

Structured Finance Rating Transitions: 1983–2002

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The structured finance world has experienced explosive growth in recent years. Securitization has expanded into virtually every aspect of the market economy—from traditional residential mortgages and credit card balances to aircraft leases, commercial mortgages, mutual fund fees, emerging market bonds, synthetic arbitrage (collateralized debt obligations), and credit derivatives.

Structured finance ratings are often linked, either directly or indirectly, to ratings of industrial corporations, financial institutions, and sovereign entities. Obviously, the ratings of guaranteed or letter of credit (LOC) backed structured securities are directly affected by changes in their credit enhancer's ratings. In addition, corporate rating transitions have a powerful effect on the rating transitions of CDOs, credit derivatives, and other credit-linked notes. Moreover, the financial performance of collateral originators and servicers also influences the ratings of individual structured securities.

It is therefore important to note that the structured ratings migration statistics we report could be the result of unexpected changes of collateral performance, changes in corporate or other fundamental credit ratings, or a combination of both.

For all the asset classes we study, which include, ABS, CDO, CMBS, RMBS, and other structured deals (OTHER) such as structured notes and credit derivatives, ratings have been considerably more stable than corporate

ratings over the same period. Over a one-year horizon, unlike corporate ratings, where average downgrade rates generally exceed upgrade rates, annual average downgrade and upgrade rates have been roughly equal in structured finance. The average number of notches per rating move in the structured finance sector is higher than in the corporate finance sector.

We find that structured finance ratings, like corporate ratings, display path-dependence, or rating change momentum. In other words, ratings that were downgraded (or upgraded) in a year tend to be downgraded (or upgraded) again within the following year. In addition, we find that rating changes in the same deal, not surprisingly, tend to be highly correlated. Also, statistics from different structured finance sectors reveal strong similarity in their average rating volatility, but the upgrade and downgrade rates have been different across these sectors.

We begin with descriptions of the data sample and the methodology. Analysis of the aggregate rating transitions in structured finance includes analysis of annual rating transition matrices, aggregate downgrade and upgrade rates, age profiles of rating transitions by broad rating categories, rating drift, rating volatility, and rating transition matrices over multiple-year horizons. We examine serial and contemporaneous dependence of rating changes in structured finance ratings. Finally, we compare rating transitions across structured finance sectors and the corporate sector, and offer some interpretations of our key findings. Full

methodological details and rating transition matrices appear in appendices.

I. DATA POOL

One objective is to present a statistical analysis of rating transitions for Moody's structured finance long-term ratings as a whole, with comparisons across sectors. We consider six criteria in selecting rating observations for this study:

1. The study sample covers a 20-year period from 1983 through 2002.
2. We include all structured finance securities that carried a standard Moody's long-term bond rating at some time between the beginning of 1983 until the end of 2002.¹ This allows us to capture structured finance securities in the ABS, CDO, CMBS, and RMBS sectors and a separate sector that includes credit derivative securities and structured notes. Asset-backed commercial paper (ABCP) programs, which carry short-term rather than long-term ratings, are excluded.
3. All securities wrapped by financial guaranty insurers or guaranteed by federal agencies or government-sponsored enterprises (GSEs) are excluded.
4. Tranches whose ratings are effectively single-name pass-throughs of individual corporate or sovereign ratings are excluded.
5. Tranches carrying the same rating from the same deal are collapsed into a single tranche. In this case, the outstanding tranche with the longest maturity is selected.²
6. The sample includes both U.S. and international (non-U.S.) transactions.

Applying all six criteria, we obtain a total of 79,176 rating-year observations. For example, by the end of 2002, there were 15,721 structured finance ratings in our sample, of which 5,498 are from the ABS sector, 4,576 are from the RMBS sector, 2,569 are from the CMBS sector, and 2,448 are from the CDO sector. Home equity loans (HEL) and manufactured housing (MH) are included in the ABS sector. Explanations for the use of these criteria and the details of our transition study methodology are illustrated in Appendix A.

Distributions of structured finance ratings by broad rating and by sector are displayed in Exhibit 1 and Exhibit 2. For comparison, we also provide the rating distribu-

tion for corporate ratings in Exhibit 1.

Two attributes stand out in Exhibit 1. First, the rating distribution in structured finance is quite different from that in corporate finance. In structured finance, ratings are predominantly investment-grade while in corporate finance a significant portion consists of speculative-grade issuers. For instance, at the beginning of 2002, 41.5% of outstanding ratings were speculative-grade in corporate finance, while only 12.9% were speculative-grade in structured finance. Furthermore, of the investment-grade securities, the most common rating is Aaa in structured finance, while it is Baa in corporate finance.

Second, there has been phenomenal growth in structured finance. Moody's had given fewer than 1,000 outstanding ratings before 1990, but by the end of 2001, the number greatly exceeded 10,000. Note that Exhibit 1 reports numbers of issuers in the case of rated corporate issuers but the number of securities in the case of structured finance, except that tranches of a single rating within a transaction are collapsed. Even accounting for this difference, structured finance still has grown significantly faster than corporate finance. This can be seen in Exhibit 2, which compares the distributions of structured finance ratings and structured deals.

The average number of Moody's ratings in a structured deal has increased significantly over time. According to data presented in Exhibit 2, at the beginning of 1995, there were an average of 1.6 ratings per transaction (again collapsing same-rating tranches in the same deal into a single tranche); at the beginning of 2002, the number had become 2.4. Meanwhile, the dominance of the share of RMBS deals in the Moody's-rated structured finance universe has declined substantially over time, and ABS (HEL included) has taken over as the largest sector.

II. ANNUAL RATING TRANSITIONS IN STRUCTURED FINANCE

Exhibit 3 presents the broad rating-based annual rating transition matrix. Each cell of the matrix is the weighted average percentage of ratings at the beginning of each year in the sample that end up in each rating category at the end of that year. For comparison, Exhibit 3 also includes the corporate rating transition matrix, where the default column is merged into the Caa or below column (i.e., the Caa, Ca, and C rating categories combined).

Exhibit 3 shows that Moody's structured finance ratings are very stable. For five of the seven broad rating categories and all investment-grade categories, over 90%

EXHIBIT 1

Distribution of Structured Finance and Corporate Finance Ratings

Rating	Structured Finance					Corporate Finance				
	1/1/85	1/1/90	1/1/95	1/1/00	1/1/02	1/1/85	1/1/90	1/1/95	1/1/00	1/1/02
Aaa	91.7%	36.4%	41.5%	35.4%	33.2%	3.5%	3.7%	2.5%	1.4%	1.5%
Aa	0.0%	58.2%	28.2%	16.9%	16.2%	17.4%	10.0%	10.1%	8.3%	10.3%
A	8.3%	1.8%	13.7%	20.0%	20.3%	31.2%	24.4%	27.6%	21.9%	22.4%
Baa	0.0%	2.9%	10.9%	16.2%	17.4%	17.1%	15.1%	18.6%	22.1%	24.3%
Ba	0.0%	0.5%	3.7%	6.2%	7.7%	18.0%	22.1%	17.0%	11.9%	11.5%
B	0.0%	0.0%	1.7%	3.7%	3.7%	9.8%	19.6%	18.8%	25.2%	19.6%
Caa-C	0.0%	0.2%	0.3%	1.6%	1.6%	3.0%	5.2%	5.4%	9.3%	10.4%

Investment-Grade	100%	99.4%	94.3%	88.6%	87.1%	69.2%	53.1%	58.8%	53.7%	58.5%
Speculative-Grade	0.0%	0.6%	5.7%	11.4%	12.9%	30.8%	46.9%	41.2%	46.3%	41.5%
Total Ratings Outstanding	12	649	3325	8201	12296	1585	2119	2200	3149	2950

EXHIBIT 2

Distribution of Structured Finance Ratings and Deals by Sector

	Structured Finance Ratings					Structured Finance Deals				
	1/1/85	1/1/90	1/1/95	1/1/00	1/1/02	1/1/85	1/1/90	1/1/95	1/1/00	1/1/02
ABS	8.3%	18.6%	23.9%	36.7%	35.6%	8.3%	18.3%	25.7%	38.6%	38.8%
CDO	0.0%	0.0%	2.0%	9.3%	14.5%	0.0%	0.0%	2.5%	8.0%	12.3%
CMBS	0.0%	1.4%	5.1%	13.4%	16.5%	0.0%	1.5%	3.0%	5.7%	6.9%
RMBS	91.7%	79.8%	68.1%	36.3%	29.4%	91.7%	80.1%	67.5%	39.1%	33.2%
Other	0.0%	0.2%	0.9%	4.3%	4.0%	0.0%	0.2%	1.2%	8.6%	8.8%
Total Ratings/Deals Outstanding	12	649	3325	8201	12296	12	617	2072	3788	5136

do not experience rating changes in one year, excluding withdrawn ratings.³ The percentage of unchanged ratings for Aaa is close to 99%. Compared to the corporate finance ratings, structured finance ratings have been more stable. This is particularly true for Aaa-rated securities, which have a frequency of unchanged ratings of 98.90%, as compared to 89.83% for Aaa-rated corporate issuers.

Exhibit 3 also indicates that structured finance securities have not just been less likely to be changed, but also particularly less likely to be downgraded than similarly rated corporate securities. A review of the first off-diagonal cells (or one broad rating category change) reveals that most of the downgrade/upgrade ratios in structured ratings are much lower than those in corporate ratings. This is especially true for Aa, A, and Ba ratings.

In fact, as shown in Exhibit 4, the aggregate average downgrade/upgrade ratio based on broad ratings in structured finance is only 1.2, as compared to 2.3 in corporate finance. Exhibit 4 also breaks out the downgrade/

upgrade ratios for 2002 only. In 2002 alone, structured finance ratings were downgraded much more often than upgraded. They are very similar in this regard to corporate ratings in terms of their broad rating-based downgrade/upgrade ratios.

Exhibit 3 also indicates that structured finance ratings powerfully discriminate against the risk of transition to sharply higher expected loss rates over one-year horizons. The Caa or below column shows that lower-rated securities have higher percentages moving into this column—the lowest rating category with the highest expected loss in this study. The percentages in this column are very similar for structured finance and corporate finance. This implies that as opinions of future relative creditworthiness, Moody's structured finance ratings provide discriminatory power.

Exhibit 5 shows the comparison of transition rates for both structured ratings and corporate ratings to the lowest rating category. Overall, the risk of moving from

EXHIBIT 3

Moody's All Structured Finance Annual Rating Transition Matrix—1983-2002

Moody's Structured Finance Rating Transitions 1983-2002							
	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	98.90%	0.89%	0.13%	0.04%	0.00%	0.00%	0.03%
Aa	5.45%	91.46%	2.28%	0.63%	0.09%	0.03%	0.06%
A	1.13%	2.74%	93.54%	1.82%	0.52%	0.07%	0.18%
Baa	0.53%	0.65%	2.25%	90.40%	3.83%	1.26%	1.08%
Ba	0.14%	0.06%	0.78%	3.99%	86.33%	3.24%	5.46%
B	0.00%	0.06%	0.06%	0.46%	0.85%	88.95%	9.62%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.17%	0.34%	99.49%

Moody's Corporate Finance Rating Transitions 1983-2002							
	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	89.83%	9.17%	1.00%	0.00%	0.00%	0.00%	0.00%
Aa	0.79%	89.66%	9.04%	0.37%	0.09%	0.02%	0.03%
A	0.05%	2.53%	90.68%	5.77%	0.70%	0.22%	0.04%
Baa	0.05%	0.28%	5.94%	86.95%	5.25%	1.12%	0.41%
Ba	0.01%	0.04%	0.61%	5.50%	82.59%	9.01%	2.23%
B	0.01%	0.06%	0.23%	0.61%	6.19%	81.22%	11.68%
Caa or Below	0.00%	0.00%	0.00%	1.01%	2.57%	6.53%	89.88%

Adjusted for withdrawn ratings.

EXHIBIT 4

Comparison of Aggregate Average Downgrade and Upgrade Rates—1983-2002

	Downgrade Rate	Upgrade Rate	Unchanged Rate	Downgrade/Upgrade Ratio
Structured Finance 1983-2002	3.21%	2.70%	94.09%	1.2
Corporate Finance 1983-2002	9.42%	4.14%	86.44%	2.3
Structured Finance 2002 only	6.46%	1.41%	92.13%	4.6
Corporate Finance 2002 only	14.42%	2.61%	82.97%	5.5

Broad rating-based, adjusted for withdrawn ratings.

a higher rating category into the Caa or below category within one year is slightly higher in structured finance than in corporate finance. Except for the B rating category, the likelihood of transition into Caa or below of all rating categories is more than twice as high in structured finance as in corporates.

III. MULTIPLE-YEAR RATING TRANSITIONS IN STRUCTURED FINANCE

Ratings in structured finance are very stable not only within a one-year horizon but also within horizons of two, three, or even more years. Multiyear transition

matrices, ranging from two- to five-year horizons, are presented in detail in Appendix B.

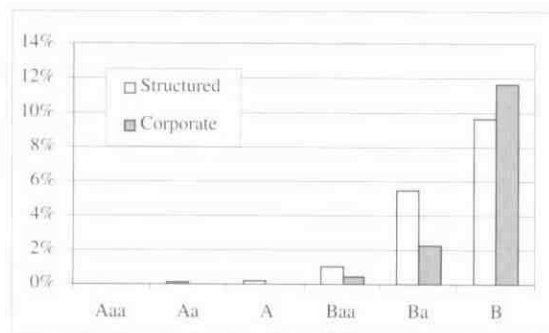
A summary measure of stability is exhibited in Exhibit 6. This shows that even after three years, the cumulative percentage of ratings unchanged remains above 70% for all broad rating categories. Aaa ratings are particularly stable; over 95% of structured securities maintain their Aaa ratings even over the five-year horizon.

As the horizon extends, more ratings are withdrawn, and fewer ratings are eligible in the calculation of these rating transition percentages in Exhibit 6. In other words, the sample sizes could be different over different time horizons.

There are also substantial differences in rating with-

EXHIBIT 5

Likelihood of Transition into Lowest Rating Category Within One Year—1983-2002



drawn frequencies across ratings. On average, structured securities rated Ba or B have had much lower withdrawn frequencies than those rated Aaa or A, reflecting typically shorter average lives for Aaa- or A-rated securities than Ba- and B-rated ones. In fact, about half of the Aaa-rated securities would be withdrawn in five years.

We compare in Exhibits 7 and 8 the likelihood of transitioning from higher rating categories into the lowest rating category, as a measure of the discriminating power of ratings. The results show over different horizons that the structured finance and corporate sectors are similar even over longer time horizons. There is a much higher likelihood of transition to the lowest rating category for speculative-grade than for investment-grade credits.

Exhibit 7 shows the risk of corporate securities has generally been higher, as roughly 32% of all speculative-grade corporate securities have transitioned to Caa or lower within five years; the comparable number for struc-

tured finance is only about 12%. The historical long-term transition rates for structured finance may change over time since the growth of the speculative-grade component of the structured finance sector has been a fairly recent phenomenon.

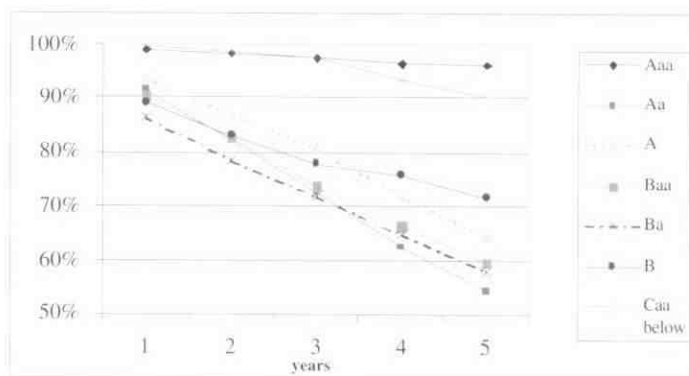
Moreover, Exhibit 8 indicates, that although the risk of investment-grade structured finance credits transitioning into the lowest rating category has been very low, it has been higher than seen for comparably rated corporate securities. It is worth noting, however, that most of the corporate bonds that transitioned from investment-grade into these lower rating categories subsequently defaulted and suffered fairly high loss severity. Most of the investment-grade structured finance transitions have been to the Caa category, rather than the Ca or C category, implying that Moody's does not expect loss rates on these structured securities to be as high as those typically observed on defaulted corporate securities.

IV. AGE PROFILES OF STRUCTURED FINANCE RATING TRANSITIONS

The majority of structured deals have a fixed pool of (perhaps amortizing) assets. As newly originated transactions age, detailed performance information on the underlying asset pools becomes available. This information, which is factored into the models used to help evaluate the expected loss in these transactions, may change the original assessment of credit risk on some tranches, causing ratings to change. After a certain point in the life of a deal, as collateral performance becomes more stable, senior bonds are paid off, and deals become de-levered, ratings would then also be stabilized, or in some cases rise. Is there

EXHIBIT 6

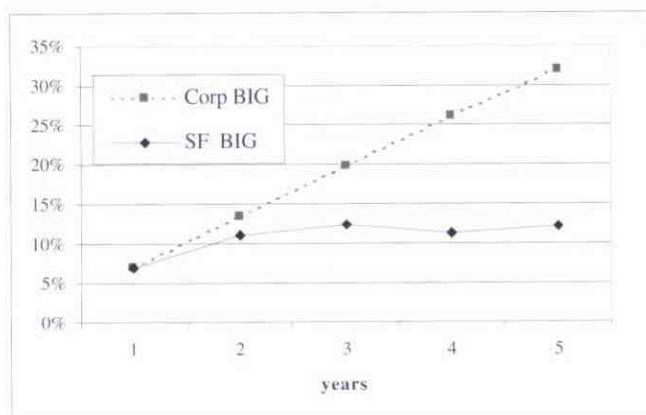
Cumulative Frequencies of Ratings Unchanged—1983-2002



Adjusted for withdrawn ratings, broad ratings-based.

EXHIBIT 7

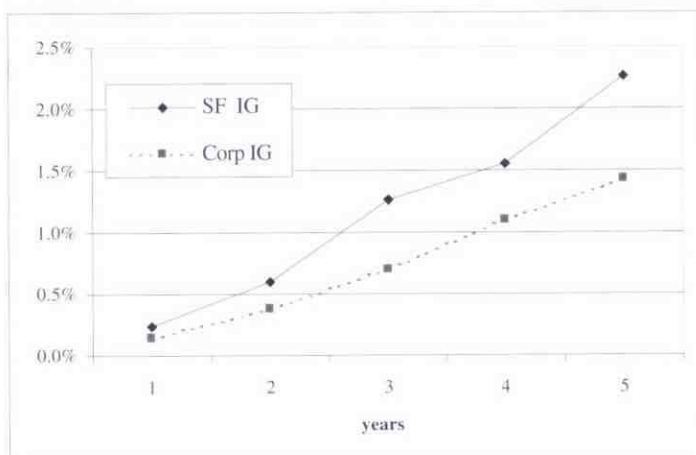
Cumulative Frequencies of Transition into Lowest Rating Category from Below Investment-Grade—1983-2002



Broad rating-based, adjusted for withdrawn ratings; for corporate ratings, defaults are merged into the Caa or below category.

EXHIBIT 8

Cumulative Frequencies of Transition into Lowest Rating Category from Investment-Grade—1983-2002



Broad rating-based, adjusted for withdrawn ratings; for corporate ratings, defaults are merged into the Caa or below category.

such an age pattern or seasoning effect in rating changes?

Because almost all structured finance ratings are first assigned at the time of the transaction origination, the age of a rating is a reasonable proxy for the age of a transaction. The rating age is defined as the number of years from the starting year of a rating to the cohort year. The starting year is the year after a rating is officially assigned. For instance, if a rating is assigned in April 1997, the starting year is 1998. If the cohort year is 2001, then the age of the rating is three. The rating age is measured only by years.

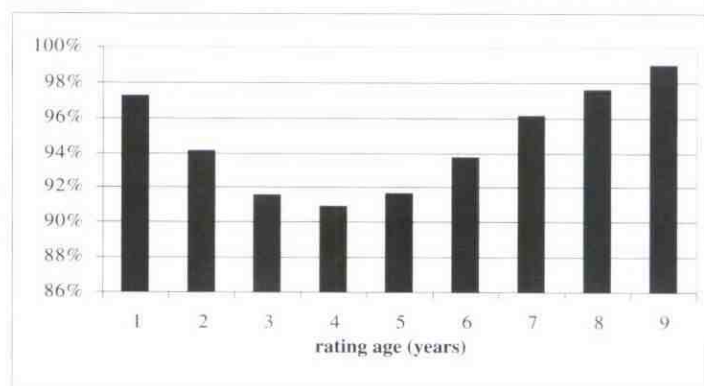
Using this definition, we sort all structured securities into each rating-age vintage. For instance, all one-year-old

securities are in the one-year vintage, and all two-year-old securities are in the two-year vintage. These rating-age vintages are different from rating-year cohorts, in the sense that a rating-year cohort consists of all securities at the beginning of a year, regardless of rating age. For each rating-age vintage, the weighted average annual downgrade, upgrade, and unchanged frequencies (adjusted for withdrawn ratings, weighted by sizes of each rating-age vintage) are computed. The frequencies of ratings unchanged over a year are shown on the vertical axis of Exhibit 9. Exhibit 10 shows the frequencies of annual downgrades and upgrades.

Exhibit 9 indicates that, after a rating is assigned, ratings become increasingly vulnerable to change. This trend

EXHIBIT 9

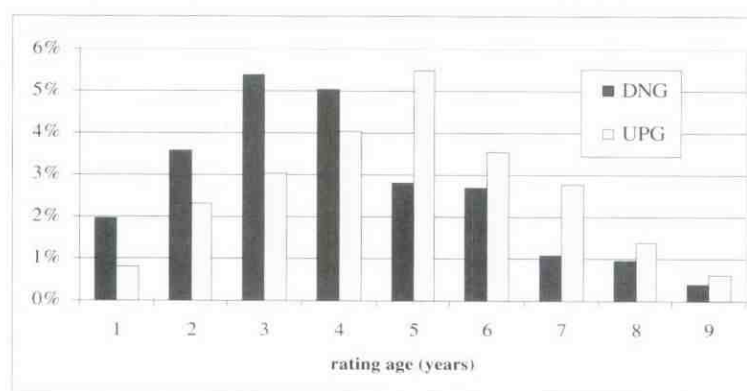
Annual Frequencies of Rating Unchanged Conditional on Rating Age—1990-2002



Adjusted for withdrawn ratings; broad rating-based.

EXHIBIT 10

Annual Downgrade and Upgrade Frequencies Conditional on Rating Age—1990-2002



Adjusted for withdrawn ratings; broad rating-based. DNG: downgrade; UPG: upgrade.

bottoms out in the fourth year. After the fifth year, ratings gradually become more stable. More specifically, about 8% of structured securities have experienced a broad rating change in the fourth or fifth year, and only about 2% have had rating changes in the first year or the eighth year.

Exhibit 10 highlights the humped shapes in average annual rating downgrades and upgrades as a function of rating age. Both the annual upgrade and downgrade frequencies increase in the first years and then decline. On average, the frequency of annual broad rating downgrades peaks in the third year of the life of a rating, and the frequency of upgrades peaks in the fifth year.

Exhibit 10 also shows that in the first four years after a rating is assigned, annual downgrade frequencies marginally surpass annual upgrade frequencies, but after year five, annual upgrade frequencies are consistently and substantially higher than annual downgrade frequencies.

These results imply that rating transition frequencies may also be age-dependent.

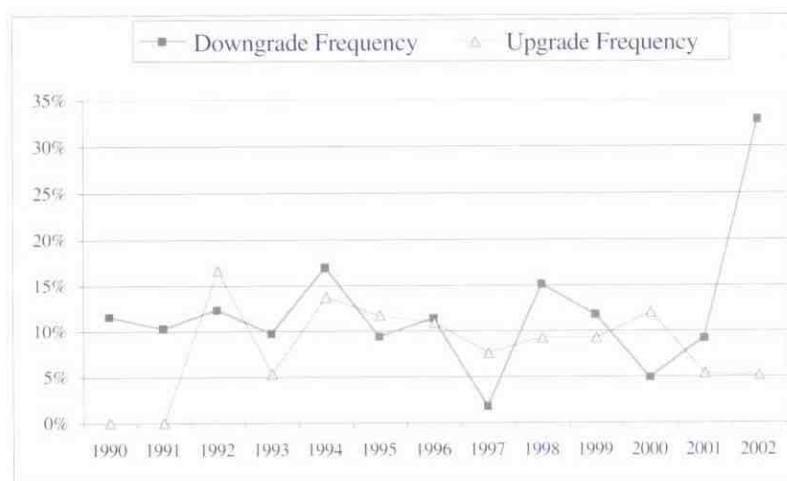
V. RATING DRIFT, VOLATILITY, AND NOTCHES PER RATING MOVE IN STRUCTURED FINANCE

We move now to rating transition statistics measured at the level of refined rating categories. Exhibit 11 depicts the annual time series of upgrade and downgrade frequencies weighted by the number of notches per rating move. Because there are few observations before 1990, the graph begins as of that year.

The downgrade frequency in Exhibit 11 is computed as the total number of downgraded notches (i.e., the number of downgrades weighted by the size of downgrades) divided by the total number of outstanding ratings

EXHIBIT 11

Weighted-Average Upgrade and Downgrade Frequencies



Adjusted for withdrawn ratings, refined rating-based; adjusted for number of notches per rating move.

at the beginning of the year. We adjust the denominator for withdrawn ratings by subtracting half of the ratings withdrawn for that year—a statistical technique commonly used to correct for data truncation. This technique assumes that ratings are withdrawn regularly throughout the year. The upgrade frequencies are calculated similarly.

Exhibit 11 shows there is no clear trend in the upgrade and downgrade frequencies. Both appear to fluctuate around a constant mean, except in 2002. For instance, in 1998 and 1999 we observed higher downgrade rates, but in 2000 there were higher upgrade rates. Then in 2001, the balance tipped again toward more downgrades; the downgrade rate was at 9.02% and the upgrade rate at 5.39%.

The year 2002 marks a significant shift in the downgrade frequency from past experiences in structured finance. The refined rating-based downgrade frequency reached 32.83%, while the upgrade frequency was about the same as 2001 at 5.23% (both frequencies adjusted for withdrawn ratings and notches per rating move).

Downgrade and upgrade frequencies can also be combined into a single metric, *rating drift*, that illustrates the overall trend of rating movement. Rating drift is defined as the difference between the weighted-average upgrade frequency and the weighted-average downgrade frequency on the basis of refined ratings, weighted by notches per rating change and adjusted for withdrawn ratings.

This definition imparts several properties to the drift term. First, if there are no downgrades or upgrades, the rating drift is zero. Second, if the weighted-average downgrade frequency equals the weighted-average upgrade fre-

quency, the rating drift is also zero. Third, the greater the difference between the upgrade and downgrade frequencies, the greater the upward rating drift.

Rating volatility here is defined as the sum of the number of downgrade rates and upgrade rates. Again these are weighted by the number of notches per rating change, divided by the total outstanding ratings at the beginning of the year minus half of the withdrawn ratings. Rating volatility has several properties. First, if there is no rating move, the rating volatility is zero. Second, if the rating downgrade rate equals the upgrade rate (notice that the rating drift is zero in this case), the rating volatility will be strictly positive. The combination of rating drift and rating volatility provides a good picture of rating dynamics.

Exhibit 12 displays the time series of rating drift and rating volatility for structured securities. It shows that the rating drift was randomly distributed around zero between 1992 and 2001. As we commented earlier, 2002 is an extremely volatile year, with very steep downward drift and high rating volatility. The weighted-average rating drift over time (i.e., further weighted by the number of outstanding ratings each year) before 2002 is minuscule, -0.39% , and the rating volatility is 18.55% . From 1990 through 2002, however, the weighted-average rating drift becomes -5.69% , and the weighted-average rating volatility reaches 22.35% .

We report the weighted-average rating migration frequencies primarily so that we can classify rating moves into different types. For example, ratings may move in small steps (one or two notches) but move frequently, or they might not move frequently but might move mul-

EXHIBIT 12

Rating Drift and Volatility in Structured Finance

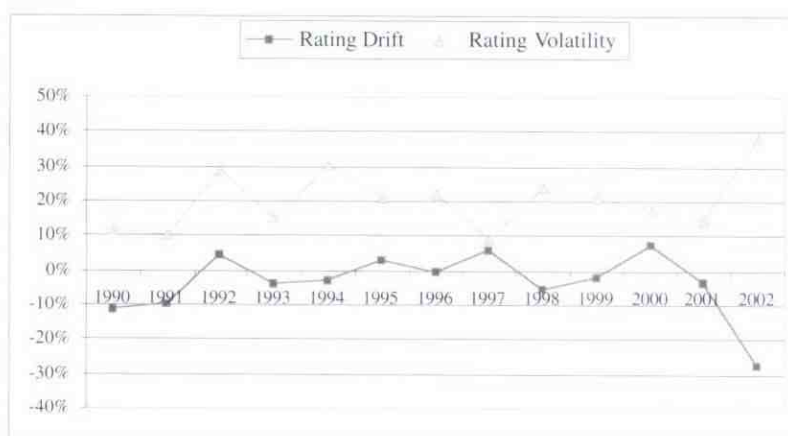
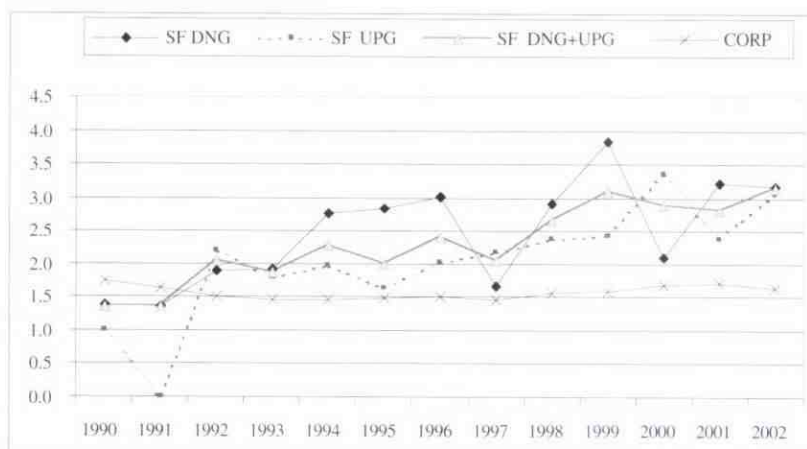


EXHIBIT 13

Average Notches per Rating Move in Structured Finance and Corporate Finance



DNG: downgrade rating moves. UPG: upgrade rating moves. DNG+UPG: downgrade and upgrade rating moves combined. CORP: all rating moves in the corporate sector.

tiple notches at once. A simple metric that would capture this subtle difference is a measure of the number of notches per rating move.

Exhibit 13 provides the time series values of this metric for overall rating moves (downgrades and upgrades combined) between 1990 and 2002, as well as for downgrades and upgrades separately. For comparison, we also include the notches per rating move in corporate ratings.

Exhibit 13 reveals that the average size of a rating move in structured finance has increased slightly over time. Before 1997, even though there were periods of big rating moves, on average the number of notches per rating move is below 2.0. Since 1998, it has consistently stayed above 2.6.

Exhibit 13 also shows that the average number of notches per downgrade generally exceeds that per upgrade (1997 and 2000 are exceptions). As a comparison, notches per rating action in the corporate sector appears to be very stable (approximately 1.6) over the entire sample period, and actually tapered off a little bit in 2002.

VI. STRUCTURED FINANCE RATING CHANGE MOMENTUM

An examination of momentum, or path-dependence, in rating changes is critically important to interpreting the relative riskiness of different securities that carry the same

EXHIBIT 14

Rating Change Momentum—1983-2002

Structured Finance Ratings	Downgraded in t	Upgraded in t	Unchanged in t
Downgraded in t - 1	36.36%	3.55%	60.10%
Upgraded in t - 1	3.39%	9.97%	86.65%
No Change in t - 1	3.52%	4.32%	92.16%
Unconditional	4.15%	3.71%	92.14%
Corporate Finance Ratings	Downgraded in t	Upgraded in t	Unchanged in t
Downgraded in t - 1	25.78%	7.11%	67.11%
Upgraded in t - 1	6.68%	16.15%	77.17%
No Change in t - 1	14.01%	8.53%	77.46%
Unconditional	14.70%	8.84%	76.46%

Adjusted for withdrawn ratings, refined rating-based. Unadjusted for number of notches per rating move. t is the current year and t - 1 is the previous year, and downgrades include transitions into default.

rating. If rating changes are path-dependent, they may be predictable to some degree; recently upgraded securities would entail less transition risk than recently downgraded securities. One-year transition matrices should not be used to extrapolate multiyear transitions.⁴

To examine structured finance rating change momentum, we follow the method illustrated in Fons [2002]. For each rating year, we construct not one, but three rating cohorts: one consisting of securities that were downgraded in the previous year, one consisting of securities that were upgraded in the previous year, and one consisting of securities that had no rating change in the previous year. These three cohorts enable us to calculate conditional rating transition matrices.

Exhibit 14 provides a summary of the conditional downgrade and upgrade rates in structured finance and corporate ratings. It shows there is strong positive path-dependence in structured finance ratings. For instance, 36.36% of the securities that were downgraded in a year were also downgraded in the following year. This number is much higher than 3.39%, the downgrade frequency conditional on an upgrade. Similarly, the conditional upgrade frequency is 9.97%, much higher than 3.55%, the upgrade frequency conditional on a downgrade.

Exhibit 14 also includes a comparison to the corporate sector. Structured finance downgrade momentum appears to have been stronger than the momentum in corporate ratings, while upgrade momentum appears to have been weaker. Corporate ratings, however, are generally more volatile.

In terms of conditional downgrade-to-upgrade or upgrade-to-downgrade ratios, structured finance ratings appear to have stronger upgrade and downgrade momentum than corporate ratings. Exhibit 14 shows that when conditioned on downgrade, the downgrade-to-upgrade ratio in structured finance is 10.24, but is about 3.6 for the corporate

sector. (We treat default as a downgrade in this particular measure.) Similarly, the conditional upgrade-to-downgrade ratio, conditioned on an upgrade, is 2.94 in structured finance, but only 2.42 in corporate finance.

Rating change momentum is shown in further detail through conditional rating transition matrices in Exhibit 15. Here we can see that, if a security with a B rating had been downgraded in the previous year, it would have a particularly high chance (55.94%) of being downgraded one broad category further into the Caa or below category. Similarly, if a Baa rating was downgraded in the previous year, its chance of being downgraded one broad category further to the Ba category is 22.22%. Also, Ba and B have particularly high upgrade momentum.

It should be noted that the upgrade rate from Ba to Baa conditional on a downgrade is also very high at 15.96%, and the downgrade rate from Baa to Ba conditional on an upgrade is also high at 26.26%. The rating reversals observed here in the Baa and Ba rating categories are driven mainly by the GreenTree/Conseco rating changes. In November 1998, its long-term senior debt ratings had been lowered to Ba1 from Baa3. In December 1999, its rating was upgraded from Ba1 to Baa3, and then again in April 2000, downgraded again back to Ba1. There are more than 50 structured securities guaranteed by GreenTree/Conseco that were affected by these rating reversals across three calendar years. Because these securities are not treated as single-rating pass-throughs, they are included in this study.

Rating Change Dependence Across Tranches in the Same Deal

Rating changes in a deal are likely correlated, as the same collateral pool backs different tranches. To estimate this correlation, we form a downgrade cohort each year as follows.

EXHIBIT 15

Conditional Annual Rating Transition Matrices in Structured Finance—1983-2002

Structured Finance Annual Rating Transition Matrix, Conditional on Previously Downgraded							
	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Aa	0.36%	83.27%	10.32%	5.34%	0.71%	0.00%	0.00%
A	0.30%	0.30%	80.91%	13.33%	3.03%	0.00%	2.12%
Baa	0.48%	0.00%	0.48%	62.32%	22.22%	5.80%	8.70%
Ba	0.00%	0.00%	0.00%	15.96%	52.84%	13.83%	17.38%
B	0.00%	0.00%	0.00%	0.00%	0.00%	44.06%	55.94%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

Structured Finance Annual Rating Transition Matrix, Conditional on Previously Upgraded							
	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Aa	13.44%	86.32%	0.24%	0.00%	0.00%	0.00%	0.00%
A	2.14%	8.93%	88.21%	0.71%	0.00%	0.00%	0.00%
Baa	1.12%	5.03%	7.82%	59.78%	26.26%	0.00%	0.00%
Ba	0.00%	0.00%	3.03%	21.21%	75.76%	0.00%	0.00%
B	0.00%	0.00%	0.00%	0.00%	22.22%	77.78%	0.00%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

We first check each structured security, let's say, tranche X, to see if the deal to which tranche X belongs also includes another tranche, let's say, tranche Y, that has been downgraded. In other words, X and Y belong to the same deal, and Y is downgraded in that year. In this case, X is in the downgrade cohort in that same year. If there is no such downgraded Y in the same deal with X, X is not included in the downgrade cohort. Notice if both X and Y experience downgrades in the same year, both of them belong to the downgrade cohort.

We use the same method to form upgrade cohorts and unchanged rating cohorts, and then compute all rating transition percentages. Exhibit 16 reports the aggregate downgrade and upgrade frequency conditional on whether a different tranche in the same deal experienced a downgrade, an upgrade, or no change within the same year.

Exhibit 16 shows that contemporaneous rating change dependence is strongly positive. Specifically, given that a different tranche in the same deal is experiencing a rating downgrade, 70.53% of tranches experience downgrades, compared to 0.57% if a different tranche in the same deal is experiencing an upgrade, or 1.69% if a dif-

ferent tranche has no rating change. Similarly, given that a different tranche in the same deal is experiencing an upgrade, 66.62% of tranches experience upgrades, compared to 0.60% if a different tranche in the same deal is experiencing a downgrade, or 2.29% if another tranche has no rating change.

To examine more details of rating change dependence within deals, we also compute conditional rating transition matrices. These transition matrices are in Exhibit B-5 in the appendix (also broad rating-based). Two observations are worth noting.

First, conditional on another tranche in the same deal experiencing a downgrade, the B-rated tranches have the highest percentage of downgrades (above 84.5%) after being adjusted for withdrawn rating. The remaining 15.5% of the B-ratings stay the same, although there may be rating changes on a refined basis. The Baa-rated tranches have had the second-highest percentage of downgrades (about 75%).

Second, conditional on another tranche experiencing an upgrade, the Ba-rated tranches have the highest upgrade percentage of upgrades (about 69%) after being adjusted for withdrawn ratings, and the Aa-rated tranches

EXHIBIT 16

Contemporaneous Rating Change Dependence Across Tranches in Same Deal—1983-2002

	Downgraded	Upgraded	Unchanged
Conditional on Another Tranche Being Downgraded	70.53%	0.60%	28.87%
Conditional on Another Tranche Being Upgraded	0.57%	66.62%	32.81%
Conditional on Another Tranche Sustaining No Rating Change	1.69%	2.29%	96.02%
Unconditional	4.15%	3.71%	92.14%

Adjusted for withdrawn ratings, refined rating-based; unadjusted for number of notches per rating move.

EXHIBIT 17

Annual Downgrade, Upgrade, and Rating Unchanged Frequencies by Sector

	Downgrade Rate	Upgrade Rate	Unchanged Rate	Withdrawn Rate	Downgrade/Upgrade Ratio
ABS, 1991-2002	2.95%	1.27%	86.59%	9.19%	2.3
CDO, 1991-2002	10.88%	0.57%	83.35%	5.20%	19.0
CMBS, 1991-2002	1.57%	3.49%	88.72%	6.22%	0.4
RMBS, 1991-2002	1.88%	3.61%	89.18%	5.34%	0.5
Other, 1991-2002	4.20%	2.78%	79.84%	13.18%	1.5
All Structured, 1983-2002	2.99%	2.52%	87.66%	6.84%	1.2
All Corporates, 1983-2002	8.88%	3.90%	81.49%	5.73%	2.3

Broad rating-based.

have the second-highest percentage (about 66%). Notice that these percentages are from the broad rating-based conditional transition matrices. Similar percentages by ratings on a refined rating basis will even be higher.

Rating Transitions Across Structured Finance Sectors

As mentioned earlier, we group all structured securities into five main sectors: ABS, CDO, CMBS, RMBS, and OTHER. Exhibit 17 summarizes the weighted-average annual rating downgrade, upgrade, and unchanged frequencies in five sectors. For comparison, the same frequencies in corporate ratings are also listed.

There are several interesting observations to be made about Exhibit 17. First, rating stability is similar across different structured finance sectors with the exception of CDOs. The unchanged rating percentages for the four main sectors are above 80% on average (not adjusted for withdrawn ratings).

Second, there are some significant differences in the downgrade and upgrade frequencies across sectors. CMBS and RMBS have higher upgrade frequencies than downgrade frequencies, while the CDO sector has experienced an extremely high downgrade frequency. Higher upgrade frequencies in the general mortgage collateral (CMBS/RMBS) sectors can be explained by the seasoning of transactions (i.e., loans in the collateral are more seasoned),

and the strength of the residential and commercial real estate markets over the last decade.⁵

The extremely high downgrade frequency in the CDO sector mirrors similar observations in the corporate sector. For detailed explanations of the CDO sector rating performance, see Fu and Harris [2003].

Third, ABS has a relatively high average frequency of withdrawn ratings. This reflects the much shorter average lives of many ABS securities.

Exhibit 17 shows the frequencies of downgrades and upgrades based only on broad rating categories. As in our analysis earlier, analysis of the downgrade and upgrade frequencies of refined ratings can provide us a more detailed picture of rating changes. These statistics and their time series are in Exhibits 18 and 19.

The sector-specific differences of downgrade and upgrade frequencies evident in Exhibits 18 and 19 reaffirm the results shown in Exhibit 17. Specifically, the CDO and ABS sectors have had higher downgrade frequencies than the other sectors, especially in the most recent three years, while the CMBS and RMBS sectors have historically had higher upgrade frequencies.

Exhibit 20 provides annual broad rating transition matrices for the four major sectors (the transition matrix for the "other" sector is in Appendix B). Exhibit 20 reveals several interesting findings.

First, the stability of speculative-grade ratings is markedly different across sectors. Speculative-grade secu-

rities in the CMBS and RMBS sectors are much more stable than those in the ABS and CDO sectors.

Second, the rating stability of investment-grade securities has been very similar across three of the four main sectors (CDO is the exception, although its Aaa rating is fairly comparable to Aaa ratings in the other three sectors). Rating unchanged frequencies for the Aaa rating are above 95% in all four sectors, and for Aa, A, and Baa ratings they are almost always above 90% (those in the CDO sector are exceptions).

Third, in the ABS and CDO sectors, the B-rated securities migrated at a very high rate into the Caa or below category (more than 20% in the ABS sector, and more than 30% in the CDO sector). In the CMBS sector, the rate of such migration was only about 2%. For the Ba-rated securities in the ABS sector, rating volatility has been particularly high.

Fourth, few securities have ever been upgraded out of the Caa or below category. In both the ABS and CDO sectors, there is actually no such transition. On the other hand, it is also very rare for investment-grade securities to migrate within one year into the Caa or below category. As a comparison, in the corporate sector, on average more than 10% of the Caa or below rated issuers were upgraded.

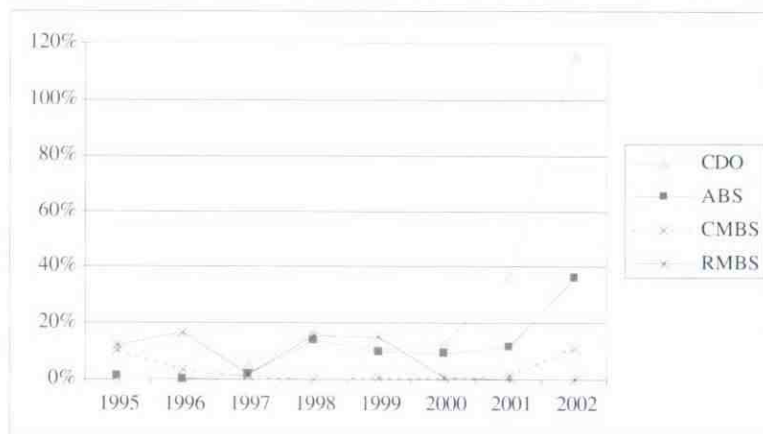
VII. SUMMARY COMPARISONS AND INTERPRETATIONS

When we compare structured finance to corporate rating transitions, we have found that: Structured finance ratings have been less likely to change than corporate ratings, over both one-year and multiyear horizons. When structured securities have experienced rating changes, their downgrade-to-upgrade ratio has been lower than that of corporates. When there are rating changes in structured finance, they have been greater on average than changes of corporates. Overall, structured finance ratings have been more stable than corporate ratings, as the effect of structured securities' lower frequency of rating changes has more than outweighed their greater propensity for large rating changes when rating changes do occur.

For speculative-grade securities, migration rates to

EXHIBIT 18

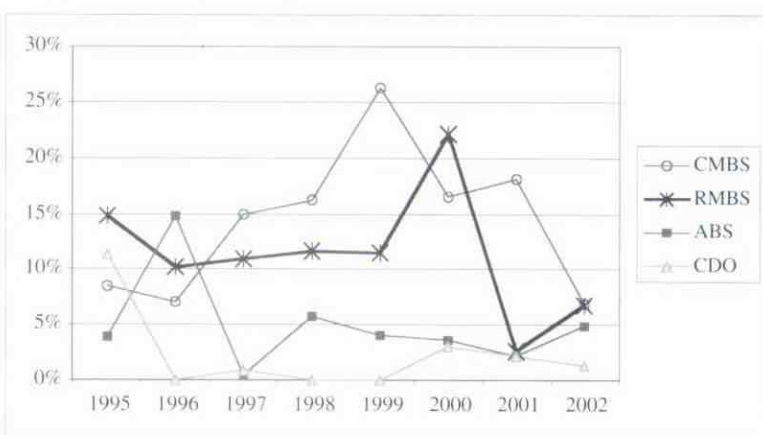
Weighted-Average Downgrade Frequencies by Sector—1995-2002



Adjusted for withdrawn ratings, refined rating-based, and weighted by number of notches per rating move.

EXHIBIT 19

Weighted-Average Upgrade Frequencies by Sector—1995-2002



Adjusted for withdrawn ratings, refined rating-based, and weighted by number of notches per rating move.

the lowest rating categories (Caa or below) have been much lower for structured finance than for corporate ratings, over both short and long horizons.

For investment-grade securities, migration rates to the lowest rating categories have been higher for structured finance than for corporate ratings, over both short and long horizons.

Like corporate securities, structured finance securities undergoing rating changes in one year are much more likely to sustain further changes in the same direction in the next year, in comparison to securities that experience no rating change or a change in the opposite direction.

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EXHIBIT 20

Weighted-Average Annual Transition Matrices by Sector—1991-2002

ABS	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	99.05%	0.82%	0.04%	0.01%	0.00%	0.00%	0.08%
Aa	2.57%	94.62%	1.82%	0.67%	0.08%	0.00%	0.24%
A	0.63%	1.07%	96.34%	1.15%	0.63%	0.08%	0.10%
Baa	0.59%	0.46%	0.97%	89.59%	6.47%	1.22%	0.71%
Ba	0.28%	0.14%	0.42%	7.45%	74.40%	5.63%	11.67%
B	0.00%	0.00%	0.00%	0.60%	0.00%	76.65%	22.75%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

CDO	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	95.37%	3.09%	0.93%	0.51%	0.10%	0.00%	0.00%
Aa	0.58%	89.04%	5.48%	3.50%	1.05%	0.23%	0.12%
A	0.16%	0.98%	89.59%	6.02%	1.95%	0.33%	0.98%
Baa	0.00%	0.09%	0.51%	86.19%	6.17%	3.69%	3.34%
Ba	0.00%	0.00%	0.00%	1.37%	81.48%	5.83%	11.32%
B	0.00%	0.00%	0.00%	0.00%	0.00%	68.98%	31.02%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

CMBS	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	98.49%	1.51%	0.00%	0.00%	0.00%	0.00%	0.00%
Aa	5.58%	93.35%	0.63%	0.18%	0.00%	0.18%	0.09%
A	1.45%	3.23%	93.87%	1.45%	0.00%	0.00%	0.00%
Baa	0.62%	1.24%	3.03%	93.18%	1.45%	0.28%	0.21%
Ba	0.00%	0.00%	0.59%	2.52%	94.67%	1.78%	0.44%
B	0.00%	0.00%	0.16%	0.65%	1.79%	94.95%	2.44%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	2.70%	97.30%

RMBS	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	99.34%	0.49%	0.14%	0.03%	0.00%	0.00%	0.00%
Aa	8.03%	89.85%	1.70%	0.43%	0.00%	0.00%	0.00%
A	2.07%	4.28%	91.06%	2.15%	0.21%	0.03%	0.21%
Baa	0.67%	0.76%	3.37%	91.58%	1.88%	0.85%	0.88%
Ba	0.21%	0.07%	1.41%	4.08%	90.01%	1.76%	2.46%
B	0.00%	0.14%	0.00%	0.42%	0.56%	92.31%	6.57%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.28%	0.00%	99.72%

Corporate	To:						
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below
Aaa	90.28%	9.31%	0.41%	0.00%	0.00%	0.00%	0.00%
Aa	0.54%	90.54%	8.73%	0.17%	0.01%	0.01%	0.00%
A	0.05%	2.35%	91.67%	5.33%	0.45%	0.11%	0.05%
Baa	0.05%	0.26%	5.36%	88.48%	4.66%	0.72%	0.46%
Ba	0.00%	0.04%	0.70%	6.34%	81.49%	9.35%	2.08%
B	0.02%	0.05%	0.24%	0.69%	6.66%	79.81%	12.53%
Caa or Below	0.00%	0.00%	0.00%	0.00%	1.85%	8.41%	89.75%

While it is by no means clear that we can expect these observed differences and similarities to persist over time, it is worthwhile to consider some of the possible explanations for these findings.

First, structured finance securities may have experienced more stability than corporate ratings because Aaa-rated securities are more common, and Aaa ratings tend to be particularly stable. At the beginning of 2002, about one-third of all structured securities carried Aaa ratings, compared to merely 1.5% of all corporate ratings.

Second, the relative rating stability in structured finance may also be explained in part by the numerous instances in which originators or servicers of structured securities have supported troubled transactions—something typically not considered in rating assignments in structured finance—and thereby averted rating transitions on the affected securities.

Third, the higher propensity of investment-grade structured securities (relative to corporate investment-grade securities) to transition into the lowest rating category may be explained by the structured finance sector's large concentration in exposure to high-yield bonds issued in the late 1990s and exposure to the credit strength of GreenTree/Conseco.

Fourth, asset pools originated or serviced by weak corporate entities are often structured with high levels of credit enhancement that make rating changes less likely to respond to modest changes in pool performance, but nonetheless may require sharp rating downgrades if the servicer's credit quality deteriorates or the servicer or originator commits fraud. This may partially explain the stability and the extent of rating actions in structured finance compared to corporate finance.

Finally, there are differences in the evolution of credit risk between the structured and corporate sectors. In the corporate sector, as an issuer's credit circumstances change, Moody's ratings often change gradually, as more is learned over time about how management is reacting to the changed circumstances. In structured finance, however, the underlying asset pool is often fixed so that as pool performance begins to deviate from expected performance, there is generally little likelihood that this deviation will be reversed over time, and there is therefore less reason to take a gradual approach to rating changes. This helps explain why, when changed, structured finance ratings tend to move in larger steps than corporate ratings if rating adjustments are required.

APPENDIX A: METHODOLOGY

Exclusion of Guaranteed Securities and Single-Rating Pass-Throughs

We decided to exclude all structured securities that are either guaranteed by a federal agency or a GSE such as Fannie Mae and Freddie Mac, or by one of the financial guaranty insurers. This is because the ratings on these wrapped securities are from these guarantors, and these guarantors have always been rated Aaa. The majority of agency-guaranteed securities are in the RMBS sector, while most of the securities excluded due to a financial wrap by one of the four big financial guarantors—MBIA, FSA, AMBAC, and FGIC—are in the ABS sector.

We also have chosen not to include any other pure single-name rating pass-throughs. Although not guaranteed, a large number of structured notes and some CMBS lease-backed securities directly inherited a single corporate (or a single sovereign) rating. In other words, the ratings on these securities have effectively a 100% correlation with the single ratings that support them. These securities are excluded.

The sample does include securities whose ratings could practically be influenced by the ratings of two (or more) securities or issuers, even if one of them plays a dominant role. For example, we include ratings on repackaged securities because the default risks of both the bond in the asset and the swap counterparty could potentially affect the rating of the security. For these securities, it is mainly the rating of the bond in the asset that determines the rating of the security, but we do not treat them as having a 100% correlation. Similarly, the structured finance transactions supported by Green Tree/Conseco are included in the sample.

Inclusion of Earliest Observations

There are few observations in structured finance in the 1980s, particularly in the early 1980s. Although we choose to include them for the sake of sample completeness, we also show additional exhibits in Appendix B that cover only the more recent periods (see Exhibit B-2). Since most of the statistical analysis in this study uses weighted-average values, these earliest observations have very little impact on the aggregate statistics.

About Rating Transition Intervals

Following the same methods used in our past rating transition studies, we first form rating-year cohorts. For each structured finance security, we track its year-end ratings (or equivalently the next year-start ratings). We do not track individual rating changes during a year; rather, we track only the beginning- and end-of-year ratings. For each rating year cohort, we then compute percentages of ratings migrating from one

rating category to another over defined horizons varying from one year to a number of years. These rating transition percentages are then averaged over years, weighted by the size of each rating-year cohort.

Treatment of Withdrawn Ratings

In most of the text, we report rating transitions that have been calculated by excluding withdrawn ratings (WRs). Exhibits that show these WR-excluded statistics are labeled as adjusted for withdrawn ratings.⁶ Otherwise, exhibits are labeled as unadjusted for withdrawn ratings, and the frequency with which ratings were withdrawn is reported explicitly.⁷ The Appendix B transition matrices are all unadjusted for withdrawn ratings.

Treatment of Broad versus Refined Ratings

We also distinguish between transitions that are based on broad ratings (i.e., with no numeric modifiers) and refined rat-

ings (i.e., with numeric modifiers). Most of the exhibits and analysis in the text are broad rating-based.

Treatment of Multinotch Rating Changes

Finally, in calculating aggregate downgrade and upgrade frequencies of all refined ratings, we have occasionally adjusted for the number of notches per rating move—a rating move of three notches (on a refined rating scale), for instance, is considered as three rating changes. When these adjustments are made, we label exhibits adjusted for number of notches per rating move. Aggregate downgrade and upgrade frequencies based on broad ratings are typically not adjusted for number of notches per rating move. The Appendix B transition matrices are all refined rating-based.

APPENDIX B: TRANSITION MATRICES

EXHIBIT B - 1

Annual Rating Transition Matrix—1983-2002

All Structured Finance Annual Rating Transition Matrix—1983-2002								
	To:							
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	89.92%	0.81%	0.12%	0.04%	0.00%	0.00%	0.03%	9.08%
Aa	5.15%	86.34%	2.15%	0.60%	0.08%	0.03%	0.06%	5.59%
A	1.05%	2.54%	86.90%	1.69%	0.48%	0.06%	0.17%	7.10%
Baa	0.51%	0.63%	2.17%	86.93%	3.68%	1.21%	1.04%	3.83%
Ba	0.14%	0.06%	0.75%	3.84%	83.09%	3.11%	5.26%	3.75%
B	0.00%	0.05%	0.05%	0.44%	0.82%	85.54%	9.26%	3.83%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.15%	0.30%	86.72%	12.84%

All Corporate Finance Annual Rating Transition Matrix—1983-2002									
	To:								
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below	Default	WR
Aaa	86.09%	8.79%	0.96%	0.00%	0.00%	0.00%	0.00%	0.00%	4.16%
Aa	0.76%	86.18%	8.69%	0.36%	0.09%	0.02%	0.00%	0.03%	3.87%
A	0.04%	2.43%	86.97%	5.54%	0.67%	0.21%	0.02%	0.02%	4.10%
Baa	0.05%	0.27%	5.63%	82.40%	4.97%	1.06%	0.17%	0.22%	5.24%
Ba	0.01%	0.03%	0.56%	5.02%	75.31%	8.22%	0.68%	1.36%	8.81%
B	0.01%	0.05%	0.21%	0.56%	5.67%	74.40%	3.84%	6.86%	8.40%
Caa or Below	0.00%	0.00%	0.00%	0.91%	2.31%	5.87%	54.44%	26.29%	10.18%

EXHIBIT B - 2

Annual Rating Transition Matrices by Sector—1983-2002

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ABS 1983-2002

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	87.21%	0.75%	0.03%	0.01%	0.00%	0.00%	0.07%	11.93%
Aa	2.36%	88.74%	1.67%	0.62%	0.07%	0.00%	0.22%	6.32%
A	0.58%	0.97%	87.96%	1.06%	0.58%	0.07%	0.09%	8.68%
Baa	0.56%	0.44%	0.92%	85.74%	6.25%	1.16%	0.68%	4.25%
Ba	0.27%	0.13%	0.40%	7.09%	71.12%	5.35%	11.10%	4.55%
B	0.00%	0.00%	0.00%	0.57%	0.00%	73.14%	21.71%	4.57%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	77.98%	22.02%

CDO 1991-2002

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	89.12%	2.89%	0.87%	0.48%	0.10%	0.00%	0.00%	6.54%
Aa	0.56%	85.27%	5.25%	3.35%	1.00%	0.22%	0.11%	4.24%
A	0.15%	0.90%	82.36%	5.53%	1.79%	0.30%	0.90%	8.07%
Baa	0.00%	0.08%	0.49%	81.97%	5.87%	3.51%	3.18%	4.89%
Ba	0.00%	0.00%	0.00%	1.34%	79.43%	5.69%	11.04%	2.51%
B	0.00%	0.00%	0.00%	0.00%	0.00%	66.52%	29.91%	3.57%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	96.43%	3.57%

CMBS 1988-2002

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	88.67%	1.43%	0.00%	0.00%	0.00%	0.00%	0.00%	9.90%
Aa	5.11%	85.67%	0.66%	0.16%	0.00%	0.16%	0.08%	8.15%
A	1.36%	3.05%	88.52%	1.36%	0.00%	0.00%	0.00%	5.70%
Baa	0.59%	1.19%	2.90%	89.06%	1.38%	0.26%	0.20%	4.41%
Ba	0.00%	0.00%	0.57%	2.41%	90.77%	1.70%	0.43%	4.12%
B	0.00%	0.00%	0.16%	0.63%	1.73%	91.81%	2.36%	3.31%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	2.50%	90.00%	7.50%

RMBS 1983-2002

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	92.49%	0.45%	0.13%	0.03%	0.00%	0.00%	0.00%	6.90%
Aa	7.05%	85.91%	2.05%	0.40%	0.00%	0.00%	0.00%	4.58%
A	1.98%	4.09%	87.49%	2.06%	0.20%	0.03%	0.20%	3.95%
Baa	0.65%	0.74%	3.27%	89.44%	1.83%	0.83%	0.86%	2.39%
Ba	0.21%	0.07%	1.37%	3.97%	87.48%	1.71%	2.39%	2.80%
B	0.00%	0.13%	0.00%	0.40%	0.53%	88.25%	6.41%	4.27%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.24%	0.00%	87.08%	12.68%

OTHER 1990-2002

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	83.36%	3.80%	0.15%	0.00%	0.00%	0.00%	0.00%	12.70%
Aa	0.29%	84.37%	3.76%	0.00%	0.00%	0.00%	0.00%	11.58%
A	0.00%	11.75%	69.50%	1.75%	1.00%	0.00%	0.25%	15.75%
Baa	0.00%	0.00%	4.29%	67.86%	8.57%	1.43%	2.14%	15.71%
Ba	0.00%	0.00%	0.00%	2.38%	75.00%	1.19%	2.38%	19.05%
B	0.00%	0.00%	0.00%	0.00%	0.00%	95.35%	2.33%	2.33%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	85.71%	14.29%

EXHIBIT B - 3

All Structured Finance Multiple-Year Rating Transition Matrices—1983-2002

One-Year Rating Transition Matrix

	To:							
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	89.92%	0.81%	0.12%	0.04%	0.00%	0.00%	0.03%	9.08%
Aa	5.15%	86.34%	2.15%	0.60%	0.08%	0.03%	0.06%	5.59%
A	1.05%	2.54%	86.90%	1.69%	0.48%	0.06%	0.17%	7.10%
Baa	0.51%	0.63%	2.17%	86.93%	3.68%	1.21%	1.04%	3.83%
Ba	0.14%	0.06%	0.75%	3.84%	83.09%	3.11%	5.26%	3.75%
B	0.00%	0.05%	0.05%	0.44%	0.82%	85.54%	9.26%	3.83%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.15%	0.30%	86.72%	12.84%

Two-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	79.51%	1.18%	0.20%	0.08%	0.01%	0.00%	0.07%	18.96%
Aa	10.62%	72.88%	3.45%	1.14%	0.22%	0.03%	0.10%	11.57%
A	2.39%	5.01%	73.54%	2.03%	0.89%	0.22%	0.45%	15.47%
Baa	1.10%	1.31%	4.62%	75.63%	4.59%	1.95%	2.53%	8.28%
Ba	0.38%	0.26%	1.77%	5.43%	71.85%	3.32%	8.79%	8.19%
B	0.00%	0.15%	0.07%	1.09%	1.53%	75.29%	12.54%	9.33%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.42%	0.63%	76.99%	21.97%

Three-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	68.14%	1.35%	0.29%	0.12%	0.02%	0.00%	0.11%	29.98%
Aa	16.05%	59.79%	4.05%	1.62%	0.49%	0.11%	0.13%	17.77%
A	3.87%	6.47%	59.99%	2.06%	0.80%	0.36%	0.80%	25.65%
Baa	1.68%	2.00%	7.08%	63.79%	4.35%	2.39%	5.16%	13.53%
Ba	0.77%	0.72%	3.14%	8.50%	62.31%	2.73%	8.60%	13.23%
B	0.00%	0.30%	0.10%	1.79%	1.98%	65.77%	14.48%	15.58%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.90%	0.90%	67.57%	30.63%

Four-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	56.88%	1.44%	0.30%	0.09%	0.03%	0.01%	0.22%	41.04%
Aa	21.77%	47.70%	4.33%	1.59%	0.44%	0.22%	0.24%	23.71%
A	6.50%	7.94%	47.27%	1.92%	0.72%	0.42%	1.10%	34.13%
Baa	2.63%	2.75%	9.06%	54.98%	5.92%	2.12%	5.27%	17.27%
Ba	1.24%	1.39%	5.48%	11.89%	54.05%	1.93%	7.41%	16.60%
B	0.00%	0.47%	0.16%	3.13%	2.66%	60.47%	12.97%	20.16%
Caa or Below	0.00%	0.00%	0.00%	0.00%	2.45%	1.84%	60.74%	34.97%

Five-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	47.27%	1.18%	0.34%	0.12%	0.01%	0.04%	0.18%	50.87%
Aa	24.34%	37.52%	3.95%	1.71%	0.46%	0.34%	0.52%	31.16%
A	7.56%	8.22%	35.62%	1.78%	0.69%	0.43%	1.12%	44.58%
Baa	3.72%	3.24%	10.39%	46.09%	4.09%	2.25%	7.52%	22.70%
Ba	1.42%	1.72%	6.57%	13.85%	44.79%	1.72%	7.18%	22.75%
B	0.00%	0.41%	0.21%	4.15%	2.90%	52.07%	12.86%	27.39%
Caa or Below	0.00%	0.00%	0.00%	0.00%	3.23%	2.42%	50.81%	43.55%

EXHIBIT B - 4

All Corporate Finance Multiple-Year Rating Transition Matrices—1983-2002

One-Year Rating Transition Matrix

	To:								
From:	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	WR
Aaa	86.09%	8.79%	0.96%	0.00%	0.00%	0.00%	0.00%	0.00%	4.16%
Aa	0.76%	86.18%	8.69%	0.36%	0.09%	0.02%	0.00%	0.03%	3.87%
A	0.04%	2.43%	86.97%	5.54%	0.67%	0.21%	0.02%	0.02%	4.10%
Baa	0.05%	0.27%	5.63%	82.40%	4.97%	1.06%	0.17%	0.22%	5.24%
Ba	0.01%	0.03%	0.56%	5.02%	75.31%	8.22%	0.68%	1.36%	8.81%
B	0.01%	0.05%	0.21%	0.56%	5.67%	74.40%	3.84%	6.86%	8.40%
Caa-C	0.00%	0.00%	0.00%	0.91%	2.31%	5.87%	54.44%	26.29%	10.18%

Two-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	WR
Aaa	74.87%	15.11%	1.76%	0.00%	0.18%	0.00%	0.00%	0.00%	8.09%
Aa	1.31%	73.96%	15.28%	1.10%	0.33%	0.10%	0.02%	0.05%	7.87%
A	0.09%	4.50%	75.81%	9.19%	1.47%	0.47%	0.05%	0.09%	8.33%
Baa	0.10%	0.56%	10.11%	68.66%	7.20%	2.15%	0.36%	0.57%	10.30%
Ba	0.03%	0.07%	1.08%	8.34%	56.19%	12.12%	1.18%	3.66%	17.34%
B	0.02%	0.09%	0.34%	1.08%	8.83%	55.35%	4.45%	13.40%	16.45%
Caa-C	0.00%	0.00%	0.05%	2.28%	2.02%	8.24%	33.55%	33.41%	20.46%

Three-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	WR
Aaa	65.03%	20.17%	2.52%	0.00%	0.38%	0.00%	0.00%	0.00%	11.89%
Aa	1.82%	63.01%	20.35%	2.12%	0.50%	0.17%	0.02%	0.10%	11.90%
A	0.13%	5.79%	66.51%	11.59%	2.17%	0.65%	0.11%	0.26%	12.79%
Baa	0.13%	0.89%	13.01%	58.59%	7.84%	2.75%	0.56%	0.89%	15.34%
Ba	0.03%	0.09%	1.76%	9.80%	42.32%	12.89%	1.46%	6.21%	25.43%
B	0.04%	0.13%	0.35%	1.74%	8.87%	42.04%	3.93%	18.29%	24.61%
Caa-C	0.00%	0.00%	0.10%	1.27%	3.33%	8.42%	21.89%	37.30%	27.71%

Four-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	WR
Aaa	56.15%	23.77%	3.85%	0.00%	0.27%	0.06%	0.00%	0.07%	15.82%
Aa	2.13%	54.36%	23.09%	3.20%	0.60%	0.28%	0.05%	0.23%	16.07%
A	0.14%	6.44%	59.22%	13.09%	2.70%	0.81%	0.14%	0.43%	17.02%
Baa	0.18%	1.04%	14.43%	51.22%	8.01%	3.07%	0.63%	1.39%	20.05%
Ba	0.03%	0.17%	2.05%	10.21%	32.07%	12.46%	1.44%	8.65%	32.92%
B	0.06%	0.16%	0.49%	1.95%	8.17%	31.54%	3.39%	21.80%	32.44%
Caa-C	0.00%	0.00%	0.00%	1.45%	3.40%	9.18%	12.61%	40.42%	32.95%

Five-Year Rating Transition Matrix

	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	WR
Aaa	48.06%	26.18%	4.98%	0.45%	0.06%	0.07%	0.13%	0.19%	19.89%
Aa	2.26%	47.35%	24.88%	3.98%	0.83%	0.25%	0.03%	0.36%	20.06%
A	0.14%	6.49%	53.63%	13.86%	3.11%	0.93%	0.16%	0.57%	21.10%
Baa	0.25%	1.21%	14.75%	45.86%	7.82%	2.93%	0.55%	1.83%	24.82%
Ba	0.03%	0.25%	2.22%	10.00%	24.63%	11.32%	1.21%	10.53%	39.79%
B	0.09%	0.15%	0.78%	1.70%	7.14%	23.66%	2.86%	24.34%	39.28%
Caa-C	0.00%	0.00%	0.00%	1.65%	3.46%	7.88%	7.70%	41.75%	37.57%

EXHIBIT B - 5

Annual Rating Transition Matrices Conditional on Rating Changes for Different Tranches in Same Deal—1983-2002

Conditional on Another Tranche Being Downgraded

	To:							
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	64.86%	28.11%	4.10%	1.32%	0.15%	0.00%	0.88%	0.59%
Aa	0.76%	55.84%	31.49%	8.77%	1.19%	0.43%	0.87%	0.65%
A	0.19%	0.00%	47.96%	35.87%	10.22%	1.30%	3.53%	0.93%
Baa	0.00%	0.00%	0.14%	24.60%	46.47%	15.25%	13.09%	0.43%
Ba	0.00%	0.00%	0.00%	0.55%	15.62%	30.68%	51.78%	1.37%
B	0.00%	0.00%	0.00%	0.00%	0.00%	14.98%	81.64%	3.38%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	84.62%	15.38%

Conditional on Another Tranche Being Upgraded

	To:							
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	94.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.33%
Aa	64.78%	32.99%	0.19%	0.00%	0.00%	0.00%	0.00%	2.04%
A	18.32%	44.27%	35.57%	0.15%	0.31%	0.00%	0.00%	1.37%
Baa	9.41%	11.51%	39.75%	37.45%	1.05%	0.00%	0.21%	0.63%
Ba	1.98%	0.79%	10.67%	54.55%	30.04%	0.79%	0.40%	0.79%
B	0.00%	1.37%	1.37%	10.96%	20.55%	61.64%	4.11%	0.00%
Caa or Below	0.00%	0.00%	0.00%	0.00%	11.11%	22.22%	66.67%	0.00%

Conditional on Another Tranche Sustaining No Rating Change

	To:							
From:	Aaa	Aa	A	Baa	Ba	B	Caa or Below	WR
Aaa	98.51%	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	1.39%
Aa	2.82%	95.34%	0.73%	0.18%	0.01%	0.00%	0.01%	0.90%
A	0.82%	1.52%	96.08%	0.71%	0.11%	0.02%	0.04%	0.71%
Baa	0.26%	0.46%	1.66%	93.33%	2.64%	0.71%	0.38%	0.55%
Ba	0.00%	0.06%	0.49%	3.21%	90.59%	1.89%	3.15%	0.61%
B	0.00%	0.06%	0.06%	0.18%	0.66%	92.59%	5.14%	1.32%
Caa or Below	0.00%	0.00%	0.00%	0.00%	0.17%	0.17%	94.23%	5.42%

ENDNOTES

¹Moody's standard bond ratings are Aaa, Aa1, Aa2, Aa3, A1, A2, A3, Baa1, Baa2, Baa3, Ba1, Ba2, Ba3, B1, B2, B3, Caa1, Caa2, Caa3, Ca, and C.

²As a comparison, we note that in corporate rating transition and default studies, only the issuer rating (on the basis of a senior implied rating) is used.

³The seven broad rating categories are Aaa; Aa (including Aa1, Aa2, Aa3); A (including A1, A2, A3); Baa (including Baa1, Baa2, Baa3); Ba (including Ba1, Ba2, Ba3); B (including B1, B2, B3); and Caa or below (including Caa1, Caa2, Caa3, Ca, C). For corporate ratings, Caa or below also includes defaults.

⁴Without path-dependence, this would be feasible. In general, if rating transition follows a Markov process, there should be only one-period memory and no serial correlation. This is

because in a Markov process, the next period's distribution is dependent only on the present state and not on any developments in the past. We use the terms, multiperiod memory, serial correlation, path-dependence, and rating change momentum, interchangeably.

⁵Studies on a wide range of mortgage loans have generally shown the humped shaped age pattern of default rates. In fact, the Bond Market Association's standard default assumption (SDA) employs such a default rate curve as a function of the loan age. In other words, loan performance is strongly tied to seasoning. Note that some parts of the commercial real estate market did experience some significant stresses in 2001 and 2002.

⁶This adjustment simply removes all securities—from both the beginning- and end-of-period cohorts—whose ratings were withdrawn during the period of analysis.

⁷Most of the statistics in Appendix B are unadjusted for withdrawn ratings. To convert them into rating transition percentages adjusted for withdrawn ratings, readers can divide unadjusted rating transition percentages by one minus the percentage of securities that were withdrawn. Additionally, the vast majority of withdrawn structured securities are simply the results of deal paydown and maturity—in other words, almost always not credit risk-related.

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