Financial Crisis Inquiry Commission

Preliminary Staff Report

CREDIT RATINGS AND THE FINANCIAL CRISIS

June 2, 2010

This preliminary staff report is submitted to the Financial Crisis Inquiry Commission (FCIC) and the public for information, review, and comment. Comments can be submitted through the FCIC's website, www.fcic.gov/contact.

This document has not been approved by the Commission.

The report provides background factual information to the Commission on subject matters that are the focus of the FCIC's public hearing on June 2, 2010. In particular, this report provides information on credit ratings. Staff will provide investigative findings as well as additional information on these subject matters to the Commission over the course of the FCIC's tenure.

Deadline for Comment: July 14, 2010

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I.   Introduction

The purpose of this preliminary staff report is to present background on the role that credit rating agencies (RAs) may have played in the financial crisis. Most subprime and Alt-A mortgages were held in residential mortgage-backed securities (RMBS), most of which were rated investment grade by one or more RA. Furthermore, collateralized debt obligations (CDOs), many of which held RMBS, were also rated by the RAs. Between 2000 and 2007, Moody's rated $4.7 trillion in RMBS and $736 billion in CDOs. The sharp rise in mortgage defaults that began in 2006 ultimately led to the mass downgrading of RMBS and CDOs, many of which suffered principal impairments. Losses to investors and writedowns on these securities played a key role in the resulting financial crisis.

Inflated initial ratings on mortgage-related securities by the RAs may have contributed to the financial crisis through a number of channels. First, inflated ratings may have enabled the issuance of more subprime mortgages and mortgage-related securities by increasing investor demand for RMBS and CDOs. If fewer of these securities had been rated AAA, there may have been less demand for risky mortgages in the financial sector and consequently a smaller amount originated. Second, because regulatory capital requirements are based in part on the ratings of financial institutions' assets, these inflated ratings may have led to greater risk-adjusted leverage in the financial system. Had the ratings of mortgage-related securities not been inflated, financial institutions would have had to hold more capital against them. On a related point, the ratings of mortgage-related securities influenced which institutions held them. For example, had less subprime RMBS been rated AAA, pension funds and depository institutions may have held less of them. Finally, the rapid downgrading of RMBS and CDOs beginning in July 2007 may have resulted in a shock to financial institutions that led to solvency and liquidity problems.

In addition, downgrades of monoline bond insurers such as Ambac and MBIA and other providers of credit protection such as AIG triggered collateral calls built into insurance and derivative contracts, exacerbating liquidity pressures at these already troubled firms. This led to ratings downgrades of the securities these firms insured, prompting increased capital requirements at the firms which held these securities and – in the case of money market mutual funds only permitted to hold highly rated assets – sales of assets into an already unstable market.

Section II of the report provides general background on the credit rating industry. Section III describes how RMBS and CDOs were rated. Section IV describes the collapse of credit ratings on RMBS and CDOs during the financial crisis.

II.   Background on Credit Ratings

A.   A Brief History of the Credit Rating Industry

Credit rating agencies (RAs) have existed for well over a century, and the market has been dominated by a few large players since its inception. The first securities ratings were issued in 1909, when John Moody published a book of ratings for U.S. railroad bonds. He extended his ratings to utilities and industrial bonds the following year. Additional entrants followed, with Poor's Publishing Company issuing its first ratings in 1916, Standard Statistics Company six years later in 1922, and Fitch Publishing Company soon after in 1924. In 1962, Dun & Bradstreet bought Moody's; nearly 40 years later, in 2000, it spun Moody's off as an independent public corporation. Standard and Poor's merged in 1941, and then was acquired by McGraw-Hill in 1966. Fitch merged with a number of smaller ratings agencies: IBCA in 1997 (through the merger with IBCA, Fitch Ratings became owned by Fimalac S.A.), Duff & Phelps in 2000, and Thomson BankWatch in 2000. Thus, by 2000, the three major RAs remaining were Moody's, Standard & Poor's (S&P), and Fitch.

An important change to the structure of the industry was the evolution in the 1970s from a *subscriber pays* model, in which bond investors pay the agencies for access to their analysis and ratings, to an *issuer pays* model, in which the bond issuers choose and pay the RA's that rate their bonds.

B.   The Meaning of Credit Ratings

Credit ratings provide a measure of the creditworthiness of debt securities to investors. Each of the RAs considers a number of factors to determine ratings, including firm- and security-specific factors, market factors, regulatory and legal factors, and macroeconomic trends. Their ratings intend to provide a means of comparison of credit risk across asset classes and time.

The ratings from different agencies measure slightly different credit risk characteristics. S&P and Fitch, for example, base their ratings on the probability of default. Moody's, in contrast, bases its ratings on *expected loss*, which is equal to the product of (1) the probability of default and (2) the proportion of the investment that investors on average lose in the event of default. However, investors and regulators tend to view the ratings of the major RAs as roughly equivalent. Table 1 shows the rating scales of Moody's, S&P, and Fitch by credit quality category.   The ratings are divided into two categories: bonds rated BBB- and above are considered *investment grade*; bonds rated below BBB- are *speculative*

grade (sometimes also called *junk*). When rating a structured product like an RMBS or CDO, the RAs estimate the probability of default or expected loss of the bond and compare it to benchmarks for each of their ratings. The five-year expected loss benchmarks for Moody's ratings are in Appendix 1. The expected loss over five years on a bond that Moody's rates Aaa is less than 0.0016%, which for a $1 million bond amounts to $16. For a bond rated Baa1 it is less than 0.605%, which for a $1 million bond amounts to $6,050.

Table 1: Meaning of Credit Ratings			
	Credit Rating Agency		
Credit Quality	**Moody's**	**S&P**	**Fitch**
Investment grade			
Highest credit quality	Aaa	AAA	AAA
High credit quality	Aa1 to Aa3	AA+ to AA-	AA
Strong payment capacity	A1 to A3	A+ to A-	A
Adequate payment capacity	Baa1 to Baa3	BBB+ to BBB-	BBB
Speculative grade			
Possibility of credit risk	Ba1 to Ba3	BB+ to BB-	BB
Significant credit risk	B1 to B3	B+ to B-	B
High credit risk	Caa1 to Caa3	CCC+ to CCC-	CCC
Default is likely / imminent	Ca	CC, C	CC, C
In default	C	SD, D	D

C.   The Use of Ratings in Regulation

The RAs' ratings of bonds and entities have been used in financial regulation since 1931, when the Office of the Comptroller of the Currency (OCC) required that bank holdings of publicly traded bonds have a rating of BBB or better in order to be allowed to be carried at book value. Publicly traded bonds with ratings below BBB would have to be valued on the bank's balance sheet at a discount. The two primary uses of credit ratings in financial regulation are in (1) determining capital requirements of financial institutions and (2) restricting financial institutions' asset allocations.

1.   Determining Capital Requirements

Credit ratings have been used as a determinant of capital requirements in the United States since 1951, when the National Association of Insurance Commissioners began imposing higher capital requirements on lower-rated bonds held by insurers. However, the watershed event in the use of independent credit ratings in federal regulation occurred in

1975, when the Securities and Exchange Commission (SEC) modified its minimum capital requirements for broker-dealers to take into account the riskiness of their portfolios and based its assessment of riskiness on bond ratings. Fearing that broker-dealer demand for high bond ratings would lead to inflated credit ratings from the RAs, the SEC created a new designation, the "nationally recognized statistical rating organization" (NRSRO), and only recognized the bond ratings of RAs designated as NRSROs. The SEC initially recognized Moody's, S&P, and Fitch as NRSROs, but additional firms have been recognized over time.

Credit ratings have more recently played a role in the regulatory capital determinations of U.S. bank and thrift regulators as well. Regulators permit banks and thrifts to use ratings as an element in their internal assessments of the credit quality of the assets they hold. Further, ratings are used as a part of the regulatory capital calculations for certain classes of assets. In 2001, U.S. bank and thrift regulators passed a new capital rule governing asset securitization on depository institutions. Among other provisions, the new rule set risk weights for RMBS and other asset-backed securities based on the rating of the bond. Risk weights for bonds rated AAA or AA were below weights for lower-rated bonds. Institutions were required to hold capital in proportion to the risk weights. For example, relative to the required capital for AAA or AA securities, BBB securities required five times greater capital and BB securities required ten times greater capital.

Internationally, credit ratings have even greater force in determining capital adequacy. The Basel II standards, an international attempt to standardize capital requirements that followed the 1988 Basel I standards, allow banks to rely on external credit ratings to determine the risk weights for the capital requirements associated with various exposures. The European Union's "Capital Requirements Directive," adopted in 2006, introduced the risk-weighted capital requirements in Basel II to financial institutions within the EU. For U.S. firms, Basel II had not been implemented when the financial crisis began.

2. Restrictions on Asset Allocation

A number of U.S. regulations use credit ratings to determine the permissibility of certain classes of investments. For example, the SEC makes the use of rated securities attractive by restricting money market mutual funds to "securities that have received credit ratings from any two NRSROs … in one of the two highest short-term rating categories or comparable unrated securities." Similarly, in 1989 the federal government relaxed a Department of Labor rule restricting pension funds from investing in asset-backed securities---including RMBS---to allow them to invest in securities rated A or higher. Additionally, bank regulators restrict permissible investment securities by national banks using credit rating cut-offs. For example, under OCC regulations on investment securities, a national bank may

buy and sell for its own account investment company shares that meet other requirements provided that the shares are rated investment grade or the credit equivalent of investment grade.

3.   Statutory References to Credit Ratings

While much of the use of credit ratings in financial regulation has occurred via regulatory actions by federal agencies, Congress has explicitly prescribed the use of ratings in some statutes. Primarily, credit ratings have been used in order to define terms in legislation. For example, P.L. 98-440, Secondary Mortgage Market Enhancement Act, which permitted federally chartered financial institutions to invest in "mortgage related securities," included in the definition of "mortgage related securities" a requirement that the security be rated in one of the two highest categories by an NRSRO. Similar ratings-dependent definitions have been used in legislation to define allowable investments by federally chartered financial institutions in "small business related securities,"[1] Federal Housing Administration eligibility to enter into "partnerships or other contractual arrangements including reinsurance and risk-sharing agreements" with a "qualified housing finance agency,"[2] and to delineate the exemption of certain companies from provisions of the Investment Company Act of 1940.[3] Further, P.L. 106-102, Gramm-Leach-Bliley Act of 1999, in addition to other references to ratings agencies, gave authorization to "conduct in subsidiaries certain activities that are financial in nature" to qualifying banks which, among other requirements, cannot have "fewer than 1 issue of outstanding eligible debt that is currently rated within the 3 highest investment grade rating categories by a nationally recognized statistical rating organization."

In certain cases, legislation has incorporated credit ratings in other ways. For example, the Federal Deposit Insurance Act was amended in 1989 in P.L. 101-73, Financial Institutions Reform, Recovery, and Enforcement Act, to disallow "savings associations" from acquiring or retaining any corporate debt security not of investment grade, and defines "investment grade" as "rated in one of the 4 highest rating categories by at least one nationally recognized statistical rating organization." P.L. 109-171, Federal Deposit Insurance Reform

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[1] "Rated in 1 of the 4 highest rating categories by at least 1 nationally recognized statistical rating organization"; P.L. 103-325: Riegle Community Development and Regulatory Improvement Act of 1994.

[2] "carries the designation of `top tier' or its equivalent, as evaluated by Standard & Poor's or any other nationally recognized rating agency; receives a rating of `A' for its general obligation bonds from a nationally recognized rating agency; or otherwise demonstrates its capacity as a sound and experienced agency based on, but not limited to, its experience in financing multifamily housing, fund balances, administrative capabilities, investment policy, internal controls and financial management, portfolio quality, and State or local support"; P.L. 102-550: Housing and Community Development Act of 1992.

[3] "any debt security that is rated investment grade by not less than 1 nationally recognized statistical rating organization"; 15 USC § 80a-6(a)(5)(A)(iv)(I))

Act of 2005, mandated that the FDIC use ratings as one source of information for estimating risk of loss. Finally, as a part of the Sarbanes-Oxley Act of 2002, the Securities and Exchange Commission was required to conduct a study of the role of credit rating agencies in the operation of the securities markets. The study identified a number of issues for future examination, including disclosure of ratings processes, potential conflicts of interest, anti-competitive practices, regulatory barriers to entry, and the need for additional SEC oversight.

D.   The Use of Ratings by Firms, Investors, and Other Private Entities

Rating agencies influence economic activity through market channels as well. Most prominently, many private contracts rely upon credit ratings to protect creditors. *Ratings triggers*, for instance, can mandate that a debtor post collateral, or give creditors the right to demand immediate repayment of debts in full, in the event of a downgrade.[4] In January 2008 such triggers made monoline bond insurer MBIA liable for $2.9 billion in termination payments and $4.5 billion in collateral and left many of the securities it had insured vulnerable to downgrades.[5] A 2004 survey by the Association for Financial Professionals revealed that 87 percent of responding organizations, which are mostly large corporations, with outstanding debt had been required to maintain a specified rating from at least one of the four NRSROs in existence at the time.[6]

Ratings also figure into the decisions of private and public entities to extend credit or purchase securities. Many institutional investors, such as pension funds or university endowments, do not have the resources to evaluate all of the securities they purchase, which in any case would be duplicative of the agencies' work. In addition, these investors do not have access to the same information that the ratings agencies do. Consequently, they use credit ratings as a substitute for the more granular information they would otherwise have to gather. As former Moody's Managing Director Jerome Fons has acknowledged, "subprime RMBS and their offshoots offer little transparency around the composition and characteristics of the loan collateral. ... Loan-by-loan data, the highest level of detail, is generally not available to investors." Methods of credit analysis, he added,

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[4] Securities and Exchange Commission, "Report on the Role and Function of Credit Rating Agencies in the Operation of the Securities Markets" (Jan. 2003), 29.
[5] "MBIA Comments on the Impact of the Moody's Downgrade of MBIA's Insurance Financial Strength Rating to A2 on its Asset/Liability Management Business," press release (June 20, 2008).
[6] Association for Financial Professionals, "2004 Credit Rating Agency Survey: Report of Survey Results" (Oct. 2004).

"are quite technical, often relying on advanced statistical techniques" and therefore "beyond the grasp of many investors."[7]

However, not all investors and credit default swap protection writers relied exclusively upon ratings. AIG, for example, used internal models to calculate the exposure it would agree to assume on the super senior credit default swaps it wrote.[8] However, provisions in the underlying contracts did stipulate that ratings downgrades would trigger collateral calls, which were a proximate cause of the firm's problems that led to government intervention.

E. The Regulation of Rating Agencies

The primary regulation of RAs occurs via recognition as an NRSRO by the SEC. In 1975, when the SEC began relying on credit ratings to determine the capital adequacy of broker-dealers, it recognized S&P, Moody's, and Fitch as NRSROs and later recognized four additional NRSROs between 1982 and 1991 (Duff & Phelps, McCarthy, Crisanti & Maffei, IBCA, and Thomson BankWatch). The procedure for approving a new NRSRO was not explicitly defined in statute. The principal requirement was that the agency be "nationally recognized by the predominant users of ratings in the United States as an issuer of credible and reliable ratings." Following the request of an RA to become an NRSRO, the SEC investigated the RA with regards to internal processes, financial resources, and organizational structure. If an RA was approved, the SEC issued a "no-action" letter stating that "it will not recommend enforcement action to the Commission if ratings from the rating agency are considered by registered broker-dealers to be ratings from an NRSRO for purposes of applying the relevant portions of the net capital rule."[9]

Following the expansion of the use of credit ratings in regulation, the SEC began a review of the potential need for greater regulatory oversight beginning in a Concept Release issued in 1994, which solicited public comment on the Commission's use of NRSRO ratings. Following over a decade of discussion on RA reform, Congress passed Credit Rating Agency Reform Act of 2006, P.L. 109-291, which defined an NRSRO and offered more concrete direction regarding the recognition process of NRSROs by the SEC. Introducing the first oversight or monitoring of NRSROs, the new application process required, among other things, an analysis of the historical performance of credit ratings by the applicant, rating

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[7] Quoted in *Ohio Police & Fire Pension Fund et al. v. Standard & Poor's et al.* (US District Ct., Southern District of Ohio, 2009), case no. 2:09cv1054.

[8] "American International Group Investor Meeting," Thomson StreetEvents transcript (Dec. 5, 2007), 11.

[9] U.S. Securities and Exchange Commission (2003) "Report on the Role and Function of Credit Rating Agencies in the Operation of the Securities Markets: as required by Section 702(b) on the Sarbanes-Oxley Act of 2002."

procedures and methodologies, policies regarding potential misuse of material, organizational structure, potential conflicts of interest, and a list of the twenty largest issuers and subscribers that use its ratings by revenue in the year preceding the application date. The law took effect in June 2007, and existing NRSROs were recertified through the application process. However, the law focused on mandatory disclosure of rating agencies' methods and expressly prohibited the SEC from regulating "the substance of the credit ratings or the procedures and methodologies" by which any NRSRO determines credit ratings.[10]

Over the years, ratings agencies have acquired strong defenses against being held liable for erroneous ratings through private litigation. Most prominently, Rule 436(g)(1) of the Securities Act of 1933 explicitly exempts them from liability for misstatements made in connection with securities registration statements. Moody's and S&P have also succeeded in using the First Amendment as a shield against liability and in quashing subpoenas with the argument that they are providing journalistic services protected by the First Amendment or reporters' privilege.[11] Moreover, court cases have accepted the NRSROs' disclaimers that their ratings are merely "opinions," with one judge going so far as to rule in 1999 that an investor's reliance on them was "not reasonable" despite the fact that regulators relied upon these same ratings.[12]

III.   The Rating of RMBS and CDOs

A.   The Structure of Structured Products

RMBS and CDOs are types of *structured products*. Generally, structured products involve the *pooling* of assets into a *special purpose vehicle* (SPV) and the *tranching* of the bonds issued by the SPV into classes of securities with particular payment rights. The cash flows of the SPV's assets are used to make the promised payments to the SPV's bondholders.[13]

A crucial goal of the tranched capital structure of the SPV is to create some bonds that are deemed low risk and can receive investment-grade ratings from the rating agencies. One key tool used to achieve this is *subordination*. The classes of securities issued by the SPV are ordered according to their priority in receiving distributions from the SPV. The structure is set up to operate like a waterfall, with the holders of the more senior tranches being paid prior to the more junior (or subordinate) tranches. The most senior set of

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[10] 15 U.S.C.78-o7(c)(2),
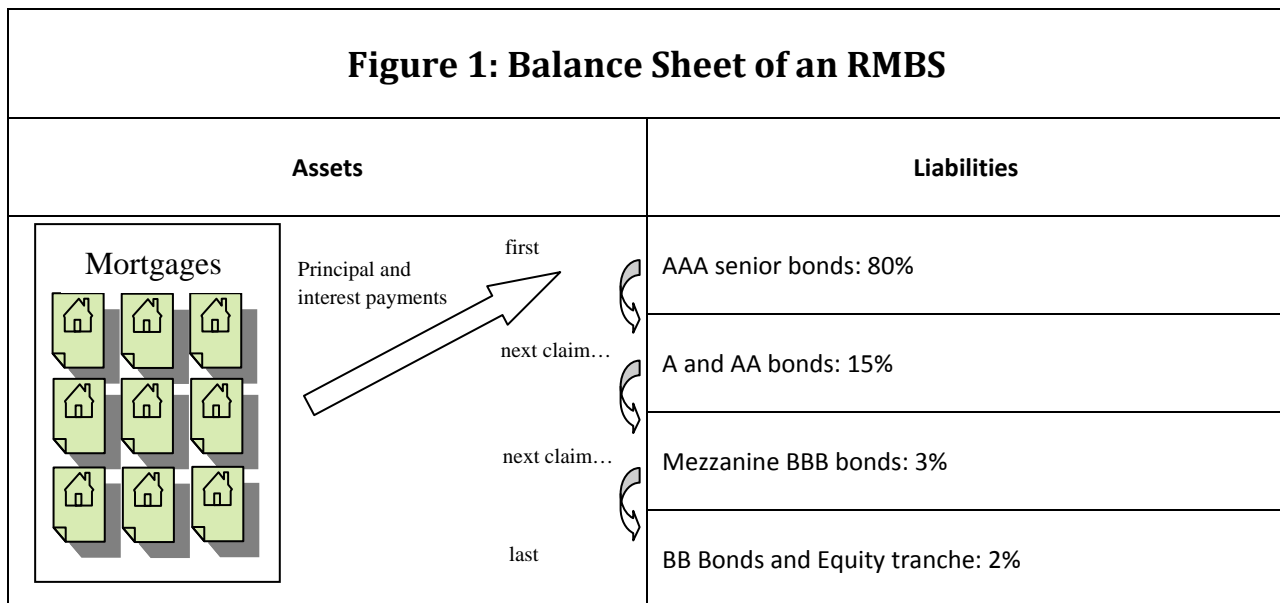[11] See, for example, *In re Pan Am Corp.*, 161 BR 577 (SDNY, 1993).
[12] *Quinn v. McGraw-Hill*, 168 F3rd 331 (7th Cir., 1999).
[13] RMBS and CDOs are discussed in more detail in the FCIC's April 7, 2010, Preliminary Staff Report, "Securitization and the Financial Crisis."

tranches—referred to simply as *senior securities*—represent the lowest risk and consequently pay the lowest interest rate. They are set up to be paid prior to any of the classes below and are typically rated AAA. Senior securities typically make up the majority of bonds issued by the SPV. The next most senior tranches are the *mezzanine* tranches. These carry higher risk and pay a correspondingly higher interest rate. The most junior tranche in the structure is called the *equity* or *residual* tranche and receives whatever cash flow is left over after all other tranches have been paid. These tranches, which are typically not rated, suffer the first losses on any defaults of assets in the collateral pool.

Figure 1 provides a notional balance sheet for a typical RMBS. The entity holds a pool of residential mortgages that make principal and interest payments. In the case of an RMBS, the assets are residential mortgages.

Figure 1: Balance Sheet of an RMBS

| Assets	Liabilities
Mortgages — Principal and interest payments — first — next claim… — next claim… — last	AAA senior bonds: 80%
	A and AA bonds: 15%
	Mezzanine BBB bonds: 3%
	BB Bonds and Equity tranche: 2%

A CDO can hold a pool of collateral that includes many types of assets. CDOs that contain RMBS or other types of asset-backed securities are called *ABS CDOs*. ABS CDOs that largely contain the mezzanine tranches of RMBS are referred to as *mezzanine* CDOs; those containing higher-rated RMBS are called *high-grade* CDOs.

Figure 2 provides a notional balance sheet for a typical mezzanine ABS CDO. In this example, the AAA senior bonds make up 76 percent of the principal amount of debt issued by the SPV, A - AA bonds account for 14 percent, mezzanine BBB bonds make up 6 percent, and the residual tranche amounts to 4 percent.

Figure 2: Construction of a mezzanine ABS CDO
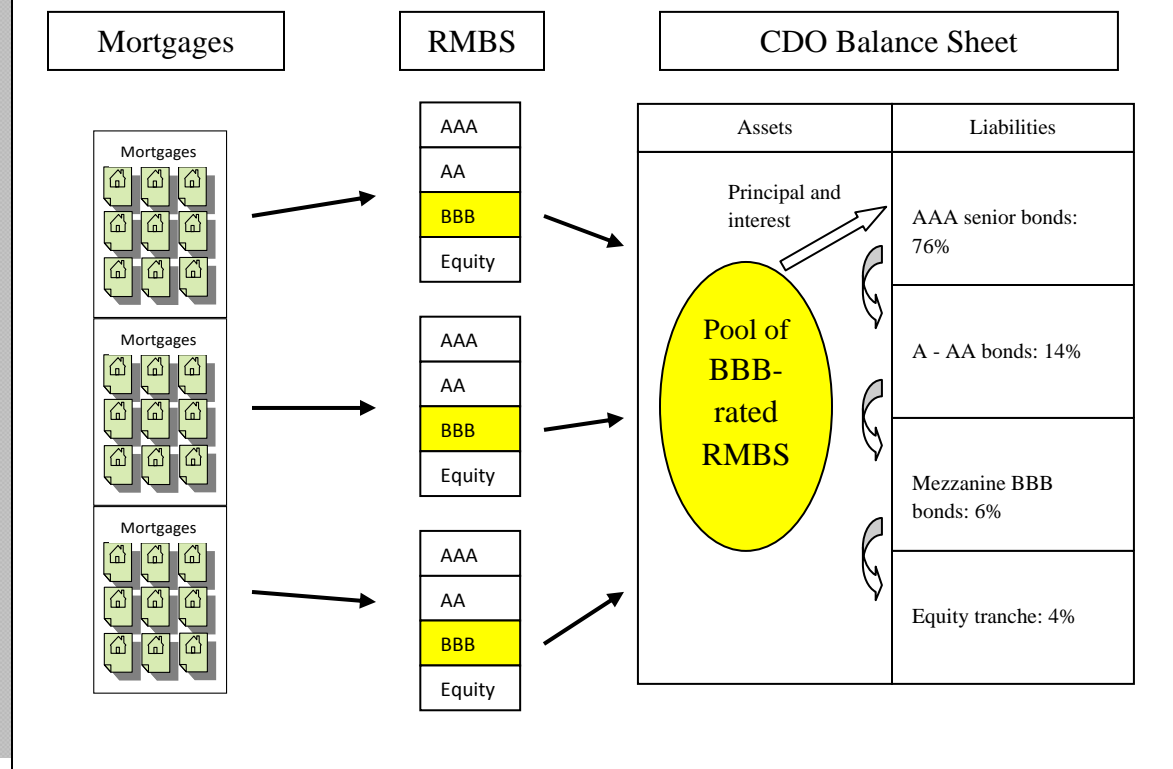
The CDOs described above that hold actual bonds as collateral are referred to as *cash flow* CDOs. Another type of CDO, called a *synthetic* CDO, is based on credit default swaps (CDS) rather than actual bonds. A CDS is a derivative contract in which the buyer pays a stream of periodic payments to the seller, and in return the seller has to pay out some amount if some *reference security* defaults. These CDS contracts are structured so that the synthetic CDO bonds roughly mimic the payments of a cash flow CDO that holds cash positions in those same RMBS. Synthetic CDOs that are based on RMBS, the investors in the CDO effectively act as the seller of credit default swaps on a pool of RMBS as reference securities to some set of counterparties. *Hybrid* CDOs also exist that are based in part on holding bonds as collateral and in part on CDS.[14]

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[14] FCIC staff will release in the near future a preliminary staff report on derivatives that will describe synthetic CDOs in greater detail.

B.   How Pooling and Tranching Can Create AAA Securities

The goal of the *pooling* of assets and *tranching* and *subordination* of liabilities in structured products is to transform relatively risky collateral assets (e.g., mortgages or BBB-rated mezzanine RMBS tranches) into a set of bonds that includes very low risk bonds. A crucial assumption for this to be possible is that the assets held by the SPV are not perfectly correlated so that there are benefits to diversification.

To see this, consider the following simple example.[15] Suppose a CDO holds two identical $1 bonds as assets. If a bond does not default, it pays $1, but if it does default it pays nothing. Suppose each bond defaults with probability equal to one-half (0.5). Furthermore, suppose the CDO issues both a junior and senior tranche of bonds, each of which pay $1. The senior tranche gets the first claim on the cash flows of the CDO so that it only defaults if *both* of the bonds held as collateral default. In contrast, the junior tranche suffers the first loss and defaults if *either* of the collateral bonds defaults.

To see the importance of correlation, consider first the case in which the two bonds held as collateral are *perfectly correlated*. This means that the two bonds either both default or both pay out – it is not possible for one to default and the other not to default. This means that with probability one-half the CDO has no money to pay either of its bonds, and with probability one-half the CDO can pay *both* the junior and senior bonds. With perfect correlation in its assets' defaults, then, the CDO has not transformed its collateral assets into any lower-risk bonds. Both the bonds held as collateral and the bonds issued by the CDO all have a probability of default equal to one-half.

Consider now the alternative extreme assumption in which the bonds held as collateral are *uncorrelated.* This means that whether one bond defaults does not provide any information about whether the other bond defaults. Under this assumption, there are three possible amounts of cash paid out by the CDO's collateral: $0, $1, and $2. The CDO's senior tranche will only default if the CDO receives $0, which occurs when both bonds default. Because they are uncorrelated, both bonds default with probability 0.5 x 0.5 = 0.25. The CDO receives $1 if just one of the bonds default, which occurs with probability 0.5. In this scenario the senior tranche is paid but the junior tranche defaults. Finally, the CDO receives $2 if neither of the bonds default, which occurs with probability 0.25. This is the only scenario in which the junior tranche gets paid, so the junior tranche defaults with probability 0.75.

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[15] This example draws on Coval, et al (2009).

These two cases represent the extremes of perfect correlation and zero correlation. More realistically, collateral assets are typically imperfectly correlated. This means that knowing that one of the bonds defaults makes it more likely (but not certain) that the other bond will default. Common factors that influence the performance of bonds are one source of correlation. For example, when housing prices go down, it can affect the performance of many RMBS.

With such imperfect correlation, pooling and tranching can produce a senior tranche of securities that are lower risk than the CDO's underlying assets, as in the case of zero correlation considered above. The higher the correlation of the assets' defaults, however, the less the pooling and tranching can reduce the default risk of the structure's senior tranche. Intuitively, the senior CDO bond will default only if the CDO's collateral pool experiences massive losses. A well-diversified (i.e., low correlation) collateral portfolio is unlikely to sustain such large losses. But a highly concentrated (i.e., high correlation) collateral portfolio has a higher probability of realizing very large losses because if one asset defaults, many other assets are also more likely to default.

C.   Rating Methodology

We describe now the methodology used to rate RMBS and CDOs according to the rating agencies' publicly available documentation. These financial instruments are complex, and the rating agencies' methodologies are complex. What follows is the FCIC staff's attempt to distill the essence of these methodologies, which assumes some familiarity with statistics and omits many details.

1.   RMBS

The RAs' methodology for rating an RMBS begins with an assessment of the riskiness of the mortgages held as collateral in the RMBS. Here we describe Moody's approach to rating subprime RMBS from roughly 1996 through the end of 2006 as described in Moody's public documentation.[16]

The analysis would begin with an evaluation of the credit risk of the mortgages in the RMBS's collateral pool. Moody's used a set of quantitative relationships that relate mortgage characteristics to default probability and default severity (i.e., the loss on the mortgage given that it defaults) to calculate an expected (i.e., mean) pool loss estimate, which is the total loss expected to occur over the lifetime of the pool as a fraction of the original total principal balance of the pool. A key adjustment that Moody's made to its

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[16] Moody's (1996) lays out the basic analytic framework.

expected pool loss estimate was based on the *originator* of the loans. Loss estimates for pools of mortgages made by originators that Moody's deemed to be lower risk were adjusted downward. For originators deemed high risk, loss estimates were adjusted upward.

Because the pool loss is uncertain, Moody's also assumed some variation in the pool loss expressed as a standard deviation and adjusted that standard deviation based on the number of loans in the pool, their geographic diversification, and other factors. The pool loss distribution was then modeled as a lognormal distribution (an example of which is shown below in Figure 3) with this estimated mean and standard deviation.

Table 2 below provides a list of the principal pool characteristics that Moody's considered in estimating the mean pool loss. Appendix 2 shows the sensitivity of mean pool loss to changes in various pool characteristics using Moody's model. For example, increasing average LTV in the hypothetical pool A by 10 points increases mean pool loss from 0.82% to 1.39%; for pool B it increases mean pool loss from 2.96% to 4.76%.

Table 2: Principal Factors Considered by Moody's Subprime RMBS Model as of 2004	
Factor	**Effect**
Loan-to-value ratio (LTV)	Higher LTV increases default probability and default severity.
Combined loan-to-value ratio (CLTV)	Higher CLTV increases default probability and default severity.
Credit score	Higher credit score lowers default probability.
Debt-to-income ratio (DTI)	Higher DTI increases default probability.
Originator quality	Expected loss estimates are multiplied by an "originator factor," with high-quality originators getting a factor less than one, and low-quality originators getting a factor greater than one.
Loan seasoning	Loans that were originated a longer time prior to the RMBS being issued are generally considered to have lower probability of default and default severity due to the accumulation of equity. Moody's factors in housing price depreciation on seasoned loans as well, which can increase their default probability and default severity.

Time to foreclose	Moody's incorporates variation across states in the time to foreclose, which affects default severity.
Local housing market projections	Moody's estimate of a housing market's prospects are represented by a factor that raises or lowers a loan's default probability and default severity.
Property type	Attached housing and multifamily properties are assigned a higher default severity.
House value relative to local market	The higher a property's relative price, the higher the assigned default severity and default probability.
ARM vs. FRM	The default probability of ARMs is adjusted upward.
Balloon mortgages	Default probability is adjusted upward.
Interest only and negatively amortizing loans	Default probability is adjusted upward.
Loan purpose	Home purchases and refinance loans are assigned lower default probability than home equity loans.
Owner occupancy	Default probability is adjusted downward.
Mortgage insurance	Presence of mortgage insurance reduces default severity.
Coupon	Higher interest rate loans have higher expected loss.
Pool size	Larger pools have lower standard deviation.
Geographic diversification	Pools with greater geographic diversification have lower standard deviation.
Mortgage servicer	Moody's rates servicer quality in collecting payments and effectiveness in modifying delinquent loans and adjusts the credit enhancements needed for a given ratings level.
Documentation status	Moody's adjusts upward the credit enhancement required for loans that contain partial or no documentation of the borrower's income or assets.
Lien type	Second liens are assumed to have higher expected loss than first liens.
Sources: Moody's (1996), Moody's (2001), Moody's (2004a), Moody's (2004b).	

Moody's explains the data used to create their pool loss model as follows:

> We draw on historical data from many sources, beyond rated
> loan pools, to determine the relationship between loan
> characteristics and credit risk. Key data sources are the
> Mortgage Bankers Association; Fannie Mae and Freddie Mac;
> private mortgage insurers; and a database of rated loan pools
> tracked by Moody's. Default frequency and loss severity data
> were collected at the individual loan level as well as at the pool
> level.[17]

Figure 3

Determining Credit Support

The estimated density function is the starting point for determining security ratings.
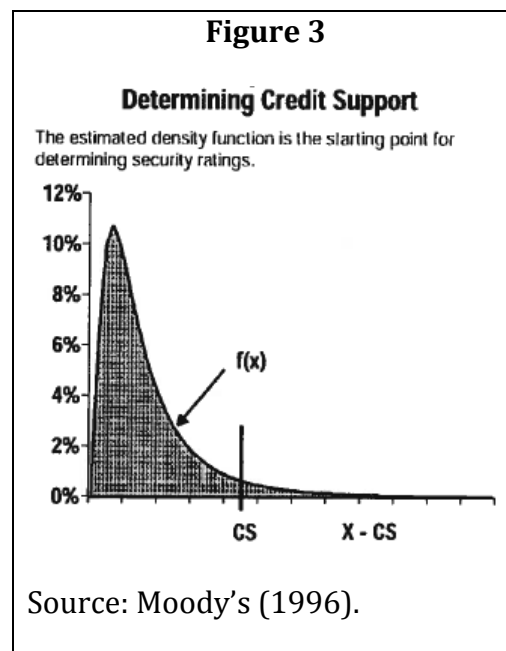
Source: Moody's (1996).

Figure 3 illustrates a lognormal probability density function for the losses incurred in a
pool of loans in a hypothetical example. The horizontal axis indicates the total dollar
amount of losses incurred by the pool. (For example, CS and X- CS indicate different dollar
amounts.) The density function – indicated by the curve – illustrates the probability of each
dollar amount of loss. For a given tranche, the *credit support level* is the dollar amount of
losses that can be sustained before the particular tranche being rated begins to experience
a decline in payments. A hypothetical level for one tranche is indicated by CS in Figure 3.
For example, a more junior tranche begins to experience a decline in payments after

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[17] Moody's (1996).

relatively minor losses in the overall pool. Hence, the credit support level, or CS, for the junior tranche would be to the left of the credit support level of the more senior tranche.

If the pool of mortgages sustains losses greater than CS, then there are *unsupported losses* equal to the difference between the total losses to the overall pool and the credit support level for the tranche. For example, if a pool experiences a loss of $3 million due to defaults, and a credit support level for a particular tranche is $1 million, the unsupported loss for this tranche is $2 million. Moody's then calculates the probability of each possible scenario of losses to estimate the expected loss to the tranche. The expected loss to the tranche is equal to the sum across all loss outcomes greater than CS of the product of the unsupported losses and the probability that the loss outcome occurs.

Finally, Moody's assigns a rating to each tranche. It does this by first calculating the effect on the yield of the bond from these expected losses. In a sense, the expected loss "discounts" the expected payments on the security. Moody's compares this discount to a standardized schedule of ratings and discounts to assign ratings to the tranches.

In 2003, Moody's adopted a new model for rating prime jumbo and Alt-A mortgage pools called Moody's Mortgage Metrics (M3), which incorporated losses associated with macroeconomic factors. In public documentation, Moody's described the adoption of the model. While the public documents are not completely clear on Moody's methodology and what precisely changed over time, in 2003 Moody's stated that it "has refined its RMBS model for [a] set of large, geographically diverse Jumbo A and Alt-A pools from established originators and rated servicers to the point of delegating the bulk of the determination of these credit support levels to the model."[18] It was not adopted at that time for use on subprime pools. It was based on a dataset from Loan Performance, Inc., containing over 500,000 mortgages. The M3 model simulates the performance of each loan in the pool through 1,250 different economic scenarios. These economic scenarios are generated using Moody's projections of interest rates, state-level unemployment scenarios, and state-level home price appreciation scenarios. In the simulation, home prices broadly trend upward at approximately 4% per year on average.[19] Moody's uses the resulting distribution of pool losses to estimate the expected loss to each tranche and assign its rating.

A similar model was then developed for use with subprime pools called M3 Subprime. Its use was phased into Moody's ratings process in late 2006.

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[18] Moody's (2003).
[19] Moody's (2003 p. 10).

In addition to the quantitative analysis described above, Moody's legal analysts considered whether there were any legal issues that would affect the bonds' payments.[20]

When the initial quantitative and qualitative analysis was complete, the lead analyst on the deal convened a rating committee composed of other analysts and managers to determine the ratings for the RMBS's bonds. The lead analyst presented an overview of the transaction and Moody's quantitative and qualitative analyses of the transaction, and after deliberation and potential adjustments, the committee voted on Moody's ratings for the bonds.

> ### 2. CDOs

The RAs rate ABS CDOs using information about the rating and type of each bond held in the collateral pool to estimate the probability distribution of losses to the collateral. Here we describe Moody's approach. The main ingredients used to estimate the collateral pool loss distribution are the default correlation among the collateral bonds and the collateral bonds' default rates and recovery rates. The default correlation is the degree to which the default of one of the collateral bonds implies a higher probability of default of the other bonds that the CDO holds as collateral assets---its importance is described in section III.B. above. The rating agencies use a mix of assumptions and historical data to determine the default correlation between different types of assets. Default rates and recovery rates are set based on the ratings of the collateral bonds.

Once Moody's has estimated a collateral loss distribution, it then calculates the expected losses to each of the CDO's tranches.

The final step in the quantitative analysis is to compare the expected loss for each tranche to a set of benchmarks in order to determine the modeled rating of each tranche. Appendix 2 provides the five-year idealized expected loss percentages for each of Moody's ratings. The modeled rating for each tranche is the highest rating for which its expected loss over the appropriate time horizon is less than the idealized expected loss for that rating.

In addition to this quantitative analysis, Moody's legal analysts conduct a qualitative analysis, examining the CDO's legal documentation and adjusting ratings for any risks associated with features of the CDO. In the end, the published rating assigned to the bond is set by a ratings committee, which considers both the quantitative and qualitative analysis of the CDO's bonds. As a result, the published rating can differ from the "modeled rating."

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[20] Moody's (2001).

3.   Monitoring RMBS and CDOs

After issuing an initial rating on an RMBS or CDO, the rating agencies *monitor* the bonds to determine whether they perform as expected or instead should be either *downgraded* to a lower rating or *upgraded* to a higher rating.

To monitor ratings on RMBS on a monthly basis, Moody's uses quantitative screens to flag RMBS whose performance suggests a need to consider changing their ratings.[21] One important tool is the pipeline loss calculation. This takes as inputs the fraction of mortgages in the pool in various stages of delinquency or default (e.g., current, 30-day delinquent, 90-day delinquent, in foreclosure, etc.) and using assumed *roll rates* at which each delinquency type will ultimately result in a loss, a new expected loss for the pool is calculated.   Moody's then calculates a ratio of each tranche's credit enhancement to the updated expected loss and flags tranches for which this ratio suggests that the tranche's current rating is inappropriate. An analyst is then assigned to do an in-depth review of the bonds and Moody's may publicly announce that the bonds are on a watchlist for possible downgrade. A rating committee ultimately decides whether to downgrade the bonds.

Moody's procedure for monitoring CDOs is described in Moody's (2002). Moody's "regularly reviews whether the CDO notes continue to conform to the guidelines that were the basis of the initial ratings."[22] It monitors monthly trustee reports looking for any deterioration in the quality of the CDO's collateral pool. If Moody's detects any problems with the CDO's collateral, it will contact the CDO's manager to investigate and determine whether it is necessary to downgrade the CDO. If Moody's determines that there is a chance that the CDO's ratings will change, the Moody's rating committee will place the affected securities on a watchlist. It will then proceed to model the cash flows of the CDO based on the current collateral pool, given their performance to date. Once it has updated its expected-loss analysis, the rating committee will determine whether a rating action is appropriate for the CDO's securities.

D.   Market Share of Major Rating Agencies in RMBS and CDOs

Moody's, S&P, and Fitch dominate the market for rating both RMBS and CDOs. Figure 4 below shows the fraction of new RMBS that were rated by each of the three RAs in each quarter from 2000 to 2007. The market shares add to greater than 100% because most RMBS are rated by more than one RA. While the three RAs had similar market shares of

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[21] See Moody's (2003b).
[22] Moody's (2002, p. 2).

between 50% and 70% in 2000, over the next seven years Moody's and S&P's shares grew to over 90%, while Fitch's share fell to around 40%.

Figure 4
Market Share of RMBS Ratings (by $ value)

Note: Includes Home equity loans, home improvement loans, home equity lines of credit, high-LTV loans, non-performing mortgages, residential mortgages (including Alt-A), and subprime mortgages .
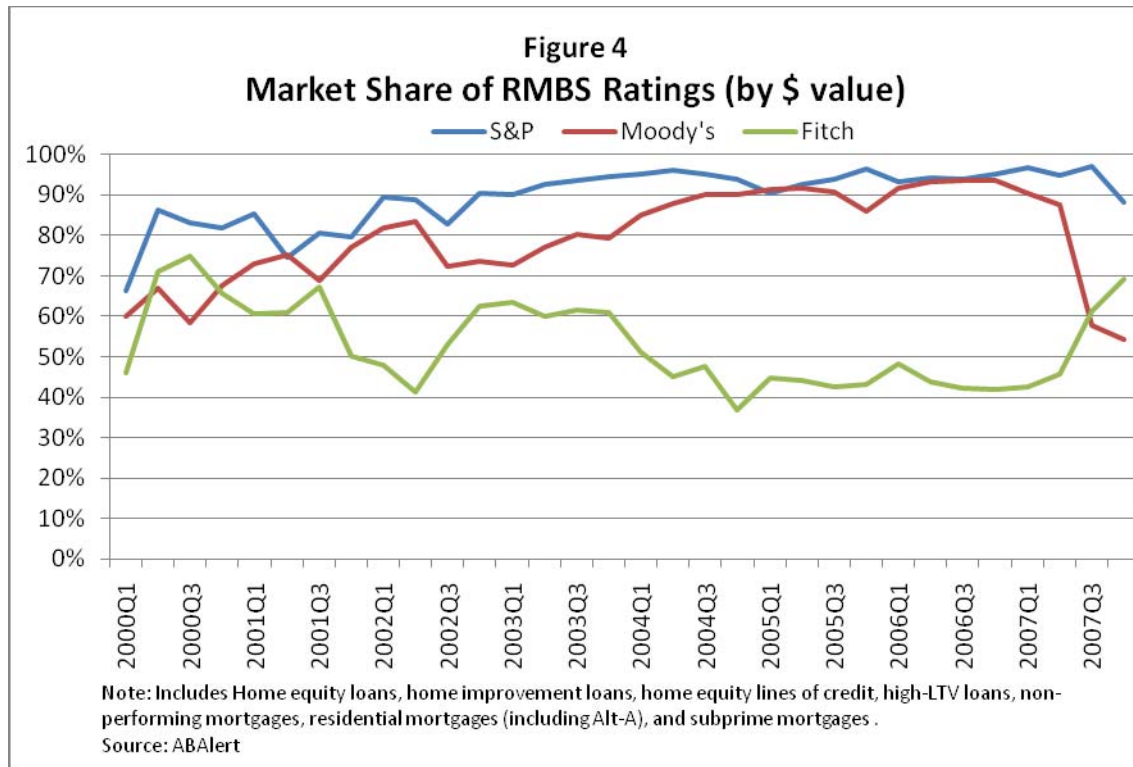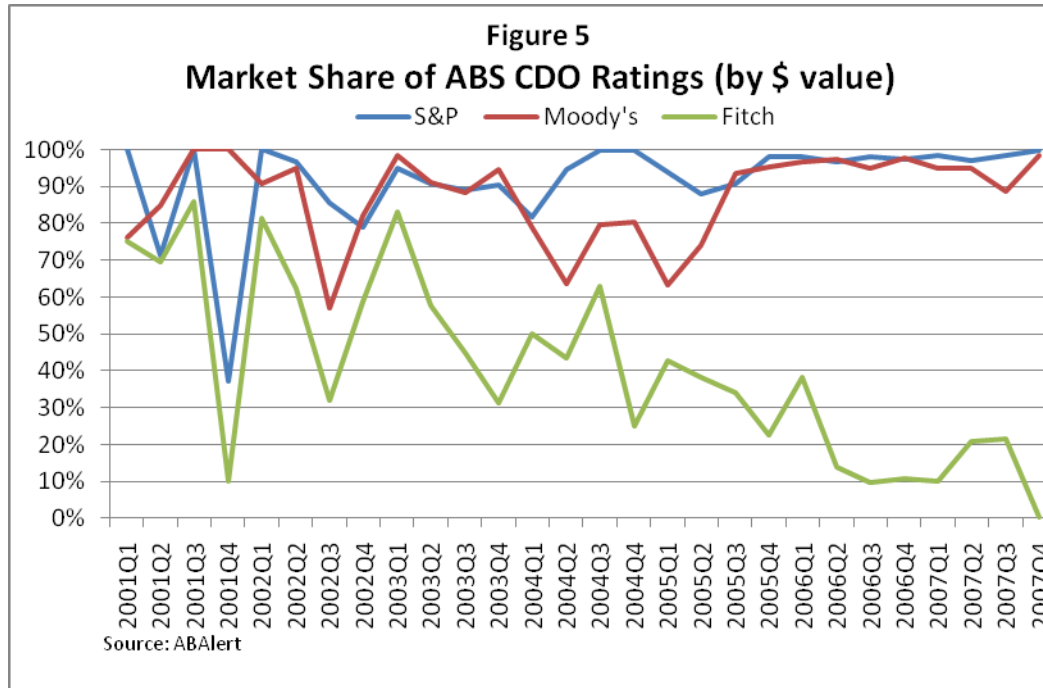Source: ABAlert

Figure 5 shows the same market share plot for CDOs. From 2003 to 2004 Moody's share in CDO ratings dropped from over 90% to between 60% and 70%. By the third quarter of 2005, though, Moody's share increased back over 90%.

Figure 5
Market Share of ABS CDO Ratings (by $ value)
Source: ABAlert

E.   Volume of Rated RMBS and CDOs

For simplicity, we focus here on the volume of ratings by Moody's, which as described above covered most of the RMBS and ABS CDO markets. Figures 6 and 7 below depict the amount of RMBS and ABS CDOs, respectively, newly rated by Moody's in each rating level for each quarter from 2000 through 2007. Both markets grew dramatically over the period. A total of 72,461 tranches of RMBS, totaling $4.7 trillion, were rated by Moody's during this period. The CDO market was smaller, with 5,650 tranches of ABS CDOs, totaling $736 billion, rated by Moody's over the period.[23] The bulk of these bonds---42,625 tranches of RMBS (90% by dollar amount) and 2,160 tranches of CDOs (84% by dollar amount)---were rated Aaa.

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[23] There were also unrated tranches of RMBS and CDOs, typically just the equity tranche of each SPV, issued over this period.
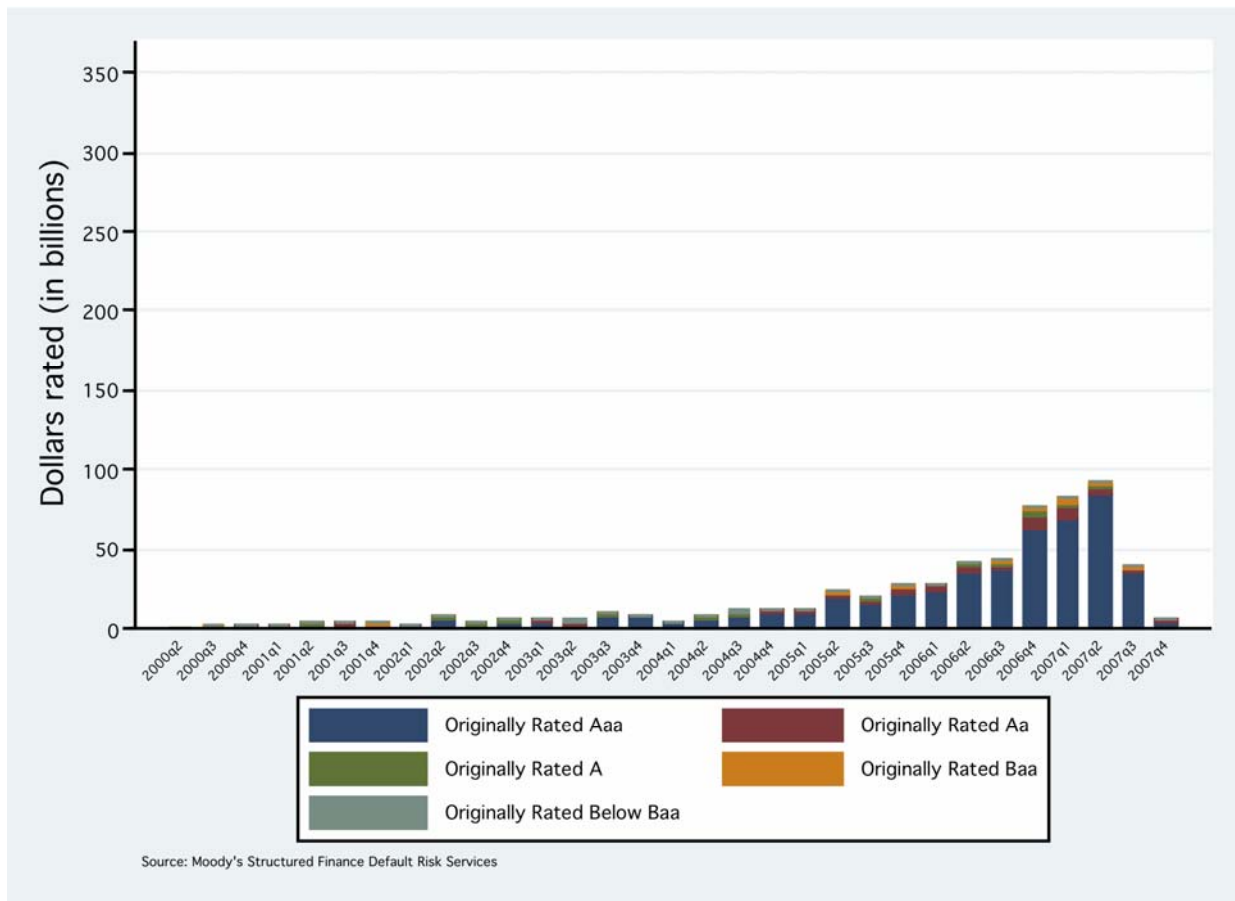
Figure 6: Volume of new RMBS ratings from Moody's
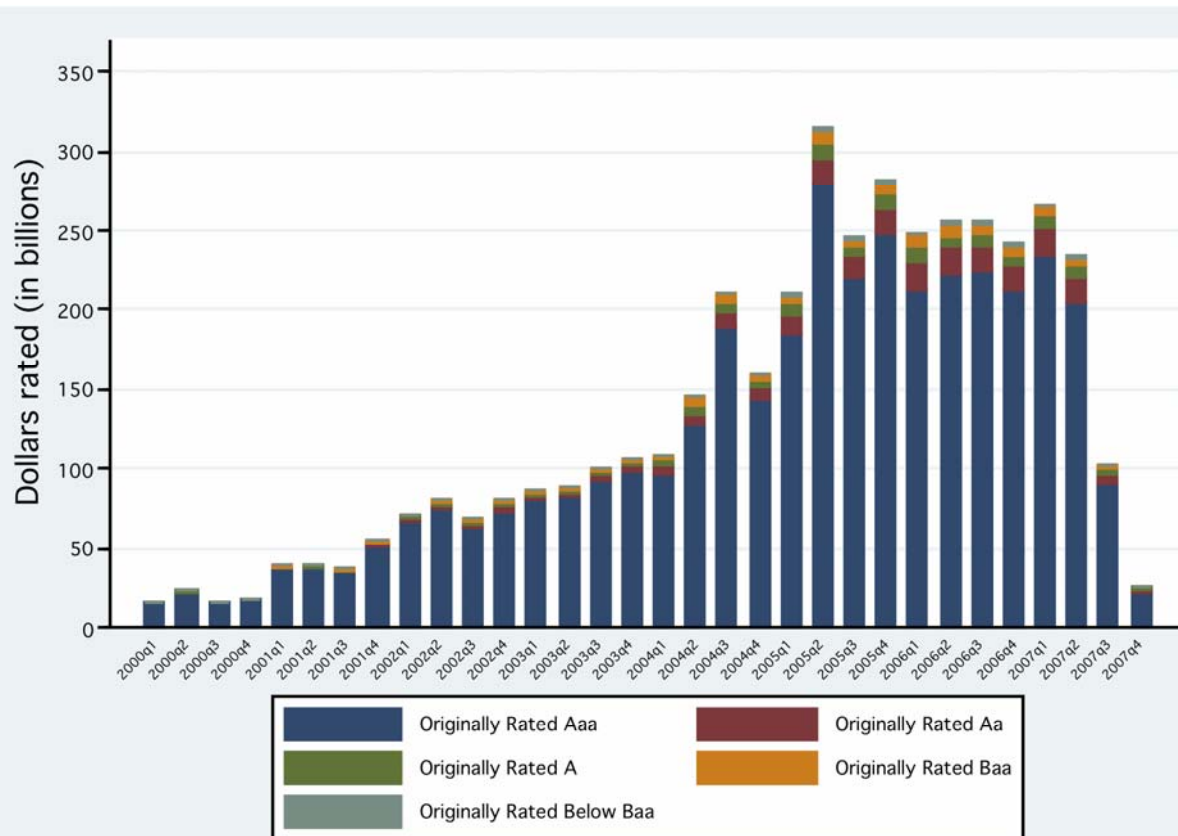
Source: Moody's Structured Finance Default Risk Services

Figure 7: Volume of new ABS CDO ratings from Moody's

Source: Moody's Structured Finance Default Risk Services

IV.   Credit Ratings during the Financial Crisis

A.   Rise in Mortgage Defaults

Mortgage-related securities performed worse than expected due to a large fall in housing prices and a large increase in mortgage defaults beginning in 2006. Nominal housing prices peaked in 2005 and in 2006 began to decline nationally. Figure 8 shows national nominal housing prices over this period as measured by the Case-Shiller Index. By the beginning of 2007, national housing prices were down about 2% from their peak. By the beginning of 2008, they were down a total of 15%. By the first quarter of 2009, housing prices had fallen 31% nationally.

Figure 8
Nominal National Home Prices
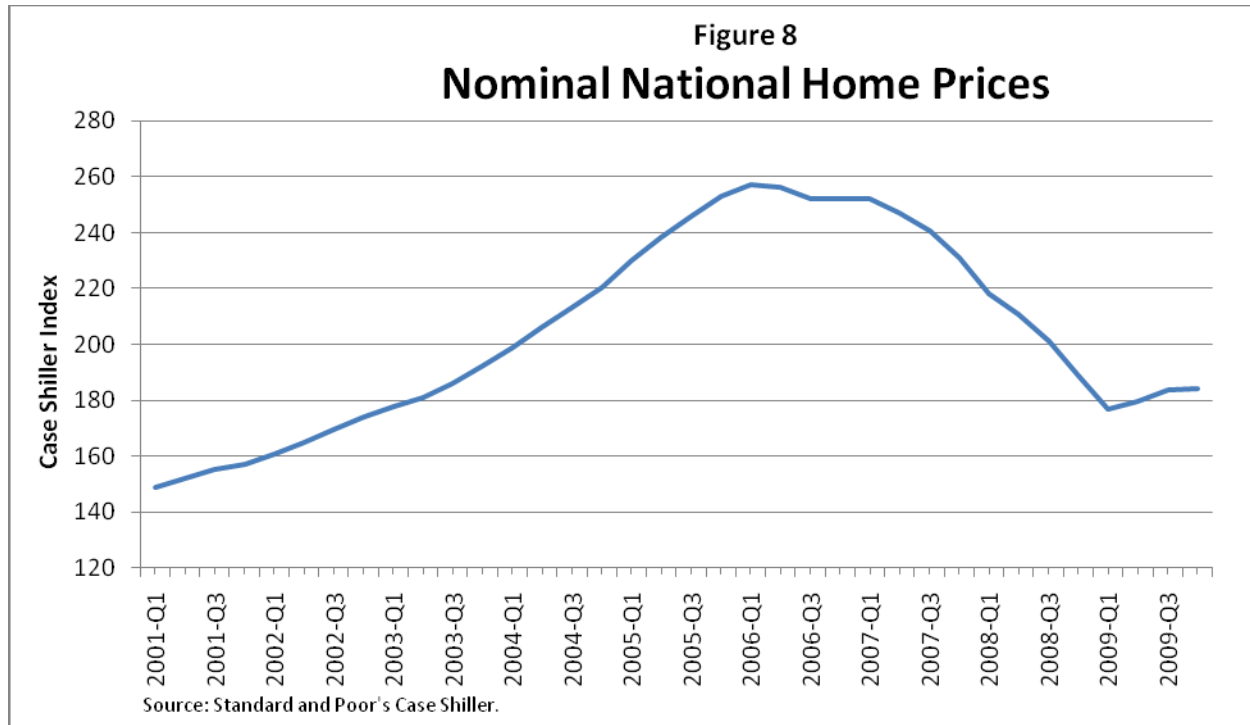
In October 2006, with the housing market downturn well underway, Moody's Economy.com, which is a separate Moody's subsidiary from the Moody's unit that rates structured products, issued a report authored by Chief Economist Mark Zandi titled "Housing at the Tipping Point: The Outlook for the U.S. Residential Real Estate Market." Based on a structural econometric model of housing supply and demand, the report concluded that:

> Nearly 20 of the nation's metro areas will experience a crash in house prices: a double-digit peak-to-trough decline in house prices... These sharp declines in house prices are expected along the Southwest coast of Florida, in the metro areas of Arizona and Nevada, in a number of California areas, throughout the broad Washington, D.C. area, and in and around Detroit. Many more metro areas are expected to experience only house-price corrections in which peak-to-trough price declines remain in the single digits. In addition to the some 30 metro areas that are already experiencing price declines, the structural econometric approach identified 70 other metro areas that will soon experience a measurable decline in prices.

It is important to note that price declines in various markets
are expected to extend into 2008 and even 2009.

With over 100 metro areas representing nearly one-half of the
nation's housing stock experiencing or about to experience
price declines, national house prices are also set to decline.
Indeed, odds are high that national house prices will decline in
2007; the first decline in nominal national house prices since
the Great Depression.[24]

Accompanying this decline in housing prices was a sharp increase in mortgage
delinquencies. Figure 9 below shows the fraction of mortgages past due and in foreclosure
over time. The rise in delinquencies was initially concentrated in subprime mortgages and
included an abnormally large number of *early payment defaults* in which the borrower
defaults in the first three months of his mortgage.

Figure 9
Mortgages Past Due and In Foreclosure
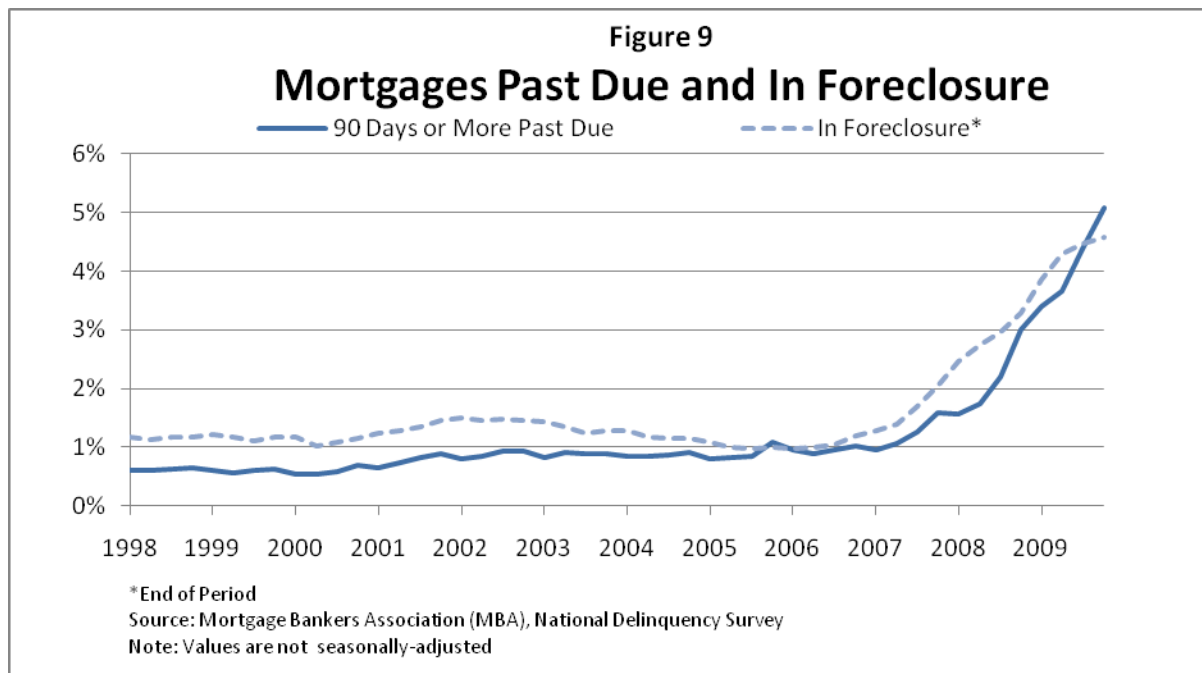
B. Downgrades and Impairments of RMBS and CDOs

To characterize what happened to credit ratings during the financial crisis, we again for
simplicity focus on Moody's ratings. The initial rise in mortgage defaults was concentrated
in subprime mortgages that had been originated in 2005 and 2006.

[24] Moody's (2006).

On Jan. 18, 2007, Moody's issued a Special Report, "Early Defaults Rise in Mortgage Securitizations," that noted that "mortgages backing securities issued in late 2005 and early 2006 have had sharply higher rates of foreclosure … than previously issued securities at similar, early points in their lives."[25] These foreclosures were concentrated in subprime mortgage pools.

On March 7, 2007, Moody's issued a Special Report, "Challenging Times for the US Subprime Mortgage Market," which stated that:

> It is generally too early to predict ultimate performance for the subprime mortgage loans originated in 2006 and the bonds secured by such loans. A number of factors will determine the ultimate losses. Home price appreciation and refinancing opportunities available in the next few years are expected to have the biggest impact. Economic factors, such as interest rates and unemployment, will also play a significant role as will loss mitigation techniques employed by loan servicers.[26]

Moody's attributed the poor performance of 2006 subprime loans primarily "to the recent slowdown in home price appreciation … and the introduction of risky mortgage products over the past several years…" Nevertheless, Moody's asserted that "we believe that performance would need to deteriorate significantly for the vast majority of bonds rated A or higher to be at risk of loss. On average, for lower-rated Baa bonds to be at risk of loss, performance would have to continue to decline materially." Moody's concluded that "it is generally too soon to tell whether ultimate losses will materially exceed our original loss expectations for 2006 securitized subprime mortgage pools."

On March 23, 2007, Moody's issued a Special Comment, titled "The Impact of Subprime Residential Mortgage-Backed Securities on Moody's-Rated Structured Finance CDOs: A Preliminary Review," which discussed the implications of the subprime mortgage crisis for CDOs. Moody's had performed an analysis of the effect of hypothetical scenarios of subprime RMBS portfolio deterioration on CDOs. Moody's found that for CDOs that contained large concentrations of RMBS as collateral, "the potential downgrade impact on the … CDO [bonds] was severe – in some cases 10 or more notches."[27] For example, for a CDO with 100% of its collateral in subprime RMBS, if 10% of subprime RMBS collateral immediately defaulted with a 20% recovery and the remainder was immediately

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[25] Moody's (2007a).
[26] Moody's (March 7, 2007).
[27] Moody's (March 23, 2007, p. 2).

downgraded four notches, then Moody's estimated that all of the CDO's bonds would be downgraded, with the non-AAA bonds downgraded to speculative grade.[28]

On April 20, 2007, Moody's issued a report stating that:

> Even though early delinquencies for the 2006 securitized loans
> are closely tracking those of loans backing deals issued in 2000
> …. – which had cumulative losses of approximately 6% after 72
> months – early losses for the 2006 loans are trending higher
> than those of the 2000 loans. While the employment outlook
> today is stronger than that actually experienced in the post-
> 2000 period, the outlook for other major drivers of mortgage
> losses – home price appreciation, interest rates, and
> refinancing opportunities for subprime borrowers facing rate /
> payment rests – is less favorable. As a result, Moody's is
> currently projecting that cumulative losses for loans backing
> 2006 subprime securitizations will generally range between
> 6% and 8%, though particularly strong or poor performing
> pools may fall outside of this range. … Barring cumulative
> losses well in excess of current expectations, we do not expect
> a material number of downgrades to bonds rated A or higher.

The first mass downgrade of RMBS occurred on July 10, 2007. In the morning S&P announced that it was placing 612 subprime RMBS tranches issued in late 2005 through 2006 on watch for possible downgrade. That afternoon Moody's followed by downgrading 399 tranches of 2006 vintage subprime RMBS and placing an additional 32 tranches on watch for possible downgrade. The downgraded securities totaled $5.3 billion in value and constituted 1.3% of 2006 vintage first lien RMBS.[29] All but one of the downgraded tranches was originally rated Baa or below. Moody's also downgraded 52 tranches of second lien subprime RMBS issued in 2005.

The next day, on July 11, 2007, Moody's placed 184 tranches of CDOs backed primarily by RMBS, with original face value of approximately $5 billion, on watch for possible downgrade.

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[28] Moody's (March 23, 2007, p. 6). Moody's did not intend the scenarios to represent Moody's actual expectations about the future performance of subprime RMBS.
[29] Moody's July 12, 2007, teleconference presentation, p. 12.

On July 12, 2007, S&P downgraded 498 of the 612 tranches it had placed on watch two days earlier. The majority of the tranches were rated BBB or lower, but 8 AAA rated tranches were included. At that point nominal housing prices had fallen approximately 4% nationally from their peak at the beginning of 2006.[30]

The second half of 2007 saw a continued slide in housing prices and continued mass downgrades of RMBS and CDOs. Figures 10 and 11 below show the monthly volume of downgrades of RMBS and ABS CDOs, respectively.
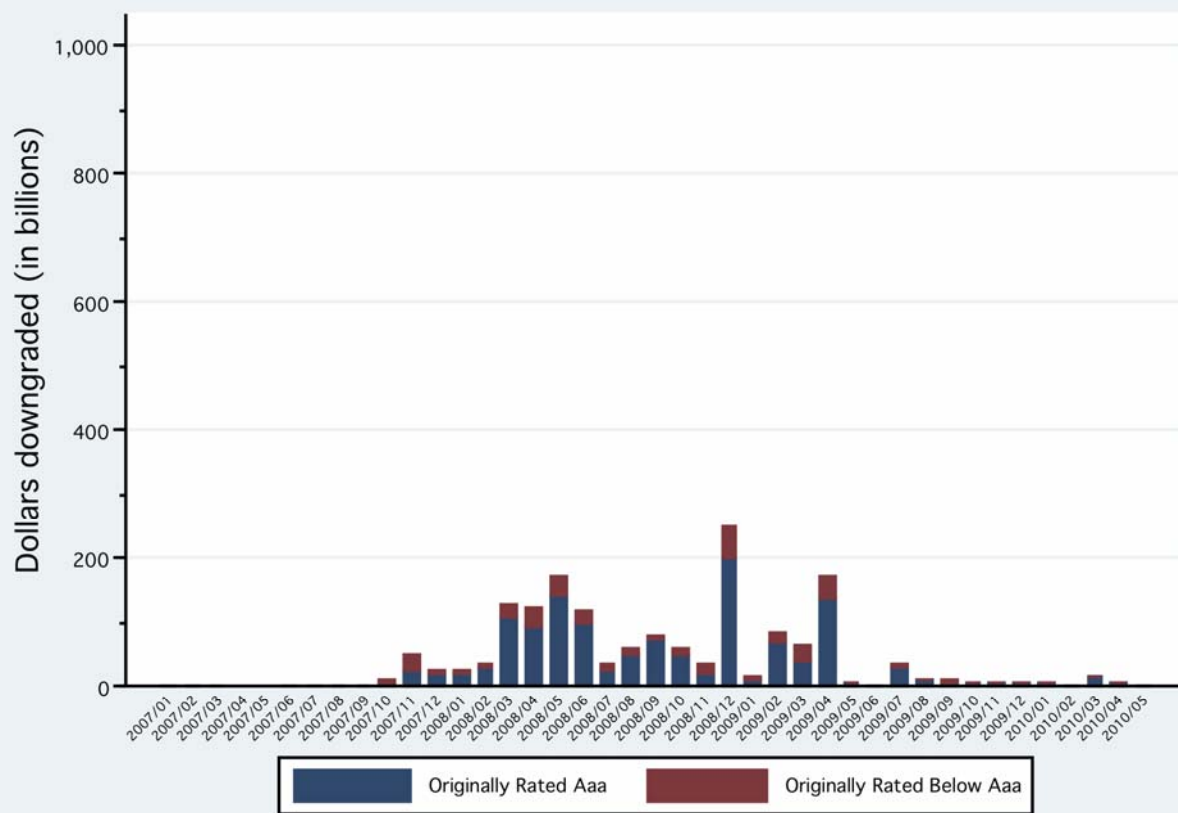

Figure 10: RMBS downgrades by Moody's

Source: Moody's Structured Finance Default Risk Services

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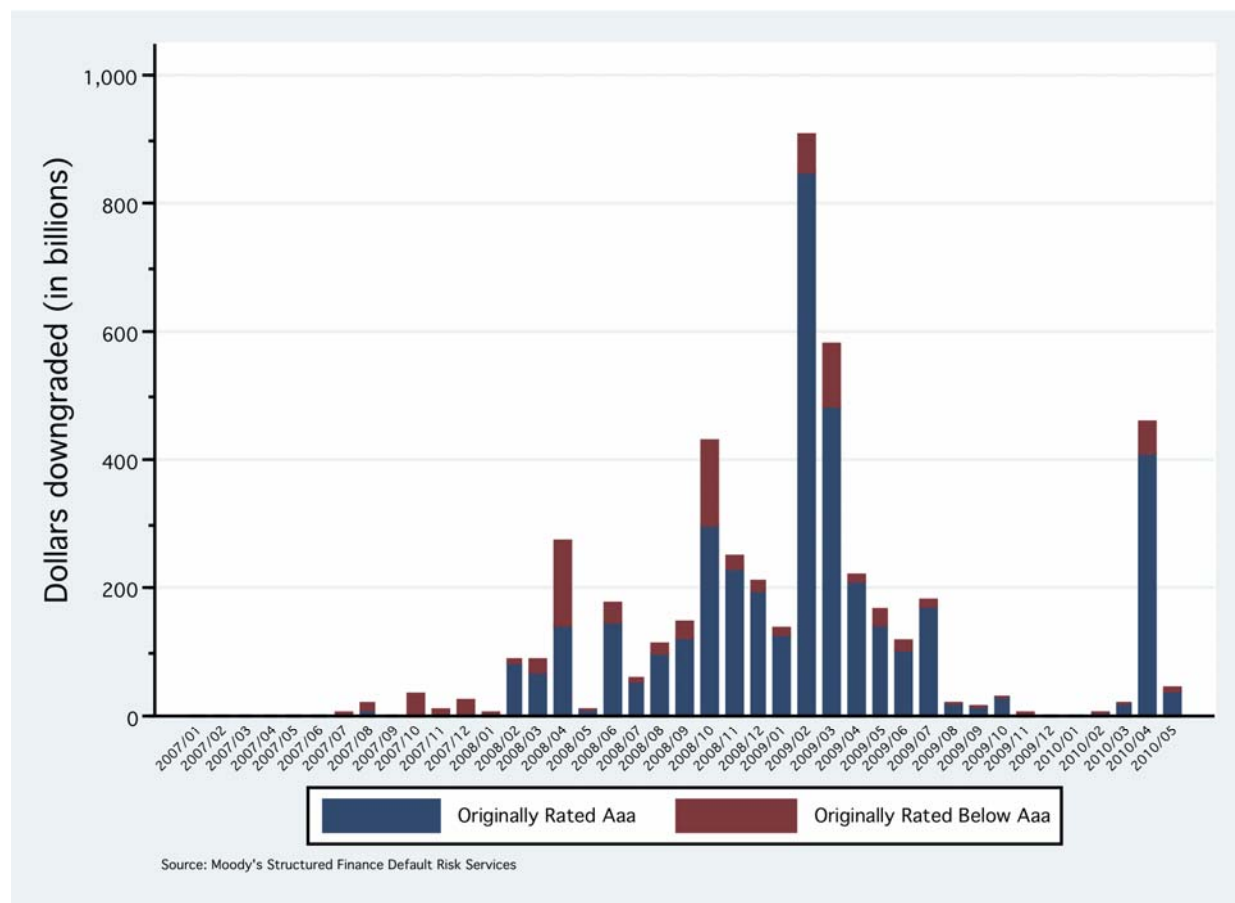
[30] S&P's Case-Shiller Index.

Figure 11: ABS CDO downgrades by Moody's

Source: Moody's Structured Finance Default Risk Services

By the first quarter of 2008, housing prices had fallen 15% from their peak.

Figure 12 below shows the downgrades and ultimate principal impairments suffered by the 2006 vintage of RMBS that were rated Aaa and Baa. The dashed lines depict the cumulative fraction of each set of bonds downgraded at each point in time; downgrades indicate Moody's changed expectations about the bonds' performance. The solid lines depict the cumulative fraction of each set of bonds that have suffered any principal impairment (i.e., for which promised principal payments on the bonds were not made).

The Baa tranches of RMBS were downgraded first, with a particularly large jump in October 2007. By the middle of 2008 over 90% of Baa tranches had been downgraded. Impairments of those tranches occurred after the downgrades, with large jumps in impairments occurring in April 2008 and October 2008. Impairments of Baa tranches

leveled out by the middle of 2009, with over 80% of tranches failing to make promised principal payments to investors.

Downgrades of Aaa tranches of RMBS did not begin in earnest until the middle of 2008 and continued steadily until the middle of 2009, when they leveled off with about 80% of tranches downgraded. Impairments of Aaa tranches occurred at much lower levels, with a number of bonds defaulting in the spring of 2009, bringing the total fraction of Aaa RMBS impaired to just under 10%.

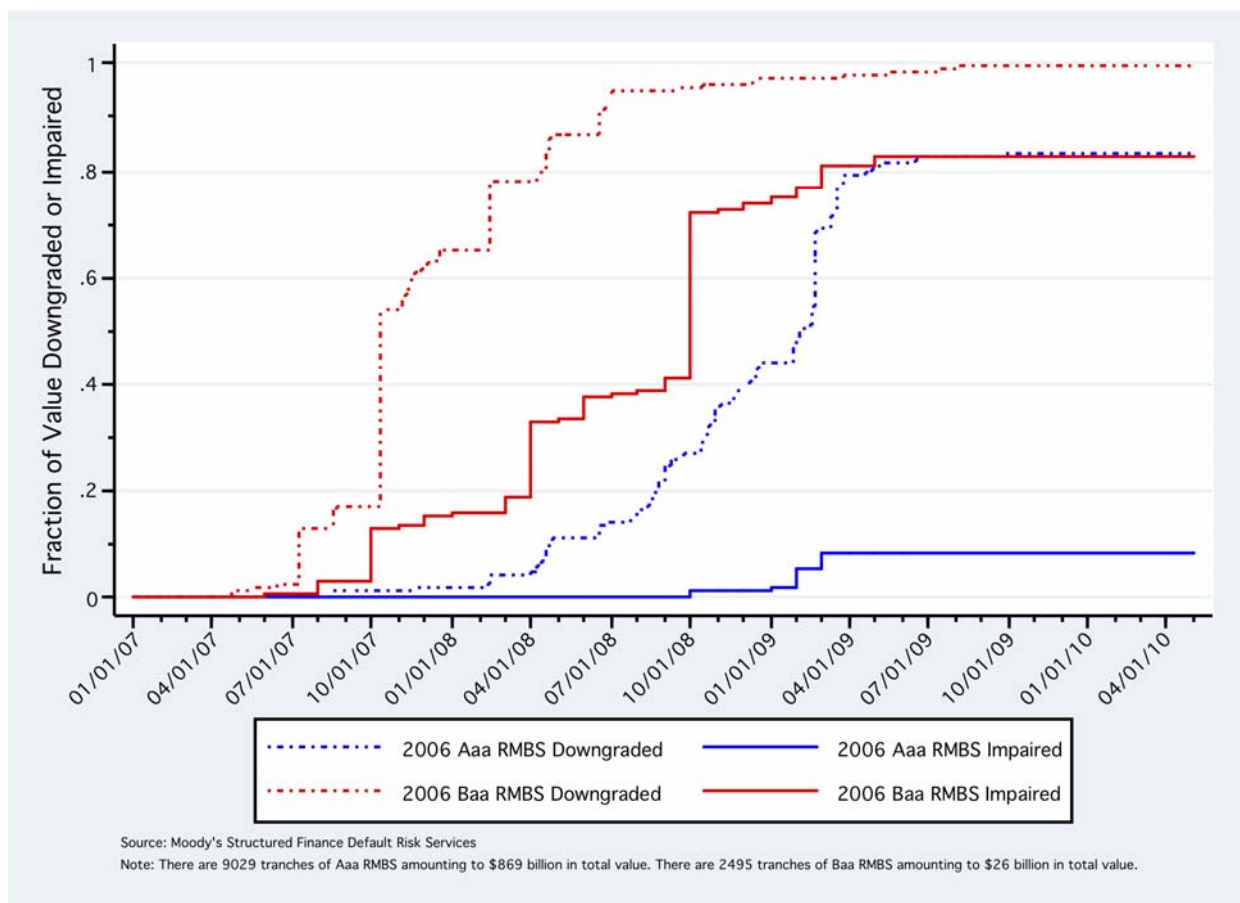Figure 12: Moody's downgrades and impairments of 2006 vintage RMBS.

Figure 13 below depicts the downgrades and impairments of the Aaa and Baa notes from ABS CDOs, which contain large amounts of RMBS as collateral. Baa CDO downgrades began a few months after Baa RMBS downgrades began but otherwise track the Baa RMBS closely. Impairments of Baa CDOs track downgrades very closely, suggesting that tranches were
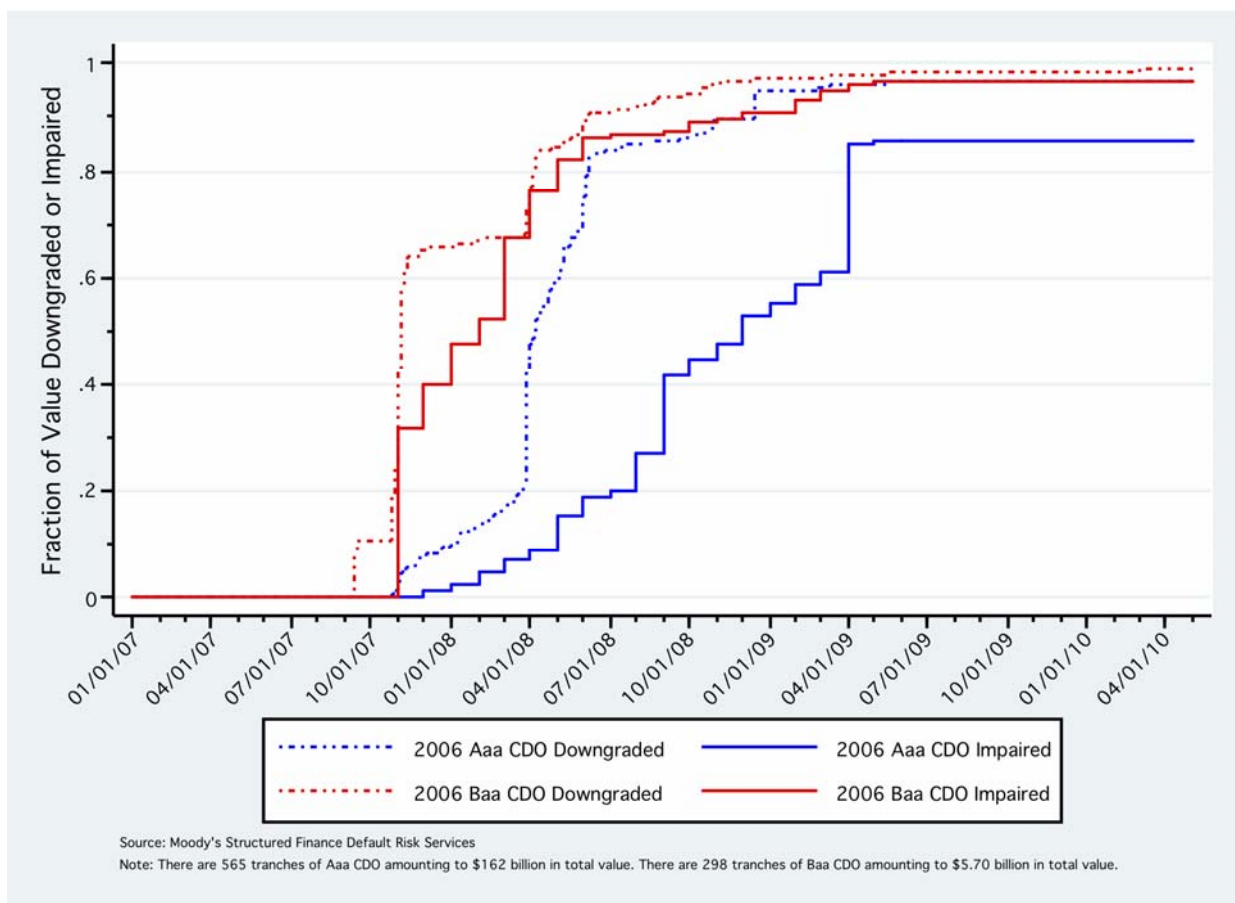
being downgraded at about the same time they were failing to make principal payments. Aaa CDO bonds were downgraded later than the Baa CDO notes, but by the end of 2008 more than 90% of both Aaa and Baa CDO notes had been downgraded.   Over 90% of Baa CDO bonds and 80% of Aaa CDO bonds were ultimately impaired.

Appendix 4 contains figures that further break out the downgrades and impairments of ABS CDOs into various subgroups, such as mezzanine CDOs, high-grade CDOs, and synthetic CDOs.

Figure 13: Moody's downgrades and impairments of 2006 vintage cash flow and hybrid ABS CDOs.

Source: Moody's Structured Finance Default Risk Services
Note: There are 565 tranches of Aaa CDO amounting to $162 billion in total value. There are 298 tranches of Baa CDO amounting to $5.70 billion in total value.

In total, $2.5 trillion worth of RMBS and $564 billion worth of CDOs have been downgraded since January 2007.[31]

One way to assess the timing of credit rating agency downgrades of RMBS relative to contemporaneous market views regarding the risk of subprime mortgage securities is by comparing the downgrades of 2006 vintage RMBS to trends in the price of the ABX index. The ABX is a series of benchmark indices for the price of credit default swaps (CDS) on subprime RMBS. A CDS is a derivative contract that requires the buyer to make a series of payments to the protection seller in return for protection against the event that the reference bond defaults. Launched by Markit in January 2006, each ABX index references 20 RMBS that are rated by Moody's and S&P and issued in the six months prior to the launch of the index.[32] Each index vintage consists of five individual subindices, each referencing exposures to the same 20 underlying subprime mortgage securitizations at different rating levels:[33] AAA, AA, A, BBB, BBB-. Therefore, each ABX index reflects the trading price of credit default swaps on RMBS within a certain rating level for a 6-month vintage. A decline in the ABX index corresponds to an increase in CDS rates, which in turn reflects an increase in the probability assessed by investors that the underlying RMBS will default.

Figures 14 and 15 depict the price of each ratings-based ABX index during 2007-2010 for the 2006H2 vintage and 2007H1 vintage, respectively. The index for each vintage represents tranches from a pool of RMBS originating in the previous half-year. For example, the ABX 06-2 AAA index references tranches with an original rating of AAA originated in the first half of 2006, whereas the ABX 07-1 BBB index references tranches with an original rating of BBB originating in the latter half of 2006.

As early as February 2007, the 2006H2 ABX and 2007H1 ABX indices for lower ratings began experiencing noticeable drops, signaling an expected increase in the rate of default on low investment-grade RMBS originated in 2006. On February 27, 2007, the 2007H1 BBB price index was trading at 67.13, down more than 30 points from the starting price of 100.00. By comparison, Figure 12 shows that the earliest date at which Baa tranches of RMBS were significantly downgraded was October 2007, almost eight months after the initial drop in the corresponding ABX price index.

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[31] These are the total principal amount of securities that were *ever* downgraded; securities that were downgraded multiple times are only counted once.
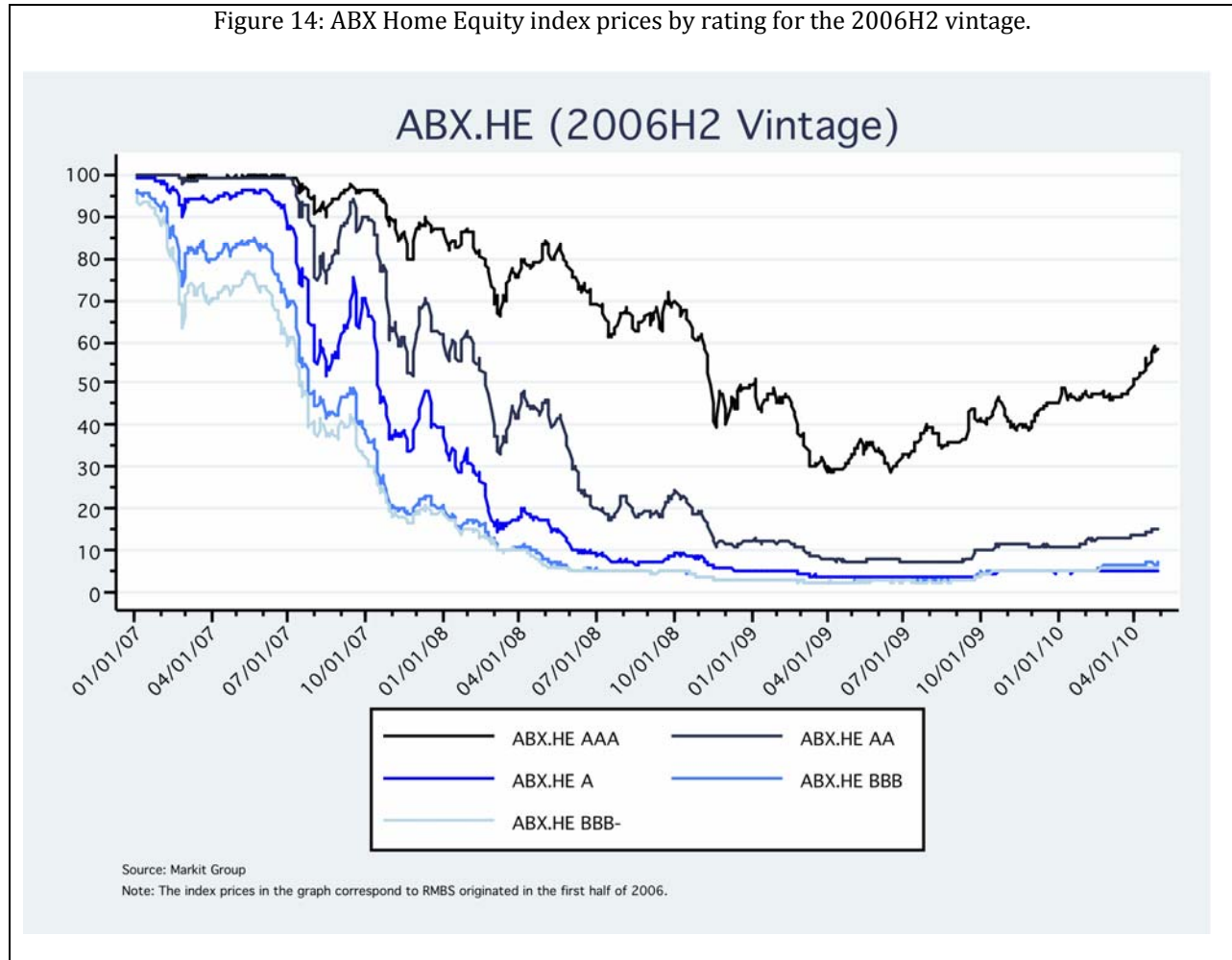
[32] Markit ABX Marketing Presentation, January 2006.

[33] The reference securities are sorted into these indices based on the lesser of the two ratings assigned by Moody's and S&P. Once created, index composition remains fixed, which means that the underlying credit quality can migrate to ratings lower than indicated by the index name.

Figure 14: ABX Home Equity index prices by rating for the 2006H2 vintage.

ABX.HE (2006H2 Vintage)

Source: Markit Group
Note: The index prices in the graph correspond to RMBS originated in the first half of 2006.
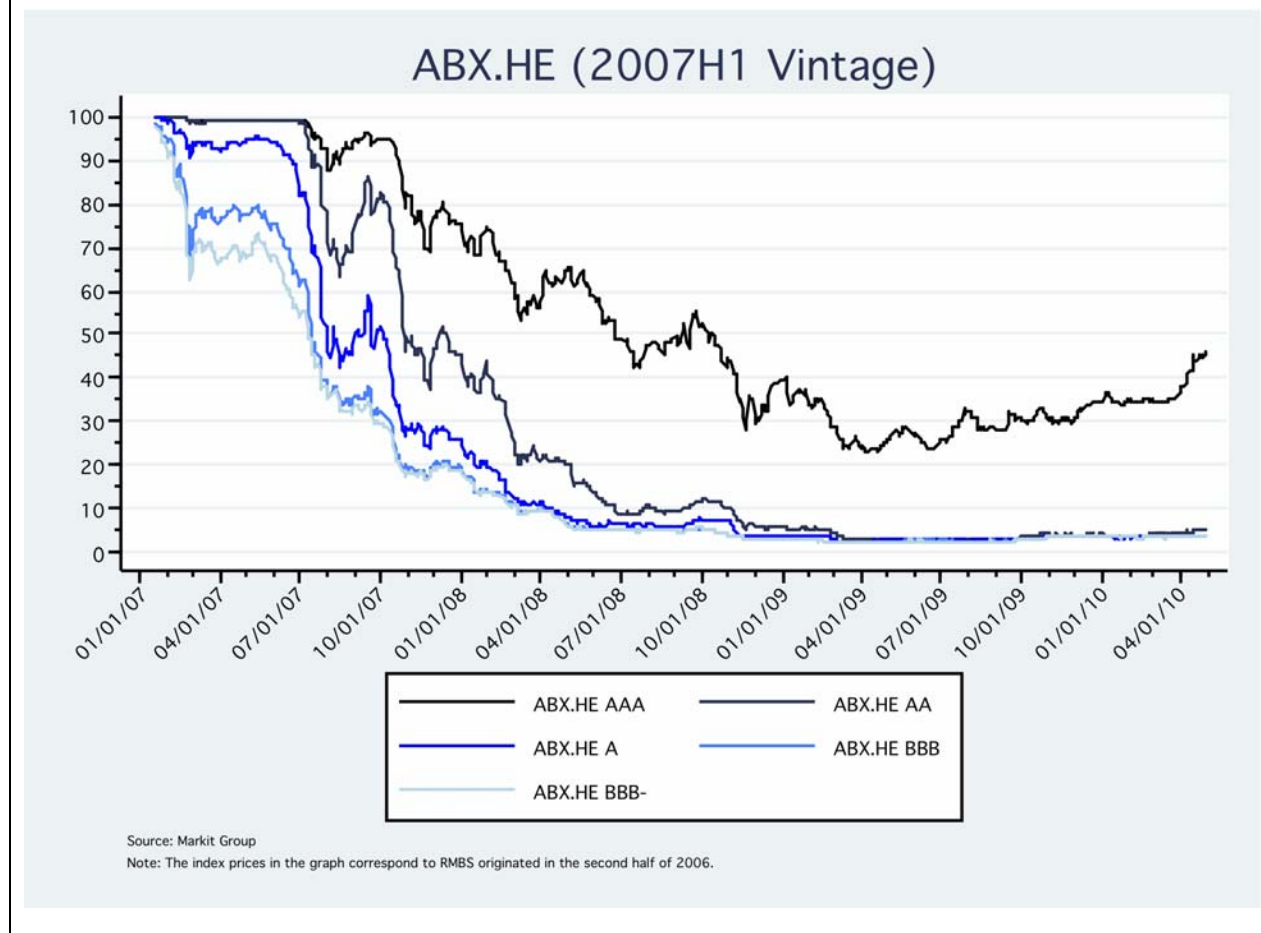
Similarly, the AAA ABX indices experienced their first significant declines in early August and late November of 2007, with the 2007H1 vintage declining more precipitously than the 2006H2 vintage. In contrast, downgrades of Aaa tranches of RMBS were virtually nonexistent until the middle of 2008.

Figure 15: ABX Home Equity index prices by rating for the 2007H1 vintage.

Source: Markit Group
Note: The index prices in the graph correspond to RMBS originated in the second half of 2006.

In 2007 through 2008, the frequency of downgrades of RMBS and CDOs reached record levels. Benmelech and Dlugosz (2009) compared the mass downgrades of RMBS and CDOs during this time to the historical rate of rating changes on corporate bonds. Between 1983 and 1996, the number of rated corporate bonds that experienced downgrades remained at roughly similar proportions. Moreover, the average change in credit ratings of outstanding bonds per year due to upgrades and downgrades remained essentially stable; from 1983 to 1996, the average downgrade never exceeded –1.6 notches in any given year. These modest transitions in the credit ratings of corporate bonds, even during major macroeconomic events, contrast with the rapidity and magnitude with which RMBS and CDO tranches were downgraded in 2007 and 2008. Even when corporate bonds underwent significant downgrading during the bankruptcy wave and recession in 2000-2002, where the number of outstanding bonds downgraded at least once increased from 12% to 30%, the average change in credit rating when there was an upgrade or downgrade

was only –1.8 notches. In contrast, the average downgrade of structured finance securities by Moody's in 2007 and 2008 was –4.7 and –5.6 notches, respectively.

Throughout 2006 and the first half of 2007, Moody's continued to rate large volumes of new CDOs and RMBS despite market events suggesting a continued rise in delinquency and foreclosure rates and mass downgrades of CDOs and RMBS. It was not until the summer of 2007, around the time of the first wave of mass downgrades of RMBS and CDOs, that the amount of new issuances began to decline. Moody's gave Aaa ratings to billions of dollars of new CDOs and RMBS even after those mass downgrades. Out of a total of $119 billion in RMBS rated since the downgrades of July 10, 2007, 90% were rated Aaa. Similarly, out of a total of $51 billion in CDOs Moody's rated since July 10, 2007, 88% were rated Aaa.

Figure 16 below shows the total number of dollars of newly rated RMBS and CDOs per month from the beginning of 2006 through the first half of 2008 in comparison to the progression of the mortgage crisis as chronicled by several Moody's reports.

Figure 16: Newly rated CDOs/RMBS per month
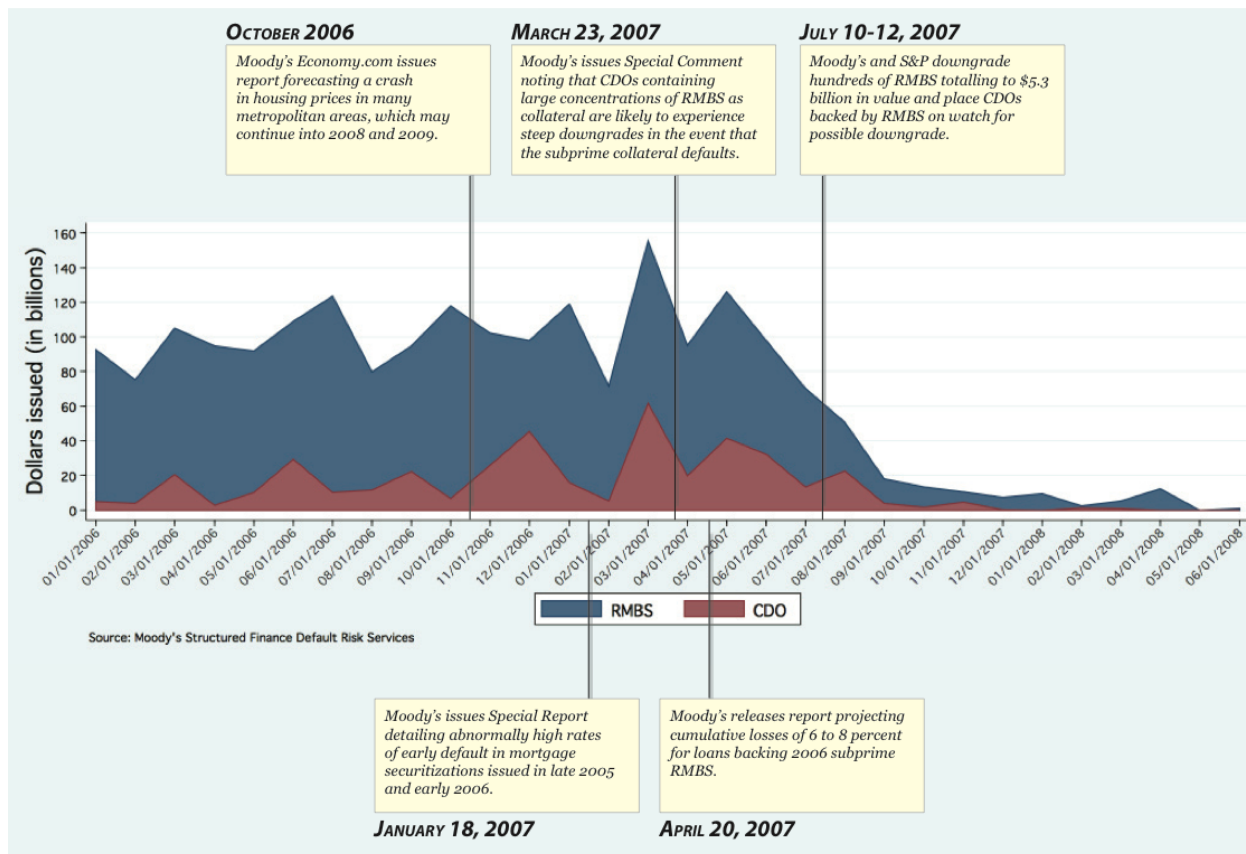
Note: Figure 16 displays the *sum* of dollars issued in RMBS and CDOs. The shaded colors represent proportions of the total amount issued in RMBS and CDOs, respectively.

The last batch of RMBS and CDOs that were rated prior to the rapid decline of the housing market were issued in the second half of 2007. Figures 17 and 18 depict the downgrades and ultimate principal impairments suffered by the 2007H2 vintage of RMBS and CDOs, respectively. While Moody's made some adjustments to their rating methods during the preceding months as the performance of 2006 securities declined precipitously, these figures show, in comparison to Figures 12 and 13, that the final vintage performed similarly poorly in comparison to RMBS and CDOs originating from the previous year. By mid-2009, virtually all of these RMBS originally rated Baa as well as Aaa had been downgraded.

Figure 17: Moody's downgrades and impairments of 2007H2 vintage RMBS

Source: Moody's Structured Finance Default Risk Services
Note: There are 1455 tranches of Aaa RMBS amounting to $112 billion in total value. There are 323 tranches of Baa RMBS amounting to $4.07 billion in total value.
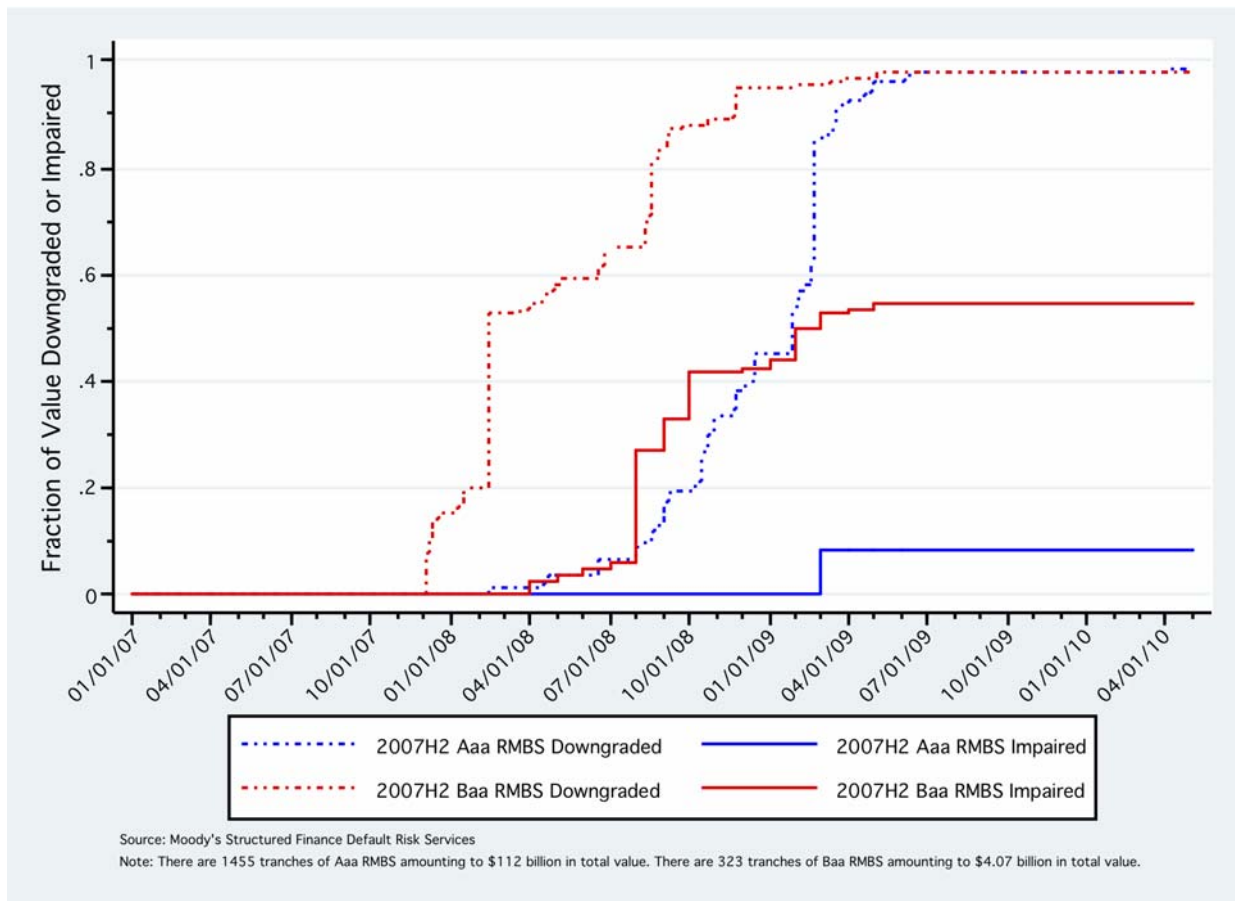
Figure 18: Moody's downgrades and impairments of 2007H2 vintage cash flow and hybrid ABS CDOs
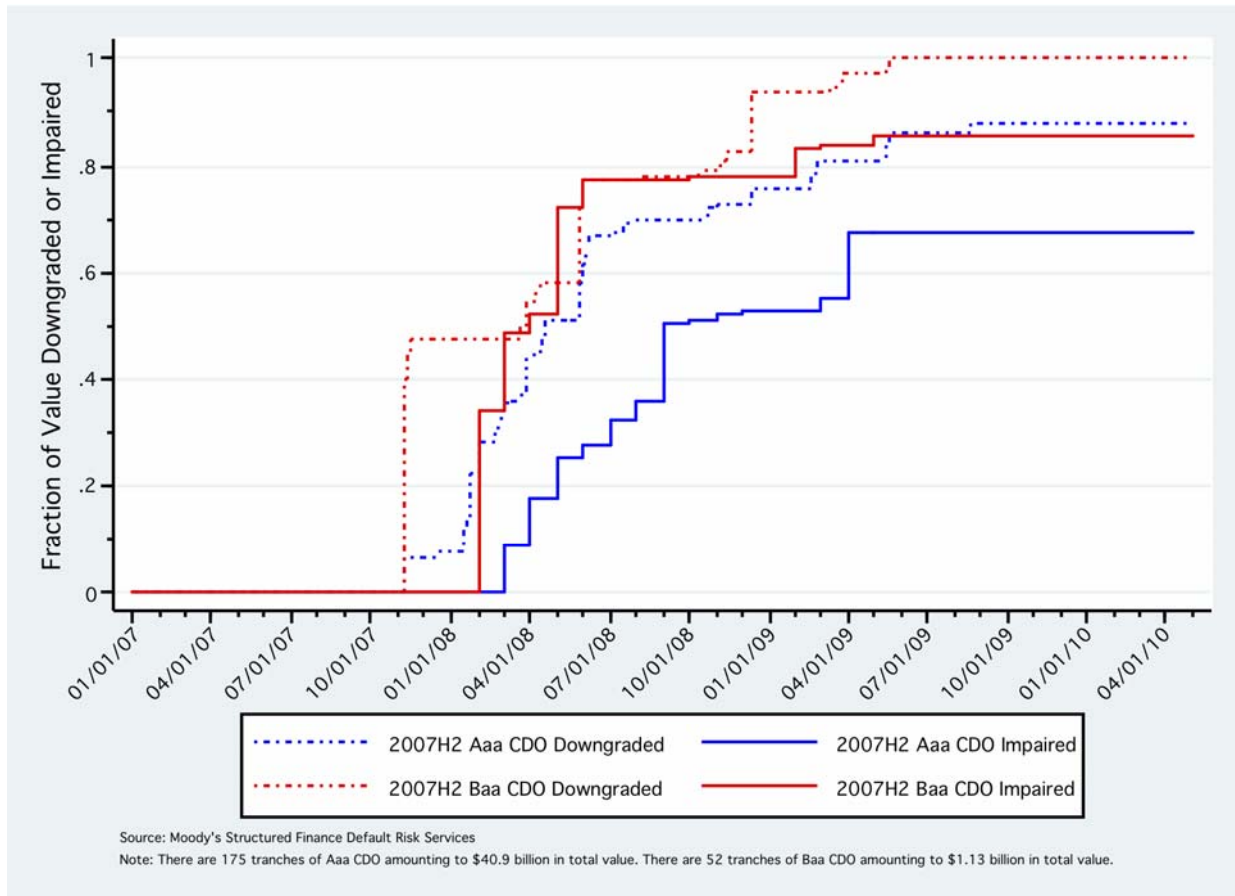
C.   Downgrades of Other Financial Institutions

In addition to rating RMBS and CDOs, the credit rating agencies rated the debt of many financial institutions that played key roles in the financial crisis. In some cases the ratings of those institutions lagged market events. In spite of the warnings of October 2006 and their own downgrades of RMBS in July 2007, the NRSROs did not reevaluate the companies that held or insured those securities until November 2007 at the earliest, the lone exception being Lehman Brothers, which two of the agencies had downgraded in June. In the case of Bear Stearns, the firm enjoyed investment-grade ratings days before JPMorgan Chase acquired it with the help of the U.S. Treasury. Similarly, the credit rating agencies gave Lehman Brothers ratings in the upper-medium range of investment grade the week before it filed for bankruptcy. Both firms' credit default swaps had been trading at spreads

consistent with junk bonds (Ba1) since July 2007. Up to days before its bailout, AIG received upper-medium investment grade ratings by all three major credit rating agencies; Moody's, S&P, and Fitch rated the firm A2, A-, and A respectively.[34] Nevertheless, it warrants attention that apart from Lehman Brothers none of these firms ever defaulted upon its debts. Therefore, to the extent that the agencies were presuming that these institutions were too big to fail, their ratings may have been accurate. Table 3 summarizes the credit ratings of several major financial institutions the day before major events occurred.

Ambac and MBIA were also downgraded well after the financial crisis had begun. Each of these bond insurers had disclosed in public filings that it had insured billions of dollars in subprime RMBS, diversified CDOs, and CDO-squareds. Nevertheless, in December 2007 S&P affirmed its Aaa ratings of the two companies, although it assigned them a negative outlook. In making this determination, S&P cited the quality of the firms' CDO underwriting, the "back-ended timing" of their potential liabilities, and their access to opportunities to raise capital. The agency in turn based its evaluation of the firms' underwriting upon the AAA and "super AAA" ratings of their insured CDOs.[35] The agencies did not take definitive action to revise their ratings of these firms until January of the following year, when S&P and Fitch downgraded Ambac and MBIA, and Moody's placed them on credit watch.

Table 3: Credit ratings of major firms at time of bankruptcy, acquisition or bailout.

Firm	Date	Event	Moody's	S&P	Fitch
Lehman Bros.	9/15/08	Filed for bankruptcy.	A2	A	A+
AIG	9/16/08	Received an $85 billion loan from the Federal Reserve in exchange for a 79.9 percent equity stake.	A2	A-	A
Citigroup	11/23/08	Received $20 billion in equity and guarantees on $300 billion of its assets from the US Treasury.	Aa3	AA-	AA-
Merrill Lynch	9/14/08	Struck deal to be acquired by Bank of America.	A2	A	A+

[34] David Evans and Caroline Salas, "Flawed Credit Ratings Reap Profits as Regulators Fail," Bloomberg (Apr. 29, 2009).

[35] See Dick P. Smith, David Veno, and Robert E. Green, "Detailed Results of Subprime Stress Test of Financial Guarantors," Standard & Poor's Commentary Report (Dec. 19, 2007), 1-4.

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Wachovia	9/29/08	Announced a government-forced sale to Citigroup (later Wells Fargo).	A1	A+	A+
Bear Stearns	3/14/08	Offered a $25 billion loan for 28 days by the Federal Reserve.	A2	A	A+
	3/16/08	Purchased by JPMorgan Chase with the help of a government guarantee on the firm's most toxic securities.	Baa1	BBB	BBB

Source: Bloomberg

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Appendix 1: Moody's Ratings' Idealized Expected Loss Rates

Rating	5-year Idealized Expected Loss Rate
Aaa	0.0016%
Aa1	0.0171%
Aa2	0.0374%
Aa3	0.0781%
A1	0.1436%
A2	0.2569%
A3	0.4015%
Baa1	0.6050%
Baa2	0.8690%
Baa3	1.6775%
Ba1	2.9040%
Ba2	4.6255%
Ba3	6.5230%
B1	8.8660%
B2	11.3905%
B3	14.8775%
Caa1	19.9726%
Caa2	26.8125%
Caa3	38.4017%
Ca	55.0000%
C	100.0000%
Source: Moody's (2009).	

Appendix 2: Sensitivity of Moody's RMBS Model to Pool Characteristics

Appendix
Sensitivity Results

Loan and pool characteristics vary widely in their impact on our estimate of a pool's lifetime loss. For two representative pools, we show how the expected pool loss can change as we change each characteristic.

Case	Pool A* Mean Pool Loss (%)	% Change	Pool B** Mean Pool Loss (%)	% Change
Baseline	0.82	–	2.96	–
LTV +10 Points	1.39	+70%	4.76	+61%
LTV -10 Points	0.52	-37%	1.95	-34%
Coupon + 2 Points	0.96	+17%	3.3	+11%
Coupon - 2 Points	0.68	-17%	2.62	-11%
Oterm & Rterm - 120 Months	0.62	-24%	2.25	-24%
All Second Mortgages (w/junior LTV=10)	3.41	+316%	9.22	+211%
All Single Family Homes	0.81	-1%	2.92	-1%
All Condos	1.05	+28%	3.36	+14%
All Owner Occupied	0.81	-1%	2.92	-1%
All Rental Properties	1.21	+48%	4.37	+48%
All Purchase Money Loans	0.81	-1%	2.52	-15%
All Cash-Out Refi Loans	1.21	+48%	3.35	+13%
All Fixed Rate Loans	NA	–	2.56	-14%
All ARMs (LIBOR)	0.94	+15%	NA	–
5-Yrs Seasoning	0.56	-32%	2.03	-31%
DTI = 25	0.58	-29%	1.66	-44%
DTI = 50	1.31	+60%	3.73	+26%
All "A" Quality Borrowers	NA	–	1.44	-51%
All "B" Quality Borrowers	1.08	+32%	3.5	+18%
All "C" Quality Borrowers	1.63	+99%	4.39	+48%

*   Pool A consists of approximately 1100 fixed-rate first mortgage loans to "A" borrowers as classified by a medium quality originator. The average debt-to-income ratio came in at 37%. The average combined LTV is 81%, average original term is 359 months, average seasoning of 3 months.

** Pool B consists of approximately 850 fixed-rate and adjustable loans of various quality grades as classified by a weak originator. The average debt-to-income ratio came in at 40%. The average combined LTV is 72%, average original term is 346 months with no seasoning.

Source: Moody's (1996).

Appendix 3: Moody's Model for Rating ABS CDOs

We focus here on Moody's approach to rating cash flow CDOs. It begins with a *quantitative* analysis of the performance of each of the tranches of securities issued by the CDO.[36] The goal of the quantitative analysis is to estimate the *expected loss* of each of the tranches. This is done by specifying a set of scenarios for losses experienced by the collateral assets and then to:

1. Specify the probability of each loss scenario.

2. For each scenario, calculate the loss to each tranche of the CDO.

3. Calculate the expected loss to each tranche of the CDO by averaging the product of (a) the probability of each loss scenario and (b) the loss to the tranche under that loss scenario.

To estimate the loss distribution of the collateral asset pool in step 1, for static transactions Moody's relies on a Gaussian copula-based Monte Carlo simulation of the performance of the collateral pool, which is a statistical technique for modeling default correlation. Each RMBS in the pool is assigned a default probability and recovery rate (i.e., the expected amount of the asset's value that is retained in the event the asset defaults). Moody's assumptions about the recovery rate of each collateral bond are a function of the sector type (e.g., RMBS, ABS, etc.), the thickness (i.e., amount of principal contained in) of the bond's tranche (thicker tranches have greater recovery rates), and the bond's rating (higher-rated bonds are assumed to have higher recovery rates). The default probability assumed for an asset is based on its Moody's rating (which represents expected loss) and the asset's assumed recovery rate.

For managed transactions or for static transactions that have not yet been fully ramped up (i.e., for which not all of its collateral has been acquired), Moody's models the collateral asset portfolio as a set of identical correlated bonds, to specify the collateral loss distribution. For these types of CDOs, the collateral manager is bound by covenants that specify bounds on the ultimate weighted average characteristics of the collateral pool, including its average rating, recovery rate, and life. These covenanted average characteristics are used to specify the parameters of the model. The four parameters of that distribution are the (1) common default probability; (2) number of representative assets; (3) common recovery rate; and (4) a correlation assumption. When the collateral

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[36] Moody's (2005) describes Moody's quantitative analysis of cash flow CDOs.

is acquired, the collateral manager has to check the collateral pool's correlation assumption by running Moody's model inputting the CDO's actual collateral.

Once the collateral loss distribution is specified, each is run through a cash flow model that incorporates the CDO's subordination structure to calculate an expected loss to each of the CDO's tranches.

Appendix 4: Downgrades and Impairments of ABS CDOs

Source: Moody's Structured Finance Default Risk Services

Note: There are 187 tranches of Aaa High Grade CDO amounting to $83.1 billion in total value. There are 296 tranches of Aaa Mezzanine CDO amounting to $68.9 billion in total value. There are 61 tranches of Baa High Grade CDO amounting to $810 million in total value. There are 158 tranches of Baa Mezzanine CDO amounting to $4.06 billion in total value.

Source: Moody's Structured Finance Default Risk Services

Note: There are 484 tranches of Aaa Cash/Hybrid CDO amounting to $152 billion in total value. There are 81 tranches of Aaa Synthetic CDO amounting to $9.84 billion in total value. There are 219 tranches of Baa Cash/Hybrid CDO amounting to $4.88 billion in total value. There are 79 tranches of Baa Synthetic CDO amounting to $820 million in total value.