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The Credit Rating Crisis

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I. Introduction

By December 2008, structured finance securities accounted for over $11 trillion worth of outstanding U.S. bond market debt (35%).[1] The lion's share of these securities was highly rated by rating agencies. More than half of the structured finance securities rated by Moody's carried a AAA rating—the highest possible credit rating. In 2007 and 2008, the creditworthiness of structured finance securities deteriorated dramatically; 36,346 tranches rated by Moody's were downgraded. Nearly one-third of downgraded tranches bore the AAA rating.

Both academics and practitioners have blamed structured finance for being, in part, responsible for the current credit crisis. In September 2007, Princeton economist Alan Blinder wrote, "Part of the answer is that the securities, especially the now-notorious C.D.O.s, for collateralized debt obligations, were probably too complex for anyone's good. Investors placed too much faith in the rating agencies which, to put it mildly, failed to get it right. It is tempting to take the rating agencies out for a public whipping. But it is more constructive to ask how the rating system might be improved" (Blinder 2007). The goal of our paper is to inform economists about the credit rating crisis of 2007–8. We begin by describing what happened to structured finance credit rating during the crisis. We then try to explain why the ratings collapsed. Using detailed information on rating decisions made by Moody's for every structured finance tranche, we document the ratings performance of structured finance products since 1983. We augment the evidence on structured finance ratings performance with data on rating transitions of all corporate bonds rated by Moody's over the same period. The data on corporate bonds are used as a benchmark for the true distribution of credit ratings that are based on economic fundamentals. The comparison

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is important since many of the new exotic structured finance products were engineered to obtain high ratings, but the credit ratings were determined through cash flow simulations that are prone to model errors.

Decomposing structured finance downgrades by collateral type, we find that 64% of all downgrades in 2007 and 2008 were tied to securities that had home equity loans (HELs) or first mortgages as collateral. Collateralized debt obligations (CDOs) backed by asset-backed securities (ABS) accounted for a large share of the downgrades and some of the most severe downgrades.[2] ABS CDOs accounted for 42% of the total write-downs of financial institutions around the world. As of October 2008, Citigroup, AIG, and Merrill Lynch took write-downs totaling $34.1 billion, $33.2 billion, and $26.1 billion, respectively, because of ABS CDO exposure (see table 1).

Using microlevel data on their collateral composition, we document three features of ABS CDOs: (i) high concentration in residential housing (on average, 70% of the underlying securities were residential mortgage-backed securities [RMBS] or home equity loan securities, and 19% were CDO tranches backed by housing assets), (ii) high exposure to the most risky segment of residential housing (54.7% of the assets of ABS CDOs were invested in home equity securities), and (iii) low intervintage diversification (about 75% of ABS CDOs were composed of mortgages that originated in 2005 and 2006). We discuss possible explanations for the collapse of ABS CDOs' ratings. Our regression analysis shows that tranches with one rater only were more likely to be downgraded—a finding consistent with issuers shopping for the highest ratings available from the rating agencies. Consistent with claims made in the news media, we find evidence that Standard & Poor's (S&P's) ratings were somewhat inflated. Our regressions show that tranches rated by S&P only were more likely than tranches rated by either Moody's or Fitch to be downgraded subsequently. While some "rating shopping" probably took place, more than 80% of all tranches were rated by either two or three agencies and were less prone to rating shopping. We also provide anecdotal evidence that one of the main causes of the credit rating disaster was overreliance on statistical models that failed to account for default correlation at a macroeconomic level. Given the uniformity of CDO structures and their highly leveraged nature (Benmelech and Dlugosz 2009), any mistakes embedded in the credit rating model have been compounded over the many CDOs structured by issuers using these models.

The rest of our paper is organized as follows. In Section II we explain the economics of structured finance. Section III provides background on

Table 1
ABS CDOs and Crisis-Related Write-Downs ($ Millions)

Write-Downs	Latest Announcement	ABS CDOs	Corporate Credit	RMBS	Other	Total
Select financial institutions:						
Insurers/Asset managers:						
ACA Capital	11/8/2007	1,700	…	…	…	1,700
AIG	11/10/2008	33,190	…	…	33,753	66,943
Ambac	11/5/2008	11,136	360	1,046	219	12,761
MBIA	5/12/2008	3,500	1,600		1,800	6,900
Prudential	7/30/2008	…	…	3,410	…	3,410
North American banks:						
Bank of America	1/16/2009	9,089	932	…	2,834	12,855
Bear Stearns	1/29/2008	2,300	…	…	…	2,300
Citigroup	10/16/2008	34,106	4,053	1,319	15,904	55,382
Goldman Sachs	9/16/2008	…	4,100	1,700	1,400	7,200
JP Morgan Chase	1/15/2009	1,300	5,467	5,305	…	12,072
Lehman Brothers	6/16/2008	200	1,300	4,100	3,400	9,000
Merrill Lynch	10/16/2008	26,100	2,845	12,998	13,125	55,068
Morgan Stanley	12/17/2008	7,800	3,810	3,781	1,992	17,383
European banks:						
Credit Suisse	10/23/2008	3,427	3,057	530	2,523	9,537
Deutsche Bank	10/30/2008	2,092	5,820	3,386	3,677	14,975
Fortis Bank	8/4/2008	4,359	3,660	144	…	8,163
ING	11/12/2008	565	…	8,028	25	8,618
Royal Bank of Scotland	11/4/2008	3,609	1,849	2,566	4,122	12,146
UBS	8/12/2008	21,870	348	1,716	13,871	37,805
Asian and emerging market banks:						
Aozora Bank	5/15/2008	510.0	…	…	…	510.0
Mitsubishi UFJ	8/13/2008	359.5	2,348	921	11	3,640
Mizuho	11/13/2008	3,898	629	2,539	584	7,650
National Australia Bank	10/21/2008	669.5	…	…	…	669.5
Sumitomo Mitsui	11/19/2007	561.7	…	…	…	561.7
Aggregate:						
Insurers/asset managers		61,074	6,320	10,386	38,347	116,127
North American banks		84,319	23,702	42,272	59,011	209,304
European banks		63,464	18,579	26,423	62,634	171,100
Asian and emerging market banks		9,358	4,724	5,728	3,743	23,553
Total		218,215	53,325	84,809	163,735	520,084

Note: ABS = asset-backed securities; CDO = collateralized debt obligation; RMBS = residential mortgage-backed securities.

structured finance products. Section IV describes our data sources and provides summary statistics on the evolution of the structured finance market. Section V compares credit rating transitions of structured finance products to corporate and sovereign bonds. Section VI documents the collapse of ABS CDOs' credit ratings. In Section VII we

study potential reasons for the ratings' collapse. Section VIII explores the future of structured finance, and Section IX concludes.

II. Securitization and AAA Rating

"Securitization" is a broad term that encompasses several kinds of structures in which loans, mortgages, or other debt instruments are packaged into securities. There are two basic types of securitization: pass-through securitizations and tranched securitizations. Ginnie Mae and Freddie Mac have been structuring pass-through mortgage securities since the 1970s. In a pass-through securitization, the issuer pools a set of assets and issues securities to investors backed by the cash flows. A single type of security is issued so that each investor holds a proportional claim on the underlying assets. Tranched securitizations are more complex. After pooling a set of assets, the issuer creates several different classes of securities, or tranches, with prioritized claims on the collateral. In a tranched deal, like a CDO, some investors hold claims more senior to others' claims. In the event of default, the losses are absorbed by the lowest-priority class of investors before higher-priority investors are affected. Naturally, the process of pooling and tranching creates some securities that are riskier than the average asset in the collateral pool and some that are safer.

While the benefits from diversification generated by the pooling of assets seem to be well understood, the economic role of tranching is less clear. According to DeMarzo and Duffie (1999) and DeMarzo (2005), asymmetric information plays a key role in explaining the existence of tranched securities. DeMarzo (2005) presents a model of a financial intermediary who would like to sell assets about which he has superior information. When the number of assets is large and their returns are imperfectly correlated, the intermediary maximizes his revenue from the sale by pooling and tranching, as opposed to simply pooling or selling the assets individually. As Myers and Majluf (1984) and Gorton and Pennacchi (1990) intuit, pooling and tranching allow the intermediary to concentrate the default risk in one part of the capital structure, resulting in a large share of the liabilities being almost riskless, which in turn reduces the overall lemons discount that buyers demand.

Financial regulation provides additional motivation for pooling and tranching in the real world. The extensive use of credit ratings in the regulation of financial institutions created a natural clientele for CDO securities. Minimum capital requirements at banks, insurance companies, and broker-dealers depend on the credit ratings of the assets on their balance sheets. Pension funds also face ratings-based investment restrictions.

CDO securitizations allow these investors to participate in asset classes from which they would normally be prohibited. For example, an investor required to hold investment grade securities could not invest in B-rated corporate loans directly, but he could invest in a AAA-rated collateralized loan obligation (CLO) security backed by a pool of B-rated corporate loans. CDO securities yield a higher interest rate than similarly rated corporate bonds, making them an attractive investment for ratings-constrained investors.

Asymmetric information and financial regulation only partially explain the deal structures we observe. A common feature of all structured finance deals, regardless of the type of underlying collateral, is that a large share of the securities issued (typically 70%–85%) are carved out as AAA. While asymmetric information and financial regulation can explain the motivation for creating highly rated securities, they do not explain the preponderance of AAA ratings. Models of adverse selection imply that the highest-rated tranches should be structured to bear no risk; however, there is a negligible difference among the conditional default probabilities of AAA-, AA+-, and AA-rated bonds. Investors should perceive AAA, AA+, and AA as similarly low risk, on the basis of this data, yet AA+ and AA tranches are in short supply relative to AAA tranches. Similarly, financial regulation can explain the demand for highly rated securities but not AAA in particular. For example, the Investment Company Act of 1940 requires money market funds to hold highly rated securities, but they are not required to be AAA rated. It requires that "the security has received a long-term rating from the Requisite NRSROs in one of the three highest rating categories," which implies that AAA, AA+, and AA are all eligible assets for money market funds.[3]

The adoption of Basel II, which ties bank capital requirements to credit ratings, provides additional demand for highly rated securities. However, the role of Basel II in fueling the securitization boom may be overstated since, by mid-2008, U.S. banks were still not required to implement the proposed rules.

Behavioral economics provides an additional insight as to why investors may demand AAA securities, even in the absence of ratings-based regulation. If investors use heuristics to classify assets, as in Barberis and Shleifer (2003), and only AAA-rated securities are perceived to be riskless, then issuers would cater to investor demand by carving out large portions of their deals as AAA. Benmelech and Dlugosz (2009) argue that the uniformity of CDO structures suggests that investor demand in general is an important determinant of deal structures.

III. Structured Finance Background

The market for structured finance has experienced remarkable growth since the inaugural issue of mortgage-backed securities (MBS) by Bank of America in 1977. Ranieri (1996) attributes the creation of structured finance products to concerns about the ability of thrifts—the major providers of mortgages in the 1980s—to fund the growing demand for housing in the late 1970s and 1980s. Wall Street attempted to address the impending demand by creating alternative, more efficient, and less expensive sources of funds. According to John Reed, a former chairman of Citicorp, "Securitization is the substitution of more efficient public capital markets for less efficient, higher cost, financial intermediaries in the funding of debt instruments" (quoted in Kendall 1996, 2). As of January 2008, there were 111,988 individual rated tranches outstanding worldwide, with structured finance becoming the largest financial market in the world.

While there are many different types of structured finance products, we provide a brief description of the main types of structured finance instruments that appear in our data.

Asset-backed securities (ABS). The general term for bonds or notes backed by pools of assets rather than a single corporation or government. Common types of collateral for ABS are auto loan receivables, student loan receivables, and so on. ABS appear in our sample because they are sometimes used as collateral for CDOs.

Mortgage-backed securities (MBS). ABS whose cash flows are backed by the principal and interest payments of a set of mortgage loans. MBS can be divided into RMBS and commercial-mortgage-backed securities (CMBS), depending on the type of property underlying the mortgages.

Home equity loan securities (HELS). RMBS whose cash flows are backed by a pool of HELs.

Collateralized debt obligations (CDOs). Structured finance securities that are pooled and tranched. CDOs are backed by a pool of assets, like other structured finance securities, but they issue classes of securities with some investors having priority over others.

Collateralized bond obligations (CBOs). CDOs backed primarily by high-yield corporate bonds.

Collateralized loan obligations (CLOs). CDOs backed primarily by leveraged high-yield bank loans.

Collateralized mortgage obligations. CDOs backed by mortgage collateral (often RMBS or CMBS rather than individual mortgages).

IV. Data and Summary Statistics

A. Sample Construction

Our analysis uses three main data sets: (i) Moody's Structured Finance Default Risk Services database, (ii) Moody's Corporate Default Risk Services database, and (iii) Pershing Square's Open Source Research data. The primary data source for this study is Moody's Structured Finance Default Risk Services, which covers all structured finance products issued since 1982. The Moody's data include a short description of the tranche; its Committee on Uniform Security Identification Procedures (CUSIP) number; the amount issued; the seniority, final maturity, and currency in which it was issued; and the initial credit rating, for every structured finance security rated by them. The data track rating changes through September 2008. Finally, the Moody's Structured Finance Default Risk Services database also reports the date and amount of defaults for impaired tranches. As of September 2008, there are ratings' data covering 179,760 tranches and 33,978 deals. Structured finance products are classified into seven broad deal types: ABS, CDOs, CMBS, MBS, public finance (PF), RMBS, and other.

We augment the data with detailed information on 30,499 structured finance tranches from the Open Source Research data set assembled by Pershing Square Capital Management. These data have been collected by Pershing in an attempt to improve the level of disclosure in the marketplace on potential losses in the bond insurance industry. The data include information on all CDOs of ABS that were insured by MBIA or Ambac—a total of 534 CDOs—issued during 2005–7. For each CDO in the data, all of the underlying collateral assets are identified by CUSIP, along with a description of the collateral type, amount outstanding, and initial and current (as of January 2008) rating by Fitch, Moody's, and S&P, when available. The data distinguish among subprime, midprime, Alt-A, and prime RMBS collateral within the CDOs. Using detailed information on the underlying collateral of the CDOs, which are structured finance products themselves, we obtain detailed information on the collateral profile and liability structure for 30,499 individual structured finance tranches.

The third data set that we use is Moody's Corporate Default Risk Services database, which contains data for over 11,000 corporate entities, including more than 380,000 debts. The data span from 1970 to September 2008 and include information on default, recovery, and rating's history and outlook, as well as a description of each security and information on the issuer.

B. *The Evolution of the Structured Finance Market*

Table 2 displays the evolution of the structured finance market across deal types from 1983 to 2008. The total number of structured finance tranches issued every year increased from 29 in 1983 to 1,581 in 1990, 9,353 in 2000, and 47,055 in 2006. While 2007 was on the track to surpass the record numbers of 2006, the credit crisis that began in summer 2007 brought the market for structured finance to a halt. The largest category of structured finance by number of tranches issued is RMBS (89,573), followed by ABS (76,288), PF (32,351), and CDO (36,160). New issues of RMBS and ABS reached record levels in 2006, with 15,895 and 12,629 new tranches, respectively, while PF reached its

Table 2
Structured Finance Tranche Issuance by Year and Type (%)

Year	ABS	CDO	CMBS	MBS	PF	RMBS	Other	No. Deals
1983	.0	.0	.0	100.0	.0	.0	.0	1
1984	16.7	.0	.0	16.7	.0	66.7	.0	6
1985	3.6	.0	.0	.0	.0	96.4	.0	28
1986	9.1	.0	.0	.0	.0	90.9	.0	77
1987	11.3	.0	.0	.0	.0	88.7	.0	142
1988	11.3	.0	.3	.0	.0	88.3	.0	300
1989	10.6	.1	.9	.1	.1	87.8	.3	705
1990	13.4	.7	1.0	.1	.2	83.8	.9	1,010
1991	18.5	1.1	1.0	.3	.2	77.9	1.2	1,333
1992	22.6	1.0	1.2	.3	.2	73.2	1.5	1,704
1993	25.3	.8	1.9	.2	.3	69.5	2.0	2,105
1994	26.4	1.9	2.3	.2	.5	66.6	2.2	2,571
1995	29.8	1.8	2.6	.2	.8	62.1	2.7	2,988
1996	32.7	1.7	2.6	.2	1.6	56.3	4.9	3,567
1997	37.0	2.1	2.7	.2	4.1	49.4	4.5	4,088
1998	37.7	3.3	3.0	.1	8.1	40.9	6.9	5,050
1999	38.2	4.5	3.5	.1	13.0	33.6	7.2	6,010
2000	39.0	6.1	4.0	.1	14.7	28.2	7.8	6,856
2001	39.0	7.4	4.5	.1	15.1	25.3	8.5	7,667
2002	37.9	8.9	5.1	.1	14.9	23.6	9.5	8,704
2003	36.8	10.8	5.4	.1	14.7	22.1	10.2	9,893
2004	35.6	13.5	5.6	.1	14.6	19.8	10.8	10,964
2005	34.1	15.5	5.8	.1	15.0	18.8	10.8	12,208
2006	31.6	16.6	5.8	.0	16.5	20.2	9.3	14,371
2007	29.4	18.9	5.8	.0	16.5	21.0	8.3	16,890
2008[a]	26.3	20.4	5.5	.0	20.0	20.8	7.1	19,715

Note: Percent of total issuance by number for main deal types as well as total issuance by number are shown. ABS = asset-backed securities; CDO = collateralized debt obligation; CMBS = commercial mortgage-backed securities; MBS = mortgage-backed securities; PF = public finance; RMBS = residential mortgage-backed securities.
[a]Rating actions as of 9/22/2008.

highest level of 5,303 new tranches in 2007. As table 2 demonstrates, CDO was the fastest-growing sector of the structured finance market between 2003 and 2006; the number of CDO tranches issued in 2006 (9,278) was almost twice the number of tranches issued in 2005 (4,706). Figure 1 illustrates the dramatic growth in the dollar value of global CDOs issued compared to all mortgage-related securities. Global CDO issuance went up from $157.4 billion in 2004 to $551.7 billion in 2006. While it was expected that CDO issuance in 2007 would top the 2006 record, total issuance declined to $502.9 billion as a result of the financial turbulence that began in July 2007. As investors lost confidence in credit ratings, the market for structured finance products' issuance dried up. CDO issuance fell to its lowest level since the mid-1990s, with a total of $53.1 billion. Likewise, the number of all new structured finance tranches issued between January and September 2008 fell to 6,644 from a peak of 47,055 tranches in 2006.

V. Credit Rating: Structured Finance versus Corporate Bonds

A. Credit Rating Transitions of Structured Finance Products

Table 3 and figure 2 display the behavior of structured finance rating transitions over time. We form cohorts of all existing tranches that were

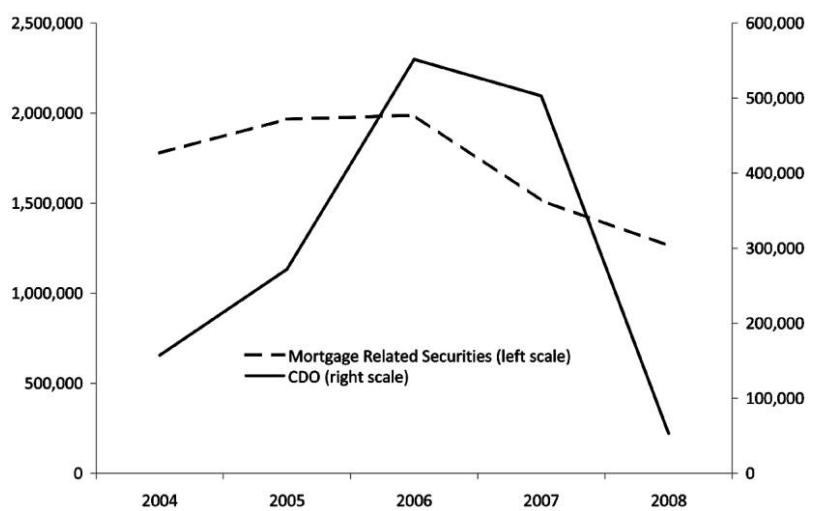

Fig. 1. Collateralized debt obligations and mortgage-related securities issuance, 2004–8 ($ millions).

Table 3
Structured Finance Upgrades and Downgrades

		A. Total Upgrades and Downgrades					
		Downgrade		Upgrade		Withdrawn Rating	
Cohort Formed	Rated Tranches	No.	Average Change[a]	No.	Average Change[a]	No.	%
1/1/1990	2,825	85	−1.2	…	.0	48	1.7
1/1/1991	3,993	155	−1.2	…	.0	124	3.1
1/1/1992	5,571	87	−1.8	122	2.1	828	14.9
1/1/1993	7,290	149	−1.5	131	1.5	1,336	18.3
1/1/1994	9,320	192	−2.8	237	1.9	1,038	11.1
1/1/1995	11,083	148	−2.0	352	1.7	637	5.7
1/1/1996	13,403	175	−2.7	272	1.9	1,065	7.9
1/1/1997	15,298	49	−1.5	439	1.5	1,100	7.2
1/1/1998	18,214	447	−2.4	366	2.0	1,924	10.6
1/1/1999	20,419	330	−3.6	380	2.2	2,169	10.6
1/1/2000	23,358	463	−1.5	642	2.3	2,235	9.6
1/1/2001	26,905	476	−2.5	557	1.7	3,084	11.5
1/1/2002	31,901	1,847	−2.9	720	1.8	4,598	14.4
1/1/2003	38,147	2,515	−3.1	699	2.5	7,920	20.8
1/1/2004	43,476	1,798	−3.6	1,216	2.4	6,953	16.0
1/1/2005	52,843	874	−2.5	2,202	2.2	6,878	13.0
1/1/2006	71,462	986	−2.5	2,748	2.3	7,085	9.9
1/1/2007	94,127	8,109	−4.7	2,990	1.9	6,692	7.1
1/1/2008[b]	442,908	36,880	−5.6	1,269	2.4	6,380	1.4

		B. Tranches Affected					
		Downgrade		Upgrade		Upgrade and Downgrade	
		No.	%	No.	%	No.	%
1/1/1990	2,825	80	2.8	…	.0	…	.0
1/1/1991	3,993	154	3.9	…	.0	…	.0
1/1/1992	5,571	84	1.5	121	2.2	…	.0
1/1/1993	7,290	145	2.0	131	1.8	18	.2
1/1/1994	9,320	181	1.9	236	2.5	1	.0
1/1/1995	11,083	134	1.2	350	3.2	…	.0
1/1/1996	13,403	144	1.1	269	2.0	…	.0
1/1/1997	15,298	46	.3	439	2.9	…	.0
1/1/1998	18,214	371	2.0	359	2.0	2	.0
1/1/1999	20,419	311	1.5	374	1.8	4	.0
1/1/2000	23,358	401	1.7	638	2.7	6	.0
1/1/2001	26,905	421	1.6	545	2.0	5	.0
1/1/2002	31,901	1,298	4.1	710	2.2	5	.0
1/1/2003	38,147	1,947	5.1	681	1.8	20	.1

(continued)

Table 3
Continued

		B. Tranches Affected					
		Downgrade		Upgrade		Upgrade and Downgrade	
		No.	%	No.	%	No.	%
1/1/2004	43,476	1,634	3.8	1,168	2.7	9	.0
1/1/2005	52,843	737	1.4	2,138	4.0	8	.0
1/1/2006	71,462	885	1.2	2,495	3.5	14	.0
1/1/2007	94,127	6,801	7.2	2,834	3.0	88	.1
1/1/2008[b]	442,908	29,545	6.7	1,254	.3	464	.1

Note: A single tranche downgraded k times in the year shows up k times. Tranches that are downgraded and withdrawn show up in both the downgrade column and the withdrawn-rating column. This is in contrast to Moody's method in which a tranche that is downgraded and then withdrawn in the same year shows up as withdrawn only.
[a]Average size of a single rating action on a tranche (not just the difference in rating between beginning and end of year).
[b]Rating actions as of 9/22/2008.

rated as of January 1 of each year from 1990 to 2008. Then, for each cohort, we calculate the number of downgrades, upgrades, and withdrawn ratings over the course of the year.[4] For example, the first row of table 3 tracks rating changes from 1/1/1990 until 12/31/1990 for the cohort of securities that were rated as of 1/1/1990. As table 3 shows, the total number of rated tranches as of 1/1/1990 was 2,825, out of which 85 tranches were downgraded, none of the tranches were

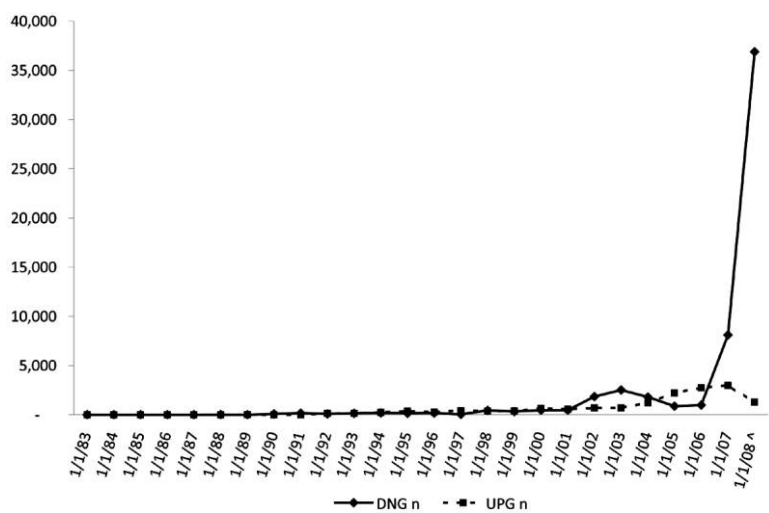

Fig. 2. Number of downgrades versus upgrades of structured finance products

upgraded, and ratings were withdrawn for 48 tranches by the end of 1990. It is important to note that table 3 provides information for all outstanding tranches at the time of the formation of the cohort, while table 2 displays information on new issues. Put differently, table 2 illustrates the evolution of the structured finance market using data on the flow of new securities, while table 3 presents rating transitions for the stock of structured finance tranches. As table 3 shows, the number of downgrades and the number of upgrades were roughly similar before 2002. Table 3 also reports the average magnitude of downgrades and upgrades, where a change of 1 notch (say from A2 to A3) is coded as −1.0. For example, a downgrade from Aa2 to A2 would be coded as −3.0 (moving from Aa2 to Aa3 to A1 and then to A2). In 2002 and 2003, the number of downgrades rose dramatically and exceeded the number of upgrades. Many CBOs were downgraded during this time as corporate credit quality deteriorated in the economic slowdown of 2001–2. Downgrades again fell below upgrades during the structured finance boom of 2005 and 2006.

Downgrades of structured finance products spiked in 2007. Whereas the total number of tranches outstanding increased from 71,462 to 94,127, or by 31.7%, the number of downgrades skyrocketed eightfold from 986 to 8,109. There were 36,880 downgrades of structured finance tranches in the first three quarters of 2008, overshadowing the cumulative total number of downgrades in 2005–7. Downgrades were not only more common but also more severe in 2007 and 2008. The average downgrade was −4.7 in 2007 and −5.6 in 2008, compared to −2.5 in both 2005 and 2006. Meanwhile, upgrades were less frequent and smaller in magnitude on average. There were 2,990 upgrades in 2007 and 1,269 in the first three quarters of 2008. The average upgrade in each year was 1.9 and 2.4 notches, respectively.

Panel A of table 3 and figure 2 present the total number of yearly upgrade and downgrade actions of structured finance tranches. Since the rating of a tranche can change more than once within each year, we also calculate the number of tranches affected by an upgrade or downgrade action within a year. The picture that emerges from table 3, panel B, is similar to the one portrayed by figure 2; the deterioration in the credit quality of structured finance securities is most pronounced in 2007–8. During this period, 6.9% of tranches were affected by downgrades, and only 1.6% of tranches were upgraded, on average. However, in relative terms, the percentage figures show that there was a deterioration in credit quality in 2002–3 that was only slightly less severe than the current crisis. The overall market was much smaller in 2002 than in 2008.

The number of rated tranches outstanding in 2002 was one-tenth of the number outstanding in 2008. In dollar terms, the structured finance market in 2002 was 54% of its size in 2008 (SIFMA Outstanding Bond Market Debt Statistics; http://www.sifma.org).

B. Credit Rating Transitions of Corporate Bonds

The previous subsection demonstrated that the magnitude of the credit rating crisis of 2007–8 was unprecedented. For comparison, we now analyze transitions in the credit ratings of "single-name" corporate bonds. We use corporate bond rating transitions as a barometer to assess what "normal" rating transition should look like on the basis of the fundamentals of the macroeconomic environment.

Similar to the results displayed in table 3, we report the total number of upgrade and downgrade actions on corporate bonds in panel A of table 4 and the number of securities affected by ratings actions in panel B. As before, we form cohorts of all corporate bonds with available credit ratings as of January 1 of each year from 1990 to 2008 and calculate downgrades, upgrades, and withdrawn ratings until the end of the year. The number of rated bonds in the sample ranges from 3,016 as of 1/1/1990 to 13,523 in 2004. Taken together, tables 3 and 4 illustrate the impressive growth in the structured finance market compared to the bond market. The number of rated structured finance tranches grew by a factor of 40 from 2,825 to 442,908 in 2008, while in the bond market the number of rated bonds in 2008 was roughly four times higher than its level in 1990.

Downgrades and upgrades of bonds occurred with similar frequency and magnitude before 1998 (see fig. 3). After the East Asian crisis, the number of downgrades increased to 1,524 in 1998 and 2,137 in 1999, while the number of upgrades was no more than 800. It is also interesting to note that during this global financial crisis, there was no spike in structured finance downgrades (see table 3 and fig. 2 for comparison). Corporate bonds experienced a significant credit deterioration in 2001 and 2002, mainly because of the bankruptcy wave of 2001 and a slowing economy during that time. Nearly half of the downgrades in 2002 involved technology, telecommunications, and energy trading firms. As figure 2 demonstrates, downgrades of structured finance products increased during this period, when many CBOs, backed predominantly by high-yield corporate bonds, were downgraded. One important observation on corporate bonds' rating performance is that the average

Table 4
Corporate Bonds Upgrades and Downgrades

		A. Total Upgrades and Downgrades					
		Downgrade		Upgrade		Withdrawn Rating	
Cohort Formed	Rated Bonds	No.	Average Change[a]	No.	Average Change[a]	No.	%
1/1/1990	3,016	349	−1.5	287	1.3	321	10.6
1/1/1991	3,115	343	−1.4	231	1.4	326	10.5
1/1/1992	3,582	582	−1.4	141	1.4	621	17.3
1/1/1993	3,899	465	−1.3	142	1.6	772	19.8
1/1/1994	4,229	398	−1.3	264	1.4	435	10.3
1/1/1995	4,599	342	−1.3	426	1.3	445	9.7
1/1/1996	5,124	441	−1.3	457	1.3	520	10.1
1/1/1997	6,727	732	−1.2	522	1.3	754	11.2
1/1/1998	8,514	1,524	−1.6	577	1.3	985	11.6
1/1/1999	10,623	2,137	−1.5	800	1.5	1,117	10.5
1/1/2000	11,867	1,752	−1.6	898	1.6	1,398	11.8
1/1/2001	12,437	3,190	−1.7	807	1.5	1,989	16.0
1/1/2002	12,885	5,027	−1.8	431	1.5	2,068	16.0
1/1/2003	13,056	2,453	−1.6	611	1.4	2,579	19.8
1/1/2004	13,523	1,233	−1.3	1,540	1.5	2,425	17.9
1/1/2005	13,305	1,424	−1.5	1,626	1.4	2,425	18.2
1/1/2006	12,727	2,107	−1.3	1,687	1.2	2,082	16.4
1/1/2007	12,586	1,539	−1.4	1,869	1.2	1,851	14.7
1/1/2008[b]	12,753	1,482	−2.2	367	1.3	1,517	11.9

		B. Bonds Affected					
		Downgrade		Upgrade		Upgrade and Downgrade	
		No.	%	No.	%	No.	%
1/1/1990	3,016	326	10.8	285	9.4	3	.1
1/1/1991	3,115	319	10.2	209	6.7	7	.2
1/1/1992	3,582	537	15.0	138	3.9	6	.2
1/1/1993	3,899	420	10.8	130	3.3	2	.1
1/1/1994	4,229	361	8.5	251	5.9	12	.3
1/1/1995	4,599	310	6.7	420	9.1	3	.1
1/1/1996	5,124	410	8.0	443	8.6	4	.1
1/1/1997	6,727	550	8.2	516	7.7	7	.1
1/1/1998	8,514	1,271	14.9	555	6.5	11	.1
1/1/1999	10,623	1,865	17.6	771	7.3	36	.3
1/1/2000	11,867	1,429	12.0	870	7.3	37	.3
1/1/2001	12,437	2,241	18.0	778	6.3	43	.3
1/1/2002	12,885	3,885	30.2	416	3.2	23	.2
1/1/2003	13,056	2,211	16.9	591	4.5	22	.2

(continued)

Table 4
Continued

		B. Bonds Affected					
		Downgrade		Upgrade		Upgrade and Downgrade	
		No.	%	No.	%	No.	%
1/1/2004	13,523	1,069	7.9	1,459	10.8	34	.3
1/1/2005	13,305	1,149	8.6	1,520	11.4	23	.2
1/1/2006	12,727	1,767	13.9	1,555	12.2	162	1.3
1/1/2007	12,586	1,411	11.2	1,802	14.3	41	.3
1/1/2008[b]	12,753	1,332	10.4	367	2.9	5	.0

Note: A single bond downgraded *k* times in the year shows up *k* times. Bonds that are downgraded and withdrawn show up in both the downgrade column and the withdrawn-rating column. This is in contrast to Moody's method in which a bond that is downgraded and then withdrawn in the same year shows up as withdrawn only.
[a]Average size of a single rating action on a bond (not just the difference in rating between beginning and end of year).
[b]Rating actions as of 9/22/2008.

change in credit rating when there is an upgrade or downgrade is fairly stable and low (fig. 4). Even in the midst of the recession in 2000–2001 when more than 30% of the outstanding bonds were downgraded at least once, the average downgrade was only −1.8 notches. Taken together, these results suggest that corporate bond ratings were well calibrated to the underlying economic risk of the issuer. In contrast, the

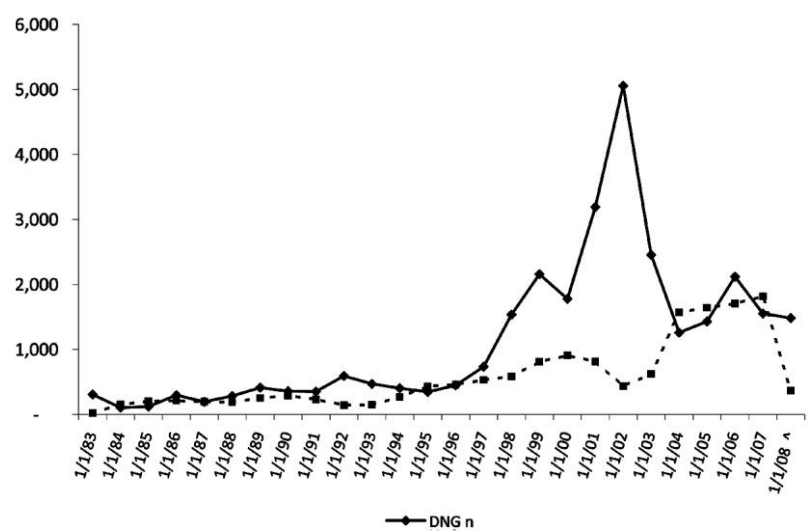

Fig. 3. Number of downgrades versus upgrades of corporate bonds

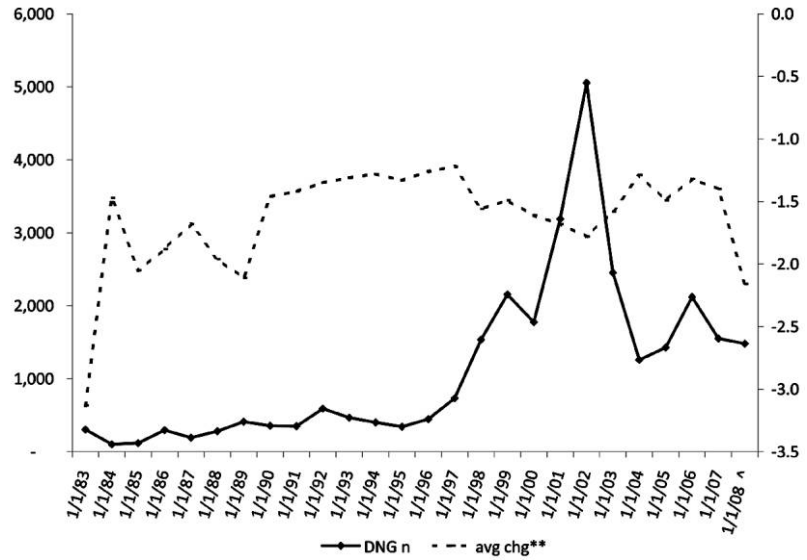

Fig. 4. Number of corporate bonds downgrades versus average downgrade level

average downgrades of structured finance products in 2007 and during the first 3 months of 2008 were −4.7 and −5.8 notches, respectively (fig. 5), suggesting that the initial distribution of structured finance credit ratings was inflated.

Fig. 5. Number of structured-finance downgrades versus average downgrade level

C. *The Structured Finance Credit Rating Crisis*

We dig in to the structured finance rating crisis by examining downgrades by deal type and identifying the asset classes that suffered the most severe downgrades. Table 5 presents information on downgrades across the four largest deal types: ABS, CDO, CMBS, and RMBS. While RMBS accounted for most of the downgrades during the early to mid-1990s, very few RMBS tranches were downgraded between 2000 and 2006. CMBS accounted for a significant share of downgrades between 1994–96 and 2004–6 but explain only 1% of the downgrades during the most recent crisis. In 2007–8, nearly 95% of all downgrades were tied to RMBS, ABS, or CDO securities.

Table 6 supplements the data in table 5 by refining the broad deal types with more detailed information on the underlying assets. We report the asset types that experienced the highest (left part of the table)

Table 5
Structured Finance Downgrades by Cohort and Deal Type

Cohort Formed	Rated Downgrades	ABS		CDO		CMBS		RMBS	
		No.	%	No.	%	No.	%	No.	%
1987	1	…	0	…	0	…	0	…	0
1988	15	8	53	…	0	…	0	2	13
1989	1	1	100	…	0	…	0	…	0
1990	85	10	12	…	0	2	2	72	85
1991	155	12	8	…	0	2	1	136	88
1992	87	31	36	2	2	11	13	41	47
1993	149	14	9	…	0	…	0	129	87
1994	192	12	6	…	0	26	14	150	78
1995	148	1	1	1	1	34	23	91	61
1996	175	55	31	…	0	42	24	76	43
1997	49	15	31	3	6	3	6	15	31
1998	447	239	53	43	10	3	1	35	8
1999	330	179	54	55	17	6	2	37	11
2000	463	169	37	53	11	20	4	10	2
2001	476	131	28	194	41	20	4	…	0
2002	1,847	544	29	893	48	174	9	5	0
2003	2,515	1,427	57	699	28	200	8	24	1
2004	1,798	1,126	63	316	18	229	13	21	1
2005	874	231	26	210	24	153	18	80	9
2006	986	423	43	277	28	119	12	44	4
2007	8,109	5,246	65	1,057	13	85	1	1,388	17
2008[a]	36,880	12,522	34	8,086	22	257	1	13,492	37

Note: ABS = asset-backed securities; CDO = collateralized debt obligation; CMBS = commercial mortgage-backed securities; RMBS = residential mortgage-backed securities.
[a]Rating actions as of 9/22/2008.

and second-highest (right part of the table) number of downgrades each year. For example, in 2001 there were 97 downgrades of high-yield CBOs (which is a subcategory of CDOs), which accounted for 20% of downgrades in that year, followed by balance sheet CDOs (which is also a subcategory of CDOs) with 57 downgrades. As table 6 shows, 54% of all downgrades in 2007—a total of 4,405—were downgrades of residential securities backed by HELs. The second-largest sector in terms of number of downgrades in 2007 was MBS collateralized by first mortgages (1,342 downgrades). Securities backed by first mortgages were the worst-performing assets in the first three quarters of 2008, followed by HELs with 9,459 downgrades (26% of the total downgrades).

Another unique aspect of the downgrade wave of structured finance products in 2007 and 2008 is its concentration among AAA-rated tranches. The large magnitudes of the downgrades in the structured finance market shown in figure 6 suggest that many of the tranches downgraded in 2007 and 2008 were highly rated; 11,327 (31%) of all

Table 6
Asset Types with Most Downgrades

	Total	Most Downgrades			Second-Most Downgrades		
Year	Downgrades	Asset Type	No.	%	Asset Type	No.	%
1990	85	MBS first mortgage	70	82	ABS	3	4
1991	155	MBS first mortgage	133	86	ABS	4	3
1992	87	MBS first mortgage	31	36	CMBS	11	13
1993	149	MBS first mortgage	130	87	ABS	3	2
1994	192	MBS first mortgage	143	74	CMBS	16	8
1995	148	MBS first mortgage	80	54	CMBS	23	16
1996	175	MBS first mortgage	70	40	HEL other	55	31
1997	49	MBS resecuritized	12	24	Other repackaged	9	18
1998	447	HEL other	98	22	ABS	80	18
1999	330	HEL other	94	28	ABS	50	15
2000	463	PF	130	28	ABS	100	22
2001	476	High-yield CBO	97	20	CDO balance sheet	57	12
2002	1,847	High-yield CBO	566	31	ABS	198	11
2003	2,515	ABS	677	27	ABS	327	13
2004	1,798	ABS	425	24	ABS	367	20
2005	874	Other structured	146	17	CMBS	126	14
2006	986	HEL	290	29	CDO synthetic	125	13
2007	8,109	HEL	4,405	54	MBS first mortgage	1,342	17
2008[a]	36,880	MBS first mortgage	13,015	35	HEL	9,459	26

Note: ABS = asset-backed securities; CBO = collateralized bond obligation; CDO = collateralized debt obligation; CMBS = commercial mortgage-backed securities; HEL = home equity loan; MBS = mortgage-backed securities; PF = public finance; RMBS = residential mortgage-backed securities.
[a]Rating actions as of 9/22/2008.

downgrade actions in the first three quarters of 2008 involved AAA-rated tranches. In contrast, figure 7 displays downgrades in the corporate bond market. With the exception of 1983, very few AAA-rated corporate bonds were downgraded between 1984 and 2008. The lack of downgrades of AAA securities in the bond market is particularly pronounced during the 2001–2 recession and is consistent with the fairly small magnitude of downgrades in this sector and the fact that only a small share of corporate bonds are rated AAA.

D. Fallen Angels

Next we examine structured finance securities that suffered the most severe downgrades. From 1983 to 2008, 11% of the tranches were eventually downgraded 8 or more notches (fallen angels). Table 7 decomposes these fallen angel tranches by their original credit rating. Tranches rated below Ba3 cannot fall more than 8 notches by definition (the lowest rating, C, is precisely 8 notches below Ba3). Surprisingly, we find that most fallen angels were originally rated AAA (19%). Tranches originally rated Baa2 or A2 make up the next largest portions of fallen angels at 12% and 10%, respectively. Clearly, some of this is supply

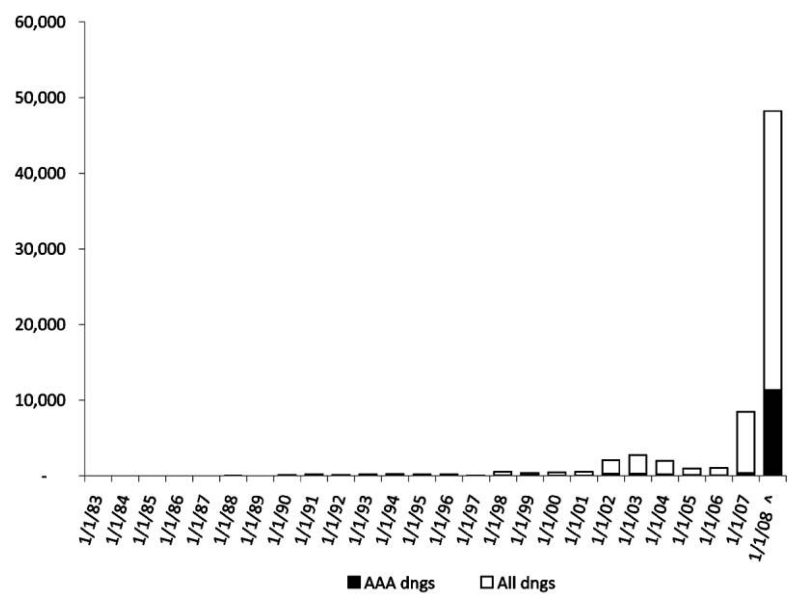

Fig. 6. Total number of downgrades and number of AAA structured finance securities downgrades.

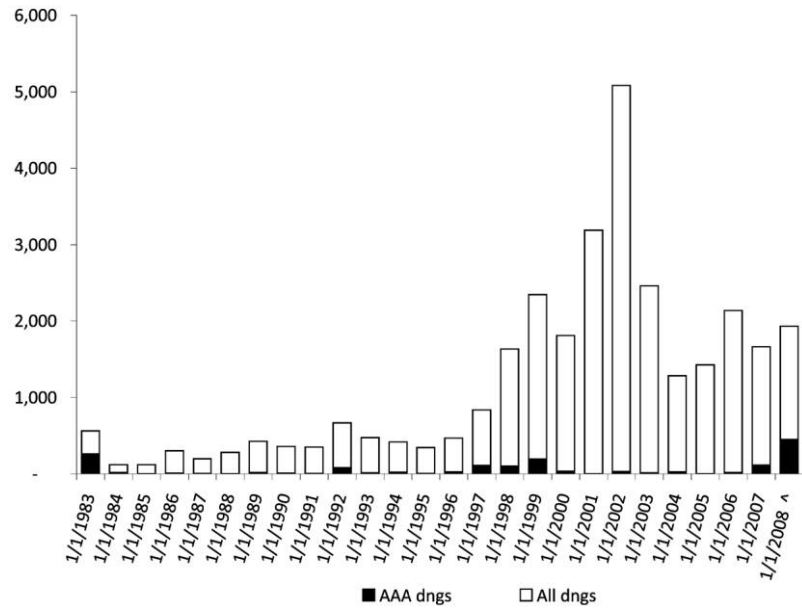

Fig. 7. Total number of downgrades and number of AAA corporate bonds downgrades

driven (every CDO has a AAA tranche, but not every CDO has a Aa1 tranche). Table 7 also shows that nearly all of the fallen angel tranches (86%) were issued between 2006 and 2008, underlining the poor quality of recent deals. In the previous section, we showed that ABS CDOs and deals backed by HELs or first mortgages account for a large fraction of total downgrades. Table 7 shows that these types of securities experienced the most severe downgrades as well: 69% of all tranches that were downgraded 8 notches or more belong to deals backed by HELs or first mortgages; 19% belong to ABS CDOs. Clearly, these are the segments in which the rating model failed most severely. We now analyze the failure of AAA-rated CDOs in 2008.

VI. The Collapse of ABS CDOs' Credit Ratings

Many of the downgrades in 2007–8 were tied to CDOs backed by assets that are themselves structured (ABS CDOs). This section conducts a systematic microlevel analysis of ABS CDOs in an attempt to explain the collapse of this segment of the structured finance market. Our data come from the Open Source Research data set that was assembled by Pershing Square Capital Management and include information on all CDOs of ABS insured by MBIA and Ambac and issued between 2005

Table 7
Fallen Angels, 1983–2008

	No.	%		No.	%
Initial credit rating:			Vintage:		
AAA	3,707	19	1983–96	171	1
Aa1	992	5	1997	58	0
Aa2	1,809	9	1998	113	1
Aa3	1,221	6	1999	153	1
A1	1,058	5	2000	140	1
A2	2,036	10	2001	170	1
A3	1,421	7	2002	318	2
Baa1	1,403	7	2003	304	2
Baa2	2,421	12	2004	405	2
Baa3	1,735	9	2005	842	4
Ba1	805	4	2006	3,127	16
Ba2	738	4	2007	5,404	28
Ba3	75	0	2008	8,216	42
Total	19,421	100	Total	19,421	100
Deal type:			Asset type:		
ABS	8,752	45	HEL closed-end not high LTV	6,662	34
RMBS	6,218	32	MBS first mortgage	6,037	31
CDO	4,111	21	ABS CDO cash flow	1,729	9
Other	249	1	ABS CDO synthetic	1,318	7
CMBS	49	0	HEL closed-end high LTV	813	4
PF	42	0	ABS CDO other	509	3
Total	19,421	100			
Total tranches	179,760		Fallen tranches	19,421	
Total deals	33,978		Fallen deals	3,879	

Note: ABS = asset-backed securities; CDO = collateralized debt obligation; CMBS = commercial mortgage-backed securities; HEL = home equity loan; LTV = loan to value; MBS = mortgage-backed securities; PF = public finance; RMBS = residential mortgage-backed securities.

and 2007 (534 CDOs in total). For each CDO, we observe the CUSIP of each asset in the collateral pool, along with a description of the collateral type, the par value of securities outstanding, and the initial and current (as of January 2008) ratings by Fitch, Moody's, and S&P, when available. The data enable us to identify the underlying collateral of the CDOs at the security level. There are 30,499 individual structured finance securities in the collateral pools of the 534 ABS CDOs in the sample.

A. What Are ABS CDOs?

ABS CDOs were first issued in 1999. Initially, ABS CDOs were diversified and collateralized by ABS from different sectors, such as aircraft, mutual

fund fees, and manufactured housing. However, since 2003 the primary asset classes backing ABS CDOs have been subprime and nonconforming RMBS and CDO tranches. ABS CDOs are broadly classified into two categories: (1) high-grade ABS CDOs that are backed by AA- and A-rated collateral and (2) mezzanine ABS CDOs that are backed by BBB collateral. Since AA- or A-rated collateral provides low credit spreads, the opportunities for ratings-based arbitrage are limited. As a result, high-grade ABS CDOs are highly leveraged and larger, typically between $1 billion and $3 billion. According to Lancaster, Schultz, and Fabozzi (2008), "Because … the commonly held belief was that the risk of default for high grade collateral was close to zero, the credit support for a triple-B note can be less than 1%. Such a highly leveraged structure, however, leaves little room for error, not only for the default risk, but also for the timing of the cash flows" (210). Mezzanine ABS CDOs are collateralized by mezzanine tranches of subprime RMBS and other structured products. Mezzanine ABS CDOs are typically smaller than high-grade ABS CDOs, with deal sizes ranging from $300 million to $1.5 billion.

B. The Collateral Structure of ABS CDOs

Table 8 provides a detailed analysis of the collateral structure of 533 ABS CDOs.[5] The table reports summary statistics on the 534 collateral pools, including the weighted-average rating (by the par value) of the underlying assets and a breakdown by asset type and vintage. Portfolio allocation percentages are based on the par value of the securities in each CDO's collateral pool and then averaged across all CDOs.

The total value of securities used as collateral for ABS CDOs is measured by the sum of the book values of each of the securities in the collateral pool. There are, on average, 149.7 (median: 137) individual securities in an ABS CDO, and the standard deviation is 73.1. The smallest number of securities is 26, and one ABS CDO has as many as 990 different tranches of ABS in its collateral pool. The average collateral amount is $1,006.7 million (median: $849.7 million), with values ranging from $100 million for the smallest CDO to $11,132 million for the largest. Table 8 displays summary statistics on the composition of the collateral pools by rating, asset type, and vintage. Since only a small fraction of the underlying collateral is rated by Fitch, we calculate the weighted-average rating of the securities in each collateral pool according to S&P and Moody's. Moody's and S&P's assessments of collateral quality are almost identical: the weighted-average rating on the pools according to Moody's ranges from Baa3 to Aaa, while the weighted-average

Table 8
ABS CDO Collateral Structure

Collateral	Mean	Twenty-fifth Percentile	Median	Seventy-fifth Percentile	SD	Min	Max
Amount ($ millions)	1,006.7	492.8	849.7	1,283.3	916.9	100.0	11,132.2
No. securities	149.7	103	137	182	73.1	26	990
Weighted-average credit rating:							
Standard & Poor's	A	BBB+	A–	AA	NA	BBB–	AAA
Moody's	A2	Baa2	A3	Aa2	NA	Baa3	Aaa
Share by asset type (%):							
CDO	18.8	3.2	9.3	22.6	25.9	.0	100.0
Home equity ABS	54.7	36.3	59.9	83.3	31.8	.0	100.0
RMBS	15.0	.0	9.0	21.5	19.8	.0	100.0
CMBS	4.6	.0	.0	3.8	13.1	.0	100.0
Share by mortgage type (%):							
Prime	8.2	.0	4.5	11.2	12.2	.0	91.8
Midprime	29.7	13.2	29.1	45.0	20.2	.0	77.5
Alt-A	5.2	.0	2.0	7.1	8.0	.0	72.6
Subprime	24.2	13.1	24.8	34.5	16.3	.0	100.0
Vintage (%):							
2005H1	15.3	2.4	8.5	22.4	17.9	.0	96.1
2005H2	21.0	4.9	16.9	31.8	18.4	.0	96.7
2006H1	23.4	4.8	21.8	37.3	19.7	.0	100.0
2006H2	15.9	1.3	8.4	26.4	18.0	.0	90.5
2007H1	7.3	.0	2.4	7.9	12.4	.0	93.4
2007H2	.9	.0	.0	.6	1.9	.0	13.8

Note: ABS = asset-backed securities; CDO = collateralized debt obligation; CMBS = commercial mortgage-backed securities; RMBS = residential mortgage-backed securities.

rating according to S&P ranges from BBB– to AAA. The average CDO holds collateral with a weighted-average rating of A, according to S&P, and A2, according to Moody's, which are equivalent ratings across the two scales.

ABS CDOs invest in a variety of structured finance securities, including RMBS, CMBS, home equity ABS, and other CDO tranches. HELs are the largest asset type, accounting for 54.7% (median: 59.9%) of collateral pools on average. In a quarter of the sample (133 CDOs), more than 83% of the collateral pool is invested in HELs, and in 10 cases, the entire collateral pool is composed of HELs. The next two largest asset classes in which ABS CDOs are invested are tranches of other CDOs and RMBS. Tranches of other CDOs account for 18.8% of the assets in ABS CDOs on average, while RMBS account for 15% of collateral pools. The share of CMBS in ABS CDOs is smaller, accounting, on average, for 4.6% of the entire collateral pool.

Table 8 also reports additional information on the kinds of mortgages underlying the RMBS or CMBS that serve as collateral for the ABS CDOs and their vintage. Midprime- and subprime-based ABS account, on average, for 29.7% and 24.2% of the collateral, respectively, followed by prime mortgages, with an average of 8.2%, and Alt-A (5.2%). Following market convention, we use a 6-month resolution to define vintage; thus, 2005H1 stands for the first 6 months of 2005 and 2006H2 for the second half of 2006. Since our sample covers most of the ABS that were issued between 2005 and 2007, it is not surprising that more than 40% of their assets are invested in 2005H2 and 2006H1 vintages. The mean vintage shares of 2005H2 and 2006H1 are 21.0% and 23.4%, respectively, followed by 2006H2 (15.9%), 2005H1 (15.3%), and 2007H1 (7.3%).

Figures 8–11 plot the evolution of the ABX indexes over time. The ABX indexes were launched by Markit in January 2006, and each of the indexes tracks the price of credit default insurance on RMBS and other securities backed by residential mortgages. There are five indexes based on the rating of the security being insured: AAA, AA, A, BBB, and BBB–. Each of the five ratings-based indexes is calculated for a 6-month vintage; figure 8 presents the behavior of the AAA, AA, A, BBB, and BBB– indexes for the 2006H1 vintage, and figures 9–11 track the performance of the indexes by the vintages of 2006H2, 2007H1, and 2007H2, respectively.

Of the 533 ABS CDOs in our data, 299 can be clearly classified as high grade with a collateral weighted-average S&P rating of A, and 205 are mezzanine grade with an average collateral rating of BBB.[6] Table 9 decomposes the collateral in high-grade and mezzanine ABS CDOs by vintage. The table reports the mean share (median share is reported in brackets) of collateral assets in each of the vintages 2005H1–2007H2. Columns 5 and 6 report the price of the corresponding ABX index based on rating and vintage as of September 25, 2008. As the table demonstrates, both high-grade and mezzanine-grade ABS CDOs have considerable exposure to the 2005 and the 2006 vintages. In column 4, we report the difference in vintage share between high-grade and mezzanine-grade ABS CDOs and its corresponding *t*-test for equal means. Mezzanine-grade ABS CDOs have significantly higher exposure to 2006H1, but high-grade ABS CDOs have significantly higher exposure to 2007H1 and 2007H2. The exposure of both classes of CDOs to the 2007H2 is negligible and is because of the decline in CDO issuance with the eruption of the credit crisis in July 2007.

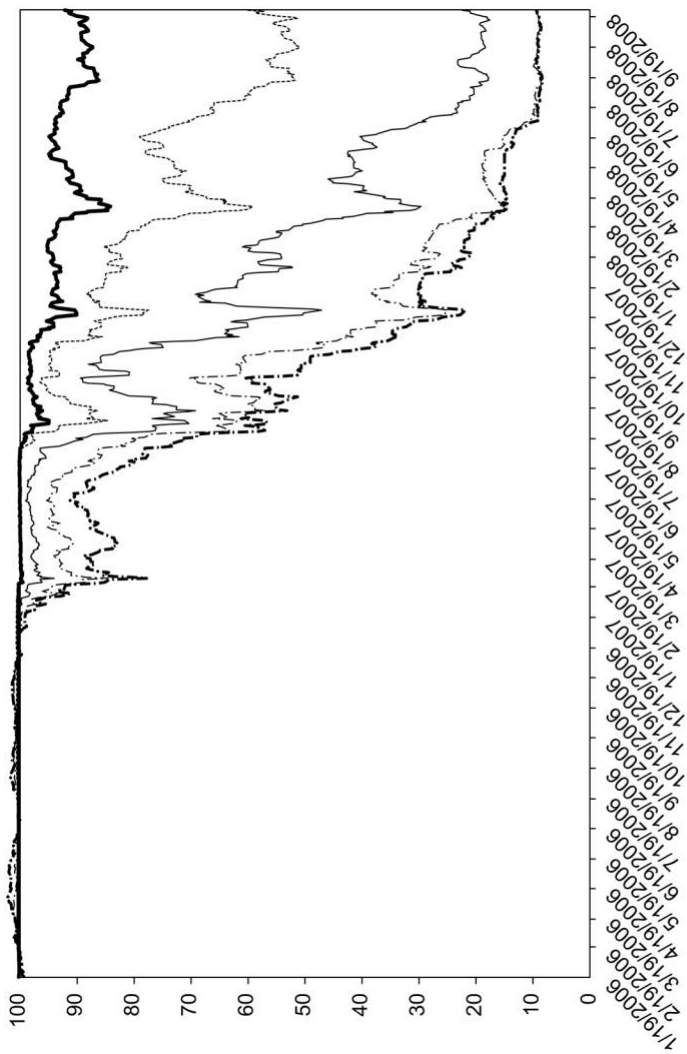

Fig. 8. ABX1 (2006H1 vintage) prices by rating

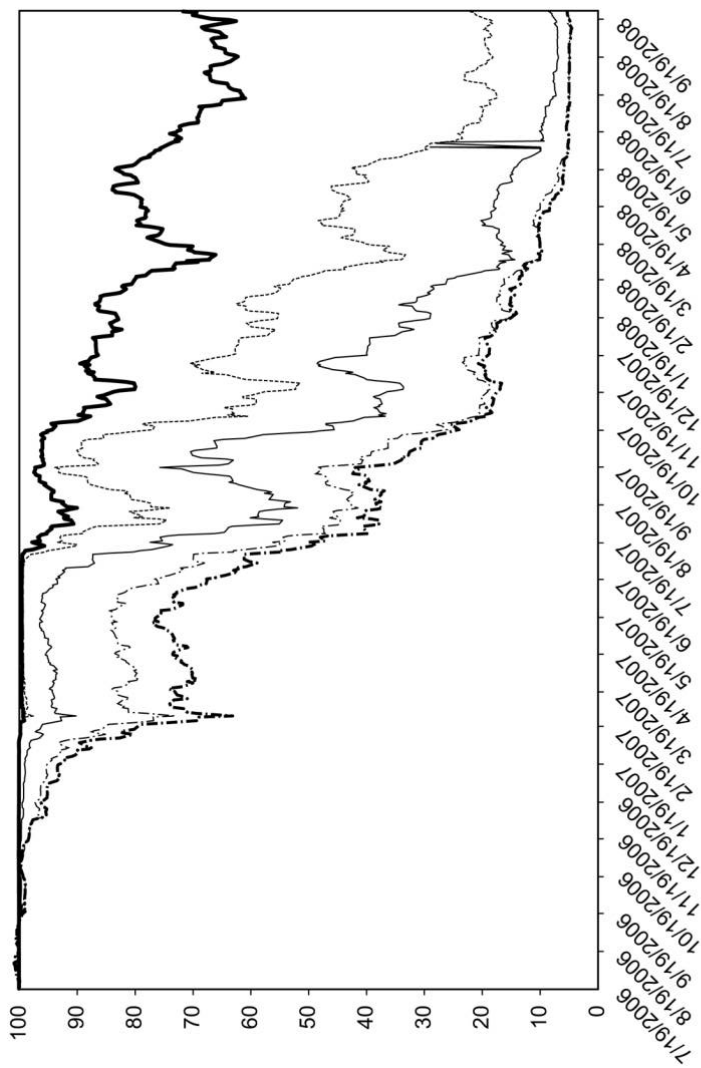

Fig. 9. ABX2 (2006H2 vintage) prices by rating

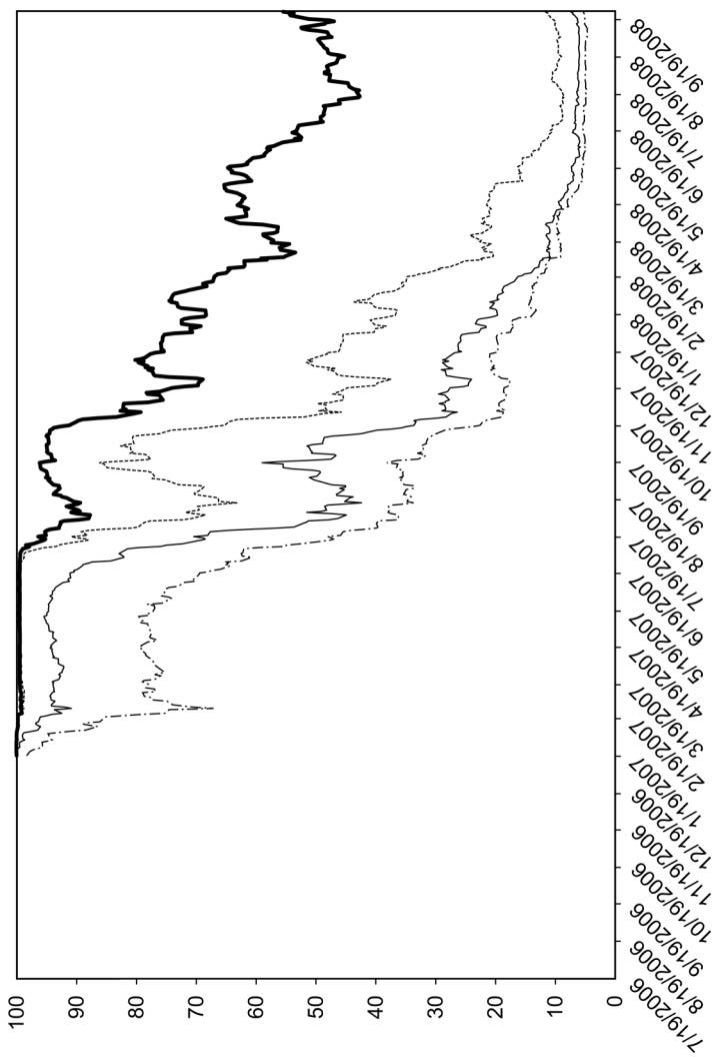

Fig. 10. ABX3 (2007H1 vintage) prices by rating

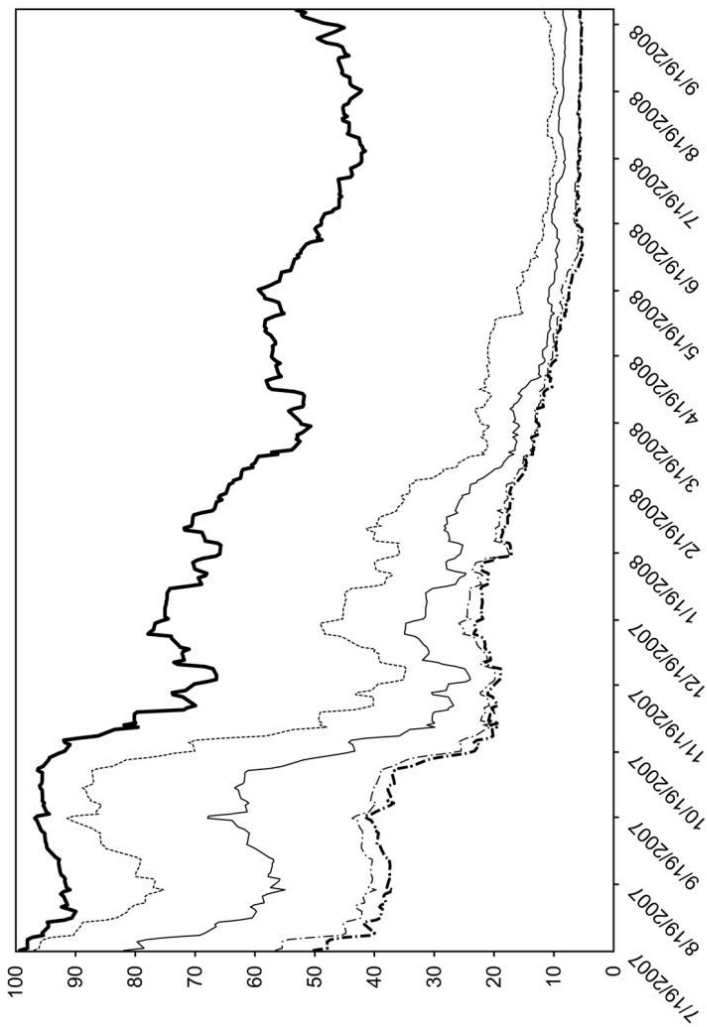

Fig. 11. ABX4 (2007H2 vintage) prices by rating

Table 9
Collateral Vintage by Credit Rating

Collateral Vintage (1)	Collateral Weighted-Average Standard & Poor's Rating: ABS CDO Grade (%) High/A (2)	Mezzanine/BBB (3)	Difference (High–Mezzanine) (4)	Corresponding ABX Price (as of September 25, 2008): A (5)	BBB (6)
2005H1	15.7	16.0	−.003	NA	NA
	[7.9]	[9.9]	(−.270)	NA	NA
2005H2	21.0	22.7	−.017	NA	NA
	[16.0]	[22.1]	(−.890)	NA	NA
2006H1	21.6	28.6	−.070*	22.42	9.44
	[16.8]	[29.1]	(−3.990)		
2006H2	16.5	16.2	.004	8.54	5.35
	[7.5]	[13.2]	(.250)		
2007H1	8.4	5.9	.025**	7.42	5.33
	[3.1]	[2.1]	(2.490)		
2007H2	1.1	.6	.005*	8.50	5.85
	[.0]	[.0]	(3.700)		
No. CDOs	299	205			

Note: ABS = asset-backed securities; CDO = collateralized debt obligation. Median share is reported in brackets; *t*-tests in parentheses.
*Significant at 10%.
**Significant at 5%.

The summary statistics in tables 8 and 9 and figures 8–11 jointly point to the main woes of the ABS CDOs issued between 2005 and 2007:

1. Lack of intersector diversification, with a high concentration in residential housing. On average 70% of the assets of ABS CDOs were invested in RMBS and home equity securities, and 18.8% were invested in other CDOs that were concentrated in the housing market as well.

2. Very high concentration in home equity ABS, especially the most risky segment of the sector. On average, 54.7% of the assets of ABS CDOs were invested in home equity securities that included first-lien subprime mortgages, second-lien HELs, and home equity lines of credit.

3. Low intervintage diversification. About 75% of ABS CDOs were composed of 2005H1–2006H2 vintages; figures 8 and 9 show that the 2006H1 and 2006H2 vintages performed miserably since summer 2007.

C. The Consequences of the ABS CDOs Collapse

Table 1 provides information on aggregate crisis-related write-downs as well as write-downs for some of the largest financial institutions in

the world.[7] As the table demonstrates, as of October 2008, Citigroup had written down $34.1 billion as a result of exposure to ABS CDOs, followed by AIG ($33.2 billion), Merrill Lynch ($26.1 billion), UBS ($21.9 billion), Ambac ($11.1 billion), and Bank of America ($9.1 billion). As of February 2009, the total value of write-downs by financial institutions around the world was $520.1 billion, out of which $218.2 billion (42.0%) was due to exposure to ABS CDOs. Write-downs driven by ABS CDOs were more than four times the size of corporate credit-related write-downs. North American banks accounted for the largest share of ABS CDO write-downs, followed by European banks and insurers and asset managers.

VII. Why Did the Ratings Collapse?

Having presented the main facts about the credit rating crisis of 2007 and 2008, we discuss the potential reasons for this collapse. We consider two main candidate explanations for the surge in downgrades of structured finance products and, in particular, of ABS CDOs. The first is that rating agencies were being deliberately aggressive in rating securities—assigning overly high credit ratings to structured finance products. We test one variant of this story that is based on "rating shopping" in which issuers shop around among rating agencies for the highest rating, which might have led to inflated ratings of structured finance products. The second potential explanation is model error, in particular, underestimation of default correlation across firms or households. Of course these two explanations are not mutually exclusive; for example, if a model error makes rating more lenient and that is public knowledge, then issuers will shop for the particular rating agency with the most lax model.

A. Rating Shopping

Structured finance products often exploit ratings-based arbitrage between the credit rating of the securities they purchase as assets and the rating of the liabilities that they issue. The credit rating arbitrage is higher when liabilities are more leveraged—that is, when the gap between the credit rating of the assets and the liabilities is higher.[8] Leveraging assets up and obtaining as a high credit rating as they can get may induce issuers to shop for ratings. According to Nomura Fixed Income Research, "Rating shopping occurs when an issuer chooses the rating agency that will assign the highest rating or that has the most lax

criteria for achieving a desired rating. Rating shopping rarely involves corporate, sovereign, and municipal bonds. However, it is common for securitization issues. Rating shopping has a strong effect when one rating agency's criteria is much more lax than its competitors' criteria. Unless investors demand multiple ratings on deals, issuers will tend to use only rating from the agency with the most lenient standards" (Adelson 2006, 1).

While rating shopping has been suggested as one of the explanations for the poor performance of structured finance products, there is little empirical research that evaluates the effect of rating shopping on rating quality and performance. Bolton, Freixas, and Shapiro (2008) and Damiano, Li, and Suen (2008) develop models in which a rating agency trades off the value from inflating its client's rating against an expected reputation cost. Skreta and Veldkamp (2008) construct an alternative model in which rating agencies report the true rating; however, rating of complex assets such as CDOs may create systematic bias in disclosed ratings, even if the raters disclose their unbiased estimate of the assets' true quality. Sangiorgi, Sokobin, and Spatt (2009) develop a model in which rating shopping is motivated by the regulatory advantages of high ratings. In a recent empirical paper, Becker and Milbourn (2008) show that competition between the rating agencies after the entry of Fitch to the market controlled previously by the duopoly of Moody's and S&P led to more issuer-friendly and less informative credit rating in the bond market. However, there is little empirical evidence on the extent of rating shopping in the structured finance market. One exception is the study of ABS's rating migrations from January 1990 through June 2001, conducted by Mark Adelson, Yu Sun, Panos Nikoulis, and James Manzi from Nomura Fixed Income Research. The study finds that ABS rated by S&P alone were more likely to be downgraded and that tranches rated by both S&P and Moody's were less likely to default. Our analysis below complements their evidence by studying downgrades of securities during 2005–8, when credit ratings of many structured finance products collapsed.

Using data on 30,499 structured finance tranches, we examine whether the number of agencies that rated a security can predict the probability of future downgrades.[9] Structured finance tranches are rated by Moody's and S&P and to a lesser degree by Fitch; hence, the number of raters can range from zero to three. Table 10 reports the number of raters for each security in our sample.[10] Almost 10% of the tranches in the sample are unrated because they are either equity tranches or privately placed senior tranches. Tranches rated by one

Table 10
Number of Raters

	Raters			
	0	1	2	3
Period:				
Pre-2004	603	133	550	535
	(33.11%)	(7.30%)	(30.20%)	(29.38%)
2004	374	439	1,993	1,186
	(9.37%)	(11.00%)	(49.92%)	(29.71%)
2005	547	778	5,363	2,537
	(5.93%)	(8.43%)	(58.14%)	(27.50%)
2006	573	392	7,060	2,786
	(5.30%)	(3.63%)	(65.30%)	(27.77%)
2007	171	94	2,478	845
	(4.76%)	(2.62%)	(69.07%)	(23.54%)
Entire period	2,268	1,836	17,444	7,889
	(7.70%)	(6.24%)	(59.26%)	(26.80%)
Security type:				
CMBS	10	16	1,116	257
	(.71%)	(1.14%)	(79.77%)	(18.37%)
RMBS	463	1,371	6,768	1,065
	(4.79%)	(14.18%)	(70.01%)	(11.02%)
Home equity	346	406	6,997	5,983
	(2.52%)	(2.96%)	(50.95%)	(43.57%)
CDO	91	35	2,909	723
	(2.42%)	(.93%)	(77.41%)	(19.24%)

Note: CDO = collateralized debt obligation; CMBS = commercial mortgage-backed securities; RMBS = residential mortgage-backed securities.

agency only account for 6.09% of the sample, and most of the tranches that were initially rated by one agency were issued in 2004 and 2005. Most of the tranches are rated by either two or three agencies; 17,444 (59.26%) have two raters, and 7,889 tranches (26.80%) are rated by all three agencies. Table 10 also stratifies the data by the number of raters and common deal types. Although RMBS and home equity securities are more likely than CMBS and CDOs to have one rater only, the fact that most structured finance products—especially complex assets such as CDOs—are likely to have at least two raters may suggest that the potential for rating shopping will be mitigated by competition. Indeed, researchers at the Bank for International Settlements concluded that rating shopping is not a significant problem in practice since CDOs commonly have two raters (Fender and Kiff 2004). However, as Becker and Milbourn (2008) show for that bond market, competition among raters led to less accurate, issuer-friendly ratings. Furthermore, having more than one rater does not necessarily dismiss the concern about rating shopping. If an issuer can threaten to use one rater only when

negotiating with two rating agencies, both raters may conform to lenient standards, even when jointly rating a security.

Table 11 provides additional summary statistics on securities with one or two rating agencies only. It shows that, conditional on having one rater only, 69.72% of the tranches (1,280) were rated by S&P, while 10% of the tranches were rated by Moody's and 20% by Fitch. Table 11 also displays the number of tranches rated by two agencies. The most common combination of two agencies is S&P and Moody's (15,266 tranches), followed by S&P and Fitch (1,265 tranches), and Moody's and Fitch (913 tranches). Finally, table 12 presents the distribution of rating transitions by the number of raters. The Pershing Square Capital Management data provide us with two snapshots of credit rating at

Table 11
Most Common Raters

	A. Securities Rated by One Agency Only			
	Fitch	Moody's	Standard & Poor's	Total
Pre-2004	20	21	92	133
	(15.04%)	(15.79%)	(69.17%)	(100.00%)
2004	66	32	341	439
	(15.03%)	(7.29%)	(77.68%)	(100.00%)
2005	97	46	635	778
	(12.47%)	(5.91%)	(81.62%)	(100.00%)
2006	162	56	174	392
	(41.33%)	(14.29%)	(44.39%)	(100.0%)
2007	29	27	38	94
	(30.85%)	(28.72%)	(40.43%)	(100.00%)
Entire period	374	182	1,280	1,836
	(20.37%)	(9.91%)	(69.72%)	(100.00%)
	B. Securities Rated by Two Agencies			
	Standard & Poor's and Moody's	Standard & Poor's and Fitch	Moody's and Fitch	Total
Pre-2004	402	86	62	550
	(73.09%)	(15.64%)	(11.27%)	(100.00%)
2004	1,695	225	73	1,993
	(85.05%)	(11.29%)	(3.66%)	(100.00%)
2005	4,413	566	384	5,363
	(82.29%)	(10.55%)	(7.16%)	(100.00%)
2006	6,433	313	314	7,060
	(92.12%)	(4.43%)	(4.45%)	(100.00%)
2007	2,323	75	80	2,478
	(93.71%)	(3.03%)	(3.23%)	(100.00%)
Entire period	15,266	1,265	913	17,444
	(87.51%)	(7.25%)	(5.23%)	(100.00%)

Table 12
Rating Transitions and Number of Raters

	1	2	3	Total
No. downgrades	238	2,912	1,788	4,938
	(12.81%)	(16.24%)	(21.84%)	(17.65%)
No. upgrades	85	561	369	1,015
	(4.57%)	(3.13%)	(4.51%)	(3.63%)
No. unchanged	1,535	14,454	6,030	22,019
	(82.62%)	(80.63%)	(73.65%)	(78.72%)
Total	1,858	17,927	8,187	27,972
	(100.00%)	(100.00%)	(100.00%)	(100.00%)

the tranche level: (i) the rating at the issue date and (ii) the rating as of January 2008. We measure rating transition as the rating change from issuance to January 2008. Consistent with the results in table 3, there are more downgrades than upgrades. Out of the 27,972 rated tranches in the sample, 4,938 (17.65%) were downgraded at least once, 1,015 (3.63%) were upgraded, and 22,019 (78.72%) remain unchanged. Tranche downgrade frequency is increasing in the number of raters: while 12.81% of the tranches with one rating are eventually downgraded, the downgrade rates for tranches with two and three raters are 16.24% and 21.84%, respectively. One potential explanation for the positive relation between the number of raters and downgrades is that an omitted variable correlated with the number of raters also drives future downgrades. For example, if complex CDOs that are harder to evaluate and, hence, more prone to rating mistakes are required to have at least two raters because of their complexity, then it is not surprising that the number of raters is correlated with the likelihood of default.

To test the conjecture of rating shopping, we run a probit regression relating the number of raters to the likelihood of a rating downgrade:

$$\Pr(\text{downgrade}_{i,\text{ as of January 2008}} = 1) = \Phi(\mathbf{Raters}_{i,\,\mathbf{issue\ date}}\beta + \mathbf{Vintage}_i\Gamma + \mathbf{Type}_i\theta), \quad (1)$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function, $\mathbf{Raters}_{i,t=\text{issue}}$ is a vector that includes the number of raters or dummies for the identity of the raters, $\mathbf{Vintage}_i$ is a vector of vintage fixed effects, and $\mathbf{Type}_i$ is a vector of security-type fixed effects. We report the results from estimating different variants of regression (1) in table 13. We report regressions' marginal effects, and standard errors are clustered at the security-type level (in parentheses).

Table 13
Rating Shopping: Probit Regression Models for Probability of a Downgrade

Dependent Variable	Pr(Downgrade)				Rating Change		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
No. raters			.045***	.086***			.132
			(.004)	(.007)			(.503)
One rater	.061**	.075**			−2.716***	−1.808***	
	(.030)	(.043)			(.793)	(.727)	
Two raters	−.005				−.909***		
	(.010)				(.201)		
Three raters		.027***				.909***	
		(.009)				(.201)	
Standard & Poor's only			.169***	.322***			−2.579***
			(.049)	(.034)			(.300)
Moody's only			.084**	.223***			−1.937*
			(.049)	(.070)			(1.011)
Fitch only			.093	.240***			−2.043***
			(.073)	(.056)			(.861)
Standard & Poor's and Moody's				.061***			−.828
				(.016)			(.534)
Moody's and Fitch				.046*			−.692***
				(.029)			(.151)
Fixed effects:							
Vintage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	Probit	Probit	Probit	Probit	OLS	OLS	OLS
Observations	28,238	28,238	28,238	28,238	4,904	4,904	4,904
Pseudo R^2	.12	.12	.12	.13	.15	.15	.15

Note: OLS = ordinary least squares. Standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

Column 1 in table 13 reports the coefficients from estimating regression (1) with dummies for one and two raters. The coefficient on the one-rater dummy suggests that securities rated by one agency are 6.1 percentage points more likely to be downgraded. The effect is significant at the 5% level, while the marginal effect of the two-raters dummy is close to zero and not statistically significant. This result is consistent with a rating shopping argument in which tranches certified by one rater only obtain inflated ratings. Column 2 includes dummies for one and three raters as well as vintage and security-type fixed effects. As before, we find that the likelihood of a downgrade is higher

when a security is rated by one agency only. While the marginal effect of the three-raters dummy is positive and significant as well, the one-rater effect is three times larger and is slightly higher than the marginal effect found in column 1.[11] In the specifications reported in columns 3 and 4, we try to identify the relationship between the rater's identity and the probability of subsequent downgrades. Our results show that after controlling for the number of raters, tranches rated by S&P only were the most likely to be downgraded.

In unreported results, we estimate a similar specification to regression (1), in which the dependent variable is the probability of an upgrade. Despite the fact that there are few upgrades in the sample, we find that tranches rated by S&P are less likely to be upgraded compared to those rated by Fitch and Moody's. These results are consistent with the downgrade results in table 13.

Finally, in columns 5–7 of table 13, we examine how the magnitude of the downgrade (conditional on being downgraded) relates to the number of raters and the rater's identity. Our dependent variable is measured as the difference in the numeric scale between the initial rating at the time of the issue and the rating as of January 2008. A negative difference implies a downgrade. Tranches with one rater only are more likely to be downgraded and also experience more severe downgrades. Likewise, tranches rated by S&P only experience larger downgrades than those rated by Fitch or Moody's only. Ashcraft, Goldsmith-Pinkham, and Vickery (2009) find similar results in a recent study of MBS ratings.

The results in table 13 suggest that S&P's ratings may have been inflated and that rating shopping may have played a role in the collapse of the structured finance market. Industry experts questioned the S&P rating model and some of its underlying assumptions. On December 19, 2005, S&P put 35 tranches from 18 different deals on a watch list after an update of its CDO rating criteria. Out of the 18 deals, 14 carried ratings from S&P only. According to Mark Adelson, director of structured finance research at Nomura Securities, "The absence of ratings from a second rating agency on those 14 deals probably reflected 'rating shopping' by the deals' issuers'' (2006, 1). The model used by S&P to rate CDOs backed by corporate debt included an assumption of no correlation between companies in different industries. According to Adelson, "That assumption was very lenient and often allowed CDO issuers to achieve their target rating levels with less credit enhancement than other rating agencies would have required" (1). Structured finance experts at Wachovia Securities called the assumption "outdated and implausible" and, specifically addressing the issue of rating

shopping, stated, "Given S&P's generous interindustry correlation assumption of 0%, it is not surprising that S&P has the dominant market share of the publicly rated part of this market" (Cifuentes and Chen 2005, 3).

In table 14, we repeat the previous analysis, limiting the sample to tranches that were initially rated AAA. We do this to alleviate concerns about differences between securities with very different ratings. Moreover, given that many of the tranches that were downgraded were originally rated as AAA, we want to understand how important rating shopping was for this segment of the structured finance market. As table 14 shows, we do not find that the identity of the rater has any predictive power for downgrades of AAA tranches. However, tranches with either two or three raters are less likely to be downgraded, compared to those rated by one agency only. When we compare the effect of

Table 14
Rating Shopping and AAA Securities

	Pr(Downgrade)			
Dependent Variable	(1)	(2)	(3)	(4)
No. raters			−.016***	−.048***
			(.004)	(.007)
One rater	.138**	.077		
	(.061)	(.068)		
Two raters	.014***			
	(.003)			
Three raters		−.014***		
		(.003)		
Standard & Poor's only			.050	−.018
			(.085)	(.042)
Moody's only			.007	−.019
			(.046)	(.061)
Fitch only			.005	.007
			(.004)	(.008)
Standard & Poor's and Moody's				−.049***
				(.006)
Moody's and Fitch				−.018***
				(.0003)
Fixed effects:				
Vintage	Yes	Yes	Yes	Yes
Security type	Yes	Yes	Yes	Yes
Estimation	Probit	Probit	Probit	Probit
Observations	4,654	4,654	4,654	4,654
Pseudo R^2	.21	.21	.21	.23

Note: Standard errors in parentheses.
**Significant at 5%.
***Significant at 1%.

one rater to that of two raters (col. 1), we find that being rated by one agency only increases the probability of a downgrade by 13.8 percentage points.[12] Moreover, columns 3 and 4 show that the probability of a downgrade significantly declines with the number of raters.

B. The Failure of the Black Box

Rating agencies use different models to assess credit risk. For example, Moody's focuses on expected loss, while S&P focuses on default probability. In table 15, we look for differences of opinion across rating agencies for the securities in our sample by converting ratings to a numerical scale. In general, ratings are similar across agencies; 81% of the tranches rated by both S&P and Fitch bore the same initial rating, the mean difference is −0.02, and the standard deviation is 0.601. Similar results emerge when we compare S&P and Moody's, and Moody's and Fitch. While S&P assigns higher ratings than Moody's, the bias is small (−0.26), and in 16,806 tranches, both assign the same rating. Table 15 demonstrates that rating agencies tend to assign very similar ratings to structured finance tranches and that the difference between the ratings is typically small. Table 16 shows that the ratings of S&P, Moody's, and Fitch are highly correlated and that the correlation coefficient is between 0.962 and 0.983. While it is unlikely that Fitch, S&P, and Moody's colluded in determining structured finance ratings, it is possible that competition among the raters leads to a "race to the bottom" in which each of the agencies constructs a rating model that will produce high ratings at the lowest cost.[13] One common model used by the rating agencies is the mixed-binomial model that is used when analyzing defaults. The key inputs in the binomial

Table 15
Credit Rating Dispersion

	Mean	Twenty-fifth Percentile	Median	Seventy-fifth Percentile	SD	Min	Max	No. Tranches in Which Difference = 0	No. Tranches
Standard & Poor's and Fitch	−.02	.0	.0	.0	.601	−5.0	5.0	7,671	9,507
Standard & Poor's and Moody's	−.26	.0	.0	.0	.881	−10.0	7.0	16,806	23,839
Moody's and Fitch	.31	.0	.0	1.0	.665	−4.0	10.0	6,478	9,150

Table 16
Ratings Correlation

	Standard & Poor's	Moody's	Fitch
Standard & Poor's	1.0		
Moody's	.983*	1.0	
Fitch	.962*	.979*	1.0

*Significant at 10%.

model are the default correlations across and within sectors, which determine both the value that is created from pooling assets together and the tranching capacity of the pool. The appendix presents a simple version of Moody's binomial model.

In January 2003, industry experts expressed concerns about model risk, in which default correlations and, especially, exposure to macroeconomic shocks are underestimated.

> It is impossible to specify a model that assumes no correlation among individual borrowers that can replicate the waves of corporate defaults that have been experienced in the United States and Japan. There is a high degree of correlation among corporate borrowers because of a common dependence on the same set of macro factors.… The modeling approaches [used by practitioners] … ignore this link between specific macro shocks and the default probability of each reference name.
>
> This is the proverbial 'making of a silk purse out of a sow's ear.' Some argue that there are pools of investors who strongly prefer low-risk pools of credit and the value difference coming from structuring transactions for those investors. Veterans of the security industry, like the authors, think model error … might explain more of the value difference than investors would care to admit. (van Deventer and Imai 2003, 255–56)

Moody's introduced the binomial model in 1996 and used different variants of it to rate CBOs and CLOs. According to Cifuentes (2008), the binomial approach has performed well under very stressful market conditions. In 2004, Moody's changed its model to the Gaussian copula for many structured finance products, including ABS CDOs. In a technical document that lists the details of their new rating methodology, Moody's explained the need to revise its existing binomial model:

> Over the past year and half, the structured finance cash flow CDO transactions have seen an increase concentration in a single asset sector, namely RMBS, in the collateral pools. The highly concentrated collateral pools normally leads to a fat-tailed loss distribution, i.e., larger probability associated with high multiple defaults scenarios

> due to the correlation among collateral assets. To better assess and capture this fat-tail effect, Moody's introduced a new modeling framework in August last year, the Correlated Binomial Method (the CBM), in order to achieve a more accurate evaluation of he credit risk embedded in this category of CDO transactions. (Moody's Investors Service, September 26, 2005, 2)

According to Cifuentes (2008), ABS CDOs that were rated with the new methodology have exhibited bad performance: "This new approach was introduced in the early 2000s. An approximate back-of-the-envelope calculation gives the impression that the so called default probability and correlation assumptions used with this new approach were more 'relaxed' than the assumptions used with the Binomial method. Although this observation is by no means conclusive, it points to the necessity to look into this issue more carefully. This might be the reason behind the abysmal performance of CDO of ABS" (9). But what spurred the growth in ABS CDOs that concentrated in residential housing, which eventually became the worst-performing segment of the structured finance market? According to Lancaster et al. (2008), strict diversity requirements based on the diversity score of the Moody's model caused CDOs' managers to purchase ABS from other sectors. This suggests that the rating model is not only determined by the type of securities that are issued in the marketplace but that it also has a causal effect on the creation of new securities that cater to the model.

VIII. The Future of Structured Finance

While securitization allows intermediaries to leverage their capital more efficiently, the recent credit crisis has cast doubt on the future of structured finance. Will the market recover? Are some deal types more likely to disappear than others?

In thinking about the future of structured finance, it may be useful to examine the past. In 2002–3, there was deterioration in the credit quality of structured finance securities that was only slightly less severe than in the current period, after adjusting for the size of the market. Studying downgrades over 2002–4, we find that the following three deal types suffered the most downgrades: high-yield CBOs, securities backed by tobacco settlement bonds, and securities backed by manufactured housing. Downgrades of these three types of securities account for approximately 50% of downgrade actions between 2002 and 2004. Figures 12 and 13 show how the market for CBOs and securities backed

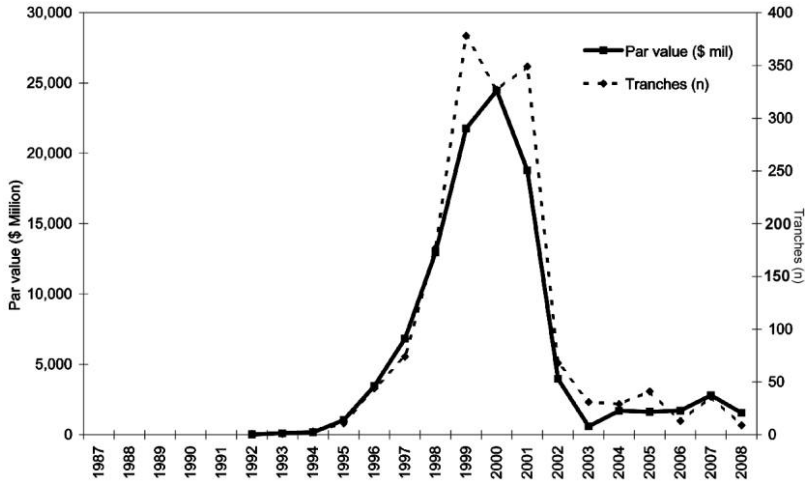

Fig. 12. Collateralized bond obligations issuance

by manufactured housing evolved after their poor performance in 2002–4. We focus on CBOs and manufactured housing ABS, given that tobacco settlement bond issuance is sporadic and driven by tobacco litigation.[14] In 2003, CBO issuance fell to 2.4% of its peak in 2000; in the following years, it recovered to only 11% of that peak value. In 2004, securities backed by manufactured housing fell to 3.4% of their peak level in 1999; afterward, maximum issuance reached only 14%

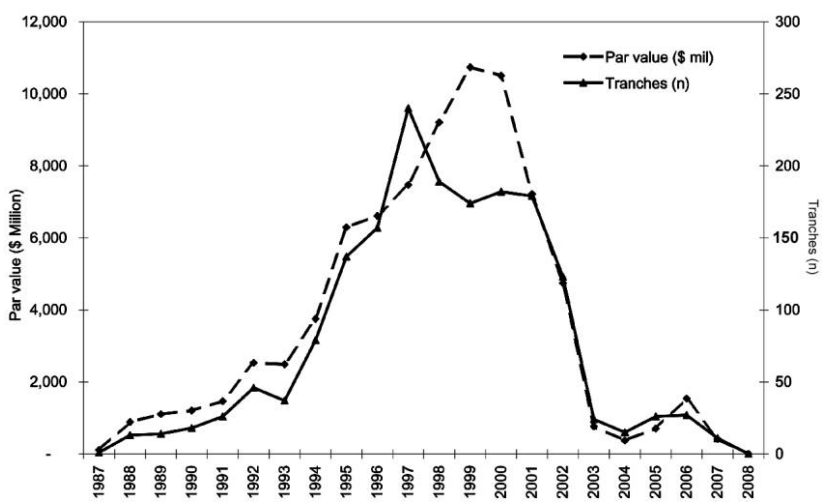

Fig. 13. Asset-backed securities, manufactured housing

of its 1999 peak. According to de Servigny and Jobst (2007), the poor performance of high-yield CBOs and the perception that they were very risky led to the disappearance of CBOs from the new issue market, as illustrated by figure 12. The pattern of boom and bust in financial innovation is well documented (see Persons and Warther 1997).

The collapse and the eventual disappearance of the CBO market potentially indicate that rating models did not anticipate how badly the underlying assets would be hit in a recession. The evidence from the recessions of 2001–2 and 2008 suggests a pattern of boom and bust, in which a certain kind of structuring becomes widespread in good macroeconomic times and survives relatively unscathed until the economic climate worsens.

IX. Summary and Conclusion

Academics, practitioners, and the media have apportioned a large share of the blame for the current credit crisis to rating agencies. The purpose of our paper is not to point fingers but rather to provide facts about what happened to structured finance securities' ratings in 2007–8. Using data from Moody's on structured finance ratings and corporate bond ratings from 1983 to the present, we put the size of the current rating crisis in context. While the percentage of tranches downgraded remained below 10%, the frequency and magnitude of downgrades reached record levels. In 2007 and 2008, respectively, 7.2% and 6.7% of structured finance securities rated by Moody's were downgraded, and the average downgrade was −4.7 and −5.6 notches. Looking at the history of structured finance ratings, we establish several facts.

First, from 1992 to 2001, downgrades and upgrades were relatively infrequent (1%–2% of outstanding tranches) and roughly balanced. The years 2002 and 2003 saw a spike in downgrades that was only slightly less severe than the current crisis—nearly 5% of tranches were downgraded 3 notches on average, but the overall market was much smaller at that time. The number of outstanding structured finance securities in 2002 was roughly one-third of the number outstanding in 2007 and only one-tenth the size of the market in 2008. Nearly 30% of downgrades in 2002 and 2003 affected tranches of high-yield CBOs, indicating that rating models did not anticipate how badly these assets would perform in a recession. This prior incident is important because it shows the beginnings of a pattern of boom and bust in the structured finance industry, in which a certain kind of structuring

becomes widespread in good macroeconomic times and survives relatively unscathed until the economic climate worsens.

Second, the current crisis is notable for the size and severity of downgrades. We show that in 2007 and 2008, approximately 62% of downgrades can be attributed to securities backed by HELs or first mortgages. Examining securities that suffered the most severe downgrades (8 notches or more), we find that the majority of these tranches come from deals backed by HELs, first mortgages, and CDOs of ABS. It is these asset classes for which the rating model experienced the most dramatic failures. By now, it is well established that rating models failed to properly account for the correlation of home prices at the national level. ABS CDOs would also be affected by this since they often contain RMBS as collateral. But ABS CDOs are also more sensitive to errors in correlation assumptions since they are higher-level securitizations (securitizations that contain securitized assets in their collateral pools). Structured finance securities that fell 8 or more notches were most likely to be rated AAA.

Third, we compare the performance of structured finance ratings to the performance of corporate bonds from 1983 to 2008. While corporate bonds are also sensitive to macroeconomic events, the magnitude of downgrades is relatively low and stable over time. Even during the 2001–2 recession when 30% of corporate bonds were downgraded, the average downgrade was only −1.8 notches. Downgrades of structured finance securities in the 2007–8 crisis were much more severe, averaging around 5–6 notches.

Using microlevel data on ABS CDOs—one of the structured asset classes that performed relatively poorly in the recent crisis—we provide evidence that rating shopping may have played a role in the current crisis. Among 534 ABS CDOs issued between 2005 and 2007, we find that tranches rated solely by one agency, and by S&P in particular, were more likely to be downgraded by January 2008. Further, tranches rated solely by one agency are more likely to suffer more severe downgrades. Nevertheless, it is not clear that rating shopping led to the ratings collapse as the majority of the tranches in our sample are rated by two or three agencies.

Appendix

Mixed-binomial models are used in a wide class of models analyzing defaults.[15] We start by assuming that the default probability of a mortgage is a Bernoulli random variable, taking the value of one with

probability p and zero with probability $1 - p$. Next, we consider that we have a pool of mortgages, in which the default probability of mortgage i is denoted X_i and is equal to one if the mortgage defaults and zero otherwise. Each mortgage in the pool is assumed to have a different default probability; hence, we need to randomize the default probability p. The randomization of the default probability is achieved using a mixture distribution, which randomizes the default distribution of the binomial model, inducing dependence between different default probabilities. The dependence that is generated by the mixing distribution mimics an environment in which pools of different mortgages are subject to a common economic risk. Assume that the default parameter $\tilde{p} \in [0, 1]$ is independent of the X_i's and that conditional on $\tilde{p}$ all the X_i's are independent. Denoting the density of $\tilde{p}$ by f, we have

$$\bar{p} = E\tilde{p} = \int_0^1 pf(p)\,dp.$$

Using the law of iterated expectations and variance decomposition, we have

$$\bar{E}X_i = \bar{p}, \quad \text{Var } X_i = \bar{p}(1 - \bar{p}), \quad \text{and} \quad \text{Cov}(X_i, X_j) = E(\tilde{p}^2) - \tilde{p}^2.$$

We can now express the default correlation as

$$\bar{p}(X_i, X_j) = \frac{E(\tilde{p}^2) - \tilde{p}^2}{\bar{p}(1 - \bar{p})}. \tag{A1}$$

As Lando (2004) shows, the default correlation is 0 if $\tilde{p}$ is constant. Moreover, the default correlation in equation (A1) is always nonnegative in this model (see Lando 2004, 217).

The total number of defaults among the pool of mortgages is $D_n = \sum_{i=1}^{n} X_i$, and $ED_N = n\bar{p}$. The variance of the total number of defaults in the mortgage pool is

$$\text{Var } D_n = n\bar{p}(1 - \bar{p}) + n(n - 1)[E(\tilde{p}^2) - \tilde{p}^2], \tag{A2}$$

and

$$\text{Var}\left(\frac{D_n}{n}\right) = \frac{\bar{p}(1 - \bar{p})}{n} + \frac{n(n - 1)}{n^2}[E(\tilde{p}^2) - \bar{p}^2] \to E(\tilde{p}^2) - \bar{p}$$

$$\text{as} \quad n \to \infty. \tag{A3}$$

That is, for a large enough n, the variance of the default rate D_n/n is determined by that of the distribution of $\tilde{p}$. Using the fact that when

n is large the realized frequency of defaults is almost identical to the realized value of $\tilde{p}$, the distribution of defaults becomes that of $\tilde{p}$, and hence we can show that

$$P\left(\frac{D_n}{n} < \theta\right) \to \int_0^\theta f(p)\,dp \equiv F(\theta) \quad \text{as} \quad n \to \infty.$$

That is, for a large pool of assets, the distribution of $\tilde{p}$ determines the risk distribution of the portfolio, and the more variability in the mixture distribution of $\tilde{p}$, the more correlation of defaults there is, and hence there is more weight on the tails of the distribution. Increasing the correlation between assets in the collateral pool decreases the value of the most senior tranches as the likelihood of a large number of defaults increases and more of the junior tranches are likely to be wiped out. However, as the correlation increases, the value of the least-senior tranches increases and more weight is put on the other tail of the distribution (and very few defaults are more likely). Hence, the mixing distribution in the binomial model is crucial not only for the value of diversification of the collateral pool but also for the ability to carve out highly rated risk-free tranches.

Endnotes

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1. Aggregate structured finance balances are based on Securities Industry and Financial Markets Association (SIFMA) reports available at http://www.sifma.org.

2. ABS CDOs are CDOs that are backed by securities that are themselves structured. We discuss the composition of these securities extensively in Sec. VI.

3. In addition, money market funds are not allowed to hold securities with a remaining maturity of 397 calendar days or more, while a typical maturity of a CDO at the time of the issuance is between 5 and 7 years.

4. A rating is considered withdrawn if the issuer refuses to provide information to the rating agency or when the rating agency decides that there is not enough information to continue to ascertain a credit rating for the issue.

5. While the Pershing Square Capital Management data include information on 534 ABS CDOs, there is one CDO with incomplete information on its underlying collateral.

6. We lump together collateral ratings of A+, A, and A– as high grade with an A-rating category, and BBB+, BBB, and BBB– as mezzanine grade with a collateral rating of BBB.

7. The data are from Creditflux, a leading global information source for credit trading and investing, credit derivatives, structured credit, distressed credit, and credit research.

8. See Benmelech and Dlugosz (2009) for a discussion.

9. These 30,499 tranches are the collateral assets of the 534 ABS CDOs in the Pershing Square Capital Management data.

10. We count the number of ratings available at the issuance of the security.
11. We cannot include all three dummies in one specification because of perfect multicollinearity.
12. When we include one and three raters, the effect is smaller but not statistically significant.
13. See Cifuentes (2008) for a similar argument.
14. In 2004, issuance of securities backed by tobacco settlement bonds fell to 2% of its peak level in 2002. The number of ABS's tobacco settlement deals did not return to its previous levels; however, in 2007, the dollar value of issuance of these securities surpassed its 2002 level.
15. The appendix draws heavily from Lando (2004).

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