

Rating performance and agency incentives of structured finance transactions

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Abstract

This paper compares and analyzes cross-sectional and time-series characteristics of credit rating agency (CRA) ratings, implied impairment rate estimates and realized impairment rates of asset portfolio securitizations. This is of highest importance as past shortcomings may have been instrumental to past, current and future loss rates of financial institutions in relation to securitizations. The disappointment of investors manifested in the criticism of models applied by CRAs.

Our most substantial finding is that rating agencies do not include all factors explaining securitization impairment risk. In particular, systematic risk is not addressed as CRAs average over the business cycle. Hence, CRA ratings are unable to predict impairment risk and the recent deterioration CRA rating standards can not be confirmed. Additional results are that CRA ratings for securitizations do not fully account for the average credit quality in asset portfolios and do not fully account for structural elements of structured finance transactions. In addition, CRA ratings for selected asset categories underestimate risk in origination years when the fee revenue is high.

Key words: Asset-backed Security, Collateralized Debt Obligation, Economic Downturn, Fee Revenue, Forecasting, Home Equity Loans, Impairment Rate, Mortgage-backed Security, Structured Finance Rating, Sub-prime Mortgage Crisis

JEL classification: G20, G28, C51

1 Introduction

This paper compares and analyzes cross-sectional and time-series characteristics of credit rating agency (CRA) ratings, implied impairment rate estimates and realized impairment rates of asset portfolio securitizations (structured finance transactions). This is of highest importance as past shortcomings may have been instrumental to past, current and future loss rates of financial institutions in relation to securitizations. Structured finance ratings and associated fee revenue have experienced an unprecedented growth in past years and dominate today in terms of numbers as well as CRA fee revenue.¹

The current financial crisis led to an unprecedented and unexpected increase of impairment and loss rates for securitizations. The disappointment of investors manifested in the criticism of models applied by credit rating agencies (CRAs). Examples are VECTOR from Fitch rating agency (see Fitch Ratings 2006), CDOROM from Moody's rating agency (see Moody's Investors Service 2006) and CDO Evaluator from Standard and Poor's rating agency (see Standard & Poor's 2005). Similar critique has been put forward after the South East Asian Crisis of 1997 in relation to corporate bond issuer and bond issue credit ratings. For example, Leot et al. (2008) find that ratings follow rather than predict the crisis as systematic downgrades have occurred subsequent to the crisis.

Securitizations involve the sale of assets into bankruptcy-remote special purpose vehicles, which are funded by investors of different seniorities (tranches). Based on the nature of the securitized asset portfolios, important transactions types include asset-backed securities (ABSs), collateralized debt obligations (CDOs), home equity loan-backed securities (HEL) and mortgage-backed securities (MBS). Despite their name, securitizations are generally over-the-counter contracts and involve a funded as well as unfunded risk transfers. Therefore, no secondary market prices are available. Counterparties publish accounting values for funded, and to a lesser degree for unfunded transactions.² Information is generally available to measure the risk of securitizations and includes credit ratings, impairment histories and proxies for the asset port-

¹ For example, in the financial year 2007, CRA Moody's Investor Services has generated a fee revenue of \$873.3 million for structured finance ratings, \$411.5 million for corporate issuer and issue ratings, \$274.3 million for financial institution issuer and issue ratings and \$220.8 million for public project and infrastructure ratings. The relative fee revenues in 2007 (1998) were 49% (32%) million for structured finance ratings, 23% (33%) for corporate issuer and issue ratings, 15% (20%) for financial institution issuer and issue ratings and 12% (15%) million for public project and infrastructure ratings.

² The latter are accounted for off-balance sheet and thus only included in the notes of annual reports.

folio risk such as asset value indices or cash flow indices. The evaluation of individual risks, their dependence structure and derivatives (i.e., the funded or unfunded exposures of investors and guarantors) is complicated by the low liquidity of the assets, the unavailability of secondary markets and the recent origination of such transactions. Two main streams exist in literature on the measurement of financial risks of securitizations. The first stream focuses on the pricing of structured finance transactions where the central issue is to explain observed (market) prices such as credit spreads of credit default swap (CDS) indices. The most prominent examples are the CDX North America and iTraxx Europe indices, which reference a portfolios of 125 firms. These indices were originated in 2003 and 2004. Credit spreads for the index as well as tranches are available daily. Longstaff & Rajan (2008) and Hull & White (2004) apply a risk-neutral pricing framework to develop pricing techniques for these spreads. A central point of these risk models is the specification of the dependence structure for the portfolio assets.

The second stream is concerned with the modeling and estimation of the risk characteristics of the underlying asset portfolio, which generally comprises loans without relying on market prices. The focus is on the derivation of the distribution of future asset values (or losses) based on individual risk parameters. In the case of a loan portfolio, the relevant parameters are default probabilities, loss rates given default, exposures at default and dependence parameters such as correlations or more general copulas. Merton (1974), Leland (1994), Jarrow & Turnbull (1995), Longstaff & Schwartz (1995), Madan & Unal (1995), Leland & Toft (1996), Jarrow et al. (1997), Duffie & Singleton (1999), Shumway (2001), McNeil & Wendin (2007) and Duffie et al. (2007) address the default likelihood. Dietsch & Petey (2004) and McNeil & Wendin (2007) model the correlations between default events. Carey (1998), Acharya et al. (2007), Pan & Singleton (2008), Qi & Yang (2009) and Grunert & Weber (2009) develop economically motivated empirical models for recoveries using explanatory co-variables. Altman et al. (2005) model correlations between default events and loss rates given default.

Within this stream, credit ratings are often used as explanations of financial risk. Ratings measure the financial risk of corporate bond issuers, corporate bond issues, sovereigns and structured finance issues. In the contemporary climate of the US sub-prime mortgage crisis (2007-2008), the role and importance of ratings to all market participants (e.g., issuers, investors and regulators), while controversial, is beyond question. Fundamental issues relating to the general extent to which corporate credit rating changes convey new information has a rich pedigree that is the subject of ongoing academic debate and investigation. For example, Radelet & Sachs (1998) find that rating changes are pro-cyclical. This suggests that they 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 pro-

vide news to the market. Jorion et al. (2005) show that after Regulation Fair Disclosure, the market impact of both downgrades and upgrades is significant and of greater magnitude compared to that observed in the pre-Regulation Fair Disclosure period. The relative roles of different CRAs have also been studied. For example, Miu & Ozdemir (2002) examine the effect of divergent Moody's and S&P ratings of banks.

With regard to the current crisis, Rajan et al. (2008) show that omission of soft information in the ratings can lead to substantial model risk. Mayer et al. (2008) find that the decline of housing prices was responsible for increasing sub-prime mortgage delinquency rates. Benmelech & Dlugosz (2008) analyze collateralized loan obligations (CLOs) rated by Standard and Poor's and find a mismatch between credit ratings and the quality of the underlying loan portfolios. Crouhy et al. (2008) point out that CRAs' fee revenues depend on the number of ratings and may be supported by higher ratings. Similarly, Franke & Krahnert (2008) argue that incentive effects have played an important role in the crisis, particularly associated with the allocation of equity tranches of securitizations. Hull (2008) and Hellwig (2008) identify deficient CRA models as a cause of the current financial crisis.

Unfortunately, the literature has not yet analyzed CRA ratings of securitizations and their accuracy. This paper addresses this shortcoming. Based on the rating and impairment data of one CRA, cross-sectional and time-series characteristics of ratings, implied impairment rate estimates and realized impairment rates of asset portfolio securitizations are compared and analyzed.

The remainder of this paper is organized as follows. Section 2 provides a framework for the financial risk in securitizations and develops hypotheses, consistent with the current literature in relation to the risk and uncertainty of CRA assessments. Section 3 describes the data used in the study and analyzes the central hypotheses. Section 4 discusses the major ramifications of the empirical results for risk measurement models for securitizations and provides suggestions for a new stability framework for financial markets, institutions and instruments.

2 Model Framework and Hypothesis Development

2.1 Model Framework

Structured finance transactions are investments in special purpose companies investing the funds in a portfolio of assets. These investments cover, within legal maturities, losses to the asset portfolio in excess of a retention (also known as attachment level, AL) and up to a limit (also known as detachment level). The paper refers to the entire transaction as ‘deal’ and the individual investment segments as ‘tranche’. In other words, one transaction may consist of one or more tranches of various seniority levels. The asset portfolio of a deal generally consists of financial assets (e.g., loans) that are subject to financial risk (e.g., credit risk).

The major CRA models to evaluate structured finance transactions share a similar structure, which is presented below. Examples are VECTOR from Fitch rating agency (see Fitch Ratings 2006), CDOROM from Moody’s rating agency (see Moody’s Investors Service 2006) and CDO Evaluator from Standard and Poor’s rating agency (see Standard & Poor’s 2005).

2.1.1 Default process for an individual asset and the portfolio default rate

Consistent with Gordy (2000), Gordy (2003) and McNeil & Wendin (2007), credit risk of an individual borrower is modeled by a one factor model for the individual asset return based on Merton (1974). Let S_{kt} denote the asset return of borrower k in time period t ($k = 1, \dots, K; t = 1, \dots, T$) and is generated by the following process

$$S_{kt} = \sqrt{\rho} \cdot F_t + \sqrt{1 - \rho} \cdot U_{kt} \quad (1)$$

where F_t and U_{kt} are independent standard normally distributed systematic and idiosyncratic risk factors and ρ is a parameter denoting the correlation between asset returns.

A default event occurs if the asset return S_{kt} falls below a threshold c_t . The threshold may be interpreted as the credit quality. For simplicity of exhibition we assume in the following that all assets in a portfolio are of equal credit quality c_t at time t for a given risk segment.³ A borrower default event occurs

³ Risk segments may be defined by transaction types such as asset-backed securities (ABS), collateralized debt obligations (CDO), home equity loan-backed securities (HEL) or mortgage-backed securities (MBS).

if the asset return falls below the critical threshold c_t

$$D_{kt} = 1 \Leftrightarrow S_{kt} < c_t \quad (2)$$

where D_{kt} is an indicator variable with

$$D_{kt} = \begin{cases} 1 & \text{borrower } k \text{ defaults in } t \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

The probability of default conditional on the systematic risk factor f_t is then

$$\pi_t(f_t) = P(S_{kt} < c_t | f_t) = \Phi\left(\frac{c_t - \sqrt{\rho}f_t}{\sqrt{1-\rho}}\right) \quad (4)$$

and has expectation (the unconditional probability of default)

$$\begin{aligned} \pi_t &= P(S_{kt} < c_t) = \int_{-\infty}^{\infty} \Phi\left(\frac{c_t - \sqrt{\rho}f_t}{\sqrt{1-\rho}}\right) d\Phi(f_t) \\ &= \Phi(c_t) \end{aligned} \quad (5)$$

where $\Phi(\cdot)$ denotes the standard normal cumulative distribution function.

K_t assets are pooled to an asset portfolio and the portfolio default rate is the average over the default indicators

$$P_t = \frac{1}{K_t} \sum_k^{K_t} D_{kt} \quad (6)$$

The default rate of the asset pool then follows a binomial-normal mixture probability distribution

$$g(p_t) = \int_{-\infty}^{\infty} \binom{K_t}{K_t \cdot p_t} \pi_t(f_t)^{K_t \cdot p_t} (1 - \pi_t(f_t))^{K_t(1-p_t)} d\Phi(f_t) \quad (7)$$

The probability density is given for portfolios of (infinitely) many borrowers with sufficiently small credit exposures⁴ by

⁴ See Gordy (2003) for a mathematical definition.

$$\tilde{g}(p_t) = \frac{\sqrt{1-\rho}}{\sqrt{\rho}} \cdot \exp\left(\frac{1}{2}(\Phi^{-1}(p_t))^2 - \frac{1}{2\rho}(c_t - \sqrt{1-\rho} \cdot \Phi^{-1}(p_t))^2\right) \quad (8)$$

The cumulative distribution function is given by

$$F(p_t) = P(P_t < p_t) = \Phi\left(\frac{\sqrt{1-\rho}\Phi^{-1}(p_t) - c_t}{\sqrt{\rho}}\right) \quad (9)$$

Note that P_t in Equation (8) and Equation (9) can also be interpreted as the loss rate (rather than the default rate) of the portfolio when losses given default are deterministic and equal to unity.

2.1.2 Impairment process for a tranche within a transaction

In the following, let P_{it} denote the default rate of asset pool i ($i = 1, \dots, I$), i.e., of a transaction or deal. A tranche j ($j = 1, \dots, J_i$) of this deal experiences a loss and therefore an impairment if the default rate P_{it} in the portfolio exceeds the relative attachment level (or subordination level) AL_{ijt}

$$D_{ijt} = 1 \Leftrightarrow P_{it} > AL_{ijt} \quad (10)$$

where D_{ijt} is an indicator variable with

$$D_{ijt} = \begin{cases} 1 & \text{tranche } j \text{ of deal } i \text{ is impaired in } t \\ 0 & \text{otherwise} \end{cases} \quad (11)$$

The relative attachment level is calculated by the ratio of the attachment level (in \$) and the deal principal (in \$) of period t . As a result of this definition, impaired tranches of previous years have reduced both the attachment level as well as the deal principal. The probability of a tranche impairment is thus

$$P(D_{ijt} = 1) = P(P_{it} > AL_{ijt}) \quad (12)$$

Inserting Equation (12) in Equation (9) and replacing c_t by $\Phi^{-1}(\pi_t)$ results in

$$P(D_{ijt} = 1) = 1 - \Phi \left(\frac{\sqrt{1 - \rho} \Phi^{-1}(AL_{ijt}) - \Phi^{-1}(\pi_t)}{\sqrt{\rho}} \right) \quad (13)$$

This implies that the tranche impairment probability is a function of the

- Average portfolio asset quality;
- Asset correlation;
- Attachment level (subordination level) of a tranche relative to the total deal principal.

A credit rating measures the impairment risk of a securitized tranche. Thus, it should account for these factors to explain tranche impairment probabilities. On the other hand, if a rating omits information, then additional information besides the rating may explain the tranche impairment probability. Examples may relate to the asset portfolio quality, the securitization structure as well as the business cycle.

2.2 Hypotheses development

The following hypotheses aim to answer whether CRA structured finance ratings (from now on referenced as ‘ratings’) are inaccurate and may have been causal for the current financial crisis. The hypotheses are as follows:

- H1a: Ratings represent the average asset quality of the asset portfolio;
- H1b: Ratings represent structured finance transaction characteristics such as resecuritization status, subordination level and transaction cash flow structure;
- H2: Ratings include time varying information;
- H3a: Rating standards have not declined over time;
- H3b: Ratings predict impairment risk;
- H4: Ratings indicate low risk in origination years and high risk in monitoring years.

The hypotheses H1a and H1b relate to idiosyncratic, H2 to systematic and H3a and H3b to the interaction between idiosyncratic and systematic risk characteristics of securitizations. H4 relates to incentive mechanisms induced by the fee structure of securitizations.

H1a addresses characteristics of the asset portfolio. Rajan et al. (2008) find that securitization risk models omit ‘soft’ information. This implies that the CRA ratings, relying on such models, mis-evaluate the average credit quality of the asset portfolio. Crouhy et al. (2008) suggest that CRAs did not

monitor raw data, were tardy in recognizing the implications of the declining state of the sub-prime market for the ratings of monoline insurers, paid by clients for ratings and that competition is limited by regulation. Important drivers of asset portfolio risk may be ratings as well as other asset portfolio characteristics.

H1b addresses the tranching structure of securitizations and the current discussion on the appropriate specification of the dependence structure of various assets in a portfolio (compare Hull 2008, Hellwig 2008). Credit rating implied correlations are, for example, derived in Gordy (2000). The probability distribution as well as the percentiles of losses associated with the pool are particularly sensitive to the correlations in the underlying asset pool. Thus, the level of subordination may be a key driver if correlations are mis-specified and should explain tranche impairments after controlling for credit ratings.

H2 identifies the degree to which business cycles are included into CRA risk models. Previous research has analyzed whether CRA ratings for corporate issuer and bond issue ratings address the state of the economy (point-in-time rating) or not (through-the-cycle rating). An analysis of both rating paradigms is given in Loeffler (2004). While through-the-cycle ratings are often more stable through time, see Nickell et al. (2000), they may react too slowly in economic up- or downturns. Franke & Krahen (2008) argue that sensitivities to macroeconomic factors may be higher for securitized tranches than for corporate bonds.

H3a relates to a hypothesis suggested by various authors (e.g., Crouhy et al. 2008) that lending standards have declined in recent years. Blume et al. (1998) present a similar hypothesis for corporate bond issuers. Rajan et al. (2008) analyze individual securitized sub-prime loans and assess the performance of the FICO score⁵ and loan-to-value ratio for the prediction of mortgage default events. They find that the default model performs poorly in times of higher securitization. Downing et al. (2008) present evidence for declining subordination levels for commercial MBSs.

H3b addresses the information degree of credit ratings. Hellwig (2008) argues that the omission of systematic factors related to real-estate prices such as interest rates and the availability of housing finance may have led to an overoptimism of valuations and ratings. Such expectations may be adjusted in an economic downturn.

H4 addresses a potential conflict of interest of rating agencies. Crouhy et al. (2008) argue that CRA fees are paid by issuers. This may imply that the credit quality measured by CRAs and CRA fee revenue are positively correlated. However, CRAs publish default and rating migration tables, which are

⁵ Developed by Fair, Isaac and Company.

used to calibrate ratings to metric risk measures. Thus, a systematic ‘rating for fee’ policy would be noticed and priced by investors when analyzing the financial risk in relation to ratings. Generally speaking, the fee revenue of rating agencies is high when the first rating is generated (origination year) and low in later years when ratings are revisited (monitoring years).⁶ In addition, the fees in relation to origination and monitoring years are often paid upfront despite their lagged recognition as accounting income. As a result, CRAs may have an incentive to assign i) low risk ratings in origination years to increase fee revenue and ii) high risk ratings in monitoring years to maintain stable default and rating migration performance measures. These measures are generally calculated as an average per rating class or per observation year.

⁶ In financial year 2007, CRA Moody’s Investors Service has generated 77% of fee revenue for origination of ratings and 23% for monitoring of ratings. The empirical data suggests that 37% of structured finance ratings relate to an origination year and 63% of structured finance ratings relate to a monitoring year. These numbers imply that an origination rating generates approximately 5.7 times more fee revenue than monitoring a rating for one year.

3 Empirical analysis

3.1 Structured finance data

The paper analyzes a panel data set of structured finance transactions rated by CRA Moody’s Investors Service. The data covers characteristics of transactions, characteristics of tranches, ratings of tranches over time as well as occurrences of impairment events. The time horizon is 1987-2007.

The central event in the present study is the impairment event. An impairment event is defined as follows (compare Moody’s Investors Service 2008):

“Material impairments fall into one of two categories, principal impairments and interest impairments. Principal impairments include securities that have suffered principal write-downs or principal losses at maturity and securities that have been downgraded to Ca/C, even if they have not yet experienced an interest shortfall or principal write-down. Interest impairments, or interest-impaired securities, include securities that are not principal impaired and have experienced only interest shortfalls.”

Filter rules were applied and the following observations deleted. The filter rules were chosen in order to create homogeneous risk segments:

- Transaction observations which can not be placed into the categories ABS, CDO, CMBS, RBMS or HEL.⁷ These are mainly asset backed commercial paper, structured covered bonds, catastrophe bonds, and derivative product companies (30,772; 20.5%);
- Transaction observations which are not based on the currency USD or transaction observations which are not originated in the USA (17,717; 11.8%);
- Tranche observations which relate to years prior to 1997 due to a limited number of impairment events (21,442; 14.3%);
- Tranche observations which have experienced an impairment event in prior years (93; 0.1%).

The numbers in brackets indicate the number of tranche observations, which were deleted by each filter rule. The percentages in brackets indicate the fraction in relation to the initial data sample of 149,859 tranche observations. The resulting dataset comprises 79,835 annual tranche observations and 15,728 annual transaction observations. The number of impaired tranche observations is 2,293 while the original data set included 2,340 impairment events before the application of filtering rules.⁸

⁷ See below for definitions.

⁸ This implies that structured finance transactions are more common and impair-

The following categorical variables were generated:

- Impairment (1: impairment, 0: no impairment) indicates that a tranche is impaired in the observation year;
- Rating at the origination of the transaction (Aaa, Aa, A, Baa, Ba, B, Caa-C) reflects the expected loss of a tranche and is measured at the beginning of an observation year;⁹
- Rating at the beginning of the respective year (Aaa, Aa, A, Baa, Ba, B, Caa-C) reflects the expected loss of a tranche and is measured at the beginning of an observation year.
- Deal category (ABS: asset backed security, CDO: collateralized debt obligation, CMBS: commercial mortgage-backed security, HEL: home equity loan security, RMBS: residential mortgage-backed security);
- Original Rating Year (ORY; 1: transaction is originated, 0: transaction is not originated) indicates whether the transaction is originated and rated for the first time by the CRA in the observation year;
- Principal Payment Year (PPY; 1: principal is repayable, 0: principal is not repayable) indicates whether principal is repayable in the observation year;
- Resecuritization (1: resecuritization, 0: no resecuritization) indicates whether a transaction is a resecuritization of previous transactions. These transactions are often called ‘squared’ (e.g., CDO-squared);
- Relative subordination level (Junior, Mezzanine and Senior) indicates the subordination level relative to the average impairment rate of an asset class (see below).

The relative subordination level (RSUB) is divided into the levels ‘Junior’, ‘Mezzanine’ and ‘Senior’:

$$RSUB_{it} = \begin{cases} \text{Junior} & SUB_{it} \in [0, IR_j[\\ \text{Mezzanine} & SUB_{it} \in [IR_j, k \cdot IR_j[\\ \text{Senior} & SUB_{it} \in [k \cdot IR_j, 1] \end{cases} \quad (14)$$

with the multiplier k and the average impairment rate IR_j of asset class j with $j \in \{ABS, CDO, HEL, MBS\}$. The empirical analysis applies a multiplier of $k = 2$.¹⁰

Table I and Table II describe the number of observations over time. The overall number of rated securitizations has increased at an increasing rate over time.

ment events more frequent in the US than in non-US regions.

⁹ In the empirical analysis, the rating categories Aaa to A are aggregated to category Aaa-A due to the limited number of past impairment events in these categories.

¹⁰ Other multipliers ($k > 2$) were used to analyze the robustness of results. The results were similar to the case presented.

Similar observations may be made for the value of securitizations.¹¹

[insert Table I here]

[insert Table II here]

Table I shows the relative frequency of rating categories at origination (Panel A) and at the beginning of the observation year (Panel B). In both Panels, the average rating quality deteriorates over time as the relative frequency of the rating category Aaa declined. This may reflect i) a deterioration of the average asset portfolio quality, ii) a higher average risk level induced by the securitization structure (e.g., subordination, thickness or features such as embedded options, which are not addressed in this paper) or iii) a change of the rating process (compare Hypothesis H3a).

Table II shows the relative frequency of deal and transaction characteristics. Deal characteristics (Panel A) include the asset portfolio type and the resecuritization status. HELs may be seen as sub-prime mortgage loan portfolio securitizations and have increased during the observation period. This is of high relevance as the impairment rate for HELs (next to CDOs) has increased over-proportionately. Generally speaking, asset portfolio securitizations are relatively heterogeneous despite the contribution by the International Swap and Derivatives Dealer Association by providing structure templates. Retail asset portfolios generally comprise a large number of exposure amounts (e.g., 100,000) with small exposures (e.g., \$100,000) and are mainly exposed to systematic risk. Corporate/wholesale asset portfolios comprise a small number (e.g., 100) of exposures with large exposure amounts (e.g., \$10 million) and are exposed to idiosyncratic as well as systematic risk. ABSs generally comprise retail asset portfolios (e.g., auto, credit card and student loans) as well as corporate/wholesale asset portfolios (e.g., equipment loans and leases). CDOs generally comprise corporate/wholesale asset portfolios (e.g., unsecured or secured corporate loan exposures). HELs generally relate to retail sub-prime mortgage portfolios while MBSs generally relate to prime mortgage portfolios of commercial (CMBS) and residential (RMBS) borrowers. Resecuritizations have increased over time while the relative frequency of principal payment years has decreased in 2006 and 2007 as the overall number of tranches has increased.

Transaction characteristics (Table II, Panel B) include the subordination level, the origination year and the principal payment year. The relative frequency of

¹¹ All tables weight individual transactions equally. The average transaction size has declined during the observation period: 1997: \$182.78 million, 1998: \$160.32 million, 1999: \$131.86 million, 2000: \$117.51 million, 2001: \$105.52 million, 2002: \$92.00 million, 2003: \$88.56 million, 2004: \$91.73 million, 2005: \$89.40 million, 2006: \$88.73 million, 2007: \$81.02 million.

mezzanine and senior tranches has increased. Origination years show a U-shape as the fraction is high when these issues were first rated and most recently due to the exponential growth of the structured finance market. For the same reason, principal payment years show an inverse U-shape.

Generally speaking, the validation of credit ratings is complicated as the use of ratings involves two steps: firstly the ordinal assessments of the financial risk of issuers or issues by CRAs and secondly the calibration of these ordinal ratings to metric credit risk measures such as default rates, loss rates given default or unconditional loss rates. This calibration step is generally opaque as investors rely on impairment rate tables. These tables aggregate the impairment events over dimensions such as rating or observation year. The data set enables the estimation of impairment risk on the most detailed information level the individual transaction in a given observation year. Table III and Table IV show the impairment rates over time for all tranches as well as per rating category, asset portfolio type, resecuritization status, principal payment year status and subordination level.

US securitizations have experienced two economic downturns in past years: the first one in 2002 subsequent to the US terrorist attacks (a period characterized by large bankruptcies such as Enron, Parmalat, WorldCom and various US airlines) and the most recent financial crisis. The impairment rate has increased by a factor of 10 within one year between 2006 (minimum of time series) and 2007 (maximum of time series). Approximately 65% of the impairment events relate to 2007, the year with the highest impairment rate and highest number of transactions and tranches.

[insert Table III here]

[insert Table IV here]

Table III shows that impairment rates for rating categories at origination (Panel A) and at the beginning of the observation year (Panel B). In both Panels, the impairment rate increases for lower rating categories (i.e., from Aaa-A to Caa). It is the aim of this paper to analyze whether these inaccuracies are random or may be explained and therefore anticipated. Please note that inconsistencies (e.g., a higher impairment rate for a lower risk rating in a selected year) may reflect model errors or may reflect the stochastic nature of impairment events. The latter is particularly relevant if the number of observations is low for a given category.¹²

Table IV shows the impairment rates for deal (Panel A) and transaction characteristics (Panel B). The impairment rates are fundamentally different be-

¹² Such inconsistencies are in line with reports by the data-providing CRA (compare Moody's Investors Service 2008).

tween the various asset portfolio categories. The economic downturn in 2002 relates mainly to CDOs while the recent financial crisis has increased the impairment ratios for CDOs, HELs and MBSs. HELs may be interpreted as sub-prime mortgage loans and the impairment risk has increased to a larger degree than the one of MBSs. It can also be seen that HELs and MBSs did not experience an economic downturn in 2002. Impairment rates of resecuritizations have increased to a much larger degree in 2007.

Transaction characteristics (Table IV, Panel B) show that impairment rates have increased in 2007 for equity tranches and mezzanine tranches.¹³ The impairment rate has increased dramatically in 2007 for original rating years and principal payment years.

3.2 H1a: Ratings represent the average asset quality of the asset portfolio

A major concern in the current financial crisis is that current credit portfolio risk models, including the models used by CRAs, do not capture credit portfolio risk accurately. If credit ratings correctly assess the impairment risk of a tranche, then the tranche impairment probability should solely be explained by the ratings. Other variables may impact upon the likelihood of an impairment event taking place. This would indicate that ratings omit information.

Table V presents in Column 1 and Column 2 two Probit models linking the impairment of tranche j ($j = 1, \dots, J_i$) of pool i ($i = 1, \dots, I$) in time t ($t = 1, \dots, T$) with observable information

$$P(D_{ijt} = 1) = \Phi(\beta'x_{ijt}) \quad (15)$$

x_{ijt} is a vector of observable and thus known variables. β is the respective vector of sensitivities and includes an intercept. The models may be used for forecasting as the CRA ratings are measured at the beginning of the observation year.

Model 1 (Column 1) takes the ratings provided by CRAs into account. Aaa-A is the reference category. As measures for in-sample accuracy of the models the Pseudo- R^2 , re-scaled R^2 , and the area under the receiver operating characteristic (AUROC) are given (see Agresti 1984). The parameter estimates increase from rating Aaa-A to Caa. This demonstrates the predictive power of ratings. Model 2 (Column 2) includes the ratings as well as the type of the underlying asset portfolios. The impairment likelihood of CDOs is larger than

¹³ Transactions may consist of single and multiple tranches.

HELs, which is larger than ABSs, which is larger than MBSs.¹⁴

[insert Table V here]

In summary, CRAs do not take all available asset portfolio information into account. Important ramifications are that i) CRAs may have to include asset portfolio characteristics into the rating models and ii) investors should apply asset portfolio specific impairment rates to ratings when interpreting CRA ratings.

3.3 H1b: Ratings represent structured finance transaction characteristics such as resecuritization status, subordination level and transaction cash flow structure

In order to test the hypothesis whether CRAs mis-specify structured finance transaction characteristics, we include three additional variables:

- **Resecuritization:** the variable indicates whether the transaction consists of a resecuritized asset portfolio. Hull (2008) suggests that resecuritizations contributed to the increased number of impaired structured finance transactions. Resecuritizations were originated to create a market for mezzanine tranches. Mezzanine tranches are generally less popular amongst investors. Thus a resecuritization often involves the tranching of a portfolio of mezzanine investment tranches. To date, no empirical evidence was presented as to whether ratings for resecuritizations have the same information content as ratings for primary securitizations;
- **Subordination:** the metric variable represents the subordination level of the observed tranche and relates to an ongoing discussion of whether CRAs apply reasonable levels of asset correlations. Asset correlations measure the dependence between the asset performances of the portfolio underlying the transaction and are an important input parameter in the risk models of CRAs as well as many financial institutions;
- **Principal payment year (PPY):** securitizations may be more likely to be impaired in the principal payment year than in an interest payment year. The impact of this variable on the impairment risk of tranches has never been formally tested. However, it is important as structured finance transactions are fundamentally different to other credit risk exposures such as corporate bonds and retail loans:
 - Retail loan repayments are generally structured as annuities and aligned with the income of a borrower. Early years relate mainly to interest payments while later years relate mainly to principal repayments. Retail bor-

¹⁴ We estimated Logit models as a robustness check (i.e., nonlinear models with a logistic link function). The results are comparable.

rowers who are unable to meet payment obligations may avoid impairment by refinancing or renegotiating their debt.¹⁵

- Corporate loans or bonds involve periodic interest payments and repayment of principal at maturity. However, bonds are issued by large corporations and financed by a portfolio of equity, hybrid capital and debt of various maturities. Corporate borrowers who are unable to meet payment obligations may avoid default by refinancing or renegotiating their debt. Please note that restructuring may or may not be a default criteria in risk models.
- Structured finance transactions are fundamentally different from retail and corporate loans as the life of the special purpose vehicles and thus the liabilities are generally termed. This implies that the liquidation value of the assets has to be sufficient to meet all contractual interest and principal payments in the final period. Impairment occurs per definition if this is not the case.

Table V confirms that impairment risk increases significantly, if i) a transaction is a resecuritization (Model 3, Column 3), ii) the subordination increases (Model 4, see column 4) and iii) in principal payment years (Model 5, see column 5).¹⁶

The significance of the subordination may imply that the CRA risk models do not properly include the subordination level or alternatively, the distribution of portfolio losses is mis-specified. In the instance of CRA risk models, this may imply that the Gaussian copula model may not reflect the empirical data or that a dependence parameter such as the asset correlation or the correlation between default events and loss given default may be mis-specified. Asset correlations are naturally asset specific.¹⁷ Table VI shows the parameter estimates for Model 6, which includes the subordination level relative to the average impairment rate of a given asset class (compare Equation 14).

[insert Table VI here]

The positive (negative) coefficient for ‘Mezzanine’ and ‘Senior’ exposures indicates that the risk is higher (lower) than reflected in CRA ratings. This implies that ratings for the asset categories ABS and HEL (CDO and MBS) underestimate (overestimate) the likelihood of losses in excess of the subordination level. An underestimation (overestimation) may be caused by the underestimation (overestimation) of positive correlations between underlying stochastic asset value processes and/or a mis-specification of functional forms

¹⁵ Please note that restructuring may or may not be a default criteria in risk models.

¹⁶ Model 6 (Column 6) confirms the robustness of the results by including all three variables.

¹⁷ Despite the common practice to estimate implied volatilities and correlation per tranche.

such as the copula model. The empirical results suggest with regard to the asset correlations, the standard assumptions applied by CRAs should be higher for ABS and HEL securitizations and lower for CDO and MBS securitizations.

Thus, CRAs do not take all available information on structured finance transaction characteristics into account. Similar to hypothesis H1a, important ramifications are that i) CRAs may have to include structured finance transaction characteristics into their rating models and ii) investors should apply transaction structure-specific impairment rates to CRA ratings.

3.4 H2: Ratings include time varying information

CRAs are known to rate ‘through-the-cycle’ for corporate bonds (see e.g., Loeffler 2004) and include mainly idiosyncratic characteristics. Cyclical effects or macroeconomic information are not included as the assessment of credit quality should only reflect a borrower’s ability to pay based on firm fundamentals and aim to avoid rating changes over time. This explicitly includes rating changes induced by changes of the general economy. Omitting business-cycle information from ratings for securitizations may lead to the observed mismatch of the time-constant rating and cyclical impairment risk.

We extend the models by a time-specific, contemporaneous and thus random effect and analyze to what extent ratings of securitizations include or omit macroeconomic information. The conditional probability of impairment (given a random variable F_t) is given by a probit transformation of a linear combination of an intercept α and a random time-varying component F_t :

$$P(D_{ijt} = 1|F_t) = \Phi(\alpha + b \cdot F_t) \quad (16)$$

F_t is a proxy for unobserved economic information explaining the impairment risk. We assume that F_t is standard normally distributed and the tranche exposure to F_t is denoted by b . The parameters are estimated by the Maximum-Likelihood method.

In Model 7 (Table VII, Panel A), we estimate the stand-alone sensitivity to systematic risk. The parameter estimates are shown in Table VII (Panel A). The first version is based on the whole data set and serves as a base case (Column 1). The estimate for the intercept is -2.1255, the estimate for the exposure to the latent factor is 0.2734 and highly significant. This shows that tranche impairment risk is driven by the economy. Columns 2 to 6 estimate Model 7 for data sets, which are restricted to the same rating grade. Higher rated tranches (Aaa to Ba) are more sensitive to the economy than lower rated tranches (B and Caa). Vice versa, this implies that if economic information is

omitted from the ratings, a change in macroeconomic conditions will lead to a higher discrepancy of rating and true risk for the higher rated tranches. All macroeconomic exposures are significant at the 10 per cent level.

[insert Table VII here]

Table VII (Panel B) presents the estimation results of Model 7 for different deal types. All macroeconomic exposures are highly significant and there is a clear difference between asset pool types. ABSs (Column 1) and CDOs (Column 2) have a similar medium-high sensitivity, HELs (see column 4) have the highest exposure and MBSs (Column 3) the lowest exposure. Hence, HEL are more sensitive to economic downturns than other securitization categories.

In Table VIII, we investigate whether differences exist between resecuritized deals and primary securitizations. Such structures are known as ‘tranches of tranches’ or ‘squared’ products. The intuition is that resecuritization eliminates idiosyncratic risk and therefore tranches of tranches should be exposed to a larger degree to systematic risk, see Hull (2008). The results confirm that the exposure of resecuritized tranches is 0.5771 (Column 3) and thus more than twice as much as for unsecuritized tranches where it is 0.2703 (Column 1). As most resecuritized tranches are CDOs, we estimate separate models for this asset pool type. The relatively higher macroeconomic exposure also holds for CDOs but is less pronounced (Columns 2 and 4).

[insert Table VIII here]

After analyzing the macroeconomic exposure of tranches in general, we eventually test if, and how much, business cycle information is included in the CRA ratings. We extend the random effects probit model by including rating dummies (Model 8)

$$P(D_{ijt} = 1|F_t) = \Phi(\beta'x_{ijt} + b \cdot F_t) \quad (17)$$

The exposure b of the latent factor should no longer be significant after controlling for ratings if all information on the economy affecting the impairment probabilities is captured by the rating. Table IX shows the estimates for the base case model (Model 7 without ratings, Column 1) and the model controlling for the ratings (Model 8 with ratings, Column 2). The analysis shows that ratings increase the sensitivity to the business cycle. The hypothesis that CRA ratings include time-varying systematic information on the economy is rejected. In other words, CRA ratings do not explain systematic components of impairment risk.

[insert Table IX here]

The ramifications are that the exposure to the business cycle increases i) with a CRA rating indicating lower financial risk, ii) for sub-prime mortgage loans and iii) for resecuritizations. Thus, CRA ratings should reflect the degree of systematic risk or alternatively, investors should assign time-varying impairment rates controlling for asset portfolio type and resecuritization status next to CRA ratings.

3.5 H3a: Rating standards have not declined over time

The next hypothesis addresses the critique that rating standards of CRAs may have declined over time. The deterioration of rating quality by CRAs may have been a possible reason for the current financial crisis. This should be reflected in a declining quality of rating standards or deteriorating quality of risk forecasts from credit ratings, particularly in the years prior to the sub-prime crisis. In other words, the implied impairment probability and thus observed impairment rate of a given rating grade may have increased over time as the impairment risk of transactions has increased.

We test this hypothesis using a random effects model (Model 9) of the form

$$P(D_{ijt} = 1|F_t) = \Phi(\alpha + \beta \cdot t + b \cdot F_t) \quad (18)$$

where $t = (\text{year} - 1996)$ counts the number of years from the beginning of the observation period and is thus a year effect. If the sensitivity of the variable is positive, then the impairment probability of a rating grade increases over time. This may imply that in year $t + 1$ the same rating grade exhibits higher impairment risk than in year t .¹⁸ Table X shows the results for Model 9. For none of the rating grades we find a significant time trend of impairment probabilities. However, the parameters are positive in five out of six models. The exception are Baa-rated securitizations (Column 3). Therefore, we can not reject the hypothesis that the rating standards have not declined over time.

[insert Table X here]

¹⁸ We included nonlinear transformations of the time-variable as a robustness check. The results were comparable.

3.6 H3b: Ratings predict impairment risk

Ratings are generally applied as proxies for future impairment risk. The information content of corporate bond issue has been analyzed by Blume et al. (1998). However, to the best of our knowledge, no evidence for CRA ratings on securitizations has been presented.

We test the forecasting power of credit ratings by an approach related to Rajan et al. (2008). The approach proceeds in three steps. First we estimate a probit regression for each year

$$P(D_{ijt} = 1) = \Phi(\beta' x_{ijt}) \quad (19)$$

where x_{jit} are dummy variables for the ratings, which are observed at the beginning of the observation period. Next, we calculate the linear predictor for the subsequent year

$$\hat{\eta}_{ijt+1} = \hat{\beta}' x_{ijt+1} \quad (20)$$

and the impairment probability prediction for the subsequent year

$$\hat{p}_{ijt+1} = \Phi(\hat{\beta}' x_{ijt+1}) \quad (21)$$

using the estimated coefficients $\hat{\beta}$ from (19). Finally, we assess the forecasting power by running a probit regression (Model 10).

$$P(D_{ijt+1} = 1) = \Phi(\gamma_0 + \gamma_1 \hat{\eta}_{ijt+1}) \quad (22)$$

If the rating provides perfect forecasts, then $\gamma_0 = 0$ and $\gamma_1 = 1$, which will be tested. As a robustness check we run a linear regression (Model 11)

$$D_{ijt+1} = \delta_0 + \delta_1 \cdot \hat{p}_{ijt+1} + \varepsilon_{ijt+1} \quad (23)$$

so that $E(D_{ijt+1}) = P(D_{ijt+1}) = \delta_0 + \delta_1 \cdot \hat{p}_{ijt+1}$ where $\delta_0 = 0$ and $\delta_1 = 1$.

We repeat all steps for each year from 1999 to 2007 where in the probit regression (19) all data up to year t is used. Table XI shows the parameter estimates from each regression Model 10 (Equation 22). Table XII contains the estimation results from each regression Model 11 (Equation 23).

[insert Table XI here]

[insert Table XII here]

It can be seen that in most years, both coefficients of either regression are statistically significant and thus different from their ideal values (Columns 1 and 2). Moreover, the respective R^2 neither increase nor decrease throughout. This implies that the rating quality has neither consistently declined nor improved.¹⁹ While for most years, the evidence of underprediction or overprediction is mixed, years 2002 and 2007 exhibit a significant underestimation of risk by the ratings. If ratings predict impairment risk accurately, they should have anticipated the downturns in 2002 and 2007 and should have downgraded the transactions accordingly. However, the observation that the estimates of γ_0 and δ_0 are greater than zero and estimates for γ_1 and δ_1 are greater than one indicates that impairment risk has been under-predicted by the ratings in these years. In summary, the analysis shows that the rating quality has neither consistently declined nor improved through time. In other words, there has been a mix of years of overprediction and years of underprediction of impairment risk. This indicates that CRA ratings have a limited ability to predict impairment risk.

The ramifications are that CRAs do not predict impairment risk and that investors relying on predictions of future levels of impairment risk may have to build private models. Alternatively, CRAs may easily adjust their ratings by a projection of the future state of the economy. This may be accomplished by including time-lagged variables of the level and change of the total impairment rate.

3.7 H4: Ratings indicate low risk in origination years and high risk in monitoring years

Rating agencies face a potential conflict of interest. CRAs may have an incentive to assign i) low risk ratings in origination years to increase fee revenue and ii) high risk ratings in monitoring years to maintain accurate default and rating migration performance measures over origination and monitoring years.

In order to test the existence of such a conflict of interest, we extend Model 6 by i) an origination year effect and ii) an interaction between origination year and principal payment year to reflect the special case of single year transactions. Table XIII shows the parameter estimates for the whole data set as well as the various asset classes.

¹⁹ A comparison of the R^2 should be carefully interpreted as each year has a different number of observations.

[insert Table XIII here]

The parameter of the dummy variable ORY for the category ABS and MBS is negative, which suggests that the impairment risk in the origination year is lower than suggested by the CRAs.

However, for the categories CDO and HEL, the parameters for ORY as well as the interaction term ORY and PPY are positive and significant. Both risk segments have experienced the largest impairment rate increases (and thus disappointments of investors) in the latest economic downturn. This result suggests that ratings are overoptimistic (i.e., reflect a level of risk, which is too low) in the origination year. This is particularly true for one-year transactions, i.e., in instances where the origination year coincides with the principal payment year.

In summary, the empirical analysis finds evidence that financial risk for the asset classes CDOs and HEL is higher than indicated by ratings in the original rating year and even higher when the originated transaction expires within a year. This mis-specification of financial risk coincides with high fee revenues. Fee revenues for original rating years exceed fee revenues for monitoring years and the fees for original rating and monitoring years are paid in the original rating year.²⁰

²⁰ Compare Footnote 1.

4 Discussion and Outlook

To date, literature has not analyzed the accuracy of ratings and risk models for securitizations. The article's main objective is to analyze the impact of idiosyncratic and systematic risk characteristics on impairment risk of securitizations.

Our most substantial finding is that rating agencies do not include all factors explaining securitization impairment risk. In particular, the state of the economy is not addressed as CRAs average over the business cycle. Hence, CRA ratings are unable to predict impairment risk and a recent deterioration of CRA rating standards can not be confirmed and may be a result of an economic downturn, which was not predicted by CRA ratings. Additional results are that CRA ratings for securitizations do not fully account for the average credit quality in asset portfolios and do not fully account for structural elements of structured finance transactions. Such elements include the subordination level, the resecuritization status and principal payment years.

In response to the presented hypotheses, CRA ratings for securitizations

- Do not fully account for the average credit quality in asset portfolios;
- Do not fully account for the structure of asset securitizations;
- Reflect the average impairment risk over the business cycle: risks are assessed through-the-cycle rather than point-in-time;
- Are based on rating standards, which have not systematically declined over time;
- Do not predict impairment risk;
- Under-predict financial risk in origination years and over-predict risk in monitoring years for CDOs and HELs.

The findings may not be interpreted as a critique of the valuable work CRAs provide. Please note that the major CRAs cover a large number of rated debt issuers and issues per year²¹ with a limited number financial analysts²². These ratings may provide useful information on the average idiosyncratic impairment risk over the business cycle.

To date, only CRAs make their financial risk measures as well as the respective realizations (e.g., impairment histories) available to the general public. Little is known of the quality of models of other vendors as well as financial institution

²¹ For instance, in 2007, Moody's Investors Service rated 100 sovereign nations; 12,000 corporate issuers; 29,000 public finance issuers; and 96,000 structured finance obligations.

²² For instance, in 2007, Moody's Investors Service employed more than 1,000 analysts.

internal models as the respective information is kept private. However, recent earnings announcements of financial institutions suggest that other models applied in industry share similar properties.

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Tables

Table I

Total number of observations, relative frequencies of ratings at origination and at the beginning of the year, 1997-2007

This table shows the total number of observations and the relative frequencies of ratings at origination and at the beginning of the year.

The panel data is based on structured finance transactions rated by CRA Moody's Investors Service. The following observations were excluded: i) transaction observations which can not be placed into the categories asset-backed security, collateralized debt obligation, commercial mortgage-backed security, residential mortgage-backed security or home equity loan security; ii) transaction observations which are not based on the currency USD or transaction observations which are not originated in the USA; iii) tranche observations which relate to years prior to 1997 due to a limited number of observations, iv) tranche observations which have experienced an impairment event in prior years.

The number of rated tranches has increased at an increasing rate. The rating quality of rated tranches has generally decreased over time as a smaller fraction of tranches are rated Aaa.

Panel A: Rating at Origination

Year	All	Aaa	Aa	A	Baa	Ba	B	Caa-C
1997	889	61.53%	16.54%	13.50%	4.95%	2.59%	0.90%	0.00%
1998	1,034	63.25%	15.57%	12.28%	5.42%	2.61%	0.87%	0.00%
1999	1,556	57.13%	13.30%	14.91%	6.81%	6.11%	1.61%	0.13%
2000	2,220	55.59%	11.80%	14.86%	8.65%	6.22%	2.48%	0.41%
2001	3,183	52.43%	11.00%	16.02%	11.12%	6.47%	2.58%	0.38%
2002	4,576	52.91%	11.19%	15.06%	12.81%	6.05%	1.70%	0.28%
2003	6,413	54.44%	11.38%	14.58%	13.18%	4.60%	1.59%	0.23%
2004	8,519	53.18%	11.91%	15.15%	14.22%	3.82%	1.36%	0.36%
2005	11,352	50.73%	12.19%	16.00%	16.16%	3.60%	1.10%	0.21%
2006	16,010	46.63%	13.69%	16.66%	17.33%	4.62%	0.89%	0.17%
2007	24,083	42.00%	15.86%	17.76%	18.21%	5.49%	0.59%	0.09%
Total	79,835	53.62%	13.13%	15.16%	11.71%	4.74%	1.42%	0.21%

Panel B: Rating at the beginning of a year

Year	All	Aaa	Aa	A	Baa	Ba	B	Caa-C
1997	889	63.78%	14.51%	13.61%	3.82%	3.15%	1.12%	0.00%
1998	1,034	66.34%	12.77%	12.28%	4.45%	3.09%	1.06%	0.00%
1999	1,556	58.80%	11.70%	14.78%	5.72%	6.94%	1.80%	0.26%
2000	2,220	57.12%	10.54%	14.64%	9.77%	4.55%	2.39%	0.99%
2001	3,183	53.25%	10.56%	15.99%	10.46%	6.60%	2.67%	0.47%
2002	4,576	53.54%	12.06%	13.68%	12.00%	6.29%	1.88%	0.55%
2003	6,413	54.34%	11.87%	13.63%	12.55%	4.74%	2.06%	0.81%
2004	8,519	53.10%	11.93%	14.40%	13.51%	4.08%	1.91%	1.06%
2005	11,352	50.90%	12.26%	15.48%	15.42%	3.70%	1.47%	0.77%
2006	16,010	47.30%	13.62%	16.06%	16.68%	4.65%	1.12%	0.57%
2007	24,083	43.01%	15.87%	17.13%	17.29%	5.50%	0.83%	0.37%
Total	79,835	54.68%	12.52%	14.70%	11.06%	4.85%	1.66%	0.53%

Table II

Total number of observations, relative frequencies of deal and transaction characteristics, 1997-2007

This table shows the total number of observations and the relative frequencies of deal and transaction characteristics. Deal characteristics are the deal category and the resecuritization status. Transaction characteristics are the subordination level, the original rating year status and the principal rating year status. The deal categories are asset backed security (ABS), collateralized debt obligation (CDO), commercial mortgage-backed security (CMBS), home equity loan security (HEL) and residential mortgage-backed security (RMBS). The resecuritization status (1: resecuritization, 0: no resecuritization) indicates whether a transaction is a resecuritization of previous transactions. The Original Rating Year (ORY; 1: transaction is originated, 0: transaction is not originated) indicates whether the transaction is originated and rated for the first time by the CRA in the observation year. The Principal Payment Year (PPY; 1: principal is repayable, 0: principal is not repayable) indicates whether principal is repayable in the observation year. The relative subordination level (Junior, Mezzanine and Senior) indicates the subordination level relative to the average impairment rate of an asset class (compare Equation 14).

The number of rated tranches has increased at an increasing rate. The relative frequency of HEL has increased. The resecuritization level has generally increased. The relative frequency of mezzanine and senior tranches has increased. The relative frequency of principal payment years has decreased as the overall number of tranches has increased.

Panel A: Deal characteristics								
Year	All	ABS	CDO	CMBS	HEL	RMBS	Resec.=0	1
1997	889	47.24%	0.45%	3.94%	12.71%	35.66%	96.40%	3.60%
1998	1,034	50.68%	0.68%	3.68%	12.57%	32.40%	95.55%	4.45%
1999	1,556	48.20%	3.66%	4.82%	20.31%	23.01%	96.27%	3.73%
2000	2,220	50.18%	9.23%	8.96%	15.41%	16.22%	97.48%	2.52%
2001	3,183	48.63%	12.38%	12.94%	15.05%	11.00%	97.61%	2.39%
2002	4,576	38.35%	12.39%	12.57%	25.42%	11.28%	96.42%	3.58%
2003	6,413	33.00%	8.79%	10.63%	33.90%	13.68%	95.63%	4.37%
2004	8,519	31.60%	9.32%	8.79%	40.06%	10.22%	94.91%	5.09%
2005	11,352	27.13%	8.60%	8.31%	45.77%	10.19%	94.85%	5.15%
2006	16,010	22.53%	7.58%	6.58%	50.50%	12.82%	95.12%	4.88%
2007	24,083	15.48%	7.94%	4.86%	54.68%	17.05%	93.78%	6.22%
Total	79,835	37.55%	7.37%	7.83%	29.67%	17.59%	95.82%	4.18%

Panel B: Transaction characteristic								
Year	All	Junior	Mezz.	Senior	ORY=0	1	PPY=0	1
1997	889	29.70%	1.24%	69.07%	61.98%	38.02%	95.84%	4.16%
1998	1,034	32.40%	1.26%	66.34%	65.57%	34.43%	93.33%	6.67%
1999	1,556	34.32%	1.41%	64.27%	63.37%	36.63%	94.41%	5.59%
2000	2,220	34.55%	2.48%	62.97%	72.97%	27.03%	95.41%	4.59%
2001	3,183	31.61%	3.90%	64.50%	73.89%	26.11%	93.21%	6.79%
2002	4,576	28.58%	4.22%	67.20%	68.66%	31.34%	91.48%	8.52%
2003	6,413	25.15%	4.29%	70.56%	71.25%	28.75%	88.18%	11.82%
2004	8,519	24.67%	4.86%	70.47%	69.39%	30.61%	89.46%	10.54%
2005	11,352	23.21%	5.39%	71.40%	70.81%	29.19%	88.05%	11.95%
2006	16,010	21.12%	5.86%	73.02%	69.38%	30.62%	89.78%	10.22%
2007	24,083	20.08%	6.51%	73.42%	62.59%	37.41%	90.01%	9.99%
Total	79,835	27.76%	3.76%	68.47%	68.17%	31.83%	91.74%	8.26%

Table III

Impairment rates for all observations, per rating at origination and at the beginning of the year, 1997-2007

This table shows impairment rates for all observations, per rating at origination and at the beginning of the year. The impairment rate is the ratio between the number of impairment events and the total number of observations in a given category and observation year. Impairment events '[...]fall into one of two categories, principal impairments and interest impairments. Principal impairments include securities that have suffered principal write-downs or principal losses at maturity and securities that have been downgraded to Ca/C, even if they have not yet experienced an interest shortfall or principal write-down. Interest impairments, or interest-impaired securities, include securities that are not principal impaired and have experienced only interest shortfalls.' (compare Moody's Investors Service 2008).

Impairment rates are high in 2002 and 2007 and low in 1997, 1998 and 2006. Impairment rates per rating category fluctuate over time. The rating categories Aaa, Aa and A are aggregated into one category Aaa-A due to the limited number of impairment events. The number of impairment events for ratings at origination for all years is 18 (Aaa), 62 (Aa) and 177 (A). The number of impairment events for ratings at the beginning of the year is 28 (Aaa), 87 (Aa) and 224 (A).

Panel A: Rating at Origination						
Year	All	Aaa-A	Baa	Ba	B	Caa-C
1997	1.01%	0.00%	4.55%	17.39%	37.50%	0.00%
1998	0.87%	0.21%	5.36%	11.11%	11.11%	0.00%
1999	1.86%	0.53%	7.55%	7.37%	24.00%	50.00%
2000	1.35%	0.27%	0.00%	9.42%	14.55%	44.44%
2001	1.79%	0.24%	4.80%	7.28%	18.29%	33.33%
2002	3.45%	0.36%	6.66%	28.52%	25.64%	53.85%
2003	2.25%	0.43%	5.92%	14.92%	23.53%	26.67%
2004	2.10%	0.91%	2.81%	12.31%	17.24%	74.19%
2005	0.76%	0.12%	2.45%	2.93%	9.60%	25.00%
2006	0.60%	0.11%	1.19%	2.84%	11.19%	46.43%
2007	6.21%	1.09%	15.80%	42.28%	27.46%	33.33%
Total	2.02%	0.39%	5.19%	14.22%	20.01%	35.20%

Panel B: Rating at the beginning of a year						
Year	All	Aaa-A	Baa	Ba	B	Caa-C
1997	1.01%	0.00%	2.94%	17.86%	30.00%	0.00%
1998	0.87%	0.21%	4.35%	12.50%	9.09%	0.00%
1999	1.86%	0.30%	7.87%	5.56%	32.14%	75.00%
2000	1.35%	0.11%	0.46%	7.92%	9.43%	63.64%
2001	1.79%	0.24%	4.80%	7.14%	18.82%	26.67%
2002	3.45%	0.30%	4.74%	27.78%	30.23%	60.00%
2003	2.25%	0.18%	4.10%	14.47%	29.55%	36.54%
2004	2.10%	0.46%	2.35%	10.63%	19.63%	57.78%
2005	0.76%	0.01%	0.46%	4.05%	15.57%	39.08%
2006	0.60%	0.00%	0.30%	1.88%	13.97%	53.26%
2007	6.21%	1.04%	15.01%	42.60%	31.66%	59.55%
Total	2.02%	0.26%	4.31%	13.85%	21.83%	42.86%

Table IV

Impairment rates for all observations, per deal and transaction characteristics, 1997-2007

This table shows the impairment rates for all observations, per deal and transaction characteristics. Deal characteristics are the deal category and the securitization status. Transaction characteristics are the subordination level, the original rating year status and the principal rating year status. The impairment rate is the ratio between the number of impairment events and the total number of observations in a given category and observation year.

The deal categories are asset backed security (ABS), collateralized debt obligation (CDO), commercial mortgage-backed security (CMBS), home equity loan security (HEL) and residential mortgage-backed security (RMBS). The securitization status (1: securitization, 0: no securitization) indicates whether a transaction is a securitization of previous transactions. The Original Rating Year (ORY; 1: transaction is originated, 0: transaction is not originated) indicates whether the transaction is originated and rated for the first time by the CRA in the observation year. The Principal Payment Year (PPY; 1: principal is repayable, 0: principal is not repayable) indicates whether principal is repayable in the observation year. The relative subordination level (Junior, Mezzanine and Senior) indicates the subordination level relative to the average impairment rate of an asset class (compare Equation 14).

Impairment rates are high in 2002 and 2007 and low in 1997, 1998 and 2006. Impairment rates per rating category fluctuate over time. Impairment rates per asset portfolio type increase in 2002 for CDOs and in 2007 for CDOs, MBSs and HELs. The asset classes CMBS and RMBS are aggregated to the category MBS due to the limited number of impairment events. The number of impairment events for CMBS is 72 and for RMBS is 134 for all years. The impairment rate has particularly increased in 2007 for securitizations, all subordination levels, original rating years and principal payment years.

Panel A: Deal characteristics

Year	All	ABS	CDO	HEL	MBS	Resec.=0	1
1997	1.01%	0.00%	0.00%	0.57%	6.19%	1.05%	0.00%
1998	0.87%	0.19%	0.00%	0.00%	6.15%	0.91%	0.00%
1999	1.86%	0.53%	0.00%	0.92%	6.65%	1.94%	0.00%
2000	1.35%	1.17%	3.41%	0.36%	2.34%	1.34%	1.79%
2001	1.79%	1.55%	7.36%	0.13%	0.63%	1.80%	1.32%
2002	3.45%	4.16%	12.70%	0.64%	0.52%	3.58%	0.00%
2003	2.25%	3.97%	6.38%	0.71%	0.60%	2.20%	3.21%
2004	2.10%	4.64%	4.03%	0.99%	0.18%	2.00%	3.92%
2005	0.76%	0.68%	2.36%	1.24%	0.31%	0.61%	3.42%
2006	0.60%	0.89%	1.15%	0.87%	0.28%	0.58%	0.90%
2007	6.21%	0.48%	14.70%	2.08%	8.25%	5.46%	17.50%
Total	2.02%	1.66%	4.74%	0.77%	2.92%	1.95%	2.91%

Panel B: Transaction characteristics

Year	All	Junior	Mezz.	Senior	ORY=0	1	PPY=0	1
1997	1.01%	3.03%	0.00%	0.16%	1.63%	0.00%	1.06%	0.00%
1998	0.87%	1.49%	0.00%	0.58%	1.33%	0.00%	0.93%	0.00%
1999	1.86%	1.69%	4.55%	1.90%	2.94%	0.00%	1.91%	1.15%
2000	1.35%	2.61%	0.00%	0.72%	1.67%	0.50%	1.42%	0.00%
2001	1.79%	3.08%	5.65%	0.93%	2.42%	0.00%	1.85%	0.93%
2002	3.45%	9.17%	5.70%	0.88%	4.77%	0.56%	3.75%	0.26%
2003	2.25%	3.72%	3.64%	1.64%	3.09%	0.16%	2.49%	0.40%
2004	2.10%	3.00%	2.42%	1.77%	2.89%	0.31%	2.31%	0.33%
2005	0.76%	2.05%	1.14%	0.31%	1.07%	0.00%	0.75%	0.81%
2006	0.60%	1.63%	0.96%	0.27%	0.85%	0.04%	0.63%	0.37%
2007	6.21%	16.32%	15.44%	2.63%	2.28%	12.80%	4.17%	24.59%
Total	79,835	4.34%	3.59%	1.07%	2.27%	1.31%	1.93%	2.62%

Table V
Parameter estimates for Model 1 to Model 6

This table shows parameter estimates from the probit models Model 1 to Model 6. The model specification is $P(D_{ijt} = 1) = \Phi(\beta' x_{ijt})$. Standard errors are in parentheses. The significance is indicated as follows: ***, significant at 1%, **, significant at 5%, *, significant at 10%. AUROC is the area under the receiver operating characteristic curve (see Agresti 1984).

The deal categories are asset backed security (ABS), collateralized debt obligation (CDO), commercial mortgage-backed security (CMBS), home equity loan security (HEL) and residential mortgage-backed security (RMBS). The resecuritization status (1: resecuritization, 0: no resecuritization) indicates whether a transaction is a resecuritization of previous transactions. The Subordination indicates the fraction of tranches which are subordinate to the observed tranche. The Principal Payment Year (PPY; 1: principal is repayable, 0: principal is not repayable) indicates whether principal is repayable in the observation year.

The inclusion of deal type and structural elements after controlling for credit ratings explain the impairment risk. The ramifications are that CRA ratings do not sufficiently account for the average credit quality in asset portfolios and for structural elements of securitizations.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	-2.6429*** (0.0211)	-2.7197*** (0.0313)	-2.7558*** (0.0322)	-2.4570*** (0.0349)	-2.8411*** (0.0326)	-2.6400*** (0.0367)
Baa	1.1195*** (0.0277)	1.0897*** (0.0288)	1.1107*** (0.0292)	0.8893*** (0.0316)	1.1447*** (0.0300)	0.9654*** (0.0333)
Ba	1.8127*** (0.0310)	1.8273*** (0.0323)	1.8757*** (0.0329)	1.6219*** (0.0349)	1.8375*** (0.0333)	1.6818*** (0.0366)
B	1.8711*** (0.0469)	2.0300*** (0.0498)	2.1414*** (0.0507)	1.8460*** (0.0512)	2.0768*** (0.0511)	2.0159*** (0.0535)
Caa	2.6692*** (0.0612)	2.7945*** (0.0634)	2.9197*** (0.0643)	2.6040*** (0.0645)	2.8838*** (0.0647)	2.8361*** (0.0666)
CDO		0.3435*** (0.0389)	-0.0691*** (0.0491)	0.3153*** (0.0391)	0.3780*** (0.0392)	-0.0670*** (0.0502)
HEL		0.1889*** (0.0323)	0.2002*** (0.0328)	0.1599*** (0.0325)	0.1426*** (0.0454)	0.1433*** (0.0331)
MBS		-0.5329*** (0.0447)	-0.6015*** (0.0457)	-0.5561*** (0.0450)	-0.5921*** (0.0456)	-0.6711*** (0.0468)
Resecuritization			0.7887*** (0.0508)			0.8273*** (0.0525)
Subordination				-1.0547*** (0.0916)		-1.0426*** (0.0909)
PPY					0.7506*** (0.0297)	0.8067*** (0.0307)
Pseudo R^2	0.0733	0.0795	0.0822	0.0816	0.0861	0.0913
R^2 re-scaled	0.3196	0.3466	0.3585	0.3558	0.3755	0.3978
AUROC	0.8787	0.9078	0.9117	0.9162	0.9118	0.9210

Table VI

Parameter estimates for Model 6 with subordination dummy variables, per deal type

This table shows parameter estimates from the probit model Model 6 with subordination dummies for the complete data set and per asset portfolio category. The model specification is $P(D_{ijt} = 1) = \Phi(\beta'x_{ijt})$. Standard errors are in parentheses. The significance is indicated as follows: ***: significant at 1%, **: significant at 5%, *: significant at 10%. † indicates that the parameter for resecuritization can not be estimated as the variable is a linear combination of other explanatory variables. AUROC is the area under the receiver operating characteristic curve (see Agresti 1984).

The deal categories are asset backed security (ABS), collateralized debt obligation (CDO), commercial mortgage-backed security (CMBS), home equity loan security (HEL) and residential mortgage-backed security (RMBS). The resecuritization status (1: resecuritization, 0: no resecuritization) indicates whether a transaction is a resecuritization of previous transactions. The relative subordination level (Junior, Mezzanine and Senior) indicates the subordination level relative to the average impairment rate of an asset class (compare Equation 14). The Principal Payment Year (PPY; 1: principal is repayable, 0: principal is not repayable) indicates whether principal is repayable in the observation year.

The impairment risk of mezzanine and senior tranches is higher than indicated by credit ratings and structural elements for ABSs and HELs and lower for CDOs and MBSs. The ramifications are that CRA asset correlation assumptions should be higher for ABSs and HELs and lower for CDOs and MBSs.

	(1)	(2)	(3)	(4)	(5)
Variable	All	ABS	CDO	MBS	HEL
Intercept	-2.9634*** (0.0425)	-3.2929*** (0.0840)	-2.1887*** (0.0812)	-3.2852*** (0.1372)	-3.2681*** (0.0619)
Baa	1.1859*** (0.0329)	1.2438*** (0.0900)	0.6601*** (0.0725)	1.1648*** (0.1409)	1.3713*** (0.0477)
Ba	1.9301*** (0.0390)	2.2973*** (0.0879)	0.9451*** (0.0847)	1.6469*** (0.1469)	2.3546*** (0.0612)
B	2.2474*** (0.0549)	2.5286*** (0.1010)	1.5748*** (0.1173)	1.9211*** (0.1558)	2.6639*** (0.1145)
Caa	3.0718*** (0.0676)	3.3266*** (0.1145)	2.1717*** (0.1476)	2.9022*** (0.1768)	3.3593*** (0.1598)
CDO	-0.0618*** (0.0498)				
HEL	0.1380*** (0.0332)				
MBS	-0.6694*** (0.0467)				
Resecuritization	0.8603*** (0.0519)	0.0000 †	0.7085*** (0.0597)	-0.1416*** (0.2362)	0.0000 †
Mezzanine	0.2173*** (0.0402)	0.3729*** (0.1665)	-0.0258*** (0.0788)	-0.9882*** (0.2258)	0.4399*** (0.0566)
Senior	0.0850*** (0.0296)	0.5890*** (0.0734)	-0.5650*** (0.0784)	-0.9444*** (0.1259)	0.3495*** (0.0463)
PPY	0.7938*** (0.0303)	-0.6459*** (0.1943)	-0.0887*** (0.1234)	1.3290*** (0.0938)	1.0782*** (0.0403)
Obs.	79,835	21,334	6,692	17,230	35,579
Pseudo R^2	0.0896	0.0833	0.1091	0.0554	0.1068
R^2 re-scaled	0.3907	0.4946	0.2665	0.4560	0.4108
AUROC	0.9143	0.9327	0.8417	0.9529	0.9025

Table VII

Parameter estimates for Model 7 (random effect), per rating and deal type

This table shows parameter estimates from the random effects probit model model 7. The model specification is $P(D_{ijt} = 1|F_t) = \Phi(\alpha + b \cdot F_t)$. Standard errors are in parentheses. The significance is indicated as follows: ***: significant at 1%, **: significant at 5%, *: significant at 10%. AIC is the Akaike Information Criterion.

The deal categories are asset backed security (ABS), collateralized debt obligation (CDO), commercial mortgage-backed security (CMBS), home equity loan security(HEL) and residential mortgage-backed security (RMBS).

The time specific random effects are significant. The ramifications are that CRA ratings do not fully account for systematic risk and that HEL are more cyclical than other deal types.

Panel A: Rating at the beginning of the years						
	(1)	(2)	(3)	(4)	(5)	(6)
Rating	All Grades	Aaa-A	Baa	Ba	B	Caa
Intercept	-2.1255*** (0.0848)	-3.0155*** (0.1560)	-1.9228*** (0.1641)	-1.2268*** (0.1622)	-0.7946*** (0.0867)	0.02115 (0.0949)
b	0.2734*** (0.0601)	0.4653*** (0.1313)	0.5091*** (0.1183)	0.5145*** (0.114)	0.2255** (0.0742)	0.1999* (0.0956)
Obs.	79,835	62,528	11,811	3,907	1,113	476
AIC	19,321	3,063	4,735	3,223	1,161	660

Panel B: Deal type				
	(1)	(2)	(3)	(4)
Deal Type	ABS	CDO	MBS	HEL
intercept	-2.2912*** (0.1325)	-1.7045*** (0.1460)	-2.4341*** (0.0816)	-2.1937*** (0.1725)
b	0.4111*** (0.1066)	0.4121*** (0.1123)	0.205*** (0.0688)	0.5563*** (0.1242)
Obs.	21,334	6,692	17,230	35,579
AIC	3,670	3,244	2,198	8,791

Table VIII

Parameter estimates for Model 7 (random effect), per deal type and resecuritization status

This table shows parameter estimates from the random effects probit model Model 7 per resecuritization status. The model specification is $P(D_{ijt} = 1|F_t) = \Phi(\alpha + b \cdot F_t)$. Standard errors are in parentheses. The significance is indicated as follows: ***: significant at 1%, **: significant at 5%, *: significant at 10%. AIC is the Akaike Information Criterion.

The deal categories are asset backed security (ABS), collateralized debt obligation (CDO), commercial mortgage-backed security (CMBS), home equity loan security(HEL) and residential mortgage-backed security (RMBS). The resecuritization status (1: resecuritization, 0: no resecuritization) indicates whether a transaction is a resecuritization of previous transactions.

The time specific random effects are significant. The ramification is that resecuritizations are more cyclical than primary securitizations.

	(1)	(2)	(3)	(4)
resecuritization	0		1	
Deal Type	All	CDO	All	CDO
intercept	-2.1366*** (0.0839)	-1.8302*** (0.1562)	-2.1439*** (0.2226)	-1.8881*** (0.2523)
b	0.2703*** (0.0594)	0.4346*** (0.1203)	0.5771** (0.1823)	0.5801** (0.2073)
Obs	75,825	3,622	4,010	3,070
AIC	27,128	1,325	1,924	1,771

Table IX

Parameter estimates for Model 7 (random effect) and Model 8 (random effect controlling for rating)

This table shows parameter estimates from the random effects probit model Model 7 and Model 8. The model specification is $P(D_{ijt} = 1|F_t) = \Phi(\beta' x_{ijt} + b \cdot F_t)$. Standard errors are in parentheses. The significance is indicated as follows: ***: significant at 1%, **: significant at 5%, *: significant at 10%. AIC is the Akaike Information Criterion.

The time specific random effects are significant. The parameter estimate b is greater after CRA ratings are included. The ramification is that CRA ratings do not explain (and may increase) systematic risk.

	(1)	(2)
	Model 7	Model 8
intercept	-2.1255*** (0.0848)	-2.8533*** (0.1350)
Baa		1.1013*** (0.0401)
Ba		1.8208*** (0.0583)
B		2.0696*** (0.0727)
Caa		2.9167*** (0.0983)
b	0.2734*** (0.0601)	0.3541*** (0.0672)
Obs.	79,835	79,835
AIC	19,321	12,963

Table X

Parameter estimates for Model 9 (random effect controlling for time), per rating

This table shows parameter estimates from the random effects probit model Model 9. The model specification is $P(D_{ijt} = 1|F_t) = \Phi(\alpha + \beta \cdot t + b \cdot F_t)$. $t = (year - 1996)$ and counts the number of years from the beginning of the observation period and is thus a year effect. Standard errors are in parentheses. The significance is indicated as follows: ***: significant at 1%, **: significant at 5%, *: significant at 10%. AIC is the Akaike Information Criterion.

The number of years from the beginning of the observation period are insignificant. The ramification is that CRA rating standards have not declined over time.

	(1)	(2)	(3)	(4)	(5)	(6)
	All grades	Aaa-A	Baa	Ba	B	Caa
c	-2.2819*** (0.1816)	-3.0197*** (0.3519)	-1.8121*** (0.3800)	-1.2770*** (0.3637)	-0.8287*** (0.2367)	-0.0260*** (0.3572)
beta	0.02543 (0.0263)	0.000674 (0.0505)	-0.01725 (0.0536)	0.008043 (0.0522)	0.004828 (0.0311)	0.005858 (0.0428)
b	0.2634*** (0.0575)	0.4653*** (0.1314)	0.5061*** (0.1176)	0.5135*** (0.1140)	0.2252** (0.0742)	0.1972* (0.0975)
Obs.	79,835	62,528	11,811	3,907	1,113	476
AIC	19,322	3,065	4,737	3,225	1,163	662

Table XI

Parameter estimates for Model 10 (prediction model, probit regression)

This table shows the results of out-of-sample prediction probit regression Model 10. The model specification is $P(D_{ijt+1} = 1) = \Phi(\gamma_0 + \gamma_1 \hat{\eta}_{ijt+1})$. Standard errors are in parentheses. The significance is indicated as follows: ***, significant at 1%, **, significant at 5%, *, significant at 10%. The tested hypotheses are that $\gamma_0 = 0$ and $\gamma_1 = 1$.

The estimated parameters γ_0 and γ_1 are statistically different from $\gamma_0 = 0$ and $\gamma_1 = 1$. The ramification is that CRA ratings do not predict impairment risk.

	(1)	(2)	(3)	(4)	(5)
Prediction year	γ_0	γ_1	Pseudo R^2	R^2 Rescaled	AUROC
1999	-0.3623* (0.2106)	0.7647** (0.1001)	0.0416	0.266	0.872
2000	-0.4889*** (0.1555)	0.9471 (0.0998)	0.0633	0.4743	0.941
2001	-0.2884* (0.1505)	0.8176** (0.0726)	0.0438	0.2664	0.879
2002	0.7389*** (0.126)	1.1986*** (0.0658)	0.1035	0.399	0.917
2003	-0.0389 (0.0933)	0.9906 (0.053)	0.072	0.3723	0.918
2004	-0.227*** (0.0804)	0.8775*** (0.0427)	0.0609	0.3303	0.867
2005	-0.2617** (0.1047)	1.2778*** (0.0833)	0.0415	0.4875	0.97
2006	0.0432 (0.114)	1.5492*** (0.0998)	0.0392	0.5544	0.948
2007	1.2847*** (0.0531)	1.1665*** (0.0224)	0.124	0.3331	0.864

Table XII

Parameter estimates for Model 11 (prediction model, linear regression)

This table shows the results of out-of-sample prediction linear regression Model 11. The model specification is $D_{ijt+1} = \delta_0 + \delta_1 \cdot \hat{p}_{ijt+1} + \varepsilon_{ijt+1}$. Standard errors are in parentheses. The significance is indicated as follows: ***, significant at 1%, **, significant at 5%, *, significant at 10%. The tested hypotheses are that $\delta_0 = 0$ and $\delta_1 = 1$.

The estimated parameters $\hat{\delta}_0$ and $\hat{\delta}_1$ are statistically different from $\delta_0 = 0$ and $\delta_1 = 1$. The ramification is that CRA ratings do not predict impairment risk.

	(1)	(2)	(3)
Prediction year	$\hat{\delta}_0$	$\hat{\delta}_1$	Adj. R^2
1999	0.0035 (0.0034)	0.7808*** (0.0699)	0.0733
2000	-0.0049** (0.0022)	0.72835*** (0.0241)	0.2913
2001	0.0068*** (0.0024)	0.62567*** (0.0407)	0.0688
2002	0.007*** (0.0026)	1.60006*** (0.0507)	0.1785
2003	0.0020 (0.0018)	0.87975*** (0.0263)	0.1483
2004	-0.0020 (0.0015)	0.0015 (0.0218)	0.1979
2005	-0.0055*** (0.0008)	0.6465*** (0.0127)	0.1849
2006	-0.0068*** (0.0006)	0.7879*** (0.0111)	0.2397
2007	0.0352*** (0.0015)	2.16958*** (0.0369)	0.1253

Table XIII
Parameter estimates for Model 12

This table shows parameter estimates from the probit model Model 12. The model specification is $P(D_{ijt} = 1) = \Phi(\beta'x_{ijt})$. Standard errors are in parentheses. The significance is indicated as follows: ***: significant at 1%, **: significant at 5%, *: significant at 10%. † indicates that the parameter for resecuritization can not be estimated as the variable is a linear combination of other explanatory variables. AUROC is the area under the receiver operating characteristic curve (see Agresti 1984). For the categories CDO and HEL, the parameters for ORY as well as the interaction term ORY and PPY are positive and significant, which suggests that the impairment risk in the origination year is higher than suggested by the CRA. The ramification is that financial risk for the asset classes CDOs and HEL is higher than implied by ratings and structural elements in the original rating year and lower in monitoring years. These results are magnified for one-year transactions, i.e., when original rating years and principal payment years coincide.

	(1)	(2)	(3)	(4)	(5)
Variable	All	ABS	CDO	MBS	HEL
Intercept	-3.0815*** (0.0456)	-3.1833*** (0.0846)	-2.3906*** (0.0892)	-3.3258*** (0.1528)	-3.6890*** (0.0733)
Baa	1.2280*** (0.0346)	1.2584*** (0.0917)	0.7209*** (0.0745)	1.1812*** (0.1516)	1.4164*** (0.0508)
Ba	1.9542*** (0.0410)	2.2932*** (0.0887)	1.0178*** (0.0871)	1.6878*** (0.1572)	2.3520*** (0.0661)
B	2.4172*** (0.0564)	2.4955*** (0.1017)	1.7462*** (0.1212)	1.9878*** (0.1665)	3.0919*** (0.1179)
Caa	3.2509*** (0.0693)	3.2584*** (0.1147)	2.4068*** (0.1523)	2.9561*** (0.1871)	3.8149*** (0.1633)
CDO	-0.0885* (0.0506)				
HEL	-0.0116 (0.0346)				
MBS	-0.7201*** (0.0475)				
Resecuritization	0.8010*** (0.0528)	0.0000 †	0.6542*** (0.0608)	-0.1094 (0.2379)	0.0000 †
Mezzanine	0.1424*** (0.0420)	0.3953* (0.1681)	0.0203 (0.0803)	-0.9606*** (0.2245)	0.2472*** (0.0618)
Senior	0.1015*** (0.0307)	0.5466*** (0.0739)	-0.5223*** (0.0801)	-0.9503*** (0.1329)	0.2796*** (0.0495)
PPY	0.3650*** (0.0476)	-0.7029*** (0.1947)	-0.3896* (0.1638)	1.0282*** (0.1115)	0.7764*** (0.0707)
ORY	0.4120*** (0.0281)	-0.7604*** (0.1318)	0.3861*** (0.0575)	-0.0025 (0.1090)	0.7840*** (0.0447)
PPY*ORY	1.1658*** (0.0656)	-2.0633 (89.8283)	1.4490*** (0.2938)	1.3393*** (0.1956)	0.8784*** (0.0898)
Obs.	79,835	21,334	6,692	17,230	35,579
Pseudo R^2	0.0997	0.0853	0.1196	0.0588	0.1275
R^2 re-scaled	0.4348	0.5067	0.2922	0.4840	0.4904
AUROC	0.9263	0.9417	0.8534	0.9534	0.9301