Internet Appendix IA 1

Table IA.1

Amount of Bloomberg CDO Universe Rated by the Rating Agencies

Panel A: AAA Tranche Overlapping Rating Coverage by Year

	Total # of Tranches	Total Capital ($B)	% Tranches Rated by Both	% Capital Rated by Both
1997	20	13.0	50.0	63.4
1998	70	65.2	62.5	93.7
1999	131	43.0	75.7	89.0
2000	141	94.8	75.4	78.4
2001	178	190.5	80.5	96.3
2002	246	199.9	79.4	96.4
2003	290	140.5	76.9	92.3
2004	423	146.8	71.3	67.4
2005	590	132.6	72.2	80.3
2006	1154	259.5	83.2	88.7
2007	1051	242.3	80.4	77.6

Panel B: Universe Rated by Either S&P or Moody's

	Total # of Deals	Both Rate Equally	Both, S&P Favorable	Both, Moody's Favorable	S&P Exclusive	Moody's Exclusive
Pre-2004	870	656	33	11	60	110
Year 2004	275	207	4	4	41	19
Year 2005	358	275	9	3	42	29
Year 2006	659	566	10	7	42	34
Year 2007	628	490	12	5	75	46
ABS	766	648	16	6	69	27
CDO[2]	101	82	0	0	18	1
CBO	154	119	11	1	19	4
CLO	992	842	10	5	42	93
Total	2790	2194	68	30	260	238

This table reports the ratings coverage of S&P, Moody's, and Fitch for all CDOs from January 1997 to December 2007 listed in the Bloomberg Database. Panel A reports the number of AAA tranches, total market capitalization, and percentage of tranches rated by both S&P and Moody's on a yearly basis. Panel B reports the number of CDOs covered by Bloomberg that were rated by S&P and/or Moody's. *Both, S&P (Moody's) Favorable* denote deals that were rated by both agencies, but where S&P (Moody's) gave more tranches a AAA rating. *S&P (Moody's) Exclusive* denote deals where only S&P (Moody's) assigned ratings to the deal.

Table IA.2
Replication of S&P's Collateral Risk Model

Dependent Variable: S&P Reported SDR	
	(1)
Estimated SDR	1.13
	(118.34)
Intercept	-.006
	(-1.77)
No. Obs.	683
R-squared	.9536

This table reports the results of OLS regressions. The dependent variable is the SDR of the AAA tranches in the first surveillance report as published by S&P. *'Estimated SDR',* or Estimated Scenario Default Rate, is the SDR generated from our replication of S&P's collateral risk model. White (1980) heteroskedasticity-adjusted t-statistics are in parentheses.

Table IA.3
Multiple Credit Ratings and Worst Performance

	All CDOs		ABS CDOs	
One Rater	0.998	1.145	0.605	0.978
	(-0.01)	(0.48)	(-1.39)	(-0.05)
Two - Disagree	0.864	0.749	1.785	1.876
	(-0.40)	(-0.77)	(1.20)	(1.37)
Credit Spread		1.258		1.220
		(6.21)		(3.59)
Spread w/ Price		1.091		1.016
		(1.71)		(0.16)
Fitch Rated	0.540	0.523	0.465	0.460
	(-3.66)	(-3.39)	(-3.72)	(-3.46)
CDO^2	1.388	1.057		
	(1.27)	(0.19)		
CBO	0.090	0.119		
	(-2.37)	(-2.06)		
CLO	0.054	0.059		
	(-7.42)	(-6.02)		
ABS Year Controls	Y	Y	Y	Y
Year Controls	Y	Y	-	-
No. Obs.	2790	2466	766	686
R-Squared	0.335	0.383	0.194	0.200

This table reports the results of ordered logit regressions. The dependent variables, '*Worst Performance*', is a binary variable that takes on a value of one if an originally AAA rated tranche in the deal either a) holds a rating of 'C' or 'D' as of June 30, 2010 or b) has its rating withdrawn as of June 30, 2010 following sufficient downgrades to classify the deal as speculative grade. *One Rater* is a dummy variable that takes on a value of one when the deal is rated by either S&P or Moody's, but not both agencies, and zero otherwise. Similarly, *Two - Disagree* is a dummy variable that takes on a value of one when the CDO is rated by both S&P and Moody's and they disagree about ratings on some AAA tranches, and zero otherwise. *Credit Spread* (*Spread w/ Price*) is the weighted-average AAA credit (yield) spread scaled by 10 basis points. *Fitch Rated* is a dummy variable that is set to one when Fitch rates at least one tranche in the CDO, and zero otherwise. *CDO^2* is a dummy variable that takes on a value of one when the security is a CDO of CDOs and zero otherwise. *CBO* is a dummy variable that takes on a value of one when the security is a collateralized bond obligation and zero otherwise. *CLO* is a dummy variable that takes on a value of one when the security is a collateralized loan obligation and zero otherwise. *(ABS) Year Controls* indicates specifications when year fixed effects (interacted with an ABS collateral dummy) were used for years 2003-2007. Reported are odds ratios with White (1980) heteroskedasticity-adjusted t-statistics in parentheses.

Table IA.4

Bloomberg Universe, Alternative Regression Models on CDO Performance

Panel A: Ordered Probit Regression

	S&P Downgrades	Moody's Downgrades	E.O.D.	Worst Performance
One Rater	-0.373 (-3.17)	-0.038 (-0.30)	-0.538 (-3.66)	0.139 (0.98)
Two - Disagree	-0.106 (-0.70)	-0.286 (-2.01)	-0.245 (-1.16)	-0.229 (-1.10)
Spread	0.055 (2.33)	0.067 (2.44)	0.050 (2.67)	0.134 (6.81)
Spread w/ Price	0.027 (1.15)	0.049 (2.36)	-0.046 (-1.79)	0.056 (2.17)
Fitch Rated	-0.049 (-0.74)	-0.178 (-2.63)	-0.167 (-1.77)	-0.356 (-3.40)
CDO^2	-0.281 (-1.93)	-0.021 (-0.16)	-0.328 (-2.10)	0.020 (0.12)
CBO	-0.088 (-0.59)	-0.071 (-0.54)	-0.443 (-1.35)	-0.985 (-2.42)
CLO	-0.550 (-6.99)	-0.721 (-9.28)	-1.345 (-8.56)	-1.202 (-6.68)
ABS Year Controls	Y	Y	Y	Y
Year Controls	Y	Y	Y	Y
No. Obs.	2231	2175	2466	2466
R-Squared	0.180	0.176	0.428	0.384

Table IA.4
Continued
Panel B: OLS Regression

	S&P Downgrades	Moody's Downgrades	E.O.D.	Worst Performance
One Rater	-1.233 (-2.10)	0.955 (1.77)	-0.072 (-4.00)	0.008 (0.46)
Two - Disagree	-0.711 (-0.97)	-0.988 (-1.48)	-0.046 (-1.42)	-0.025 (-1.06)
Spread	0.285 (2.52)	0.344 (2.37)	0.012 (3.14)	0.024 (6.37)
Spread w/ Price	0.140 (1.32)	0.265 (2.47)	-0.003 (-0.90)	0.012 (3.52)
Fitch Rated	-0.165 (-0.54)	-0.119 (-0.37)	-0.028 (-1.74)	-0.045 (-3.26)
CDO^2	-1.810 (-2.55)	-0.131 (-0.21)	-0.108 (-2.20)	0.035 (0.76)
CBO	-0.692 (-1.23)	-1.633 (-3.58)	-0.069 (-4.64)	-0.063 (-4.88)
CLO	-4.639 (-13.13)	-4.963 (-13.81)	-0.107 (-7.70)	-0.066 (-5.90)
Intercept	2.964 (4.81)	2.918 (4.32)	0.077 (4.16)	-0.011 (-0.59)
ABS Year Controls	Y	Y	Y	Y
Year Controls	Y	Y	Y	Y
No. Obs.	2231	2175	2466	2466
R-Squared	0.620	0.639	0.402	0.319

This table reports the results of ordered probit (Panel A) and OLS (Panel B) regressions. The dependent variables are listed in the column headers. '*S&P Downgrades'* is the number of notches that the lowest tranche originally rated AAA was downgraded by S&P as of June 30, 2010. '*Moody's Downgrades'* is the number of notches that the lowest tranche originally rated AAA was downgraded by Moody's as of June 30, 2010. *'E.O.D.',* or Event of Default, is a binary variable that takes on a value of 1 if the deal has issued an event of default notice, and zero otherwise. '*Worst Performance*' is a binary variable that takes on a value of 1 if an originally AAA rated tranche in the deal either a) holds a rating of 'C' or 'D' as of June 30, 2010 or b) has its rating withdrawn as of June 30, 2010 following sufficient downgrades to classify the deal as speculative grade. *S&P (Moody's*) *Exclusive* is a dummy variable that takes on a value of 1 on deals where only S&P (Moody's) assigned ratings to the deal. *Both, S&P (Moody's*) *Favorable* is a binary variable that assumes a value of 1 on deals that were rated by both agencies, but where S&P (Moody's) gave more tranches a AAA rating. *Fitch Rated* is a dummy variable that is set to 1 when Fitch rates at least one tranche in the CDO, and zero otherwise. All other variables are described in Table 5. Reported are regression coefficients with White (1980) heteroskedasticity-adjusted t-statistics in parentheses.

Table IA.5
AAA Adjustments Across Agencies and Number of Ratings

Panel A: AAA Adjustments Across Rating Agencies

	S&P	Moody's	Difference	*p*-value	Welch *p*-value
AAA Adjustment	3.44%	2.07%	1.37%	0.0006	-
Subordination Level	23.64%	26.55%	-2.91%	0.3345	0.3481
W.A. Collateral Rating	10.67	11.21	-0.54	0.6066	0.6273
Deal Size ($M)	409.00	420.00	-11.20	0.8487	0.8537

Panel B: AAA Adjustments Across Number of Ratings

	1 Rater	2 Raters	Difference	*p*-value	Welch *p*-value
S&P's Adjustment (w/o C.F.)	13.06%	11.30%	1.76%	0.4212	0.5246
Moody's Adjustment	3.85%	4.18%	-0.33%	0.9028	0.9369
Subordination Level	24.89%	26.34%	-1.45%	0.3995	0.3537
W.A. Collateral Rating	10.89	11.58	-0.69	0.1352	0.1889
Deal Size ($M)	413.00	601.00	-188.00	0.0003	<.0001

Panel C: Multiple Credit Ratings and S&P AAA Adjustments

	(1)	(2)	(3)	(4)	(5)
One Rater	0.023	0.025	0.026	0.024	0.027
	(1.04)	(1.04)	(1.10)	(1.02)	(1.12)
Two - Disagree	-0.003	-0.003	-0.011	-0.002	-0.013
	(-0.13)	(-0.11)	(-0.48)	(-0.06)	(-0.53)
Fitch Rated		-0.002	0.014	-0.002	0.014
		(-0.16)	(1.01)	(-0.11)	(0.97)
Has Price				0.003	-0.005
				(0.35)	(-0.52)
CDO^2	0.047	0.047	0.067	0.047	0.067
	(1.53)	(1.52)	(2.14)	(1.54)	(2.14)
CBO	0.019	0.019	-0.005	0.019	-0.005
	(1.21)	(1.09)	(-0.28)	(1.08)	(-0.26)
CLO	0.077	0.077	0.032	0.077	0.033
	(8.07)	(7.57)	(2.04)	(7.55)	(2.04)
Intercept	0.082	0.083	0.105	0.081	0.109
	(8.14)	(6.77)	(7.19)	(5.63)	(6.48)
ABS Year Controls	N	N	Y	N	Y
Year Controls	Y	Y	Y	Y	Y
No. Obs.	1182	1182	1182	1179	1179
R-Squared	0.091	0.091	0.115	0.090	0.115

Panel D: Multiple Credit Ratings and Moody's AAA Adjustments

	(1)	(2)	(3)	(4)	(5)
One Rater	-0.010	-0.010	-0.006	-0.010	-0.007
	(-0.25)	(-0.26)	(-0.16)	(-0.26)	(-0.16)
Two - Disagree	-0.091	-0.092	-0.093	-0.091	-0.092
	(-2.54)	(-2.57)	(-2.55)	(-2.55)	(-2.52)
Fitch Rated		0.002	0.002	0.002	0.002
		(0.12)	(0.09)	(0.14)	(0.11)
Has Price				0.002	0.003
				(0.20)	(0.32)
CDO^2	-0.065	-0.064	-0.061	-0.064	-0.061
	(-2.43)	(-2.35)	(-1.98)	(-2.32)	(-1.97)
CBO	-0.025	-0.025	-0.023	-0.025	-0.023
	(-1.42)	(-1.31)	(-1.17)	(-1.31)	(-1.14)
CLO	-0.041	-0.040	-0.023	-0.040	-0.022
	(-2.99)	(-2.77)	(-1.59)	(-2.75)	(-1.51)
Intercept	0.056	0.055	0.055	0.054	0.052
	(6.11)	(4.87)	(4.19)	(4.04)	(3.39)
ABS Year Controls	N	N	Y	N	Y
Year Controls	Y	Y	Y	Y	Y
No. Obs.	794	794	794	791	791
R-Squared	0.033	0.033	0.053	0.033	0.053

This table reports the results of difference in means tests (Panels A & B) and OLS regressions (Panels C & D). Reported are *p*-values assuming equal variances across samples (*p-value*) and unequal variances (*Welch p-value*) with one exception. In Panel A, S&P's model has been augmented with an estimate of deal-specific cash flow protection and a paired *t*-test is reported. The details of the estimation can be found in Internet Appendix IA 2.G. For the OLS regressions, the dependent variable is S&P's AAA Adjustment (Panel C) and Moody's AAA Adjustment (Panel D). All independent variables are defined in Table IA.4. White (1980) heteroskedasticity-adjusted t-statistics are in the parentheses.

Table IA.6
Regressing S&P AAA Adjustment on Differences in Assumptions and Deal Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Positive CRD	0.845	0.908	0.770	0.786	0.356	0.468
	(7.77)	(8.08)	(5.41)	(6.02)	(5.23)	(4.63)
Negative CRD	0.620	0.623	0.470	0.439	0.436	0.463
	(4.47)	(4.48)	(3.05)	(2.88)	(4.34)	(3.97)
SDR					0.575	0.570
					(17.41)	(12.31)
CBO			0.079	0.080		0.004
			(4.87)	(4.95)		(0.30)
CLO			0.083	0.091		0.000
			(7.78)	(8.00)		(0.01)
CDO^2			0.143	0.154		0.014
			(4.19)	(4.70)		(0.66)
Other			-0.085	-0.066		-0.144
			(-2.31)	(-2.78)		(-3.07)
Fitch Rated		-0.033		0.009		-0.004
		(-2.53)		(0.71)		(-0.39)
Insured		0.087		0.078		0.058
		(2.95)		(2.76)		(3.10)
Log(Manager)		-0.014		-0.015		-0.003
		(-3.44)		(-4.04)		(-1.06)
Log(Underwriter)		-0.004		-0.009		-0.005
		(-1.19)		(-2.77)		(-2.05)
Intercept	0.106	0.139	0.046	0.075	-0.095	-0.075
	(19.51)	(9.26)	(3.54)	(4.39)	(-7.91)	(-4.73)
Year Controls	N	N	Y	Y	N	Y
No. Obs.	643	643	643	643	643	643
R-squared	0.279	0.327	0.426	0.467	0.635	0.660

This table reports the results of OLS regressions. The dependent variable is the S&P AAA Adjustment (Panel A) and Moody's AAA Adjustment (Panel B). *'Positive (Negative) CRD'* is set equal to CRD when the value is positive (negative), and zero otherwise. *CRD*, or Collateral Risk Disagreement, is the SDR using S&P's assumptions minus the SDR using Moody's assumptions, under our version of S&P's model. *'SDR'* is the AAA SDR reported in S&P's surveillance report. *'CBO', 'CLO,* and *'CDO*^{2} are dummy variables that take on a value of one when the security is collateralized with bonds, loans, or CDOs respectively and zero otherwise. *'Other'* is a dummy variable that takes on a value of one when the security is not any of the preceding types, or an ABS CDO, and zero otherwise. *'Fitch Rated'* is a dummy variable that takes on a value of one when Fitch also rated the AAA tranches and zero otherwise. *'Insured'* is a dummy variable that takes on a value of one when at least one of the AAA tranches was wrapped and zero otherwise. *'Log(Manager)'* is the log of the number of previous deals the collateral manager has been involved with. *'Log(Underwriter)'* is the log of the number of previous deals the lead underwriter has previously underwritten. *Year Controls* indicates specifications when year fixed effects were used for years 2003-2007. 81 additional reports lack the initial AAA scenario SDR needed to calculate the AAA adjustment and are excluded from the sample. White (1980) heteroskedasticity-adjusted t-statistics are in the parentheses.

Table IA.7
Average Distance from Realized AAA Sizes to Model-Implied AAA Sizes

	Full Sample	$AAA_{Moody's} > AAA_{Actual} > AAA_{S\&P}$	$AAA_{S\&P} > AAA_{Actual} > AAA_{Moody's}$
AAA Distance to S&P's Model	8.42%	7.08%	4.87%
	(.0023)	(.0080)	(.0080)
AAA Distance to Moody's Model	6.53%	4.07%	3.20%
	(.0030)	(.0041)	(.0045)
Difference	1.88%	3.01%	1.67%
p-value	*<0.0001*	*0.0006*	*0.0860*
No. Obs.	492	72	49

This table reports the average distance from realized AAA tranche sizes to model-implied AAA sizes for S&P and Moody's. S&P's model has been augmented with an estimate of deal-specific cash flow protection. Standard errors are reported in the parenthesis. The statistical significance of the difference between the two values is assessed using a paired *t*-test from which we report the *p*-value in *italics*.

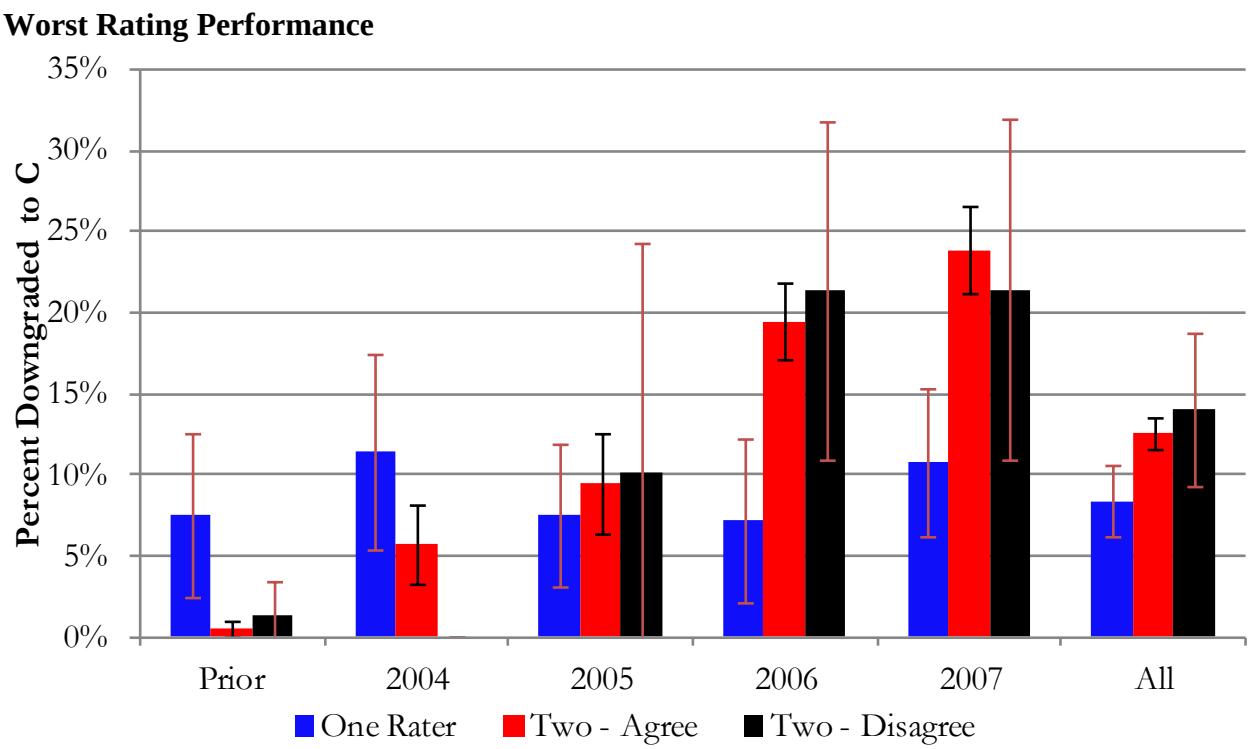

Figure IA.1
CDO Performance and Agency Participation and Agreement
This figure illustrates the percentage of CDOs experiencing downgrades to a rating of C or D by year of issuance. The number of notches downgraded is computed as of June 30, 2010. *Two - Agree* refers to CDOs who receive a rating by both Moody's and S&P, and they agree about ratings for all originally AAA tranches. *Two - Disagree* refers to CDOs who are rated by both S&P and Moody's and they disagree about ratings on some AAA tranches. The collateral-type distribution for each column is standardized using weights from the overall sample before calculating the mean. Reported for each column is its 90% confidence interval.

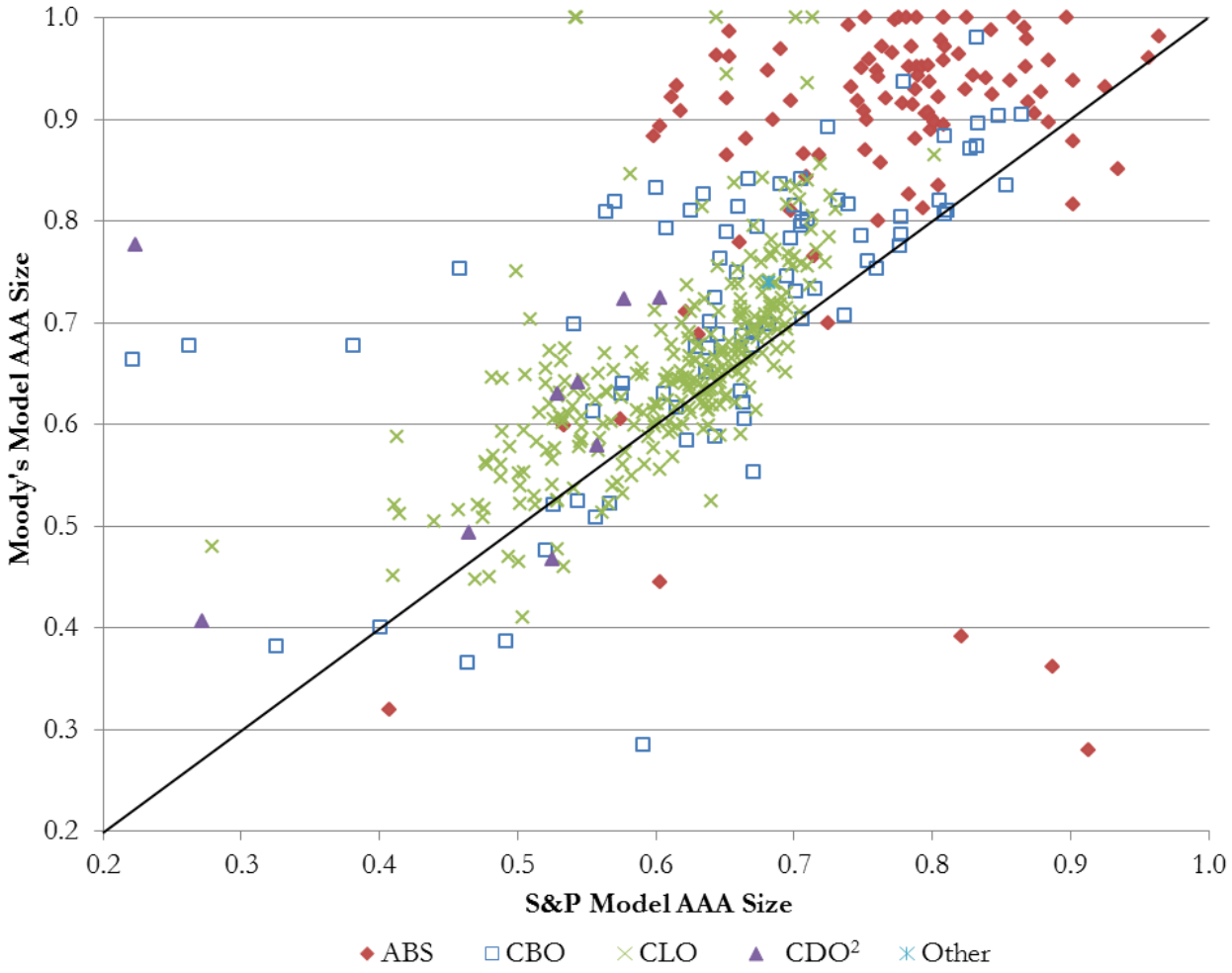

Figure IA.2

S&P Model AAA with S&P's Assumptions (x-axis) and Moody's Model AAA with Moody's Assumptions (y-axis)

This figure graphs the allowable percentage of AAA from S&P's model and Moody's model. S&P's allowable AAA is calculated using S&P's assumptions and Moody's allowable AAA is calculated using Moody's assumptions.

Internet Appendix IA 2

A. Moody's and S&P Modeling Methodologies.

Moody's and S&P use different underlying frameworks to model CDO risk. Moody's primarily uses the binomial expansion technique (BET) method to model CDOs, while S&P uses the Gaussian Copula Monte Carlo Simulation approach that is widely distributed in industry.

The main innovation in Moody's BET CDO valuation model is to incorporate default correlations by modeling the collateral pool as a smaller number of independent assets, where the number of representative assets in the pool is the diversity score (*DS*). Each representative asset has an independent probability of default of *p*. Therefore, the total number of defaults over the life of a deal follows a binomial distribution. A tranche loss rate is calculated for each possible number of these *DS* assets experiencing default. Total expected loss is calculated by computing a weighted average of the tranche's loss given *j* defaults, where the probability of *j* defaults out of *DS* independent assets is determined by the binomial distribution. An "idealized" expected loss table then converts the expected loss to a credit rating.

In contrast to Moody's reduced-form diversity score approach, the structural approach used by S&P (or copula approach, which is also used by Fitch) assumes that movements in asset values are correlated. All asset values are simulated many times with a given correlation structure to produce a distribution of the portfolio value. This distribution is then used to generate a set of scenario default rates (SDR). The calculation of SDR is analogous to finding Value-at-Risk (VaR) at a given confidence level for a rating.

Apart from S&P's credit risk modeling of the collateral pool, each tranche must undergo a separate cash flow analysis (except synthetic CDOs which are relatively more recent). However, secondary cash flow modeling is only sparsely described and S&P's cash flow model is not publically distributed. The Gaussian Copula credit risk model is the main model S&P discussed and distributed in industry. Hence, we focus on the S&P credit risk model, but in additional tests allow for deal-specific cash flow features.

B. Bloomberg Universe of CDOs.

For the majority of the analysis we rely on CDOs rated by both S&P and Moody's and use information reported by these two agencies as our primary data source. The biggest exception is the use of Bloomberg to gather the ratings history for the deals in our sample. In addition, we perform a broader set of analysis on all securities classified as CDOs by Bloomberg. Included in the Bloomberg data is deal level information related to each deal's characteristics as well as tranche level data including the full rating history of each agency rating the tranche. While Bloomberg contains data on a large number of securities, steps must be taken to prepare the raw information for analysis.

The first step in the cleaning process is identifying and removing any duplicate entries that relate to the same underlying CDO. Each deal in the Bloomberg universe is assigned a ticker, however there is not a one-to-one relationship between a ticker and a CDO. Instead, due to regulations and reporting requirements, CDOs are often listed under multiple tickers.[1] Luckily, the tickers are constructed in such a way that that identifying multiple tickers that correspond to the same CDO can be done quite effectively. Specifically, a CDO that is registered under two different names will have tickers that only differ in their final letter. Therefore, duplicate entries can be easily identified and removed, using the effective date and relative tranche sizes of the security as a secondary check to verify that multiple tickers do in fact represent the same deal.

After removing duplicate entries from the database, the deal level characteristics such as the year of origination and the type of underlying collateral used in the deal are gleaned from Bloomberg. When type information is unavailable, the data is collected by performing hand searches on the rating agency websites, matching on the issuer name and effective date reported by Bloomberg for the CDO.

Following this, we supplement the dataset with a list of Event of Default (EOD) notifications received from deal managers as reported by S&P. The report used contains a comprehensive list of all CDOs that were rated by S&P that experienced an EOD notice. This list was linked back to the previous data by searching Bloomberg for the CDO name and collecting the tickers associated with the deal. While

[1] An example of this is 1888 Fund, Ltd. In Bloomberg, this CDO is represented by both GUGG 2002-1A and GUGG 2002-1X.

the report contains a comprehensive list of all CDOs rated by S&P (and possible Moody's as well), it does not include CDOs that were rated by Moody's but not S&P. For the 272 deals that fall into this category, hand searches were performed on the internet to identify any EOD notices that would be posted on financial websites such as Reuters or Bloomberg, as well as press releases issued by the deal's collateral manager or underwriter. It should be noted that it is possible that not all CDOs that experienced an Event of Default notice would be caught by such a methodology. However, since only deals rated by Moody's and not S&P would be affected by such steps, any EOD notices not caught would bias against finding evidence of deals rated solely by Moody's underperforming other groups, an relationship that we still find in our sample.

Finally, when classifying deals as having the worst possible performance we rely solely on the ratings issued by Moody's and S&P. Deals which either get downgraded to the lowest possible level, are listed as being in default, or, in some cases, have their ratings withdrawn, fall into this category. However, deals which are fully paid off would also have their ratings withdrawn after the deal closes. Therefore, we require that a deal contain a AAA tranche that has been previously downgraded to speculative grade and is not upgraded back to investment grade prior to its rating being withdrawn to be considered in default, therefore placing it in the badly performing category.

C. Missing Data from a Portion the Dataset.

In our sample, the data we use is gathered almost exclusively from documents published from the rating agencies themselves. However, for a small subset of the CDOs that we study we must rely on preliminary reports that do not contain all the information needed. However, we can estimate these missing values based on the data that the rating agencies do provide.

While the surveillance reports in our sample do list the aggregate number of obligors in the underlying collateral pool, they do not contain asset level data. Beyond that, we do not have any information on the number of obligors for the 24 CDOs where the New Issue report was used as a data source. Because the sizes of the underlying assets are important when computing the correlation, we estimate the number of equal weighted assets that the pool is equivalent to using information on the loss

distribution provided by S&P. The derivation for the number of assets is provided below. When comparing the estimated number of assets to the actual number reported by S&P, the two numbers exhibit a correlation of 0.85. However, the Monte Carlo simulations are not sensitive to this fact—the correlation between the model outputs when the estimated number of assets is used and when the reported number of obligors is used is 0.9807 in our sample.

D. Representative Number of Obligors

Given the variance of an asset pool, the amount of this variance that asset correlation contributes, and probability of default of the underlying assets, one can easily estimate the number of obligors that the pool should be composed of. In particular, given the probability of default for any given asset in the pool, p, and the number of assets that comprise the pool, n,the variance of the defaults in the pool will be:

$$Var(Correlated\ Asset\ Pool) = \frac{p \cdot (1-p)}{n}$$

When taking correlation of the underlying assets into consideration and using the definition of Correlation Measure, CM, provided by S&P, the variance becomes:

$$Var(Correlated\ Asset\ Pool) = \frac{p \cdot (1-p)}{n} \cdot CM^2$$

In S&P's case, they report the annualized standard deviation of the defaults for the asset pool with correlation, VM. Therefore, the variance of the pool over the life of the deal (WAM) is equivalent to:

$$Var(Correlated\ Asset\ Pool) = VM^2 \cdot WAM$$

Finally, given that the annual probability of default is reported as the Default Measure, DM, one can calculate the probability of default of the average asset in the pool as $DM \cdot WAM$ and substitute this value in for p. Therefore, setting the two equations above equal to each other, one will get that:

$$VM^2 \cdot WAM = \frac{(DM \cdot WAM) \cdot (1 - (DM \cdot WAM))}{n} \cdot CM^2$$

or alternatively, given all the other metrics, one can calculate the number of assets the underlying pool represents as:

$$n = \frac{DM \cdot (1 - DM \cdot WAM)}{VM^2} \cdot CM^2$$

E. Asset Correlation

The variance of the percentage of defaults in a pool of assets, $Var(D_P)$ is:

$$Var(D_P) = \sum_{i=1}^{N} h_i \cdot Var(D_i) + \sum_{i=1}^{N} \sum_{j \neq i}^{N} h_i \cdot h_j \cdot Cov(D_i, D_j)$$

$$= \sum_{i=1}^{N} {h_i}^2 \cdot Var(D_i) + \sum_{i=1}^{N} \sum_{j \neq i}^{N} h_i \cdot h_j \cdot \sqrt{Var(D_i)Var(D_j)}\rho_{i,j}$$

where D_i is the default of asset i, and h_i is the percentage of asset i's size relative to the total asset pool. In the case of equal sized assets and equal probabilities of default, the assets become homogeneous with respect to their variances, $Var(D_k)$, and the equation simplifies to:

$$= \frac{1}{N} \cdot Var(D_k) + \sum_{i=1}^{N} \sum_{j \neq i}^{N} \frac{1}{N \cdot N} \cdot Var(D_k)\rho_{i,j}$$

Therefore, substituting the Average Correlation (ρ)

$$= \frac{1}{N} \cdot Var(D_k) + \frac{N-1}{N} \cdot Var(D_k)\rho$$

$$= \left[\frac{1}{N} + \frac{N-1}{N} \cdot \rho\right] Var(D_k)$$

In the case of Moody's correlation metric, the Diversity Score is such that the variance of a pool of DS independent and equal sized assets is:

$$\frac{1}{DS} \cdot Var(D_k)$$

Therefore the average correlation should be such that both portfolios have the same variance:

$$\frac{1}{DS} \cdot Var(D_k) = \left[\frac{1}{N} + \frac{N-1}{N} \cdot \rho\right] Var(D_k)$$

$$\frac{1}{DS} = \frac{1}{N} + \frac{N-1}{N} \cdot \rho$$

$$\frac{N - DS}{DS} = (N-1) \cdot \rho$$

$$\rho = \frac{N - DS}{DS \cdot (N-1)}$$

In contrast, S&P's correlation measure, CM, is defined as the ratio of the standard deviation of the portfolio defaults with pair-wise correlations to the standard deviation of the portfolio without any correlations:

$$CM = \frac{SD(Port\ with\ Corr.)}{SD(Port\ without\ Corr.)}$$

$$CM^2 = \frac{Var(Port\ with\ Corr.)}{Var(Port\ without\ Corr.)}$$

With equal sized assets, this equality reduces to:

$$CM^2 = \frac{\frac{1}{N} \cdot Var(D_k) + \frac{N-1}{N} \cdot Var(D_k)\rho}{\frac{1}{N} \cdot Var(D_k)}$$

$$= \frac{\frac{1}{N} + \frac{N-1}{N} \cdot \rho}{\frac{1}{N}}$$

$$CM^2 = 1 + (N-1) \cdot \rho$$

$$CM^2 - 1 = (N-1) \cdot \rho$$

$$\rho = \frac{CM^2 - 1}{N-1}$$

Note: Both of these derivations use the assumption that the underlying assets are equal sized, which may be slightly restrictive. However, it should be noted that since the purpose of a CDO is to diversify risk, the most efficient way to do this with N assets is to choose assets of equal sizes.

F. Derivation of Yield Spread from Credit Spread

Within our analysis, we infer investor risk perception from the spread they demand above an index rate for floating rate CDO tranches. If a note is sold at par, the demanded yield spread is simply equal to the coupon spread. However, tranches are not always sold at par. Furthermore, because investors receive coupons based on the index rate in addition to their note's coupon spread, the interest rate of the index must also be accounted for. In these cases the yield is estimated using the coupon spread and issuance price using the following methodology.

We first estimate the equivalent fixed coupon rate the investor could earn in lieu of their floating payments by adding the tranche's coupon spread to the fixed leg of an appropriate interest rate swap based on the tranche's index (most commonly the 3-Month Libor). We choose the swap whose maturity most closely matches the weighted average life of the CDO tranche, and use the fixed rate as of the CDO's issuance date. Using this fixed coupon payment, the tranche's issuance price and the time to maturity (weighted average life), we calculate the yield to maturity. Finally, the fixed leg of the swap is subtracted from this yield. The result is the approximate floating spread above an index rate an investor would have earned had they bought the tranche at par.

G. Use of Moody's Binomial Expansion Technique Model

Moody's introduced the BET model in 1996, and then introduced the Correlated BET model, an extension of the original BET model, in 2004. Moody's states that they use Monte Carlo simulations for synthetic CDOs and CDO^{2}s (since 2004). However, for all CDOs in our sample Moody's continued to report the Diversity Score used in the original version of their BET model. In the continuing surveillance reports for all CDOs in our sample the underlying collateral correlation metric reported by Moody's is the Diversity Score. Since this is a direct model input used in their BET model, we infer that all of the CDOs

in our sample also use the Moody's BET model. Therefore, this is the model that we replicate and use throughout our analysis.