normal cumulative distribution function; G(z) the inverse cumulative distribution function; and RWA the risk-weighted assets. The input parameters PD, EAD and LGD are defined on page 3-4 of *An Explanatory Note on the Basel II IRB Risk Weight Functions* (BIS, 2005a) as:

- *"probability of default (PD) per rating grade, which gives the average percentage of obligors that default in this rating grade in the course of one year*
- *exposure at default (EAD), which gives an estimate of the amount outstanding (drawn amounts plus likely future drawdowns of yet undrawn lines) in case the borrower defaults*
- *loss given default (LGD), which gives the percentage of exposure the bank might lose in case the borrower defaults. These losses are usually shown as a percentage of EAD, and depend, amongst others, on the type and amount of collateral as well as the type of borrower and the expected proceeds from the work-out of the assets."*

The IRB approach has two versions; the foundation and advanced method. Under the foundation IRB approach, the bank estimates the PD only, while under the advanced IRB approach the banks also estimates the EAD and LGD (BIS, 2005a).

The PD estimate that is inserted in the formula for K is the average PDs that reflects the expected default rates under normal business conditions. The Vasicek formula[2] turns the average PD into a downturn PD (dPD) which represents the PD in periods of economic stress. The Vasicek formula applies a confidence level of 99.9% (BIS, 2005a).

In contrast to the PD, Basel III does not propose an explicit function to transform the LGD into a downturn LGD (dLGD) and expect banks to determine this themselves (BIS, 2005a). As explained on page 8 of *An Explanatory Note on the Basel II IRB Risk Weight Functions*

[2] $N\left(\sqrt{\frac{1}{1-R}}G(PD) + \sqrt{\frac{R}{1-R}}G(0.999)\right)$

(BIS, 2005a), both LGD parameters that are inserted in the formula for K are estimates of the dLGD.

Since Basel III does not specify how this dLGD has to be computed, this differs per bank.

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In the United States, in contrast to Europe, the Federal Reserve System proposed a generic formula to compute the dLGD (Moody's Global Credit Policy, 2007)[3]:

$$\mathrm{dLGD} = 8\% + 92\% * \mathrm{LGD}$$

The estimates of the average PD and the dLGD that are inserted in the formula to compute K, are also restricted to a floor of 0.03% and 10% respectively (§266 & §331, BIS, 2005b). However, the dLGD floor of 10% does not hold for mortgages that have NHG.

Applying the formula of K for non-performing loans will results in a K of zero, since both the Vasicek formula and the PD are equal to 100%. Therefore, on page 8 of *An Explanatory Note on the Basel II IRB Risk Weight Functions* (BIS, 2005a) is explained that the required capital for defaulted mortgages is calculated via[4]:

$$\mathrm{K} = \max(0; \mathrm{dLGD} - \mathrm{LGD})$$

Operational risk-weight

The capital charges for operational risk can be computed using the basic indicator approach, the (alternative) standardized approach or the advanced measurement approach. Within ABN, the alternative standardized approach is used to calculate the operational risk-weight.

The alternative standard approach is related to the standardized approach. The standardized approach defines the bank's activities into eight categories and the capital charge is computed by summing up the individual charges for each business line. The alternative standard approach uses the same business lines and only changes the computation of the business lines retail banking and commercial banking. As stated in §653 (BIS, 2005b) mortgages fall under the retail banking and the operational capital charge is:

$$\mathrm{K_{rb}} = \beta_{\mathrm{rb}} \cdot \mathrm{m} \cdot \mathrm{LA_{rb}}$$

[3] Note that dLGD = 1 - downturn recovery rate, and that this could be rewritten to dLGD = $\alpha + (1 - \alpha)$LGD

[4] *"The difference of the downturn LGD and the best estimate of EL represents the UL capital charge for defaulted assets."*

Where β_{rb} is the beta for the retail business line which is set at 12%; m is equal to 0.035; and LA_{rb} is the average of outstanding loans and advances over the last three years (non-risk weighted and gross of provisions) (BIS, 2005b).

3.1.2 Capital adequacy ratio

The risk-weight of the operational and credit risk together is multiplied with a capital adequacy ratio. This ratio was 8% under Basel II. In Basel III this ratio is still 8%, but the quality of the capital is improved and additional capital buffers are introduced. Improving the quality of the capital is done by changing the proportions of Tier-1 and Tier-2 capital that needs to be held. As of January 2015 the minimum amount of CET1 will increase from 4% to 4.5%, the minimum amount of Tier-1 capital will rise from 5.5% to 6% and the remaining part of the 8% can be met with Tier-2 capital (BIS, 2011).

The extra capital buffers that are introduced in Basel III are the capital conservation buffer, countercyclical capital buffer and the systematically risk buffer. These buffers are described below in more detail. Figure 3.1 shows how the capital adequacy ratio is set from 2013 till 2019 (BIS, 2011).

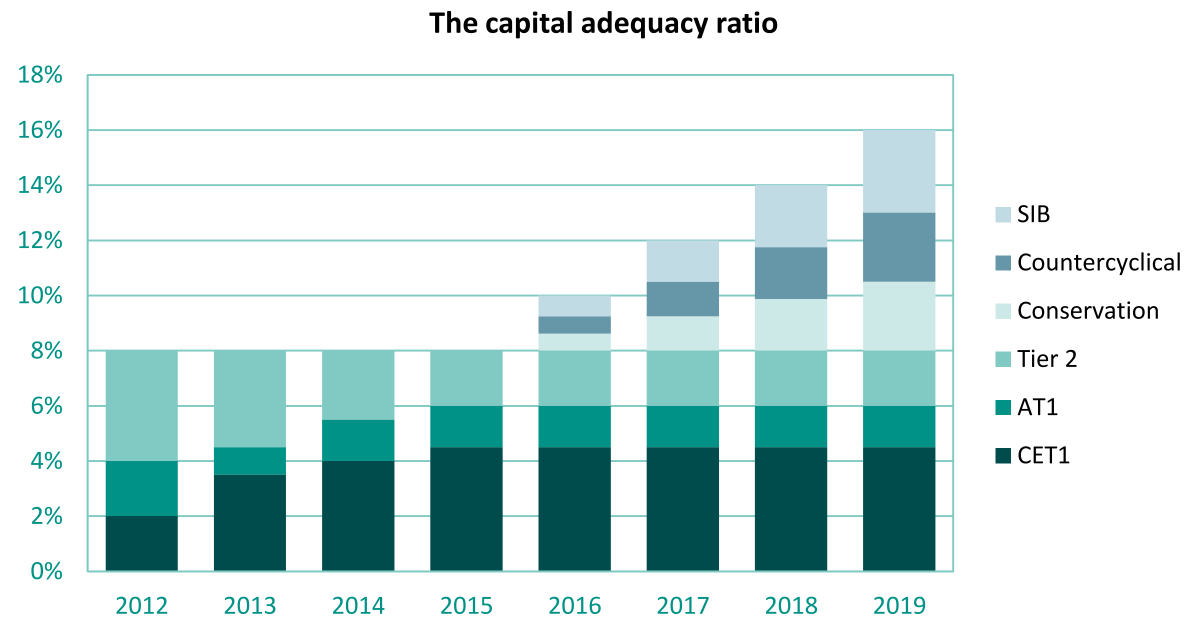

Figure 3.1 The Basel III capital adequacy ratios for the system banks

Capital conservation buffer[5]

The capital conservation buffer is designed to enable banks to hold capital in periods of economic growth, which may be used to compensate for losses during periods of stress. This

[5] See for the original definitions pages 54-57 (BIS, 2011)

means that banks are heading towards a two-level approach; one level is the ‘desired’ amount of capital which can be used to absorb unexpected losses and the second level is the absolute minimum amount of capital which has to be hold. However, consuming this buffer will lead to supervisory restrictions. The capital conservation buffer requires banks to hold 2.5% of CET1 above the minimum capital requirements of 8% and this will increase annually from 2016 until the value of 2.5% is reached in 2019.

Countercyclical capital buffer[6]

Banks can face severe losses in the event that a period of excessive credit growth is followed by an economic downturn. The countercyclical buffer is introduced to prevent banks from the consequences of such an event. This buffer will be set at 0% in times of normal credit expansion and national authorities can raise it to a maximum of 2.5% if their country faces excessive credit growth. Banks that are internationally active have to hold a weighted average of the required buffers from the different countries. The countercyclical buffer is introduced in the same way as the conservation buffer.

The BCBS noticed that a fast increase in the ratio of credit loans / gross domestic product (GDP) often leads to problems (DNB, 2010). Therefore, national authorities are required to compute this ratio over the long-term and compare this with the ratio of the last quarter. If the current ratio exceeds the long-term ratio with more than 2%, the countercyclical buffer will be set. The countercyclical buffer will be set at the maximum of 2.5% when the current ratio exceeds the long-term ratio with 10% or more. The DNB computes what this buffer would have been over history for Germany, the Netherlands, the United Kingdom and the United States. These graphs are presented in Appendix C.

SIB Buffer

Some banks needed government support during the financial crisis to avoid a collapse that would cause large economic problems. These banks are ‘too big to fail’ and therefore defined as a SIB. Basel III wants to avoid that these banks cause economic problems by introducing a SIB buffer. This buffer requires a SIB to hold extra CET1 capital (BIS, 2011). The percentage of CET1 capital is defined by the national authorities. The DNB requires ABN, ING Bank and Rabobank to hold a buffer of 3% and 1% for SNS Bank (DNB, 2014b). This buffer is introduced similarly to the conservation and countercyclical buffer.

[6] See for the original definitions page 57-60 (BIS, 2011)

3.1.3 Leverage Ratio

Whereas the capital requirement – as explained above; RWA multiplied with the capital adequacy ratio – are risk based, the leverage ratio is a non-risk based capital ratio. Therefore, it will function as a 'back stop' measure for the risk-weighted capital charge, since a banks has to hold the greater of the risk-weighted capital charge and the leverage ratio. The leverage ratio is defined as Tier-1 capital divided by the total exposure and should equal 3% of the outstanding exposure. It should be noted that this 3% is set as a test value by the European Banking Authority and the real percentage will be published in 2017 (BIS, 2013). In the Netherlands, there are already political discussions whether this leverage ratio should be raised to 4% or even higher for Dutch banks (Z24, 2014a).

3.2 Capital requirements for the insurance industry

The regulatory framework for insurers is developed by the EC and is named Solvency. In contrast to the Basel Accords, this framework holds the status of a law for insurers operating in the European Union (EU). These guidelines are further specified in the Quantitative Impact Study (QIS) done by the European Insurance and Occupational Pension Authority (EIOPA). The results of the QIS are transformed into national legislation by the national authorities. As of January 2016, Solvency II becomes effective (DNB, 2013).

In order to prepare for the Solvency II regulation EIOPA introduced preparatory guidelines which are known as Solvency 1.5. National authorities have to apply these preparatory guidelines in their country on a comply-or-complain basis as of January 2014, which means that national authorities decide that their country applies these guidelines or explains why they do not apply these guidelines. The DNB requires insurers to apply these guidelines as of January 2015. However, the 40 largest life insurers already apply a Notional Solvency Criterion (NSC), which is based on the Solvency II regulations. Insurers that breach the NSC are not allowed to pay out dividends (DNB, 2013).

Solvency II makes a distinction between the solvency capital requirement (SCR) and the minimal capital requirement (MCR). The SCR is the level of capital that an insurer needs to hold to have sufficient resources over the next year with a certainty of 99.5%. Breaching this requirement will lead to moderate supervision actions. The MCR is the absolute minimum of capital that needs to be held and is set between 25% and 45% of the SCR. Breaching this requirement will lead to serious supervision measures or even a bankruptcy. Solvency II divides the capital into three different tiers: Tier-1, Tier-2 and Tier-3. The definitions of these tiers can be found on page 295-307 the *QIS5 Technical Specifications* (CEIOPS, 2010) . The SCR should be met with at least 50% of Tier-1 items and could exist of utmost 15% Tier-3.

The SCR can be computed using either an internal model, standard model, a combination of both models or by using simplifications. The regulation specifies rules that apply to the standard model, but it does not specify any formulas for an internal model. Therefore, this section only provides an overview of the capital requirements that are set regarding mortgages under the standard model.

The next steps have to be executed to compute the SCR and are described in more detail in the Sections 3.2.1-3.2.4. A full overview of the Solvency II frameworks is presented in Appendix D.

1. Compute the solvency capital requirement for counterparty default risk for type 2 exposures ($SCR_{def,2}$);
2. Compute the solvency capital requirement for counterparty default risk (SCR_{def});
3. Compute the basic solvency capital requirement (BSCR);
4. Compute the adjustment and operational risk.

3.2.1 $SCR_{def,2}$

Mortgages are treated as type 2 exposures under the counterparty default risk module if the following requirements are met (p. 195-196, EIOPA, 2014): "*(1) The exposure shall be either to a natural person or persons or to a small or medium sized enterprise. ... (3) The total amount owed to the insurance or reinsurance undertaking ... shall not, to the knowledge of the insurance or reinsurance undertaking, exceed EUR 1 million. ... (4) The residential property is or shall be occupied or let by the owner. (5) The value of the property does not materially depend upon the credit quality of the borrower.*"

To compute the $SCR_{def,2}$ the following formula is used (141, CEIOPS, 2010):

$$\mathrm{SCR}_{\mathrm{def,2}} = \Delta\mathrm{NAV} \,|\, \text{type 2 counterparty default shock}$$

Where NAV is the net value of assets; and the type 2 counterparty default shock is computed as follows:

$$\text{type 2 counterparty default shock} = 0.15 \cdot \mathrm{E} + 0.9 \cdot \mathrm{E}_{\mathrm{past-due} > 3m}$$

Where $E_{\text{past-due} > 3m}$ is the sum of values of receivables that are past due for more than 3 months; and E the sum of values for type 2 which is computed as follows:

$$E = \max(0; \text{Exposure}_i - \text{Secured}_i)$$

Exposure_i is the mortgage exposure to borrower i; and Secured_i the fully and completely secured part of the exposure to borrower i. The fully and completely secured part is the part of the exposure covered by real estate after subtracting a haircut, which is 25% for residential real estate (i.e. the secured part is 75% of the real estate value).

3.2.2 SCR_{def}

The SCR_{def} consist of type 1 and type 2 exposures; type 1 exposures may not be diversified and the counterparty is usually rated, whereas type 2 exposures are usually diversified and the counterparty is usually unrated (p. 134-135, EIOPA, 2010). As explained in Section 3.2.1, mortgages are categorized as type 2 exposures. The $\text{SCR}_{\text{def,1}}$ and $\text{SCR}_{\text{def,2}}$ should be calculated separately and the risk module SCR_{def} is than computed via (p. 136, CEIOPS, 2010):

$$\text{SCR}_{\text{def}} = \sqrt{\text{SCR}_{def,1}^2 + 1.5 \cdot \text{SCR}_{\text{def,1}} \cdot \text{SCR}_{\text{def,2}} + SCR_{def,2}^2}$$

3.2.3 BSCR

When the SCR is computed for each risk module individually, the BSCR can be computed via the following formula (p. 95, CEIOPS, 2010):

$$\text{BSCR} = \sqrt{\sum\nolimits_{\text{ij}} \text{Corr}_{\text{ij}} \cdot \text{SCR}_i \cdot \text{SCR}_j} + \text{SCR}_{\text{intangibles}}$$

Where i and j refer to the market, default, life, health and non-life risk; and Corr_{ij} is the correlation of i and j as given in the correlation matrix given in Table 3.1.

Table 3.1 The BSCR correlation matrix (CEIOPS, 2010)

Risk type	Market	Default	Life	Health	Non-Life
Market	1	0.25	0.25	0.25	0.25
Default	0.25	1	0.25	0.25	0.5
Life	0.25	0.25	1	0.25	0
Health	0.25	0.25	0.25	1	0
Non-Life	0.25	0.5	0	0	1

3.2.4 SCR

The SCR is computed by adding up the BSCR, operational risk and adjust this for the risk absorbing effect of technical provisions and deferred taxes. For residential mortgage loans, the module adjustment for the risk absorbing effect of technical provisions and deferred taxes is not applicable. Therefore, only the module BSCR and operational risk have to be calculated. The operational risk is computed as follows (p.103-104, CEIOPS, 2010):

$$\mathrm{SCR_{Op}} = \min(0.3 \cdot \mathrm{BSCR}; \mathrm{Op}) + 0.25 \cdot \mathrm{Exp_{ul}}$$

Where $\mathrm{Exp_{ul}}$ represents the annual expenses during the previous 12 months in life insurance; $\mathrm{Op} = \max(\mathrm{Op_{premiums}} ; \mathrm{Op_{provisions}})$; $\mathrm{Op_{premiums}}$ is calculated via a specified formula that uses earned premiums as input paramters; $\mathrm{Op_{provisions}}$ uses obligations as input parameters.[7]

3.2.5 NSC

The DNB requires the 40 largest life insurers to stress-test their capital requirements which specifies the computation for the capital requirements of mortgages similar to Solvency II. However, the applied haircut for the residential real estate increases to 40% and mortgages with NHG are treated differently; the type 2 counterparty default shock for mortgages with NHG equals 0.07% of the outstanding exposure.

3.3 Theoretical comparison

Section 3.1 and 3.2 describe the methods to compute the regulatory capital requirements that banks and insurers need to hold regarding mortgages. The methods of both regulations make a distinction between performing and defaulted loans, where mortgages are defined to be in default if the payments are past-due for more than three months. The major differences between Basel III and Solvency II that could be noticed based upon these theoretical descriptions are as follows:

- The mortgage exposure is related to operational and credit risk under Basel III and to operational and counterparty default risk under Solvency II;
- The operational and credit risk of Basel III are based on a Value-at-Risk (VaR) of 99.9%[8], while Solvency II uses a VaR of 99.5% for all their risk modules;

[7] See pages 102-104 (CEIOPS, 2010) for more information on these formulas.
[8] For the market risk Basel III uses a VaR of 99%.

- The standard approach of Basel III is not risk based, while the standard approach of Solvency II does reflect risk within the $SCR_{def,2}$ which is based upon the Loan-to-Foreclosure-Value (LtFV);
- The regulatory capital requirements of Basel III are the greater of the capital ratio times the risk-weight or the leverage ratio of 3% times the outstanding exposure. Insurers do not have such a non-risk based ratio;
- Solvency II has a two-level approach with the SCR and MCR, while Basel III does only include a two-level approach in the conservation buffer;
- Solvency II has a diversification benefit within the SCR_{def} module and one for the calculation of the BSCR[9], while Basel III does not include a diversification benefit;
- The IRB approach under Basel III and the calculation of the SCR do not include any explicit maturity adjustment. However, the fixed interest rate period is one of the parameters that is used to model the PD such that the fixed interest rate period is implicitly included in the IRB approach.

[9] There is also a global diversification effect at the consolidated group level (Gatzert & Wesker, 2011)

4 The numerical comparison

The aim of this chapter is to compare the regulatory capital requirements of banks and insurers based upon the XX mortgage portfolio of ABN. Section 4.1 will describe the regulatory capital requirements for banks based upon this portfolio, Section 4.2 does this for insurers and Section 4.3 will compare the regulatory capital requirements of both industries.

This study compares the advanced IRB approach of ABN with the standard model of Solvency II. This is the consequence of the fact that ABN applies the advanced IRB approach to their portfolio which makes it possible to obtain the appropriate data. However, Solvency II does not describe how an internal model is built and therefore it is not possible to apply an internal model with the obtained data. Some arguments that justify this approximation are presented in Appendix E.

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4.1 The capital requirement for banks

The first part of this section describes how the regulatory capital requirements for banks are computed and the second part shows the results.

4.1.1 The regulatory capital requirements calculation

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Finally, the regulatory capital requirement is the greatest among the risk-weighted capital requirements and the leverage ratio. To show the influence of the leverage ratio this will be presented separately from the risk-weighted capital charge. For a summary of the used methods and all the assumptions to compute the regulatory capital requirement for banks, see Table 4.1.

Table 4.1 Methods and assumptions used in this study for banks

Bank	Assumptions
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4.1.2 The results

The regulatory capital requirements regarding the credit and operational risk are presented in Figure 4.1. This figure uses the LGD as input and not the dLGD. The figure shows that the regulatory capital requirements of mortgages under the first pillar are dominated by the leverage ratio, regardless if it is 3 or 4%. It should be noted, however, that pillar 2 is not included in this comparison and that the leverage ratio is applied over the whole portfolio of the bank and not for each individual investment. Therefore, business lines or mortgages with a risk-weighted capital charge that is higher than the leverage ratio can compensate for those that are below the leverage ratio.

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Figure 4.1 The regulatory capital requirements for credit and operational risk

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Figure 4.2 The influence of the downturn factor

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Table 4.2 The influence of the fixed interest rate period on the credit risk capital charge

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4.2 The capital requirement for insurers

Similar to Section 4.1 this section describes first how the regulatory capital requirements for insurers under the standard model are computed and the second part shows the results. In appendix E is justified that comparing the IRB approach of banks with the standard model of insurers is not a bad approximation.

4.2.1 The regulatory capital requirements calculation

The first step under Solvency II is to compute the $SCR_{def,2}$. This is done by applying the following formula in Excel:

$$0.15 \cdot \text{MAX}(0;\ \text{residual debt} - \ 0.75 \cdot \text{foreclosure value})$$

Once the $SCR_{def,2}$ is computed, the SCR_{def} can be computed as described in Section 3.2.2. The formula for SCR_{def} uses correlation factors between type 1 and type 2 exposures and therefore a diversification effect occurs. When the SCR_{def} is computed, the BSCR should be computed as described in Section 3.2.3. This formula also uses correlations and creates another diversification effect.

With the data used in this study, it is only possible to compute the $SCR_{def,2}$. Therefore, this study uses a diversification factor to get from the $SCR_{def,2}$ to the BSCR of 0.4078 (i.e. the diversification effect is -59.22% for both steps together). This diversification factor is estimated based upon the average breakdown of type 1 / type 2 exposures and the average breakdown for the six risk modules based upon the *draft Technical specifications for QIS5* (EC, 2010). The assumption of the diversification effect is discussed in more detail in Appendix G.

The last step to compute the SCR is to add the operational risk and adjustment to the BSCR. The adjustment does not apply to mortgages and the operational risk can be calculated as explained in Section 3.2.4. However, this is not possible with the obtained data. Therefore, the operational risk is estimated at 5.4% of the BSCR, which is similar to the operational risk as presented in the *EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II* (2011). The 5.4% is distributed proportional to the residual debt of each risk class.

4.2.2 NSC

The SCR for mortgages under the NSC can be computed using similar steps as mentioned in Section 4.2.1. The only difference is that the $SCR_{def,2}$ is applied in Excel as follows:

$$\text{IF}(\text{NHG} = \text{“J”};\ 0.07\% \cdot \text{residual debt};\ 0.15 \cdot \text{MAX}(0;\text{residual debt} - 0.60 \cdot \text{foreclosure value}))$$

An overview of all the methods and assumptions to compute the regulatory capital requirements regarding mortgages for insurers is presented in Table 4.3.

Table 4.3 Methods and assumptions used in this study for insurers

Insurers	Assumptions
Regulation framework	Solvency II and NSC
Method to compute SCR	Standard model
Treatment operational risk	5.4% of the BSCR*
Diversification factor from $SCR_{def,2}$ to BSCR	0.4078 (i.e. diversification of -59.22%)

* As explained before, with the data used in this study it is not possible to compute the operational risk-weight

4.2.3 The results

The result of applying the standard model of Solvency II and NSC with the diversification factor of 0.4078 is presented in Figure 4.3. The $SCR_{def,2}$ for LtFVs up to 75% are zero for Solvency II (up to 60% for NSC). Therefore, the SCR for LtFVs below these values consist of the operational risk only.

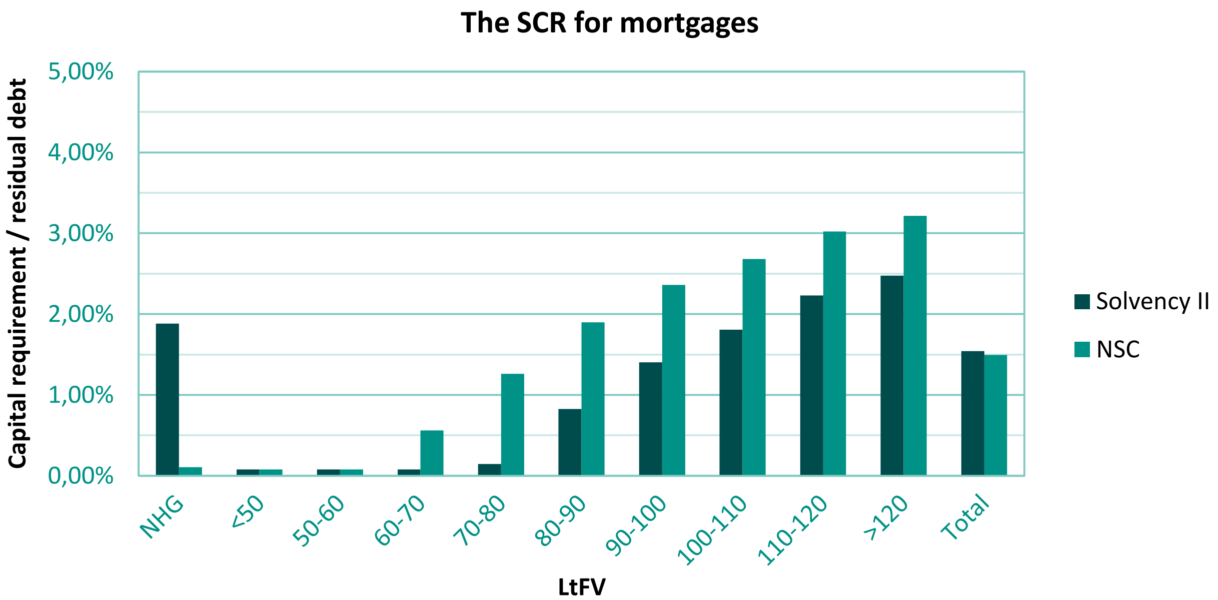

Figure 4.3 The RC requirements exclusive operational risk

The figure shows that the NSC and Solvency set different capital requirements. Most striking is the difference in the treatment of NHG mortgages, for which the NSC does specify separate rules, whereas Solvency II does not make such a distinction.

4.3 Comparison

To show the differences in the regulatory capital requirements for banks and insurers, the regulatory capital requirements of both industries are presented in Figure 4.4.

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Figure 4.4 The regulatory capital requirements of Solvency II, NSC and Basel III

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5 The pricing

This chapter shows what the cost of capital are for the regulatory capital requirements as derived in Chapter 4 for banks and insurers. After deriving the cost of capital, it is analysed if these differences are reflected in the interest rates that banks and insurers set for the customer.

5.1 Cost of capital

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Table 5.1 total regulatory capital requirements per regulation

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Table 5.2 cost of capital in EUR 1,000

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Table 5.3 cost of capital in basis points

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5.2 Interest rates comparison

The numerical comparison of Chapter 4 shows that there are differences in the regulatory capital requirements of banks and insurers and Section 5.1 shows that there are differences in the cost of capital that has to be included in the interest rates. This chapter will show whether these differences are reflected in the pricing by analysing the interest rates. This chapter starts with an explanation of how the analysis is conducted after which the results are shown and discussed.

The interest rates fluctuate over time. To deal with these fluctuations, the interest rates of are averaged over the last year for each mortgage provider. The interest rates that are used are those as reported within ABN on the first Monday of each month from October 2013 till September 2014. In Appendix H is shown which mortgage providers are included in this dataset and which providers are seen as a bank or insurer. The differences in the average interest rates over the last year between banks and insurers are presented in Figure 5.1. A positive value indicates that banks are offering lower interest rates and vice versa.

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Figure 5.1 The average interest rate difference between banks and insurers of the last year

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Figure 5.2 The interest rate differences between banks and insurers of September 1, 2014

6 Conclusions & Recommendations

Whereas the main providers of Dutch residential mortgages have been banks during history, insurers have increased their mortgage production during the last years. This could be the effect of the recent developments in the regulation frameworks for banks and insurers. These frameworks set capital requirements to make the financial system more stable. *It is the aim of this research to indicate if there are differences in the regulatory capital requirements for banks and insurers for the product Dutch mortgages.*

As hypothesis, it is assumed that there are differences in the regulatory capital requirements and therefore this study gives a more in-depth insight in the differences based on a theoretical description of the regulations and a numerical comparison of the regulations based upon the XX mortgage portfolio.

The theoretical description shows that mortgages are exposed to operational and credit risk under the Basel III approach with a VaR of 99.9%, whereas mortgages are exposed to operational and counterparty default risk under Solvency II with a VaR of 99.5%. The methods to compute the credit risk under Basel III and counterparty default risk under Solvency II are both risk-based, except for the standard approach of Basel. In addition to the risk-based capital requirements, Basel III introduced a leverage ratio which is a non-risk based measurement. Furthermore, Solvency II takes a diversification effect into account which is not considered under Basel III.

The numerical comparison confirms that there are differences in the regulatory capital requirements between both regulations. This comparison is restricted to the first pillar and computes the credit risk of Basel III with the advanced IRB approach and the SCR of solvency II with the standard model. To compute the SCR, the diversification effect is estimated at 59.22%, which is based upon the averages as presented in *EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II* (2011) for solo undertakings.

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The analysis of the interest rates shows that there are differences between the average interest rates of banks and insurers last year. This analysis shows that the interest rates of insurers are lower for long-term fixed interest rates and high LtMVs. This could be the consequence of the fact that insurers try to match their long-term liabilities with long-term assets.

6.1 Limitations

There are a few features of the current research that limit the conclusions that can be drawn from these results. Foremost among these is the exclusion of the second pillar. It is likely that its inclusion would increase the gap between the capital requirements of both regulations, since Basel III does expect banks to hold more capital above the requirements as set under the first pillar, while the use of these capital add-ons is not explicitly planned under Solvency II (Gatzert & Wesker, 2011). Besides the exclusion of the second pillar, this study also excludes mortgages that are in default. Including both the second pillar and the defaulted mortgages would show the full capital requirements that are set under both regulations. Another limitation is the lack of data from an insurer's perspective. A comparison which is constructed in cooperation with both a bank and an insurer would increase the reliability.

Furthermore, it should be noted that the development of the Solvency II regulations is still in progress. Since this framework is not fully developed yet, it is unclear what the precise capital requirements will be. One of the most important things that is still unclear is whether the matching adjustment will apply to mortgages.

6.2 Suggestions for future research

This study contributes to a better understanding of the differences between banks and insurers regarding the issuance of mortgages. However, further research can help to get a better insight in the differences between the behaviour of banks and insurers on the mortgage market:

- A complete comparison of the regulatory capital requirements which also includes defaulted mortgages and the second pillar;
- The analysis as executed in this study can be supplemented with an analysis of the capital requirements under an internal model for insurers, since it could be expected that insurers with an increased activity in the mortgage market would like to gain from the advantages of an intern model. Therefore, such a model would give a better insight in the estimation of the risks and it is likely that the capital requirements are lowered;
- Valuable insights could be gained by comparing all the aspects that affect the pricing of mortgages for the banking and insurance industry. Some examples of aspects that could be included are the cost of funding, liquidity and provisions;
- Better products could be offered if all the factors that influence the customer choice for a specific mortgage provider are analysed.

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8 Appendix

Appendix A The mortgage providers and their regulatory environment

Table 8.1 The regulatory environments of the mortgage providers

Mortgage provider	Method to compute the regulatory capital requirements	Total mortgage exposure 2013
ABN AMRO (ABN, 2014a)	The advanced IRB approach of Basel is applied for the whole mortgage portfolio.	EUR 150.5 bln
Achmea (Achmea, 2014)	Computes the SCR using a standard model for the risk modules life, counterparty default and operational risk, but mortgages are provided under the bank entity that applies Basel.	EUR 11.6 bln
AEGON (AEGON, 2014)	The insurance entities of AEGON apply an internal model to compute the SCR. The banking entity applies the standard approach to fulfil the Basel regulation. Mortgages are provided under their banking entity and later sold to other insurance entities.	Aegon Bank: EUR 4.2 bln Aegon Hypotheken: EUR 1.4 bln Aegon Levensverzekering: EUR 16.8 bln Aegon Schadeverzekering: EUR 0.5 bln
Argenta (ARGENTA, 2014)	A Belgium bank that applies the foundation IRB approach.	EUR 10.7 bln
ASR (A.S.R., 2014)	A standard model of solvency is applied, but the intention is to develop an internal model.	EUR 4.8 bln
Delta Lloyd (Delta Lloyd Group, 2014)	Mortgages are sold under a banking entity that uses the standardized approach of Basel. Some mortgages are sold to insurance entities that fulfil the Solvency regulation.	Total: EUR 16.8 bln Life business: EUR 247.2 mln Other insurance business: EUR 62.3 mln
ING Bank (ING Group, 2014)	The advanced IRB approach of Basel is applied to EUR 137.40 bln out of EUR 138.36 bln. The other part is computed via the standardized approach.	EUR 138.4 bln
Nationale Nederlanden (NN Bank N.V., 2014) (NN Levensverzekering Maatschappij N.V., 2014)	The banking entity uses the standardized approach to fulfil the Basel regulation. For mortgages on the balance sheet of NN Life is the SCR computed via the standard model, but the intention is to develop an internal model.	NN Bank: EUR 6.23 bln NN Life: EUR 7.99 bln
Rabobank (Rabobank Groep, 2014)	The advanced IRB approach of Basel is applied for the whole mortgage portfolio.	EUR 209.1 bln
SNS Reaal (SNS REAAL, 2014)	The advanced IRB approach of Basel is applied for the whole mortgage portfolio.	EUR 47.0 bln

Appendix B A schematic overview of Basel III

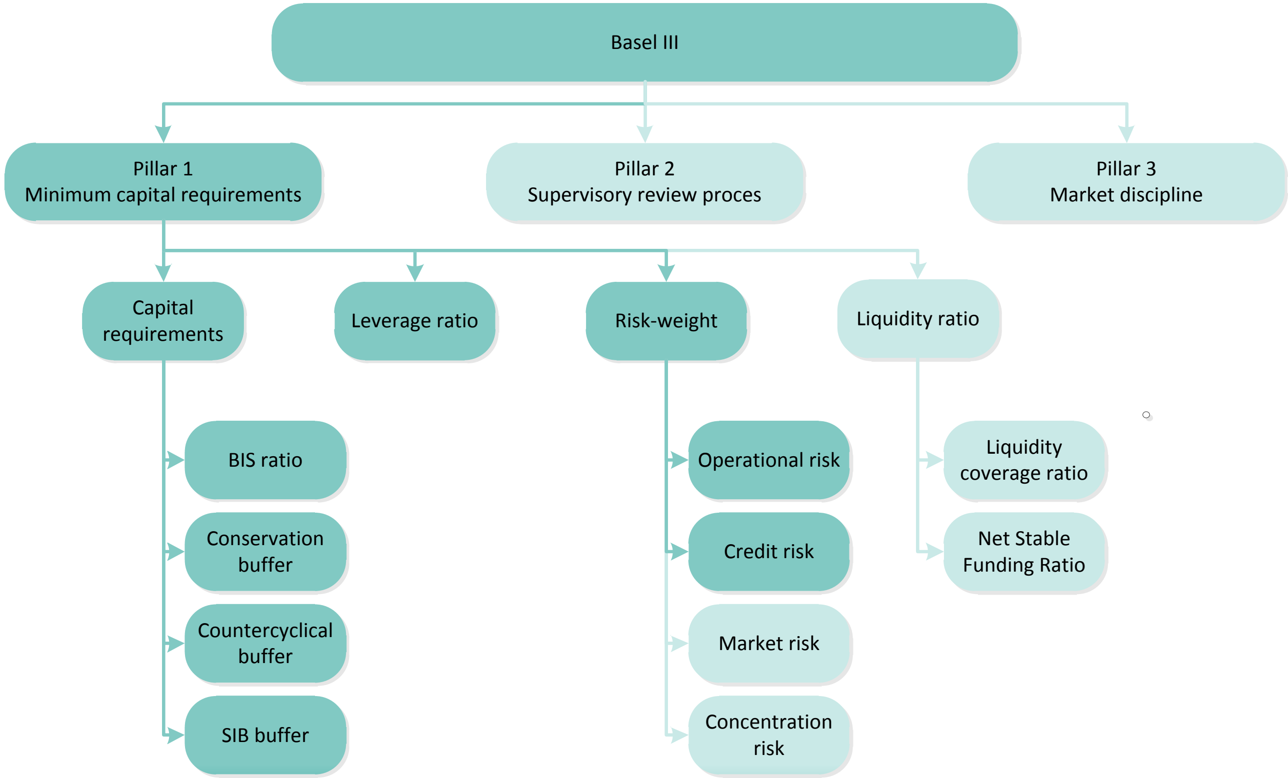
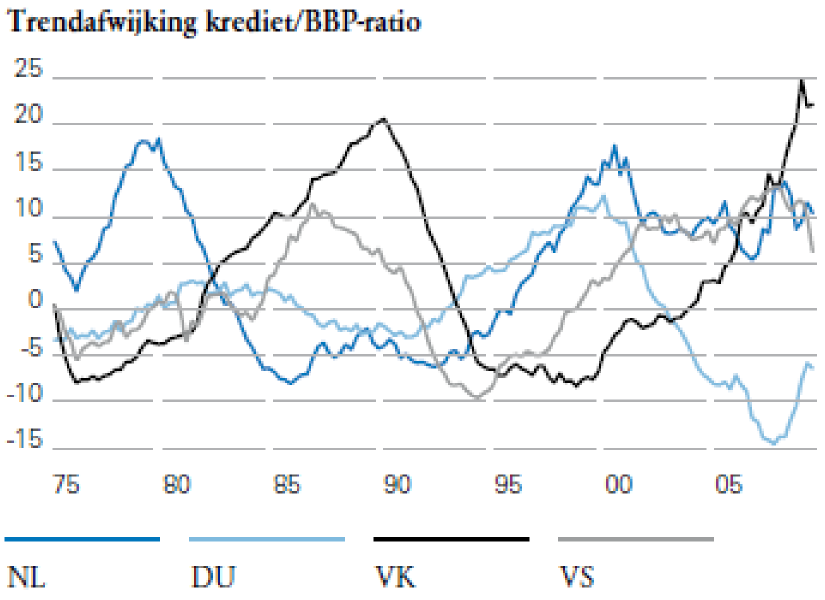
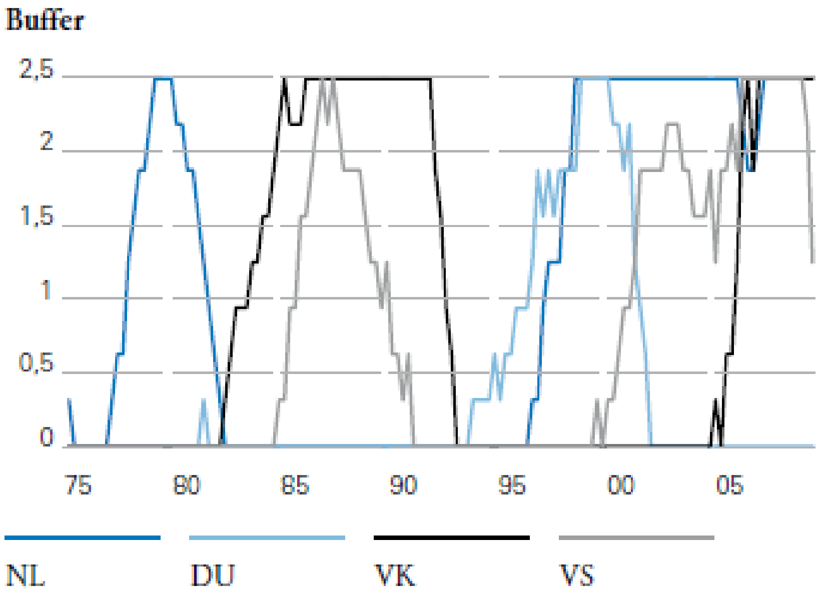


Figure 8.1 Basel III, dark green parts are used in this study (BIS, 2011)

Appendix C The countercyclical buffer as it would have been during history



(a)



(b)

Figure 8.2 (a) Trend deviation long-term credit / GDP (b) The corresponding countercyclical buffer (DNB, 2010)

Appendix D A schematic overview of Solvency II

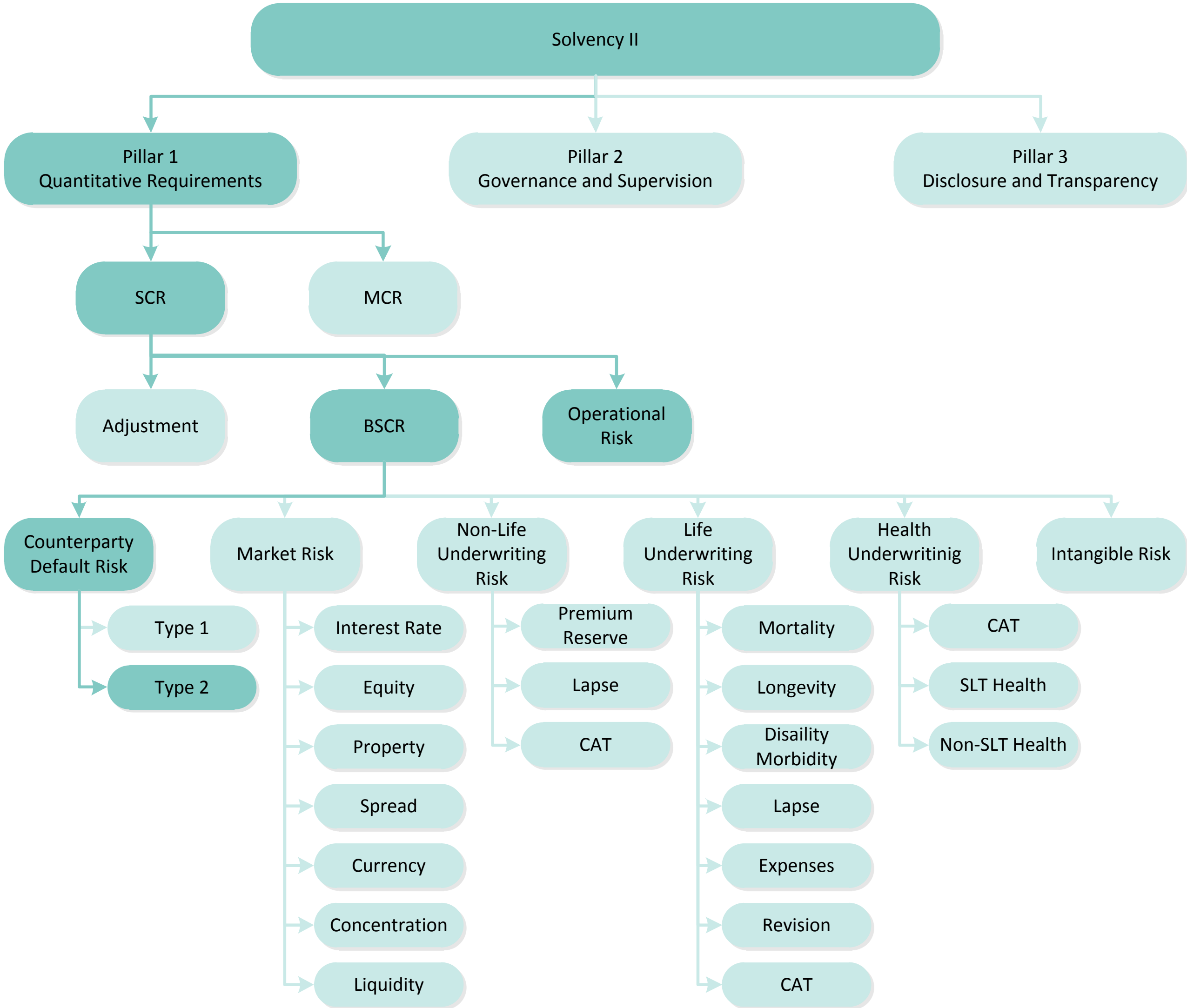


Figure 8.3 Solvency II, the dark green parts are used in this study (CEIOPS, 2010)

Appendix E The IRB approach versus standard model

As mentioned in the introduction of Chapter 4 the regulatory capital requirements for banks and insurers are compared based upon the IRB approach of Basel and the standard model of Solvency II. It is possible to compute the regulatory capital requirements with the IRB approach since this thesis is performed within ABN. However, Solvency II does not explain how an internal model should be constructed and therefore it is only possible to compute it for the standard model. Below, some arguments will be presented that justify the choice for these methods.

1. As presented in Appendix A, all system banks use an advanced IRB approach while not all the insurers use an internal model.
2. The *EIOPA report on the fifth Quantitative Impact Study (QIS5) for Solvency II* (2011) shows that only 10% of the European insurers used the internal model and 42% a partial internal model. The insurers that are planning to use a partial internal model argue that the most common risk modules they are going to model internally are the modules non-life underwriting risk, market risk and life underwriting risk.
3. The *EIOPA report on the fifth Quantitative Impact Study (QIS5) for Solvency II* (2011) also shows that the difference in capital requirements calculated with the standard method or (partial) internal model are not that large. The SCR for solo undertakings that is computed via an internal model is on average 99% of the value computed via the standard model (median 91%). For group undertakings is the SCR on average 82% of the value computed via the standard model (median 86%).

Due to these reasons, the capital requirements of insurers are computed via the standard model in this research.

Appendix F Data collection and adjustments

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1. *Defaulted mortgages are removed*; banks hold provisions for the expected loss of mortgages. In order to be able to include these data in this study, it should be known how many provisions banks make for their defaulted mortgages. Since this data is not easily to obtain, the defaulted mortgages are neglected in this study.
2. *Residual debt greater than zero*; in the event that the residual debt is equal or negative, it indicates that the mortgage has been paid off. Banks and insurers do not have to hold regulatory capital for mortgages that are paid off.
3. *Exposure at default greater than zero*; in the event that the exposure at default is equal to zero or negative, it indicates that the mortgage exposure is deposited on the credit account of the customer, but the administration has yet to be started. These mortgages are not officially started and are therefore left out of the computation for the regulatory capital requirements.
4. *Foreclosure value greater than zero*; the foreclosure value is set at zero when the mortgage is paid off. Therefore, the data is restricted to positive foreclosure values.

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Table 8.2 The influence of each adjustment on the data

Appendix G Calculation and discussion of the diversification effect

As mentioned in Section 4.2.1, it is only possible to compute the $SCR_{def,2}$ with the data that is used in this study. However, the formulas for the SCR_{def} and BSCR are based upon correlations such that a diversification effect occurs in these steps. See Figure 8.4 for an overview of BSCR calculation and the corresponding diversification steps.

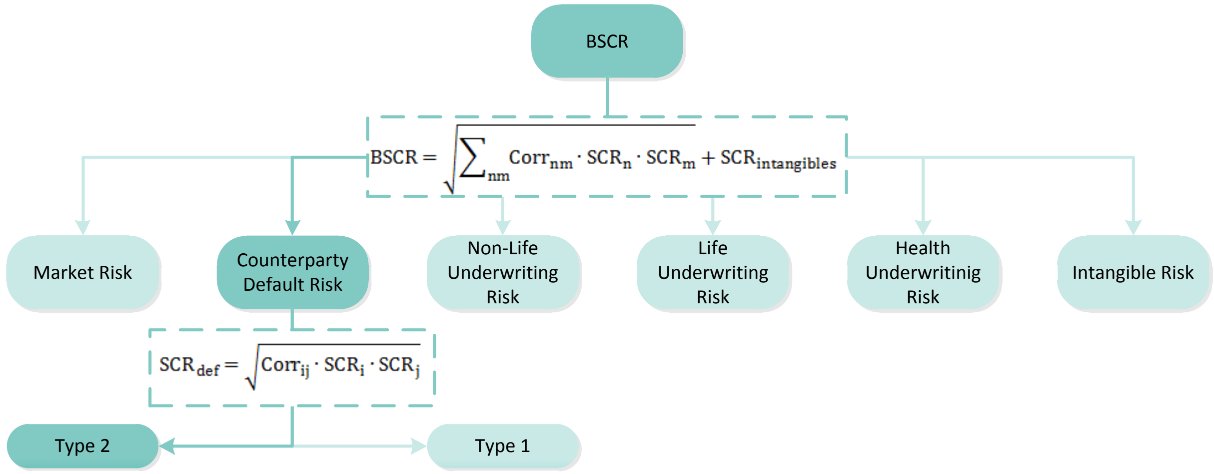

Figure 8.4 The two diversification steps that occur in the calculation of the BSCR

During this study is a diversification factor of 0.4078 is used to get from the $SCR_{def,2}$ to the effects of this on the BSCR. This diversification factor is estimated based upon the average breakdown of type 1 / type 2 exposures and the average breakdown for the six risk modules based upon the *draft Te*chnical specifications for QIS5 (EC, 2010). These breakdowns are presented in Table 8.3.

Table 8.3 the four scenarios with corresponding diversification effect

The ratios of type 1 and type 2 exposures within the SCR_{def}	
Type 1	72.5%
Type 2	27.5%
The ratios of the risk modules within the BSCR	
Market	56.7%
Default	6.7%
Life	15.6%
Health	4.4%
Non-Life	16.7%

The first step is to compute the diversification effect within the SCR_{def} module that is assigned to the $SCR_{def,2}$. This is done with the following six steps:

1. Create a 1 x n matrix of the undiversified capital charges;

$$\begin{bmatrix} 72.50 & 27.50 \end{bmatrix}$$

2. Multiply the matrix with undiversified capital charges with the correlation matrix;

$$\begin{bmatrix} 72.50 & 27.50 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0.75 \\ 0.75 & 1 \end{bmatrix} = \begin{bmatrix} 93.13 & 81.88 \end{bmatrix}$$

3. Multiply the result of step 2 with the $M_{UCC}{}^{T}$;

$$\begin{bmatrix} 93.13 & 81.88 \end{bmatrix} \cdot \begin{bmatrix} 72.50 \\ 27.50 \end{bmatrix} = 9003.13$$

4. Compute the diversified capital charge by taking the square root of the scalar of step 3;

$$\sqrt{9003.13} = 94.88$$

5. Allocate the diversification effect per type of risk by multiplying the undiversified capital charge with the result of second step and divide it with the diversified capital charge of step 4;

$$\text{Allocation type 1} = \frac{72.50 \text{ x } 93.13}{94.88} = 71.16$$

$$\text{Allocation type 2} = \frac{27.50 \text{ x } 81.88}{94.88} = 23.73$$

6. The diversification benefit is than;

$$\text{Diversification benefit type 1} = 100\% \text{ x } \left(1 - \frac{71.16}{72.50}\right) = 1.85\%$$

$$\text{Diversification benefit type 2} = 100\% \text{ x } \left(1 - \frac{23.73}{27.50}\right) = 13.71\%$$

This indicates that the diversification benefit for type 2 exposures is 13.71% within the SCR_{def} risk module. The same steps are used to compute the diversification benefit for the SCR_{def} module within the computation of the BSCR. This results in a diversification benefit for the SCR_{def} module of 52.74%. Therefore, the total diversification factor to get from the $SCR_{def,2}$ to the BSCR module is:

$$(100\% - 13.71\%) * (100\% - 52.74\%) = 40.78\%$$

This indicates that from every euro $SCR_{def,2}$ only 0.4078 euro BSCR has to be hold.

Discussion on the diversification effect

The diversification effect as described above is based on the averages for solo undertakings as presented in the *EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II* (2011). In order to check whether this is a reasonable estimation, three other scenarios will be discussed.

1. The ratios that are presented for group undertakings in the *EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II* (2011) for group undertakings.

Furthermore, it is possible to derive two hypothetical scenarios;

2. An insurance company that is focussing on the issuance of mortgages can try to optimize the diversification benefit for mortgages, i.e. the diversification percentage for $SCR_{def,2}$ should be maximized.
3. An insurance company can also try to maximize the total diversification benefit over the whole portfolio, i.e. the nominal diversification benefit within SCR_{def} and BSCR should be maximized.

The input parameters of Scenario 2 and 3 are obtained with the Solver function in Excel. The input parameters and corresponding diversification effects per scenario are presented in Table 8.4. The table shows that the maximum diversification effect that can be reached for mortgages is -81.25%. It should be noted, however, that this is a hypothetical scenario which is not realistic, since this can only be reached if the 100% of the SCR_{def} is divided into almost 100% $SCR_{def,1}$ and around 0% $SCR_{def,2}$. Therefore, it can be concluded that an insurance company would not build such a portfolio.

In contrast to this scenario, the scenario in which the total amount of diversification effect for the whole portfolio is maximized looks more attractive. The diversification effect within the SCR_{def} is maximized in case the ratio type 1 and type 2 is equal. To reach the maximum diversification effect over the risk modules together, the market / counterparty default / life underwriting / health / non-life underwriting risk are 15% / 5% / 25% / 25% / 30%. Although it looks more realistic, it should be noted that the market risk module is usually the largest for insurers and therefore this scenario is too optimistic.

The other two scenarios are based on the European averages as published by EIOPA and are therefore realistic numbers. Although there is a large difference between the diversification effect within the counterparty default risk module, 3.83% versus 13.67%, the total diversification for mortgages is almost similar with 57.69% and 59.22%. Since there is only a small difference between these values the diversification factor of 40.78% seems to be a good approximation.

Table 8.4 the four scenarios with corresponding diversification effect

Risk class	**Solo undertakings**	**Group undertakings**	**Maximum $SCR_{def,2}$ diversification (%)**	**Maximum total diversification (€)**
Ratios of the exposure types within the counterparty default risk				
Type 1	72.5%	39.0%	100.0%	50.0%
Type 2	27.5%	61.0%	0.0%[10]	50.0%
Diversification benefit $SCR_{def,2}$	*13.7%*	*3.9%*	*25.0%*	*6.5%*
Ratios of the different risk classes within the BSCR				
Market	56.7%	57.7%	100.0%	15.0%
Default	6.7%	4.1%	0.0%[10]	5.0%
Life	15.6%	17.3%	0.0%[10]	25.0%
Health	4.4%	5.1%	0.0%[10]	25.0%
Non-Life	16.7%	15.8%	0.0%[10]	30.0%
Diversification benefit SCR_{def}	*52.7%*	*56.0%*	*75.0%*	*39.8%*
Diversification effect $SCR_{def,2}$ to BSCR	**59.2%**	**57.7%**	**81.3%**	**43.7%**

[10] This value is not zero, but very small.

Appendix H An overview of the average interest rates of last year

Table 8.5 the average interest rates of last year (part 1/3)

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Table 8.7 the average interest rates of last year (part 2/3)

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Table 8.7 the average interest rates of last year (part 3/3)

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