The Credit Rating Crisis*

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* We thank Daron Acemuglo, Adam Ashcraft, George-Marios Angeletos, Bengt Holmström, David Laibson, Chris Mayer, Ken Rogoff, Andrei Shleifer, Jeremy Stein and Luigi Zingales for insightful discussions, as well as seminar participants at Harvard University, the 24th annual conference on Macroeconomics, and the Minneapolis Federal Reserve Bank for useful comments. We also thank and Anna-Kathrine Barnett-Hart for help with the data. Shaunak Vankudre provided fantastic research assistance. All errors are our own.
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Abstract

Since June 2007, the creditworthiness of structured finance products has deteriorated rapidly. The number of downgrades in November 2007 alone exceeded 2,000 and many downgrades were severe, with 500 tranches downgraded more than 10 notches. Massive downgrades continued in 2008. More than 11,000 of the downgrades affected securities that were rated AAA. This paper studies the *credit rating crisis* of 2007-2008 and in particular describes the collapse of the credit ratings of ABS CDOs. Using data on ABS CDOs we provide suggestive evidence that ratings shopping may have played a role in the current crisis. 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.

Introduction

By December 2008, structured finance securities accounted for over $11 trillion dollars 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.*[2]

The goal of our paper is to inform economists about the credit rating crisis of 2007-2008. We begin by describing *what* happened to structured finance credit rating during the crisis of 2007-2008. 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 is used as a benchmark for the true distribution of credit ratings that are based on economic fundamentals. The comparison 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 which 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 or first mortgages as collateral. Collateralized debt obligations (CDOs) backed by asset-backed securities (ABS CDOs) accounted for a large share of the downgrades, and some of the most severe downgrades. ABS

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

[2] Blinder, Alan, Six Fingers of Blame in the Mortgage Mess, New York Times, 9/30/2007.

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, due to ABS CDO exposure.[3]

Using micro-level data on the collateral composition of ABS CDOs we fdocument three features of ABS CDOs: (i) a high concentration in residential housing – on average 70% of the underlying securities were residential mortgage backed securities 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. (iii) Low inter-vintage diversification: about 75% of ABS CDOs were comprised of mortgages that were originated in 2005 and 2006.

We discuss possible explanations for the collapse of ABS CDOs ratings. Our regression analysis shows that tranches rated only by one rater 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 S&P's ratings were somewhat inflated. Our regressions show that tranches that were rated only by S&P were more likely to be downgraded subsequently, than tranches rated by either Moody's or Fitch. While some 'rating shopping' probably took place, more than 80% of all tranches were rated by either 2 or 3 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 over reliance 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 1 we explain the economics of structured finance. Section 2 provides background on structured finance products. Section 3 describes our data sources and provides summary statistics on the evolution of the structured finance market. Section 4 compares credit rating transitions of structured finance products to corporate and sovereign bonds. Section 5 documents the collapse of ABS CDOs' credit ratings. In Section 6 we study potential reasons for the ratings' collapse. Section 7 concludes.

[3]See Table 9.

1. Securitization and AAA rating

Securitization is a broad term that encompasses several kinds of structures where 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 collateralized debt obligation, some investors hold more senior claims than others. 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 of 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 that would like to sell assets about which it 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. Similar to the inuition in Myers and Majluf (1984) and in Gorton and Pennacchi (1990), pooling and tranching allows 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 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. Models of adverse selection imply that the highest rated tranches should be structured to bear no risk, however, there is a negligible difference between the conditional default probabilities of AAA, AA+ and AA rated bonds. Investors should perceive AAA, AA+ and AA as similarly low risk based on 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. For example, while money market funds are required by the Investment Company Act of 1940 to hold highly rated assets, they are not required to be AAA-rated: '...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.[4]

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, US 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 (2008) argue that the uniformity of CDO structures suggest that

[4]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.

investor demand in general is an important determinant of deal structures.

2. Structured Finance Background

The market for structured finance saw a remarkable development since the inaugural issue of mortgage-backed securities 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 an 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 market for less efficient, higher cost, financial intermediaries in the funding of debt instruments."[5] As of January 2008, there were 111,988 individual rated tranches outstanding worldwide with structured finance becoming the largest financial market in the world.

2.1. Common Structured Finance Products

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, etc. ABS appear in our sample because they are sometimes used as collateral for CDOs.

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

- Home Equity Loans securities (HEL) are residential mortgage-backed securities whose cash flows are backed by a pool of home equity loans.

[5] See Kendall (1996).

- Collateralized debt obligations (CDOs) are 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) are CDOs backed primarily by high-yield corporate bonds.
- Collateralized loan obligations (CLOs) are CDOs backed primarily by leveraged high-yield bank loans.
- Collateralized mortgage obligations (CMOs) are CDOs backed by mortgage collateral (often RMBS or CMBS rather than individual mortgages)

3. Data and Summary Statistics

This section describes our data, and displays summary statistics on structured finance products.

3.1. 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. The primary data source for this study is Moody's Structured Finance Default Risk Services (SF DRS) which covers all structured finance products issued since 1982. The Moody's data include a short description of the tranche, CUSIP number, amount issued , seniority, final maturity, and the currency in which it was issued for every structured finance security rated by Moody's. The data lists the initial Moody's credit rating of all tranches rated by Moody's and tracks 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 is rating data covering 179,760 tranches and 33,978 deals. Structured finance products are classified into 7 broad deal types: Asset-Backed Securities (ABS), Colateralized Debt Obligations (CDO), Commercial Mortgage-Backed Securities (CMBS), Mortgage-Backed Securities (MBS), Public Finance (PF), Residential Mortgage-Backed Securities (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, L.P. These data have been collected by Pershing Square Capital Management, L.P 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 the period 2005-2007. 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 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 Servicesdatabase which contains data for over 11,000 corporate entities, including more than 380,000 debts. The data span the period from 1970 to September 2008 and include information on default, recovery, rating history and outlook, as well as description of each security and information on the issuer.

3.2. The Evolution of the Structured Finance Market

Table 1 displays the evolution of the structured finance market across deal types from 1983 to 2008. 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 the year 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 tracnhes, respectively, while PF reached its highest level of 5,303 new tranches in 2007. As Table 1 demonstrates, CDOs have been 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 dollars 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 issuanace dried up. CDO issuance fell to its lowest level since the mid-1990s, with a total of 53.1

billion dollars. 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.

4. Credit Rating: Structured Finance vs. Corporate Bonds

4.1. Credit Rating Transitions of Structured Finance Products

Table 2 and Figure 2a display the behavior of structured finance rating transitions over time. We form cohorts of all existing tranches that were rated as of January 1st 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.[6] For example, the first line of Table 2, Panel A tracks rating changes for the cohort of securities that were rated as of 1/1/1990 from 1/1/1990 until 12/31/1990. As Table 2 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 upgraded, and ratings were withdrawn for 48 tranches by the end of 1990. It is important to note that Table 2 provides information for all outstanding tranches at the time of the formation of the cohort, while Table 1 displays information on new issues. Put differently, Table 1 illustrates the evolution of the structured finance market using data on the *flow* of new securities, while Table 2 presents rating transitions for the *stock* of structured finance tranches. As Table 2 shows, the number of downgrades and upgrades were roughly similar before 2002. Table 2 also reports the average magnitude of downgrades and upgrades, where a change of one 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 collateralized bond obligations were downgraded during this time as corporate credit quality deteriorated in the economic slowdown of 2001-2002. 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 by 31.7%, the number of downgrades sky rocketed 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, 2006 and 2007. Downgrades were not only more common in 2007 and 2008 but also more

[6] Rating is being 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 and ascertain credit rating for the issue.

severe. The average downgrade was -4.7 in 2007, and -5.8 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 2 and Figure 2a present the total number of upgrade and downgrade actions during a year 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 Panel B is similar to the one portrayed by Figure 2a; The deterioration in the credit quality of structured finance securities is most pronounced in 2007-2008. 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 2002-2003 that was only slightly less severe than the current crisis. In 2002-2003, 4.6% of tranches were affected by downgrades and only 2% were upgraded. The average downgrade in this period was 3.4 notches, compared to 5.2 notches in 2007-2008. However, 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).

4.2. Credit Rating Transitions of Corporate Bonds

The previous subsection demonstrated that the magnitude of the credit rating crisis of 2007-2008 was unprecedented. For comparison, we now turn to 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 based on the fundamentals of the macroeconomic environment.

Similar to the results displayed in Table 2, we report the total number of upgrade and downgrade actions on corporate bonds in Panel A of Table 3, and the number of securities affected by ratings actions in Panel B. As before, we form cohorts of all corporate bonds with available credit rating as of January, 1st of each year from 1990 to 2008, and calculate downgrades, upgrades and withdrawn rating (WR) 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 2 and 3 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 112,908 in 2008, while in the bond market the number of rated bonds in 2008 was roughly 4 times higher than its level in 1990.

Downgrades and upgrades of bonds occurred with similar frequency and magnitude before 1998. Following 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 less than 800. It is also interesting to note that during this global financial crisis, there was no spike in structured finance downgrades (See Table 2 and Figure 2a for comparison). Corporate bonds experienced a significant credit deterioration in 2001 and 2002 mainly due to 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 2a 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 change in credit rating when there is an upgrade or downgrade is fairly stable and low (Figure 3b). 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 bonds rating were well calibrated to the underlying economic risk of the issuer. In contrast, the average downgrade of structured finance products in 2007, and during the first three months of 2008 were 4.7 and 5.8 notches, respectively (Figure 3a), suggesting, that the initial distribution of structured finance credit ratings was inflated.

4.3. The Structured Finance Credit Rating Crisis

In this subsection 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 4 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. Commercial Mortgage-Backed Securities (CMBS) accounted for a significant share of downgrades between 1994-1996 and 2004-2006, but explain only 1% of the downgrades during the most recent crisis. In 2007-2008, nearly 95% of all downgrades were tied to RMBS, ABS, or CDO securities.

Table 5 supplements the data in Table 4 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), 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 5 shows, 54% of all downgrades in 2007 – a total of 4,405 – were downgrades of residential Asset-Backed Securities backed by home equity loans (HELs). The second largest sector in terms of number of downgrades in 2007 was MBS collateralized by 1st mortgages (1,342 downgrades). Securities backed by home equity loans were the worst performing assets in the first three quarters of 2008 as well, followed by Resecuritization CDOs with 2,476 downgrades (24% of the total downgrades).[7]

Another unique aspect of the downgrade wave of structured finance products in 2007 and 2008 is its concentration amongst AAA-rated tranches. The large magnitudes of the downgrades in the structured finance market shown in Figure 4a suggests that many of the tranches downgraded in 2007 and 2008 were highly rated. 11,327 (31%) of all downgrade actions in the first three quarters of 2008 involved AAA rated tranches. In contrast, Figure 4b displays a very different picture for downgrades in the corporate bond market. With the exception of 1983 ery few AAA-rated corporate bonds were downgraded between 1984 and 2008. The lack of downgrades of AAA securities in the bond market is in particular pronounced during the 2001-2002 recession and is consistent with the fairly small magnitude of downgrades in this sector, and the the fact that only a small share of corporate bonds are rated AAA.

4.4. Fallen Angels

Next we examine structured finance securities that suffered the most severe downgrades. From 1983 to 2008, 11% of tranches were eventually downgraded 8 or more notches (fallen angels), affecting 11% of deals. Table 6, Panel B 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 9% respectively. Clearly, some of this is supply driven (every CDO has

[7]Resecuritization CDOs is the term used by Moody's for CDOs that are collateralized by securities that are themselves structured. These securities are also referred to as ABS CDOs or Structured Finance CDOs. ABS CDOs account for nearly 84% of all CDO downgrades in the recent crisis

a AAA tranche but not every CDO has a Aa1 tranche). Panel C 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 home equity loans or first mortgages account for a large fraction of total downgrades. Panel E 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 home equity loans or first mortgages; 19% belong to ABS CDOs. Clearly, these are the segments where the rating model failed most severely. We now turn to analyze the failure of AAA-rated CDOs in 2008.

5. The Collapse of ABS CDO's Credit Ratings

Many of the downgrades in 2007-2008 were tied to CDOs backed by assets that are themselves structured (ABS CDOs). This section conducts a systematic micro-level analysis of ABS CDOs in an attempt to explain the collapse of this segment of the structured finance market. Our data comes from the Open Source Research data set that was assembled by Pershing Square Capital Management, L.P., and includes information on all CDOs of ABS insured by MBIA and AMBAC issued between 2005 and 2007 (534 CDOs in total). For each CDO in the data, we observe the CUSIP of each asset in the collateral pool, along with a description of collateral type, par value of securities outstanding, and initial and current (as of January 2008) ratings by Fitch, Moody's, and S&P, when available. The data enables 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.

5.1. 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 ABS, mutual fund fees, manufactured housing. However since 2003 the primary asset classes backing ABS CDOs have been subprime and non-conforming RMBS and CDO tranches. ABS CDOs are broadly classified into 2 categories: (1) High Grade ABS CDOs which are backed by AA and A-rated collateral, and (ii) Mezzanine ABS CDOs that are backed by BBB collateral. Since AA or A-rated collateral provides low credit spreads the opportunities for rating-based arbitrage are limited. As a result, high grade (HG) ABS CDOs are highly leveraged, and larger, typically between $1 billion to $3 billion. According to Lancaster

et al. (2008): "Because of 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."[8] 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.

5.2. The Collateral Structure of ABS CDO

Table 7 provides a detailed analysis of the collateral structure of 533 ABS CDOs.[9] The table reports summary statistics on the 534 collateral pools including the weighted average rating of the underlying assets (weighted by the par value of the underlying securities) and a breakdown by asset type and vintage. Portfolio allocation percentages are based on the par value securities in each CDO's collateral pool and then averaged across all CDOs.

The total 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 ABS securities in an ABS CDO, and the standard deviation is 73.1. The smallest number of securities is 26, and one ABS CDOs (DORSTF) 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 7 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 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. Home Equity Loans (HEL) are the largest asset type,

[8] Lancaster et al. (2008) p. 210, emphasis added.

[9] While the Pershing Square Capital Management, L.P. data includes information on 534 ABS CDOs, there is 1 CDOs with incomplete information on its underlying collateral

accounting on average 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 HEL, and in 10 cases, the entire collateral pool is comprised of home equity loans. 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 BS CDOs on average, while RMBS account for 15% of collateral pools. The share of Commercial Mortgage-backed Securities (CMBS) in ABS CDOs is smaller, accounting on average for 4.6% of the entire collateral pool.

Table 7 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%). Turning to vintage, following market convention we use a 6-month resolution to define vintage, thus 2005H1 stands for the first six months of 2005, and 2006H2 for the second half of 2006. Since our sample covers most of the ABS securities 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 share of 2005H2 and 2006H1 are 21.0% and 23.4%, respectively, followed by 2006H2 (15.9%), 2005H1 (15.3%), and 2007H1 (7.3%).

Figures 5a through 5d plot the evolution of the ABX indices over time. The ABX indices were launched by Markit in January 2006, each of the indices tracks the price of credit default insurance on RMBS and other ABS backed by residential mortgages. There are five indices based on the rating of the security being insured: AAA, AA, A, BBB, and BBB-. Each of the five rating-based indices are calculated for a six-month vintage; Figure 5a presents the behavior of the AAA, AA, A, BBB, and BBB- indices for the 2006H1 vintage, and Figures 5b, 5c, and 5d track the performance of the indices 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.[10] Table 8 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 through 2007H2. The last two columns of the table report the price of the

[10]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 collateral rating of BBB.

corresponding ABX index based ion 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 2006 vintages. In the fourth column of the table 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 due to the decline in CDO issuance in the second half of 2007 with the eruption of the credit crisis in July 2007.

The summary statistics in Tables 7 and 8, and Figures 5a-5d jointly point to the main woes of the ABS CDOs issued between 2005 and 2007:

1. **Lack of inter-sector diversification**: 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% in other CDOs that are 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 are invested in home equity securities that include: first-lien subprime mortgages, second-lien home equity loans, and home equity lines of credit.

3. **Low inter-vintage diversification**: about 75% of ABS CDOs were comprised of 2005H1 through 2006H2 vintages, Figures 5a and 5b shows that the 2006H1 and 2006H2 vintages performed miserably since summer 2007.

5.3. The Consequences of the ABS CDOs Collapse

Table 9 provides information on aggregate crisis related write-downs as well as write-downs for some of the largest financial institutions in the world.[11] As the table demonstrates, as of October 2008. Citigroup has written down $34.1 billion as a result of exposure to ABS CDOs, followed by AIG with $33.2 billion, Merril Lynch with $26.1, 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 (42.0%) were due to exposure to ABS CDOs.

[11] The data is from Creditflux a leading information source globally for credit trading and investing, credit derivatives, structured credit, distressed credit and credit research.

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.

6. Why did the Ratings Collapse?

After presenting the main facts about the credit rating crisis of 2007 and 2008, we turn to 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 too high credit ratings to structured finance products. We test one variant of this story which is based on 'rating shopping' in which issuers shop around among rating agencies for the highest rating, which might have led to inflated rating 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 is public knowledge, then issuers will shop for the particular rating agency with the most lax model.

6.1. Ratings Shopping

Structured finance products often exploit rating-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 the gap between the credit rating of the assets and liabilities is higher.[12] Leveraging assets up and obtaining as high credit rating as they can get may induce issuers to shop for rating. 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*

[12] See Benmelech and Dlugosz (2008) for a discussion.

the most lenient standards. (Rating Shopping - Now the Consequences, Nomura Fixed Income Research Report, February, 16, 2006. p. 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. In an alternative model, Skreta and Veldkamp (2008) construct a 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 each of the raters disclose its unbiased estimate of the asset's 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 Millbourn (2008) show that competition between the rating agencies following 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 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 downgraded and that tranches rated by both S&P and Moody's were least likely to default. Our analysis below complements their evidence by studying downgrades of securities during the 2005-2008 period 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.[13] 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 0 to 3. Panel A of Table 10 reports the the number of raters for each security in our sample.[14] Almost 10% of the tranches in the sample are unrated, either because they are equity tranches or privately-placed senior tranches. Tranches rated by only one agency account for 6.09% of the sample, most of the tranches that were initially rated by one agency were issued in 2004 and

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

[14]We count the number of ratings available at the issuance of the security.

2005. Most of the tranches are rated by either 2 or 3 rating agencies; 17,721 (58.10%) are rated by 2 raters, and 8,033 tranches (26.34%) are rated by all three agencies. Panel B of Table 10 stratifies the data by number of raters and common deal types. Whereas RMBS and Home Equity securities are more likely to be rated by only one rater, most CMBS and CDOs have either 2 or 3 raters. The fact that most structured finance products are likely to be rated by at least 2 raters, and especially complex assets such as CDOs, 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 are commonly rated by two raters.[15] 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 only one rater 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 rated by only one or by two rating agencies. Panel A shows that conditional on having only one rater, 69.72% of the tranches (1,280 ranches) were rated by S&P, while 10% of the tranches were rated by Moody's and 20% by Fitch. Panel B displays the number of tranches rated by 2 agencies. The most common combination of 2 agencies is S&P+Moody's (15,266 tranches), followed by S&P+Fitch (1,265 tranches), and Moody's+Fitch (913 tranches). Finally, Table 12 presents the distribution of rating transition by the number of raters. The Pershing Square Capital Management, L.P. data provides us with two snapshots of credit rating at 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 2 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 rate for tranches with 2 and 3 raters are 16.24% and 21.84%, respectively. One potential explanation for the positive relation between number of raters and downgrades is that an omitted variable correlated with number of rater also drives future downgrades. For example, if complex CDOs that are harder to evaluate and hence are more prone to rating mistakes are required to have

[15] Fender and Kiff (2004).

at least 2 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 we run a probit regression relating the number of raters to the likelihood of a rating downgrade:

$$Pr(downgrade_{i,as\,of\,Jan\,2008} = 1) = \Phi(\mathbf{Raters_{i,issue\,date}}\beta + \mathbf{Vintage_i}\Gamma + \mathbf{Type_i}\theta), \qquad (1)$$

where $\Phi(\cdot)$ is the is the standard normal cumulative distribution function, $\text{Raters}_{i,t=issue}$ is a vector that includes the number of raters or dummies for the identity of the raters. Vintage_i is a vector of vintage fixed-effects, and 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).

The first column in Table 13 reports the coefficients from estimating regression 1 with dummies for one and two raters. The 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 only one rater 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 only by one agency. 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.[16] In the next two specifications reported in the third and fourth columns we try to identify the relationship between the rater's identity and probability of subsequent downgrades. Our results show that after controlling for the number of raters, tranches that were rated only by S&P 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 only few upgrades in the sample we find that tranches rated by S&P less likely to be upgraded with a year compared to those rated by Fitch and Moody's. These results are consistent with the downgrade results in Table 13.

Finally, in the last three columns 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

[16] We cannot include all three dummies in one specification because of perfect multicollinearity.

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 rated by only one rater are not only more likely to be downgraded, but also experience more severe downgrades. Likewise, tranches rated only by S&P experience larger downgrades than those rated only by Fitch or Moody's. Ashcraft Goldsmith-Pinkham and Vickery (2009) find similar results in a recent study of MBS ratings.

The results in Table 13 provide suggestive evidence 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 watch list following an update of its CDO rating criteria. Out of the 18 deals, 14 carried ratings only from S&P. 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'."[17] The model used by S&P to rate CDOs backed by corporate debt included an assumption of zero correlation between companies in different industries. According to Adelson (2008): '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."[18] Structured finance experts at Wachovia Securities called the assumption 'outdated and implausible', specifically addressing the issue of rating shopping: "[g]iven S&P's generous inter-industry correlation assumption of 0%, it is not surprising that S&P has the dominant market share of the publicly rated part of this market."[19]

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 rated by either two or three raters are less likely to be downgraded compared to those rated by only one agency. When we compare the effect of one rater to that of two raters (first column of the table) we find that being rated by only

[17] Adelson (2006) p. 1)
[18] Adelson (2006) p. 1.
[19] Cifuentes and Chen (2005)

one agency increases the probability of a downgrade by 13.8 percentage points.[20] Moreover, the last two columns of the table show that the probability of a downgrade significantly declines with the number of raters.

6.2. 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 and, 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 assign 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" where each of the agencies constructs a rating model that will produce high ratings at the lowest cost.[21] One common model used by the rating agencies is the mixed-binomial model which is used in a wide class of models analyzing defaults. The key inputs in the binomial 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. Appendix A presents a simple version of Moody's Binomial Model.

In January 2003, industry experts expressed concerns about a 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...All three of*

[20] When we include one and three rater the effect is smaller but not statistically significant.
[21] See Cifuentes (2008) for a similar argument.

the modeling approaches mentioned above 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). p. 255-256.)

Moody's introduced the binomial model in 1996, and used different variants of the model 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 Gaussian Copula for many structured finance products including ABS CDOs. In a technical document that is listing the details of their new rating methodology Moody's explains the need to revise their 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. p. 2.)

According to Cifuentes (2008) ABS CDO which 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. (Cifuentes (2008) p. 9)

However what spurred the growth in ABS CDO 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 market place, but rather has a causal effect on the creation of new securities that cater to the model as well.

7. 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 2002-2003, there was deterioration in the credit quality of structured finance securities that was only slightly less severe than the current period, after adjusting for the size of the market. Studying downgrades over this period, we find that the following three deal types suffered the most downgrades: High-Yield CBO, ABS backed by tobacco settlement bonds, and ABS backed by manufactured housing. Downgrades of these three types of securities account for approximately 50% of downgrade actions between 2002 and 2004. Figures 6a and 6b shows how the market for CBOs and ABS backed by Manufactured Housing evolved after their poor performance in 2002-2004. We focus on CBOs and ABS-Manufactured Housing given that tobacco settlement bond issuance is sporadic and driven by tobacco litigation.[22] In 2003, CBO issuance fell to 2.4% of its peak in 2000; in the following years it only recovered to 11% of that peak value. In 2004, ABS backed by manufactured housing fell to 3.4% of its peak level in 1999; afterwards, maximum issuance only reached 14% of its 1999 peak. According to de Servingy and Jobst (2007) the poor performance of high-yield CBOs and the perception that they were very risky led to the disappearance of CBOs

[22]Issuance of ABS backed by tobacco settlement bonds, in 2004, fell to 2% of its peak level in 2002. The number of ABS Tobacco Settlements deals did not return to its previous levels, however in 2007, the dollar value of issuance of these securities surpassed their 2002 level.

from the new issue market as illustrated by Figure 6a. The pattern of boom and bust in financial innovation is well documented.[23]

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 2001-2002 and 2008 suggests a pattern of boom and bust, where a certain kind of structuring becomes widespread in good macroeconomic times and survives relatively unscathed until the economic climate worsens.

8. 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 2007-2008. 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. 2002 and 2003 saw a spike in downgrades which 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 collateralized bond obligations (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, where 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

[23] See Persons and Warther (1997).

2007 and 2008, approximately 62% of downgrades can be attributed to securities backed by home equity loans 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 home equity loans, 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 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 2001/2002 recession when 30% of corporate bonds were downgraded, the average downgrade was only 1.8 notches. Downgrades of structured finance securities in the 2007/2008 crisis were much more severe, averaging around 5-6 notches.

Using micro-level data on ABS CDOs – one of the structured asset classes that performed relatively poorly in the recent crisis – we provide suggestive evidence that ratings 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 2 or 3 agencies.

Appendix A

Mixed Binomial models are used in a wide class of models analyzing defaults.[24] We start by assuming that the default probability of a mortgage is a Bernoulli random variable, taking the value of 1 with probability p and 0 with probability $1-p$. Next, we consider that we have a pool of mortgages, where the default probability of mortgage i is denoted X_i, and is equal to 1 if the mortgage defaults, and 0 otherwise. Each mortgages 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 a 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 thw law of iterated expectations and variance decomposition, we have

$$\bar{E}X_i = \bar{p}, VX_i = \bar{p}(1-\bar{p}), \;\; and \;\; Cov(X_i, X_j) = E(\tilde{p}^2) - \tilde{p}^2,$$

We can now express the default correlation as

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

As Lando (2004) shows, the default correlation is 0 if $\tilde{p}$ is constant. Moreover, the default correlation in 2 is always nonnegative in this model.[25]

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:

$$VD_n = n\bar{p}(1-\bar{p}) + n(n-1)(E(\tilde{p}^2) - \tilde{p}^2). \tag{3}$$

and

$$V(D_n/n) = \bar{p}(1-\bar{p})/n + n(n-1)/n^2(E(\tilde{p}^2) - \tilde{p}^2) \to .E(\tilde{p}^2) - \bar{p}, \;\; as \;\; n \to \infty \tag{4}$$

[24] This section draws heavily from Lando (2004).
[25] See Lando (2004) p. 217.

That is for 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:

$$P(D_n/n < \theta) \longrightarrow \int_{\theta}^{o} f(p)dp \equiv F(\theta), \;\; as \;\; n \to \infty$$

That is for large pool of assets, the distribution of $\tilde{p}$ determines the risk distribution of the portfolio, the more variability in the mixture distribution of $\tilde{p}$, the more correlation of defaults there is, and hence 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. On the other hand, as the correlation increases, the value of the least senior tranches increases as well as more weight is being put on the other tail of the distribution - and very few defaults are more likely as well. 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 highly rated risk-free tranches as well.

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Table 1:
Structured Finance Tranche Issuance By Year and Type

Year	ABS(%)	CDO(%)	CMBS(%)	MBS(%)	PF(%)	RMBS(%)	Other(%)	Number of 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	0.3	0	0	88.3	0	300
1989	10.6	0.1	0.9	0.1	0.1	87.8	0.3	705
1990	13.4	0.7	1.0	0.1	0.2	83.8	0.9	1,010
1991	18.5	1.1	1.0	0.3	0.2	77.9	1.2	1,333
1992	22.6	1.0	1.2	0.3	0.2	73.2	1.5	1,704
1993	25.3	0.8	1.9	0.2	0.3	69.5	2.0	2,105
1994	26.4	1.9	2.3	0.2	0.5	66.6	2.2	2,571
1995	29.8	1.8	2.6	0.2	0.8	62.1	2.7	2,988
1996	32.7	1.7	2.6	0.2	1.6	56.3	4.9	3,567
1997	37.0	2.1	2.7	0.2	4.1	49.4	4.5	4,088
1998	37.7	3.3	3.0	0.1	8.1	40.9	6.9	5,050
1999	38.2	4.5	3.5	0.1	13.0	33.6	7.2	6,010
2000	39.0	6.1	4.0	0.1	14.7	28.2	7.8	6,856
2001	39.0	7.4	4.5	0.1	15.1	25.3	8.5	7,667
2002	37.9	8.9	5.1	0.1	14.9	23.6	9.5	8,704
2003	36.8	10.8	5.4	0.1	14.7	22.1	10.2	9,893
2004	35.6	13.5	5.6	0.1	14.6	19.8	10.8	10,964
2005	34.1	15.5	5.8	0.1	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

This table presents percent of total issuance by number for main deal types as well as total issuance by number. (a) Rating actions as of 9/22/2008.

Table 2:
Structured Finance Upgrades and Downgrades

Panel A: Total Upgrades and Downgrades*

Cohort formed:	Rated Tranches	DNG #	DNG Avg. change**	UPG #	UPG Avg. change	WR #	WR percent
1/1/90	2,825	85	-1.2	-	0.0	48	1.7%
1/1/91	3,993	155	-1.2	-	0.0	124	3.1%
1/1/92	5,571	87	-1.8	122	2.1	828	14.9%
1/1/93	7,290	149	-1.5	131	1.5	1,336	18.3%
1/1/94	9,320	192	-2.8	237	1.9	1,038	11.1%
1/1/95	11,083	148	-2.0	352	1.7	637	5.7%
1/1/96	13,403	175	-2.7	272	1.9	1,065	7.9%
1/1/97	15,298	49	-1.5	439	1.5	1,100	7.2%
1/1/98	18,214	447	-2.4	366	2.0	1,924	10.6%
1/1/99	20,419	330	-3.6	380	2.2	2,169	10.6%
1/1/00	23,358	463	-1.5	642	2.3	2,235	9.6%
1/1/01	26,905	476	-2.5	557	1.7	3,084	11.5%
1/1/02	31,901	1,847	-2.9	720	1.8	4,598	14.4%
1/1/03	38,147	2,515	-3.1	699	2.5	7,920	20.8%
1/1/04	43,476	1,798	-3.6	1,216	2.4	6,953	16.0%
1/1/05	52,843	874	-2.5	2,202	2.2	6,878	13.0%
1/1/06	71,462	986	-2.5	2,748	2.3	7,085	9.9%
1/1/07	94,127	8,109	-4.7	2,990	1.9	6,692	7.1%
1/1/2008^	442,908	36,880	-5.6	1,269	2.4	6,380	1.4%

Panel B: Tranches Affected

Cohort formed:	Rated Tranches	DNG # of tranches	DNG % of tranches	UPG # of tranches	UPG % of tranches	UPG&DNG # of tranches	UPG&DNG percent
1/1/90	2,825	80	2.8%	-	0.0%	-	0.0%
1/1/91	3,993	154	3.9%	-	0.0%	-	0.0%
1/1/92	5,571	84	1.5%	121	2.2%	-	0.0%
1/1/93	7,290	145	2.0%	131	1.8%	18	0.2%
1/1/94	9,320	181	1.9%	236	2.5%	1	0.0%
1/1/95	11,083	134	1.2%	350	3.2%	-	0.0%
1/1/96	13,403	144	1.1%	269	2.0%	-	0.0%
1/1/97	15,298	46	0.3%	439	2.9%	-	0.0%
1/1/98	18,214	371	2.0%	359	2.0%	2	0.0%
1/1/99	20,419	311	1.5%	374	1.8%	4	0.0%
1/1/00	23,358	401	1.7%	638	2.7%	6	0.0%
1/1/01	26,905	421	1.6%	545	2.0%	5	0.0%
1/1/02	31,901	1,298	4.1%	710	2.2%	5	0.0%
1/1/03	38,147	1,947	5.1%	681	1.8%	20	0.1%
1/1/04	43,476	1,634	3.8%	1,168	2.7%	9	0.0%
1/1/05	52,843	737	1.4%	2,138	4.0%	8	0.0%
1/1/06	71,462	885	1.2%	2,495	3.5%	14	0.0%
1/1/07	94,127	6,801	7.2%	2,834	3.0%	88	0.1%
1/1/2008(a)	442,908	29,545	6.7%	1,254	0.3%	464	0.1%

* A single tranche downgraded k times in the year shows up k times. Tranches that are downgraded and withdrawn show up in the dng column and the wr column. This is in contrast to Moodys method where a tranche that is downgraded then withdrawn in the same year only shows up as withdrawn. ** Average size of a single downgrade action on a tranche (not just the difference in rating between beginning of year and end of year) (a) Rating actions as of 9/22/2008.

Table 3:
Corporate Bonds Upgrades and Downgrades

Panel A: Total Upgrades and Downgrades*

Cohort formed:	Rated Bonds	DNG #	DNG Avg. change**	UPG #	UPG Avg. change**	WR #	WR percent
1/1/90	3,016	349	-1.5	287	1.3	321	10.6%
1/1/91	3,115	343	-1.4	231	1.4	326	10.5%
1/1/92	3,582	582	-1.4	141	1.4	621	17.3%
1/1/93	3,899	465	-1.3	142	1.6	772	19.8%
1/1/94	4,229	398	-1.3	264	1.4	435	10.3%
1/1/95	4,599	342	-1.3	426	1.3	445	9.7%
1/1/96	5,124	441	-1.3	457	1.3	520	10.1%
1/1/97	6,727	732	-1.2	522	1.3	754	11.2%
1/1/98	8,514	1,524	-1.6	577	1.3	985	11.6%
1/1/99	10,623	2,137	-1.5	800	1.5	1,117	10.5%
1/1/00	11,867	1,752	-1.6	898	1.6	1,398	11.8%
1/1/01	12,437	3,190	-1.7	807	1.5	1,989	16.0%
1/1/02	12,885	5,027	-1.8	431	1.5	2,068	16.0%
1/1/03	13,056	2,453	-1.6	611	1.4	2,579	19.8%
1/1/04	13,523	1,233	-1.3	1,540	1.5	2,425	17.9%
1/1/05	13,305	1,424	-1.5	1,626	1.4	2,425	18.2%
1/1/06	12,727	2,107	-1.3	1,687	1.2	2,082	16.4%
1/1/07	12,586	1,539	-1.4	1,869	1.2	1,851	14.7%
1/1/2008 (a)	12,753	1,482	-2.2	367	1.3	1,517	11.9%

Panel B: Bonds Affected

Cohort formed:	Rated Bonds	DNG # of Bonds	DNG % of Bonds	UPG # of Bonds	UPG % of Bonds	UPG&DNG # of Bonds	UPG&DNG percent
1/1/90	3,016	326	10.8%	285	9.4%	3	0.1%
1/1/91	3,115	319	10.2%	209	6.7%	7	0.2%
1/1/92	3,582	537	15.0%	138	3.9%	6	0.2%
1/1/93	3,899	420	10.8%	130	3.3%	2	0.1%
1/1/94	4,229	361	8.5%	251	5.9%	12	0.3%
1/1/95	4,599	310	6.7%	420	9.1%	3	0.1%
1/1/96	5,124	410	8.0%	443	8.6%	4	0.1%
1/1/97	6,727	550	8.2%	516	7.7%	7	0.1%
1/1/98	8,514	1,271	14.9%	555	6.5%	11	0.1%
1/1/99	10,623	1,865	17.6%	771	7.3%	36	0.3%
1/1/00	11,867	1,429	12.0%	870	7.3%	37	0.3%
1/1/01	12,437	2,241	18.0%	778	6.3%	43	0.3%
1/1/02	12,885	3,885	30.2%	416	3.2%	23	0.2%
1/1/03	13,056	2,211	16.9%	591	4.5%	22	0.2%
1/1/04	13,523	1,069	7.9%	1,459	10.8%	34	0.3%
1/1/05	13,305	1,149	8.6%	1,520	11.4%	23	0.2%
1/1/06	12,727	1,767	13.9%	1,555	12.2%	162	1.3%
1/1/07	12,586	1,411	11.2%	1,802	14.3%	41	0.3%
1/1/2008 (a)	12,753	1,332	10.4%	367	2.9%	5	0.0%

* A single bond downgraded k times in the year shows up k times. Bonds that are downgraded and withdrawn show up in the dng column and the wr column. This is in contrast to Moodys method where a bond that is downgraded then withdrawn in the same year only shows up as withdrawn. ** Average size of a single downgrade action on a bond (not just the difference in rating between beginning of year and end of year) (a) Rating actions as of 9/22/2008.

Table 4:
Structured Finance Downgrades by Cohort and Deal Type

Cohort formed:	Rated n (dng)	ABS n(dng)	ABS %(dng)	CDO n(dng)	CDO %(dng)	CMBS n(dng)	CMBS %(dng)	RMBS n(dng)	RMBS %(dng)
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	1847	544	29%	893	48%	174	9%	5	0%
2003	2515	1427	57%	699	28%	200	8%	24	1%
2004	1798	1126	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	8109	5246	65%	1057	13%	85	1%	1388	17%
2008 (a)	36880	12522	34%	8086	22%	257	1%	13492	37%

(a) Rating actions as of 9/22/2008.

Table 5:
Asset Types with Most Downgrades

		Types with most downgrades (1st)			Types with most downgrades (2nd)		
Year:	total(dng)	Asset type	n(dng)	%(dng)	Asset type	n(dng)	%(dng)
1990	85	MBS - 1st Mortgage	70	82%	ABS	3	4%
1991	155	MBS - 1st Mortgage	133	86%	ABS	4	3%
1992	87	MBS - 1st Mortgage	31	36%	CMBS	11	13%
1993	149	MBS - 1st Mortgage	130	87%	ABS	3	2%
1994	192	MBS - 1st Mortgage	143	74%	CMBS	16	8%
1995	148	MBS - 1st Mortgage	80	54%	CMBS	23	16%
1996	175	MBS - 1st 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 - FS IRBs	130	28%	ABS	100	22%
2001	476	High-Yield CBO	97	20%	CDO - Balance Sheet	57	12%
2002	1847	High-Yield CBO	566	31%	ABS	198	11%
2003	2515	ABS	677	27%	ABS	327	13%
2004	1798	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	8109	HEL	4405	54%	MBS - 1st Mortgage	1342	17%
2008	36880	MBS - 1st Mortgage	13015	35%	HEL	9459	26%

(a) Rating actions as of 9/22/2008.

Table 6:
Fallen Angels

Panel A: Fallen Angles 1983-2008

Number of tranches	Number of deals	Fallen tranches	Fallen deals
179,760	33,978	19,421	3,879

Panel B: Fallen Angels by Credit Ratings

Initial Rating	Number	Percent
AAA	3,707	19%
Aa1	992	5%
Aa2	1,809	9%
Aa3	1,221	6%
A1	1,058	5%
A2	2,036	10%
A3	1,421	7%
Baa1	1,403	7%
Baa2	2,421	12%
Baa3	1,735	9%
Ba1	805	4%
Ba2	738	4%
Ba3	75	0%
Total	19,421	100%

Panel C: Fallen Angels by Vintage

Vintage	Number	Percent
1983-1996	171	1%
1997	58	0%
1998	113	1%
1999	153	1%
2000	140	1%
2001	170	1%
2002	318	2%
2003	304	2%
2004	405	2%
2005	842	4%
2006	3,127	16%
2007	5,404	28%
2008	8,216	42%
	19,421	100%

Panel D: Fallen Angels by Deal Type

Deal	Number	Percent
ABS	8,752	45%
RMBS	6,218	32%
CDO	4,111	21%
Other	249	1%
CMBS	49	0%
PF	42	0%
Total	19,421	100%

Panel E: Asset Types with Most Fallen Angels

Asset Type	Number	Percent
HEL - Closed-End - Not High LTV	6,662	34%
MBS - First Mortgage	6,037	31%
ABS CDO - Cash Flow	1,729	9%
ABS CDO - Synthetic	1,318	7%
HEL - Closed-End - High LTV	813	4%
ABS CDO - Other	509	3%

Table 7:
ABS CDO Collateral structure

	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max
Collateral amount (million)	$1,006.7	$492.8	$849.7	$1,283.3	$916.9	$100.0	$11,132.2
Number of collateral securities	149.7	103	137	182	73.1	26	990
Collateral weighted-average credit rating							
S&P	A	BBB+	A-	AA	N/A	BBB-	AAA
Moody's	A2	Baa2	A3	Aa2	N/A	Baa3	Aaa
Collateral share by asset type:							
CDO	18.8%	3.2%	9.3%	22.6%	25.9%	0.0%	100.0%
Home Equity ABS	54.7%	36.3%	59.9%	83.3%	31.8%	0.0%	100.0%
RMBS	15.0%	0.0%	9.0%	21.5%	19.8%	0.0%	100.0%
CMBS	4.6%	0.0%	0.0%	3.8%	13.1%	0.0%	100.0%
Collateral share by mortgage type:							
Prime	8.2%	0.0%	4.5%	11.2%	12.2%	0.0%	91.8%
Midprime	29.7%	13.2%	29.1%	45.0%	20.2%	0.0%	77.5%
Alt-A	5.2%	0.0%	2.0%	7.1%	8.0%	0.0%	72.6%
Subprime	24.2%	13.1%	24.8%	34.5%	16.3%	0.0%	100.0%
Collateral vintage							
2005H1	15.3%	2.4%	8.5%	22.4%	17.9%	0.0%	96.1%
2005H2	21.0%	4.9%	16.9%	31.8%	18.4%	0.0%	96.7%
2006H1	23.4%	4.8%	21.8%	37.3%	19.7%	0.0%	100.0%
2006H2	15.9%	1.3%	8.4%	26.4%	18.0%	0.0%	90.5%
2007H1	7.3%	0.0%	2.4%	7.9%	12.4%	0.0%	93.4%
2007H2	0.9%	0.0%	0.0%	0.6%	1.9%	0.0%	13.8%

Table 8:
Collateral Vintage by Credit Rating

	Collateral weighted average S&P rating			*Corresponding ABX price (as of September 25, 2008)*	
	ABS CDO Grade		High - Mezzanine		
	High Grade A	Mezzanine Grade BBB	difference (t-test)	A	BBB
Collateral vintage					
2005H1	15.7%	16.0%	-0.003	N/A	N/A
	[7.9%]	[9.9%]	(-0.27)	N/A	N/A
2005H2	21.0%	22.7%	-0.017	N/A	N/A
	[16.0%]	[22.1%]	(-0.89)	N/A	N/A
2006H1	21.6%	28.6%	-0.070 ***	22.42	9.44
	[16.8%]	[29.1%]	(-3.99)		
2006H2	16.5%	16.2%	0.004	8.54	5.35
	[7.5%]	[13.2%]	(0.25)		
2007H1	8.4%	5.9%	0.025 **	7.42	5.33
	[3.1%]	[2.1%]	(2.49)		
2007H2	1.1%	0.6%	0.005 ***	8.50	5.85
	[0.0%]	[0.0%]	(3.70)		
Number of CDOs	299	205	–	–	

Table 9:
ABS CDOs and Write-Downs

Panel A: Crisis-related Write-Downs for Selected Financial Institutions ($ millions)

	latest announcement	ABS CDOs	Corporate credit	RMBS	Other	Total
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 Streans	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	9,357
Deutsche Bank	10/30/2008	2,092	5,820	3,386	3,677	14,974
Fortis Bank	8/4/2008	4,359	3,660	144	-	8,163
ING	11/12/2008	565	-	8,028	25	8,617
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	5/15/08	510.0	-	-	-	510.0
Mitsubishi UFJ	8/13/08	359.5	2,348	921	11	3,640
Mizuho	11/13/08	3,898	629	2,539	584	7,650
National Australia Bank	10/21/08	669.5	-	-	-	669.5
Sumitomo Mitsui	11/19/07	561.7	-	-	-	561.7

Panel B: Aggregate Crisis-related Write-Downs ($ millions)

	ABS CDOs	Corporate credit	RMBS	Other	Total
Insurers/Asset managers	61,074	6,320	10,386	38,3471	116,126
North American Banks	84,319	23,702	42,272	59,011	209,305
European Banks	63,464	18,579	26,423	62,634	171,100
Asia/Emerging markets Banks	9,358	4,724	5,728	3,743	23,553
Total	218,216	53,324	84,810	163,735	520,084

Table 10:
Number of Raters

Panel A: Number of raters over time

	Number of raters			
	0	1	2	3
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	2,479	845
	(4.76%)	(2.62%)	(69.07%)	(23.54%)
entire period	2,888	1,857	17,721	8,033
	(9.47%)	(6.09%)	(58.10%)	(26.34%)

Panel B: Number of raters by security type

	Number of raters			
	0	1	2	3
CMBS	10	16	1,116	257
	(0.71%)	(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%)	(0.93%)	(77.41%)	(19.24%)

Table 11:
Most common raters

Panel A: Securities rated by only one of the agencies

	Fitch	Moody's	S&P	Total
pre 2004	20	21	92	133
	(15.04%)	(15.79%)	(69.17%)	(100.0%)
2004	66	32	341	439
	(15.03%)	(7.29%)	(77.68%)	(100.0%)
2005	97	46	635	778
	(12.47%)	(5.91%)	(81.62%)	(100.0%)
2006	162	56	174	392
	(41.33%)	(14.29%)	(44.39%)	(100.0%)
2007	29	27	38	94
	(30.85%)	(28.72%)	(40.43%)	(100.0%)
entire period	374	182	1,280	1,836
	(20.37%)	(9.91%)	(69.72%)	(100.00%)

Panel B: Securities rated by two agencies

	S&P+Moody's	S&P+Fitch	Moody's+Fitch	Total
pre 2004	402	86	62	550
	(73.09%)	(15.64%)	(11.27%)	(100.0%)
2004	1,695	225	73	1,993
	(85.05%)	(11.29%)	(3.66%)	(100.0%)
2005	4,413	566	384	5,363
	(82.29%)	(10.55%)	(7.16%)	(100.0%)
2006	6,433	313	314	7,060
	(92.12%)	(4.43%)	(4.45%)	(100.0%)
2007	2,323	75	80	2,479
	(93.71%)	(3.03%)	(3.23%)	(100.0%)
entire period	15,266	1,265	913	17,445
	(87.51%)	(7.25%)	(5.23%)	(100.00%)

Table 12:
Rating Transitions and Number of Raters

	1	2	3	Total
number of downgrades	238	2,912	1,788	4,938
(downgrade %)	(12.81%)	(16.24%)	(21.84%)	(17.65%)
number of upgrades	85	561	369	1,015
(upgrade %)	(4.57%)	(3.13%)	(4.51%)	(3.63%)
number unchanged	1,535	14,454	6,030	22,019
(unchanged %)	(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%)

Table 13:
Rating Shopping: Probit regression models for probability of a downgrade

Dependent Variable=	Pr(down)	Pr(down)	Pr(down)	Pr(down)	rating change	rating change	rating change
Number of raters			0.045 a	0.086 a			0.132
			(0.004)	(0.007)			(0.503)
One rater	0.061 b	0.075 b			-2.716 a	-1.808 a	
	(0.030)	(0.043)			(0.793)	(0.727)	
Two rater	-0.005				-0.909 a		
	(0.010)				(0.201)		
Three raters		0.027 a				0.909 a	
		(0.009)				(0.201)	
only S&P			0.169 a	0.322 a			-2.579 a
			(0.049)	(0.034)			(0.300)
only Moody's			0.084 b	0.223 a			-1.937 c
			(0.049)	(0.070)			(1.011)
only Fitch			0.093	0.240 a			-2.043 a
			(0.073)	(0.056)			(0.861)
S&P and Moody's				0.061 a			-0.828
				(0.016)			(0.534)
Moody's and Fitch				0.046 c			-0.692 a
				(0.029)			(0.151)
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/Adjusted R^2	0.12	0.12	0.12	0.13	0.15	0.15	0.15

Table 14:
Rating Shopping and AAA Securities

Dependent Variable=	Pr(down)	Pr(down)	Pr(down)	Pr(down)
Number of raters			-0.016 a	-0.048 a
			(0.004)	(0.007)
One rater	0.138 b	0.077		
	(0.061)	(0.068)		
Two rater	0.014 a			
	(0.003)			
Three raters		-0.014 a		
		(0.003)		
only S&P			0.050	-0.018
			(0.085)	(0.042)
only Moody's			0.007	-0.019 c
			(0.046)	(0.061)
only Fitch			0.005	0.007
			(0.004)	(0.008)
S&P and Moody's				-0.049 a
				(0.006)
Moody's and Fitch				-0.018 a
				(0.0003)
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	0.21	0.21	0.21	0.23

Table 15:
Credit Rating Dispersion

	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max	# of tranches where diff=0	# of tranches
S&P - Fitch	-0.02	0.0	0.0	0.0	0.601	-5.0	5.0	7,671	9,507
S&P - Moody's	-0.26	0.0	0.0	0.0	0.881	-10.0	7.0	16,806	23,839
Moody's - Fitch	0.31	0.0	0.0	1.0	0.665	-4.0	10.0	6,478	9,150

Table 16:
Ratings Correlation

	S&P	Moody's	Fitch
S&P	1.0		
Moody's	0.983	1.0	
	(0.000)		
Fitch	0.962	0.979	1.0
	(0.000)	(0.000)	

Figure 1: CDO and Mortgage-related securities Issuance 2004-2008

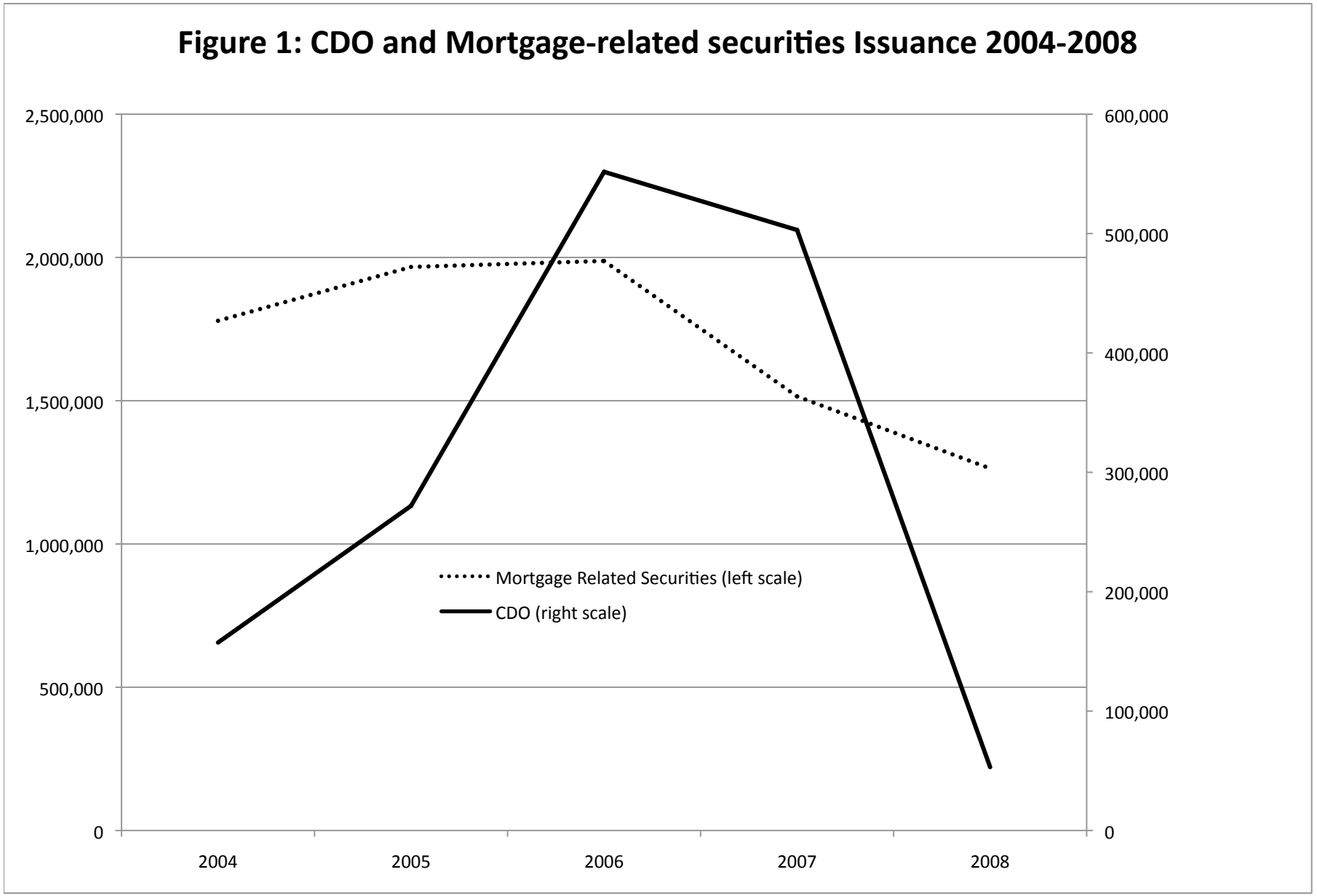


Figure 2a
Number of Downgrades vs. Upgrades of Structured Finance Products

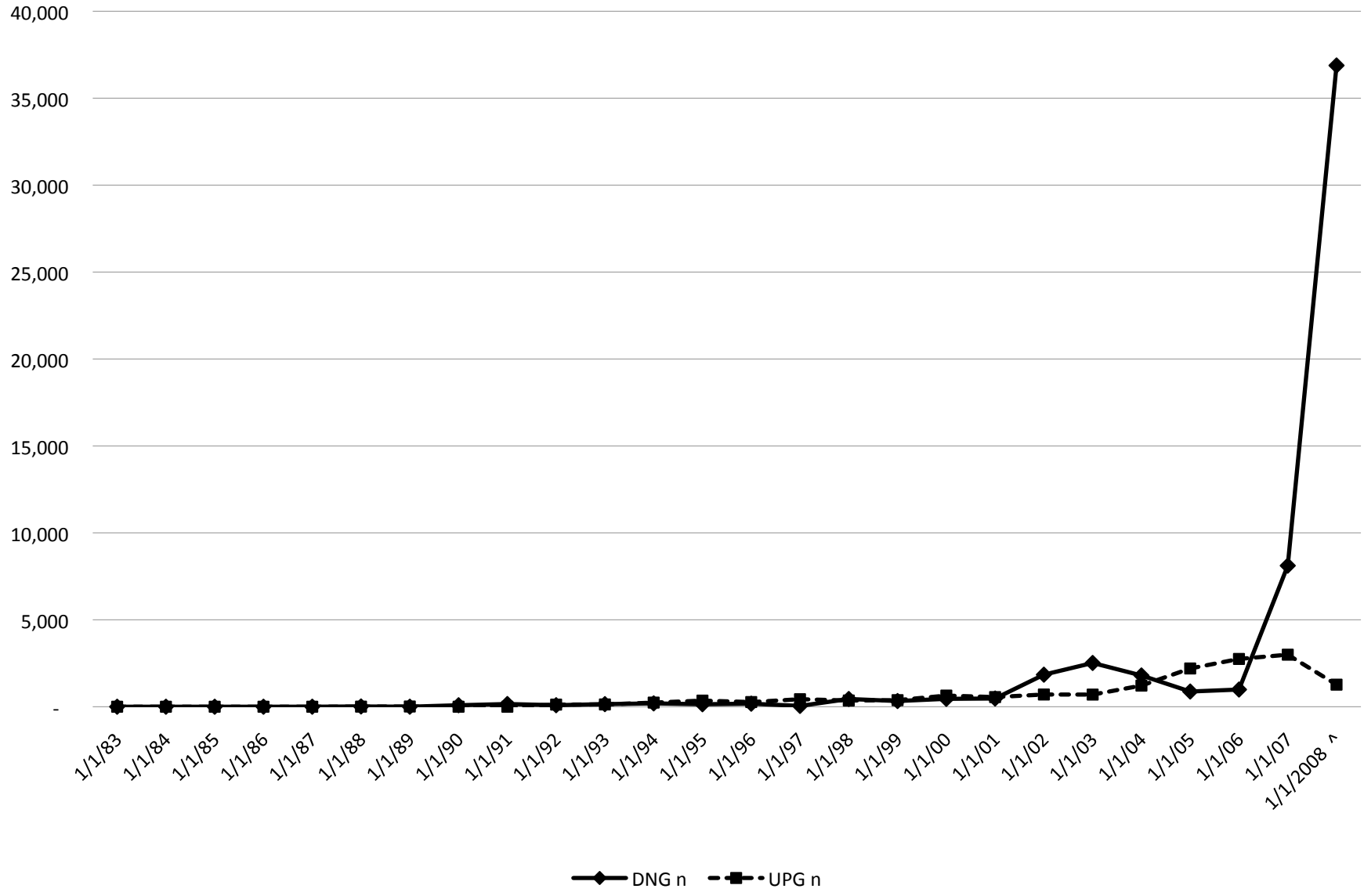


Figure 2b
Number of Downgrades vs. Upgrades of Corporate Bonds

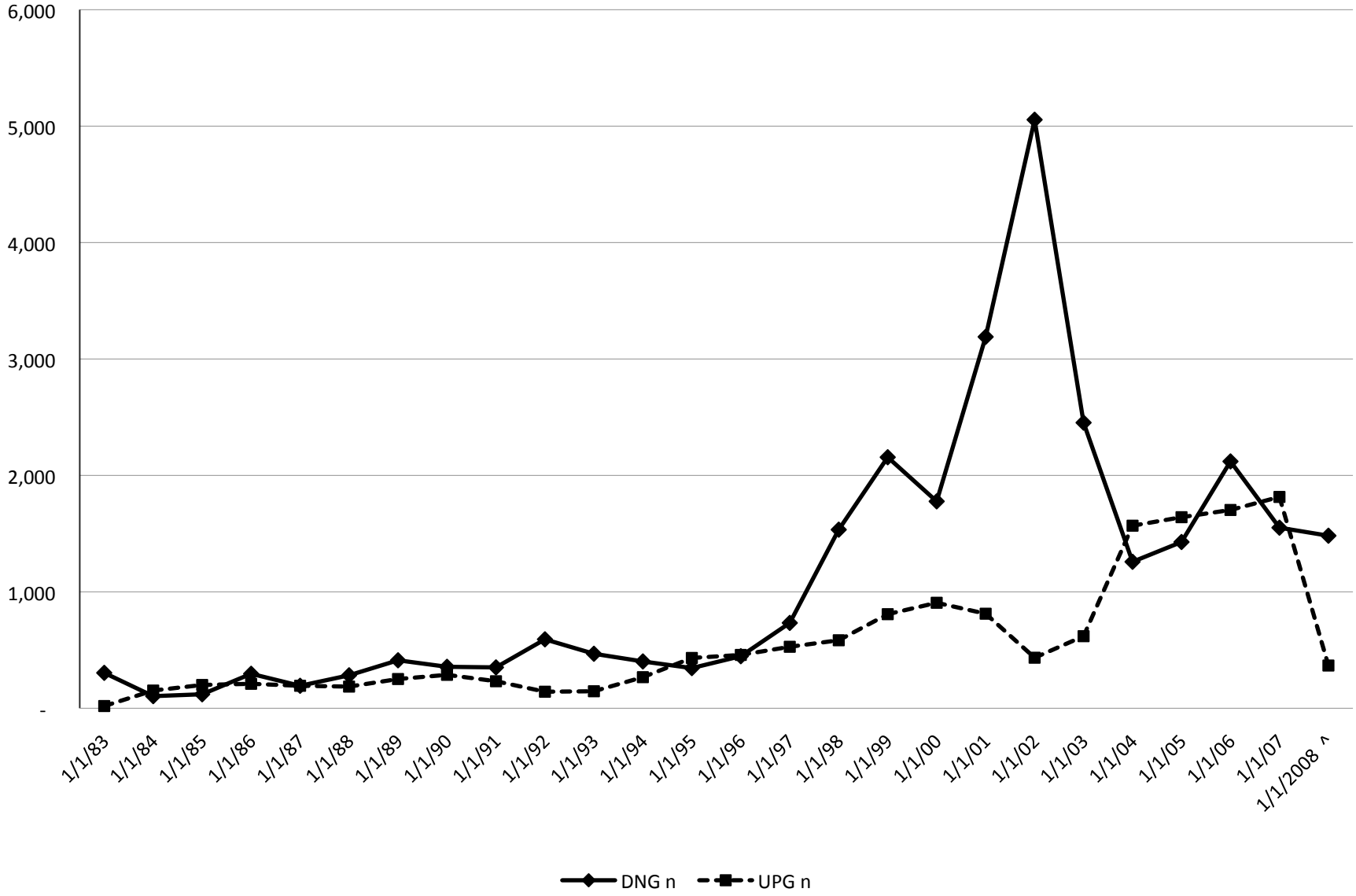


Figure 3a

Number of Structured-Finance Downgrades vs. Average Downgrade level

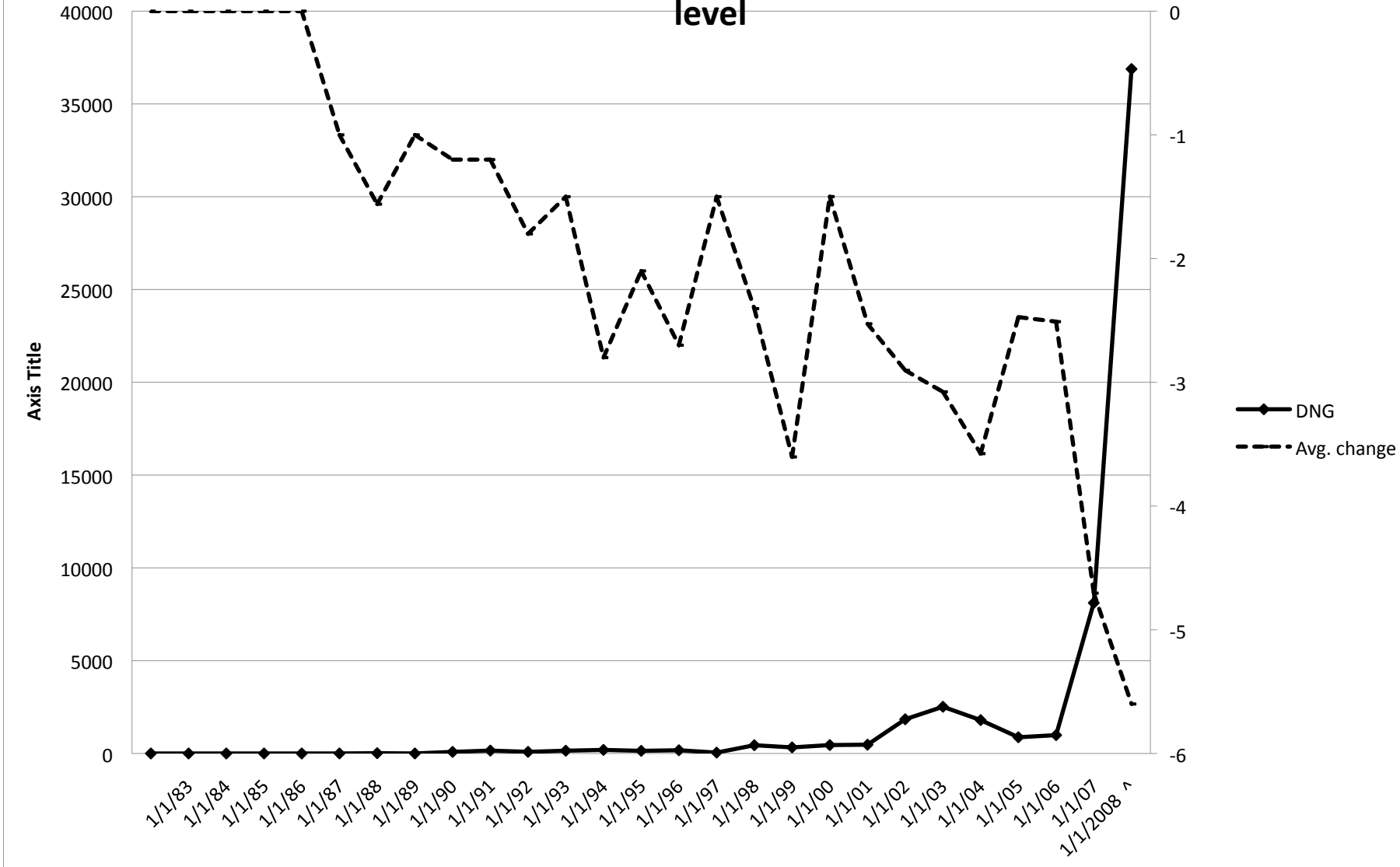


Figure 3b
Number of Corporate Bonds Downgrades vs. Average Downgrade level

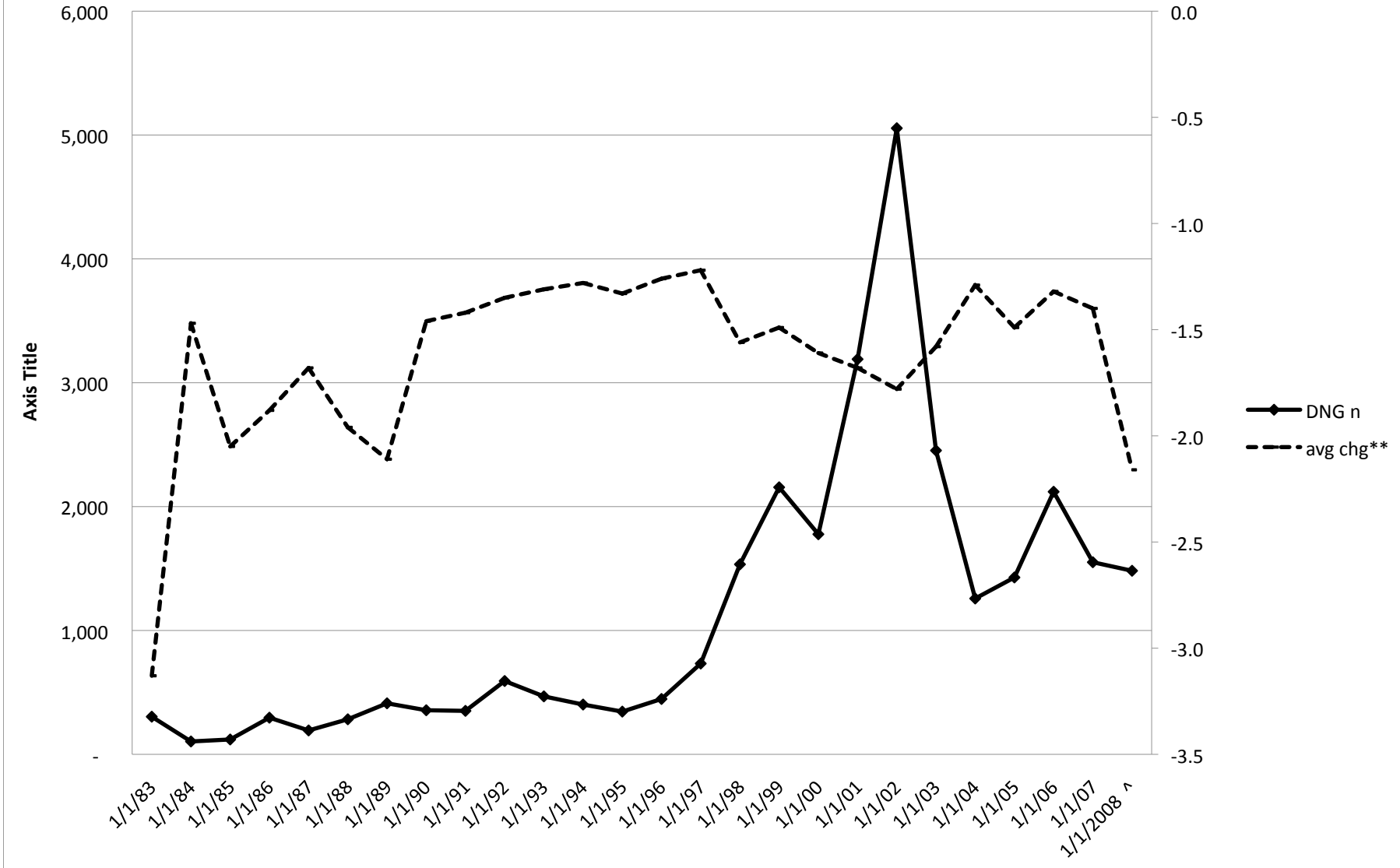
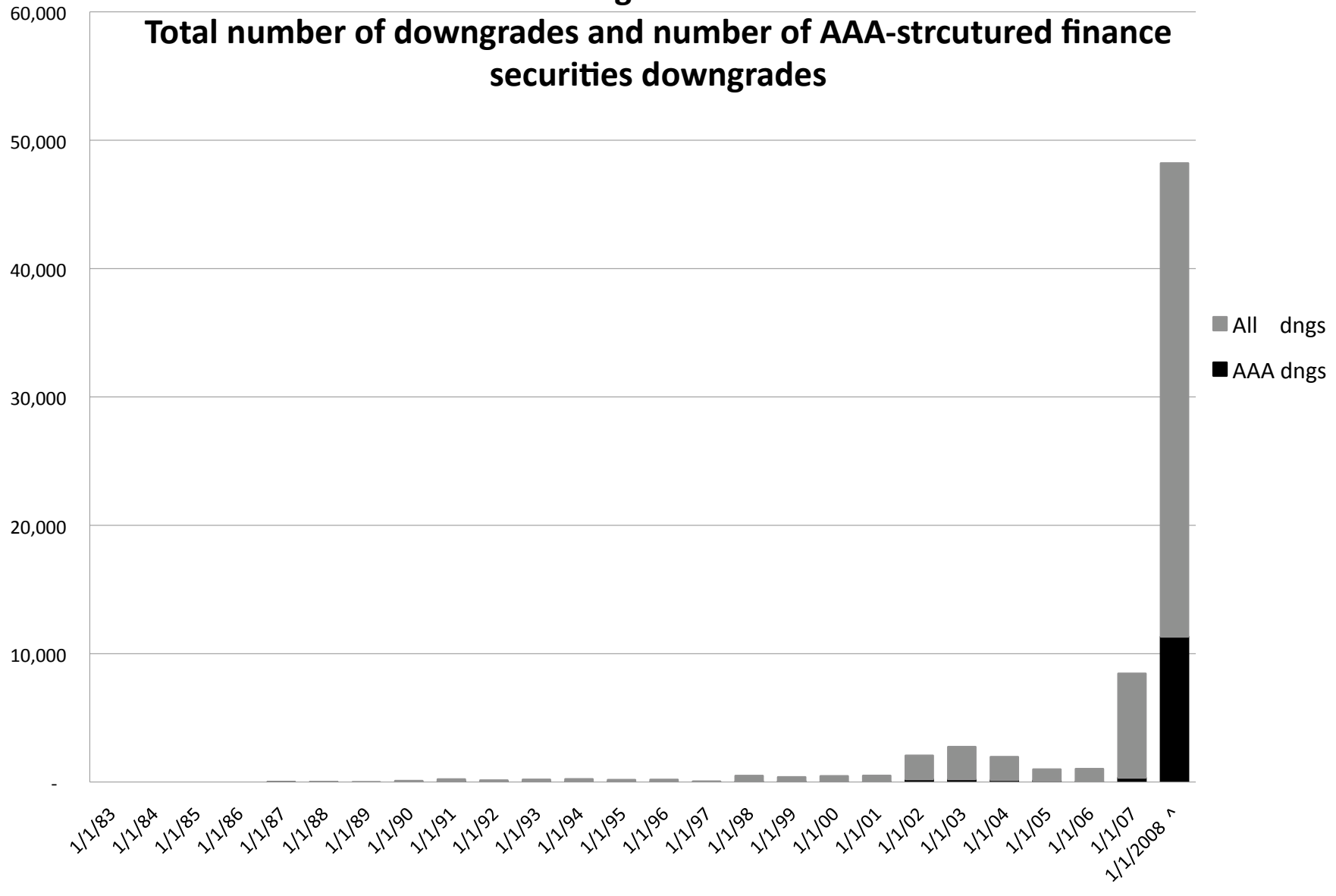


Figure 4a


Total number of downgrades and number of AAA-strcutured finance securities downgrades
60,000
50,000
40,000
30,000
20,000
10,000
-
All dngs
AAA dngs
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
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1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/2008 ^

Figure 4b

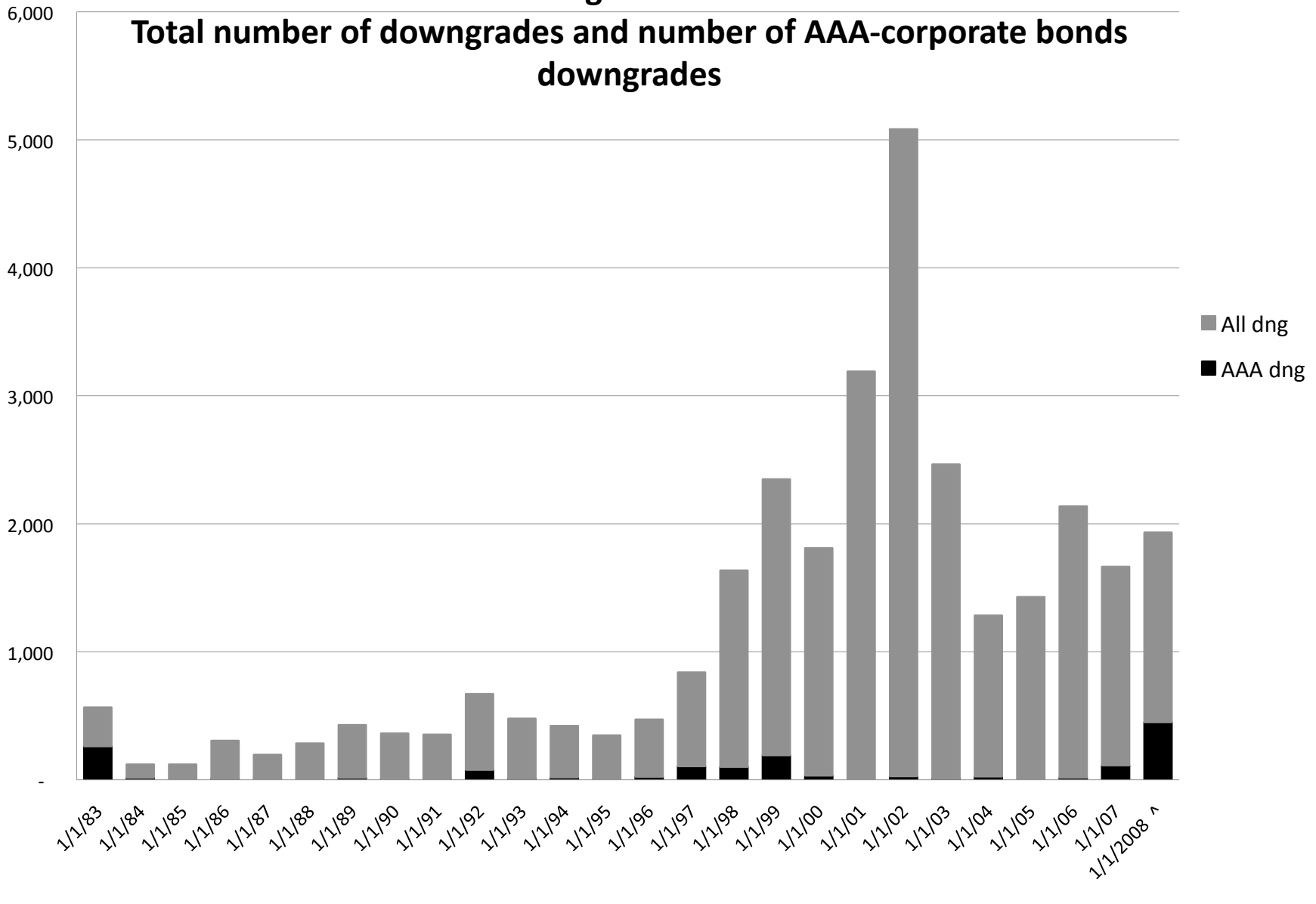

Total number of downgrades and number of AAA-corporate bonds downgrades
6,000
5,000
4,000
3,000
2,000
1,000
-
All dng
AAA dng
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/2008 ^

Figure 5a: ABX1 (2006H1 Vintage) Prices by Rating

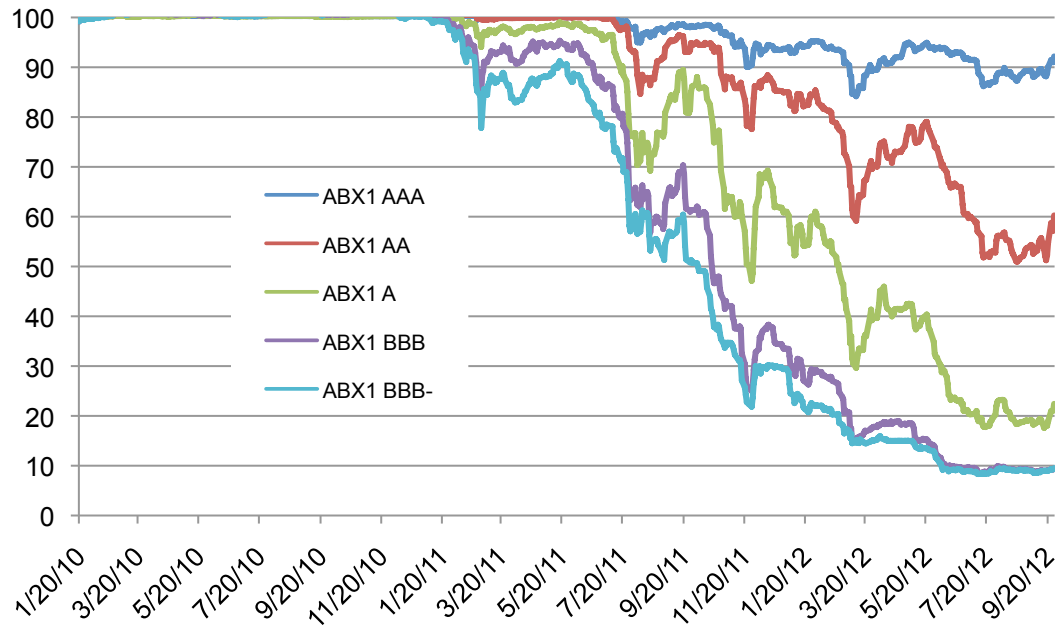
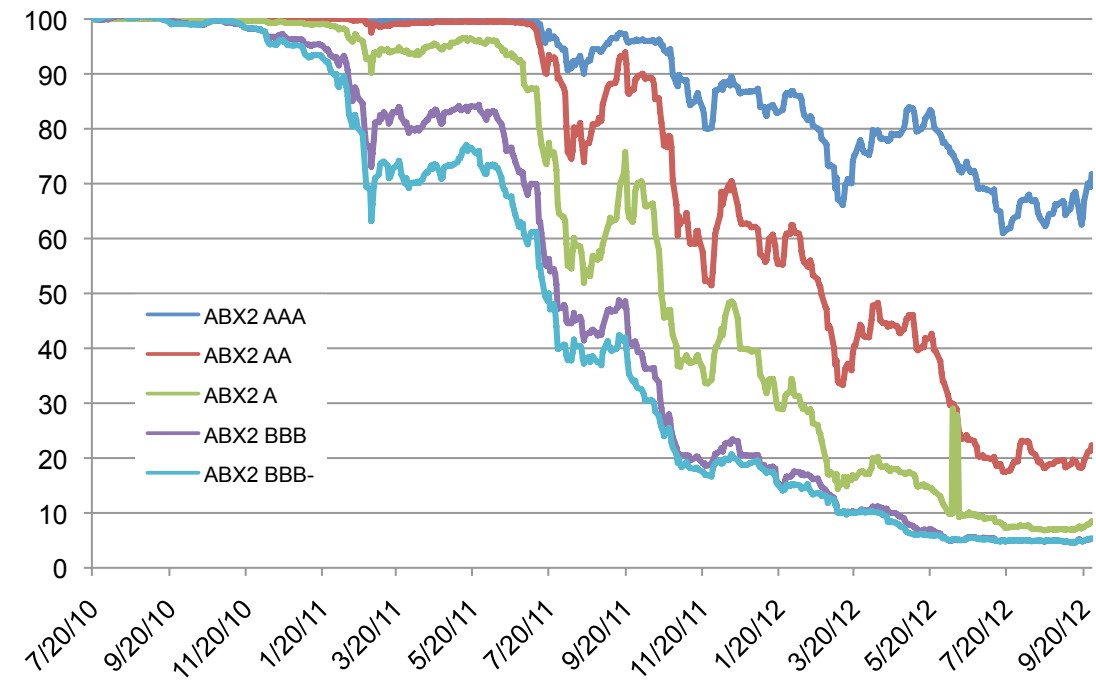


Figure 5b: ABX2 (2006H2 Vintage) Prices by Rating



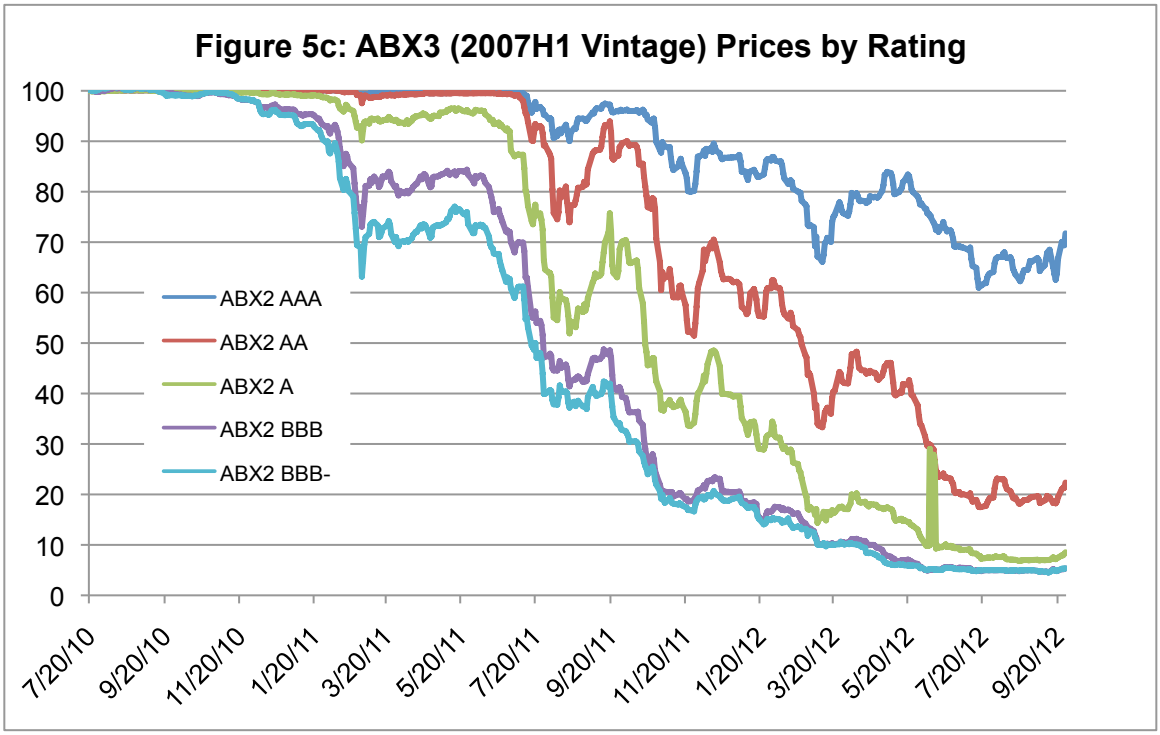


Figure 5c: ABX3 (2007H1 Vintage) Prices by Rating
100
90
80
70
60
50
40
30
20
10
0
ABX2 AAA
ABX2 AA
ABX2 A
ABX2 BBB
ABX2 BBB-
7/20/10
9/20/10
11/20/10
1/20/11
3/20/11
5/20/11
7/20/11
9/20/11
11/20/11
1/20/12
3/20/12
5/20/12
7/20/12
9/20/12

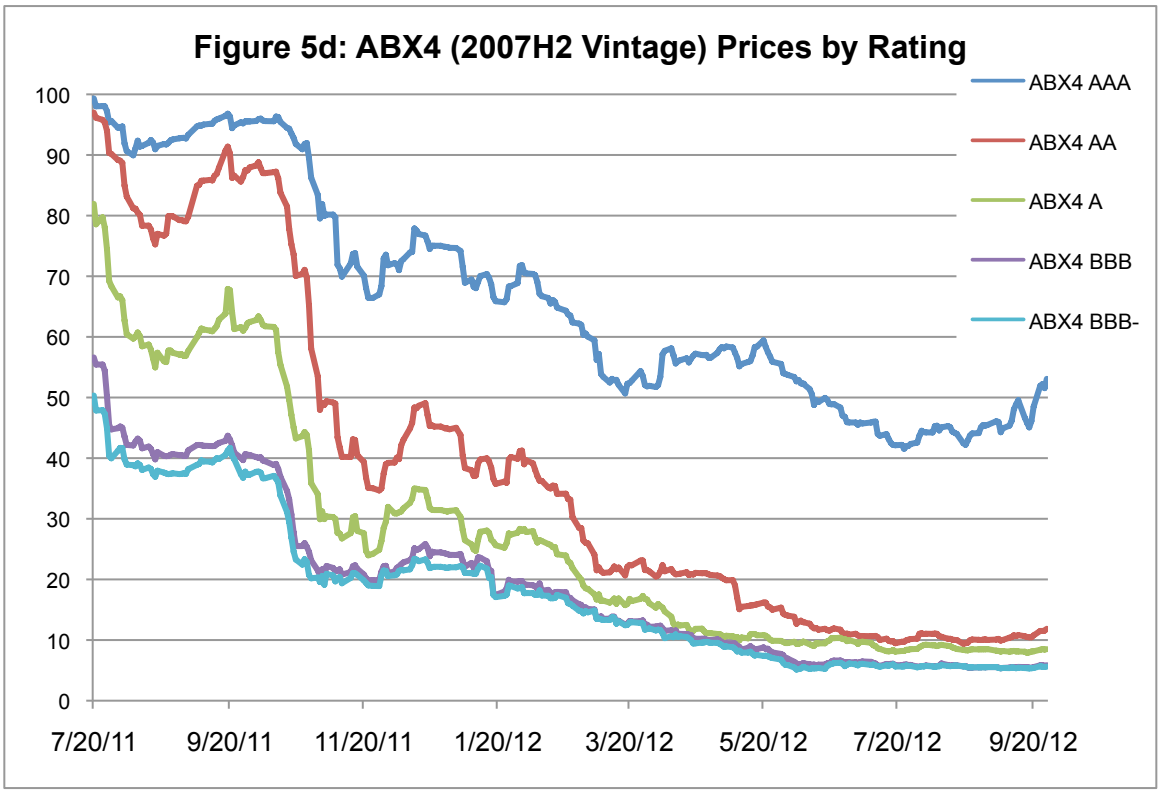


Figure 5d: ABX4 (2007H2 Vintage) Prices by Rating
100
90
80
70
60
50
40
30
20
10
0
ABX4 AAA
ABX4 AA
ABX4 A
ABX4 BBB
ABX4 BBB-
7/20/11
9/20/11
11/20/11
1/20/12
3/20/12
5/20/12
7/20/12
9/20/12

Figure 6a: CBO Issuance

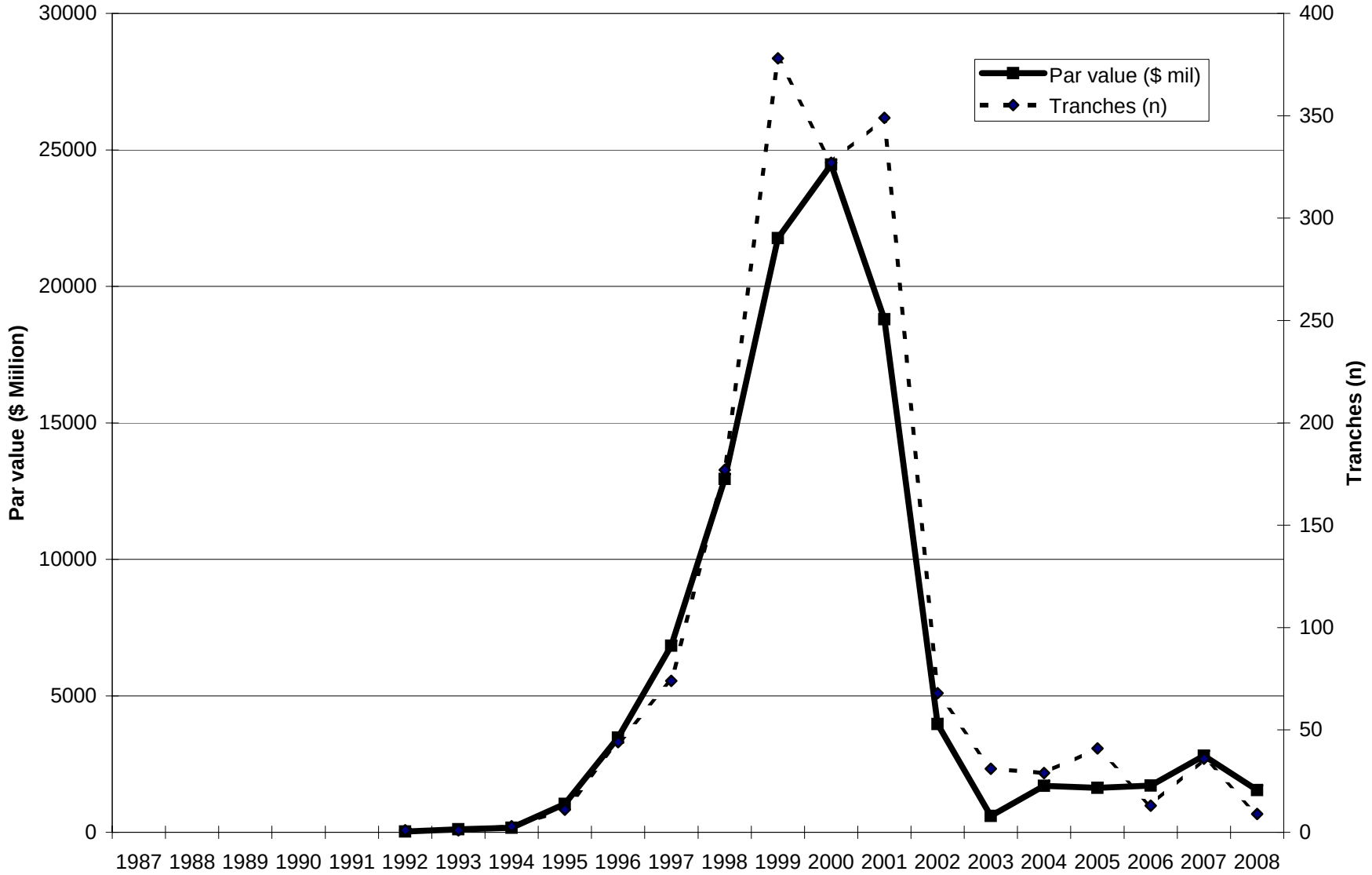


Figure 6b: ABS - Manufactured Housing