Adequacy of Capital Requirements for Securitizations –

Financial Engineering of Regulatory Approaches, Cyclicality, Systematic Risk and Rating Standards

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Abstract

Regulatory capital requirements for securitizations are currently part of the discussion regarding future changes to the regulation of financial institutions also known as Basel III. The merits of securitizations are generally excepted. They are regarded as an additional source of funding and as a tool enabling further dispersion of credit risk for financial institutions. However, structured products are considered as an essential contributor or at least an amplifier to the Global Financial Crisis (GFC). The inadequate risk evaluation of securitizations by rating agencies and market participants are the main cause for enormous investor losses and institution failures.

This cumulative thesis is mainly focussing on the theoretical and empirical analysis of the adequacy of the regulatory capital requirements for securitizations. At first an overview of the existing approaches for securitizations is provided including an analysis of the functioning of the approaches (Ratings-Based Approach and Supervisory Formula Approach for IRB-Banks).

Thereafter, this cumulative thesis addresses the issue of capital volatility for securitizations along the economic cycle. By using comprehensive Monte-Carlo-Simulations regulatory capital requirements of credit portfolios on the one hand and asset portfolio securitizations on the other are compared with regard to potential levels of cyclicality. It turns out, that the cyclicality of capital requirements for asset portfolio securitizations is considerably higher resulting in a further worsening of economic downturns during a crisis. In addition, it is shown that the cyclicality of capital requirements is higher for the Ratings-Based Approach (RBA) compared to the Supervisory Formula Approach (SFA) in particular if a point-in-time rating methodology is applied.

Then, this cumulative thesis investigates whether current regulatory rules sufficiently account for systematic risk. Based on a comprehensive empirical dataset, a framework to measure the risk exposure of securitizations is developed. Afterwards, the ratings-based capital requirements are determined and it is analyzed whether current rules reflect this exposure to systematic risk. As a result it is demonstrated that capital charges for tranches with the highest rating are insufficient under the current RBA. Accordingly, a new calibration of risk weights is proposed.

Finally, this cumulative thesis addresses the question whether rating agencies loosened their rating standards for mortgage-backed securities in the years prior to the crisis as assumed by many market participants due to the known

rating phenomena such as 'rating shopping' and 'rating inflation'. Using empirical data, time series dynamics of ratings are analyzed and it is examined whether investors incorporate their knowledge regarding possible changes in the rating standard into tranche pricing. The findings provide no evidence that rating agencies have loosened their rating standards prior to the crisis.

As a general conclusion of this thesis it is confirmed, that current regulatory capital requirements for securitizations are insufficient and a revision of the current regulation framework appears essential.

Keywords: Securitizations, Regulatory capital, Rating

Zusammenfassung

Im Rahmen der geplanten Neuregelungen zu Basel III werden u.a. umfangreiche Änderungen der regulatorischen Ansätze für Verbriefungstransaktionen diskutiert. Kreditverbriefungen stellen bedeutende Instrumente zur Refinanzierung und Risikodiversifikation von Kreditinstituten dar. Strukturierte Produkte gelten aber auch als maßgeblicher Auslöser und Verstärker der globalen Finanzkrise. Die Fehleinschätzung von Verbriefungsrisiken durch Marktteilnehmer und Ratingagenturen führte zu erheblichen Verlusten bei Investoren und zu Schieflagen von Kreditinstituten.

Kernpunkt dieser kumulativen Dissertation ist die theoretische und empirische Analyse der Angemessenheit von regulatorischen Kapitalanforderungen für Verbriefungen. Zunächst werden die geltenden regulatorischen Ansätze für Verbriefungen (Ratings-Based Approach und Supervisory Formula Approach für IRB Banken) vorgestellt und analysiert.

Die kumulative Dissertation befasst sich dann mit dem Thema der Volatilität von Kapitalanforderungen für Verbriefungen im Konjunkturzyklus. Mit Hilfe von umfangreichen Monte-Carlo Simulationen werden die regulatorischen Kapitalanforderungen von Kreditportfolien und Verbreifungsportfolien in Bezug auf konjunkturabhängige Schwankungen verglichen. Es stellt sich heraus, dass die Kapitalanforderungen für Verbriefungsportfolien eine deutlich höhere Volatilität aufweisen und damit in Krisenzeiten den wirtschaftlichen Abschwung noch weiter verschärfen. Zudem erweist sich der Ratings-Based Approach (RBA) gegenüber dem Supervisory Formula Approach (SFA) als deutlich volatiler insbesondere für eine Point-in-Time Ratingmethodik.

Die kumulative Dissertation untersucht dann, ob die geltenden regulatorischen Ansätze dem systematischen Risiko von Verbriefungstransaktionen Rechnung tragen. Anhand eines umfangreichen empirischen Datensatzes wird zunächst ein Modell zur Messung des Risikos von Verbriefungen entwickelt. Anschließend wird untersucht ob die rating-basierten Kapitalanforderungen das ermittelte systematische Risiko hinreichend abdecken. Es ist festzustellen, dass der geltende RBA Ansatz zu unzureichenden Kapitalanforderungen bei den höher gerateten Tranchen führt. Infolgedessen wird eine Neukalibrierung der Risikogewichte im RBA vorgeschlagen unter Einbeziehung der systematischen Risikosensitivität von Verbriefungen.

Abschließend widmet sich die kumulative Dissertation noch der Frage, ob Ratingagenturen beim Rating für Verbriefungen von Hypothekenkrediten in

der Zeit vor der Finanzkrise ihre Ratingstandards gelockert haben, was von vielen Markteilnehmern auf Grund von Fehlanreizen der Ratingagenturen oftmals vermutet wurde. Anhand empirischer Daten wird untersucht ob sich der Ratingstandard verändert hat und ob Investoren dies ggf. bei den Bepreisungen von Tranchen berücksichtigt haben. Im Ergebnis lässt sich kein Nachweis für eine Lockerung der Ratingstandards feststellen.

Die Ergebnisse der Dissertation bestätigen, dass die bestehenden regulatorischen Anforderungen für die Kapitalhinterlegung von Verbreifungstransaktionen nicht ausreichend sind und einer Überarbeitung bzw. Neufassung bedürfen.

Schlagwörter: Verbriefungen, Regulatorische Kapitalanforderungen, Rating

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Chapter 1

Introduction

1.1 Securitizations and Capital Regulation

Securitization is a special financial instrument for a company or a financial institution to restructure the asset risks of their portfolios and to sell these partially or completely to investors. Income producing assets like e.g. commercial and residential mortgages, private loans, car loans, investment credits or credit card debt obligations are pooled into a reference portfolio and the pooled assets are transformed into tradable securities with different levels of seniority and thereafter sold to the money- and capital markets. The investors in these structured finance securities obtain a claim on future collateralized cash flows generated by the underlying pool of debt assets (see, e.g., Perraudin (2006), Franke & Krahnen (2008), Hull (2009), among others).

The company or financial institution that owns the original assets is called originator. The originator sells the pooled assets outright to the issuer ('true sale securitization'), an entity which is usually set up as a special purpose vehicle (SPV) just to purchase the assets and to sell the securities after securitization. Sometimes the originator sells only the credit risk inherent to the assets instead of the legal asset claim ('synthetic securitization') to the issuer and finally to the money- and capital markets (see e.g., Bluhm & Wagner (2011)).

Securitization started in the 1970s with pooled home mortgages in the U.S (see Crouhy et al. (2008)). Since then the market has grown drastically not only in the U.S. but also in all other major markets worldwide. The increasing number of financial institutions which employ securitization is due to a

variety of reasons. Basically securitization is considered as a tool to reinforce the liquidity currently tied in debt assets and it is often less expensive to raise money through securitizations rather than through the underlying pool of individual assets. Furthermore asset securitization offers an opportunity to transfer credit risks to the balance sheets respectively profit and loss statements of other companies or financial institutions. Finally, securitization may be employed in order to reduce regulatory capital requirements.

In principle securitizations were accepted as to generate economic benefits like dispersing risk concentration. However, structured financial instruments are subject of a controversial discussion since they were identified as a major contributor to credit losses in the Global Financial Crises (GFC) (see, e.g., Longstaff (2010)). This has triggered a broad discussion regarding the adequacy of regulatory capital requirements for securitizations (see, e.g., Hamerle et al. (2011)). Capital requirements for structured products under Basel II allow two different approaches to allocate capital to securitization transactions. The Ratings-based Approach (RBA) and the Supervisory Formula Appraoch (SFA). The RBA has been developed in order to establish a clear and simple industry standard comprising elementary risk wights at the level of external (or inferred) credit rating grades for individual tranches. As long as these ratings are available this approach is mandatory. The SFA determines the capital required for securitized tranches on the basis of parameters provided by the bank. These parameters are related to pool characteristics and tranche properties. In 2009, the Basel Committee on Banking Supervision has already introduced a few enhancements to the existing Basel Framework as a response to the large losses of these assets during the GFC (see Basel Committee on Banking Supervision (2009)).

These enhancements were incorporated primarily to encounter the evident failures of resecuritizations. However, in order to address all deficiencies identified during the GFC, the question whether the RBA or alternatively the SFA ensures that sufficient capital is provided to cover the risk of securitized transactions has been discussed extensively further on (e.g., Rösch & Scheule (2012)). Beyond this, in December 2010, the Basel Committee on Banking Supervision Basel Committee on Banking Supervision (2012) announced that it was planning a comprehensive review of the securitization framework, particularly addressing the dependence of securitized transactions on external ratings.

Actually, the fact-findings after the GFC suggest that the evaluation meth-

ods from external rating agencies were insufficient regarding structured finance products as the effective loss ratios of numerous securitized exposures were significantly higher than rating agencies had expected. Furthermore, the ability of investors to monitor the risk inherent to structured instruments seems to be rather limited due to the complex structure of some securitized products and in particular in the case of resecuritizations. Additionally, originators may have been encouraged to cut back on regular monitoring activities after the risk has disappeared from their balance sheets. As a consequence, securitization markets seem to be exceptionally vulnerable to a deterioration of credit scoring and credit signing standards. Other investigations demonstrate that securitized products are more sensitive to macroeconomic risk factors then the underlying pool of assets which was not adequately considered in external credit ratings for these asset classes (compare e.g., Claußen et al. (2014)). In this respect, the risk of procyclical effects of regulatory capital requirements seem to be even more severe in the area of securitization.

This cumulative thesis provides a detailed insight into current regulatory capital approaches for securitizations. Potential revisions of the regulatory rules after the experiences of the GFC are systematically analyzed and discussed.

Based on Monte Carlo Simulations evidence is provided that securitized transactions are highly sensitive to systematic risk. It is shown that the systematic risk sensitivity of securitized tranches enhances the amplitude of regulatory capital volatility. Accordingly, the challenges for regulators are discussed and potential approaches to deal with cyclicality are presented.

Due to these findings, a special framework to measure the real exposure to systematic risk for pools of asset securitizations is developed. This framework is utilized to calibrate new risk weights which account more accurately for systematic risk especially in economic downturns.

As already mentioned, the GFC has unfolded major issues associated with securitized exposures. Massive defaults were experienced and some securitization markets (in particular the risky U.S. subprime mortgage market) suffered from unexpected large and persisting deteriorations in the quality of the underlying assets and caused numerous downgrades of securitizations and huge unexpected losses for the investors. The decision of potential investors to put money in securitized products was mainly supported by the risk assessment of the Credit Rating Agencies (CRAs). Due to the high default rates of securitiza-

tions during the GFC, CRAs were suspected of being too optimistic in assigning ratings for structured products. However, the rating agencies argue that the poor performance was a result of the unexpected macroeconomic shocks which were unpredictable by any other market participant (compare e.g., Moody's Investors Service (2007)). In the light of this discussion, the cumulative thesis substantiates rating standard dynamics for Mortgage-backed Securities (MBS) prior to the GCF. Furthermore it is demonstrated that changes in the rating standards impact investors' pricing decisions.

In conclusion this thesis targets

- a better understanding of the theoretical foundation, the functionality and the major issues of the regulatory capital approaches for securitizations,
- the recognition of strong cyclical effects related to securitized portfolios and potential mitigation mechanisms,
- the appropriateness of regulatory risk weights for securitizations (RBA) in consideration of systematic risk, providing sufficient capital charges along the economic cycles and
- the identification of time-series dynamics in rating standards for MBS and the impact on tranche pricing.

The findings and proposals presented in this thesis may contribute to gain more confidence in a sufficient and sustainable capital coverage for structured finance products. Thus, the results from the empirical and simulation based investigations and the conclusions are addressed to several groups, e.g., other researchers in the field of securitization transactions, investors in securitized tranches, risk managers in banks and regulatory authorities respectively policy makers.

1.2 Outline and Contributions

The remainder of this thesis proceeds as follows.

In Chapter 2, the regulatory rules to determine capital requirements for structured products under Basel II are considered. Therefore the set of different approaches to calculate the capital charges for securitized exposures

are systemically described. Furthermore the main objectives of regulators are reviewed, the theoretical model foundations are explained and the financial engineering behind the regulatory capital approaches are discussed. In addition, the effects of variations of the essential parameters used in the models are explained. Besides it is shown that the approaches may provide insufficient capital during economic downturns such as the GFC. Therefore the changes which have already been implemented in the regulatory framework after the experiences of the GFC are described and finally further potential revisions of the regulatory rules in relation to Basel III are discussed.

In Chapter 3, the level and cyclicality of regulatory bank capital for asset portfolio securitizations in relation to the cyclicality of capital requirements for the underlying loan portfolio as under Basel II/III is analyzed. A comprehensive simulation approach is developed and four re-investment rules, two securitization regimes, two approaches to calculate regulatory capital and two rating methodologies are analyzed. In addition, the analysis of an empirical dataset provides feedback on the rating methodology preferred in practice and the adequacy of current capital requirements. The most important findings of this chapter are as follows: Firstly, cyclicality of capital requirements is higher for i) asset portfolio securitizations relative to primary loan portfolios, ii) the Ratings Based Approach relative to the Supervisory Formula Approach, iii) given the RBA for a point-in-time rating methodology relative to a rate-and-forget rating methodology, and iv) under the passive reinvestment rule relative to alternative rules. Secondly, the analysis with regard to the capital requirements of the individual tranches reveal that the volatility of aggregated capital charges for the securitized portfolio is triggered by the most senior tranches. This is due to the fact that senior tranches are more sensitive to the macroeconomy. Thirdly, the empirical analysis provides evidence that current credit ratings are time-constant and that economic losses for securitizations have exceeded the required capital in the GFC.

In Chapter 4, a framework to measure the exposure to systematic risk for pools of asset securitizations is developed. In addition it is empirically measured whether current ratings-based rules for regulatory capital of securitizations under Basel II and Basel III reflect this exposure. The analysis is based on a comprehensive US dataset on asset securitizations for the time period between 2000 and 2008. The results show that the shortfall of regulatory capital during the GFC is strongly related to ratings. In particular, it is empirically

verified that insufficient capital is allocated to tranches with the highest rating. These tranches account for the greatest part of the total issuance volumes. Furthermore, the approach is the first to calibrate risk weights which account for systematic risk and provide sufficient capital buffers to cover the exposure during similar economic downturns. These policy-relevant findings suggest a re-calibration of RBA risk weights and may contribute to the current efforts by the Basel Committee on Banking Supervision and others to re-establish sustainable securitization markets and to improve the stability of the financial system.

In Chapter 5, rating standards that credit rating agencies applied to mortgage-backed securities from 2001 to 2010 are analyzed. The findings suggest that a divergent pattern exists between home equity loans and residential mortgage-backed securities. Rating agencies tightened their standards for home equity loans, while holding their standards for residential mortgage-backed securities rather constant over time. It is shown that the dynamics are the same for rating standards at origination and rating standards during monitoring years. The findings are robust after controlling for systematic risk. Furthermore, the results suggest that investors are aware of the dynamics of rating standards and incorporate their knowledge into tranche prices. Tighter rating standards are associated with lower yield spreads. This may be an indication that the mortgage burst came suddenly and was unexpected because otherwise lower yield spreads would not have been justified.

Chapter 6 concludes and provides a brief outlook to current developments.

Chapter 2

Regulatory Capital Requirements for Securitizations

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Chapter 3

Asset Portfolio Securitizations and Cyclicality of Regulatory Capital

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Chapter 4

Ratings Based Capital Adequacy for Securitizations

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Chapter 5

Rating Standard Dynamics for Mortgage-backed Securities

The content of this chapter refers to the working paper 'Rating Standard Dynamics for Mortgage-backed Securities' by Lützenkirchen, K., Rösch D. & Scheule, H., 2014.

5.1 Introduction

5.1.1 Motivation

In the years prior to the Global Financial Crisis (GFC) a large demand for mortgage-backed securities could be observed in all financial markets, particularly the US. The decision of potential investors to put money in securitzed products was mainly supported by the risk assessment of the Credit Rating Agencies (CRAs). Due to the massive defaults and downgrades of securitizations during the GFC, the role of the rating agencies has been broadly discussed. The rating practice of the CRAs is subject to a sharp criticism regarding its inadequate capability in assessing the real risk of securitized products.

However, the rating agencies argue, that the poor performance of securitzed products in general, mirrors the unexpected macroeconomic shocks which were unpredictable by any market participant. In particular, they refer to the unprecedented declines in home prices and to the sharp cutback in mortgage credit supply in the MBS market. CRAs also clarified that early warnings were provided prior to the crisis about increasing levels of risk. In July 2003,

Moody's started to report a deterioration in origination standards and inflated housing prices in their reports (Moody's Investors Service (2007)). According to Michael Kanef, Managing Director of Moody's, the rating agency published an extraordinary report in 2007 highlighting the increasing defaults of subprime mortgages originated in the year before. Moody's also stated that in response to the observed increase of riskiness in the subprime market their rating criteria were tightened. In the period between 2003 and 2006 the loss expectations and enhancement levels increased by about 30% according to Kanef.

The criticism that rating agencies systematically relaxed their rating standards prior to the crisis is a widespread assumption to explain the basic reasons for the GFC. However, so far there is no empirical study to verify the statement of the rating agencies that rating criteria were tightened in the years prior to the crisis.

We are the first to identify time-series dynamics in rating standards and to prove that rating agencies actually tightened their standards – at least to a certain extent. Moreover, we are the first to show that investors realized the changes in the rating standards and that their knowledge was incorporated into the pricing of tranches, partially thwarting the intentions of the rating agencies.

5.1.2 Related Literature

This paper relates to four streams in the literature. The first stream focuses on the rating standard of corporate bonds. Blume et al. (1998) apply an ordered probit model in order to empirically investigate whether changing rating standards may explain the downgrades in US corporate bond ratings. Their study confirms that rating standards indeed became more stringent in the period between 1978 and 1995.[1] Using the same methodology, Alp (2013) analyzes the time series variation in corporate credit rating standards for investment-grade and speculative-grade ratings from 1985 to 2007. The study reveals that investment-grade rating standards tightened and speculative-grade rating standards loosened from 1985-2002. The investigation detects a structural shift towards more stringent ratings in 2002. Baghai et al. (2013) confirm in

[1] This trend is confirmed more recently by Amato & Furfine (2004) for macroeconomic conditions. In addition, Jorion et al. (2009) link the tightening of rating standards to a deterioration of accounting quality.

their investigation that rating agencies became more conservative in assessing credit risk of corporate bonds over the time period 1985-2009. Wang (2012) analyzes whether reputation concerns may impact rating agencies and consequently their rating standards. The results of the empirical study suggest that reputational concerns are not strong enough to support self-disciplining mechanisms. Furthermore, the author finds an asymmetric effect of the business cycle on rating standards providing evidence, that ratings are inflated during recessions. On the other side, there is almost no indication that CRAs deflate ratings during economic upturns. Other authors find both empirically and theoretically, that rating standards have declined due to competition with the entry of CRA Fitch into the market. Examples are Becker & Milbourn (2009), Camanho et al. (2010) and Bar-Isaac & Shapiro (2013). Bae et al. (2010) compare the two claims applying a different set of control variables and find that neither hypothesis – tightening and loosening rating standard – can be confirmed when controlling for the slow adjustment of ratings over time.

A vibrant literature exists regarding the information content of ratings for corporate bond issuers and issues. Radelet & Sachs (1998) find that rating changes are pro-cyclical. This suggests that rating changes provide only a limited amount of new information to the market. Ederington & Goh (1993), Dichev & Piotroski (2001) and Purda (2007) find that corporate credit rating downgrades provide news to the market. Löffler (2004) finds that the default prediction power of ratings is low. Poon et al. (2009) analyze solicited and unsolicited bank credit ratings and show that solicitation is a significant explanatory variable between both groups. The relative roles of different CRAs have also been studied. For example, Morgan (2002) examines the effect of divergent Moody's and S&P's ratings of banks and Becker & Milbourn (2011) analyze the link between information efficiency of ratings and competition after the market entry of CRA Fitch. Güttler & Wahrenburg (2007) find that bond ratings by Moody's and Standard & Poor's are highly correlated and Livingston et al. (2010) find that the impact of Moody's ratings on market reactions is stronger compared to Standard & Poor's.

The second stream analyzes the rating standard of securitization. First contributions find a deterioration of rating standards prior to the GFC driven by the tremendous growth of the market and earnings of CRA. Mathis et al. (2009) show in a theoretical model that CRAs always inflate ratings if the fraction of CRA revenues coming from the rating of complex products becomes the

most important source of income. White (2010) states that the downgrade figures of originally Aaa-rated mortgage-backed securities are a strong indicator for an widely overoptimism for securities that were issued and rated in 2005-2007. Stanton & Wallace (2010) show that rating standards have declined over time for commercial mortgage-backed securities due to falling subordination levels between 1996 and 2007. He et al. (2011) find in their empirical study that rating agencies inflate ratings for larger issuers. Our paper extends this study as it i) controls for the quality of the underlying mortgage portfolio as well as credit enhancement approaches[2], ii) analyzes ratings at origination and monitoring years and iii) compares rating standards over time. Ashcraft et al. (2009) empirically study variations in credit ratings for subprime and Alt-A mortgage securitizations issued between 2001-2007. Due to their results ratings became less conservative prior to the GFC.

The third stream focusses on mortgage markets and the mortgage default crisis. Dell'Ariccia et al. (2012) explain reasons for the deterioration in lending standards on mortgage markets: i) credit booms and growth episodes ii) continuing housing boom and the belief in a fast rate of house price appreciation iii) change in market structure with new aggressive institutions entering the market and iv) disintermediation. Bajari et al. (2008) provide evidence that existing pricing models underestimated the degree of nondiversifiable risk e.g., the high geographic correlation of declining housing prices and defaults, impairing the proper functioning of capital markets. Moreover they also find a deterioration in the loan quality leading to increased mortgage default rates. Krainer et al. (2009) attribute the high mortgage default rates to the realization of extreme house price shocks rather than to a mispricing of mortgages. Rajan et al. (2013) demonstrate that within the securitization process there is also a loss of information. As a consequence, the authors show that during high securitization regimes interest rates on loans become a poor predictor of the tranches' default likelihood because soft information of borrowers' creditworthiness is neglected. Micu et al. (2009) conduct a zip code analysis and find that the origin of the mortgage default crisis comes from the expansion of

[2] The Basel Committee on Banking Supervision (2006) defines: 'A credit enhancement is a contractual arrangement in which the bank retains or assumes a securitization exposure and, in substance, provides some degree of added protection to other parties to the transaction.' Please note that Griffin & Tang (2012) analyze the credit enhancement features over-collateralization, liquidity, and insurance and find that these features are not critical considerations in CRA models.

mortgage credit supply to subprime neighborhoods across the USA and likewise the increase in securitization of subprime mortgages. The authors find a negative correlation of income for these subprime neighborhoods and mortgage credit growth for the time period between 2002 and 2005.[3] Gerardi et al. (2007) analyze the role of house price appreciation in generating foreclosures in Massachusetts for the time period 1989 to 2007. The authors attribute the dramatic rise of foreclosures in 2006/2007 to the decline in house prices that started in the middle of 2005. Agarwal et al. (2011) show that securitization reduces the chance of a mortgage renegotiation and increases the likelihood for a foreclosure.

Strategic default in relation to negative equity is a particular phenomenon in the world of residential and commercial mortgages. Borrowers may decide to stop their amortization payments even if their financial position would allow further payments. Such cases are quite typical after a substantial drop in house prices in particular if the debt owed exceeds the value of the property. In several US states mortgage loans are non-recourse debt. A non-recourse debt does not allow the lender to pursue claims against the debtor other than the collateral. The lender may only exploit the house while the borrower can simply 'walk away' without any further sufferings from the defaulted mortgage. Several authors are dealing with this particular issue of strategic mortgage default, e.g., Guiso et al. (2009) investigate moral and social considerations related to strategic default in the US. The authors state that about 30% of existing defaults are strategic. The borrower's decision to default strongly depends on the effective equity shortfall e.g., about 17% of American households would strategically default when the equity shortfall reaches 50% of the value of their house. Conversely, no household would default if the equity shortfall is less than 10%. Furthermore, Guiso et al. (2013) examine the role of non-pecuniary factors on the borrowers' decision to default strategically. The authors find a social contagion effect for strategic default decisions in areas with a high proportion of foreclosures. Ghent & Kudlyak (2011) compare the effects of lender recourse and non-recourse on mortgage defaults in the US. The authors state that borrowers are more likely to default in non-recourse states.

[3] Note that von Furstenberg & Green (1974), Genesove & Mayer (1997), Ambrose & Capone (2000), Deng et al. (2000), Pennington-Cross (2003), Ruckes (2004), Ambrose et al. (2005), Dell'Ariccia & Marquez (2006), Pennington-Cross & Chomsisengphet (2007), Demyanyk & Van Hemert (2011) and Demyanyk et al. (2011) provide excellent studies on the risk drivers of individual mortgages.

The fourth stream is related to ratings and spread pricing. Cuchra (2005) underlines the importance of credit ratings for European securitizations as a key driver for spread pricing at date of issue. Adelino (2009) investigates the pricing of residential mortgage-backed securities tranches at origination. He demonstrates that investors in tranches rated below Aaa do not solely rely on ratings. Yield spreads for these tranches have predictive power for future tranche performance. At the same time, the author shows that yield spreads of Aaa-rated tranches have only low predictive power. Investors in these instruments have less information about the quality of their product in comparison to investors in much riskier securitized tranches. He et al. (2012) investigate the impact of the issuer size on yield spreads of mortgage-backed securities. The authors find that the initial yield spreads are higher for MBS tranches of large issuers than of small issuers during booming periods. This finding suggests that investors are taking into account that large issuers receive more inflated ratings than small issuers. This finding may also imply that rating standard changes have a limited contribution to the GFC.

5.1.3 Contributions

In order to examine the question as to whether rating agencies systematically relaxed their rating standards prior to the crisis we aim to identify time series-dynamics in rating standards using a narrow definition of tighter – respectively looser – rating standards. In general, the rating of a tranche relies on the specific risk profile of the tranche. The risk profile is primarily determined by the risk of the underlying mortgage pool and by the securitization characteristics such as subordination and thickness of tranches. A tranche maintaining a specific risk profile may today achieve a worse (better) rating compared to a tranche maintaining the same risk profile at a previous year. Worse ratings insinuate a tightening whereas better ratings indicate a loosening in rating standards.

Building on the analysis of Blume et al. (1998) for US corporate bond ratings, we use an ordered probit analysis of a panel of tranches from 2001-2007 for ratings at origination and from 2001-2009 for ratings at observation. We address the critique by Bae et al. (2010) that rating standard tests need to control for the slow adjustment of ratings over time. Therefore we stratify the data into origination and monitoring years avoiding such an impediment on the

origination year results. The origination year is defined as the year in which the transaction was closed and the tranche was first rated. Monitoring years are the years between origination and maturity of a securitization. We amend the second stream in literature by analyzing all ratings (i.e., all tranches) of a securitization.[4] Moreover, we extend the related literature including indicators of strategic default in our analysis. Strategic default has been identified by various contributions as the main driver of mortgage default. In our investigation we distinguish between the two asset classes: residential mortgage-backed securities (RMBS) and home equity loans (HEL). RMBS are generally backed by prime or Alt-A quality first-lien residential mortgages. HEL securities are backed by sub-prime mortgage loans, home improvement loans, high loan-to-value loans, home equity lines of credit, second-lien loans and net interest margin securitizations (compare Moody's Investors Service 2009*a*).

A further contribution of our paper is to analyze whether investors have realized any changes in the rating standard and whether this knowledge is incorporated in the pricing of tranches. We extend the approach used by He et al. (2012) and analyze the impact (via regression) from potential changes in rating standards on the yield spread at origination and at observation. The yield spread at origination is defined as the difference between the initial coupon rate and the yield of a corresponding Treasury security whose maturity is closest to the tranche's weighted average life. We calculate the yield spread at observation by reverse-engineering, the maturity from the initial yield spread, the current market price and the current risk-free rate.

We find that rating agencies tightened their standards for HEL while holding their standards for RMBS rather constant over time. The identified dynamics are the same for rating standards at origination and rating standards during monitoring years. Accordingly, we confirm that rating agencies actually applied tighter rating criteria for home equity loans prior to the crisis. Our findings are robust for different sets of control variables and also hold after controlling for systematic risk. Furthermore, we find evidence that investors are aware of changes in rating standards and that they incorporate this knowledge in pricing of tranches. Tighter ratings standards are associated with lower yield spreads, indicating that investors perceived the tightening as not completely justified.

The rest of the paper proceeds as follows. Section 5.2 specifies the applied

[4] Ashcraft et al. (2009) analyze Aaa subordination levels only.

research methodology and illustrates the dataset of asset securitizations used in the empirical study. Section 5.3 describes the empirical tests and the control variables used in the analysis. Section 5.4 presents the results according to the hypotheses (Section 5.2) and explains the impact from different rating standards on yield spreads. Section 5.5 provides robustness tests. Finally, Section 5.6 concludes.

5.2 Research Methodology

5.2.1 Hypotheses Development

Rating standard changes may be linked to origination ratings (i.e., the first time a rating is assigned) and monitoring ratings (i.e., when ratings are revisited). We analyze these ratings for vintage effects, the economic environment, time since origination (TSO) and time to maturity as well as trends.

As described in Section 5.1.1, we aim to identify time-series dynamics in rating standards, in order to find out whether the widespread criticism that rating agencies have systematically relaxed their ratings standards prior to the crisis is justified, or whether we find evidence for a move towards more stringent rating standards due to numerous announcements of major representative of the CRAs. The analysis is based on a dataset on US mortgage securitization transactions for the time period 2001-2009. The hypotheses are:

Rating Standard Hypothesis (H1): CRA rating standards at origination (H1a) and during monitoring years (H1b) do not change over time.

If these hypotheses are rejected, evidence is given that there are significant time-series variations in rating standards at origination or/and during monitoring years. If these variations tend to move significantly in one direction over the observed time period rather than to fluctuate widely, it can be assumed that rating criteria were either tightened or loosened.

In addition, we test if possible changes in CRA rating standards are perceived by the investors. The hypotheses are:

Investor Awareness Hypothesis (H2): Investors do not realize different credit rating standards at origination (H2a) and during monitoring years (H2b).

If these hypotheses are rejected, investors are aware of the rating standard dynamics applied by the major CRAs. We show that these hypotheses are rejected for home equity loans at origination and during monitoring years. Builing on these results, we analyze whether this knowledge is incorporated in the yield spread pricing of the investors.

5.2.2 Data

In our analysis we use a dataset of HEL and RMBS deals issued between 2001 and 2007 (and observed between 2001 to 2009) provided by Moody's credit rating agency on a quarterly basis. This sample includes the initial characteristics of the tranches such as the subordination level, thicknesses of tranches, issuance volumes and the rating of tranches. From Bloomberg we draw characteristics of the underlying assets including among others the borrower credit score (FICO) and the loan-to-value-ratio (LTV).

We convert the rating data from Moody's (Aaa, Aa1, Aa2, A3,..., B1, B2, B3, Caa1, Caa2, Caa3, Ca, C) into numerical equivalents and merge the rating classes into five rating categories for HEL (from category 1-5: Aaa, Aa1-Aa3, A1-A3, Baa1-Baa3, Ba1-Ba3 and worse) and six rating categories for RMBS (Aaa, Aa1-Aa3, A1-A3, Baa1-Baa3, Ba1-Ba3, B1-B3 and worse). After the consolidation of the Moody's data and the Bloomberg dataset the sample comprises 156,197 tranches at origination in total. Table 5.1 displays the total number of rated tranches and the percentage by rating category for each quarter of the given time period for home equity loans (Panel A) and residential mortgage-backed securities (Panel B) for ratings at origination.

Table 5.1: Rating Distribution

Year	Rating at origination												
	Aaa	Aa	A	Baa	Ba/B	Total abs.	Aaa	Aa	A	Baa	Ba	B	Total abs.
	Panel A: HEL						Panel B: RMBS						
2001 Q1	54.82	13.18	13.18	15.06	3.76	425	100	0	0	0	0	0	62
2001 Q2	53.92	12.41	14.18	14.18	5.32	395	67.19	10.94	10.94	10.94	0	0	64
2001 Q3	57.14	11.69	11.69	15.58	3.9	154	50	10	10	20	10	0	60
2001 Q4	62.13	14.2	11.83	11.83	0	169	23.08	15.38	15.38	15.38	15.38	15.38	52
2002 Q1	46.67	17.78	17.78	17.78	0	315	71.01	5.8	8.7	5.8	5.8	2.9	276
2002 Q2	46.04	18.48	17	17	1.48	947	79.66	4.01	4.44	6.02	3.87	2.01	698
2002 Q3	52.94	13.73	12.75	18.63	1.96	612	72.25	7.09	7.09	5.86	4.01	3.7	973
2002 Q4	47.56	13.33	13.33	24	1.78	450	63.62	9.67	9.13	7.49	5.86	4.22	734
2003 Q1	40.21	15.66	15.66	28.47	0	562	81.59	5.02	4.3	3.71	2.93	2.45	1,673
2003 Q2	42.67	13.33	17.33	26.67	0	1,050	83.5	4.41	4.31	3.92	2.05	1.81	2,879
2003 Q3	49.3	10.94	16.4	22.87	0.5	1,207	78.13	6.52	5.68	4.84	2.73	2.1	2,853
2003 Q4	48.45	12.37	19.67	19.19	0.32	1,261	71.82	8.36	6.69	6.93	3.58	2.63	1,675
2004 Q1	38.01	12.59	19.05	26.47	3.87	1,239	78.75	7.57	5.62	5.13	1.71	1.22	3,276
2004 Q2	35.83	13.82	19.01	28.39	2.96	2,836	67.05	10.68	8.37	9.11	2.76	2.03	3,800
2004 Q3	43.79	13.87	16.34	22.04	3.96	2,423	68.26	12.19	7.69	7.8	2.53	1.54	5,463
2004 Q4	45.58	15.38	16.84	18.79	3.42	1,639	63.67	12.3	9.38	9.18	3.71	1.76	2,048
2005 Q1	32.18	18.9	21	23.94	3.99	1,905	61.85	14.06	8.85	10.03	3.08	2.13	3,379
2005 Q2	36.46	19.17	18.07	19.05	7.25	5,696	71.4	11.64	6.07	8.39	1.75	0.75	11,185
2005 Q3	37.2	20.6	17.56	18.74	5.91	3,554	69.16	12.27	7.73	8.26	1.86	0.72	8,386
2005 Q4	36.65	19.55	17.48	20.12	6.21	3,479	71.76	13.07	6.45	7.08	1.3	0.34	7,067
2006 Q1	41.69	21.97	18.01	14.95	3.38	4,315	66.55	17.3	7.44	6.93	1.46	0.32	6,290
2006 Q2	44.36	21.24	16.22	13.39	4.79	3,823	68.83	16.38	6.98	6.13	1.5	0.18	10,071
2006 Q3	41.69	21.37	15.78	15.72	5.44	5,236	68.12	16.2	7.34	6.56	1.5	0.3	9,472
2006 Q4	35.88	22.21	18.65	17.37	5.88	4,300	62.43	16.21	10.54	8.94	1.8	0.08	6,490
2007 Q1	52.1	21.44	16.68	8.67	1.12	1,973	76.89	15.74	3.91	2.94	0.45	0.07	4,249
2007 Q2	57.63	18.64	12.7	10.33	0.71	1,685	74.35	17.24	4.42	3.1	0.84	0.05	6,518
2007 Q3	42.57	24.2	17.76	13.94	1.53	653	72.05	17.55	5.29	4.24	0.63	0.24	3,327
2007 Q4	38.57	25.62	19.56	14.6	1.65	363	65.56	14.68	7.63	7.83	2.15	2.15	511
Total abs.	21,860	9,860	9,084	9,659	2,203	52,666	72,845	13,820	7,097	6,986	1,916	867	103,531

Notes: The table displays the total number of issued tranches and the percentage related to each rating category per quarter for HEL as well as for RMBS at origination. Note that for RMBS in the year 2001 (Q1-Q4) and 2007 Q4 only few tranche observations are observeable. For our ordered probit analysis we skip these quarters.

5.3 Empirical Analysis

5.3.1 Empirical Tests

CRAs assign ordinal ratings to securitization tranches.[5] We face the following challenges in analyzing the rating standards: i) the modeling of ordinal ratings requires the use of a non-linear model for ordinary responses and ii) one transaction generally comprises multiple tranches and therefore ratings which requires a controlling for the clustering of transactions. Following the lead by Blume et al. (1998), we model the rating of a tranche as a function of the tranches' risk profiles and year indicators. We assume a latent continuous variable Y_{it}^* linking the tranches' risk profile to the following rating categories R_{it}:

$$Y_{it}^* = \alpha_t + \beta' \mathbf{X}_{it} + \epsilon_{it} \tag{5.1}$$

$$R_{it} = \begin{cases} 1 & \text{if } Y_{it}^* \in (-\infty, \theta_1) \\ 2 & \text{if } Y_{it}^* \in [\theta_1, \theta_2) \\ 3 & \text{if } Y_{it}^* \in [\theta_2, \theta_3) \\ 4 & \text{if } Y_{it}^* \in [\theta_3, \theta_4) \\ 5 & \text{if } Y_{it}^* \in [\theta_4, \infty) \end{cases} \tag{5.2}$$

where the indicator i relates to a single tranche and t to a time period (here quarter) and R_{it} takes the following characteristics $j = 1, 2, ..., J$. α_t describes the time-specific difference of a rating standard to the reference period. $\mathbf{X}_{it}$ is a vector of explanatory control variables related to the tranche and/or time and β is the vector of slope coefficients. $\theta_1 - \theta_4$, are thresholds or cut-off points. ϵ_{it} is a random noise variable with a standard normal distribution function.

Y_{it}^* may be interpreted as a latent continuous risk assessment by the CRA such as the perceived attachment likelihood of losses,[6] or expectation of losses.[7] The continuous risk assessment by the CRA is not observable. Changes in the

[5] Rösch & Scheule (2012) show that ratings may be linked to the probability of attachment of losses which is a metric variable.

[6] The CRA Standard and Poor's and Fitch apply such a methodology, (compare Standard & Poor's 2005, Fitch Ratings 2006).

[7] The CRA Moody's applies such a methodology (compare Moody's Investors Service 2006).

intercept over time may reflect changes in standards applied by CRAs when rating securitizations. A lower α_t than α_{t-1} implies a worse rating for a tranche with the same vector of explanatory variables in the year t as the cut-off points $\theta_1 - \theta_4$ remain the same for each year. Note, that we set the intercept for the first quarter of our panel to zero thus the rating standard of the first quarter of the panel can be regarded as the benchmark value for the remaining T-1 intercepts. Changes in the intercepts can be interpreted as changes in the rating standards relative to the benchmark quarter.

We specify the link between Y_{it}^* and the observable ordinal rating by estimating the thresholds for Y_{it}^* with which the CRA assigns its rating. The probability that the value of Y_{it}^* is in between the two thresholds is defined as the difference of the values of the distribution functions at the respective cut-off points. The likelihood function for the model is:

$$\mathcal{L} = \prod_{i=1}^{I} \prod_{t=1}^{T} \prod_{j=1}^{J} \left[\Phi(\theta_j - \alpha_t - \beta' \mathbf{X}_{it}) - \Phi(\theta_{j-1} - \alpha_t - \beta' \mathbf{X}_{it})\right]^{R_{itj}} \tag{5.3}$$

where R_{itj} is an indicator variable.

$$R_{itj} = \begin{cases} 1, & \text{if } R_{it} = j \\ 0, & \text{else} \end{cases} \tag{5.4}$$

If we apply this general expression to our rating categories (j $\in \{1, 2, 3, 4, 5\}$) we have to take into consideration that the first interval starts at $-\infty$ ($\theta_0 = -\infty$). The respective value of the distribution function is zero. The last interval ranges to $+\infty$ ($\theta_5 = +\infty$). The respective value of the distribution function is one. The general log likelihood function corresponding to Equation 5.3 is given by the following term:

$$ln\mathcal{L} = \sum_{i=1}^{I} \sum_{t=1}^{T} \sum_{j=1}^{J} R_{itj} ln\Phi\left[(\theta_j - \alpha_t - \beta' \mathbf{X}_{it}) - \Phi(\theta_{j-1} - \alpha_t - \beta' \mathbf{X}_{it})\right] \tag{5.5}$$

The probability that a tranche falls in rating category j, j $\epsilon \{1, 2, 3, 4, 5\}$, is given by:

$$\mathbb{P}(R_{it} = j|\mathbf{X}_{it}, \gamma) = \begin{cases} \mathbb{P}(\alpha_t + \beta'\mathbf{X}_{it} + \epsilon_{it} < \theta_1|\gamma) & \text{if } j = 1 \\ \mathbb{P}(\theta_{j-1} \leq \alpha_t + \beta'\mathbf{X}_{it} + \epsilon_{it} < \theta_j|\gamma) & \text{if } j = 2, 3, 4 \\ \mathbb{P}(\theta_4 \leq \alpha_t + \beta'\mathbf{X}_{it} + \epsilon_{it}|\gamma) & \text{if } j = 5 \end{cases} \quad (5.6)$$

γ is defined by a set of parameter estimates including the maximum likelihood estimates for β and θ as well as the estimates for the different α_ts. In this model setup, the intercepts may vary over time while the slope coefficients remain the same for each quarter. By applying Equation 5.6 we obtain the most probable rating category j for a tranche subject to the set of parameter estimates γ.

In the empirical part, we compare two models: i) a model in which every tranche observation is equally weighted and ii) a model in which the tranches and their ratings are weighted by the size of exposure.

In order to test the Investor Awareness Hypothesis (H2) we explain the yield spreads at origination (YSO) (respectively yield spreads at observation (YSOBS)) by the actual rating and closing quarter (CQ): in the instance that investors do not realize rating standard changes, closing quarters (or rating quarters (RQ)) should not be significant. The regression model for H2a is:

$$YSO_{it} = \delta_0 + \delta_{1t}CQ + \delta_2 R_{it} + \varepsilon_{it} \quad (5.7)$$

The aim of the research is to reject the formulated null hypotheses. Significant information of ratings implies that ratings at origination and during monitoring years are informative. An increase of δ_{1t} over time, which indicates a rejection of the null, implies that rating standards have deteriorated over time. A significant link between CQ and the yield spreads of the respective period, which indicate a rejection of the null, implies that investors have realized that CRAs rating standards for mortgage-backed securities at origination (H2a) and during monitoring years (H2b) have changed over time.

We further examine whether investors incorporate their knowledge about changes in rating standards into tranche yield spreads. In the case that investors believe that the change in rating standards are justified due to a change in the economic climate (e.g., increased risk) they should not offset the CRAs tightening because the tranches need to maintain a better risk profile today

in order to achieve the same rating as in earlier years. In contrast, if the investors perceive that the tightening in rating standards is not justified, they may have an incentive to offset the tighter standards. Consequently, the average spreads for a given rating category should decrease when investors perceive tighter ratings which are not justified by an increase of risk. Or vice versa, the average spreads should increase when investors perceive looser ratings not justified by a decrease in risk. We use our quarterly intercepts (QI) from the ordered probit analysis as proxy for the rating standard and test whether there is a relation between the rating standards and the mean yield spreads of the respective time period t. We regress the mean yield spreads per quarter for the four different rating categories (RC) (1:Aaa, 2:Aa1-Aa3, 3:A1-A3, 4:Baa and worse) on the quarterly intercepts and additional controls:

$$YSO_t^{RC} = \eta_0^{RC} + \eta_1^{RC} QI_t + \eta_2^{RC} GDPGROW_t + \varepsilon_t \tag{5.8}$$

Note that the number of observations amounts to 28 due to the fact that rating standards are available on a quarterly basis. We conduct the regressions for a Panel A reporting level regressions and for a Panel B reporting change regressions.

5.3.2 Control Variables

In this section we introduce the explanatory variables which we use in our model as drivers of impairment risk of mortgage-backed securities. The variables relate to the risk of the underlying mortgage pool, to the securitization characteristics and to features of credit enhancement. Controlling for this information is important as Keys et al. (2010) find differences in credit risk between securitized and unsecuritized mortgage loans. We then analyze the degree with which CRAs' ratings reflect those risk drivers to be able to assess the accuracy and therefore the standard of ratings.

With regard to mortgage pool risk, the control variables are: loan-to-value ratio (LTV), Non-recourse State (NRC), Fair Isaac Corporation credit score (FICO), owner occupancy (OOC), limited documentation (LIMDOC).[8]

The LTV ratio is defined as the ratio of total loan amount and the market

[8] Note that all variables are averages over the underlying mortgage portfolio.

value of the collateral (real estate) at origination.

The non-recourse State variable is a measure for strategic default defined as the fraction of mortgage loans in the underlying pool where the lender is not allowed to pursue anything other than the collateral. The recent financial crisis has shown that mortgage borrowers have an incentive to strategically default on their mortgages if the loan-to-value ratio exceeds one (i.e., equity is negative). In the presence of transaction costs this threshold may be less clear but the general hypothesis that mortgage borrowers are more likely to default the more loan values rise above the underlying real estate values remains valid.

The FICO score is a consumer credit score evaluating the borrower risk. It is a well-known and broadly used credit score in the US. The score is determined by a number (between 0 and 1000), which represents the creditworthiness of a borrower. Borrowers with higher FICO scores may obtain better interest rates on mortgages as well as higher credit limits.

Owner occupancy defines the fraction of mortgage loans in the underlying pool where the purpose of the borrower is owner-occupancy (no investment purpose). Limited documentation is the percentage of loans with only low or no-documentation records. Due to the limited documentation of the performance history it becomes more difficult for rating agencies to assign an adequate rating. In particular, for these loan types, the information is mainly based on borrowers' reports rather than verifiable information from third parties. Accordingly, LIMDOC mortgages are associated with higher risk levels. However, they enjoyed a great popularity prior to the GFC.

Regarding the securitization characteristics we include the following variables in our model: subordination (SUB), thickness (THICK), log balance (LB) and multiple CRAs (MCRA).

Subordination indicates the level of protection. Losses from the underlying pool are absorbed following the seniority level of the tranches. Realized losses affect the most junior tranche first (also called First Loss Piece or equity tranche) then the mezzanine tranche and at last the most senior tranches. Therefore, the subordinated tranches are protective layers for the most senior tranches. Subordination levels are usually set to achieve a target rating for the specific tranche. Ceteris paribus, a higher level of subordination indicates that the rating is more conservative. The thickness of a tranche is defined as the difference between the upper and lower attachment level (in percent). Log balance represents the logarithmized value of the total issuance volume.

Multiple CRA is a dummy variable indicating whether a tranche is rated by more than one CRA.

As credit enhancement features we include the following variables: cenh-insurance (CENHI) and cenh-cross (CENHC). Then cenh-insurance is a dummy variable specifying whether a supplementary insurance is in place or not. Cenh-cross is also a dummy variable indicating whether the securitization is cross-collateralized. Credit enhancement variables are limiting credit risk for the investor and enhance the credit rating for asset-backed securities.

In the case of H1b, we take into account that the collateral (real estate) values may have changed. We follow Demyanyk et al. (2011) and construct for every period an adjusted LTV ratio which accounts for changes in the outstanding loan amount under the assumption of a fixed-rate mortgage (FRM):

$$LTV_t = LTV_0 \cdot \frac{PVR_t}{CVR_t} \tag{5.9}$$

PVR_t is the principal value ratio of current to origination principal value:[9]

$$PVR_t = \frac{1 - \left(\frac{1}{1+r_0}\right)^{T-t}}{1 - \left(\frac{1}{1+r_0}\right)^{T}} \tag{5.10}$$

with 0 as the MBS origination date, t the observation date and T the loan maturity date. The loan maturity date is approximated by the median maturity of the respective loan portfolio. r_0 is the interest rate at origination and will be later approximated by the federal funds rate.[10]

CVR_t is the collateral value ratio of current to origination real estate value approximated by the Standard & Poor's Case-Shiller 10 index (SPCS10):

$$CVR_t = \frac{CS_t}{CS_0} \tag{5.11}$$

The S&P Case-Shiller Home Price Indices measure changes in the total value of residential real estate in 20 metropolitan regions of the US. The SPCS10 is a composite index of the 10 major US metropolitan statistical areas.

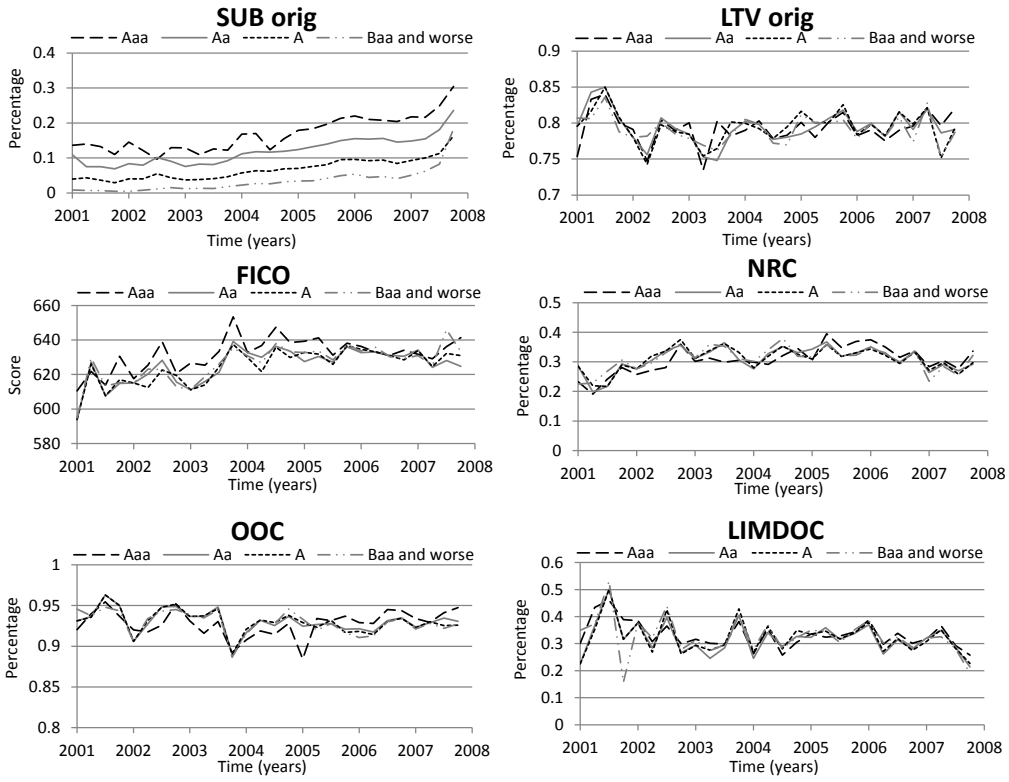
Figures 5.1 and 5.2 display the development of the major explanatory variables by rating category for the given time period and the two samples HEL

[9] Note that by including PVR we extend the approach by Demyanyk et al. (2011) by accounting for the loan amortization.

[10] Note that the mortgage rate which may be modeled by the federal funds rate plus a lending spread was analyzed to confirm the robustness of results which did not change.

and RMBS.

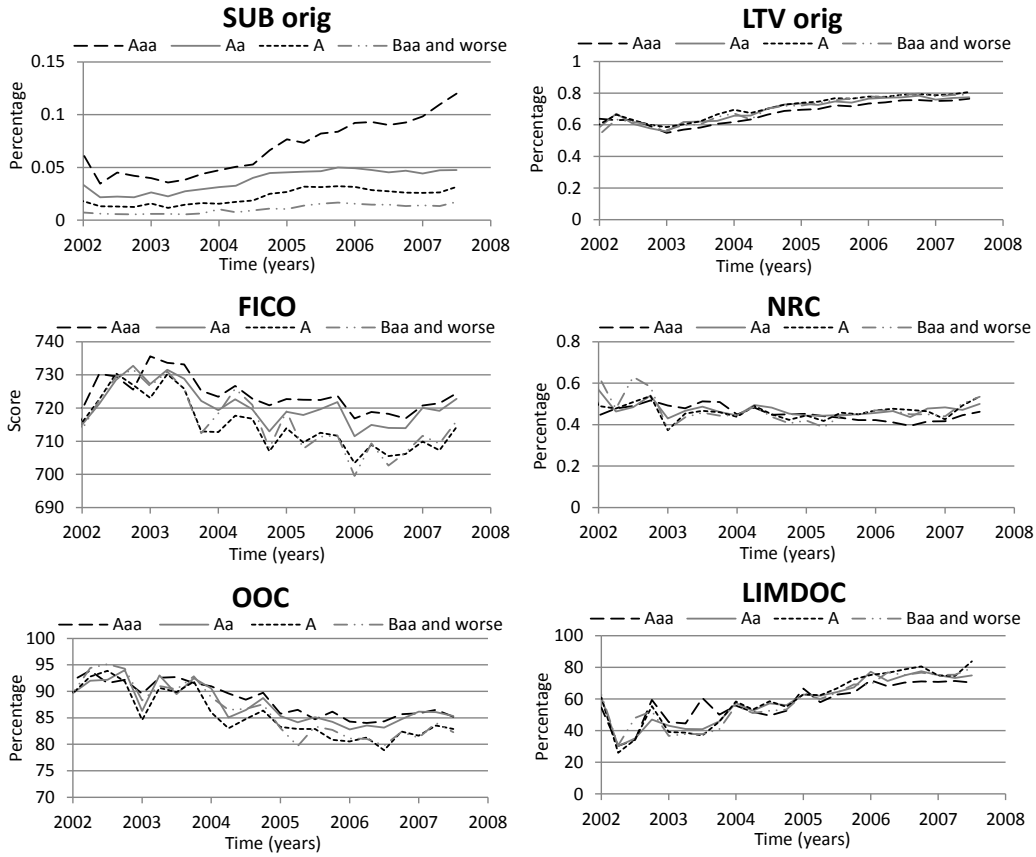
Figure 5.1: Development of major Explanatory Variables over Time - HEL Sample



Notes: The figure presents the descriptive statistics for our six major explanatory variables derived from our panel dataset over the time period between 2001 Q1-2007 Q4 for the HEL sample. The development of each variable is shown for four aggregated rating categories.

Figure 5.1 shows that the HEL subordination levels increase over time for all rating categories. As an example, for the Aaa-tranche the mean subordination level rises from 13.64% in 2001 up to 30.46% in 2007. RMBS subordination levels are in general lower than for HEL where an increase can only be observed for the Aaa-rated tranches. As anticipated, LTV ratios for HEL are on a higher level for all rating categories, however RMBS LTV ratios steadily mount over time approximating the HEL levels. As expected, FICO scores for RMBS are on average higher compared to HEL FICO scores, but we can observe a decreasing trend over time for the RMBS sample. Regarding mortgage loan documentation levels we note a sharp increase of loans with limited documentation for RMBS.

Figure 5.2: Development of major Explanatory Variables over Time - RMBS Sample



Notes: The figure presents the descriptive statistics for our six major explanatory variables derived from our panel dataset over the time period between 2002 Q2-2007 Q3 for the RMBS sample. The development of each variable is shown for four aggregated rating categories.

5.4 Empirical Results

5.4.1 Rating Standards at Origination (H1a) and during Monitoring Years (H1b)

The coefficient estimates for our control variables related to Hypotheses H1a are presented in Table 5.2 for HEL (Panel A) as well as for RMBS (Panel B). For both samples, the coefficients are estimated for four different sets of explanatory variables.[11] Securitizations in general include multiple tranches with different ratings. As a matter of fact, there are several tranches which are part of the same deal. In order to accommodate this structure we calculate clustered standard errors which are also provided in Table 5.2.

The coefficient estimates of almost all explanatory variables are statistically significant for both samples. Moreover, almost all variables have the expected signs, e.g., tranches related to higher credit scores (FICO) are associated with better ratings, tranches related to higher loan-to-value ratios are associated with worse ratings and tranches with higher levels of subordination are associated with better ratings. The same is also observable for the credit enhancement features 'additional insurance' and 'cross-collateralization'. The Non-recourse State variable is significant for the different sets and for both samples indicating that a higher fraction of non recourse borrowers in the underlying pool is associated with a higher risk and respectively with a worse rating. In contrast, the LIMDOC variable has no explanatory significance at all. Note that the results displayed in Table 5.2 are based on the assumption that every tranche observation is equally-weighted. The model in which the tranches and their ratings are weighted by the size of exposure (thickness of tranche) delivers comparable results and therefore are not presented here.

In Figure 5.3 we show the development of rating standards at origination and at observation represented by pattern of quarterly intercepts as estimated in our ordered probit model for the HEL and the RMBS sample. The quarterly intercepts are displayed for our different sets of control variables (Model 1 - Model 3).[12] In the case of HEL at origination a steady downward trend of intercepts is illustrated during the entire period between (2001 Q1 - 2007 Q4)

[11] Note that the incorporation of two further explanatory variables in our Model 3 reduces the number of observations due to missing values. However, the size of the remaining data set is sufficient to deliver reliable results.

[12] We refer to Model 4 in this table later in this paper in Section 5.5.3.

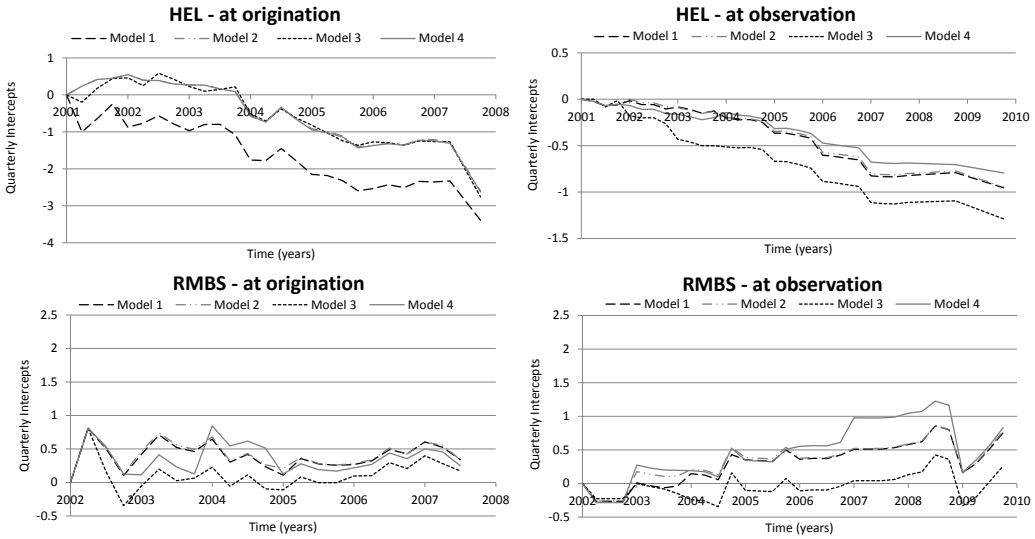
Table 5.2: Estimates for Hypotheses H1a

Panel A: HEL								
	Model 1		Model 2		Model 3		Model 4	
Variable	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Threshold	-14.3241 ***	1.4954	-14.9668 ***	1.6769	-17.0333 ***	2.3851	-14.9346 ***	1.7013
Threshold	-13.2969 ***	1.5063	-13.7829 ***	1.6954	-15.8928 ***	2.4146	-13.7492 ***	1.721
Threshold	-12.2422 ***	1.5119	-12.6156 ***	1.7029	-14.7483 ***	2.4301	-12.579 ***	1.7294
Threshold	-10.6377 ***	1.5132	-10.9063 ***	1.7038	-13.0319 ***	2.4347	-10.8747 ***	1.7299
SUB orig	21.8935 ***	0.9141	24.7573 ***	0.9706	24.2128 ***	1.0726	24.7482 ***	0.9694
LTV orig	-1.6492 ***	0.5774	-1.4733 ***	0.5663	-1.5245 **	0.624	-1.4716 ***	0.5675
FICO	0.0104 ***	0.0017	0.0096 ***	0.0019	0.0104 ***	0.0023	0.0096 ***	0.002
NRC	-1.1996 ***	0.2106	-0.9247 ***	0.2245	-1.1675 ***	0.2165	-0.9199 ***	0.2225
LB	0.4081 ***	0.0502	0.3668 ***	0.0539	0.4119 ***	0.0601	0.3666 ***	0.0539
MCRA			0.0134	0.0781	0.1236	0.0891	0.0112	0.0783
CENHI			2.0556 ***	0.3067	2.0671 ***	0.3256	2.0524 ***	0.3059
CENHC			0.4447 ***	0.0768	0.503 ***	0.0811	0.4447 ***	0.0768
OOC					0.008	0.0076		
LIMDOC					-0.0008	0.0015		
FAILBETA							-0.0107 ***	0.017
Time dummies	Yes		Yes		Yes		Yes	
N	50,272		50,272		40,856		50,272	
adj. R^2	0.6901		0.7342		0.7288		0.7351	
Panel B: RMBS								
	Model 1		Model 2		Model 3		Model 4	
Variable	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Threshold	-4.8595 *	2.5204	-4.9348 **	2.4888	-5.9914 **	2.3231	-4.5406 *	2.3372
Threshold	-4.0254	2.5139	-4.0966 *	2.4822	-5.0787 **	2.3167	-3.6722	2.3302
Threshold	-3.3575	2.5055	-3.4258	2.4738	-4.3529 *	2.3084	-2.9481	2.3208
Threshold	-2.355	2.4838	-2.4155	2.4519	-3.3128	2.2919	-1.8388	2.2994
Threshold	-1.7517	2.4675	-1.8034	2.4351	-2.6953	2.2827	-1.1386	2.2867
SUB orig	51.0008 ***	2.2046	50.5265 ***	2.2188	53.6077 ***	2.5219	47.7286 ***	2.5042
LTV orig	-5.5048 ***	0.4606	-5.4554 ***	0.4423	-5.1013 ***	0.4228	-5.3337 ***	0.4181
FICO	0.0115 ***	0.003	0.0115 ***	0.0029	0.0094 ***	0.0027	0.0111 ***	0.0027
NRC	-1.0054 ***	0.1419	-1.0055 ***	0.142	-1.2051 ***	0.1764	-0.9531 ***	0.1406
LB	-0.0588	0.0401	-0.0692 *	0.0395	-0.0243	0.0447	-0.0683 *	0.0392
MCRA			0.2766 ***	0.0856	0.1562	0.0994	0.2812 ***	0.0854
CENHI			0.3138	0.341	0.1809	0.3938	0.3289	0.3278
CENHC			0.1007 *	0.0563	0.102 *	0.0565	0.0911 *	0.0547
OOC					0.0217 ***	0.0026		
LIMDOC					-0.0036 ***	0.0014		
FAILBETA							-0.0135 ***	0.0033
Time dummies	Yes		Yes		Yes		Yes	
N	101,722		101,722		82,340		101,722	
adj. R^2	0.5312		0.5344		0.5680		0.5576	

Notes: The table shows the estimation results for the ordered probit model for the HEL sample (Panel A) and the RMBS sample (Panel B) at origination. For both panels the coefficient estimates are presented for four different sets of explanatory variables (Model 1-4). Note that the results presented here are based on the assumption that each tranche observation is equally weighted. Standard errors account for the clustered structure of the dataset where a transaction/deal generally comprises multiple tranches. Thus, the standard errors are robust to within cluster correlation. The significance is indicated as follows: ***: significant at 1%, **:significant at 5%, *:significant at 10%.

for each model. Almost all quarterly intercepts are statistically significant at the 1%-level. The decreasing trend in the intercept values accommodates the application of more stringent rating standards over time, given the identified explanatory variables in our analysis.

Figure 5.3: Rating Standards at Origination and at Observation over Time



Notes: The figure shows the estimated intercepts of the ordered probit model plotted over time for HEL and RMBS at origination as well as at observation. Note that the intercept of the first quarter is set to zero. The downward trend of quarterly intercepts for the HEL sample implies tighter ratings standards. For RMBS the variations of quarterly intercepts are not significant.

In Figure 5.3 we also display the intercept development for HEL rating standards at observation. The trend of intercepts indicates again that rating agencies tightened their rating standards for monitoring years over the time period 2001 Q1 - 2009 Q4. Most intercepts are significant at the 1% level.

The RMBS results do not exhibit significant variations of quarterly intercepts at origination or at observation, implying that rating agencies maintained rather stable rating standards over time.

In order to evaluate the adequacy of the applied probit model we compare actual versus predicted ratings. The results are presented in the table below.

Table 5.3: Goodnesss of Fit of the Probit Model

	Predicted Rating					
Actual Rating	Aaa	Aa	A	Baa	Ba/B	Total
Aaa	18,064	1,961	623	87	4	20,739
Aa	3,428	4,349	1,507	142	12	9,438
A	294	1,107	4,783	2,478	24	8,686
Baa	107	244	1,500	7,218	182	9,251
Ba/B	8	7	96	1,921	126	2,158
Total Predicted	21,901	7,668	8,509	11,846	348	50,272

Notes: The table presents the actual ratings based on our dataset in comparison to the predicted ratings resulting from the mapping of the ordered probit model. The most probable rating is within plus or minus one rating category of the actual rating for most tranches. Note that the goodness of fit is measured for the HEL sample at origination according to Model 2.

The figures in Table 5.3 show that most of the predicted ratings deviate by only one rating category which underlines the explanatory power of the used model. However, the model underpredicts the lowest rating category.

5.4.2 Investors' Awareness at Origination (H2a) and during Monitoring Years (H2b)

The further goal of this paper is to test whether investors perceive a change in rating standards at origination and during monitoring years using the model according to Equation 5.7. The results of our panel regressions are presented in Table 5.4.

We find that ratings for HEL at origination have an influence on the yield spreads which is significant at the 1%-level. Better ratings imply lower yield spreads. We also find that closing has a significant influence on the yield spreads for each observation quarter. The decrease of the quarterly coefficients over time indicates the rejection of our hypotheses H2a and implies that the rating standards have tightened over time.

Regarding our second case at observation we also observe that ratings have a significant influence on the yield spreads at the 1%-level. However better ratings now imply higher yield spreads which is owed to the extreme increase of yield spreads from 2007 onwards right for the better rating categories.[13]

[13] If we consider only the period before 2008, we also observe for the monitoring case that better ratings imply lower yield spreads.

Table 5.4: Investor's Awareness

	H2a			H2b	
	Estimate	SE		Estimate	SE
Intercept	-4.1087 ***	0.0144	Intercept	-3.2453 ***	0.0535
Rating	0.1877 ***	0.0042	Rating	-0.1124 ***	0.006
2002 Q1	0.5081 ***	0.0392	2002 Q1	0.4107 ***	0.1592
2002 Q2	0.4106 ***	0.0267	2002 Q2	0.4094 **	0.1622
2002 Q3	0.3203 ***	0.0289	2002 Q3	0.4094 **	0.1622
2002 Q4	0.1327 ***	0.0401	2002 Q4	0.3978 **	0.1671
2003 Q1	0.2807 ***	0.0372	2003 Q1	0.4841 ***	0.1262
2003 Q2	0.2011 ***	0.0271	2003 Q2	0.5151 ***	0.1295
2003 Q3	0.1042 ***	0.0276	2003 Q3	0.5246 ***	0.1331
2003 Q4	0.295 ***	0.0239	2003 Q4	0.4753 ***	0.1371
2004 Q1	0.0629 **	0.0264	2004 Q1	-0.1943 **	0.0895
2004 Q2	0.0484 **	0.0215	2004 Q2	-0.2142 **	0.0901
2004 Q3	0.2062 ***	0.0216	2004 Q3	-0.2323 **	0.0908
2004 Q4	0.0202	0.0268	2004 Q4	-0.2019 **	0.0918
2005 Q1	-0.1929 ***	0.0437	2005 Q1	-0.766 ***	0.0826
2005 Q2	-0.2743 ***	0.0255	2005 Q2	-0.7764 ***	0.0829
2005 Q3	-0.4464 ***	0.0239	2005 Q3	-0.7563 ***	0.0836
2005 Q4	-0.6569 ***	0.0311	2005 Q4	-0.7468 ***	0.0847
2006 Q1	-0.846 ***	0.0325	2006 Q1	-0.4892 ***	0.0947
2006 Q2	-0.7885 ***	0.0394	2006 Q2	-0.515 ***	0.095
2006 Q3	-0.7916 ***	0.0229	2006 Q3	-0.4972 ***	0.097
2006 Q4	-0.8522 ***	0.0364	2006 Q4	-0.495 ***	0.0996
2007 Q1	-0.8394 ***	0.0451	2007 Q1	-0.6926 ***	0.0629
2007 Q2	-0.6587 ***	0.0383	2007 Q2	-0.6925 ***	0.0631
2007 Q3	-0.4841 ***	0.0467	2007 Q3	-0.689 ***	0.0636
2007 Q4	-0.5641 ***	0.0387	2007 Q4	-0.703 ***	0.0645
			2008 Q1	0.662 ***	0.0554
			2008 Q2	0.714 ***	0.0556
			2008 Q3	0.7673 ***	0.0577
			2008 Q4	0.7831 ***	0.0579
			2009 Q1	2.2309 ***	0.0584
			2009 Q2	1.9517 ***	0.0772
			2009 Q3	1.9297 ***	0.0831
			2009 Q4	1.9316 ***	0.0852
N	6,401		N	19,528	
adj. R^2	0.5529		adj. R^2	0.4221	

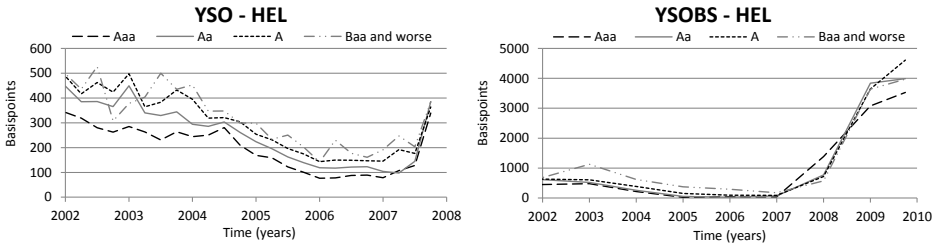
Notes: The table shows the results of our panel regressions according to Equation (5.7) for the HEL sample at origination (H2a) and at observation (H2b). The significance is indicated as follows: ***: significant at 1%, **:significant at 5%, *:significant at 10%.

We also find a significant link between the quarterly coefficients and the yield spreads at observation. Hence, investors do perceive changes in rating standards and hypothesis H2b is also rejected.

5.4.3 Yield Spread Pricing

The paper also examines whether a relationship between rating standards and yield spread pricing exists according to Equation (5.8). The mean yield spreads by rating category at origination and at observation are presented in Figure 5.4 over time for the HEL sample.

Figure 5.4: Development of the Yield Spread at Origination and Observation over Time - HEL Sample



Notes: The figure shows the development of mean yield spreads per rating category over time for the HEL sample at origination and at observation. Mean yield spreads are in general higher for riskier investments. The steady downward trend end in 2007 followed by a sharp increase of basispoints for all rating categories.

The figure shows that mean yield spreads are higher for riskier investments. Between 2002 and 2007 the mean yield spreads for all rating categories continuously declined by approximately 200 basispoints. Around 2006/2007 the level of yield spreads for the riskiest rating category is even lower than the level of yield spreads for the least risky rating category at the beginning of our observation period. In 2007, we observe an abrupt increase for all investment categories clearly indicating the unexpected macroeconomic shock.

The regression results are shown in Table 5.5 displaying the time-series regressions of mean yield spreads on rating standards and GDP growth as an additional control variable. Panel A displays level regressions, Panel B change regressions. The different columns exhibit the regression for the different rating

categories. Rating standards are approximated by estimates of quarterly intercepts for the HEL sample at origination using Model 2 illustrated in Figure 5.3.

Table 5.5: Yield Spread Regressions

Panel A: HEL - Level Regressions								
	Aaa		Aa1-Aa3		A1-A3		Baa and worse	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-3.7507 ***	0.2226	-3.4281***	0.2546	-3.2637 ***	0.2068	-3.2141 ***	0.1978
QI	0.2229 **	0.0854	0.2718 ***	0.0853	0.2620 ***	0.0693	0.2236 ***	0.0663
GDPGROW	-0.1397	0.1697	-0.1103	0.1874	-0.1225	0.1523	-0.1004	0.1456
N	28		28		28		28	
adj. R^2	0.2463		0.3077		0.3877		0.3345	
Panel B: HEL - Change Regressions								
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-0.0588 *	0.0307	-0.0579	0.0400	-0.0521	0.0363	-0.0304	0.0506
QI	0.0262 **	0.0109	0.0239 *	0.0121	0.0152	0.011	0.0122	0.0153
GDPGROW	0.0573 **	0.0229	0.0559 *	0.0287	0.0482 *	0.026	0.0315	0.0363
N	27		27		27		27	
adj. R^2	0.3134		0.2528		0.1911		0.0576	

Notes: The Table displays the results of our time-series regressions according to Equation (5.8) for the HEL sample. We regress the mean yield spreads per quarter for the four different rating categories (RC) (1:Aaa, 2:Aa1-Aa3, 3:A1-A3, 4:Baa and worse) on the rating standards and GDP growth. Note that the rating standards are approximated by estimates of the quarterly intercepts for the HEL sample at origination adopted from Model 2. Panel A reports level regressions, Panel B change regressions. The significance is indicated as follows: ***: significant at 1%, **:significant at 5%, *:significant at 10%.

Note that the quarterly intercept coefficients are positively related to average yield spreads of tranches for each rating category. The QI variable is significant for rating category Aaa at the 5%-level and for the other rating categories (Aa1-Aa3, A1-A3, Baa and worse) at the 1%-level. This implies that increasing QIs (looser rating standards) are associated with higher yield spreads for a given rating category. Vice versa, decreasing QIs (tighter rating standards) imply lower yield spreads. Overall the results suggest that the decrease in yield spreads (Figure 5.4) may be explained by – at least to some extent – pricing adjustments from investors in response to the tighter rating standards. Apparently, investors were not totally convinced that this tightening was justified by a risk increase in the economy.

5.5 Robustness Checks

Basically there are three potential objections that could challenge our main finding that rating standards for HEL tightened over time at origination and

at observation. First, the generality of findings. All results are subject to the explanatory variables used in the analysis. We address this criticism by using different sets of control variables and by an additional examination of further potential control variables. For the reliability of our model it is quite important that the predicted signs of explanatory variables are robust. In order to verify whether our predicted signs can be regarded as sustainable, we conduct a separate ordered probit analysis for each quarter of the panel to identify actual deviations. Second, the dynamics we found in our analysis may hold for Moody's but not for other rating agencies. This concern is addressed by a further analysis estimating the key models for Standard and Poor's ratings at origination. Third, the tightening of rating standards may be a reflection of a change in the systematic risk rather than a change in the CRAs' risk perception of securitized financial instruments. We address this argument by adding a specific control variable of systematic risk to our model.

5.5.1 Generality of Findings

Table 5.2 shows that our results are robust for a variation of different explanatory variables according to Model 1, Model 2 and Model 3. In addition, Figure 5.3 shows that the different models generate only minor changes in the plots of quarterly intercepts. Moreover, we have considered several further variables, one related to the risk profile of tranches (tranche default) and the others related to the macroeconomy such as the consumer price index (cpi), the SPCS10 index (lagged and anticipated), the GDP growth rate and the unemployment rate. The result is the same if we control for outcome of risk as tranche default within a year from origination. As macroeconomic variables are time dependent the concept of using time dummies is not applicable anymore. We substitute the time dummies by a metric variable where the time is linearly approximated (first quarter receives the value of 1, second quarter value of 2, etc.). The coefficient of our new time variable shows the expected negative sign and is significant at the 1% level. An increase in time is associated with lower ratings and respectively tighter rating standards. The inclusion of the macroeconomic variables has hardly any impact on the signs and the significance of the basic set of control variables. We find that the cpi and the anticipated SPCS10 index have significant explanatory power for the rating assignment. A rise in cpi is associated with worse ratings and an anticipated rise in the

SPCS10 index is also associated with a worse rating. We conclude that our results are robust to further explanatory variables for the HEL sample.

In order to check the robustness of the predicted signs we re-estimate the model for each quarter of the panel. The results are exhibited for HEL as well as for RMBS for ratings at origination and ratings at observation in Table 5.6. We present the signs of the significant variables and the number of quarters without any significant deviation in relation to the total number of quarters.

Table 5.6: Ordered Probit Estimates for each Quarter of the Panel

At origination					At observation				
	HEL		RMBS			HEL		RMBS	
Variable	Pred. sign	Total	Pred. sign	Total	Variable	Pred. sign	Total	Pred. sign	Total
SUB	+	28/28	+	23/23	SUB	+	36/36	+	32/32
LTV orig	-	23/28	-	23/23	LTV new	-	27/36	-	26/32
FICO	+	24/28	+	22/23	FICO	+	36/36	+	32/32
LB	+	23/28	/	/	LB at obs	+	36/36	/	/
NRC	-	22/28	-	19/23	NRC	-	35/36	-	31/32
MCRA	/	/	+	19/23	MCRA	+	36/36	+	32/32
CENHI	+	27/28	/	/	CENHI	+	36/36	/	/
CENHC	+	24/28	+	20/23	CENHC	/	/	+	31/32

Notes: The table presents the results of our robustness check, analyzing deviations between the predicted sign of the ordered probit model over the entire time period and the signs of the re-estimated model for each quarter of the panel. The column 'Total' displays the number of quarters without any deviation from the predicted sign in relation to the total number of quarters. Results are presented for HEL and RMBS at origination as well as at observation.

The number of deviations is quite small which further supports for the robustness of our findings.

5.5.2 Other Rating Agencies

A further criticism of the findings of this paper could be that the findings may not be observable for other rating agencies. In order to address this criticism we re-estimate the key models for the S&P ratings at origination for the HEL sample to examine whether our findings persist. As our number of rating observations from CRA Fitch is limited, we check the consistency across the two rating agencies Moody's and S&P's. In total we have more than 38,000 observations with ratings from both agencies Moody's and S&P's for the given period and the HEL sample. The rating assignments of Moody's and S&P's are deviating by 21.59%. In 89.40% of those cases Standard & Poor's provides a better rating than Moody's. Note, that the majority of rating differences

(67.95%) accounts for a single notch.

The results of the re-estimated model, exhibited in Table 5.7, clearly support our original findings.

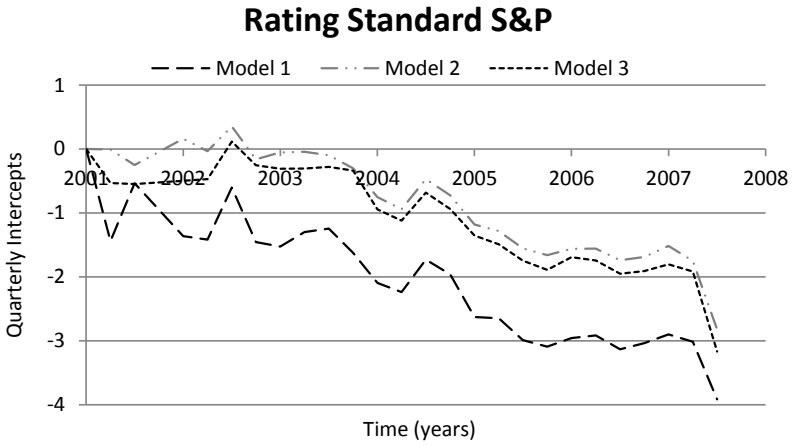
Table 5.7: Estimates for Hypotheses H1a - S&P Ratings

	Model 1 - S&P		Model 2 - S&P		Model 3 - S&P	
Variable	Estimate	SE	Estimate	SE	Estimate	SE
Threshold	-14.3687 ***	1.7545	-14.5955 ***	1.9707	-16.8816 ***	2.8685
Threshold	-13.1212 ***	1.7806	-13.2484 ***	2.009	-15.5676 ***	2.9119
Threshold	-12.0936 ***	1.7882	-12.1697 ***	2.0198	-14.5031 ***	2.9246
Threshold	-10.5049 ***	1.7853	-10.5319 ***	2.0201	-12.8305 ***	2.9233
SUB orig	21.2788 ***	0.9266	22.8076 ***	1.0611	22.3906 ***	1.0974
LTV orig	-0.7543	0.6709	-0.8042	0.7256	-0.964	0.7714
FICO	0.0094 ***	0.0022	0.0086 ***	0.0026	0.0096 ***	0.003
NRC	-0.9941 ***	0.2374	-0.8251 ***	0.2518	-1.1178 ***	0.2551
LB	0.4317 ***	0.0544	0.382 ***	0.0558	0.3805 ***	0.0646
CENHI			1.7287 ***	0.4003	1.7298 ***	0.4046
CENHC			0.3464 ***	0.0855	0.3955 ***	0.09
OOC					0.0226 ***	0.0092
LIMDOC					0.0026	0.0016
Time dummies	Yes		Yes		Yes	
N	36,382		36,382		30,282	
adj. R^2	0.6819		0.7075		0.7038	

Notes: The table shows the estimation results for the ordered probit model for S&P ratings at origination. The coefficient estimates are presented for three different sets of explanatory variables (Model 1-3). Note that the results presented here are based on the assumption that each tranche observation is equally weighted. Standard errors account for the clustered structure of the dataset where a transaction/deal generally comprises multiple tranches. Thus, the standard errors are robust to within cluster correlation. The significance is indicated as follows: ***: significant at 1%, **:significant at 5%, *:significant at 10%.

Almost all explanatory variables are significant at the 1% level and show the expected signs. The outcome is effective for all sets of explanatory variables used in our basic analysis (Model 1 - Model 3). We also observe a downward trend of quarterly intercepts (Figure 5.5) which is very close to the plot generated by the Moody's ratings.

Figure 5.5: Rating Standard S&P



Notes: The figure shows the estimated intercepts of the ordered probit model plotted over time for S&P ratings at origination for our different sets of parameters (Model 1-Model 3). Note that the intercept of the first quarter is set to zero. The downward trend of quarterly intercepts implies tighter ratings standards.

5.5.3 Systematic Risk

In this section we deal with the concern that the results of the investigation may be a mere reflection of the economic climate. One could argue that the cause for tighter rating standards is due to an increase of systematic risk during the observation period. In order to verify this proposition, we add a control variable as proxy for systematic risk to our model.

Following the approach of Hilscher & Wilson (2013) we measure systematic risk as the sensitivity of the tranche's default probability (PD) to a common factor. The authors show that the median default probability is a reliable measure of common variation in default probabilities. Therefore, in a first step, we estimate the PDs of the tranches for our basic set of explanatory variables using a probit model. Based on the individual PDs we determine the median PD for each quarter of our panel. Then, using the following regression model, we estimate the so-called 'failure betas' as a proxy for systematic risk for each rating category (RC). Higher failure betas are associated with higher systematic risk.

$$P_{it} = \beta_0^{RC} + \beta_1^{RC} P_t^{median} + \varepsilon_{it} \tag{5.12}$$

Our failure beta estimates are exhibited in Table 5.8 at origination for the HEL as well as the RMBS sample.

Table 5.8: Failure Beta

Panel A: HEL				
Rating	Intercept	FAILBETA	SE	R^2
Aaa	-0.001	0.5999	0.0217	0.0882
Aa	0.005	0.9572	0.0228	0.1884
A	0.0174	1.6419	0.0332	0.2495
Baa	0.0528	3.2618	0.0603	0.2744
Ba and worse	0.1946	4.2108	0.0874	0.1555
Panel B: RMBS				
Aaa	0.0013	0.2345	0.0033	0.0201
Aa	0.0052	0.4471	0.0036	0.0552
A	0.0174	1.4912	0.011	0.0767
Baa	0.0478	3.4859	0.0253	0.0728
Ba	0.0916	8.4088	0.0558	0.0903
B and worse	0.1647	14.4555	0.0872	0.0783

Notes: The table shows the results of the 'failure beta' estimates according to Equation (5.12) at origination for HEL and RMBS per rating category across all quarters of the panel.

In fact, our estimates of failure beta increase with worsening rating categories for ratings at origination. In principle, this is also true for ratings at observation. The chosen notification in Table 5.8 shows the average failure betas per rating grade across all quarters of the panel.

As CRAs could have only measured systematic risk with past information, failure betas enter the analysis which are estimated using past data only (ex-ante perspective). For our analysis we include failure beta (FAILBETA) estimates of the previous year per rating category and per year as control variable for systematic risk. The results are shown as Model 4 in Table 5.2. The figures demonstrate that the control variable 'failure beta' has a significant influence on the rating assignment. As expected, we observe a negative sign meaning that higher systematic risk is associated with worse ratings.[14]

Regarding the quarterly intercepts we refer to Figure 5.3 which shows that the inclusion of the control variable for systematic risk hardly changes development of the curve. This suggests that the results are robust to systematic risk.

[14] Note, that we also estimated failure betas per rating category and year with data up to the point of observation leading to similar results.

5.6 Conclusions

Rating agencies are broadly criticized for relaxing or loosening rating standards for mortgage-backed securities prior to the GFC. In this paper we examine the dynamics in rating standards for HEL and RMBS for the period between 2001 and 2007/2009. We find no evidence which supports the criticism of relaxing or loosening standard either for HEL or for RMBS. In contrast, the results suggest, that rating standards for HEL have been tightened which is in line with the statement of major representatives from the leading rating agencies. This result may appear puzzling in light of the tremendous losses coming in particular from structured financial instruments like mortgage-backed securities. Moreover, MBS for subprime borrowers are regarded as a major driver of the GFC.

However, the cause for our findings is the risk profile of the securitized tranches. Originators of securitizations were forced over time to improve the risk profile of the tranches in order to attain the same rating. Apparently, these corrections may be seen as insufficient. Moreover, part of the corrections have been offset by price adjustments of the investors. These observations suggest, that the corrections of the rating agencies could have been more drastic or inserted at an earlier point in time.

The fact that rating agencies did not fully capture the inherent risk of structured products has already been admitted in official statements of the agencies. Therefore, CRAs aim at restoring the confidence in their structured finance ratings by changing and improving their rating assignments. In 2009, Moody's Investors Service (2009*b*) published their newly requested data fields including important loan information that was thus far not considered when assigning ratings in order to improve their RMBS rating quality. Also Standard and Poor's (2009) announced changes in their calibration standard for US RMBS ratings referring to the experiences of the Great Depression.

Chapter 6

Conclusion and a Brief Outlook to Current Developments

In this cumulative thesis the results are summarized at the end of each single chapter. As a major general conclusion it is shown that capital charges for securitized products based on current regulatory rules may be inadequate due to i) high dependency of securitized tranches on the state of economy ii) negligence of possible cyclical effects in regulatory capital requirements for securitizations iii) insufficient inclusion of systematic risk in the regulatory approaches iv) over-reliance on external ratings and v) too low risk weights for highly-rated, high-issuance-volume tranches. Moreover, the results from our investigation of time-series dynamics for MBS suggest that rating agencies may have difficulties in adjusting their standards contemporarily to changes in the economic conditions.

The Basel Committee on Banking Supervision has conducted a broad review to the securitization framework and published a first consultative document submitting a comprehensive set revisions by December 2012 and a second one by December 2013 (compare Basel Committee on Banking Supervision (2012), Basel Committee on Banking Supervision (2013*a*)). In this concluding chapter the latest proposed revisions to the securitization framework are briefly described and discussed with regard to the general conclusion of this cumulative thesis.

The rationale behind the proposed revised framework is explained by three major shortcomings within the current securitization rules:

1. The Basel Committee on Banking Supervision confirms that the risk

assessments of CRAs were too optimistic for certain securitized assets. Hence deficient rating grades were determining regulatory capital requirements as the banks were obliged to apply the RBA for securitized transactions when an external (or inferred) rating was available.

2. The Committee also found that risk weights for highly-rated securitization tranches were too low whereas risk weights for low-rated tranches were too high.

3. Finally, the Committee identified procyclical issues in the securitization framework due to significant increases in capital requirements resulting from i) high absolute risk weight differences (RBA) and ii) strong leaps in capital charges triggered by even small changes in the qualities of the reference pool for unrated exposures (SFA) so called cliff-effects.

The rating issue has been broadly discussed in this thesis (see Chapter 3, 4 and 5). The matter of too low, respectively too high risk weights, has been shown in Chapter 4 where it is demonstrated that the incorporation of systematic risk suggests much higher risk weights for higher rated-tranches and much lower risk weights for lower-rated tranches. Regarding the so called cliff-effects, Figure 4.4 in Chapter 4 illustrates the steps of capital requirements based on the current risk weights. At the same time it is shown in Table 4.4 and Table 4.5 in Chapter 4 that the cliff-effects are mitigated as a consequence of our proposed new implied risk weights which increase more continuously. The smoothed structure of risk weights might also contribute to a mitigation of capital volatility along the business cycle (see Chapter 3).

One major element of the enhanced framework proposal is a new hierarchy of the set of modified and new approaches in assigning capital to securitized products. In the first consultative document (Basel Committee on Banking Supervision (2012)) the Basel Committee on Banking Supervision introduces a modified version of the SFA (Modified Supervisory Formula Approach (MSFA)) and a revised RBA (Revised Ratings-based Approach (RRBA)) (see Basel Committee on Banking Supervision (2013*b*) and Basel Committee on Banking Supervision (2013*c*)). Regarding the change in the hierarchy, two alternatives are submitted for discussion both showing a much more dominant position of the MSFA. Obviously the expressed aim in the proposals submitted by the Basel Committee is to move away from CRA ratings as the prevailing

basis for capital requirement determination. The modifications of the existing SFA and RBA approaches have been engineered in a way to support the new levels of the hierarchy where the RRBA usually requires higher capital charges compared to the MSFA.

Calibrating the new risk weights in the revised RBA, the proposal mainly incorporates two new risk drivers: maturity of the tranches and thickness of non-senior tranches. In general, all highly-rated tranches (AAA - BBB-) exhibit higher risk weights than under the current RBA and the risk-weight floor has been set to 20% which harmonizes the RRBA with the Standardized Approach (SA). Furthermore, the lower-rated tranches exhibit lower risk weights than under the current RBA and a 100% coverage is required only for tranches below rating grade CCC- (currently already below rating grade BB-). The risk weights generated in our proposal (Chapter 4) are following the same rationale.

Regarding the modifications of the SFA, the Committee essentially proposes to build in maturity effects at the level of individual tranches and further parameter adjustments in order to mitigate the above mentioned cliff-effects.

Furthermore, the Committee introduces new approaches such as a Simplified Supervisory Formula Approach (SSFA), a concentration ratio approach in particular for resecuritization exposures and other changes and clarifications.

However, as a result from the Quantitative Impact Study (QIS) and the comments from the banking industry, the Basel Committee on Banking Supervision has submitted a revision of this document (see Basel Committee on Banking Supervision (2013*a*)). The approaches proposed in the first document were regarded as being too complex for implementation purposes as well as for supervision requirements. Trying to achieve a reasonable balance between risk sensitivity and simplicity, the committee has decided to propose new approaches being more simple and easier to apply. The Modified Supervisory Formula Approach has been replaced by an Internal Ratings-based Approach (IRBA) engineering a risk sensitivity similar to that of the former proposal. Regarding the hierarchy, the IRBA is considered as the preferred approach to be used by the banks. The committee proposes to replace the Revised Ratings-based Approach (RRBA) by the External Ratings-based Approach (ERBA). The changes in the ERBA delivers similar capital charges compared to the Revised Ratings-based Approach (RRBA) introduced in the first document with some deviations. E.g., a risk weight floor of 15% (instead of 20%) is proposed for all approaches. Nevertheless, also the new proposal follows in general the

new calibration pattern as described in the first consultative document.

Under the new approaches, 'capital neutrality'[15] may not be necessarily provided for all securitizations due to the greater complexity of securitizations compared to the underlying assets. This also indicates that the Basel Committee on Banking Supervision is preferring a conservative approach for the enhanced securitization framework.

In summary, the revisions proposed by the Basel Committee on Banking Supervision and presented in the consultative documents reflect many aspects which have been analyzed and discussed in this cumulative thesis. In particular, the suggestions may alleviate the impact from external credit ratings due to the new hierarchy and mitigate procyclical effects in regulatory capital for securitizations. As a consequence, the committee may achieve more prudent capital requirements and thereby re-establish confidence in securitization markets.

[15] Capital neurality is achieved if the total capital requirement before securitization is identical to the total capital requirement after securitization.

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