The Story of the CDO Market Meltdown:

An Empirical Analysis

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Abstract:

Collateralized debt obligations (CDOs) have been responsible for $542 billion in write-downs at financial institutions since the beginning of the credit crisis. In this paper, I conduct an empirical investigation into the causes of this adverse performance, looking specifically at asset-backed CDO's (ABS CDO's). Using novel, hand-collected data from 735 ABS CDO's, I document several main findings. First, poor CDO performance was primarily a result of the inclusion of low quality collateral originated in 2006 and 2007 with exposure to the U.S. residential housing market. Second, CDO underwriters played an important role in determining CDO performance. Lastly, the failure of the credit ratings agencies to accurately assess the risk of CDO securities stemmed from an over-reliance on computer models with imprecise inputs. Overall, my findings suggest that the problems in the CDO market were caused by a combination of poorly constructed CDOs, irresponsible underwriting practices, and flawed credit rating procedures.

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1. Introduction

Collateralized debt obligations (CDOs), once a money making machine on Wall Street, have been responsible for $542 billion of the nearly trillion dollars in losses suffered by financial institutions since 2007.[1] Perhaps most disturbing about these losses is that most of the securities being marked down were initially given a rating of AAA by one or more of the three nationally recognized credit rating agencies,[2] essentially marking them as "safe" investments.[3] While the credit rating agencies have taken heavy criticism for their role in mis-rating billions of dollars in CDO tranches,[4] they were not alone in their mistake. Indeed, almost all market participants, from investment banks to hedge funds, failed to question the validity of the models that were luring them into a false sense of security about the safety of these manufactured securities. How could so many brilliant financial minds have misjudged, or worse, simply ignored, the true risks associated with CDOs? In this paper, I use novel, hand-collected data from 735 ABS CDOs to shed light on this mystery, investigating the causes of adverse performance in CDOs backed by asset-backed securities (ABS CDOs).[5] I characterize the relative importance of general CDO properties, underwriting banks, and credit rating agencies in contributing to the collapse of the CDO market and document several findings.

First, the properties of the CDO collateral, including asset class and vintage, are the most important factor in explaining the variation in CDO performance. In particular,

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[1] According to CreditFlux Newsletter, as of January 8, 2008.
[2] Moody's, S&P, and Fitch.
[3] According to financial consultant Mike Blum, underwriters would often pay for all three agencies to rate their deals to "convey the impression that these bonds were rock-solid."
[4] See Roger Lowenstein's article, "Triple-A Failure," for an overview of the criticism of the rating agencies.
[5] ABS CDOs are CDOs whose collateral consists primarily of asset-backed securities, as opposed to CDOs backed by corporate bonds or whole loans. ABS CDOs accounted for more than 90% of the U.S. CDOs downgraded in 2007.

CDOs with a high level of exposure to residential mortgage securities, specifically those backed by subprime and Alt-A adjustable-rate mortgages, consistently underperformed other CDOs. In addition, losses were higher for CDOs with a large amount of 2006 and 2007 vintage collateral. Secondly, the identity of the CDO underwriter is a significant predictor for CDO performance, even after controlling for collateral type. This finding shows that there was variation among banks' underwriting standards, with some banks consistently more careful in their collateral selection. For example, J.P. Morgan's CDOs consistently underperformed, while those from Goldman Sachs were among the top performers. Lastly, the original credit ratings assigned to CDOs failed to capture the true risks of these securities. There was a striking uniformity in the initial proportion of AAA given to all CDO deals, despite the wide variety in the characteristics of their collateral and the quality of their underwriters. On the whole, the original credit ratings of CDO bonds, most notably those given to the senior tranches, were grossly inflated.

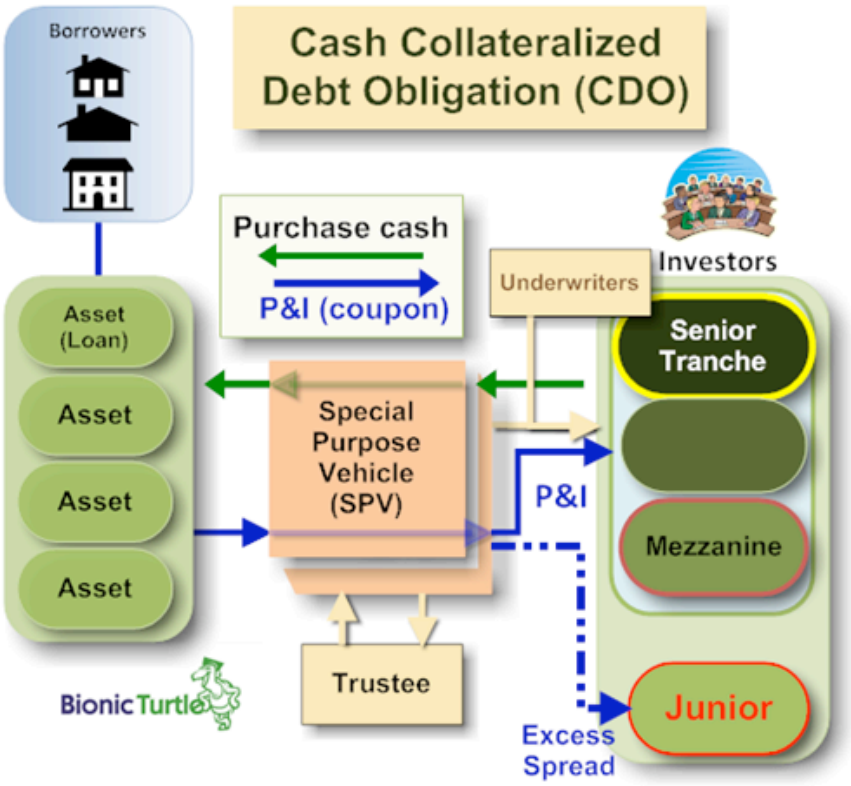
The structure of the paper is as follows: Section 2 gives an overview of CDOs, the role of the rating agencies, and the involvement of investment banks. Section 3 outlines guiding questions and hypotheses. Section 4 presents results of the multivariate regression analysis. Section 5 discusses key findings and Section 6 concludes.

2. Background: The Rise and Fall of the CDO

2.1 The Evolution of Collateralized Debt Obligations

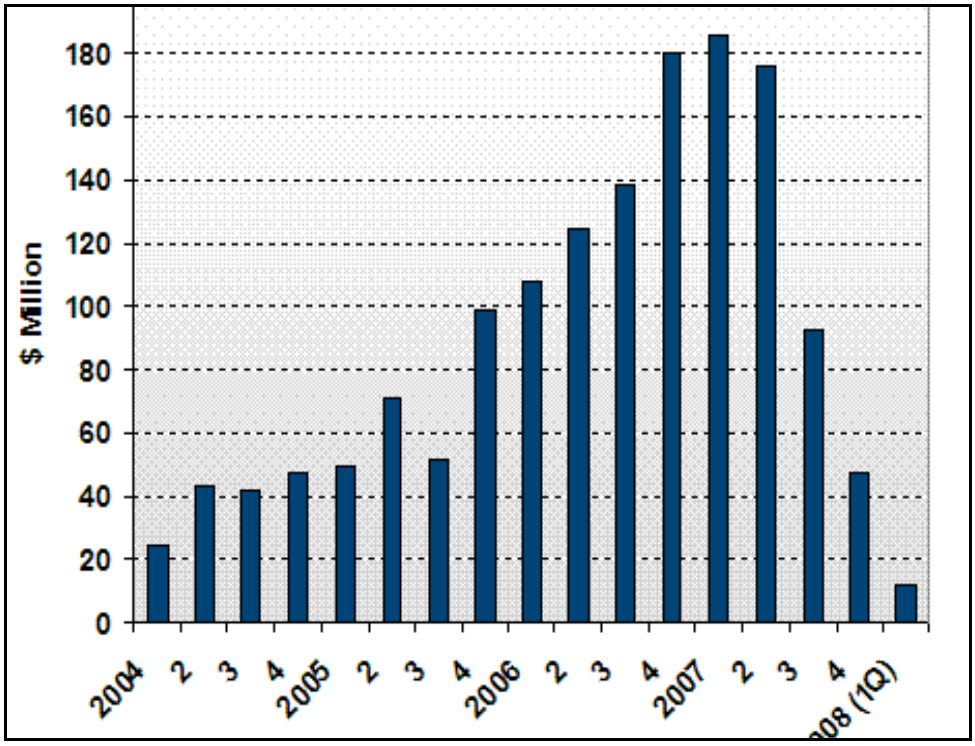
The basic principle behind a CDO involves the re-packaging of fixed income securities and the division of their cash flows according to a strict waterfall structure. A CDO is constructed by creating a "brain-dead" company, a special purpose entity (SPE) or structured investment vehicle (SIV), which buys assets and issues bonds backed by the assets' cash flows. The bonds are divided into a number of tranches with different claims on the principal and interest generated by the CDO's assets. The mechanics of a typical CDO are illustrated in Diagram A.

Diagram A: Mechanics of a CDO
Source: Bionicturtle.com



In order to understand the recent implosion of the CDO market, it is helpful to examine the factors that fueled the market's explosive growth since 2004, as illustrated in Diagram B. There are two main factors that made the pooling and tranching of loans so attractive to the investors and investment banks that created CDOs – regulatory capital relief and risk reallocation.[6]

Diagram B: CDO Issuance
Source: Asset-Backed Alert



Securitization helped many banks to free up their balance sheets, allowing them to pool and tranche a bundle of loans and either sell the tranches to outside investors or put them

[6] Bluhm (2003) analyzes the different factors that have contributed to the success of CDO trading: spread arbitrage opportunities, regulatory capital relief, funding, and economic risk transfer. Mitchell (2004) argues that tranching only creates value in the presence of market imperfections, such as asymmetric information and adverse selection, and that originators can only profit from underwriting if they "possess some sort of comparative advantage…to the extent that other intermediaries can acquire identical assets, any potential profit form tranching may be quickly driven to zero"(Mitchell 11).

in off-balance sheet vehicles. By removing loans from their books, underwriters of CDOs could decrease the capital charges imposed by the Basel Accords and their own internal risk requirements and thereby free up cash to make new loans.[7]

The second rationale for CDOs involved the pooling and re-allocation of risk. In theory, by pooling together a number of imperfectly correlated assets, it is possible to use diversification to decrease idiosyncratic risk. Furthermore, tranching the cash flows made it possible to create securities with different risk profiles appropriate to specific investors.[8] This was especially important for institutional investors, many of who can purchase only investment-grade securities (defined as those with a credit rating of BBB- or higher). CDOs allowed these investors to gain exposure to assets that, on their own, had been too risky, while investors looking to take more risk and receive potentially higher returns could buy the most junior or "equity" CDO tranches.[9] Table 1 summarizes the typical liability structures of ABS CDOs, showing the average subordination levels and yields for each rated tranche. The average number of tranches is 7.4 and the most common structure is the following: three AAA-rated tranches (2 of which are super senior bonds), one A-rated tranche, one BBB-rated tranche, and one unrated tranche. The average transaction size is $829 million and the average tranche size is $109 million.

[7] Basel I required that banks hold capital of at least 8% of their loans. Basel II modified this slightly by imposing different charges based on the riskiness of the asset, often determined by the assets' credit ratings. See Garcia et. al. (2008) for a more detailed explanation of capital requirement calculations.
[8] Krahnen (2005) finds that the senior tranches bear the highest degree of systematic risk, and Gibson (2004) shows that most of the credit risk is contained in the equity tranche, regardless of the size of its notional amount.
[9] According to Lehman Brother's estimates, as of November 13, 2007, the biggest holders of AAA-rated CDO tranches included bond insurers, insurance companies, CDO commercial paper put providers, SIV and ABCP conduits, and investment banks.

Table 1: Capital Structure in CDOs

This table summarizes the average liability structure of 735 ABS CDOs issued from 1999-2007. The % with tranche is the percent of CDOs that contained a tranche with the given rating at its issuance. The average number of tranches refers to the number per CDO with the given rating. The yield refers to the average coupon paid to the tranches, and the subordination refers to the percent of credit enhancement of the given tranche.
Source: Lehman Live

Rating	% With Tranche	Average # of Tranches	Yield	Subordination
AAA	100.0%	2.5	3.4%	21.5%
AA+	7.4%	0.1		16.8%
AA	81.7%	0.9	4.1%	14.0%
AA-	12.7%	0.1		11.0%
A+	8.1%	0.1		16.8%
A	59.6%	0.6	4.3%	11.0%
A-	25.5%	0.3		12.0%
BBB+	11.3%	0.1		14.5%
BBB	80.1%	0.9	4.4%	6.8%
BBB-	19.3%	0.2		10.2%
Below BBB-	37.2%	0.5		--
Unrated	86.3%	1.1		--
	--	7.4		--

Initially, it seemed that every player was benefiting from CDOs and issuance exploded, reaching $50 billion in 2006.[10] The rating agencies were making record profits as the demand for rated structured products skyrocketed.[11] Institutional investors loved the high-yielding AAA securities created from ABS CDOs, CDO underwriters collected fees and achieved regulatory capital relief by off-loading their assets, and CDO collateral managers earned hefty returns by retaining the equity tranches, benefiting from the low cost of funding senior tranches. However, by 2003, several changes in CDOs were working to create the perfect storm that was unleashed upon financial markets in 2007.

[10] Source: Securities Industry and Financial Markets Association
[11] According to a PBS special report, structured finance represented at least 40% of the revenues at the CRAs since 2000. Over that time, Moody's went public, saw its stock increase six fold, and its earnings grow by 900%.

First, the collateral composition of CDOs changed as collateral managers looked for ways to earn higher yields. The managers began investing more heavily in structured finance securities, most notably subprime RMBS, as opposed to corporate bonds. Furthermore, they invested in the mezzanine tranches of these securities, moves designed to create higher-yielding collateral pools. Table 2 documents the evolution of ABS CDO assets from 1999-2007, illustrating the profound increase in subprime RMBS (HEL) collateral, with 36% of the 2007 CDO collateral comprised of HEL bonds. Figure 1 depicts a detailed breakdown of the collateral backing the 2005-2007 vintage ABS CDOs and shows that the majority of collateral came from subprime and midprime RMBS.

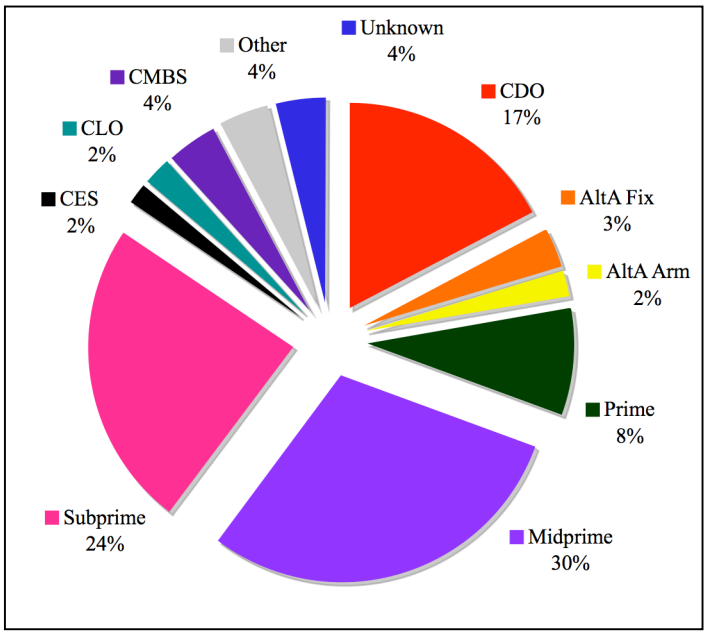
Table 2: Average Principal Allocations by Asset-Class

This table summarizes the average collateral composition for of 735 ABS CDO deals originated between 1999-2007. The abbreviations stand for: HEL – home equity loan (includes all RMBS less than prime), RMBS – residential mortgage-backed securities (by prime borrowers), CMBS – commercial mortgage-backed securities, other ABS – other asset-backed securities (including auto-loans, credit-cards, etc.).
Source: Lehman Live

Year of Origination	Deals	% HEL	% RMBS	% CMBS	% CDO	% Other ABS
1999	1	0%	14%	9%	3%	74%
2000	16	5%	1%	2%	12%	80%
2001	28	7%	6%	8%	18%	61%
2002	47	16%	6%	7%	8%	63%
2003	44	29%	14%	3%	18%	37%
2004	101	35%	14%	6%	17%	28%
2005	153	37%	16%	10%	11%	25%
2006	217	33%	16%	7%	9%	35%
2007	135	36%	12%	8%	14%	29%
TOTAL	742	34%	14%	8%	12%	32%

Figure 1: Collateral Composition of ABS CDOs, 2005-2007 Vintage

This Figure presents the collateral makeup of 2005-2007 ABS CDOs. Abbreviations – ARM: adjustable-rate mortgage, CES: closed-end second lien.
Source: OpenSource Model.



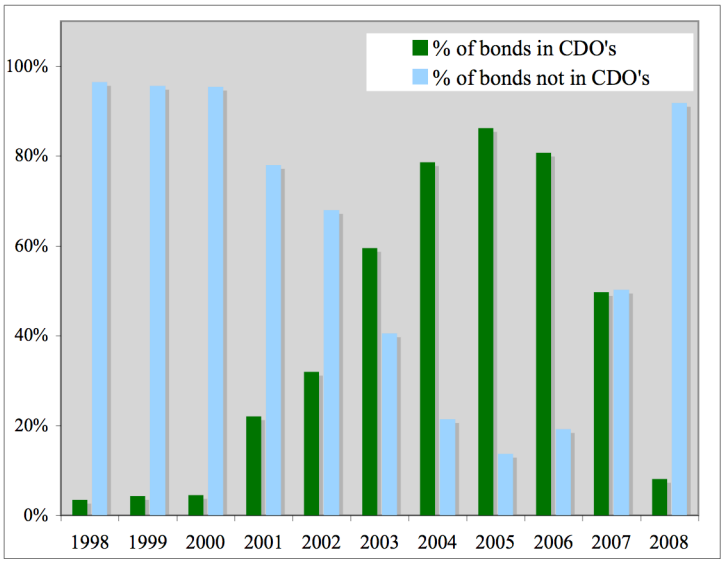
In response to the explosion in CDO issuance, the increased demand for subprime mezzanine bonds began to outpace their supply.[12] Figure 2 shows the percentage of subprime bonds that were repackaged into CDOs, illustrating the drastic increase in subprime demand by CDOs. This surge in demand for subprime mezzanine bonds helped to push spreads down – so much so that the bond insurers and real estate investors that had traditionally held this risk were priced out of the market. The CDO managers that now purchased these mortgage bonds were often less stringent in their risk analysis than the previous investors, and willingly purchased bonds backed by ever-more exotic

[12] Deng et. al. (2008) find that the demand for subprime mezzanine bonds for CDOs was so great that it was a significant factor in causing a tightening in the subprime ABS-treasury spread prior to 2007.

mortgage loans.[13] Figure 3 looks specifically at the performance of the subprime collateral, comparing the rating downgrades of the subprime bonds that were in CDOs versus those that were not put in CDOs. Clearly, the bonds in the CDOs have performed worse, indicating that there might have been a degree of adverse selection in choosing the subprime bonds for CDOs [14]

Figure 2: Repackaging of Subprime Bonds into CDOs

This figure shows the percent of subprime bonds repackaged into CDOs. "In CDO" includes bonds listed in either Lehman Live (LL) or Open Source (OS). "Not in CDO" includes all bonds in ABSNet database not in either LL or OS CDOs.

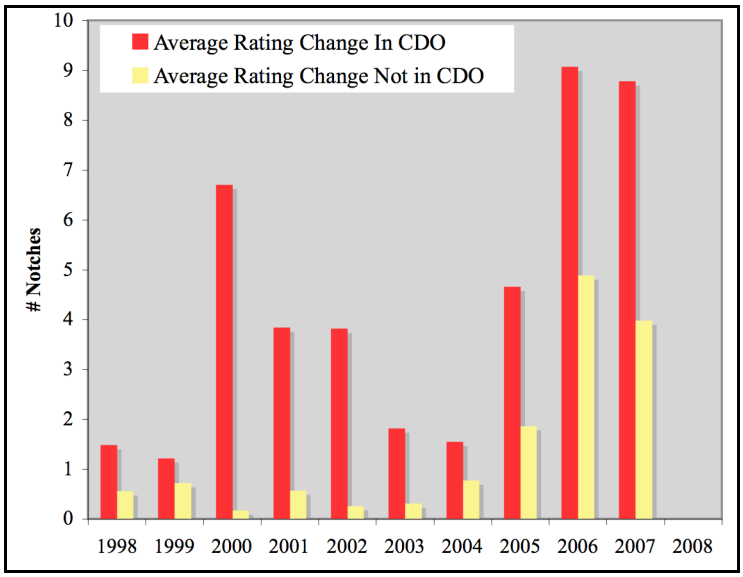


[13] A recent note by Adelson and Jacob (2008) argues that CDOs' increasing demand for subprime bonds was the key event that fundamentally changed the market.

[14] However, this result needs further investigation as it may be a result of the fact that the mezzanine tranches, most common in CDOs, have all performed the worst, or that the rating agencies had an incentive to monitor subprime bonds in CDOs more carefully, leading to a higher level of downgrades.

Figure 3: Rating Downgrades of Subprime Bonds

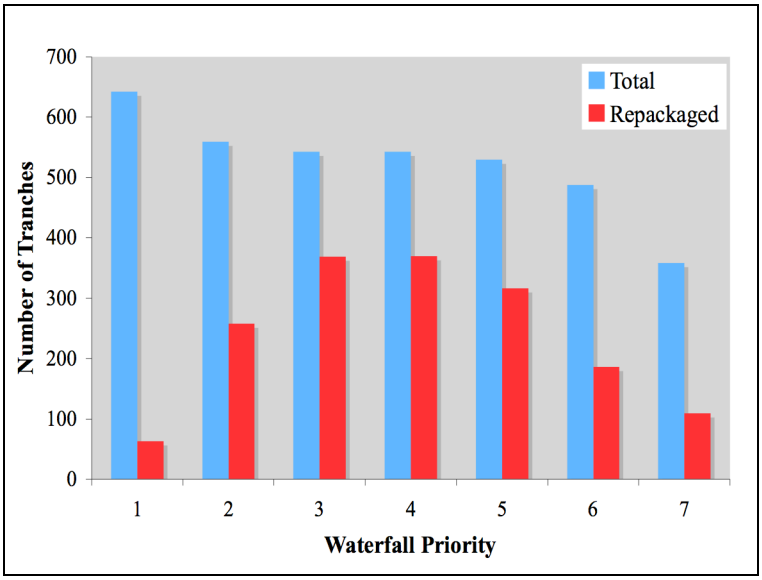
This Figure plots the number of notches of the average downgrade for subprime bonds in CDOs vs. those never repackaged. *Sources: Lehman Live, Open Source, ABSNet.*



In addition to the increased investment in risky mortgage collateral, the next development was the creation of the notorious "CDO squared," (and the occasional "CDO cubed"), which repackaged the hard-to-sell mezzanine CDO tranches to create more AAA bonds for institutional investors. Figure 4 shows the amount of CDO tranches that were repackaged into new CDOs, creating CDO squareds. The x-axis gives the tranche category by waterfall priority (i.e. seniority, 1 = first paid, last loss), and the y-axis shows the number of total tranches that were issued and repackaged. As expected, the highest percent of repackaging occurred with lower seniority CDO tranches, with few of the most senior tranches being resecuritized.

Figure 4: Repackaging of CDO Tranches

This Figure illustrates the total number of tranches issued with a given waterfall priority (1 being most senior) and the number of those tranches that were resecuritized into a CDO squared. *Source: Open Source.*



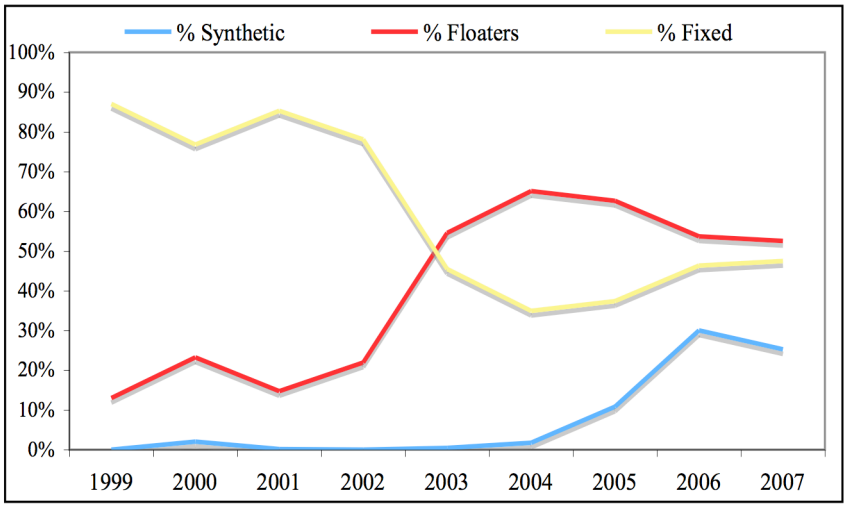
Lastly, the advent of synthetic CDOs significantly altered the evolution of the CDO market. Rather than investing in cash bonds, synthetic CDOs were created from pools of credit-default swap contracts (CDS), essentially insurance contracts protecting against default of specific asset-backed securities.[15] The use of CDS could give the same payoff profile as cash bonds, but did not require the upfront funding of buying a cash bond. Furthermore, using CDS as opposed to cash bonds gave CDO managers the freedom to securitize any bond without the need to locate, purchase, or own it prior to

[15] The advent of certain CDS indices with reference to pools of asset-backed securities encouraged this trend. The ABX Index is a series of credit-default swaps based on 20 bonds that consist of subprime mortgages. ABX contracts are commonly used by investors to speculate on or to hedge against the risk that the underling mortgage securities are not repaid as expected. The ABX swaps offer protection if the securities are not repaid as expected, in return for regular insurance-like premiums. The CMBX is a similar index referencing a basket of commercial mortgage-backed securities.

issuance.[16] Figure 5 shows two changes in CDO investments since 1999: the decrease in collateral backed by fixed-rate assets and the increased use of synthetic assets (i.e. CDS). Taken together, these observations indicate that CDOs began to invest in more risky assets over time, especially in subprime floating rate assets. Essentially, CDOs became a dumping ground for bonds that could not be sold on their own – bonds now referred to as "toxic waste." As former Goldman Sachs CMBS surveillance expert Mike Blum explains: Wall Street reaped huge profits from "creating filet mignon AAAs out of BB manure."

Figure 5: Collateral Composition Trends in ABS CDOs

This Figure shows the historical changes in CDO bond collateral among fixed rate, floating rate, and synthetic bond types. *Source*: Lehman Live.



[16] The demand for ABS bonds for CDOs was so high, that underwriters and managers often had trouble securing enough bonds for a CDO. Several former CDO managers described this situation as "extremely frustrating," as they would often spend significant amounts of time analyzing new bond issues, only to find out that they were oversold or that they could purchase just a small amount. Using CDS guaranteed that CDO managers could take "bets" on any bond they found desirable, regardless of its limited supply.

The deterioration in CDO collateral quality was matched by a *decrease* in the credit support of the rated tranches, leaving investors more exposed to losses on the collateral. Figure 6 gives a graphical presentation of the subordination levels over time: the subordination levels have decreased slightly for all tranches, with the most pronounced decline visible in the AAA-rated tranches, which went from an average of 25% subordination in 2002 to less than 15% in 2007.

Figure 6: CDO Weighted Average Subordination Levels

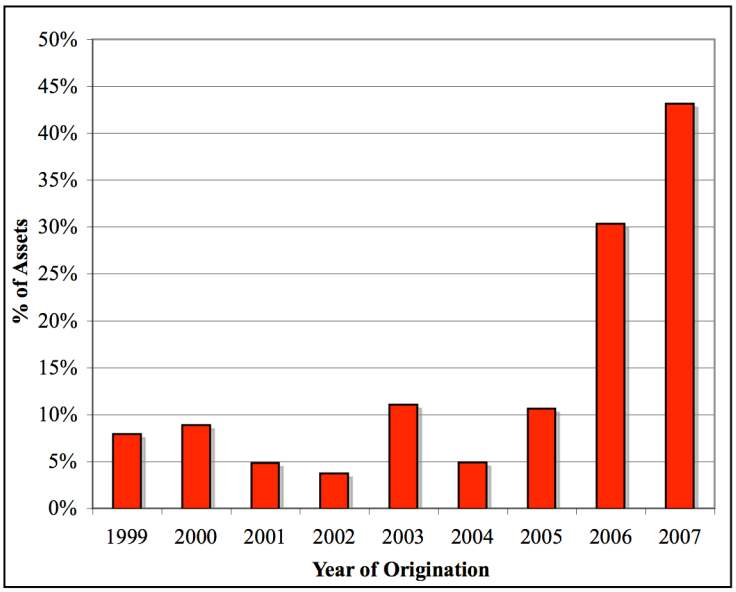
This Figure plots the annual average percentage of subordination by bond class for 697 CDOs originated between 2002-2007. *Source: Lehman Live.*

With the issuance of CDOs growing unabated and the quality of their collateral declining, both the rating agencies and the investment banks failed to recognize the

amount of risk inherent in these products. Figure 7 shows the dramatic increase in realized default levels of ABS CDOs, with over 40% of the 2007 CDO assets in default.

Figure 7: Historical Realized Default Levels

This Figure plots the default rates of CDO assets in ABS CDOs by year of origination. The default rates were calculated using data obtained from Lehman Live.



2.2 Credit Rating Agencies (CRAs)

The credit rating agencies were formed nearly a century ago to help investors gauge the risk of fixed-income securities. Credit ratings have been vital to the development of the CDO market, as investors felt more confident purchasing the new structures if they were rated according to scales that were comparable to those for more familiar corporate bonds. Investors came to rely almost exclusively on ratings to assess CDO investments: in essence substituting a letter grade for their own due diligence.[17] In

[17] In a report to shareholders, UBS cites over-reliance on ratings as a cause of their massive write-downs, saying that their risk committee "relied on the AAA rating of certain subprime positions, although the

addition, credit ratings from agencies deemed to be "nationally recognized statistical organizations" (NRSRO) were used for regulatory purposes by the SEC. While there are five credit rating agencies with the NRSRO qualification, only three were major players in the U.S. structured finance market: Moody's, Fitch, and Standard and Poor's (S&P).[18] Figure 8 shows the percent of CDO deals that contained a rating by the each of these three rating agencies (the sum is greater than 100% because many deals were rated by more than one agency). While S&P and Moody's rated almost all CDO deals, Fitch's market share declined to less than 10% by 2007. The rating agencies earned high fees from the CDO underwriters for rating structured finance deals, generating record profits as seen in Diagram C. Table 3 shows the amount of CDO business each of the CRAs did with the various CDO originators.[19]

Problems with CDO ratings rapidly developed as the rating agencies came under enormous pressure to quickly crank out CDO ratings and the market exploded faster than the number or knowledge of analysts. Analysis of CDOs came to rely almost completely on automated models, with very little human intervention and little incentive to check the accuracy of the underlying collateral ratings.[20]

CDOs were built from lower-rated tranches of RMBS. This appears to have been common across the industry. A comprehensive analysis of the portfolios may have indicated that the positions would not necessarily perform consistent with their ratings"(UBS 39).

[18] The other two NRSROs are A.M. Best and Dominion Bond Rating Service (DBRS).

[19] Not surprisingly, all three CRAs did the most CDO ratings for Merrill Lynch, the biggest CDO originator. After Merrill Lynch, the ranks of S&P and Moody's clients are almost identical. However, Fitch derived more of their CDO business from non-U.S. originators such as Calyon, UBS, and WestLB.

[20] In his testimony before congress, Frank Raiter, a former RMBS analyst at S&P, testified that he was often asked to give RMBS ratings for CDOs without essential credit information. According to Raiter, the managing director of CDO ratings, Richard Gugliada, said: "Any request for loan level tapes is TOTALLY UNREASONABLE!! Most investors don't have it and can't provide it. Nevertheless we MUST produce a credit estimate…It is your responsibility to provide those credit estimates and your responsibility to devise some method to do so." (Testimony before the Committee on Oversight and Government Reform, October 22, 2008).

Figure 8: Credit Rating Agency's Market Share in CDO Ratings

This Figure plots the percent of all CDOs (both ABS and corporate) rated by each of the three rating agencies. *Source: UBS CDO Research.*

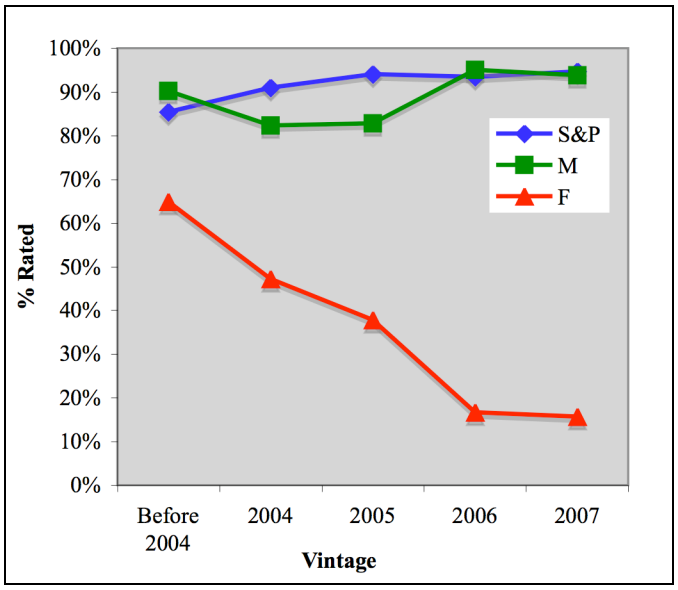


Diagram C: Revenue of the Big 3 Rating Agencies, 2002-2007

Source: thismatter.com/money

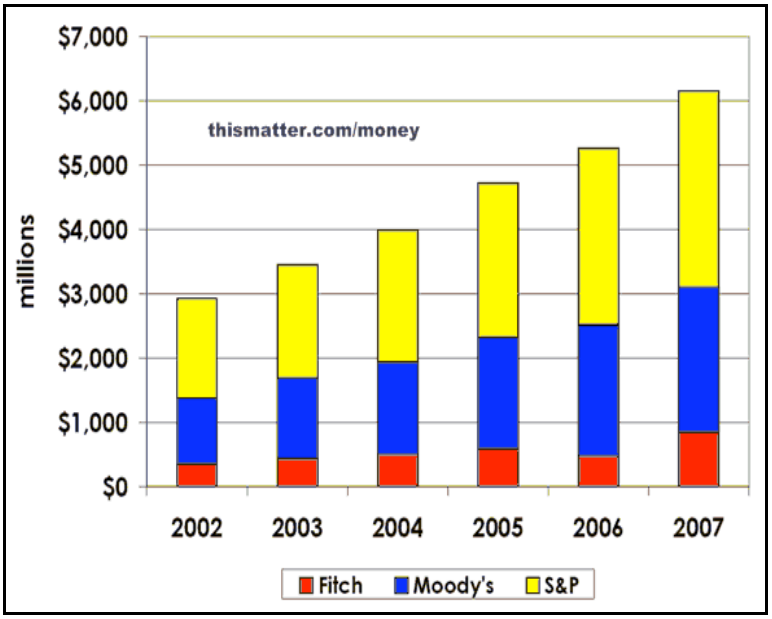


Table 3: Biggest Clients of the Credit Rating Agencies

This table shows the amount of business each CDO originator did with the three main CRAs. Ranks are based on the total par amount of CDO tranches rated by the agency: the higher ranks correspond to more business. The total amount rated by the agency is shown in parentheses under the rank. The results are sorted by average ranking.

Originator	Average Rank	Moody's Rank ($mm)	Fitch Rank ($mm)	S&P Rank ($mm)
Merrill Lynch	1	1 ($76,908)	1 ($31,269)	1 ($77,275)
Citigroup	2	2 ($28,497)	6 ($2,972)	2 ($29,106)
UBS	3	6 ($17,124)	2 ($6,962)	4 ($20,396)
Wachovia	4	4 ($20,328)	7 ($2,527)	5 ($20,337)
Calyon	5	7 ($16,877)	3 ($4,656)	7 ($16,848)
Goldman Sachs	6	3 ($22,477)	14 ($0,798)	3 ($22,617)
Deutsche Bank	7	10 ($12,251)	5 ($3,390)	8 ($14,471)
Various Small Banks	8	5 ($18,742)	13 ($0,947)	6 ($18,689)
Credit Suisse	9	8 ($13,330)	8 ($1,893)	9 ($14,088)
RBS	10	12 ($10,686)	9 ($1,673)	12 ($11,704)
Lehman Brothers	11	11 ($11,985)	12 ($1,085)	11 ($12,024)
Bear Stearns	12	9 ($13,252)	16 ($0,296)	10 ($13,530)
Unknown	13	13 ($10,596)	11 ($1,248)	13 ($10,566)
Bank of America	14	14 ($7,994)	10 ($1,259)	14 ($8,412)
WestLB	15	17 ($4,178)	4 ($3,935)	19 ($1,345)
Dresdner Bank	16	15 ($7,732)	none	15 ($7,732)
Morgan Stanley	17	16 ($6,091)	17 ($0,242)	16 ($6,091)
Barclays Capital	18	18 ($3,005)	15 ($0,479)	17 ($3,417)
JP Morgan	19	19 ($1,769)	none	18 ($1,755)

According to Mark Adelson, now Chief Credit Officer at S&P:

> The advent of CDOs in the mid-1980s was a watershed event for the evolution of rating definitions. Until the first CDOs, rating agencies were only producers of ratings; they were not consumers. With the arrival of CDOs, rating agencies made use of their previous ratings as ingredients for making new ratings – they had to eat their own cooking. For rating CDOs, the agencies used ratings as the primary basis for ascribing mathematical properties (e.g., default probabilities or expected losses) to bonds.[21]

Not only did the rating agencies fail to examine the accuracy of their own prior collateral ratings, but in many cases, they also used other agency's ratings without checking for accuracy. To correct for any shortcomings in the other agency's rating methodology, they created the practice of "notching," whereby they would simply decrease the rating of any collateral security that they did not rate by one notch.[22] In other words, if Moody's rated a CDO that was composed of collateral rated BB+ by Fitch only, Moody's would instead use a rating of BB in their own CDO model because it was not their rating. They never went back and reanalyzed the other rating agency's rating, conveniently *assuming* that decreasing it by a notch would compensate for any shortcomings in the initial risk analysis.

The inputs and definitions associated with the models were frequently changed, generating confusion and inconsistencies in the ratings: Fitch's model showed such unreliable results using its own correlation matrix that it was dubbed the "Fitch's Random Ratings Model."[23] Furthermore, it became clear that similarly rated bonds from different sectors (i.e. ABS vs. corporate bonds, RMBS vs. CMBS) had markedly different track records of realized default probabilities, and the agencies began to adjust their meanings and models haphazardly in an attempt to correct their previous mistakes. In

[21] Adelson (2006), pg. 5
[22] SEC Report on Rating Agencies
[23] Tavakoli (2005), pg. 3

S&P's 3.0 version of the CDO Evaluator, released in December 2005, the agency published complete tables of default probabilities for ABS/MBS, corporate bonds, and CDOs with conflicting definitions depending on the asset it was used to rate. Adelson voiced concerns about this lack of consistency in 2006, stating that:

> The different meanings had some bizarre implications. Suppose you have a seven-year ABS rated AA+. According to the tables, the instrument has an idealized default probability of 0.168%. If we repackage the security (all by itself) and call the repackaged instrument a CDO, it ought to get a rating of AAA because the idealized default rate for a AAA-rated *CDO* is 0.285%.[24] This seems simply an affront to common sense. It illustrates why variable definitions of rating symbols are a problem.[25]

However, investors thought, and were encouraged to believe, that the ratings of CDOs corresponded to similar default distributions as individual corporate bonds, thereby further fueling the asset-backed frenzy. Lastly, as CDO structures became more complex, incorporating features such as super senior tranches, payment-in-kind (PIK) provisions,[26] and a diversity of trigger events that could change the priority of liability payments, CDO ratings became even less meaningful.[27]

In addition to the problems with the accuracy of the ratings, there was also the fact that the ratings themselves were not meaningful indicators for assessing portfolio risk. As Coval et. al. (2009) notes, credit ratings, "by design only provide an assessment of the risks of the security's expected payoff, with no information regarding whether the security is particularly likely to default at the same time as there is a large scale decline in

[24] This means that a CDO was *allowed* to have a higher default rate (worse performance) than other securities, and still garner an AAA rating.
[25] Adelson (2006), pg. 6
[26] In the case of an interest shortfall, PIK provisions say that investors can be paid with more bonds, instead of cash. Thus, investors accrue principal as opposed to receiving their interest.
[27] According to Tavakoli, the CRAs did not acknowledge the existence of super senior tranches. They were only concerned with solving for the proper AAA attachment point. In reality though, an investor should not be indifferent to owning the AAA tranche from a CDO with a super senior and one without, for the former tranche is a first-loss tranche supporting the super senior.

the stock market or that the economy is in recession."[28] Furthermore, ratings are a static measure, designed to give a representation of expected losses at a certain point in time with given assumptions. It is not possible for a single rating to encompass all the information about the probability *distribution* that investors need to assess its risk. Dr. Clarida, an executive vice president at PIMCO, points out that, "distributions are complicated beasts – they have means, variances, skews, and tails that can be skinny or, more often, fat. Also – they have kurtosis, fourth moments, and transition probabilities."[29] Investors often overcame these limitations by looking at ratings history, filling in their missing information with data about the track record of defaults for a given rating. Since there was little historical data for CDOs, investors instead looked at corporate bond performance. However, as noted above, asset-backed ratings have proven to have very different default distributions than corporate bonds, leading to false assessments.

The heavy reliance on CDO credit ratings made it more devastating when problems with the models and processes used to rate structured finance securities became apparent.[30] The Bank for International Settlements commissioned a report summarizing the difficulties in rating subprime RMBS.[31] They found that the credit rating agencies underestimated the severity of the housing market downturn, which in turn caused a sharp increase in both the correlation among subprime mezzanine tranche defaults and their overall level of realized defaults, while decreasing the amount recovered in the event of a

[28] Coval et. al. (2007) find that "in fixed income markets, many investors focus exclusively on estimates of expected payoffs, without considering the state of the economy in which default is likely to occur," and show that "many structured finance instruments can be characterized as economic catastrophe bonds, but offer far less compensation than alternatives with comparable payoff profiles."
[29] PIMCO Global Perspectives, March 2009.
[30] For a detailed explanation of the rating methodologies of the three CRAs, see Fender and Kiff (2004).
[31] See BIS Committee on the Financial System (2008).

default (i.e. loss given default). In addition, the ratings of subprime RMBS relied on historical data confined to a relatively benign economic environment, with very little data on periods of significant declines in house prices.

Figure 9 reveals the level of optimism of original CDO ratings, showing the credit ratings of the CDO tranches and of their collateral asset pools, both at issuance and currently.[32] This Figure shows that the CRAs somehow manufactured huge amounts of AAA CDO securities from collateral with much lower ratings, confirming that one of the reason CDOs were so profitable in 2005-2007 was that it was possible to manufacture a high proportion of highly rated securities from lower quality assets. That practice has backfired, resulting in massive downgrades of the CDO tranches as it became apparent that the rating agencies had been overly optimistic. While in 2005-2007, the initial ratings given to CDO tranches were on average better than the ratings of their underlying collateral assets, current CDO tranche ratings for these years are now *significantly* worse than their associated collateral pool ratings.

Figure 10 provides a display of the devastating level of downgrades associated with CDO bonds, showing the average tranche downgrade of each CDO vintage grouped by initial tranche rating. The AAA tranches have suffered a profound increase in downgrades; while the average downgrade for AAA tranches of the 2002 vintage was just 3 notches (to a rating of AA-), the average downgrade for AAA tranches from 2007 is 16 notches, meaning AAA tranches now carry an average rating of CCC+, 7 notches below the minimum investment-grade ranking (BBB-).

[32] The numbers on the y-axis correspond with the rating scores in Appendix B (1=AAA, 22=D).

Figure 9: Evolution of CDO Tranche and Collateral Asset Ratings

This Figure shows the weighted average ratings of the CDO tranches and their underlying asset pools in the high information sample both at issuance and currently, broken down by CDO vintage. The numbers on the y-axis correspond to the rating scale outlined in Appendix B, with lower numbers equal to higher-quality ratings (1=AAA, 22=D).

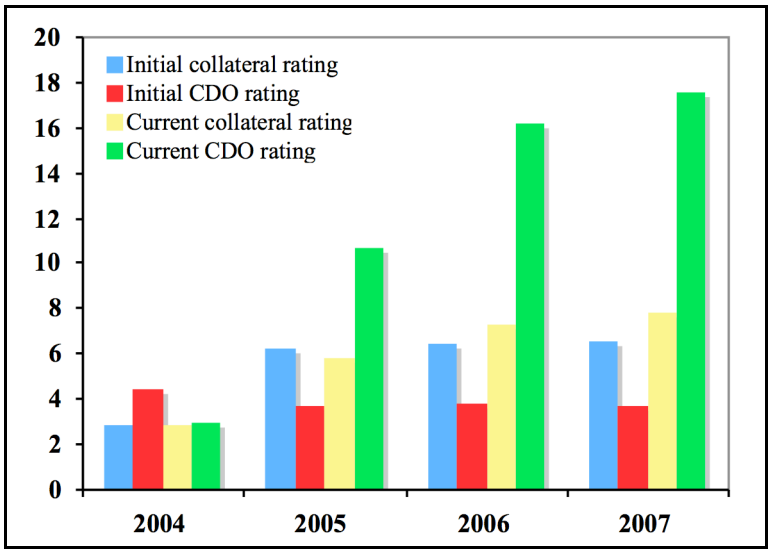
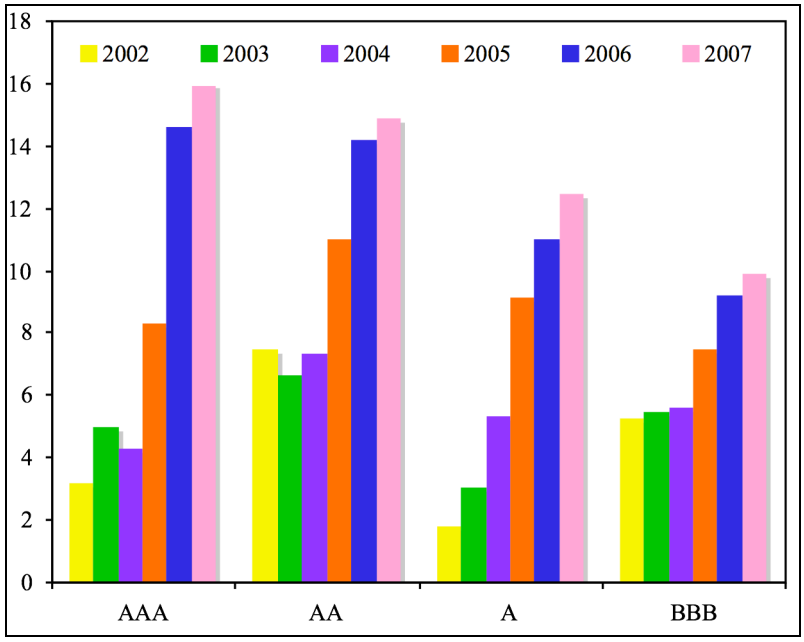


Figure 10: Downgrades of CDO Tranches Across Time

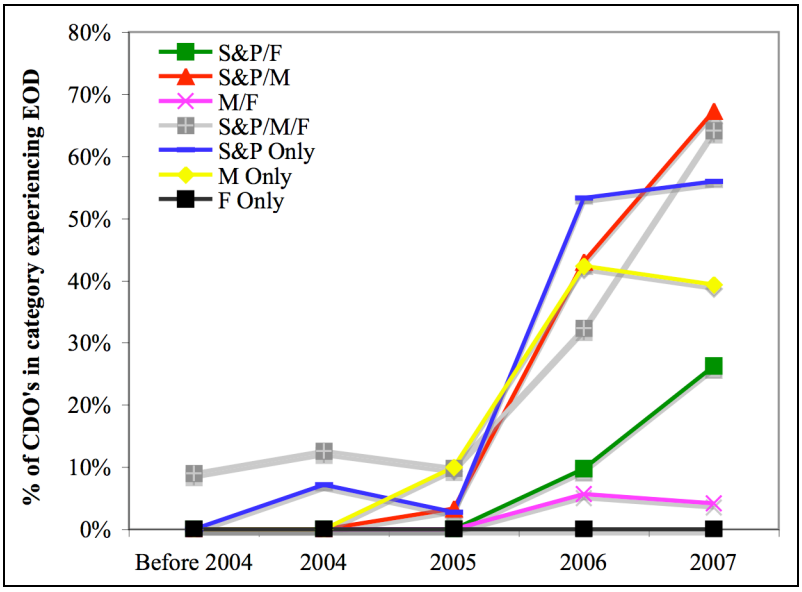
This Figure shows the average downgrade of CDO ratings from each CDO vintage, by initial tranche rating. The numbers on the y-axis correspond to the rating scale outlined in Appendix B, with lower numbers equal to higher-quality ratings (1=AAA, 22=D).



While all three rating agencies severely underestimated the true risk of CDO bonds, there has been some distinction in the ex-post performance of CDOs rated by different combinations of the three CRAs. Figure 11 shows the percent of CDOs rated by each agency combination that experienced an event of default (EOD) as of June 2008. This shows that CDOs rated by Fitch generally had less defaults than those without a Fitch rating. However, this result is not conclusive, as a number of other factors could be responsible for the lower level of defaults in Fitch-rated CDOs.

Figure 11: Event of Default Frequency by Rating Combination

This Figure plots the percent of CDOs that experienced an event of default as a function of the agencies who rated it. *Source: UBS CDO Research.*



Overall, the credit ratings of CDOs have been an utter disaster. According to Arturo Cifuentes: "The rating agencies failed twice…first when they misrated a huge number of subprime securitizations; and a second time, when they misrated CDOs of ABS. And to cap it all: they all failed together…making the same mistakes at the same time."[33]

2.3 Investment Banks

Wall Street quickly pounced on CDOs, seeing an opportunity to offload unwanted risks and make a fortune in the process.[34] Table 5 presents a list of the top CDO underwriters for each year. Merrill Lynch was by far the biggest underwriter of ABS CDOs, with a total of 107 deals, and Citigroup came in second with 80 deals.

Table 4: Top CDO Underwriters

This table presents the number of ABS CDO deals underwritten by the top 10 underwriters between 2002-2007. The data were obtained from S&P's CDO Interface.

Underwriter	2002	2003	2004	2005	2006	2007	TOTAL
Merrill Lynch	0	3	20	22	33	18	107
Citigroup	3	7	13	14	27	14	80
Credit Suisse	10	7	8	9	14	6	64
Goldman Sachs	3	2	6	17	24	7	62
Bear Stearns	5	2	5	13	11	15	60
Wachovia	5	6	9	16	11	5	52
Deutsche Bank	6	3	7	10	16	5	50
UBS	5	2	5	10	16	6	46
Lehman Brothers	3	4	3	6	5	6	35
Bank of America	2	2	4	9	10	2	32
TOTAL DEALS	47	44	101	153	217	135	697

[33] Testimony of Cifuentes (2008), pg. 2

[34] Merrill was rumored to have made between $400-$500 million in fees from its CDO business in 2006, according to a former employee.

As the CDO wave continued, Wall Street banks tired of relying on mortgage banks and other loan originators to provide them with CDO collateral acquired mortgage subsidiaries and began repackaging their own collateral into CDOs. Table 5 shows the amount of in-house RMBS and CDO collateral used by each CDO underwriter.[35] Panel A shows that Bear Stearns underwrote CDOs with as much as 30% of the collateral issued by their in-house RMBS business, and Merrill Lynch itself bought 32% of all of its in-house RMBS used in CDOs. However, Countrywide remained the biggest RMBS supplier to almost every CDO underwriter. Panel B shows that Merrill Lynch created CDO squareds with as much as 15% of the assets from their prior CDO transactions, and that Merrill bought 59% of its CDO tranches that were resold into CDO squareds. As the complexity of CDOs increased, the amount of CDO repackaging multiplied. In Panel B, the column "Level" summarizes the amount of repackaging done by the various banks. On average, Merrill Lynch's CDO assets were made of CDOs that had undergone 4.79 iterations of securitization. This illustrates the high level of complexity apparent in these securities and shows why performing analysis of the collateral was very difficult.

[35] Both tables show the average and maximum percent of each CDO originator's CDO collateral issued by itself or a subsidiary. In addition, they show how much of the originator's CDO bonds they put in their own CDOs as well as listing the largest buyers and sellers between each originator/originator pair.

Table 5: Banks as CDO Originators and Collateral Originators

Panel A: Bank's RMBS Originators

This table looks at whether CDO originator's used their own RMBS assets in CDOs. Columns 3-4 show how much of the bank's CDO collateral came from their own originator, Column 5 looks at the share of the originator's bonds in ABS CDOs that are in their parent bank's CDOs, Column 5 gives the name of the largest RMBS originator that contributed bonds to each bank's CDOs.

Bank	Name of Bank's RMBS Originator	Avg. % from originator	Max % from originator	% of bonds in parent's CDOs	Largest RMBS Supplier to Bank's CDOs
BoA	ABFC	2.9%	7.7%	3.7%	Countrywide
BoA	Countrywide	7.4%	17.9%	3.2%	Countrywide
Barclays	Securitized ABR.	2.6%	4.7%	3.6%	Countrywide
Barclays	EquiFirst	0.1%	0.4%	0.8%	Countrywide
Bear	Bear Stearns	7.0%	30.7%	7.9%	Countrywide
Bear	Encore	0.3%	1.4%	4.1%	Countrywide
Citigroup	Citigroup	2.5%	10.0%	13.9%	Countrywide
Credit S.	HEAT	4.1%	10.0%	8.4%	Countrywide
Credit S.	DLJ Mortgage	2.0%	5.2%	7.5%	Countrywide
Deutsche	Deutsche Bank	0.3%	5.2%	20.8%	Countrywide
Goldman	GSAA	2.2%	10.1%	22.2%	Countrywide
Goldman	Goldman Sachs	3.8%	10.5%	10.6%	Countrywide
JP Morgan	JPMorganChase	4.2%	6.5%	0.8%	Goldman Sachs
Lehman	SASCO	5.5%	13.4%	6.5%	Countrywide
Merrill	First Franklin	3.1%	9.5%	25.6%	Countrywide
Merrill	Merrill Lynch	3.3%	9.7%	32.8%	Countrywide
Morgan	Ixis	0.5%	2.6%	3.7%	Countrywide
Morgan	Morgan Stanley	5.7%	15.9%	2.5%	Countrywide
Morgan	Saxon	0.3%	2.0%	1.5%	Countrywide
RBS	HarborView	1.6%	10.0%	18.3%	Morgan Stanley
RBS	SoundView	2.6%	11.4%	8.9%	Morgan Stanley
UBS	MASTR	4.3%	12.3%	19.7%	Bear Stearns
UBS	UBS	0.5%	6.5%	6.7%	Bear Stearns
Wachovia	Wachovia	1.4%	6.7%	22.7%	Countrywide

Panel B: Banks using their own CDOs as collateral for CDO-squared deals

This table looks at the amount of CDO collateral underwriters repackaged into subsequent CDO deals (CDO squareds). "Total # of tranches" equals the number of tranches per underwriter that were put into subsequent securitizations. The next two columns (Avg. % and Max %) show the average and maximum amount of the bank's CDO collateral that came from their own CDO securities. Column 5 (% of originator's CDO bonds) shows the percent of the total number of tranches (from Column 2) that ended up in the underwriter's own CDO squared deals. Column 6 gives the name of the largest buyer of each bank's CDO bonds used in CDO squared deals. Column 7 provides the name of the largest provider of CDO bonds to each bank used in their CDO squared deals. Lastly, Column 7 ("Level") shows the average number of resecuritizations of the CDO collateral used by each underwriter, calculated as the weighted average number of CDO repackaging iterations in each underwriter's CDOs (for example, 3 would mean that on average their CDOs had collateral that had undergone 3 securitizations: these assets would be CDOs containing CDO collateral which itself had CDO collateral).

Bank	Total # of Tranches in any CDO	Avg. % of collateral from own CDOs	Max % of collateral from own CDOs	% of originator's CDO bonds in own CDOs	Largest CDO Buyer of Bank's CDOs	Largest CDO Supplier to Bank's CDOs	LEVEL
BoA	7	1.2%	12.8%	6.3%	Citigroup	Bank of America	3.00
Barclays	2	0.2%	0.9%	22.4%	Merrill Lynch	Barclays Capital	2.79
Bear Stearns	10	0.5%	0.3%	4.6%	Citigroup	Bear Stearns	3.94
Calyon	10	0.3%	1.9%	10.2%	Merrill Lynch	Calyon	3.73
Citigroup	117	1.7%	11.1%	32.5%	Citigroup	Citigroup	4.17
Credit Suisse	15	0.9%	7.4%	7.2%	Merrill Lynch	Credit Suisse	2.07
Deutsche Bank	6	0.2%	3.8%	1.6%	Merrill Lynch	Deutsche Bank	1.62
Dresdner Bank	1	0.0%	0.2%	2.2%	Citigroup	Dresdner Bank	4.91
Goldman Sachs	41	0.9%	5.0%	34.5%	Goldman Sachs	Goldman Sachs	2.32
JP Morgan	2	0.3%	1.0%	5.3%	Merrill Lynch	JP Morgan	2.79
Lehman	7	0.2%	1.1%	4.4%	Merrill Lynch	Lehman Brothers	2.99
Merrill Lynch	384	3.4%	15.3%	59.3%	Merrill Lynch	Merrill Lynch	4.79
Morgan Stanley	1	0.1%	0.7%	1.0%	Citigroup	Morgan Stanley	2.13
RBS	15	0.4%	3.3%	4.3%	Merrill Lynch	RBS	5.32
UBS	10	0.4%	6.3%	3.3%	Merrill Lynch	UBS	1.27
Wachovia	18	0.8%	4.1%	17.1%	Goldman Sachs	Wachovia	2.05
WestLB	7	0.0%	0.0%	0.0%	Goldman Sachs	WestLB	2.19

While the investment banks earned what they thought to be "riskless" profits from CDOs, they were actually loading up on more CDO risk than they realized thanks to so-called "super senior" tranches, created in part to generate even higher-yielding AAA tranches for CDO investors. To manufacture a super senior tranche, the AAA portion of a CDO was chopped up into smaller AAA tiers, enabling the "subordinate" AAA tranche to yield more and the "super senior" AAA tranche to carry an extremely low level of credit risk. Many banks found it convenient to simply retain the super senior tranches, as the Basel Accords imposed only a small capital charge for AAA securities.[36] In addition, a significant amount of super senior exposure was retained not by choice, but rather because underwriters had difficulty selling these bonds.[37] While certainly not all CDO underwriters held super senior tranches, a JP Morgan report released in 2007 estimated that banks alone held around $216 billion worth of super senior tranches of ABS CDOs issued in 2006 and 2007.[38] Many of these banks were untroubled by the increasing amounts of SS exposure on their books, assuming that the risk of default was almost zero; as one economist described it:

> In order to cause a hit on a super senior tranche, the economy has to turn down so heavily that it is very likely that problems will have reached a level where an upper senior swap hit is just the tip of the iceberg of a heavy global financial crisis.[39]

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[36] In the beginning days of CDOs, it was common for underwriters to keep the most junior or equity piece of their CDOs as a way to protect against adverse selection and moral hazard. However, the Basel Accords imposed a 100% capital charge against equity tranches, deterring banks from holding these bonds.

[37] Krahen and Wilde (2005) gave a warning to regulators in 2005 about the increasing number of banks retaining senior tranches, saying that: "To the extent that senior tranches absorb extreme systematic losses, banks should be encouraged to sell these tranches to outside investors. In the interest of financial system stability, these outside buyers of bank risk should not be financial intermediaries themselves. Only if this requirement is fulfilled will the bank and the financial system be hedged against systematic shocks. Since this is supposedly one of the macroeconomic objectives of regulators, one would expect that regulatory requirements stipulate the sale of senior tranches, rather than encouraging their retention.

[38] Quoted in: "Super-senior blundering." *The Economist,* December 6, 2007.

[39] Bluhm (2003), pg. 2.

Some banks simply chose to "forget" certain super senior tranches for the purposes of risk-management – assuming that the risk of default was so insignificant that they could be treated as if they were perfectly hedged. Other SS tranches were only partially hedged – usually by way of credit-default swaps.[40] However, this method of hedging left the banks exposed to counter-party risk from other financial institutions. UBS explains how partially hedged CDOs led to 63% of their CDO write-downs: "we used a hedging methodology that enabled [the CDO desk] to buy relatively low levels of market loss protection but consider the position as fully hedged."[41] In the end, these positions, once considered "riskless," were responsible for creating the majority of bank's write-downs. After reporting a $7.9 billion dollar write-down in the third quarter of 2007, Merrill Lynch described their rationale behind the $13.6 billion in SS tranches they kept, saying,

> The bottom line is that we got it wrong by being over-exposed to subprime. As the market for these (subprime) securities began to deteriorate, we began substantially reducing our warehouse risk by constructing CDOs and retaining the highest parts of the capital structure, which we expected then to be more resistant to market disruptions in terms of both liquidity and price…our hedging of the higher-rated tranches was not sufficiently aggressive nor was it fast enough.[42]

The survival of some of Wall Street's big investment banks became bound to the quality of their CDO underwriting. Figures 12 and 13 give a snapshot of different underwriters' CDOs. The first shows the amount of subprime and CDO collateral used by specific underwriters and the second shows the realized default rates of underwriters'

[40] Many banks actually obtained this protection by issuing its own CDS contracts through off-balance sheet conduits, which sold the bank CDS contracts and pooled the obligations into an SIV, issuing asset-backed commercial paper (ABCP) against them. These ABCP conduits had to be taken back on-balance sheet when the market for commercial paper dried up.
[41] UBS had three categories for CDO hedging. In negative basis trades, they bought 100% protection, but were exposed to counterparty risk. Amplified mortgage portfolio (AMPs) trades were partially hedged, and the remainder was unhedged in anticipation of buying protection before the market crashed.
[42] Merrill Lynch 3Q Earnings Conference Call. Oct. 27, 2007.

CDOs. While the banks with the highest combined amounts of CDO and subprime assets, Merrill Lynch, Citigroup, and Lehman Brothers, took write-downs of $51.2, $46.8, and $15.3 billion as of November 2008,[43] the superior performance of Goldman Sachs has mirrored that of its CDOs. CDO losses have spread far beyond the investment banks on Wall Street, affecting every pool of investment money from pension funds to Norwegian villages.[44] The ultimate principal losses on these CDO positions will not be known until the CDO bonds mature or are liquidated,[45] but the mark-to-market losses have been staggering.[46] The massive write-downs of AAA CDO positions has caused irreparable damage to many financial institutions, helping to destroy Merrill Lynch, and leaving others like AIG and Citigroup on the brink of disaster.[47] While much has been written about why market participants made crucial misjudgments about CDO risk,[48] it is still unclear how their mistakes resulted in the exponential losses that have wrought havoc on the global economy. In this paper, I show that it was a combination of poor collateral quality, lax underwriting standards, and inaccurate credit ratings that allowed the construction of a trillion-dollar CDO "house of cards."

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[43] Source: Asset-Backed Alert, November 18, 2008.

[44] In the CNBC documentary, "House of Cards," reporter David Faber travels to the small town of Narvik, Norway, which invested $200 million in American CDOs, lured in by their AAA ratings and the assurance by Citigroup of their safety. These CDO bonds are now essentially worthless, and the town has had to close schools, slash expenditure to the elderly, and cut back on fire department hours. The Mayor of Narvik says that she has "learned not to trust nice man in Armani suit," although this lesson has come too late to save her city's budget.

[45] Some CDOs that experienced an event of default have chosen not to liquidate their assets, hoping that the housing market will eventually recover. According to Moody's CDO research, as of June 2008, only 38 CDOs had been liquidated, out of 758 CDOs (including both ABS and cash CDOs) that had experienced an event of default (EOD).

[46] FASB 157 requires many financial institutions to mark their positions at "fair value," defined as "the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date." As the market for CDOs dried up, positions had to be marked to "fire-sale" prices, leading to the billions in paper losses. There has been an active debate surrounding mark-to-market accounting, but the SEC decided in December 2008 not to suspend the practice.

[47] AIG suffered mainly from having sold CDS protection on senior CDO tranches, valuing them with their own faulty models. Citigroup's troubles have been mainly a result of having to take their SIVs back on their balance sheet, many of which contained senior CDO tranches.

[48] For an overview of the credit crisis, see Brunnermeier (2008), Gorton (2008), and Calomiris (2008).

Figure 12: Percent of Underwriters' CDO Assets that are Subprime or CDO

This Figure plots the percent of collateral that is classified as CDO or subprime in all deals underwritten by the bank. *Source: S&P CDO Interface, Lehman Live.*

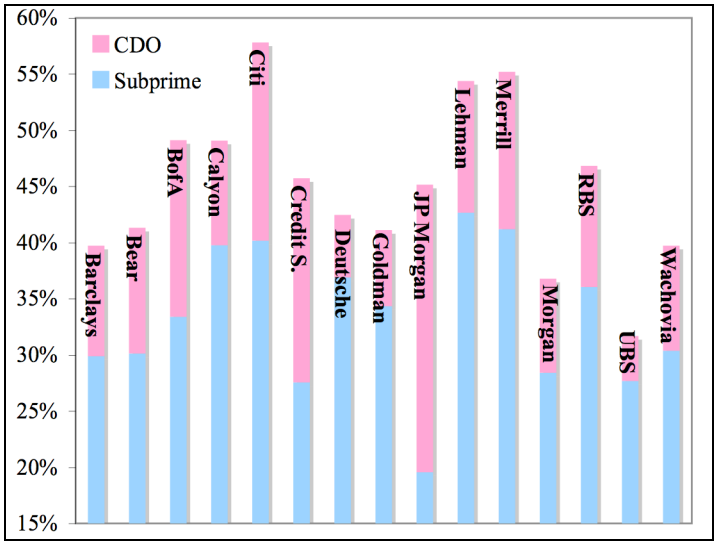
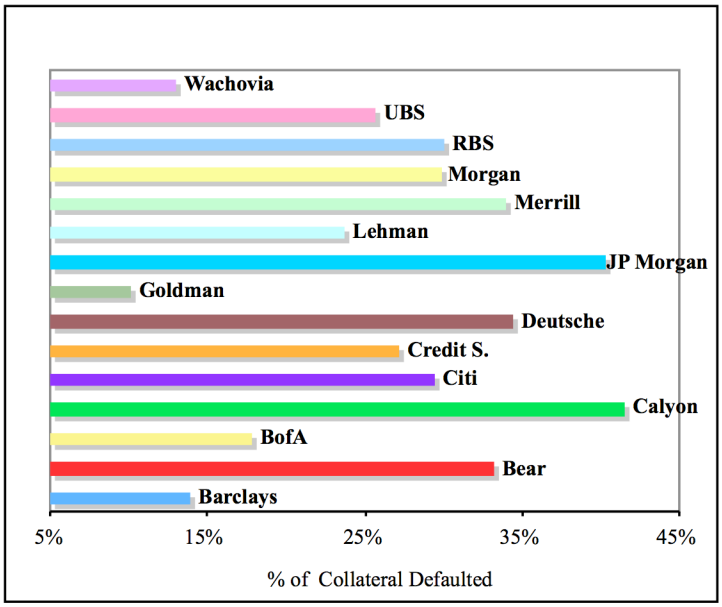


Figure 13: Performance of Underwriters' CDO's

This Figure plots the percent of CDO collateral that had defaulted as of December 2008 broken down by underwriter. *Source: S&P CDO Interface, Lehman Live.*



3. Questions and Hypothesis Development

In the following sections of this paper, I conduct a broad investigation of the factors that engendered the rise and fall of the CDO market – a process that has destroyed the credibility and the financial strength of some of the world's largest financial institutions. While there has been a wealth of opinions from the media, politicians, economists, and market practitioners about what went wrong with CDOs, there is a noticeable absence of *empirical* analysis surrounding the CDO market. This is most likely due to the difficulty in obtaining data as well as the complexity of CDO securities. The purpose of this paper is to use empirical data to provide one of the first windows inside the world of CDOs, looking at the factors that can explain their poor performance as well as the roles played by underwriting banks, collateral originators, and credit rating agencies. This broad analysis, meant to clarify some of the mystique currently surrounding the arcane CDO market,[49] will focus on three guiding questions: 1) How much of the poor performance of CDO securities is explained by the properties of their assets and liabilities?; 2) Has CDO performance varied across different underwriters and collateral originators?; and 3) How well did original CDO credit ratings forecast realized performance?

In order to answer these questions, it is necessary to find a variable that quantifies CDO "performance." Since there is no direct measure of CDO loss available, I will use two different dependent variables as proxies for CDO performance.[50] The first measure is the percentage of CDO collateral that has defaulted as of December 2008, calculated as

[49] CDOs are most commonly referred to in the popular press as "toxic assets" or "highly complex securities," with little explanation of *why* they are toxic or *what* makes them so complex.

[50] If it were possible to calculate an accurate measure of loss for a CDO, the banks would arguably not be facing many of the current problems in regards to CDOs. One of the major problems facing financial institutions is the challenge in putting a present value on their CDO holdings.

the par value of defaulted securities over the total par value of the CDO collateral. There are several weaknesses with using asset defaults as a proxy for CDO performance. First, CDOs are actively managed instruments that buy and sell collateral; the identity of the collateral applies to a specific point in time and does not necessarily represent the collateral at issuance or the collateral that will be present at the time the CDO is terminated. Second, losses on specific tranches depend not only on the performance of the CDO collateral, but also on the liability structure of the CDO; tranches from CDOs with a high level of defaulted collateral may nevertheless be paid in full depending on the amount of subordination they have to absorb losses. Lastly, the actual monetary losses in a CDO will depend not only on the number of assets that have defaulted, but also on the recovery rate of those assets. For instance, it is possible that some defaulted assets may recover much of their value after their underlying collateral is seized and liquidated.

The second measure of performance used in this study is the severity of credit rating downgrades of the CDO tranches. This measure of performance has an obvious weakness: the accuracy of credit ratings is highly questionable and downgrades may not translate into actual losses. Despite these weaknesses, using both defaults and downgrades as a proxy for CDO performance can give a general idea of the expected losses that will eventually materialize for a CDO transaction. I will now outline the specific questions and hypotheses that guide the remainder of my analysis.

3.1 General CDO characteristics

A CDO is essentially a corporate entity, constructed to purchase assets and sell the cash flows to investors. Like any business, the properties of a CDO's assets and liabilities will affect its ability to remain solvent and generate a profit for its equity holders. CDO assets can include any type of fixed-income security, but my analysis focuses on a specific type of CDO that invests in asset-backed securities, which are themselves structured products backed by collateral assets such as mortgages, credit-card payments, or even other CDO bonds. The liabilities of a CDO are the bonds it issues to fund its asset purchases, and consist of a series of "tranches" with unique risk and return profiles. The most senior tranches are paid before subordinate tranches, with the equity tranche exposed to the first losses.

The types of assets held by a CDO as well as their issuance date ("vintage") are likely to explain much of the variation in CDO performance. First, it is widely known that residential mortgage collateral has performed poorly, caused by a combination of declining underwriting standards by mortgage originators and the collapse in home values [Mayer et. al. (2008), Gan (2006), Mian et. al. (2008)].[51]

Hypothesis 1A: "The Housing Effect"

Increasing exposure to residential mortgages, specifically subprime and Alt-A RMBS, is associated with worse CDO performance as measured by defaults.

[51] For example, The Federal Reserve Board found that "the main factors underlying the rise in mortgage defaults appear to be declines in house prices and deteriorated underwriting standards, in particular an increase in loan-to-value ratios and in the share of mortgages with little or no documentation."

Second, collateral from 2006 and 2007 vintages is expected to show worse performance. In addition to the declines in underwriting standards during 2006 and 2007, these assets have had little time to amortize, leaving a greater amount of their principal at risk of defaults associated with the overall deterioration in economic conditions. Furthermore, liquidity for refinancing has dried up due to the credit crunch, leaving fewer options for troubled borrowers and exacerbating the effects of interest rate increases.

Hypothesis 1B: "The Vintage Effect"

Increasing exposure to 2006 and 2007 vintage collateral, particularly assets with floating interest rates, is associated with worse CDO performance as measured by defaults.

Lastly, increasing complexity in CDO assets might be associated with poor performance. Increasing the complexity of CDO assets makes it harder for investors to perform accurate risk assessments, increasing the likelihood that bad assets go unnoticed or overall risk is underestimated. Multiple repackaging of structured products increases this complexity, and Coval, Jurek, and Stafford (2009) show that losses become exponentially more sensitive to small imprecision in evaluating the probability of default on the underlying collateral with each new round of securitization.

Hypothesis 1C: "The Complexity Effect"

Increasing the amount of synthetic collateral, the amount of pre-securitized CDO collateral, and the overall number of collateral assets is associated with worse CDO performance as measured by defaults.

The liability structure of a CDO can be as unique as its asset pool, with variation in the number and sizes of the tranches, the rules for distributing proceeds (the "waterfall"), the credit support of the tranches, and the coupon payments offered to various note holders. The size and subordination levels of the individual tranches will affect their performance, as measured by the severity of credit rating downgrades, as these factors determine the amount of asset losses a certain class of note holder must absorb. It is also possible that the overall CDO default rate might be associated with certain liability characteristics, such as the number of tranches issued or the overall size of the deal.

3.2 Underwriters and Originators

The underwriter of a CDO, often an investment bank, plays a central role in the development and marketing of the CDO, earning a fee for its service and often retaining some of the CDO securities. The underwriter is responsible for structuring the tranches, setting criteria for the collateral assets, and making sure that the risks are appropriately communicated to investors. The amount of due diligence conducted by the underwriter is likely to influence the ultimate performance of the CDO transaction.

Hypothesis 2A: "The Underwriter Effect"

Holding constant general CDO characteristics, CDO performance varies based on the underwriting bank.

While certain banks might have been "better" CDO underwriters for unknown reasons, it is possible that the variation in underwriting standards is a function of the size of the bank's CDO business. For instance, the most aggressive CDO underwriters may have spent less time understanding each transaction, decreasing their level of due diligence. It is also possible that very small CDO underwriters had less experience in understanding CDOs, causing less accurate risk-assessments.

Hypothesis 2B: "The Size Effect"

The performance of an underwriter's CDOs varies according to the size of their CDO business, with overly-aggressive or very inexperienced banks issuing worse CDOs, as measured by their ex-post defaults and rating downgrades.

In addition to the CDO underwriter, an equally important party in determining the success of a CDO is the originator of its collateral assets. I will limit my examination to originators of residential mortgage collateral; these originators range from small residential mortgage banks to the same large investment banks underwriting the CDOs. The lending standards of the originating entity will affect the ultimate performance of the CDO assets.

Hypothesis 2C: "The Originator Effect"

Controlling for the type of mortgages issued, as measured by average FICO, CLTV, and DTI scores, the performance of a CDO depends on the specific entities that originated its collateral assets.

Lastly, I will look at whether CDO performance was affected by the emergence of banks that acted as both CDO underwriters and collateral originators. This became the norm as the market for CDOs exploded, with new issuance limited only by the underwriter's ability to access fresh collateral, in particular the high-yielding RMBS securities so sought after by CDOs. It is not a coincidence, therefore, that the biggest CDO underwriters either had an in-house mortgage business or acquired a mortgage bank subsidiary. In addition to repackaging their own mortgage collateral, underwriters also used retained tranches of their previous CDO transactions as assets for new CDOs. It is reasonable to assume that a CDO underwriter would have had inside information about its own assets, leading to a situation of asymmetric information between the underwriting bank and the investors.

It is unclear whether this asymmetry would lead to better or worse selection in CDO collateral. On the one hand, the CDO underwriter might choose the best collateral for its CDOs in order to uphold its reputation and encourage investors to continue buying its CDOs. However, the asymmetric information problem could lead to adverse selection or moral hazard, causing worse performance in CDOs with collateral issued by the underwriting bank. It seems likely that banks might use CDOs as a vehicle to unload unwanted assets from their balance sheet – the lack of transparency in the CDO allowing bad assets to go unnoticed by investors. Furthermore, if the bank is also the servicer of the asset, it might have less incentive to monitor its performance after it has been sold, leading to a moral hazard problem. Several papers find evidence of adverse selection and

moral hazard associated with the securitization of loans [Gan (2006), Mian et. al. (2008), Drucker (2008)].[52]

Hypothesis 2D: "The Asymmetric Information Effect"

CDO performance will be affected if it contains collateral originated by its underwriter, although the performance might improve or decline, depending on the importance of reputation vs. adverse selection and moral hazard.

3.3 Credit Ratings

Perhaps the most important players in the CDO market were the credit rating agencies, whose ratings helped investors to gauge the risk of CDO bonds. There are two main rating methodologies used in rating CDOs: 1) the binomial expansion technique (BET); or 2) Monte Carlo simulations.[53] In both methods, rating agencies simplified their models to require only five inputs on the underlying CDO collateral: current credit rating, maturity, asset type, country, and industry. These inputs are then used to determine the three assumptions that went into the loss model: default probability, recovery rate, and asset correlation. The CRAs have been widely blamed for mis-rating CDOs [Griffin et. al. (2008), Mason et. al. (2007), Benmelech et. al. (2008), An et. al. (2006)].[54] The SEC

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[52] Gan et al. (2006) shows that mortgage servicing is more efficient in deals where servicers have retained an equity stake. See Mian et al. (2008) and Keys et al. (2008) for empirical evidence that increased securitization caused a decline in loan quality. Drucker et al. (2008) show that when an underwriter declines to submit a bid at a secondary market sale, delinquent loans are up to four times more likely to be reported as missing their next payment and that when they do bid on the securities, the underlying mortgage pools have higher payoff rates in the subsequent four months.

[53] See BIS Working Paper 163 for a detailed explanation of ratings methodologies.

[54] Griffin and Tang (2008) explore what drove the mismatch between initial CDO credit ratings and subsequent performance, and find evidence of assumption errors, misleading inputs, and conflicts of interests playing a role in CDO ratings. Mason and Rosner (2007) investigate CDOs backed by non-agency MBS and find that even investment grade rated CDOs experience significant losses as a result of home price depreciation. Benmelech and Dlugosz (2008) examine collateralized loan obligations (a specific type of CDO backed by whole loans) and find a mismatch between the rating of CDO tranches and the credit quality of the underlying assets, saying that "while the credit rating of the majority of tranches is AAA, the

investigated claims against the rating agencies and found significant problems, observing that "there was a substantial increase in the number and complexity of RMBS and CDO deals since 2002, and some of the rating agencies appear to have struggled with the growth," and that "significant aspects of the ratings process were not disclosed, including the rationale for deviations from their models." Most troubling, they found extensive evidence that employees were aware of the shortcomings in their models, but did nothing about them. For instance, one employee wrote an email about how the rating agencies were creating an "even bigger monster – the CDO market. Let's hope we are all wealthy and retired by the time this house of cards falters. ;)"[55]

In this section, I will investigate four major questions surrounding CDO credit ratings: 1) What factors were important in determining initial CDO credit ratings?; 2) What factors have driven the wave of CDO downgrades?; 3) How well did original collateral asset and CDO tranche ratings predict performance?; and 4) What factors explain the mistakes made in forecasting performance?

To answer the first question, I will look at the percent of each CDO that was given a AAA rating by Fitch, S&P, and Moody's. When rating CDOs, it has been found that the rating agencies relied almost exclusively on the prior ratings of the underlying collateral, without making sufficient distinctions for different asset types.[56]

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average credit rating of the collateral is B+"(Benmelech 1). Finally, An et. al. (2006) examine the subordination levels in commercial mortgage-backed securities (CMBS) and find that expected losses can explain less then 30% of the variation in subordination levels, indicating the difficulty in determining appropriate subordination for structured finance tranches apriori.

[55] Summary Report of Issues Identified in the Commission Staff's Examinations of Select Credit rating Agencies (2008).

[56] The SEC report found that the credit analysis "does not include an analysis of the underlying asset pools in the RMBS," instead relying on the underlying assets' prior credit ratings.

Hypothesis 3A: "Recycled Ratings Effect"

The most important factor in explaining initial levels of AAA given to a CDO are the credit ratings of their collateral pool.

Another factor that might affect the initial percent of AAA assigned to a CDO is the number of rating agencies rating the deal. Multiple ratings might have encouraged the agencies to spend more time judging the risks, causing a more conservative rating. However, it might also be the case that the CRAs were worried about "ratings shopping," causing more liberal ratings when they knew another agency was also rating the deal, in fear that they would loose business if their rating were less desirable than their competitors.

Hypothesis 3B: "Peer Pressure Effect"

The % of AAA given to a CDO will depend on the number of rating agencies rating the deal.

In looking at the tranche downgrades, it has been noted that the senior tranches have been disproportionately affected by CDO losses, due to the sensitivity of these tranches to initial risk miscalculations [Heitfield (2008)].[57]

[57] Heitfield (2008) shows the sensitivity of different tranches to changes in correlation and probability of default inputs in a Gaussian Copula model, and finds that CDO notes with greater seniority are more sensitive to model parameters that describe the distribution of collateral losses. He notes that, "even small errors in estimating these parameters have significant effects on measures of credit risk for senior CDO notes. Typically, it is more difficult to estimate such parameters when collateral defaults are rare"(Heitfield 37).

Hypothesis 3C: "Seniority Effect"

Controlling for the default rate of the CDO collateral, senior tranches have experienced more severe downgrades.

To answer the third question, I will first look at how well CDO collateral asset ratings predicted asset default rates. It is likely that lower initial collateral ratings of certain asset classes (such as subprime) translated into more realized defaults.

Hypothesis 3D: "The Asset-Class Effect"

The realized defaults associated with a given credit grade varies based on the asset type.

In addition to looking at the predictive power of the collateral ratings, I will look at how the AAA losses relate to the initial percent of the CDO rated AAA. As a proxy for AAA losses, I will use the default rate on the collateral assets minus the current amount of AAA subordination.

Hypothesis 3E: "The Super-Senior Effect"

Rating agencies were overly optimistic in giving AAA ratings. CDOs given more initial AAA ratings, in terms of number of AAA tranches and percent of the transaction rated AAA, are now exposed to larger losses.

Lastly, I will look at the factors that explained the difference between the collateral default rate predicted by its credit ratings and the realized default rate. The results to all four questions in this section will help to address the possibility that there might be a conflict of interest arising from the fee system of the rating agencies. Many

people have alleged that this system, in which the rating agencies are paid directly by the banks whose products they are rating, gives them an incentive to assign more "desirable" ratings to the products of their biggest clients, in order to retain market share and continue to drive business. [58] For example, the SEC investigation concluded that analysts appeared to be aware, when rating an originator's products, of the rating agency's business interest in securing the rating of the deal and the importance of increasing market share.[59]

Hypothesis 3F: "Conflicts of Interest"

Conflicts of interest caused by the fee system of credit ratings would result in more aggressive initial ratings, subsequently more downgrades, and worse accuracy in prediction for the CDOs of large underwriters. If these conflicts exist, we would expect the results to questions (1)-(4) to depend on the amount of business done between the CDO underwriter and the rating agency,

[58] Several people have conducted studies regarding conflicts of interest at the CRA's. Covitz (2003) finds that reputation incentives outweigh the desire to please big originators and that conflicts of interest are not a problem.

[59] Summary Report of Issues Identified in the Commission Staff's Examinations of Select Credit rating Agencies (2008).

4. Regression Analysis

This section uses multivariate regression analysis to answer the questions and hypotheses outlined in Section 3. Each sub-section corresponds to one of my three guiding questions: 1) How much of the poor performance of CDO securities is explained by the properties of their assets and liabilities?; 2) Has CDO performance varied across different underwriters and collateral originators?; and 3) How well do the CDO credit ratings capture their performance?

4.1 Data Description

The data used in this study comes from several sources. The first source is LehmanLive, a web-based platform that provides access to Lehman's (now Barclay's) research and fixed income, credit, and equities markets analytics. This database contains detailed surveillance information on virtually the entire population of U.S. CDOs issued from January 1, 1999 through the present. The data used from this source consists of 735 ABS CDOs, and will be referred to as the "full sample." The next source of data is the "OpenSource Model," compiled by the hedge fund Pershing Capital Management, which contains detailed information on the 2005-2007 vintage ABS CDOs. While the data from this source only includes information on 430 of the 735 ABS CDOs in the full sample, it provides much more detail about each CDO in terms of their collateral composition. I refer to this dataset as the "high-information sample." Lastly, the datasets were supplemented by information from S&P Ratings Direct, CreditFlux, and proprietary CDO research from UBS.

Summary statistics for the variables of interest are presented in Appendix A, as well as detailed definitions of these variables. Panel A describes variables that are observed at the CDO level; Panel B describes variables that are observed at the tranche level; Panel C describes variables that are observed about the assets within the CDOs; Panel D summarizes the CDOs of the top underwriting banks; and Panel E summarizes the RMBS collateral of the biggest RMBS originators of the CDO collateral. Appendix B gives the credit rating grades used by the three CRAs and translates them into numerical scores that I use throughout my analysis.[60]

4.2 The Effects of Asset and Liability Characteristics on CDO Performance

Methodology

To test for the effects of general CDO characteristics on CDO performance, I perform a number of regressions relating CDO asset and liability properties to CDO performance. These are shown in Table 6 (Panels A.1, A.2, and B). The OLS regressions in Panels A.1 and A.2 are run at the CDO level, using *Default* as the performance measure (the percent of defaulted collateral per CDO), while those in Panel B are run at the tranche level, using credit rating downgrades as the performance measure (translated into numerical notches according to the rating scale in Appendix B).[61] As a robustness check, the OLS specifications are supplemented by Probit regressions using binary dependent variables: regressions (5) in Panels A.1 and A.2 use a dummy dependent variable, *Default Dummy,* that equals one if the CDO's *Default* is higher than the median *Default* (16% for the full sample and 36% for the high-information sample), and zero

[60] See Appendix C for the probability of default associated with the letter grades.
[61] For CDO-level regressions, the unit of observation is the entire CDO transaction, while for tranche-level regressions, the unit of observation is a single CDO tranche.

otherwise; regressions (2) and (4) in Panel B use a dummy variable, *Downgrade Dummy,* that equals one if the CDO tranche experienced a downgrade of any severity and zero if the tranche rating was upgraded or unchanged. All regressions are performed separately on the full sample and on the high-information sample. The high-information sample regressions contain more independent variables but fewer observations. Year fixed effect variables are added to control for changes in market conditions over the sample periods (1999-2007 for the full sample, 2004-2007 for the high-information sample). T-statistics and significance levels are computed using standard errors clustered by the CDO underwriter.

Panel A.1 presents the results of the CDO-level regressions on *Default* and *Default Dummy* using the full sample of 735 CDOs. The independent variables describing the CDO's liability properties are *Original CDO Balance, Number of Tranches, Average initial CDO rating* (a weighted average of the tranche ratings), and *WAC* (a weighted average of the tranche coupons). The independent variables describing the CDO's assets include *Number of assets,* variables giving the percent invested in each asset class: *HEL, CDO, RMBS, CMBS* (*Other* is excluded),[62] the percent of synthetic collateral (*Synthetic*), and the percent of collateral paying a fixed-rate coupon (*Fixed Rate).* The specification of the initial model is:

(1) $$\text{Default}_i = \alpha + ß_1(\text{Original CDO Balance})_i + ß_2(\text{Number of assets})_i + ß_3(\text{Number of Tranches})_i + ß_4(\text{Average Initial CDO Rating})_i + ß_5(\text{WAC})_i + ß_7(IYear\_) + \varepsilon_i$$

[62] The full sample only divides residential mortgage securities into two buckets: HEL (home equity loan) securities include those backed by non-prime mortgages, while RMBS securities are those backed by prime mortgages. The high-information has seven RMBS categories, splitting the HEL category into securities backed by subprime, midprime, Alt-A fixed-rate, Alt-A ARM, HELOC (home equity line of credit), and CES (closed-end second) mortgages.

Panel A.2 presents similar regressions, instead using the high-information sample of 430 CDOs. This sample includes more independent variables describing the CDO assets: RMBS and HEL securities are broken into seven asset classes (*Prime, Midprime, Subprime, Alt-A Fixed Rate, Alt-A ARM, HELOC, and CES*), and variables are added for the average initial credit rating of the collateral (*Average Initial Collateral Rating*) and the percent of the collateral issued in 2006 and 2007 (*2006-vintage collateral, 2007-vintage collateral).*

Panel B of Table 6 presents the results of the tranche-level regressions relating asset and liability properties to tranche credit rating changes or *Downgrade Dummy*. The asset variables are the same as those in Panels A.1 and A.2, but the liability variables are replaced for tranche-specific variables: *% Subordination* (the initial level of the tranche's credit support), *Tranche Coupon, Original Tranche Balance,* and *% of Transaction* (the size or "width" of the tranche). In addition, dummy variables are added to control for the initial rating of the tranche (*AAA-Below IG*).

Results

Overall, the regressions in Table 6 show the importance of CDO asset and liability properties in determining CDO performance – properties which account for approximately half of the variation in CDO defaults and credit rating downgrades. In terms of collateral defaults, the highest adjusted R-squared from A.1 is 41%, while in A.2, the additional detail provided by the high-information sample variables gives a value of 68%. In Panel B, the adjusted R-squared values from both samples show that the asset and liability properties explain 57-58% of the variation in tranche credit-rating changes.

Looking at the liability variables, we see that *Original Balance* has a significant negative coefficient in Panel A.1, indicating that smaller CDOs performed worse after controlling for other factors. One interpretation might be that these smaller CDOs were made up of "left-over" assets from other transactions that the bank needed to dispose of and were not purposefully selected. However, the coefficient becomes less significant when we add the amount of synthetic and fixed rate collateral; this could still be consistent with the "left-over" interpretation if small CDOs had more synthetic collateral and were created by banks needing to hedge certain positions, or wanting to get rid of previously written CDS contracts. As expected, the amount of tranche subordination is negatively related to downgrades in Panel B, as is the size of the tranche, with thinner tranches experiencing more downgrades. The CDO coupon payment is only significant in the probit specifications of Panels A.1 and B, but they are positive, indicating that the market correctly demanded a higher yield for CDOs that were "riskier than average." Lastly, the CDO's initial credit rating is *inversely* proportional to defaults and is significant in Panel A.2, indicating that CDOs with more favorable credit ratings later faced more defaults; Panel B shows that the more senior CDO tranches have faced more severe downgrades.

Turning to CDO asset characteristics, we find support for hypothesis 1A: there is a significant and consistently negative "housing effect," with low quality RMBS assets associated with worse CDO performance. The coefficient on *% HEL* is highly significant in every specification, with an increase of one standard deviation (S.D.) in *% HEL* (25%) associated with an increase of 9% (or 1/3 of a S.D.) in *Default* and a two-notch increase in downgrades. The high-information sample splits *HEL* securities into more detailed

categories, revealing that it is specifically the Alt-A ARM mortgages that have the most pronounced effect on CDO performance. Panel A.2 of Table 6 provides support for the "vintage effect" of hypothesis 1B, showing that CDOs with more collateral from 2006 and 2007 have had increased defaults and the effect is significant in all specifications. The economic significance of the 2006-vintage collateral is worse than for 2007: when all the control variables are included, a one S.D. increase in *% 2006-vintage collateral* (29%) is associated with a 10% increase in *Default*, while increasing *% 2007-vintage collateral* by one S.D. (13.5%) is associated with a 5% increase in *Default.* Also as predicted, we find that floating-rate collateral is associated with worse performance, although the coefficient is only significant in the probit specifications.

Lastly, there is a negative "complexity effect," as predicted by hypothesis 1C: the coefficients on *Number of Assets, % Synthetic, and % CDO* are all positive. A higher number of CDO assets is associated with higher *Default* and more rating downgrades, supporting the interpretation that a larger number of assets made it easier for bad assets to go unnoticed by decreasing the CDO's transparency. The coefficient is statistically significant, except when *% Synthetic* is added in Panels A.1 and A.2. However, since *% Synthetic* is also related to the level of complexity in the CDO, perhaps this variable now picks up the negative "complexity effect." Both *% Synthetic* and *% CDO* are associated with worse performance in most specifications, although the coefficient on *%CDO* is not consistently significant. Taken together, the results in Table 6 indicate that adverse CDO performance was due primarily to the inclusion of poor quality 2006 and 2007-vintage RMBS assets backed by subprime and Alt-A ARM mortgages, assets whose risks were easily overlooked amidst the high level of complexity in the CDOs.

Table 6: Determinants of CDO Performance - General CDO Characteristics

Panel A: Results based on Collateral Defaults

These tables present the results of the regressions for section 5.1. The dependent variable "Default" refers to the percent of the CDOs collateral in default as of January 2009. All regressions are OLS except for (5), which uses a Probit regression on a dummy variable that equals 1 if the variable "Default" is greater than the median "Default" (16% for the full sample and 36% for the high-information sample), and zero otherwise. The unit of observation is the entire CDO, thus no tranche-specific variables are included. Standard errors are clustered by CDO Underwriter. Coefficients are significant at the $^{+}$10%, *5%, **1% significance level.

1. Full-Sample Results, n = 735

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	**Default**	**Default**	**Default**	**Default**	**Default Dummy**
REGRESSOR:	**OLS**	**OLS**	**OLS**	**OLS**	**Probit**
Original CDO Balance	-.000073**	-0.0001**	-0.0001**	-0.00003*	-0.00007
	(.000017)	(0.00002)	(0.00001)	(0.00001)	(0.00004)
Number of assets	.0007799**	0.00059**	0.00042*	0.00017	0.00032
	(.000146)	(0.00016)	(0.00016)	(0.00019)	(0.00047)
Number of Tranches	-.00736	0.00006	0.00263	0.0071^{+}	0.01159
	(.00482)	(0.00563)	(0.00444)	(0.00389)	(0.01155)
Average initial CDO rating	-0.00411	-0.009	-0.01119	-0.01044	-0.01005
	(0.01061)	(0.00952)	(0.0092)	(0.00995)	(0.02744)
WAC	-0.00371	-0.00234	0.00243	0.0010	0.04598*
	(0.0114)	(0.01106)	(0.01027)	(0.00787)	(0.02154)
% HEL	—	0.29273**	0.23393**	0.35219**	0.84396**
		(0.06171)	(0.06739)	(0.05559)	(0.16486)
% CDO	—	0.06614	-0.02133	0.08007	0.20596
		(0.07051)	(0.0751)	(0.05959)	(0.16726)
% RMBS	—	—	-0.1149*	0.03151	0.38458+
			(0.04948)	(0.05568)	(0.21857)
% CMBS	—	—	-0.3208**	-0.16394*	-0.50782
			(0.07443)	(0.07207)	(0.31586)
% Synthetic	—	—	—	0.32089**	0.70235**
				(0.1022)	(0.21271)
% Fixed Rate	—	—	—	-0.04315	-0.17871^{+}
				(0.03438)	(0.10663)
***IYear*2001**	0.08262*	0.04505	0.04106	0.05033	0.59573**
	(0.03833)	(0.03472)	(0.03682)	(0.03415)	(0.03617)
***IYear*2002**	0.02913	-0.03147	-0.03445	-0.04553^{+}	0.63248**
	(0.02875)	(0.03062)	(0.03128)	(0.02483)	(0.03531)
***IYear*2003**	0.04042	-0.05269	-0.03969	-0.07246	0.61793**
	(0.04430)	(0.05422)	(0.05554)	(0.05078)	(0.03684)
***IYear*2004**	-0.0006	-0.10759*	-0.06889^{+}	-0.1192**	0.71464**
	(0.03522)	(0.03959)	(0.03584)	(0.02686)	(0.03117)
***IYear*2005**	0.11137*	-0.00424	0.03141	-0.04046	0.82197**
	(0.04753)	(0.04773)	(0.04433)	(0.03438)	(0.02464)
***IYear*2006**	0.24766**	0.13581**	0.16536**	0.057	0.92947**
	(0.05092)	(0.047)	(0.04658)	(0.04527)	(0.01756)
***IYear*2007**	0.42614**	0.30813**	0.33452**	0.21686**	0.84737**
	(0.05750)	(0.05396)	(0.04492)	(0.0436)	(0.02424)
Intercept	0.06203	0.02461	0.05353	-0.02267	-0.02267
Regression summary statistics					
Adj. R^2	0.3058	0.3600	0.3878	0.4125	—
SER	0.2280	0.2189	0.2141	0.2098	—

2. High-Information Sample Results, n = 430

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	**Default**	**Default**	**Default**	**Default**	**Default Dummy**
REGRESSOR:	**OLS**	**OLS**	**OLS**	**OLS**	**Probit**
Original CDO Balance	0.00001 (0.00003)	0.00002 (0.0001)	-0.00002 (0.0001)	0.0000 (0.0001)	-0.0001 (0.00007)
Number of assets	0.00072* (0.0003)	0.00041 (0.0003)	0.00068* (0.0003)	0.00031 (0.0002)	0.00209** (0.00076)
Number of Tranches	-0.00052 (0.00804)	-0.00129 (0.0046)	-0.00701 (0.0094)	-0.004 (0.0045)	-0.01008 (0.02023)
Average Initial CDO Rating	-0.046** (0.01275)	-0.030** (0.0105)	-0.040** (0.0116)	-0.0258* (0.0098)	-0.14894** (0.05571)
Average Initial Collateral Rating	0.0507** (0.01823)	0.04174* (0.0171)	0.0644** (0.0156)	0.0478** (0.0149)	0.21422** (0.04342)
WAC	-0.0036 (0.01279)	0.00882 (0.0118)	-0.00719 (0.0143)	0.00743 (0.0111)	0.03583 (0.03751)
% Subprime	0.3645** (0.12454)	-0.11709 (0.2985)	__	-0.24477 (0.2265)	-0.22927 (1.576)
% Alt-A Fixed Rate	0.02609 (0.21156)	0.10733 (0.2808)	__	-0.10481 (0.2295)	1.71031 (1.72197)
% Alt-A ARM	0.702* (0.27614)	0.79671* (0.3528)	__	0.44669 (0.3004)	3.72806* (1.7405)
% CDO	0.3711** (0.08841)	0.44547 (0.3154)	__	0.2154 (0.2484)	1.57222 (1.63275)
% Prime RMBS	__	-0.28299 (0.2934)	__	-0.37225 (0.2268)	-0.00754 (1.70039)
% Midprime RMBS	__	0.35639 (0.2824)	__	0.23627 (0.2174)	1.6933 (1.51327)
% CES RMBS	__	0.5629 (0.3480)	__	0.25367 (0.2898)	1.28413 (1.51272)
% HELOC	__	-0.05239 (2.0859)	__	0.90136 (1.7005)	-7.31818 (5.53717)
% CLO	__	-0.902** (0.3068)	__	-0.996** (0.2453)	-2.31828 (1.72703)
% CMBS	__	-0.50936 (0.3816)	__	-0.5851^{+} (0.3094)	-0.16002 (1.91292)
% Fixed Rate	__	-0.00529 (0.0337)	__	-0.02481 (0.0383)	-0.4151** (0.15021)
% Synthetic	__	0.05301 (0.0999)	__	0.08675 (0.0825)	0.35217 (0.23053)
% 2006-vintage collateral	__	__	0.4129** (0.0449)	0.3530** (0.0352)	0.79254** (0.18029)
% 2007-vintage collateral	__	__	0.3065** (0.0917)	0.3932** (0.0868)	1.34165** (0.39527)
***IYear*2005**	0.0268 (0.033)	-0.0795* (0.0321)	0.01866 (0.0265)	-0.0620* (0.0289)	0.77072 (0.68969)
***IYear*2006**	0.2441** (0.03711)	0.02278 (0.0376)	0.05938^{+} (0.0315)	-0.0913* (0.0359)	0.76903 (0.83893)
***IYear*2007**	0.3948** (0.04569)	0.1846** (0.0412)	0.13432* (0.0567)	-0.04017 (0.0515)	0.75362 (0.67228)
Intercept	-0.3400*	-0.04102	-0.2351^{+}	0.04292	__
Regression Summary Statistics					
Adj. R^2	0.4478	0.6256	0.4859	0.6823	__
SER	0.2171	0.1752	0.2053	0.1614	__

Panel B: Results based on Credit Ratings

The dependent variables in these regressions are 1) the overall change in the tranche credit using notches outlined in Table 2, and 2) a dummy variable that equals 1 if the tranche has been downgraded, and equals zero if the rating was unchanged or upgraded. Dummy variables are included for the initial rating of the tranche. The observations here are the individual CDO tranches, making the sample size much larger than in Panel A. Standard errors are clustered by CDO Underwriter. Coefficients are significant at the +10%, *5%, **1% significance level.

	Full Sample		High-Information Sample	
Dependent Variable	**Change in credit rating (# Notches)**	**Downgrade Dummy**	**Change in credit rating (# Notches)**	**Downgrade Dummy**
REGRESSOR:	OLS	Probit	OLS	Probit
% Subordination	-5.516** (1.24)	-0.142 (0.10)	-6.031** (1.20)	-0.036 (0.02)
Tranche Coupon	-0.091 (0.07)	0.017* (0.01)	-0.102 (0.06)	0.008** (0.00)
Original Tranche Balance	1E-04 (0.00)	-6E-05 (0.00)	-0.001 (0.00)	-3E-06 (0.00)
% of Transaction	-3.847** (1.06)	-0.048 (0.06)	-2.653* (1.27)	-0.009 (0.02)
Number of assets	0.013** (0.00)	0.001** (0.00)	0.010* (0.00)	0.000** (0.00)
Number of Tranches	-0.065 (0.06)	0.006 (0.01)	-0.069 (0.09)	-0.002 (0.00)
% HEL	8.245** (1.96)	0.618** (0.15)	-	-
% RMBS	3.102+ (1.65)	0.224* (0.11)	-	-
% CMBS	-4.801** (1.29)	-0.041 (0.08)	-5.795 (10.36)	0.035 (0.09)
% CDO	4.100* (1.68)	0.267** (0.09)	10.420 (10.67)	0.166+ (0.10)
% Fixed Rate	1.370* (0.67)	0.091 (0.05)	0.470 (0.86)	-0.008 (0.02)
% Synthetic	2.948 (2.07)	0.226* (0.09)	-0.375 (0.74)	0.029* (0.01)
% Subprime	-	-	3.214 (10.33)	0.105 (0.09)
% Alt-A Fixed Rate	-	-	1.106 (10.85)	0.114 (0.11)
% Alt-A ARM	-	-	26.939* (10.10)	0.573** (0.18)
% Prime RMBS	-	-	-2.881 (10.94)	0.054 (0.09)
% Midprime RMBS	-	-	11.411 (10.20)	0.187* (0.09)
% CES RMBS	-	-	17.252 (10.71)	0.229 (0.16)
% HELOC	-	-	28.985 (18.68)	1.060 (0.80)
% CLO	-	-	-10.741 (10.58)	0.002 (0.10)
Average initial collateral rating	-	-	-0.220 (0.32)	-0.007 (0.01)
Average current collateral rating	0.254** (0.07)	0.012** (0.00)	0.106 (0.10)	0.008** (0.00)

	Full Sample		High-Information Sample	
Dependent Variable	**Change in credit rating (# Notches)**	**Downgrade Dummy**	**Change in credit rating (# Notches)**	**Downgrade Dummy**
REGRESSOR:	OLS	Probit	OLS	Probit
IYear2001	-2.379 (2.04)	-0.476** (0.14)	-	-
IYear2002	-5.003** (1.52)	-0.717** (0.10)	-	-
IYear2003	-6.329** (1.51)	-0.841** (0.05)	-	-
IYear2004	-6.556** (1.63)	-0.831** (0.07)	-	-
IYear2005	-3.661* (1.71)	-0.600** (0.16)	-0.301 (0.60)	0.008 (0.01)
IYear2006	-1.376 (1.69)	-0.468** (0.15)	1.052+ (0.55)	0.019+ (0.01)
IYear2007	-1.147 (1.67)	-0.550** (0.17)	1.426* (0.56)	0.024* (0.01)
Initial Tranche Rating Dummies				
AAA	1.831+ (0.96)	-0.084 (0.06)	4.656** (0.64)	0.000 (0.01)
AA+	1.064 (0.86)		3.969** (0.78)	0.006 (0.01)
AA	1.887* (0.88)	-0.016 (0.06)	4.188** (0.47)	0.015 (0.01)
AA-	1.673+ (0.85)	0.051 (0.04)	3.076** (0.35)	0.011 (0.01)
A+	omit	-0.038 (0.08)	3.485** (0.91)	
A	-0.289 (0.82)	-0.055 (0.07)	1.608** (0.45)	0.008 (0.01)
A-	-0.826 (0.94)	-0.109 (0.09)	1.417** (0.42)	0.011 (0.01)
BBB+	-1.135 (0.82)	-0.001 (0.06)	omit	0.018** (0.01)
BBB	-1.477+ (0.83)	-0.046 (0.06)	-0.535 (0.46)	0.005 (0.01)
BBB-	-2.778** (0.70)	-0.222** (0.09)	-2.503** (0.49)	-0.074* (0.05)
Below IG	-3.923** (0.75)	-0.357** (0.10)	-3.192** (0.41)	-0.145** (0.06)
Intercept	6.127** (2.05)	-	4.895 (10.25)	-
Regression Summary Statistics				
Adj. R^2	0.585	-	0.572	-
SER	4.68	-	3.83	-
n	4511	4511	2711	2711

4.3 The Effects of CDO Underwriters and Collateral Originators

Next, I investigate the link between CDO performance and specific CDO underwriters and collateral originators. The first series of regressions looks at whether variation in CDO performance across underwriters is merely a result of the asset and liability properties of those CDOs, or whether the identity of the underwriter is a significant predictor of CDO performance after controlling for CDO properties (hypothesis 2A).[63] To do this, I rerun certain regressions from Section 4.2, adding fixed effect dummies for the largest 17 CDO underwriters. Panels A.1 and A.2 of Table 7 rank the underwriters from 1-17 according to the performance of their CDOs (after controlling for the CDO characteristics), with 1 being the "best" underwriter and 17 being the "worst." The regression specifications for (1) –(4) in Panel A.1 are identical to regressions (4)-(5) in Panels A.1 and A.2 of Table 6, and regressions (1)-(4) in Panel A.2 are identical to (1)-(4) in Panel B of Table 6, with the addition of the underwriter fixed effect dummies. The estimated regression coefficients are shown in parentheses underneath the ranking of the underwriter. The t-statistics used to calculate significance levels are based on standard errors clustered by the CDO underwriter.

The results in Panel A support hypothesis 2A, showing evidence of an "underwriter effect" on CDO performance. The adjusted R-squared values of all regressions are higher with the added underwriter dummies than those from Table 6 – in A.1 (1), the value increases by 0.03 to 0.44, in (3) by 0.02 to 0.70, in A.2 (1) and (3) the value increases to by 0.01, to 0.59 and 0.58 respectively. The specific underwriter coefficients are most consistently significant for the *best* or the *worst* underwriters, and it

[63] In other words, we want to ask whether Bank A's CDOs were bad because, for example, they used bad assets (subprime) or whether their CDOs were worse than Bank B's CDOs, who had the same amount of subprime. This would indicate a lesser ability or lower amount of due diligence on the part of Bank A.

is interesting that the rankings based on *Default* are not always the same as those based on credit rating changes. Based on the rankings in A.1, we can say that the CDOs of Goldman Sachs consistently outperformed, and are associated with a decrease of 6% in *Default* after controlling for CDO asset and liability characteristics. Among the consistent underperformers are Morgan Stanley, Merrill Lynch, Deutsche Bank, and JP Morgan – JP Morgan's CDOs are associated with a staggering 18% increase in *Default* on average, after controlling for CDO asset and liability characteristics.

Panel B examines whether the size of the bank's CDO underwriting practice is related to the performance of their CDOs (hypothesis 2B). In Panels B.1 and B.2 of Table 7, the underwriter fixed effect dummies are replaced with two variables describing the size of the CDO underwriter: *Underwriter Market Share* is equal to the number of CDOs underwritten by the bank divided by the total number of CDOs, and *Par Value of Underwriter's CDO Issuance* is equal to the natural log of the total dollar balance (in millions) of all CDOs underwritten by the bank. The results of Panel B show evidence supporting the "size effect" of hypothesis 2B. The coefficients on *Underwriter Market Share* indicate that the more aggressive the underwriter, in terms of the number of CDOs issued, the worse their CDO's performance. However, the coefficient on *Balance of Total Issuance* is consistently *negative*, indicating that for a given level of aggressiveness, *more* CDO issuance is better. The interpretation of this result is ambiguous, but it could support the experience portion of hypothesis 2B, namely that CDO quality improves with the experience of the underwriter. Taken together, the results of Table 7 provide strong evidence in favor of an "underwriter effect," and suggest that at least part of the variation

in CDO underwriting quality was due to the size of the bank's CDO business, with larger banks underwriting lower quality CDOs.

The next series of regressions ranks specific RMBS originators based on the performance of CDOs containing their collateral (hypothesis 2C). Originator variables are created for the largest 56 RMBS originators in the high-information sample CDO asset pools, equal to the percent of the CDO's assets they issued. Table 8 shows the rankings of the RMBS originators, based on the same regression specifications as Table 7, replacing the underwriter dummy variables with the RMBS originator variables. In addition, control variables are added for the average FICO, DTI, and CLTV of the RMBS collateral, whose coefficients are shown at the bottom of Panel A. The results of these rankings indicate the effect of a specific originator's collateral on CDO performance, holding constant the observable characteristics of their mortgages.

Like the rankings of the CDO underwriters, it is noteworthy that the rankings of the originators are different according to the regressions based on *Default* and those based on credit ratings. For the analysis here, I will again focus on the *Default* rankings, saving the analysis of credit rating accuracy for section 4.4. There are only a few originators that show statistically significant effects on CDO performance, indicating that most of the originator effects are a result of observable characteristics of the mortgages they issued, rather than a difference in originator ability or due diligence. In particular, the coefficient on the average CLTV of the originator's mortgages is significant and positive, confirming that CDOs containing RMBS collateral with high combined loan-to-value ratios have been adversely affected. Even after controlling for FICO, DTI, and CLTV, there are several originators that are associated with significant

underperformance in terms of CDO defaults. CDOs with more collateral issued by HSBC, Cairn, Deutsche Bank, and RALI (owned by GMAC), all experienced higher levels of defaults, controlling for other CDO asset and liability characteristics. Overall, Table 8 provides only weak support for a specific "originator effect" proposed in hypothesis 2C.

In Table 9, I explore the relationship between banks that acted as both CDO underwriters and as suppliers of CDO collateral, specifically looking at the effect of banks "rolling over" their CDO tranches into new CDOs (hypothesis 2D). I introduce interaction terms into the regression analysis, equal to the percent of CDO collateral that is invested in CDO bonds underwritten by the same bank underwriting the current CDO. The regression specifications are identical to those run on the high-information sample in Table 7, with the addition of the interaction terms. Table 9 gives the coefficients on both the underwriter fixed effect dummy (F.E.) as well as the interaction term measuring the effects of re-used collateral from the underwriter (Int.). The fixed effect coefficient reflects the overall effect of a certain underwriter on CDO performance (due to their ability, due diligence, and other unobservable factors), while the interaction terms show whether the underwriter's CDOs are improved or weakened by using their own CDO bonds as collateral.

Like the results in Tables 7-8, the results that use *Default* as the dependent variable do not match those that use credit rating changes. Basing the analysis on the *Default* results, we see that the effect of an underwriter using its own collateral (for which it is assumed to possess an informational advantage) is contingent on the specific underwriter, with some interaction coefficients positive and others negative. For

underwriters with negative interaction coefficients, the over-riding incentive seems to be maintaining their reputation, with the asymmetric information situation leading to higher quality CDOs (thus a lower value for *Default*). This is the case for Barclays, Bear Stearns, Calyon, Credit Suisse, Lehman Brothers, and RBS. Note that this does *not mean* that these bank's CDOs showed better performance overall, only that the *additional* effects of using their own collateral enhanced CDO performance. For example, Bear Stearns had an overall adverse effect on its CDOs, which were associated with a 9% increase in *Default*; however, among the Bear Stearns CDOs, those that used in-house CDO collateral performed *relatively* better than its other CDOs. Unlike the banks with a "positive asymmetric information effect," the interaction terms of other banks support the theories of adverse selection and moral hazard: the CDOs of Bank of America, Citigroup, Goldman Sachs, JP Morgan, and Morgan Stanley were adversely affected by the inclusion of in-house CDO collateral.

Incorporating all of the results from Tables 7-9, we can say that while the *actions* of the CDO underwriters had a big effect on the performance of their CDOs, the specific identity of the collateral originator was not as important as the characteristics of the mortgages they issued. The fact that the "underwriter effect" is more important in determining CDO performance than the "originator effect" could be due to the relatively high level of time and expertise needed to structure CDOs as compared to issuing mortgages.

While Table 7 distinguishes among the best and worst CDO underwriters, it does not explain *why* some of these banks were destroyed by CDO write-downs while others remained untainted by ABS CDOs. It is impossible to directly explain the ABS CDO

write-downs of specific banks, as they have not disclosed the exact nature of their exposures. It is possible that bank CDO write-downs are completely unrelated to their own CDO underwriting if they did not retain their own securities and/or bought CDOs from other underwriters. However, the anecdotal evidence in Section 2 suggests that for the banks hit worst by CDO write-downs, the bulk of the blame fell on retained CDO securities from their underwriting business. To further clarify the link between CDO underwriting quality and ultimate write-downs, I perform regressions looking at the ABS CDO write-downs (as of February 2009) of the 17 largest CDO underwriters. The dependent variable used is the dollar value of the bank's write-downs divided by the bank's total assets at year-end 2007. Independent variables (shown in all capital letters) are calculated by taking the dollar-weighted average of the CDO independent variables using all of the underwriter's CDOs. The specification used for the initial model is:

$$(2) \qquad (\text{Write-down/Total Assets})_i = \alpha + ß_1\text{DEFAULT}_i + ß_2\text{DOWNGRADE}_i + ß_3\text{AAASUB}_i + ß_5\text{YR2005}_i + ß_6\text{YR2006}_i + ß_7\text{YR2007}_i + \varepsilon_i$$

The variables YR200_ represent the total CDO issuance of each underwriter in the given year.

The results of these write-down regressions are presented in Table 10. These regressions show that bank write-downs are surprisingly *unrelated* to the quality of their own CDOs, as measured by the average *DEFAULT* and *DOWNGRADE* of their CDOs. In fact, the most significant predictor of CDO write-downs is the dollar amount of CDOs a bank underwrote in the year 2007. To gauge the economic significance of the coefficient on YR2007, we can look at the average effect of underwriting ten more CDOs in 2007 (with a balance of $1 billion): an increase in YR2007 by $ 1 billion is associated

with an increase in ABS CDO write-downs of .05% of total assets, and with the average value of the banks' assets equal to 1.5 trillion, this .05% translates into a $735 million increase in write-downs. Continuing this line of analysis, we can say that on average, 2007 CDOs caused their underwriters write-downs of 74% of their par value. This number is consistent with the statements presented in Section 2 that showed banks suffered the most write-downs from retained AAA portions of their own CDO securitizations. When the market for CDOs broke down in 2007, the most aggressive underwriters were stuck holding almost 100% of these AAA securities, which have been marked down to an average of 10 cents on the dollar according to CreditFlux. The key takeaway in this preliminary analysis is that bank CDO write-downs are *not necessarily* an accurate reflection of the underwriting quality of their CDO business. Instead, write-downs were primarily a result of the complete destruction of demand for CDO securities, which, combined with mark-to-market accounting, forced banks to realize losses of almost 100% of the par amount of retained AAA CDO securities.[64]

[64] The implications of these results are not straightforward. On the one hand, it might seem that certain banks were unfairly punished by mark-to-market accounting, causing them to mark their CDO securities to reflect the *worst* CDOs (essentially throwing out the baby with the bath-water so to speak), and that this exacerbated the financial crisis by overstating the capital needs of banks. However, the purpose of mark-to-market accounting is to accurately reflect the *current* financial strength of the institution: if they had to liquidate today, these securities would be *worth* virtually nothing. Furthermore, these banks violated the first rule of responsible underwriting: never complete a transaction *before* you have investors to buy the securities.

Table 7: Effects of Underwriter on CDO Performance

Panel A: Regression Rankings

These tables are the results of section 5.3. Each underwriter is ranked according to the performance of their CDOs, using either defaults or ratings as the measure of performance. The regressions used are identical to (4)-(5) in Panels A.1 and A.2 of Table 6, and Panel B of Table 6, adding in underwriter fixed effect dummies. Regression coefficients are given under ranking.

Ranking based on CDO defaults

Originator	Average Rank	OLS Full	Probit Full	OLS H.I.	Probit H.I.
Goldman	1	2 (-0.06**)	3 (-0.180*)	2 (-0.060*)	2 (-0.210+)
Lehman	2	5 (0.008)	7 (0.050)	1 (-0.09**)	1 (-0.32**)
Dresdner	3	1 (-0.08*)	1 (-0.300**)	3 (-0.008)	10 (0.290)
Barclays	4	3 (-0.030)	5 (-0.045)	8 (0.018)	omit
Bank of America	5	6 (0.024)	10 (0.080)	7 (0.016)	3 (-0.022)
Wachovia	6	4 (-0.030+)	2 (-0.250**)	6 (0.012)	14 (0.415**)
Credit S.	7	7 (0.030)	8 (0.050)	5 (0.005)	7 (0.160)
UBS	8	8 (0.050*)	9 (0.060)	4 (-0.004)	6 (0.090)
Citigroup	9	9 (0.060**)	6 (0.030)	9 (0.030)	5 (0.030)
RBS	10	12 (0.07**)	4 (-0.056)	11 (0.050*)	12 (0.406**)
WestLB	11	10 (0.060*)	11 (0.093)	16 (0.160**)	4 (-0.010)
Bear Stearns	12	11 (0.07**)	13 (0.110)	13 (0.073*)	9 (0.200+)
Calyon	13	16 (0.130**)	12 (0.100)	10 (0.045)	8 (0.170)
Morgan	14	14 (0.09**)	14 (0.130)	15 (0.132**)	11 (0.380**)
Merrill	15	15 (0.100**)	16 (0.230**)	12 (0.050*)	13 (0.409**)
Deutsche	16	13 (0.080**)	15 (0.160*)	14 (0.075*)	15 (0.460**)
JP Morgan	17	17 (0.170**)	17 (0.300**)	17 (0.190**)	16 (0.460**)

Ranking based on CDO downgrades

Originator	Average Rank	OLS Full	Probit Full	OLS H.I.	Probit H.I.
Calyon	1	6 (0.38)	4 (0.001)	2 (-1.16)	2 (-.19**)
Wachovia	2	1 (-0.39)	1 (-0.03)	15 (0.46)	6 (-.07+)
Deutsche	3	2 (-0.38)	3 (-0.004)	9 (0.06)	11 (-0.03)
Dresdner	4	16 (2.28+)	8 (0.04)	1 (-1.4+)	1 (-.3**)
Barclays	5	11 (1.1)	2 (-0.02)	12 (0.24)	3 (-.18**)
Bear Stearns	6	5 (0.2)	5 (0.02)	8 (0.0033)	10 (-0.04)
UBS	7	7 (0.44)	10 (0.06)	5 (-0.6)	7 (-0.07)
Bank of America	8	12 (1.19+)	11 (.056+)	3 (-1.13)	4 (-.113*)
Citigroup	9	8 (0.7)	7 (0.04)	7 (-0.03)	9 (-0.05)
Lehman	10	4 (0.17)	9 (0.056)	13 (0.255)	omit
Goldman	11	3 (-0.07)	12 (.07*)	10 (0.19)	13 (-0.02)
JP Morgan	12	15 (2.16**)	15 (.11**)	6 (-0.31)	8 (-0.07)
Credit S.	13	14 (1.33+)	13 (.08**)	14 (0.27)	5 (-.09+)
RBS	14	9 (0.78)	6 (0.02)	16 (0.48)	16 (-0.001)
WestLB	15	17 (2.4**)	14 (.1**)	4 (-0.69)	12 (-0.04)
Merrill	16	13 (1.2+)	17 (.144**)	11 (0.23)	15 (-0.01)
Morgan	17	10 (1.03)	16 (.117**)	17 (1.1)	14 (-0.02)

Panel B: Effects of Underwriter Size and Market Share

These regressions examine the effects of the market share of each Underwriter and the overall issuance on CDO performance. Underwriter market share is defined as the number of CDOs per Underwriter divided by the total number of CDOs. The par value of the Underwriter's issuance is the sum of all their CDO par values. In the regression, I use the natural log of total issuance. The tables below display only these two coefficients of interest from the set of regressions. The specifications in the first table are identical to those in Panel A, replacing the underwriter dummies with the variables presented below. Clustered standard errors are given in parentheses under estimated coefficients. Coefficients are significant at the $^{+}$10%, *5%, **1% significance level.

1. Results based on Collateral Defaults

	Full Sample		High-Information Sample	
Dependent Variable	**Default**	**Default Dummy**	**Default**	**Default Dummy**
REGRESSOR	OLS	Probit	OLS	Probit
Underwriter Market Share (by # of CDOs)	2.3558** (0.6107)	6.3339** (1.3171)	1.6261** (0.2951)	5.9599** (1.4985)
Par value of Underwriter's CDO Issuance (natural log)	-0.1160** (0.0296)	-0.2979** (0.0590)	-0.118** (0.0210)	-0.3428** (0.1052)

2. Results based on Credit Ratings

	Full Sample		High-Information Sample	
Dependent Variable	**Change in credit rating (# Notches)**	**Downgrade Dummy**	**Change in credit rating (# Notches)**	**Downgrade Dummy**
REGRESSOR	OLS	Probit	OLS	Probit
Underwriter Market Share (by # of CDOs)	23.274** (8.37615)	2.574** (0.7615)	4.1483 (5.5567)	0.3005* (0.1667)
Par value of Underwriter's CDO Issuance (natural log)	-1.2312* (0.5044)	-0.0922^{+} (0.5044)	-0.1139 (0.4237)	-0.0073 (0.0117)

Table 8: Effects of Collateral Originators – Ranking RMBS Originators

This table examines the effect of the collateral's Underwriter on the performance of the CDO using the H-I sample. For each CDO, a variable is created for the percent of collateral issued by each of the top 56 originators. The specifications are identical to those in Table 7, replacing the underwriter dummies with the originator variables, and adding variables based on the average FICO, CLTV, and DTI of the RMBS collateral (their coefficients are shown at bottom). Coefficients are significant at the $^{+}$10%, *5%, **1% significance level. The final column gives the name of the CDO underwriter who bought the largest share of each originator's collateral. The data are sorted by originator rank from best to worst.

Originator	Average Rank	Default	Default Dummy	Rating Change	Downgrade Dummy	Largest Buyer
		OLS	Probit	OLS	Probit	
EquiFirst (Barclays)	1	2 (-1.44)	1** (-33.89)	1 (-52.33)	3 (-0.45)	Merrill Lynch
Ixis (Morgan Stanley)	2	4 (-1.13)	6* (-14.92)	8 (-22.49)	1* (-0.51)	Merrill Lynch
ACA	3	14 (-0.58)	5** (-16.63)	4* (-32.60)	8 (-0.16)	Merrill Lynch
Delta	4	8 (-0.98)	3** (-24.83)	3* (-37.60)	20 (0.04)	Merrill Lynch
RAMP (GMAC)	5	21 (-0.24)	9+ (-6.06)	9* (-20.23)	9 (-0.15)	Merrill Lynch
Carrington	6	9 (-0.95)	10+ (-5.66)	27 (-4.01)	5 (-0.21)	Merrill Lynch
UBS	7	3 (-1.40)	4** (-19.32)	14 (-13.97)	34 (0.14)	Goldman Sachs
Long Beach (WAMU)	8	15 (-0.56)	13+ (-5.29)	13* (-14.79)	18 (0.01)	Merrill Lynch
Encore (Bear Stearns)	9	7 (-1.03)	12 (-5.43)	19 (-8.60)	39 (0.20)	UBS
MASTR (UBS)	10	20 (-0.32)	18 (-2.93)	20 (-7.25)	24 (0.06)	Merrill Lynch
Citigroup	11	29 (-0.13)	31 (1.57)	11 (-14.95)	12 (-0.11)	Merrill Lynch
Goldman Sachs	12	25 (-0.17)	20 (-1.73)	16 (-10.44)	22 (0.05)	Merrill Lynch
First Franklin (Merrill Lynch)	13	32 (-0.01)	15+ (-4.22)	32 (-1.60)	6* (-0.19)	Merrill Lynch
WAMU	14	13 (-0.73)	11+ (-5.47)	47 (8.98)	17 (-0.02)	Merrill Lynch
HEAT (Credit Suisse)	15	35 (0.15)	14 (-4.99)	22 (-6.50)	19 (0.03)	Merrill Lynch
Wells Fargo	16	10** (-0.91)	19 (-2.66)	35 (-0.51)	26 (0.07)	UBS
Wachovia	17	44 (0.37)	22 (-0.43)	5+ (-31.68)	21 (0.04)	Wachovia
Aegis	18	18 (-0.49)	26 (0.28)	37 (-0.20)	14 (-0.06)	Merrill Lynch
ACE	19	12 (-0.78)	8** (-7.63)	30 (-1.81)	46* (0.35)	Merrill Lynch
Saxon (Morgan Stanley)	20	6 (-1.05)	7** (-14.63)	28 (-3.69)	55+ (0.56)	Merrill Lynch
Ameriquest	21	36 (0.19)	24 (0.01)	21 (-6.69)	16 (-0.05)	Merrill Lynch

Originator	Average Rank	Default	Default Dummy	Rating Change	Downgrade Dummy	Largest Buyer
		OLS	Probit	OLS	Probit	
SASCO (Lehman Brothers)	22	17 (-0.50)	16* (-3.74)	38 (1.28)	27 (0.07)	Merrill Lynch
ABFC (Bank of America)	23	34 (0.15)	21 (-1.30)	24 (-5.76)	23 (0.06)	Merrill Lynch
New Century	24	46 (0.50)	30 (1.30)	15+ (-13.17)	13 (-0.06)	Merrill Lynch
Popular	25	41 (0.33)	49* (9.86)	12+ (-14.82)	4 (-0.22)	UBS
DLJ Mortgage (Credit Suisse)	26	11 (-0.81)	17 (-3.05)	29 (-1.89)	52 (0.46)	Merrill Lynch
BayView	27	5 (-1.10)	51* (11.01)	31 (-1.60)	25 (0.07)	Merrill Lynch
Fremont	28	39 (0.32)	34 (1.75)	26 (-4.32)	15 (-0.06)	Merrill Lynch
RALI (GMAC)	29	55* (1.64)	53** (11.70)	6* (-26.19)	2** (-0.47)	Merrill Lynch
RASC (GMAC)	30	22 (-0.22)	54** (12.08)	33 (-1.50)	7+ (-0.19)	Merrill Lynch
Merrill Lynch	31	40 (0.32)	41 (3.68)	10* (-16.79)	29 (0.09)	Merrill Lynch
OWNIT	32	24 (-0.19)	42 (4.13)	17 (-10.32)	49* (0.40)	Merrill Lynch
C-Bass	33	27 (-0.14)	25 (0.06)	46+ (8.49)	37 (0.15)	Bank of America
Option One	34	28 (-0.14)	43 (4.22)	56 (19.49)	11 (-0.12)	Merrill Lynch
Aames Mortgage	35	54 (1.54)	50+ (11.00)	25 (-4.52)	10 (-0.12)	Merrill Lynch
Countrywide	36	42 (0.34)	37+ (2.40)	34 (-1.25)	30+ (0.10)	Merrill Lynch
Deutsche Bank	37	53* (1.33)	48* (8.65)	18 (-9.48)	28 (0.08)	Deutsche Bank
NovaStar	38	43 (0.36)	28 (0.55)	44 (7.16)	36+ (0.14)	Merrill Lynch
GSAA (Goldman Sachs)	39	16 (-0.51)	44 (4.87)	59** (35.48)	33 (0.13)	Goldman Sachs
Impac	40	58+ (2.96)	52 (11.50)	7 (-24.14)	35 (0.14)	Merrill Lynch
JPMorganChase	41	48 (0.65)	32 (1.63)	42 (5.54)	31+ (0.11)	Merrill Lynch
IndyMac	42	23 (-0.19)	35 (1.88)	57** (24.50)	41+ (0.23)	Merrill Lynch
Park Place	43	26 (-0.17)	45 (5.25)	53 (16.01)	32+ (0.13)	Merrill Lynch
Morgan Stanley	44	33 (0.07)	39* (2.81)	43+ (6.32)	44** (0.25)	Merrill Lynch
Cairn	45	57+ (2.45)	59** (36.97)	2* (-47.24)	47** (0.35)	Merrill Lynch
Bear Stearns	46	38 (0.27)	40+ (3.39)	45+ (7.27)	43* (0.24)	Merrill Lynch
Argent (Citigroup)	47	45 (0.40)	23 (-0.27)	50* (14.37)	51** (0.43)	Merrill Lynch
Residential Asset (GMAC)	48	31 (-0.02)	33 (1.66)	58** (28.73)	48** (0.38)	Merrill Lynch
SoundView (RBS)	49	50 (0.95)	36 (1.89)	48+ (11.59)	40+ (0.21)	Merrill Lynch

Originator	Average Rank	Default	Default Dummy	Rating Change	Downgrade Dummy	Largest Buyer
		OLS	Probit	OLS	Probit	
Barclays	50	37 (0.21)	46 (5.31)	55 (18.47)	42 (0.24)	Merrill Lynch
HarborView (RBS)	51	49 (0.67)	27 (0.53)	51+ (14.48)	53** (0.51)	RBS
Accredited Mortgage	52	51 (1.07)	38 (2.69)	54 (16.61)	38 (0.19)	Merrill Lynch
Terwin	53	47 (0.53)	29 (0.93)	49+ (12.66)	56** (0.87)	Merrill Lynch
Fieldstone	54	30 (-0.08)	57** (18.48)	41 (4.53)	54* (0.56)	Merrill Lynch
Nomura	55	52 (1.24)	55** (14.71)	40 (2.93)	50+ (0.42)	Merrill Lynch
HSBC	56	56+ (2.09)	56** (15.26)	52 (15.75)	45** (0.27)	Merrill Lynch
MORTGAGE CHARACTERISTICS						
FICO	-	-0.0048 (0.0051)	-0.0172 (0.0195)	0.0477 (0.0684)	-0.0002 (0.0006)	-
CLTV	-	0.0190+ (0.0103)	0.2269** (0.0569)	-0.1681 (0.2003)	0.0022 (0.0015)	-
DTI	-	0.0091 (0.0068)	-0.0182 (0.0378)	-0.0171 (0.1073)	0.0085 (0.0015)	-

Table 9: Asymmetric Information: Effects of Banks using their own CDOs as Collateral

This table examines whether there is a relationship between CDO performance and the amount of CDO collateral that is issued by the bank that acts as the CDOs Underwriter. The regressions are identical those in Table 7 using the high-information sample, with the addition of interaction terms equal to the percent of CDO collateral coming from the underwriter times the underwriter fixed effect dummy. The coefficients are given for the effect of the fixed effect underwriter dummies (F.E.) and the interaction of the percent of CDO collateral coming from the CDOs underwriter (Int.). Coefficients are significant at the $^{+}$10%, *5%, **1% significance level.

Bank	Coefficient Type	Default OLS	Default Probit	Rating OLS	Rating Probit
Bank of America	**F.E**	-0.01	-0.19	-1.21^{+}	-0.13**
	Int.	2.16**	drop	-35.70**	-1.50
Barclays	**F.E**	0.09^{+}	drop	-0.80	-0.32**
	Int.	-20.86**	drop	372.48**	drop
Bear Stearns	**F.E**	0.09*	-0.24^{+}	-0.78	-0.10*
	Int.	-5.15**	37.77**	98.52**	1.96**
Calyon	**F.E**	0.09*	0.43**	-1.21^{+}	-0.18**
	Int.	-7.92**	-129.53**	-81.07**	-2.14**
Citigroup	**F.E**	0.01	-0.22*	-0.54	-0.08*
	Int.	1.17^{+}	12.13*	11.24	0.05
Credit Suisse	**F.E**	0.09**	0.47**	0.11	-0.12*
	Int.	-3.69**	-14.32**	16.57^{+}	drop
Deutsche Bank	**F.E**	0.06^{+}	0.41**	0.27	-0.04
	Int.	-0.82	drop	-6.02	drop
Dresdner Bank	**F.E**	0.00	0.41*	-1.91*	-0.34**
	Int.	2.62	drop	15.75	-11.32**
Goldman Sachs	**F.E**	-0.08*	-0.33	-0.61	-0.07^{+}
	Int.	3.85**	25.65**	32.37**	0.45^{+}
JP Morgan	**F.E**	0.15**	0.54**	-1.13	-0.33**
	Int.	12.93^{+}	-156.79	276.85**	drop
Lehman Brothers	**F.E**	-0.02	-0.10	-0.21	drop
	Int.	-17.84**	drop	124.78**	drop
Merrill Lynch	**F.E**	0.04	0.23	-0.09	-0.04^{+}
	Int.	0.47	5.37**	1.46	0.84**
Morgan Stanley	**F.E**	0.12**	0.34**	0.54	-0.03
	Int.	28.84**	drop	-120.05	-5.44^{+}
RBS	**F.E**	0.05	0.48**	-0.09	-0.04
	Int.	-4.87*	-86.96**	31.09	-0.45
UBS	**F.E**	0.02	-0.05	-1.05^{+}	-0.13*
	Int.	-1.29	drop	64.00**	drop
Wachovia	**F.E**	0.05	0.40*	-0.27	-0.15^{+}
	Int.	-2.30	8.05	14.93	0.80
WestLB	**F.E**	0.18**	0.01	-0.62	-0.09
	Int.	drop	drop	drop	drop

Table 10: Determinants of Banks' ABS CDO Writedowns

These regressions look at how each Underwriter's CDO characteristics relate to the total amount of write-downs they reported on ABS CDOs. The value of their ABS CDO write-downs is taken from CreditFlux and includes all information reported as of February 6, 2009. The dependent variable is the total amount of ABS CDO writedowns as a percent of the total assets on each bank's balance sheet at year-end 2007. All of the independent variables are weighted averages of the characteristics of each bank's CDOs. Heteroskedasticity robust standard errors are given in parentheses under estimated coefficients. Coefficients are significant at the $^{+}$10%, *5%, **1% significance level.

Dependent Variable: ABS CDO write-downs($) divided by total assets($), by underwriting bank

	(1)	(2)	(3)	(4)	(5)
REGRESSOR:	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**
Permarket	—	0.0520** (6.28E-08)	0.0494* (5.05E-03)	0.0481+ (1.03E-02)	0.051* (5.90E-03)
DEFAULT	-0.010 (1.89E-02)	0.01160 (6.23E-03)	0.00273 (6.48E-03)	0.0031 (1.43E-02)	9.03E-03 (1.03E-02)
AAASUB	-9.11E-03 (2.72E-02)	-0.00230 (9.79E-03)	-0.0093 (6.62E-03)	-0.0373 (1.38E-02)	-1.05E-02 (1.21E-02)
DOWNGRADE	-5.03E-04 (1.30E-03)	8.00E-05* (3.17E-04)	-5.157-04 (3.17E-04)	-1.17E-03 (7.15E-04)	-9.26E-04 (6.63E-04)
NUMBER OF ASSETS	—	—	-1.25E-05 (1.35E-05)	-3.32E-06 (3.03E-05)	8.30E-04 (3.60E-04)
NUMBER OF TRANCHES	—	—	0.00103* (2.36E-04)	1.08E-03 (5.48E-04)	0.0013+ (3.60E-04)
% HEL	—	—	—	4.28E-03 (1.46E-02)	—
% CMBS	—	—	—	0.0291 (2.06E-02)	—
% RMBS	—	—	—	-1.29E-02 (1.36E-02)	—
% CDO	—	—	—	-1.33E-02 (1.25E-02)	—
% SYNTHETIC	—	—	—	—	-5.85E-03 (2.75E-02)
% FIXED RATE	—	—	—	—	-4.42E-04 (1.11E-02)
Issuance 2005 ($mm)	-1.16E-06 (1.07E-06)	2.63E-07 (2.31E-07)	-1.60E-07 (2.13E-07)	-7.93E-07 (4.06E-07)	-3.51E-07 (3.35E-07)
Issuance 2006 ($mm)	6.85E-07 (6.44E-07)	-2.02E-07+ (2.01E-07)	-7.15E-08 (1.19E-07)	3.26E-09 (1.96E-07)	4.49E-07+ (1.71E-07)
Issuance 2007 ($mm)	5.74E-07* (3.15E-07)	4.26E-07** (8.01E-08)	5.83E-07* (6.64E-08)	6.13E-07* (9.10E-08)	5.83E-07* (8.44E-08)
Intercept	1.16E-02 (2.28E-02)	8.04E-03 (7.53E-03)	5.77E-03 (3.94E-03)	1.62E-02 (7.71E-03)	5.96E-03 (5.94E-03)
Regression summary statistics					
Adj. R^2	0.671	0.898	0.915	0.914	0.913
SER	0.004	0.001	0.001	0.001	0.001
n	17	17	17	17	17

4.4 CDO Credit Ratings

This final section analyzes the credit ratings given to CDO tranches and their collateral assets by Moody's, Fitch, and S&P. It is organized around the four questions given in Section 3: 1) What factors were important in determining initial CDO credit ratings?; 2) What factors have driven the wave of CDO downgrades?; 3) How well did original collateral asset and CDO tranche ratings predict performance?; and 4) What factors explain the mistakes made in forecasting performance?

Original CDO Credit Ratings

First, I consider the factors explaining the percent of the CDO that was initially rated AAA by each of the three agencies, essentially trying to "back-out" those factors that were important in the agencies' models. I limit my analysis to the CDOs in the high-information sample, because I have data on the original credit ratings of their collateral, which was an important input used by the CRAs for determining CDO ratings. There are three different dependent variables, one for the *%AAA* assigned by each agency. One complicating factor is that for most CDOs, a given CRA rated only a portion of the tranches; because of this, CDOs are only included in the regressions if the rating agency assigned ratings to 75% or more of the tranches. This means that for the regression using *Fitch % AAA* as the dependent variable, there are only 86 observations. The initial specification for these regressions is:

(3) $$\%\text{AAA (M/F/SP)}_i = \alpha + ß_1\text{Original Balance}_i + ß_2\text{HG}_i + ß_3\text{\# Assets}_i + ß_4\text{\# Tranches}_i + ß_5\text{Average initial collateral rating}_i + ß_6\text{WAC}_i + ß_7\text{IYear2005}_i + ß_8\text{IYear2006}_i + ß_9\text{IYear2007}_i + \varepsilon_i$$

The results of these regressions are presented in Panel A of Table 11. The most notable finding from Table 11 is that much of the variation in the *% AAA* can be explained by the initial credit ratings of the underlying collateral. This finding strongly supports the "recycled ratings effect" of hypothesis 3A. Reliance on prior ratings is seen in two variables – *HG* (a dummy that equals 1 if the CDO had an original weighted average rating factor of less than 180 and zero otherwise) and *average initial collateral rating.* For S&P, an HG CDO is associated with a 6% increase in *% AAA,* and a one S.D. decrease in *average initial collateral rating* (3.5 notches) is associated with a 5.6% increase in *%AAA*; both of these variables on their own explain approximately half of the S.D. of *%AAA*. Perhaps this finding is less impressive given that there is a very low level of variation in the *%AAA* of the CDOs in the sample – the standard deviation is only around 10%. However, the heavy reliance on just two input variables implies that either the agencies' rating models had been incredibly simplified, or that inputs to the models were "tweaked" until they gave the desired amount of AAA. The inclusion of additional independent variables to the regressions only slightly increases the adjusted R-squared for S&P and Moody's, and none at all for Fitch, and the coefficients on *HG* and *average initial collateral rating* are relatively unchanged.

The other interesting finding from Table 11 is the positive coefficient on *% Collateral rated by Agency*, although this effect is only statistically significant for S&P. This effect might reflect the CRAs' use of "notching." Notching refers to the practice of incorporating the ratings of another CRA into a CRA's own rating model. Because it was rare that a single CRA had rated all CDO assets and since it was too expensive to re-rate all the CDO's underlying assets, a CRA would instead use ratings

given by its competitors, but "adjust" these ratings downward before using them in their own CDO models. This would explain why a CDO would receive a higher fraction of AAA from a CRA when more of its assets were rated by that agency, as their ratings did not have to be "notched." It also shows that CDOs could receive the most AAA if they were rated by the CRA who had rated the highest percent of its collateral. This could explain the near elimination of Fitch from the CDO rating business by 2005; Fitch had a significantly lower market share in rating subprime RMBS securities, which became the main collateral for CDOs.

Next, I add underwriter fixed effects to test for differential treatment among the banks. Panel B of Table 11 ranks the underwriters based on their effect on *% AAA*, after controlling for observable CDO asset and liability properties. Deutsche Bank CDOs were associated with statistically significant smaller *% AAA* by all three CRAs, while CDOs from Citigroup, RBS, and Bank of America had a larger *% AAA* by Moody's and S&P. The reasons for these variations in *% AAA* across underwriters arise from some unobservable variable. Likely candidates include the correlation inputs associated with the underwriter's CDO asset pools or the type of relationship between the underwriter and the CRA.

Lastly, Panel C of Table 11 shows the effects of certain CRA combinations and the overall number of ratings on the *% AAA*, through the addition of independent variables equal to the percent of a CDO's par value rated by the given rating agency combination, and a variable equal to the average number of ratings on the CDO tranches (0-3). The results in Panel C provide evidence for a negative "peer pressure effect" (discussed in hypothesis 3B) on *% AAA*. The number of ratings is negatively correlated

with the *% AAA*, indicating that having fewer CRAs per CDO led to more generous AAA allotments. However, this effect might be due solely to the influence of a Fitch rating; while CDOs rated by Fitch + Moody's or Fitch + S&P were given less AAA, CDOs rated by Moody's + S&P were given *more* AAA. One possible explanation for this "Fitch effect" is that a Fitch rating decreased the "recycled ratings effect." Given that Fitch had rated relatively few of the assets used as CDO collateral, it would not normally be desirable to get a Fitch rating because of the notching effects. Presumably, CDO underwriters would use Fitch only if: 1) Moody's or S&P would not give an agreeable rating; or 2) most of the collateral assets had *no* rating and Fitch would re-rate all of the assets at a lesser cost than would the other two CRAs. Both of these actions might be the reason why the association of Fitch + Moody's and Fitch + S&P CDOs are correlated with lower *% AAA*.

Determinants of CDO Tranche Downgrades

Having ascertained the determinants of the initial CDO credit ratings, I next revisit the factors that have affected the magnitude of downgrades on CDO tranches. These regressions are similar to those performed in section 4.2; however, the dependent variables used here are specific to each rating agency, rather than the average downgrade. Fitch is not included in the present analysis because there are very few CDO tranches that carry both an original and a current Fitch rating. Also, *Default* is included as an independent variable. The results are presented in Panel A of Table 12. There is strong evidence supporting the "seniority effect" of hypothesis 3C; controlling for *Default*, the more senior tranches have experienced most downgrades. For example, the AAA

tranches rated by Moody's are associated with a 4-notch increase in downgrades. The coefficients of the other independent variables repeat many of the results from Section 4.2.

One somewhat surprising result from Panel A is the fact that even using all of these independent variables, the regressions only account for 53% of the variation in *Moody's Downgrades* and 54% in *S&P Downgrades*, as seen by the adjusted R-squared values. Adding the underwriter fixed effect dummy variables in Panel B only increases these values by 1%, indicating that primary unobservable variables are not related to CDO underwriter. One plausible explanation for the mismatch between observable CDO variables and credit-rating downgrades is that downgrades usually come after some time lag, as rating agencies wait to see a "trend" in performance before changing the rating. Further regression analysis could test for this by adding lags of the *Default* variables; unfortunately, I only had *Default* data for a single point in time. A second possible explanation for the mismatch of observable CDO performance and tranche downgrades is that the rating agencies only periodically conduct surveillance analysis on previously rated deals. Perhaps some CDO deals have not been recently revisited, or perhaps the level of post-issuance CDO surveillance is related to the amount of publicity or investor concern surrounding certain CDOs or CDO types.

How well did initial ratings predict outcomes?

Table 13 addresses the relationship between *ex-ante* credit ratings and *ex-post* performance. Panel A looks specifically at the relationship between the ratings of the CDO collateral assets and the realized asset default rate, while Panel B explores the

relationship between initial AAA CDO tranche ratings and current losses on AAA tranches. Panel A regresses the average initial collateral rating by each agency (separately) on the realized *Default*. Control variables are added for the percent of assets that were rated by the CRA in question, as it would be expected that the predictive power of the average rating would be much less if the CRA only rated a few assets. In the second regression specifications for each CRA, I add interaction terms to test if the effect of a given average rating on *Default* varies depending on the asset characteristics.

Overall, the results in Panel A provide support for the "asset-class effect" discussed in hypothesis 3D. In other words, the same credit rating translated into a different effect on *Default* depending on observable characteristics of the asset, indicating that the credit ratings did not incorporate this information. Specifically, a lower credit rating led to a less pronounced increase in *Default* if it described a CMBS asset, but led to a much higher increase in *Default* if it described an RMBS backed by Alt-A ARM mortgages. These findings confirm allegations mentioned in Section 2 that credit ratings have had inconsistent meanings over time and across different asset types.

Finally, Panel B examines the relationship between AAA losses and the amount of initial AAA given to a CDO. As discussed in Section 3, there is no direct measure for realized losses on individual tranches. For the purpose of these regressions, I create a variable that calculates the exposure of the AAA bondholders to losses on the underlying collateral: the variable *Loss* is calculated as (*Default – Current Credit Support*). I regress the *%AAA* and the number of AAA tranches given by each agency on *Loss*, with the addition of the CDO asset and liability control variables.

The results in Panel B partially support the "super-senior effect" of hypothesis 3E. While the initial *%AAA* is not a significant predictor of *Loss*, the number of AAA tranches is positively correlated to *Loss*. This indicates that the losses facing AAA bondholders are related to the number of AAA tranches originally issued, and that the more AAA tranches, the more losses facing the note-holders. However, the *Loss* measure is based on the AAA tranche with the *lowest* level of current credit enhancement, thus overstating losses to the holders of super-senior tranches. Therefore, the average measure of *Loss* may not depend on the number of initial AAA tranches, but the *Loss* to different classes of AAA tranches will depend on the number of AAA tranches, with higher *Loss* to the least senior AAA note-holders in CDOs with super-senior tranches. It is possible that investors failed to realize the nonequivalence of a AAA tranche of a CDO with super-senior tranches and a tranche from a CDO without super-seniors. On the other hand, the underwriting bank often retained the super-senior tranches and many were never rated, making it difficult for an outside AAA investor to ascertain the number or existence of such tranches.

Why did CDO credit ratings fail?

The final regressions take a first look at some possible reasons for the inaccuracy of the CDO credit ratings. In order to quantify the level of credit-rating accuracy, I create a variable based on the discrepancy of predicted and realized default levels. Using the default matrix from S&P's CDO Evaluator, version 3 (see Appendix C), I calculate the

predicted value for *Default*.[65] The regressions presented in Table 14 use the difference in *Default* and predicted default for the CDO collateral by each agency as the dependent variable.

The most striking result in Panel A is the association of credit-rating failures with the presence of 2006 and 2007-vintage collateral, whose coefficients are large and significant in all specifications. This finding supports earlier evidence showing that collateral quality declined significantly in those years, and furthermore shows that the rating agencies failed to identify this decline in quality. Also of interest are the negative and significant coefficients on *% CLO* and *% CMBS*, showing that these assets had more accurate ratings.[66] Lastly, the coefficient on *% Collateral rated by Fitch* is negative and significant, while the coefficient on *% Collateral rated by Moody's* is positive and significant. However, it is hard to compare the accuracy of Fitch against S&P and Moody's due to Fitch's markedly lower participation in the CDO rating business. The apparent superiority of Fitch ratings might result simply because Fitch had fewer opportunities to make mistakes with CDO ratings. They were no longer significant participants in CDOs when the most pronounced deterioration in collateral quality and increases in CDO complexity were occurring.

In Panel B, I rerun the regressions from Panel A with the addition of underwriter fixed effect dummies, to see if the severity of rating "mistakes" varied across underwriters. The results from these regressions show that the severity of rating "mistakes" was dependent on the identity of the underwriter. However, this does not

[65] It is difficult to ascertain whether the values used from the S&P matrix in Appendix C were the intended probability of default numbers for all three CRAs, or even for S&P, due to the lack of clear ratings definitions from the CRA publications.
[66] However, the default data is only current as of February 2009. The CMBS market has very recently experienced a prolific increase in defaults, which is not captured by my data.

mean that certain underwriters received differential treatment by the rating agencies; on the other hand, it is actually evidence that the underwriters *didn't* receive differential treatment, but that this lack of differentiation among underwriters was itself the problem. Looking at the average rankings in Panel B, we see that the severity of the rating mistakes directly mirror the quality of the underwriter's CDOs, with the "best" underwriters like Goldman Sachs associated with smaller mistakes, and the "worst" underwriters with more mistakes. Similar to the lack of variation in the *% AAA*, these results show that the rating agencies failed to realize that some underwriters were doing a better job than others. However, it might have been impossible for the rating agencies to quantify "underwriter quality," given the finding of Section 4.3 that the "underwriter effect" is not easily explained by any observable CDO asset and liability properties or by the size of the underwriter.[67]

Finally, Table 15 begins a cursory investigation of the potential "conflict of interest" problems discussed in hypothesis 3F. I create variables to indicate the amount of CDO business a CRA received for each underwriter, equal to the total par value of all of the underwriter's tranches rated by the CRA. Since the rating agencies are paid a fee based on the par value of the securities they rate, conflicts of interest would suggest that they would give more desirable ratings to bigger underwriters in order to increase their own profits. I rerun the regressions from Table 11 – Table 14, adding in the variables for the amount of business between the underwriter and CRA, and present their coefficients in Table 15.

[67] One solution might have been to use the historical performance of the underwriter's CDOs to proxy for "underwriter quality," but this too would be problematic in that the history of most underwriters only spanned a few years.

The signs of the coefficients for Moody's and S&P are consistent with the conflict of interest problem: bigger underwriters were associated with a higher initial *% AAA*, resulting in a subsequent higher level of downgrades, AAA *Loss*, and an overall higher level of prediction mistakes as calculated by the difference in predicted and actual levels of *Default*. However, these results could just as easily be caused by the fact that the most prolific underwriters were producing worse CDOs, and that rather than receive *preferential* treatment by the rating agencies, the problem was merely that these originators were treated the same as other underwriters, although in reality they were producing worse CDOs. Given the striking uniformity of initial CDO credit ratings and the fact that the prediction value of the asset credit ratings depended mainly on the quality of the underwriter, the latter explanation seems more likely, suggesting that the conflicts of interest is not as much to blame as simply a failure to distinguish among underwriter quality.

Table 11: Determinants of %AAA by each CRA

Panel A: Effect of CDO Characteristics

This table examines the factors that affected the initial amount of each CDO that was given an AAA rating by each of the three CRAs. The dependent variables are the % of AAA by S&P, Fitch, or Moody's at issuance. Standard errors, clustered by CDO underwriter, are shown in parentheses under estimated coefficients. Coefficients are significant at the +10%, *5%, **1% significant level.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**S&P %AAA**	**S&P %AAA**	**F %AAA**	**F %AAA**	**M %AAA**	**M %AAA**
HG	0.0641** (0.0126)	0.0728** (0.0124)	0.0574+ (0.0301)	0.0414 (0.0404)	0.0669** (0.0157)	0.0801** (0.0154)
Original CDO Balance	2E-05** (0.0000)	2E-05** (0.0000)	3E-05 (0.0000)	4E-05 (0.0000)	2E-05** (0.0000)	1E-05** (0.0000)
Number of assets	0.0001+ (0.0001)	0.0001+ (0.0001)	-0.0001 (0.0002)	-0.0001 (0.0002)	0.0002** (0.0001)	0.0002* (0.0001)
Number of Tranches	-0.0036+ (0.0018)	-0.0048* (0.0018)	-0.0004 (0.0025)	-0.0002 (0.0029)	-0.0039+ (0.0019)	-0.0053* (0.0021)
Average initial collateral rating	-0.0161** (0.0033)	-0.0143** (0.0033)	-0.0163* (0.0061)	-0.0172* (0.0081)	-0.0161** (0.0038)	-0.0126** (0.0039)
WAC	-0.0054 (0.0043)	-0.0048 (0.0032)	0.0053 (0.0076)	0.0006 (0.0114)	-0.0059 (0.0041)	-0.0042 (0.0030)
% Subprime	-	-0.1088* (0.0411)	-	0.0044 (0.0694)	-	-0.1093+ (0.0594)
% Alt-A Fixed Rate	-	-0.0781+ (0.0429)	-	0.0118 (0.0909)	-	-0.0947 (0.0738)
% Alt-A ARM	-	-0.0753 (0.1007)	-	-0.0145 (0.2287)	-	-0.1379 (0.1218)
% CDO	-	-0.1395** (0.0263)	-	-0.0061 (0.0850)	-	-0.1176* (0.0507)
% Prime	-	-0.1900** (0.0467)	-	-0.0621 (0.1201)	-	-0.0960+ (0.0497)
% Midprime	-	-0.1363** (0.0297)	-	-0.0358 (0.0586)	-	-0.1088* (0.0526)
% CES RMBS	-	-0.2389+ (0.1190)	-	-0.0453 (0.1861)	-	-0.2168 (0.1310)
% HELOC	-	-0.0248 (0.6567)	-	-1.6955 (1.8949)	-	-0.2736 (0.7329)
% CLO	-	-0.3533** (0.0464)	-	-0.0307 (0.3230)	-	-0.3347** (0.0729)
% CMBS	-	-0.1056 (0.0657)	-	-0.0164 (0.0822)	-	-0.0783 (0.0830)
% Fixed Rate	-	-0.0197 (0.0157)	-	-0.0195 (0.0393)	-	-0.0195 (0.0149)
% Synthetic	-	0.0003 (0.0143)	-	-0.0297 (0.0196)	-	0.0021 (0.0165)
% 2006-vintage collateral	-	0.0021 (0.0146)	-	-0.0622 (0.0368)	-	0.0036 (0.0113)
% 2007-vintage collateral	-	0.0152 (0.0175)	-	-0.0209 (0.0659)	-	0.0128 (0.0174)
% Collateral rated by Agency	-	0.1019+ (.0615)	-	0.1275 (0.1211)	-	0.0604 (0.0500)
Intercept	0.8974**	1.0498**	0.8911**	0.9350**	0.8930**	1.0173**
Regression Summary Statistics						
Adj. R^2	0.72355642	0.77984287	0.63409497	0.63409497	0.74993314	0.79321172
SER	0.05272	0.04705	0.05237	0.05237	0.05056	0.04598

Panel B: Effect of CDO Underwriter

This table examines whether the identity of the CDO underwriter affected the amount of AAA given to a CDO. The regressions are identical to (2), (4), and (6) in Panel A, with the addition of fixed effect dummies for the underwriter. The results are listed according to the average rank of the underwriter, with lower numbers corresponding to *lower* amounts of AAA given to the bank's CDOs. The estimated coefficients shown in parentheses underneath the ranking are significant at the $^{+}$10%, *5%, **1% level.

Underwriter	Average Rank	S&P %AAA	F %AAA	M %AAA
Deutsche Bank	1	1* (-0.0181)	1* (-0.1626)	2** (-0.0247)
Dresdner Bank	2	3 (-0.0031)	omit	3 (-0.0116)
UBS	3	2 (-0.0110)	6 (-0.0329)	4 (-0.0060)
WestLB	4	14+ (0.0164)	3 (-0.0787)	1** (-0.0530)
Lehman Brothers	5	5 (0.0059)	11 (-0.0024)	5 (0.0033)
Barclays Capital	6	4 (0.0022)	14 (0.0230)	6 (0.0041)
JP Morgan	7	7 (0.0090)	omit	9 (0.0108)
Merrill Lynch	8	10 (0.0128)	8 (-0.0260)	8 (0.0095)
Credit Suisse	9	13* (0.0157)	7 (-0.0309)	7 (0.0063)
Morgan Stanley	10	11+ (0.0133)	4 (-0.0651)	12+ (0.0139)
Calyon	11	8 (0.0117)	10 (-0.0200)	11 (0.0123)
Bear Stearns	12	6 (0.0079)	15 (0.0454)	10 (0.0112)
Wachovia	13	9 (0.0120)	12 (-0.0008)	13+ (0.0143)
Citigroup	14	12+ (0.0148)	9 (-0.0245)	15* (0.0164)
RBS	15	17* (0.0217)	2* (-0.1229)	17** (0.0321)
Bank of America	16	16** (0.0217)	5 (-0.0595)	16* (0.0184)
Goldman Sachs	17	15* (0.0202)	13 (0.0041)	14 (0.0148)

Panel C: Effect of Specific CRA Combinations and # Ratings

This panel shows the effect of specific CRA ratings on the average % AAA per CDO. The regression is identical to (2) in panel A, with the addition of dummies based on the combination and number of ratings of the CDO. The dependent variable is the average % AAA of S&P, F, and Moody's.

REGRESSOR	Coefficient
F only	0.0519
SP only	0.0409**
F/M only	-0.0316**
F/SP only	-0.0069
M/SP only	0.0040
M/SP/F	0.0081+
# Ratings	-0.0123*

Table 12: Determinants of Downgrades by Moody's and S&P

Panel A: Effect of CDO Characteristics

This table examines the factors that determined the magnitude of tranche downgrades by Moody's and S&P. Fitch is not included because very few tranches contain an initial and current rating from Fitch. The dependent variables are the number of notches the tranche was downgraded by Moody's or S&P. Standard errors, clustered by CDO underwriter, are shown in parentheses under estimated coefficients. Coefficients are significant at the +10%, *5%, **1% significant level.

Dependent Variable	M Downgrade	S&P Downgrade
REGRESSOR:	**OLS**	**OLS**
Default	1.6197* (0.7418)	3.2437** (0.8744)
% Subordination	-6.3645** (1.3163)	-6.3076** (1.0485)
Tranche coupon	-0.1590* (0.0649)	-0.1382** (0.0472)
Original Tranche Balance	-0.0006 (0.0008)	-0.0006 (0.0009)
% of Transaction	-3.9982** (1.2180)	-2.8395* (1.2626)
HG	-0.2442 (0.4379)	-0.8938 (0.6558)
Number of assets	0.0093* (0.0036)	0.0084* (0.0039)
Number of Tranches	-0.0261 (0.1189)	-0.0792 (0.1280)
% Subprime	1.5494 (10.1112)	4.3683 (9.0855)
% Alt-A Fixed Rate	-2.5218 (11.0595)	1.9671 (8.9815)
% Alt-A ARM	17.2572 (10.1751)	21.8594* (9.7084)
% CDO	7.5923 (10.5940)	10.0938 (9.2455)

Dependent Variable	M Downgrade	S&P Downgrade
REGRESSOR:	**OLS**	**OLS**
% CES RMBS	15.0931 (10.6224)	12.3975 (8.0916)
% HELOC	9.7576 (28.6049)	41.6293+ (22.1986)
% CLO	-12.7820 (10.5058)	-8.9135 (9.4269)
% CMBS	-9.6451 (10.4932)	-2.9709 (9.1305)
% Fixed Rate	0.5802 (0.8780)	0.1781 (0.8294)
% Synthetic	-0.8205 (0.6243)	-1.0549 (0.7566)
Change in average collateral rating	-0.0906 (0.0856)	-0.1415* (0.0554)
% 2006-vintage collateral	2.5242** (0.5617)	1.2596 (0.7656)
% 2007-vintage collateral	1.5900 (1.6712)	-0.0911 (1.5429)
Number of ratings	0.0423 (0.3165)	0.4651 (0.4277)
IYear2005	-1.4905** (0.5141)	0.5336 (0.6801)
IYear2006	0.1350 (0.6283)	2.1820** (0.5409)
IYear2007	0.3591 (0.7140)	2.1227** (0.6715)
Initial Tranche Rating Dummies		
AAA	4.0069** (0.6860)	1.5041+ (0.7869)
AA+	2.0619* (0.9674)	0.4176 (0.8148)
AA	3.7332** (0.5615)	1.3306+ (0.6850)
AA-	2.6571** (0.6612)	0.1168 (0.7816)
A+	3.4266** (0.8303)	omit
A	1.7604** (0.5387)	-1.5958* (0.7396)
A-	1.4577+ (0.7273)	-1.5122* (0.7058)
BBB+	omit	-3.2824** (0.7680)
BBB	-0.2509 (0.5642)	-3.7138** (0.8029)
BBB-	-2.1127** (0.5083)	-5.6114** (0.6355)
Below IG	-3.0050** (0.4817)	-6.3979** (0.6657)
Intercept	6.5363	4.3406
Regression Summary Statistics		
Adj. R^2	0.52907397	0.5283653
SER	3.9859	3.9849
n	2542	2555

Panel B: Effect of CDO Underwriter

This table examines whether the identity of the CDO underwriter affected the magnitude that a tranche was downgraded by Moody's and S&P. The regressions are identical to those in Panel A, with the addition of fixed effect dummies for the underwriter. The results are listed according to the average rank of the underwriter, with lower numbers corresponding to *fewer* downgrades. The estimated coefficients shown in parentheses underneath the ranking are significant at the $^{+}$10%, *5%, **1% level.

Underwriter	Average Rank	M Downgrade	S&P Downgrade
Dresdner Bank	1	1* (-1.6759)	2** (-2.6149)
Bank of America	2	3 (-0.7140)	3+ (-1.6657)
Calyon	3	2 (-0.9431)	4 (-1.1587)
WestLB	4	5 (-0.4627)	1** (-2.6855)
JP Morgan	5	6 (-0.1211)	5 (-0.4372)
UBS	6	7 (-0.0472)	7 (-0.2726)
Bear Stearns	7	9 (0.2398)	8 (-0.0339)
Wachovia	8	8 (0.0300)	9 (0.0434)
Lehman Brothers	9	12 (0.6000)	6 (-0.3736)
Deutsche Bank	10	4 (-0.5001)	17 (0.7837)
Citigroup	11	11 (0.3886)	11 (0.0925)
RBS	12	13 (0.6419)	10 (0.0552)
Goldman Sachs	13	10 (0.2572)	14 (0.3960)
Barclays Capital	14	15 (0.9504)	13 (0.3728)
Credit Suisse	15	17* (1.7464)	12 (0.3214)
Merrill Lynch	16	14 (0.6985)	15 (0.6638)
Morgan Stanley	17	16 (1.0870)	16 (0.7457)

Table 13: Predictive Power of Original Credit Ratings of the CRAs

Panel A: Significance of *ex-ante* collateral pool ratings in forecasting *ex-post* default rate

This table looks at the relationship between the original collateral ratings of the CDO assets by each of the three CRAs ("Moody", "Fitch", or "S&P") and the realized default rate. The dependent variable is the realized default rate of the assets in each CDO collateral pool. The interaction terms are computed as the collateral rating by agency "x" times the given variable. Standard errors, clustered by CDO underwriter, are shown in parentheses under estimated coefficients. Coefficients are significant at the $^{+}$10%, *5%, **1% significant level.

	M (1)	M (2)	F (1)	F (2)	SP (1)	SP (2)
Dependent Variable:	**Default**	**Default**	**Default**	**Default**	**Default**	**Default**
Moody	0.0511** (0.0083)	0.0324+ (0.0163)	-	-	-	-
Fitch	-	-	0.0499** (0.0081)	0.0242 (0.0160)	-	-
S&P	-	-	-	-	0.0520** (0.0085)	0.0281 (0.0165)
Original Balance	-3E-05 (0.0000)	-3E-05 (0.0000)	-4E-05 (0.0000)	-4E-05 (0.0000)	-3E-05 (0.0000)	-3E-05 (0.0000)
Number of assets	0.0003 (0.0002)	0.0004 (0.0003)	0.0004 (0.0002)	0.0005+ (0.0003)	0.0003 (0.0002)	0.0005 (0.0003)
% Collateral rated by Moody's	0.1937** (0.0623)	0.1477+ (0.0782)	0.1760* (0.0703)	0.1019 (0.0951)	0.1705* (0.0664)	0.1131 (0.0811)
% Collateral rated by Fitch	-0.2908** (0.0805)	-0.3058** (0.0842)	-0.2706** (0.0815)	-0.2690** (0.0823)	-0.2853** (0.0816)	-0.3025** (0.0817)
% Collateral rated by S&P	0.0615 (0.1372)	0.1056 (0.1160)	0.0075 (0.1272)	0.0687 (0.1032)	0.0501 (0.1363)	0.1073 (0.1225)
% Subprime	-0.3176 (0.2092)	-0.2907 (0.2374)	-0.2531 (0.2215)	-0.4059+ (0.2326)	-0.2941 (0.2057)	-0.3095 (0.2366)
% Alt-A Fixed Rate	-0.0096 (0.2092)	0.1498 (0.1910)	0.0614 (0.2316)	0.1395 (0.1978)	0.0014 (0.2076)	0.1353 (0.1985)
% Alt-A ARM	-0.0818 (0.3111)	-1.5674* (0.6014)	0.0600 (0.3295)	-0.8442 (0.6402)	-0.1422 (0.3003)	-1.5358** (0.5424)
% CDO	0.0766 (0.2472)	0.2269 (0.1548)	0.1374 (0.2552)	0.2247 (0.1601)	0.0823 (0.2426)	0.1961 (0.1572)
% Prime RMBS	-0.3153 (0.2056)	-0.2106 (0.1417)	-0.2601 (0.2122)	-0.2372+ (0.1388)	-0.3104 (0.1993)	-0.2393 (0.1403)
% Midprime RMBS	0.1543 (0.2003)	0.1562 (0.1568)	0.2365 (0.2044)	0.1678 (0.1641)	0.2090 (0.1932)	0.1698 (0.1541)
% CES RMBS	0.3001 (0.2646)	0.3372 (0.2768)	0.3010 (0.2751)	0.2683 (0.2703)	0.2841 (0.2592)	0.2860 (0.2716)
% HELOC	0.4927 (1.8882)	-0.9796 (1.8946)	0.8706 (1.8050)	-0.6648 (1.8893)	0.7884 (1.8900)	-0.4542 (1.8660)
% CMBS	-0.7043+ (0.3494)	-0.0314 (0.2656)	-0.6561+ (0.3503)	-0.0702 (0.2658)	-0.7080+ (0.3459)	-0.0780 (0.2761)
% CLO	-1.2661** (0.2415)	-1.1220+ (0.6363)	-1.1627** (0.2099)	-1.1630** (0.3399)	-1.2732** (0.2333)	-1.1413+ (0.6315)
% Fixed Rate	-0.0638 (0.0400)	-0.0727+ (0.0406)	-0.0540 (0.0404)	-0.0625 (0.0405)	-0.0615 (0.0401)	-0.0691+ (0.0401)
% Synthetic	0.0665 (0.0798)	0.0745 (0.0686)	0.0704 (0.0789)	0.0790 (0.0679)	0.0643 (0.0797)	0.0743 (0.0689)
% 2006-vintage collateral	0.3297** (0.0371)	0.3590** (0.0894)	0.3307** (0.0366)	0.3526** (0.0986)	0.3251** (0.0375)	0.3425** (0.0898)
% 2007-vintage collateral	0.3919** (0.0839)	0.4206** (0.1192)	0.3999** (0.0773)	0.4162** (0.1037)	0.3827** (0.0851)	0.4202** (0.1181)

	M (1)	M (2)	F (1)	F (2)	SP (1)	SP (2)
Dependent Variable:	**Default**	**Default**	**Default**	**Default**	**Default**	**Default**
IYear2005	-0.1240** (0.0386)	-0.1456** (0.0521)	-0.0951* (0.0352)	-0.1452** (0.0289)	-0.1290** (0.0390)	-0.1511** (0.0538)
IYear2006	-0.1560** (0.0405)	-0.1898** (0.0523)	-0.1179** (0.0375)	-0.1823** (0.0328)	-0.1552** (0.0409)	-0.1891** (0.0539)
IYear2007	-0.1030+ (0.0533)	-0.1339+ (0.0676)	-0.0673 (0.0515)	-0.1286* (0.0531)	-0.1061+ (0.0530)	-0.1356+ (0.0695)
Intercept	0.0164 (0.2324)	-0.0493 (0.1817)	-0.0119 (0.2289)	0.0311 (0.1851)	0.0394 (0.2252)	0.0014 (0.1872)
Interaction Variables						
% 2004-vintage collateral*x	-	-0.0148 (0.0151)	-	-0.0110 (0.0148)	-	-0.0098 (0.0153)
% 2005-vintage collateral*x	-	0.0211+ (0.0119)	-	0.0275* (0.0120)	-	0.0281* (0.0119)
% 2006-vintage collateral*x	-	0.0103 (0.0181)	-	0.0163 (0.0200)	-	0.0181 (0.0188)
% 2007-vintage collateral*x	-	0.0051 (0.0290)	-	0.0141 (0.0245)	-	0.0075 (0.0279)
% Subprime*x	-	0.0314 (0.0251)	-	0.0467+ (0.0251)	-	0.0324 (0.0263)
% Alt-A ARM*x	-	0.2739** (0.0915)	-	0.1875+ (0.1020)	-	0.2376** (0.0693)
% CMBS*x	-	-0.0802** (0.0207)	-	-0.0789** (0.0215)	-	-0.0817** (0.0213)
% CLO*x	-	0.0040 (0.0632)	-	0.0146 (0.0296)	-	0.0010 (0.0605)
Regression Summary Statistics						
Adj. R^2	0.6784	0.7027	0.6739	0.6969	0.6785	0.7025
SER	0.1625	0.1562	0.1636	0.1577	0.1624	0.1563
n	430	430	430	430	430	430

Panel B: The relationship between AAA losses and initial tranche credit ratings

This table looks at the relationship between the amount and number of AAA tranches given to a CDO by each by each of the three CRAs (M/F/SP) and the potential AAA tranche losses. The dependent variable (loss) is defined as the % of defaulted assets minus the current amount of AAA subordination. Standard errors, clustered by CDO underwriter, are shown in parentheses under estimated coefficients. Coefficients are significant at the +10%, *5%, **1% significant level.

Dependent Variable	Loss (M)	Loss (F)	Loss (SP)
M or F or SP %AAA	0.2883+ (0.1417)	0.3388 (0.2635)	0.2043 (0.1262)
M or F or SP # AAA Tranches	0.0412** (0.0079)	0.0689* (0.0243)	0.0441** (0.0078)
Original Balance	-3E-05* (0.0000)	-0.0001 (0.0001)	0.0002** (0.0001)
Number of assets	0.0003+ (0.0002)	0.0004 (0.0003)	0.0000 (0.0001)
Number of Tranches	-0.0071 (0.0059)	-0.0101 (0.0075)	-0.0066 (0.0060)
Average initial collateral rating	0.0216** (0.0062)	0.0029 (0.0183)	0.0278** (0.0052)
WAC	0.0270** (0.0093)	-0.0306 (0.0202)	0.0231* (0.0083)
% Subprime	0.1979 (0.1325)	0.0068 (0.1114)	0.2072+ (0.1109)
% Alt-A Fixed Rate	0.3187 (0.2139)	0.6366** (0.1400)	0.1697 (0.1743)
% Alt-A ARM	0.5894** (0.1908)	-1.1181* (0.4492)	0.7328** (0.1867)
% CDO	0.5497** (0.1340)	-0.0469 (0.3654)	0.5463** (0.1137)
% Prime RMBS	0.1759 (0.1355)	0.0357 (0.1239)	0.1108 (0.0876)
% Midprime RMBS	0.5048** (0.1072)	0.5547** (0.1552)	0.4760** (0.1079)
% CES RMBS	0.5730+ (0.2865)	0.0325 (0.4032)	0.5639* (0.2207)
% HELOC	-0.3777 (1.0480)	-1.8354 (1.4551)	-0.6061 (0.7254)
% CLO	-0.1777 (0.1559)	0.4522 (1.2401)	-0.2195 (0.1356)
% CMBS	0.2193 (0.1960)	0.0514 (0.2156)	0.1850 (0.1870)
% 2006-vintage collateral	0.2562** (0.0430)	0.3418** (0.0869)	0.2373** (0.0404)
% 2007-vintage collateral	0.2347** (0.0750)	0.0701 (0.2215)	0.2018* (0.0744)
% Synthetic	0.0221 (0.0385)	0.0857 (0.0743)	-0.0084 (0.0300)
% Fixed Rate	-0.0066 (0.0362)	-0.2389** (0.0766)	0.0006 (0.0345)
Intercept	-0.8017**	-0.2588	-0.7957**
Regression Summary Statistics			
Adj. R^2	0.5548	0.5854	0.5756
SER	0.1513	0.1298	0.1469
n	384	85	401

Table 14: Explaining the Rating Agency's Mistakes

Panel A: Mistakes due to general CDO Characteristics

This table looks at the factors explaining the difference in the probability of default predicted by the initial collateral ratings of CDO assets given by each agency and the actual default rate (M, F, and S&P difference). The regressions use only CDOs from the high-information sample with n=430. Standard errors, clustered by CDO underwriter, are shown in parentheses under estimated coefficients. Coefficients are significant at the +10%, *5%, **1% significant level.

Dependent Variable	M Difference	F Difference	S&P Difference
Original Balance	-3E-05 (0.0000)	-3E-05 (0.0000)	-2E-05 (0.0000)
Number of assets	0.0004 (0.0002)	0.0004+ (0.0002)	0.0004 (0.0002)
% Collateral rated by Fitch	-0.2982** (0.0809)	-0.2829** (0.0807)	-0.2929** (0.0821)
% Collateral rated by Moody's	0.2063** (0.0607)	0.1911* (0.0698)	0.1855** (0.0647)
% Collateral rated by S&P	0.0914 (0.1330)	0.0545 (0.1238)	0.0823 (0.1306)
Moody or Fitch or S&P	0.0358* (0.0142)	0.0299* (0.0126)	0.0366* (0.0148)
WAC	0.0011 (0.0093)	0.0014 (0.0094)	0.0010 (0.0095)
% Subprime RMBS	-0.3139 (0.2166)	-0.2404 (0.2233)	-0.2941 (0.2132)
% Alt-A Fixed Rate	-0.0036 (0.2098)	0.0602 (0.2188)	0.0061 (0.2095)
% Alt-A ARM	-0.1161 (0.3094)	-0.0072 (0.3086)	-0.1618 (0.3055)
% CDO	0.1150 (0.2510)	0.1942 (0.2569)	0.1225 (0.2487)
% Prime RMBS	-0.3154 (0.2097)	-0.2500 (0.2138)	-0.3112 (0.2054)
% Midprime RMBS	0.1766 (0.2066)	0.2664 (0.2080)	0.2270 (0.1985)
% CES RMBS	0.2862 (0.2807)	0.3194 (0.2813)	0.2724 (0.2778)
% HELOC	0.5213 (1.7991)	0.9819 (1.6962)	0.7918 (1.7717)
% CLO	-1.2791** (0.2559)	-1.1854** (0.2204)	-1.2864** (0.2482)
% CMBS	-0.7035+ (0.3569)	-0.6454+ (0.3551)	-0.7081+ (0.3554)
% Fixed Rate	-0.0622 (0.0392)	-0.0547 (0.0397)	-0.0603 (0.0392)
% Synthetic	0.0667 (0.0800)	0.0706 (0.0804)	0.0658 (0.0805)
% 2006-vintage collateral	0.3339** (0.0331)	0.3311** (0.0332)	0.3298** (0.0339)
% 2007-vintage collateral	0.3677** (0.0894)	0.3606** (0.0890)	0.3607** (0.0913)
Intercept	0.0764	0.0687	0.0982
Regression Summary Statistics			
Adj. R^2	0.6748	0.6727	0.6766
SER	0.1624	0.1634	0.1627

Panel B: Effect of CDO Underwriter on CRA Mistakes

This table examines whether the identity of the underwriter affected the accuracy of credit ratings. The regressions are identical to those in Panel A with the addition of fixed effect dummies for the identity of the CDO underwriter. The data are sorted according to average ranking, with lower numbers corresponding to fewer credit rating mistakes. Estimated coefficients, shown in parentheses under the ranking, are significant at the +10%, *5%, **1% significant level.

Underwriter	Average Rank	M Difference	F Difference	S&P Difference
Lehman Brothers	1	1* (-0.0713)	1* (-0.0813)	1* (-0.0756)
Goldman Sachs	2	2+ (-0.0540)	2* (-0.0422)	2* (-0.0468)
Dresdner Bank	3	3 (0.0002)	3* (-0.0070)	3+ (-0.0006)
Barclays Capital	4	4 (0.0098)	4 (0.0090)	4+ (0.0164)
Credit Suisse	5	6 (0.0269)	6 (0.0273)	5 (0.0287)
UBS	6	5 (0.0266)	7** (0.0294)	6** (0.0297)
Bank of America	7	7 (0.0312)	5* (0.0250)	7* (0.0319)
Citigroup	8	8+ (0.0416)	8 (0.0491)	8 (0.0438)
Wachovia	9	9+ (0.0435)	9** (0.0559)	9** (0.0475)
RBS	10	10* (0.0609)	10** (0.0611)	10** (0.0613)
Calyon	11	11+ (0.0622)	11 (0.0699)	11 (0.0624)
Merrill Lynch	12	12** (0.0677)	12** (0.0727)	12** (0.0690)
Deutsche Bank	13	13** (0.0876)	14 (0.0943)	13 (0.0884)
Bear Stearns	14	14** (0.0931)	13 (0.0926)	14 (0.0938)
Morgan Stanley	15	15** (0.1306)	15** (0.1372)	15** (0.1369)
WestLB	16	16** (0.1995)	16** (0.1927)	16** (0.2024)
JP Morgan	17	17** (0.2092)	17* (0.2086)	17* (0.2127)

Table 15: Potential Conflicts of Interest at the Rating Agencies

This table looks at whether ratings were affected by the amount of business done with the underwriter. The coefficients are shown for the amount ($mm) of the underwriter's CDOs rated by the CRA ("Balance"). The regressions specifications are: for (1) - (2) (4) and (6) in Table 11; for (2) – Table 12 panel A; for (3) – Table 13 Panel B; and for (4) – Table 14, panel A. Coefficients are significant at $^{+}$10%, *5%, **1%.

	(1)	(2)	(3)	(4)
Dependent Variable	**% AAA (M/F/SP)**	**Downgrades (M/F/SP)**	**AAA Loss**	**P.D. Diff (M/F/SP)**
Balance Moody's	6E-08	9E-06+	5E-07+	5E-07
Balance Fitch	3E-07	-	-5E-07	-1E-06
Balance S&P	8E-08	1E-05**	5E-07+	9E-07*

5. Discussion: What caused the CDO Market Meltdown?

While surely not the whole story, the results in Section 4 offer insights into the CDO market meltdown, illustrating the factors that caused adverse CDO performance and highlighting the role of various market participants. Table 16 summarizes the major findings from the regression results. First, adverse CDO performance resulted primarily from the inclusion of low quality collateral originated in 2006 and 2007. The worst of these assets were the mezzanine (BBB-rated) tranches of residential mortgage securities backed by borrowers with poor credit, most specifically the Alt-A adjustable-rate mortgages. While this finding is not surprising, it is a stark illustration of the consequences of the excessive (and sometimes fraudulent) mortgage lending that occurred in 2006 and 2007 – lending that first fueled, but ultimately destroyed CDOs. The high level of CDO complexity helped to hide the true credit quality (or lack thereof) of these assets from investors, encouraging the production of even more bad assets to satiate the CDO feeding frenzy.

Table 16: Summary of Important Results

This table summarizes the main findings of the regressions presented in Section 4.

Effects of CDO Properties		
Result	**Explanation**	**Possible Interpretations**
CDO Assets		
"The Housing Effect"	Increased defaults in CDOs with high levels of subprime and Alt-A ARM RMBS, most significant for Alt-A ARM	Negative house-price appreciation and decline in underwriting standards produced more defaults
"The Vintage Effect"	Increased defaults in CDOs with collateral originated in 2006 and 2007; magnitude outweighs the "housing effect"	Decline in underwriting standards; originated at peak of credit boom (had farthest to fall)
"The Complexity Effect"	Consistently higher defaults in CDOs with more assets; less consistent association of increased defaults with synthetic and CDO collateral	Complexity decreased transparency hiding bad assets and hindering risk assessments
Liabilities		
Transaction size	Smaller CDO deals associated with more downgrades	Smaller deals created from bank's left-over reject assets; small deals created by inexperienced underwriters
Tranche size	For a given rating, thinner tranches associated with more downgrades	Thin tranche more likely to be wiped out by single asset defaults
Subordination levels	For a given rating, tranches with lower amounts of subordination experience more downgrades	Less credit support exposes bond-holder to more of the asset losses
Underwriters		
Result	**Explanation**	**Interpretation**
"Underwriter effect"	CDO performance varies across underwriters, after controlling for asset and liability properties	Underwriters varied in ability, level of due diligence, and philosophy
"Size effect"	Banks with larger market share of CDO underwriting produce CDOs with worse performance	Overly aggressive underwriters had less time for each transaction
"Originator effect"	Identity of most RMBS originators not important in explaining defaults after controlling for mortgage characteristics	CLTV, FICO, DTI, and other borrower characteristics more important than originator "ability"
"Asymmetric Information Effect"	Effect of using in-house assets as CDO collateral depends on the specific bank	Different balance of adverse selection and moral hazard vs. reputation incentives among banks
Writedowns	Write-downs best explained by the amount of CDOs underwritten in 2007	The market dried up and 2007 CDOs could not be sold

Credit Ratings		
Result	**Explanation**	**Interpretation**
"Recycled ratings effect"	Most important determinant of original CDO ratings were ratings of the underlying assets	No incentive to re-rate underlying collateral
"Peer Pressure Effect"	CDOs rated by more agencies were given less AAA in general, but effect limited to addition of Fitch rating	Due diligence increased by more agency ratings; Fitch only rated deals rejected by Moody's/S&P which were inherently inferior
"Seniority effect"	More senior CDO tranches faced most severe downgrades for a given level of CDO defaults	Initial level of optimism was most inflated for AAA tranches
"Asset-class Effect"	The meaning of a single credit rating grade varies with asset type	Ratings did not fully capture all information about the risk of a security
"Super-senior effect"	AAA losses are positively associated with a higher number of initial AAA tranches	AAA bondholders in CDOs with super seniors are not the first in the waterfall priority
"Conflicts of interest"	No strong evidence that credit ratings were affected by the amount of fees brought by the CDO underwriter	Primary reasons for rating agency problems not associated with fee system
Uniformity of original ratings	Original CDO ratings showed little variation despite variation in asset types and underwriter quality	High reliance on software that banks learned to manipulate to give desired results
Prediction power	Accuracy of defaults predicted by original credit rating depends on realized CDO performance since original ratings were very similar	Little information contained in original CDO credit ratings

Second, not all CDO underwriters were equally responsible for the problems in the CDO market. Controlling for observable CDO asset and liability properties, it is clear that CDO performance was as much a product of the underwriting bank as it was the type of collateral. This means that even for CDOs with identical amounts of 2007, BBB, Alt-A RMBS, there was consistent variation in performance associated with the identity of the underwriter, most significant for the best and worst CDO underwriters. Some of the variation in underwriter quality is associated with the bank's market share in underwriting CDOs, with the most prolific underwriters on average producing worse CDOs. Another source of underwriter variation might be the level of sophistication used

to distinguish among superficially identical securities with the same rating, vintage, and asset class, perhaps by selecting higher quality originators. However, better originator selection, at least with respect to RMBS collateral, is not enough to explain all the variation amongst CDO underwriters. The best and worst CDO underwriters used mostly the same RMBS suppliers for their CDOs; furthermore, the quality of RMBS assets is not highly correlated with the identity of specific originators after controlling for observable mortgage characteristics. It is also possible that underwriter quality is linked to the use of collateral that was originated by the underwriting firm, collateral for which the underwriter would likely have an informational advantage. Overall though, the effects associated with the use of in-house CDO collateral are inconsistent, leading to worse performance for some banks' CDOs and better performance for others. While the causes of variation amongst CDO underwriters are unclear, the "underwriter effect" is most likely a combination of the bank's ability, effort, and overall philosophy used to structure and select assets for its CDOs.

Lastly, credit ratings failed to capture the true amounts of risk associated with different CDOs. There was a pronounced lack of variation in original CDO ratings, with most transactions awarded similar amounts of AAA, despite differences in the asset and liability characteristics and the identity of the underwriter. Initial CDO ratings had little relationship to the type or vintage of the collateral or the quality of the underwriter, despite the fact that this information has proved important in explaining ex-post CDO performance. This lack of variation was most likely a result of the rating agencies' over-reliance on computer models. The investment banks were given access to the software used by the rating agencies, and became skilled at selecting collateral that would give the

highest amount of AAA possible. Presumably, underwriters found ways to garner similar ratings for a multitude of CDOs by manipulating certain modeling inputs, most easily the correlation number. The realized accuracy of the original credit ratings is a direct result of the realized performance of the CDO; since most CDOs were initially treated equally, only the highest quality CDOs have performed as predicted by their initial credit ratings. The errors of the rating agencies stemmed from neither conflicts of interest nor preferential treatment given to certain banks. The true culprit behind the rating agencies' failure was the outsourcing of credit analysis to computer models and the low level of human input used to rate CDOs.

Using the anecdotal and empirical evidence presented in this paper, I offer the following interpretation of the CDO market meltdown. CDOs were flawed from the outset, used too often as a junkyard for risky and substandard assets. CDOs survived because of changes in the credit markets that produced an excess quantity of these assets and herds of investors hungry for higher yields. The first CDO underwriters entered the market before the peak of the credit boom, and many of their CDOs performed poorly. For instance, JP Morgan's CDOs, 80% of which were issued before 2005, showed the greatest underperformance among the top CDO underwriters. However, JP Morgan virtually exited the CDO market in 2005, possibly disheartened by its first failed creations. In contrast, for banks that discovered CDOs post-2005, the situation was markedly different. The U.S. was experiencing an unprecedented housing boom, kindling the belief that home prices would rise indefinitely, a belief which in turn incited the creation of previously unimaginable types of high-yielding mortgage loans. These new

mortgages provided the perfect raw material for CDOs, intoxicating underwriters and rating agencies with record profits.

The marriage of the CDO and subprime was thus consummated and Wall Street became inextricably linked with the riskiest homebuyers in America. In 2006, Merrill Lynch, Citigroup, and Bear Stearns plunged headfirst into the CDO business, loading up on the steady supply of questionable mortgages coming from a milieu of mortgage brokers located mostly in Orange County California (prime among them the now defunct lending giant Countrywide). The CDOs manufactured in 2006 and 2007 were in large part a direct manifestation of their ingredients - pools of tainted assets precariously situated atop a wave of home-price appreciation. As investors became addicted to the higher yields of investment-grade CDOs, their rose-colored glasses focused on the AAA rating rather than the pool of shoddy subprime mortgages they were really buying. The rating agencies put too much faith in their formulas, conveniently forgetting that a model is only as good as its inputs. Since there was little historical data on subprime or CDO performance, especially during times of economic distress, the inputs were essentially pulled from thin air, adjusted by the underwriters to maximize their AAA allotment. "Diversification" was the magic word that could justify the inclusion of anything remotely resembling a legitimate fixed-income asset, as Wall Street and the rating agencies claimed that even the lowest quality bonds would not all default *at the same time*.

However, that is exactly what happened. The trillion-dollar CDO market, built atop a single assumption, crumbled to ruins when house prices did the impossible: they first stopped rising and then they *fell*. In the end, who was hurt worst when the CDO

market crashed had less to do with *what* they were doing than with *when* they were doing it. The best predictor of banks' write-downs was not the *quality* of their CDOs, but instead the amount of CDOs they issued in 2007, for very few of these CDOs would ever leave the balance sheets of their creators. The CDO market was a game of musical chairs and the winners were those who sat down early on. The losers were those that lived by the philosophy of Citigroup's ex-CEO, Charles Prince, that, "as long as the music is playing, you've got to get up and dance." Unfortunately, certain players in the CDO market, including Merrill Lynch, Citigroup, Bear Stearns, Countrywide, S&P, and Moody's, were having too much fun to notice when the music ended, never pausing from their CDO craze for long enough to see the warning signs develop.

Once the conveyor belt stopped, it turned out that the hot potato, which had so efficiently been passed along the chain from mortgage broker to Wall Street and beyond, had been leaving pieces of itself along the way. Once investors no longer wanted to buy CDOs, Wall Street banks were left holding the excess of unsold CDOs and yet-to-be-securitized CDO assets. And once Wall Street CDOs no longer wanted to buy subprime mortgages, mortgage originators were left holding a huge number of mortgage loans they knew had little chance of ever being repaid. And once mortgage companies no longer wanted to originate risky mortgages, homebuyers were left holding the subprime mortgages they had planned to refinance. And once homebuyers began to default on their mortgages in mass, it became clear that the credit rating agencies had made a colossal mistake, and Moody's, Fitch, and S&P were left holding the burden of a shattered reputation in a business built on the necessity of trust.

While the story of this collapse is now familiar to many, the details of the CDOs behind it are still becoming known. The empirical analysis of this paper has served to elucidate the factors that contributed to the collapse of the CDO market, many of which were already presume to be true, but some of which were not fully understood. At the broadest level, we can say that the CDO was killed by excess. The excess of complexity, the excess of subprime, the excess of bets *on* subprime using credit default swaps, the excess of AAA ratings, the excess of bad mortgages, even the excess of *wealth* – all contributed to the creation of CDOs preordained to a future of adverse performance. At this point, perhaps the only question that really matters is what to do with the remains of these excesses that are slowly poisoning the world economy.

The key to cleaning up the CDO mess is to unravel the layers of complexity to the point at which investors can once again make informed risk assessments; until there is increased transparency, investors will assume everything to be worth zero. This paper has begun the process, documenting the composition of ABS CDOs and evaluating their performance, but it looks only at broad asset classes and vintages. Given that almost all of the problem CDOs were composed of 2006/2007-vintage RMBS and CDO collateral, the analysis needs to go a step further, conducting detailed analysis of the individual securities inside the CDOs. At this time, few investors have the resources or incentives to undertake this grueling ordeal.[68] Many market participants have suggested that the government create an aggregator bank, the so-called "bad-bank" structure, to buy the CDOs and then sell their assets individually.[69] This may be the best option, as few

[68] However, it is rumored that certain hedge funds are once again becoming interested in purchasing CDO and RMBS assets, whose quality might be low, but whose prices are even lower. As the dust settles, more investors will find ways to spot deals amongst these disfavored assets.
[69] See Appendix D for one such proposal.

investors will ever feel confident in computer models or their own ability to properly value a CDO. [70]

6. Conclusions

In this paper, I have used empirical data to illuminate some of the causes of the CDO market collapse. The results show that problems in the CDO market arose from a combination of poorly constructed CDOs, irresponsible underwriting practices, and flawed credit rating procedures. One of the main factors associated with the underperformance of CDOs was the inclusion of low quality collateral originated in 2006 and 2007 that was exposed to the residential housing market. The majority of CDOs issued after 2005 contained remarkably high levels of this collateral, allowing the decline in housing prices to cause a rapid deterioration in the financial health of CDOs. Second, the CDO underwriters played an important role in determining CDO performance, even after controlling for the asset and liability characteristics of their CDOs. The unobserved causes for this underwriter effect might be the ability, diligence, or philosophy of the underwriting bank. Lastly, the credit ratings of CDOs failed in their stated purpose, namely to provide a reflection of the CDO's ability to make timely payments of principal and interest. This failure arose from a combination of over-automation and heavy reliance on inputs whose accuracy was not easily judged.

While the findings of this paper begin to sort through the wreckage of the CDO market, much more analysis is warranted in order to fully understand the causes of this profound event in financial history. My preliminary investigation into CDOs has

[70] In an interview with David Faber in the CNBC documentary, "House of Cards," Alan Greenspan admitted that he did not fully comprehend CDOs.

unearthed far more questions than it has answered: 1) What explains the variation in performance found among superficially identical assets within the CDOs, assets that carried the same vintage, rating, and underlying collateral?; 2) Was the "underwriter effect" due to the ability, technology, diligence, or philosophy of the underwriter, or something else altogether?; 3) What explains the elimination of Fitch from the CDO rating business, and was it related to the apparent conservatism of its ratings?; and lastly, 4) What allowed a relatively arcane market to grow to such proportions that it was able to contribute to the loss of billions of dollars and the destruction of large financial institutions?

The CDO may be unequivocally dead, but answering these questions is nevertheless important. While the collateralized debt obligation will not be the cause of another financial maelstrom, it is likely that the same combination of market imperfections, misaligned incentives, and human excesses that spawned this financial monster will not disappear. By understanding the story of the CDO market meltdown, we can develop more effective regulatory and economic practices to prevent history from repeating.

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Appendix A.1: Variable Definitions

****CDO-Level Variables****

Variable	Description
General Characteristics	
Year	Year in which CDO was issued
Original CDO Balance	Original par amount of liabilities issued by CDO in millions of dollars
Current CDO Balance	Current par amount of outstanding liabilities issued by CDO in millions of dollars
Original Collateral Par	Par amount of CDO collateral at time of issuance (before ramp-up) in millions of dollars
Current Collateral Par	Par amount of CDO collateral as of December 2008 in millions of dollars
Number of assets	Number of assets held as collateral in CDO
Number of Tranches	Number of tranches issued by CDO
WAC	Weighted average of tranche coupon payments
% AAA Subordination	Original amount of subordination for the AAA CDO tranche (as a % of total)
Collateral	
% Fixed Rate	Percent of CDO collateral that pays fixed rate coupons
% Synthetic	Percent of CDO collateral that is synthetic (credit default swaps)
% HEL	Percent of total CDO collateral made up of tranches of residential mortgage-backed securities (RMBS) backed by home equity loans (equivalent to subprime)
% RMBS	Percent of total CDO collateral made up of tranches of residential mortgage-backed securities (RMBS) backed by all mortgages not classified as home equity loans
% CMBS	Percent of total collateral made up commercial mortgage-backed securities
% CDO	Percent of total CDO collateral made up of other CDO's tranches
% Alt-A Fixed Rate	Percent of total CDO collateral made up of tranches of residential mortgage-backed securities (RMBS) backed by Alt-A fixed rate mortgages
% Alt-A ARM	Percent of total CDO collateral made up of RMBS tranches backed by Alt-A adjustable rate mortgages
% Prime	Percent of total CDO collateral made up of RMBS tranches backed by prime mortgages
% Midprime	Percent of total CDO collateral made up of RMBS tranches backed by midprime mortgages (FICO 625-700)
% Subprime	Percent of total CDO collateral made up of RMBS tranches backed by subprime mortgages (FICO below 625)

Variable	Description
% HELOC	Percent of total CDO collateral made up of tranches from home equity line of credit securitizations
% CLO	Percent of total CDO collateral made up of tranches from collateralized loan obligations
% CES	Percent of total CDO collateral made up of RMBS tranches backed by closed-end second lien mortgages
% Other	Percent of total CDO collateral made up of tranches from other asset-backed securities (including auto loans, credit cards, manufactured housing, etc.)
% 2006-vintage	Percent of total CDO collateral that was originated in 2006
% 2007-vintage	Percent of total CDO collateral that was originated in 2007
Credit Ratings	
Original Fitch Rating	Weighted average original rating of CDO tranches by Fitch on a numeric scale
Original S&P Rating	Weighted average original rating of CDO tranches by S&P on a numeric scale
Original Moody Rating	Weighted average original rating of CDO tranches by Moody's on a numeric scale
Current Fitch Rating	Weighted average current rating of CDO tranches by Fitch on a numeric scale
Current S&P Rating	Weighted average current rating of CDO tranches by S&P on a numeric scale
Current Moody Rating	Weighted average current rating of CDO tranches by Moody's on a numeric scale
Fitch Downgrade	Weighted average of CDO downgrades by Fitch
S&P Downgrade	Weighted average of CDO downgrades by S&P
Moody Downgrade	Weighted average of CDO downgrades by Moody's
% AAA Fitch*	Average % AAA given by Fitch to CDOs; includes only those CDOs with at least 75% of tranches rated by Fitch
% AAA S&P*	Average % AAA given by S&P to CDOs; includes only those CDOs with at least 75% of tranches rated by S&P
% AAA Moody*	Average % AAA given by Moody's to CDOs; includes only those CDOs with at least 75% of tranches rated by Moody's
% Rated Fitch	Percent of CDO tranches that were originally assigned a rating by Fitch
% Rated S&P	Percent of CDO tranches that were originally assigned a rating by S&P
% Rated Moody	Percent of CDO tranches that were originally assigned a rating by Moody's
Performance	
Fitch Default -P.D.	The difference in realized CDO asset defaults and the probability of default given by original Fitch ratings
S&P Default -P.D.	The difference in realized CDO asset defaults and the probability of default given by original S&P ratings
Moody's Default -P.D.	The difference in realized CDO asset defaults and the probability of default given by original Moody's ratings
EOD	Dummy variable that is equal to 1 if the CDO experienced an event of default as of May 2008
Default	Percent of CDO collateral that has defaulted as of February 2008

**** Tranche-Level Variables****

Variable	Description
Tranche #	Number of tranche in capital structure
Coupon	Fixed rate equivalent of tranche coupon payment as of December 2008
Original Balance	Original tranche balance in millions of dollars
Current Balance	Current tranche balance in millions of dollars
% of Transaction	Current tranche balance as a percent of all outstanding CDO liabilities
% Subordination	Current tranche subordination

****Other Variables****

Variable	Description
Fitch Estimated P.D.	Cumulative probability of default predicted by asset's original Fitch rating, according to matrix in Appendix C
S&P Estimated P.D.	Cumulative probability of default predicted by asset's original S&P rating, according to matrix in Appendix C
Moody's Estimated P.D.	Cumulative probability of default predicted by asset's original Moody's rating, according to matrix in Appendix C
Originator Concentration	Average number of CDO assets originated by a single originator
FICO	Average FICO score for all mortgages securitized by the given originator and vintage
CLTV	Average combined loan to value score for all mortgages securitized by the given originator and vintage
DTI	Average debt-to-income ratio for all mortgages securitized by the given originator and vintage
WALA	Weighted average life off all mortgages in months
30-60d DQ	Percent of loans that were either 30-day or 60-day past due as of October 2008
REO or FC	Percent of loans that were real-estate owned or in foreclosure as of October 2008
Cum. Loss	Weighted average net cumulative loss on underlying collateral pools as of October 2008
% HG	Percent of CDOs classified as high grade; high grade CDOs are those whose assets had an original weighted average rating factor of less than 180, otherwise classified as mezzanine
Write Down	Total write-downs reported on ABS CDOs as of February 6, 2009, in millions of dollars
WD/Assets	Write Down divided by the total assets of the bank at year-end 2007

Appendix A.2: Summary Statistics

Panel A: CDO Level Statistics

****General Characteristics****

	High Information Sample					Full Sample				
Variable	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**
Year	430	2005.97	0.75	2004	2007	735	2004.95	1.78	1999	2007
Original CDO Balance	430	971.23	665.71	96	5000	735	829.44	682.63	57	6000
Current CDO Balance	430	904	647.87	68	4976	735	741.28	682.83	28	6000
Original Collateral Par	430	969.57	659.72	0	4985	735	842.59	699.9	0	6920
Current Collateral Par	430	1079.03	774.69	5	5701	735	874.28	819.46	5	6640
Number of assets	430	152.17	62.24	34	366	735	150.42	86.81	1	552
Number of Tranches	430	7.74	1.76	3	16	735	7.51	2.28	2	16
WAC	430	2.79	1.2	0	6	735	3.12	1.34	0	10
% AAA Subordination	430	0.19	0.13	0	1	735	0.22	0.16	0	1

****Collateral****

	High Information Sample					Full Sample				
Variable	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**
% Fixed Rate	430	36.73%	28.51%	0%	100%	735	43.10%	32.04%	0%	100%
% Synthetic	430	21.48%	26.91%	0%	100%	735	13.65%	23.55%	0%	100%
% HEL	430	-	-	-	-	735	33.04%	25.46%	0%	100%
% RMBS	430	-	-	-	-	735	13.21%	17.70%	0%	100%
% CMBS	430	4.12%	10.19%	0%	90%	735	6.75%	16.78%	0%	100%
% CDO	430	16.38%	19.76%	0%	100%	735	13.52%	20.08%	0%	100%
% Alt-A Fixed Rate	430	3.51%	6.57%	0%	64%	-	-	-	-	-
% Alt-A ARM	430	2.24%	4.12%	0%	44%	-	-	-	-	-
% Prime	430	9.37%	12.88%	0%	92%	-	-	-	-	-
% Midprime	430	30.01%	18.88%	0%	78%	-	-	-	-	-
% Subprime	430	25.37%	16.14%	0%	100%	-	-	-	-	-
% HELOC	430	0.14%	0.43%	0%	3%	-	-	-	-	-
% CLO	430	2.59%	9.05%	0%	66%	-	-	-	-	-
% CES	430	1.85%	3.22%	0%	18%	-	-	-	-	-
% Other	430	3.77%	7.95%	0%	73%	-	-	-	-	-
% 2006-vintage	430	37.42%	28.97%	0%	100%	-	-	-	-	-
% 2007-vintage	430	8.12%	13.41%	0%	83%	-	-	-	-	-

****Credit Ratings****

	High Information Sample					Full Sample				
Variable	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**
Original Fitch Rating	94	2.16	1.16	1.1	6.4	270	2.36	1.29	0	7.6
Original S&P Rating	426	2.06	0.94	1	6.4	717	2.13	1.19	0.18	13.06
Original Moody Rating	406	2.04	0.93	1	5.5	681	2.13	1.11	0.18	13.06
Current Fitch Rating	94	2.16	1.15	1.1	6.4	268	2.8	2.15	1	15.88
Current S&P Rating	428	14.27	6.05	1	22	715	10.85	7.08	1	22
Current Moody Rating	406	14.2	6.11	1.1	21	680	10.97	7.02	1	21
Fitch Downgrade	94	0	0	0	0	268	0.43	1.79	-0.3	13.9
S&P Downgrade	426	12.23	6.01	-0.9	19.8	713	8.72	7.12	-2.4	19.8
Moody Downgrade	406	12.15	6.02	-0.8	19.8	679	8.85	7.01	-2.3	19.8
% AAA Fitch*	86	81.80%	8.70%	57%	96%	237	79.20%	9.10%	50.30%	97%
% AAA S&P*	408	82.60%	10.10%	52%	99%	665	81.60%	9.90%	50.30%	99%
% AAA Moody*	389	82.80%	10.10%	52%	99%	632	81.70%	10.10%	50.30%	99%
% Rated Fitch	430	17.70%	34.10%	0%	100%	735	30.00%	40.30%	0%	100%
% Rated S&P	430	80.20%	14.00%	0%	100%	735	77.70%	20.10%	0%	100%
% Rated Moody	430	76.90%	22.30%	0%	100%	735	74.10%	24.80%	0%	100%

****Performance****

	High Information Sample					Full Sample				
Variable	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**	**Obs.**	**Mean**	**S.D.**	**Min**	**Max**
Fitch Default -P.D.	430	36.24%	28.57%	-5.3%	99.60%	- -	- -	- -	- -	- -
S&P Default -P.D	430	36.27%	28.61%	-5.1%	99.70%	- -	- -	- -	- -	- -
Moody's Default -P.D	430	35.94%	28.48%	-5.1%	99.70%	-	-	-	-	-
EOD	430	0.32	0.47	0	1	735	0.26	0.44	0	1
Default	430	37.60%	28.60%	0%	100%	735	26.50%	27.30%	0%	100%
Downgrade	430	11.77	6.01	-1	20	732	8.62	6.76	-1	19.86

Panel B: Tranche Level Statistics

Variable	Obs.	Mean	S.D.	Min	Max
Tranche #	5558	4.60	2.76	1	16
Coupon	4797	4.83%	2.5%	0%	30%
Original Balance	5557	109.41	266.15	0	5400
Current Balance	5558	97.88	256.74	0	5400
% of Transaction	5558	13%	20%	0%	100%
% Subordination	5551	15.97%	19.2%	0%	100%
Original Fitch Rating	1685	5.11	3.85	1	15
Original S&P Rating	4347	4.70	3.77	1	16
Original Moody's Rating	4123	4.62	3.72	1	16
Current Fitch Rating	4161	14.27	7.45	1	21
Current S&P Rating	4379	13.79	7.24	1	22
Current Moody's Rating	1685	5.57	4.51	1	21
Change in Fitch Rating	4088	9.60	7.22	-7	20
Change in S&P Rating	1685	0.46	2.07	-3	17
Change in Moody's Rating	4305	9.07	7.23	-6	21

Panel C: Individual Collateral Asset Statistics*

Variable	Obs.	Mean	S.D.	Min	Max
Original Fitch Rating	27355	6.22	3.66	1	16
Original S&P Rating	60672	5.99	3.35	1	16
Original Moody's Rating	59011	6.32	3.52	1	16
Current Fitch Rating	26169	7.43	4.55	1	22
Current S&P Rating	64018	6.86	4.19	1	22
Current Moody's Rating	62551	7.75	4.99	1	22
Fitch Estimated P.D.	27158	1.35%	1.28%	0.02%	34.94%
S&P Estimated P.D.	60313	1.23%	1.29%	0.02%	34.97%
Moody's Estimated P.D.	58673	1.46%	1.50%	0.02%	34.94%
Originator Concentration	65394	466.97	431.61	1	1501
FICO	34131	625.50	14.00	570	670
LTV	34131	81.05%	1.95%	73.5%	87.5%
CLTV	34131	85.45%	3.46%	73.5%	93.4%
DTI	29952	40.51%	3.08%	28%	44%

***** Based on CDOs from the high-information sample.

Panel D: CDO Underwriter Summary Statistics

Originator	# of Assets	Avg. Asset Rating	% Fix	% Syn	% HEL	% RMBS	% CMBS	% CDO	% 2006	% 2007	Default
Bank of America	142	4.89	31%	8%	33%	13%	11%	18%	39%	7%	28%
Barclays	182	2.84	22%	4%	30%	34%	8%	10%	51%	3%	16%
Bear Stearns	125	7.43	47%	30%	32%	9%	3%	12%	45%	14%	57%
Calyon	207	5.13	37%	24%	36%	22%	3%	10%	56%	7%	45%
Citigroup	179	5.54	30%	20%	41%	11%	3%	19%	42%	8%	41%
Credit S.	150	5.49	36%	25%	30%	16%	2%	20%	42%	10%	38%
Deutsche	126	7.68	41%	23%	43%	17%	2%	7%	40%	6%	45%
Dresdner	204	2.60	10%	2%	46%	21%	2%	22%	33%	8%	21%
Goldman	166	5.35	34%	10%	36%	13%	26%	8%	30%	3%	15%
JP Morgan	118	6.77	61%	52%	20%	12%	2%	26%	42%	3%	68%
Lehman	180	6.55	26%	10%	43%	12%	7%	16%	42%	8%	35%
Merrill	218	4.62	30%	19%	43%	18%	3%	15%	48%	13%	45%
Morgan	122	8.01	49%	32%	36%	11%	10%	9%	34%	5%	52%
RBS	158	6.16	64%	31%	37%	14%	5%	12%	40%	8%	37%
UBS	206	7.72	47%	44%	32%	19%	4%	5%	30%	5%	38%
Wachovia	171	4.68	31%	15%	34%	18%	8%	10%	25%	11%	19%
WestLB	143	2.71	34%	0%	30%	13%	8%	17%	23%	10%	19%
small	144	3.27	10%	5%	30%	38%	1%	11%	45%	25%	24%
unknown	109	4.74	50%	39%	14%	2%	20%	18%	56%	18%	38%

Originator	# of CDOs	Total Balance ($mm)	CDO Size ($mm)	Coupon	# of Tranches	Tranche Rating	% AAA	% HG	EOD	Downgrade	Write Down ($mm)	WD/ Assets (%)
Bank of America	29	14,982	761.84	3.17	7.55	1.61	85%	56%	0%	13.75	9,089	0.53%
Barclays	9	13,999	2041.14	3.26	6.97	2.40	93%	96%	45%	14.14	3,254	0.13%
Bear Stearns	54	26,046	831.56	3.16	7.81	2.10	77%	20%	37%	12.97	2,300	0.58%
Calyon	15	19,575	1602.78	2.69	8.72	1.79	87%	62%	47%	14.50	3,400	0.42%
Citigroup	80	75,088	1583.38	2.75	7.74	2.37	87%	60%	68%	15.18	3,4106	1.56%
Credit S.	63	34,808	944.74	2.72	6.89	1.86	85%	52%	40%	14.40	3,427	0.29%
Deutsche	47	23,442	798.12	3.02	7.89	2.57	67%	14%	0%	12.02	2,092	0.07%
Dresdner	7	8,882	1552.33	3.65	10.66	1.34	91%	100%	0%	14.94	1,604	0.29%
Goldman	59	79,202	1760.99	2.55	8.98	2.36	75%	72%	5%	11.77	0	0.00%
JP Morgan	10	5,558	756.12	3.00	7.35	2.53	82%	55%	82%	14.07	1,300	0.08%
Lehman	30	21,627	1222.29	3.49	7.35	2.28	82%	35%	53%	15.42	200	0.03%
Merrill	104	100,478	1504.75	3.03	8.39	1.54	89%	75%	44%	15.54	26,100	2.56%
Morgan	20	12,983	849.44	2.57	8.39	2.62	78%	14%	60%	11.48	7,800	0.75%
RBS	32	22,808	874.27	2.40	7.72	2.35	84%	42%	40%	15.18	3,609	0.10%
UBS	45	32,651	1218.71	2.62	7.87	2.69	78%	16%	26%	13.15	21,870	1.08%
Wachovia	49	36,810	1313.86	3.14	7.66	1.97	89%	81%	16%	10.09	1,860	0.24%
WestLB	8	8,160	1096.39	2.94	5.91	2.60	88%	90%	0%	9.30	0	0.00%
small	31	30,989	2224.06	3.19	7.62	1.70	91%	81%	25%	9.81	N/A	N/A
unknown	43	41,551	1477.98	2.50	7.94	1.85	88%	71%	58%	13.63	N/A	N/A

Panel E.1: RMBS Originator Summary Statistics 1

Originator	Parent	Total #	Total Par ($m)	WALA	30-60d DQ	REO or FC	Cum. Loss
Aames Mortgage		187	975	41.54	9.0%	25.3%	3.1%
ABFC	Bank of America	1,121	7,122	42.41	4.2%	12.7%	2.3%
Accredited Mortgage		417	2,293	35.78	5.1%	14.5%	2.6%
ACE		1,607	8,655	45.92	8.6%	27.6%	5.1%
Aegis		270	1,337	46.50	8.8%	19.1%	5.6%
Ameriquest		939	5,645	40.67	5.1%	17.9%	1.9%
Argent	Citigroup	652	4,188	38.23	6.3%	31.9%	3.7%
BayView		379	1,255	69.84	5.5%	10.5%	5.0%
Bear Stearns		2,342	13,716	45.00	7.0%	14.8%	5.2%
Carrington		694	4,439	41.75	8.3%	26.4%	1.5%
C-Bass		699	3,538	39.90	9.7%	17.9%	3.6%
Citigroup		1,194	8,335	37.75	6.2%	18.2%	7.4%
Countrywide	Bank of America	4,390	30,078	43.32	8.4%	12.9%	1.5%
Delta		201	1,059	35.61	10.0%	13.0%	1.9%
Deutsche Bank		221	1,171	38.45	4.5%	12.5%	9.2%
DLJ Mortgage	Credit Suisse	772	4,324	41.91	10.0%	23.0%	3.1%
Encore	Bear Stearns	169	1,059	34.12	8.4%	23.8%	2.3%
EquiFirst	Barclays	124	549	43.39	5.8%	21.8%	3.2%
Fieldstone		310	1,902		10.2%	29.1%	7.7%
First Franklin	Merrill Lynch	1,678	10,220	33.52	7.9%	23.8%	4.4%
Fremont		709	3,887	34.82	10.5%	29.8%	6.5%
Goldman Sachs		1,837	12,330	36.45	9.3%	22.3%	4.7%
GSAA	Goldman Sachs	553	3,187	39.66	5.5%	18.7%	1.5%
HarborView	RBS	344	2,094	42.06	6.6%	16.1%	8.3%
HEAT	Credit Suisse	1,837	11,436	181.39	3.2%	7.2%	5.0%
HSBC		500	2,855		6.6%	23.8%	7.9%
IndyMac		682	3,923	40.70	4.8%	5.1%	0.4%
Ixis	Morgan Stanley	243	1,470		9.6%	40.7%	5.3%
JPMorganChase	JP Morgan	1,886	14,064	35.49	5.5%	12.3%	6.5%
Long Beach	Washington Mutual	1,293	8,197	35.47	7.8%	13.1%	4.0%
MASTR	UBS	1,184	6,059	62.83	4.7%	9.0%	4.5%
Merrill Lynch		1,346	7,974	37.39	6.0%	16.1%	8.5%
Morgan Stanley		3,224	18,273	44.94	6.7%	16.9%	4.8%
New Century		821	5,390	42.58	7.2%	19.2%	2.3%
Nomura		570	2,977	38.78	7.3%	19.9%	8.4%
NovaStar		522	3,029	28.05	7.7%	17.5%	3.4%
Option One		547	2,774	36.20	6.9%	22.5%	3.1%
Other		15,084	103,938	57.80	6.6%	15.4%	5.7%
OWNIT		310	1,666		5.6%	9.3%	1.6%
Park Place		719	4,409	46.87	7.5%	19.1%	4.5%
Popular		343	1,632	22.21	6.9%	17.9%	3.7%
RALI	GMAC	476	3,324	31.43	7.7%	13.6%	6.7%
RAMP	GMAC	687	3,571	34.67	6.1%	15.4%	12.3%
RASC	GMAC	1,024	5,601	37.97	8.4%	22.4%	6.8%
Residential Asset	GMAC	1,086	6,477	32.76	7.6%	18.0%	3.9%
SASCO	Lehman Brothers	2,721	16,632	32.96	7.2%	18.6%	6.0%
Saxon	Morgan Stanley	392	2,022	36.85	7.4%	21.9%	2.8%
Securitized ABR.	Barclays	916	5,476	38.58	6.4%	23.1%	4.6%
SoundView	RBS	1,031	5,809	34.89	8.3%	23.1%	3.7%
Terwin		468	2,358	49.00	5.1%	11.2%	3.5%
UBS		180	1,544		0.1%	0.2%	0.0%
Wachovia		339	3,077	27.55	1.5%	3.9%	3.0%
Wells Fargo		552	4,203	39.67	4.2%	5.4%	1.0%

Panel E.2: RMBS Originator Summary Statistics 2

Originator	Parent	FICO	Com. LTV	Sub prime	Mid prime	AltA ARM	Orig Rating	Avg. Change
Aames Mortgage		611	82	0.0%	0.0%	0.0%	7.2	2.9
ABFC	Bank of America	648	86	10.4%	16.0%	0.0%	5.1	3.5
Accredited Mortgage		631	85	92.9%	0.0%	0.0%	6.4	2.9
ACE				37.0%	7.6%	22.7%	6.1	3.8
Aegis		618	83	100%	0.0%	0.0%	6.9	2.8
Ameriquest		640	90	0.0%	100%	0.0%	6.0	0.9
Argent	Citigroup	617	86	100%	0.0%	0.0%	5.6	3.3
BayView				100%	0.0%	0.0%	6.5	1.4
Bear Stearns		618	85	36.3%	63.7%	0.0%	7.0	3.9
Carrington		613	87	5.7%	83.6%	10.4%	7.6	2.0
C-Bass		634	80	0.0%	95.3%	0.0%	6.6	2.9
Citigroup				24.8%	54.6%	0.0%	5.8	2.9
Countrywide	Bank of America	606	83	100%	0.0%	0.0%	6.2	3.3
Delta		618	76	100%	0.0%	0.0%	5.7	1.1
Deutsche Bank				100%	0.0%	0.0%	6.8	2.9
DLJ Mortgage	Credit Suisse			2.5%	84.8%	0.8%	6.5	1.7
Encore	Bear Stearns			0.0%	0.0%	0.0%	7.2	1.7
EquiFirst	Barclays			35.2%	0.0%	0.0%	3.5	0.3
Fieldstone				89.7%	10.3%	0.0%	7.7	3.8
First Franklin	Merrill Lynch	651	92	45.6%	2.3%	0.0%	4.6	4.9
Fremont		624	88	0.0%	100%	0.0%	4.5	3.7
Goldman Sachs		627	88	90.9%	9.1%	0.0%	7.5	4.0
GSAA	Goldman Sachs			53.3%	16.6%	4.8%	6.3	2.0
HarborView	RBS			100%	0.0%	0.0%	6.9	1.7
HEAT	Credit Suisse	627	87	17.5%	27.9%	0.0%	4.7	3.6
HSBC				100%	0.0%	0.0%	7.2	3.3
IndyMac		617	83	0.0%	0.0%	0.0%	1.7	2.7
Ixis	Morgan Stanley	626	81	31.3%	8.8%	3.2%	5.3	3.5
JPMorganChase	JP Morgan	631	82	82.8%	17.2%	0.0%	7.3	2.4
Long Beach	Washington Mutual	636	90	9.9%	90.1%	0.0%	7.7	2.2
MASTR	UBS	624	86	34.8%	8.0%	23.6%	4.6	4.5
Merrill Lynch		641	88	20.7%	78.8%	0.0%	6.2	4.7
Morgan Stanley		624	82	23.0%	77.0%	0.0%	7.8	2.2
New Century		625	84	0.0%	100%	0.0%	7.7	2.0
Nomura		630	87	0.9%	27.9%	20.2%	4.5	4.0
NovaStar		615	85	71.5%	13.0%	0.0%	7.2	2.1
Option One		609	82	34.3%	18.8%	2.0%	6.5	3.7
Other				21.9%	78.1%	0.0%	7.1	3.2
OWNIT		665	84	56.5%	2.8%	2.3%	5.5	7.0
Park Place				0.0%	100%	0.0%	7.2	0.8
Popular		621	85	0.0%	0.0%	54.4%	3.6	1.7
RALI	GMAC			39.1%	11.8%	23.7%	6.4	2.5
RAMP	GMAC			11.4%	17.3%	0.0%	5.1	2.9
RASC	GMAC	618	86	0.0%	1.2%	58.7%	4.4	2.5
Residential Asset	GMAC			70.0%	30.0%	0.0%	7.9	3.4
SASCO	Lehman Brothers	626	86	93.9%	6.1%	0.0%	6.9	3.1
Saxon	Morgan Stanley	612	82	100%	0.0%	0.0%	6.4	1.8
Securitized ABR.	Barclays			0.0%	100%	0.0%	7.3	2.2
SoundView	RBS	635	89	100%	0.0%	0.0%	5.6	3.3
Terwin		648	82	100.0%	0.0%	0.0%	6.5	6.9
UBS				6.3%	3.2%	28.7%	4.2	2.7
Wachovia				50.4%	42.2%	0.0%	6.9	4.5
Wells Fargo		625	82	5.4%	8.3%	0.0%	3.8	5.6

Appendix B: Credit Rating Scale

Moodys	S&P	Fitch	Score
Aaa	AAA	AAA	1
Aa1	AA+	AA+	2
Aa2	AA	AA	3
Aa3	AA-	AA-	4
A1	A+	A+	5
A2	A	A	6
A3	A-	A-	7
Baa1	BBB+	BBB+	8
Baa2	BBB	BBB	9
Baa3	BBB-	BBB-	10
Ba1	BB+	BB+	11
Ba2	BB	BB	12
Ba3	BB-	BB-	13
B1	B+	B+	14
B2	B	B	15
B3	B-	B-	16
Caa1	CCC+	CCC+	17
Caa2	CCC	CCC	18
Caa3	CCC-	CCC-	19
Ca	CC	CC	20
C	C	C	21
D	D	D	22
NR	NR	NR	0

Appendix C: S&P Default Matrix

Source: S&P CDO Evaluator 3.0,

Year	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
1	0.0004	0.002	0.013	0.024	0.027	0.033	0.049	0.234	0.353	0.967	1.632	2.525	3.803	4.51	5.824	8.138	23.582	45.56	66.413
2	0.009	0.017	0.062	0.078	0.097	0.121	0.185	0.514	0.825	2.142	3.211	4.946	7.26	8.885	11.751	16.674	38.104	59.145	79.233
3	0.03	0.05	0.135	0.166	0.212	0.263	0.396	0.85	1.405	3.415	4.758	7.23	10.401	12.96	17.152	24.004	46.752	64.835	82.905
4	0.065	0.104	0.232	0.29	0.372	0.459	0.676	1.246	2.073	4.728	6.276	9.38	13.265	16.694	21.921	30.025	52.288	68.078	84.581
5	0.118	0.182	0.356	0.452	0.578	0.709	1.02	1.704	2.812	6.046	7.763	11.403	15.886	20.087	26.089	34.945	56.158	70.313	85.65
6	0.19	0.287	0.512	0.654	0.83	1.013	1.424	2.221	3.607	7.352	9.216	13.31	18.291	23.156	29.725	38.996	59.071	72.019	86.454
7	0.285	0.42	0.701	0.897	1.128	1.368	1.883	2.792	4.443	8.635	10.632	15.11	20.503	25.929	32.903	42.374	61.383	73.396	87.105
8	0.405	0.584	0.927	1.182	1.472	1.774	2.395	3.413	5.31	9.891	12.007	16.81	22.544	28.435	35.692	45.227	63.284	74.546	87.653
9	0.552	0.781	1.191	1.509	1.859	2.226	2.954	4.076	6.198	11.116	13.34	18.418	24.432	30.702	38.151	47.666	64.886	75.529	88.124
10	0.728	1.013	1.493	1.876	2.29	2.724	3.557	4.777	7.103	12.309	14.631	19.941	26.182	32.76	40.331	49.776	66.261	76.383	88.535
11	0.934	1.28	1.833	2.285	2.762	3.263	4.198	5.51	8.017	13.471	15.881	21.386	27.809	34.633	42.275	51.62	67.459	77.133	88.899
12	1.173	1.583	2.213	2.733	3.273	3.841	4.873	6.269	8.937	14.602	17.091	22.758	29.326	36.343	44.018	53.245	68.512	77.799	89.223
13	1.445	1.923	2.631	3.219	3.822	4.454	5.578	7.05	9.86	15.704	18.261	24.064	30.744	37.91	45.589	54.691	69.448	78.396	89.515
14	1.75	2.3	3.086	3.742	4.404	5.099	6.309	7.85	10.783	16.776	19.394	25.307	32.073	39.353	47.014	55.985	70.287	78.935	89.779
15	2.089	2.712	3.577	4.299	5.018	5.773	7.063	8.664	11.704	17.822	20.491	26.494	33.323	40.685	48.313	57.154	71.045	79.426	90.02
16	2.463	3.16	4.102	4.887	5.662	6.473	7.836	9.49	12.621	18.841	21.555	27.629	34.501	41.92	49.504	58.214	71.733	79.875	90.241
17	2.87	3.643	4.659	5.506	6.332	7.195	8.624	10.325	13.534	19.836	22.587	28.716	35.614	43.07	50.6	59.183	72.363	80.288	90.445
18	3.311	4.158	5.247	6.152	7.026	7.937	9.426	11.167	14.441	20.808	23.589	29.759	36.67	44.145	51.614	60.073	72.943	80.671	90.634
19	3.784	4.704	5.863	6.823	7.741	8.696	10.238	12.013	15.342	21.757	24.563	30.761	37.674	45.153	52.557	60.895	73.479	81.028	90.81
20	4.289	5.281	6.506	7.516	8.475	9.47	11.059	12.862	16.235	22.686	25.51	31.727	38.63	46.102	53.438	61.658	73.978	81.362	90.974
21	4.823	5.885	7.172	8.229	9.225	10.256	11.886	13.713	17.121	23.596	26.434	32.658	39.545	46.998	54.263	62.37	74.445	81.675	91.129
22	5.386	6.514	7.86	8.961	9.989	11.053	12.718	14.563	17.999	24.487	27.334	33.558	40.42	47.848	55.04	63.036	74.883	81.971	91.275
23	5.975	7.168	8.567	9.707	10.765	11.857	13.552	15.413	18.869	25.361	28.213	34.429	41.261	48.655	55.774	63.663	75.296	82.252	91.413
24	6.59	7.843	9.292	10.468	11.552	12.668	14.389	16.261	19.731	26.218	29.071	35.273	42.07	49.426	56.47	64.256	75.686	82.518	91.544
25	7.229	8.538	10.032	11.24	12.346	13.484	15.226	17.105	20.584	27.06	29.911	36.093	42.851	50.162	57.132	64.817	76.057	82.773	91.67
26	7.889	9.25	10.786	12.022	13.147	14.303	16.062	17.947	21.428	27.887	30.733	36.89	43.605	50.868	57.764	65.351	76.411	83.017	91.789
27	8.568	9.979	11.55	12.811	13.954	15.125	16.897	18.784	22.264	28.7	31.538	37.667	44.335	51.546	58.369	65.86	76.75	83.251	91.904
28	9.266	10.721	12.325	13.608	14.764	15.947	17.729	19.616	23.092	29.499	32.327	38.423	45.043	52.2	58.95	66.348	77.074	83.476	92.015
29	9.98	11.475	13.108	14.409	15.576	16.77	18.559	20.443	23.911	30.286	33.102	39.162	45.731	52.832	59.508	66.816	77.386	83.693	92.121
30	10.708	12.24	13.897	15.213	16.39	17.591	19.385	21.265	24.721	31.061	33.863	39.884	46.4	53.443	60.047	67.266	77.687	83.903	92.224

Appendix D: Policy Recommendations
Letters to Ben Bernanke

The following letter was written by Michael Blum, President of Michael Blum Consulting, a company that provides risk analysis and valuation services for complex structured products. This letter gives one proposal for cleaning up the toxic assets left by the CDO collapse.

Letter to Federal Reserve Chairman, Ben Bernanke

Jan. 19, 2008

Dear Governor of the Federal Reserve,

My name is Michael Blum. I am writing you as a private citizen, as a loyal American as well as a Goldman Sachs alumnus with over 20 years experience in the structured finance markets. I am concerned by the current credit crisis, and have a suggestion which I believe would help navigate out of it.

CDOs are like love. When they're good, they're great, but when they're bad, watch out. They resemble options on options, which regulators would hardly permit in the public equity markets. They should not have been issued with dubious collateral, but the crux of the credit crisis is that they have been, and no one knows how bad mortgage defaults are going to get.

When you buy something at a store, and discover after opening it up at home that there is something wrong with the product, you take it back to the store and return it. The store will take it back, although they may give you back something less than the price you paid.

My proposal is along these lines. Since the trustee's responsibility is to make bond payments, a CDO's bondholders can be identified by its trustee, If the dollar majority of the CDO's bondholders approve, I would make repurchase by the underwriter of all bonds in the CDO mandatory, so that the underwriter can then collapse the deal and sell the underlying collateral. There is a simple and intuitive method to calculate the repurchase price at which the underwriter makes no money on the transaction; the Fed may choose to allow the underwriter a profit as an incentive to cleaning up the market, or subtract a penalty for the underwriter's prior faulty bond origination.

The fundamental theory of mortgage securitization is that bonds can be sold at a premium to the cost of their underlying collateral. The problem arose when greedy originators and underwriters increased their revenues by introducing dubious collateral. This means that, even if dubious, the underlying collateral is now worth more than the bonds are, because CDO technology guaranteed that bond losses would be magnified.

To some extent, this collapse is already happening, as some CDOs have had an "event of default" triggered by their collateral's dismal performance. However, as this was hardly foreseen by the underwriters who prepared the offering documents, the mechanics of who gets which proceeds are murky and often, litigation is the result.

There is no longer a functioning CDO market. CDO bond prices, if marked at all, have been marked to distressed levels, or zero, by virtue of being in a CDO. Since owning all of the bonds in a CDO is akin to ownership of the collateral pool, my suggestion is to make it mandatory for underwriters to buy back all bonds in a CDO when a dollar majority of bondholders approve, so they can sell the collateral RMBS, CMBS, ABS, etc. for which there are still functioning markets. In fact, the underwriters can put the collateral up for bid for forward settlement, which allows time to set up a transaction where the bonds are bought, the collateral sold and the CDO is collapsed instantaneously. Once the aggregate proceeds at which the collapsed-CDO collateral can be sold

are known, proceeds can be allocated either according to the offering memorandum or else, based on each CDO bond's percentage of the total collateral balance. This may mean ratings are meaningless, but as a forward-looking measure of likely repayment of principal, we now know that anyway.

Removing leverage from the system by mandating the collapse of toxic CDOs would be a vital step in restoring normal capital flow to the securitized debt markets. Thank you for your time and attention.

Sincerely,

Michael Blum