Special Comment

April 2004

Contact	Phone
New York	
Jian Hu Richard Cantor	1.212.553.1653

Measuring Loss Severity Rates Of Defaulted Residential Mortgage-Backed Securities: A Methodology

Summary

This *Special Comment* describes the application of Moody's approach to measuring loss severity rates to defaulted structured finance securities backed by residential mortgages (RMBS) and home equity loans (HEL). We focus on these sectors because, compared to other structured finance sectors, RMBS and HEL are relatively homogeneous, have more rating observations, and have experienced greater numbers of defaults.

Highlights of this study include the following:

- The loss severity rate of a defaulted structured finance security is defined as the present value of its lifetime losses (both interest and principal losses) as a percentage of principal balance, measured at either the origination date or the default date (the former being of primary interest to buy-and-hold investors and the latter being of primary interest to secondary market or distressed-security investors).
- Our data set includes 86 defaulted RMBS and HEL securities that are "uncured," in the sense that there are losses outstanding on these securities, and they have "matured," in the sense that they now have zero balances and have ceased making payments to investors. For these securities, the average final loss severity rate is 44.7% of their original balances and 65.8% of their default-date balances.
- The loss severity rate on these matured securities varies systematically with "static" factors that do not change over the duration of default. For example, the tranche size at origination strongly affects loss severity rates, with "thinner" tranches sustaining higher loss severity rates. Similarly, senior securities in a deal's capital structure sustain significantly lower loss severity rates than mezzanine or subordinated securities.
- Our data set also includes 101 defaulted RMBS and HEL securities that are uncured but have not yet "matured," in the sense that they still have positive balances and they may (or may not) make future payments to investors. Many of these securities defaulted a long time ago but, unlike the matured sample, their balances have not yet been reduced to zero.
- Based on our analysis of the time pattern of loss accumulation in the sample of matured defaulted securities, we have found that during the period of loss accumulation after default, ultimate loss severity can be best predicted using a "blended" model, which weights both the static factors cited above and "dynamic" factors that change during the default period. For the sample of defaulted securities that have not matured, we predict an average final loss severity rate of 25.5% of original balances and 38.8% of default-date balances.
- Based on the entire sample, which contains both matured and non-matured uncured defaults, we estimate the average final loss severity rate, measured as a percentage of original balances, to be 34.3% and, as a percentage of default date balances, to be 51.2%.
- Moody's ratings are highly predictive of expected loss rates, both because they are highly correlated with subsequent default experience (as shown in Moody's recent structured finance default study) and because, as shown here, they predict differences in the loss severity rate given default.
- The sample used in this study does not include cured defaults, which by definition have zero outstanding losses. Neither does it include Ca- or C-rated securities that have not yet sustained losses, or the loss records of which are not available to us but are virtually certain to experience substantial losses at some point in time. The loss severity rate statistics reported in this study can be used in conjunction with uncured payment default rates (or material impairment rates, which include Ca- or C-rated securities that have not yet defaulted) to determine expected loss rates. That topic will be the subject of a future report.

Table Of Contents

Introduction

In a recent *Special Comment*,[1] Moody's demonstrated that its structured ratings are strongly predictive of subsequent default experience. In this *Special Comment*, we develop an approach to measuring loss severity, given default, for defaulted securities. We then examine the relationships between loss severity rates and tranche size, seniority, time from origination to default, and credit ratings.

Measuring loss severity in structured finance requires a different approach from that used in corporate finance.[2] Moody's typically measures recovery rates (1 - loss severity rate) on a defaulted corporate instrument as the ratio of the 30-day post-default bid prices on the defaulted securities relative to their face values. Unfortunately, bid prices on defaulted structured securities are not generally available or reliable, so the standard corporate approach to measuring loss severity is not applicable for structured finance.

However, for defaulted securities that have "matured" – securities that have had their balance reduced to zero either through pay-downs, write-downs, or a combination of both and that are no longer making payments to investors – lifetime losses can be calculated directly by summing their history of periodic losses – both missed interest and missed principal payments – and discounting them back to a reference date, using the security's own coupon rate as the discount rate.

Having measured the present value of a security's total losses, one must select a reference principal balance in order to calculate a loss severity rate. In this Special Comment, Moody's focuses on two loss severity rate measures, lifetime losses as a share of the principal balance at origination and lifetime losses as a share of the principal balance at the date of default inception. The former measure is likely to be of primary interest to buy and hold investors, whereas the latter is likely to be of greater interest to secondary market investors, in general, and distressed security investors, in particular.

It should be noted that while direct comparisons between structured and corporate loss severities on default balances may be appropriate, comparisons of severities based on origination balances are not. This is because corporate bonds rarely amortize and corporate severity estimates rarely differentiate between measures based on default balances and measures based on origination balances.

Loss severity measured at the default date exceeds loss severity measured at origination, primarily because a structured security may distribute a substantial portion of its principal to investors prior to its default, and secondarily because the present value of lifetime losses is lower at origination than at default due to discounting. By contrast, for a corporate security, the difference between loss severity at origination and loss severity at default is generally less substantial – it is limited to the discounting effect – because its balance at origination is generally equal to its balance at default.

To measure the overall average loss severity on defaulted structured finance securities, it is necessary to adopt a method for estimating ultimate loss severity rates on defaulted securities that have not yet matured. The fundamental data for this study come from 187 RMBS and HEL securities that defaulted before the end of 2002 and were not "cured." Among these, definitive lifetime cumulative loss totals are only available for the 86 securities that have subsequently "matured". Expected lifetime losses must be estimated for the other 101 defaulted securities that have positive balances and have not yet matured.

One approach – which we call the "static" approach – to estimating lifetime cumulative losses on non-matured securities is to infer their loss severity rates directly from a small number of characteristic factors at the time of default. These factors provide only static information about the defaulted security – such as tranche size, seniority, and the number of months from origination to default – to infer a loss severity rate on a non-matured security. The static approach, which relies on an estimated relationship between the static factors and final loss severity rates using only matured defaults, is likely to impart an upward bias on expected loss severities. The reason many securities in the matured sample became mature is because they experienced large losses and their balances were rapidly written down to zero. In contrast, the reason many of the non-matured securities have not matured is that their loss experience has been less severe.

Another approach – which we call the "dynamic" approach – to estimating lifetime cumulative losses on the non-matured securities relies primarily on the ratio of losses realized to date versus total principal balance reduced since the default date to predict a security's final cumulative losses. The total principal balance reduced since the default date includes principal that was lost and principal that was paid from default date to the current date. The basic idea is that as a defaulted security's principal balance declines over time, the share of this balance that is reduced through losses, as opposed to the share that is reduced through principal distribution to investors, reveals the rate at which the security is likely to suffer losses on its remaining balance.

The matured sample indicates that for most defaulted securities, losses on any remaining balance are typically incurred at a lower rate than losses on the principal balance to date. Therefore, our dynamic approach incorporates a deceleration in loss accumulation.

1. See *"Payment Defaults and Material Impairments of U.S. Structured Finance Securities: 1993-2002", Moody's Special Comment, December 2003, where one can also find our definitions of default and losses.*
2. *Details on recovery rates of defaulted corporate bonds can be found in Moody's Special Comment, "Recovery Rate of Defaulted Corporate Bonds, 1982-2003", December 2003.*

A third approach – which we call a "blended" approach – to estimating lifetime cumulative losses on non-matured securities places weight on both static and dynamic estimates of final loss severity rate, with the relative weight varying over the life of the security. We recommend the blended approach because we can show, using the matured defaulted securities sample as a guide, that the dynamic approach yields more accurate estimates of expected final loss severity rates as defaulted securities become more highly seasoned and closer to final maturity over time. The static approach, however, provides a more reasonable forecast than the dynamic approach in the period shortly after the default's inception. The blended loss severity rate estimate places weight on both approaches, with the relative weights changing over time.

The results from the static approach suggest that ultimate loss severities on the non-matured defaulted securities will be slightly lower than the loss severities observed on the matured defaulted securities. The dynamic approach predicts that the expected ultimate loss severities on the non-matured securities are much lower than those predicted by the static approach. Because many non-matured defaulted securities have already been seasoned for many years, the blended approach provides loss severity rate estimates similar to the dynamic approach.

Finally, we combine the final loss severity rates from the matured sample with the estimated final loss severity rates from the non-matured sample using the blended approach. Based on the resulting sample of 187 lifetime loss severity rates, we characterize expected loss severity rates by tranche size, seniority class, and rating category. We find, as one might expect, that loss severity decreases as each of the three variables increases.

Defining Defaults And Loss Severities

Moody's recent structured finance default study defined a structured security as being in "payment default" if it suffered either an interest shortfall or a principal write-down.[3] A payment default is called "cured" at a given date if all of its outstanding interest shortfalls and principal losses are repaid.[4] By contrast, a payment default is "uncured" if there are still interest shortfalls or principal losses outstanding.

In this study, *we focus exclusively on* <u>*uncured*</u> *payment defaults*, since cured defaults are temporary and inconsequential for most investors. One can, however, easily estimate an average loss severity rate that includes cured defaults by simply incorporating the additional defaults – with zero loss severity rates — into the calculation.

The loss severity rate (LSR), or loss given default (LGD), is the amount of losses, including both missed interest and principal write-downs, incurred by a defaulted security, as a share of its principal balance. The recovery rate is one minus the loss severity rate.

Losses on defaulted structured securities typically accrue over time because of additional missed interest and write-downs on the securities. Consequently, the amount of final losses is known only for matured defaults, where the term "mature" means zero outstanding principal balance.[5] Final loss severity rates on non-matured defaults – defaults with positive principal balances outstanding – cannot be known with any certainty.

Unlike corporate bonds, which usually carry the same par balances at origination as their face values due at maturity, many structured finance securities amortize over the life of the transaction. As a result, loss severity rate estimates for structured finance can vary greatly depending upon which balance is chosen as the basis of comparison – the balance at origination or the balance at the date of initial default or the balance of any other dates of interest.

In this study, we define the loss severity rate to be the discounted present value of periodic losses that include both interest shortfalls and losses of principal using coupon rates as discount rates. Figure 1 presents this definition as a generic formula.

Figure 1 – Definition Of Loss Severity Rate

$$LSR_t = \left\{ \sum_{s=k}^{t} \frac{IS_s + LP_s}{(1+c_s)^s} \right\} / B_k$$

where LSR_t stands for loss severity rate as of time t, IS_s and LP_s denote the amount of net interest shortfalls and net loss of principal in period s, c_s is the discount rate for the losses in period s, and B_k is the outstanding principal balance at time k where k can be one of the following two dates:

- The date of the first default event (default date), denoted by time D;

---

3. *We defined a security to be "materially impaired," if it sustained a payment default that has not been cured (i.e. no more losses outstanding), or has been rated Ca or C, even though it may not have suffered any losses yet.*
4. *Some of these cured defaults may have incurred economic losses in the present value sense (since not all structured securities promise interest on interest in the event of default). However, the economic losses on cured defaults are typically extremely small.*
5. *In some cases, even though the tranche balance has been reduced to zero, money will become available to investors of certain tranches. The amount of such reimbursement, if any, is typically small.*

- The date of origination, denoted by time O.

Time t – which is the date at which the loss severity to date is measured – can be any date after time k, where k can be either D or O. Time t can be at or after the bond's maturity, denoted by time T, which would, of course, also imply that the loss severity to date is in fact the final lifetime loss severity. Time t could also be any reporting date, such as the end of our sample period, when only the loss severity rate to date can be measured. Time s denotes any date between k and t.

Moody's uses coupon rates as discount rates. For fixed-rate securities, there is a single coupon rate, but for securities with variable coupon rates, discount rates are derived from interest payments. In cases of unusually irregular interest payments, discount rates are smoothed using regular discount rates in the neighboring payment periods.

Concerning The Data Sample

In the structured finance default study, Moody's identified a total of 390 payment defaults on securities issued between 1993 and 2002 from three major structured finance sectors – asset-backed securities (ABS), commercial mortgage backed-securities (CMBS), and RMBS.[6] For the purpose of studying loss given default, Moody's was subsequently able to identify 36 more RMBS defaults from pre-1993 vintages, which resulted in a total of 426 payment defaults.

Among these 426 payment defaults, 215 were from the RMBS and the home equity loan (HEL) component of the ABS sector. Among these, 187 were uncured, and 28 were cured before the end of 2002. This study focuses exclusively on uncured defaults in the RMBS and HEL sectors. Of the 187 uncured defaults, 86 matured before the end of 2002, while 101 did not. The sample includes default and loss information as of the end of 2002.

There are several reasons why this paper focuses exclusively on defaults in the RMBS and HEL sectors. First, the overwhelming majority of matured defaulted securities are in the RMBS and HEL sectors. There are 100 defaulted securities that had matured in the ABS, CMBS and RMBS sectors combined. Of these, 89 were either RMBS or HEL-backed securities.

Second, RMBS with HELs included are the largest asset type within structured finance. At the beginning of 2004, RMBS and HELs, combined, made up about 47% of all structured finance securities rated by Moody's.[7]

Third, the collateral underlying both of these security types is composed of mortgage loans; hence RMBS/HEL is a relatively homogenous group. At the beginning of 2004, more than 85% of the HELs were backed by subprime first-lien (B&C) mortgages. The remaining HEL collateral types included high loan-to-value (LTV) mortgages, home equity lines of credit (HELOCs), home improvement loans, and net interest margins (NIM).

Fourth, the changing nature of RMBS collateral and HELs made it difficult to clearly distinguish these two security types for a period extending from 1988 to 2002. This is because securities characterized as RMBS of early vintages are different from recent vintages with regard to the quality of their collateral. A considerable proportion of RMBS transactions of early vintages were backed by mortgages that would now be considered subprime mortgages and thus be classified as belonging in the HEL sector. This is especially true among defaulted RMBS securities. In contrast, almost all RMBS deals issued in the last three or four years were prime jumbo loans or Alt-A loans, and are of high quality. Few have experienced defaults.

The nature of collateral also changed within the HEL sector during the period in question. In the old days, HEL securitizations generally came in two types: second-lien mortgages or HELOCs. The overwhelming majority of HEL deals issued in the last three or four years, however, have been collateralized by first-lien subprime mortgage loans.

For all these reasons, Moody's does not differentiate between securities in the RMBS sector and those in the HEL sector for the purpose of this study.

Realized Loss Severity To Date For Matured And Non-Matured Defaulted Securities

Characteristics Of Matured Defaults

We first examine the sample of 86 matured defaulted securities from 59 deals. Characteristics of these defaulted securities are presented in Figure 2.

6. *For more information about these defaults, please refer to the default study cited in footnote 1.*
7. *More discussions on the entire sample of Moody's rated structured finance securities can be found in Moody's Special Comment, "Structured Finance Rating Transitions: 1983-2003", February 2004.*

Figure 2 – Characteristics Of Matured Defaults, 1988-2002	Mean	Median
Number of Observations	86	86
Number of Deals	59	59
Final Loss Severity Rate (% of default date balance *)	65.8%	89.1%
Final Loss Severity Rate (% of original balance)	44.7%	49.9%
Principal Balance at time of Default * (% of original balance)	81.9%	96.5%
Time from Origination to Default (months)	38	37
Time from Default to Maturity (months)	27	18
Tranche Size (% of total deal balance at origination)	13.8%	5.0%
Rating at Origination	Baa3	Baa3
Rating at Default	B2	B2

** Note: The principal balance at the time of default, also called default-date balance, is expressed as a percentage of the principal balance at origination (also called original balance).*

Several interesting observations can be made from Figure 2.

First, final loss severity rates were very high among the matured defaults, evidenced by a mean loss severity rate of 65.8% and a median of 89.1%.[8] About 48% of matured defaulted securities had sustained loss severities of more than 90% of their default date balance as shown in Figure 3, with the mean loss severity rate lower than the median.

Second, the median of principal balances at default was substantially higher than the mean. A substantial portion (about 60%) of matured defaulted securities defaulted with an outstanding principal balance of more than 95%, and the rest of the defaulted securities are distributed almost equally but sparsely in the whole spectrum from 5% to 95% (Figure 4).

These numbers are not surprising given the average time from origination to default of 38 months, the fact that most defaults were defaults on subordinated tranches, and the common structure of most HEL and RMBS securitizations, which significantly restricts the amount of principal paid to the subordinated tranches during the first several years of a transaction.

Figure 3 – Distribution Of Loss Severity Rates Of Matured Defaults

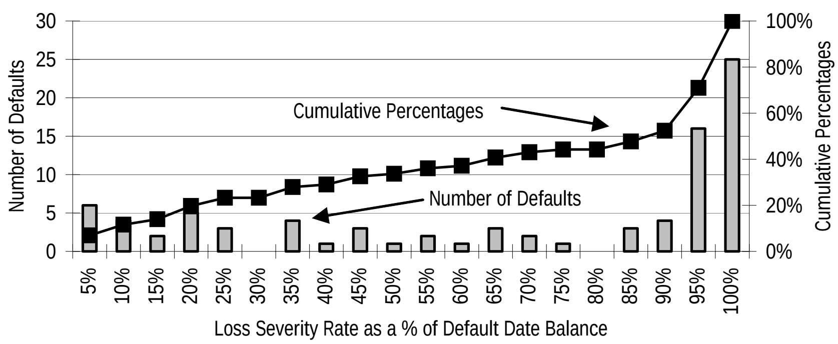
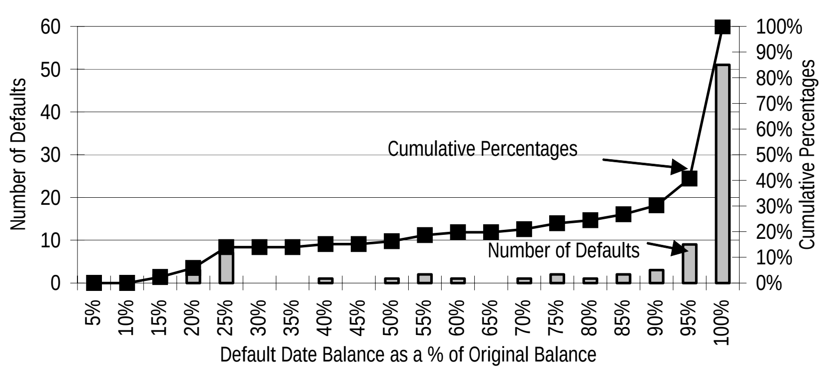


Figure 4 – Distribution Of Default Date Balances Of Matured Defaults



8. *The mean severity rate of all corporate bonds (both secured and unsecured and senior and junior bonds included) from 1982-2003 was about 65% and the median was 69%.*

Third, the mean and median original ratings were both Baa3, five notches above the B2 rating at the time of default. This means Moody's had already downgraded these securities to reflect the changes in the credit quality of the securities that ultimately went into default.

Finally, Figure 2 highlights that half of the matured defaults were small, with tranche balances at origination less than 5% of the total deal balance (i.e. the median is 5%). The mean tranche size, however, is higher (14%) than the median because there are eight senior defaulted securities and their tranche sizes are all above 80%, and the rest are securities of much smaller size.

Characteristics Of Non-Matured Defaults

For the 101 defaulted securities that had not matured as of the end of 2002, final loss severity rates cannot be yet known with any certainty.

Figure 5 describes their summary characteristics with loss severity rates measured as of the end of 2002.

Figure 5 – Characteristics Of Non-Matured Defaults, 1988-2002

	Mean	Median
Number of Observations	101	101
Number of Deals	92	92
Loss Severity Rate to Date* (% of default date balance)	28.0%	21.8%
Loss Severity Rate to Date* (% of original balance)	18.3%	12.6%
Remaining Principal Balance * (% of original balance)	32.2%	31.1%
Maximum Loss Severity Rate** (% of default date balance)	60.1%	65.7%
Principal Balance at Time of Default (% of original balance)	76.4%	90.6%
Time from Origination to Default (months)	48	45
Time from Default to Date * (months)	52	52
Tranche Size (% of total deal balance at origination)	22.7%	5.8%
Rating at Origination	Baa2	Baa3
Rating at Default	B1	B2

** Note: As of 12/31/2002.*
***For each defaulter, this is the sum of loss severity rate to date and the discounted present value of remaining principal balance (assuming all will be lost at the end of the sample period).*

Figure 5 reveals several interesting findings.

First, the mean and median loss severity rates to date for these securities were markedly lower than those of the matured defaults in Figure 2. Unlike in Figure 2 where the median loss severity rate was greater than the mean, in Figure 5 the mean is greater than the median. More than 56% of the non-matured defaulted securities have sustained loss severity rates to date of 25% or less, as shown in Figure 6. As indicated, most non-matured defaulted securities have had lower loss severity rates to date than the matured securities, as can be seen by the fact that Figure 6's distribution is skewed strongly to the right.

Second, both the mean and median of default date balances were lower than those in Figure 2, although the overall distribution of default date balances is similar between matured and non-matured defaults (Figure 7). As indicated by Figure 7, the proportion of non-matured defaults that had 95% or more principal balance outstanding at the time of default was about 26%. This is in sharp contrast with the figure of about 59% among matured defaults

Figure 6 – Distribution Of Loss Severity Rates To Date Of Non-Matured Defaults

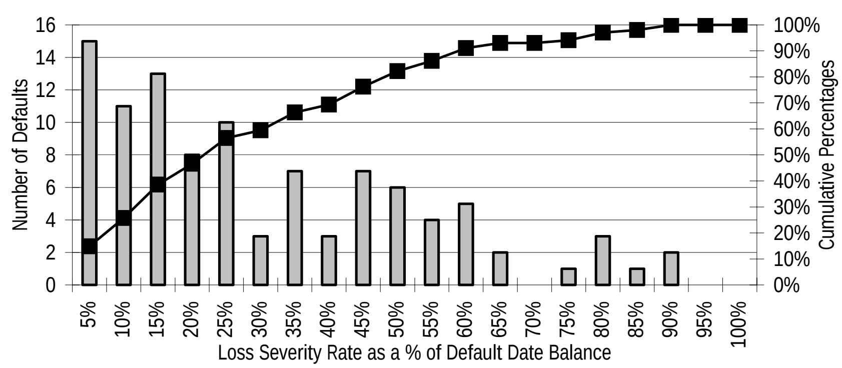
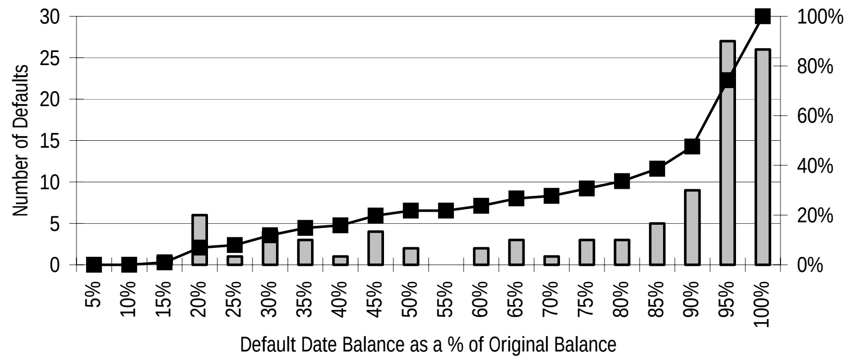


Figure 7 – Distribution Of Default Date Balances Of Non-Matured Defaults



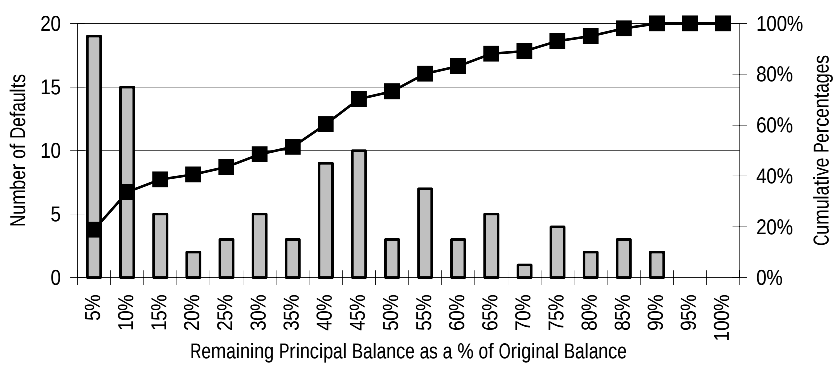
Third, Figure 5 demonstrates that non-matured defaulted securities experienced their first default event on average about 48 months after origination. This is about 12 months later than the average time to default of matured defaulted securities. Moreover, the non-matured defaulted securities continued to accumulate losses for an average of 52 months following default. In contrast, matured defaults were largely written down within an average of 27 months after default.

Fourth, many non-matured defaulted securities had only a small amount of principal balance remaining, with the average and median remaining balances around 30%. About a third of the non-matured defaulted securities had less than 10% of their original principal balance remaining (Figure 8).

Fifth, while it is certain that additional losses will accumulate on these defaults, it appears that their final loss severity rates will be lower than those of matured defaults. This becomes evident when one looks at the maximum loss severity rates of the non-matured defaults. Figure 5 shows that the average of the maximum loss severity rates is lower than the average of final loss severity rates of matured defaults, and the median of maximum loss severity rates is substantially lower that the median of matured defaults.

Sixth, the median ratings were similar for non-matured defaults and matured defaults, but the average rating was one notch higher for non-matured defaults than it was for matured defaults. That suggests that the overall credit quality of non-matured defaults could be better than that of matured defaults.

Figure 8 – Distribution Of Remaining Principal Balances Of Non-Matured Defaults



Predicting Final Loss Severity For Non-Matured Defaulted Securities

We now examine three methods of predicting final loss severity for defaulted securities that have not yet matured:

1. A static model that infers loss severity directly from a combination of default characteristics variables such as tranche size (measured by the tranche balance as a share of deal balance at origination), time to default (measured by the months from origination to default), and default date balance (measured by the balance at default as a share of original tranche balance, also called tranche factor at default date) based on the sample of matured defaulted securities;

2. A dynamic model that estimates a security's future losses (a)as a share of its remaining principal balance based on the ratio of principal balance reduced to date due to loss versus total principal balance reduction since default date, and (b) the rate at which the pace of loss accumulation historically decelerates (a parameter we will call beta); and
3. A blended model that allows the relative weights (a parameter we will call alpha) assigned to the static and dynamic severity estimates to vary for both relatively recent and relatively seasoned defaulted securities.

Using A Static Model

For the sample of matured defaulted securities, we searched through a large set of default characteristic variables for the determinants of the defaulted securities' final loss severity rates. We found the following variables to be highly correlated with severity rates: tranche size, time to default, seniority, and default date balance. These variables are static factors in the sense that they do not change once a default is identified.

Among matured defaulted securities, we found that larger tranches sustained lower losses. For instance, matured defaulted securities with tranche balances at origination greater than 70% of their deal balances sustained an average loss of 5% as a share of original balance, while defaulted securities with a tranche balance of less than 2% of their deal balances at origination sustained an average loss of roughly 60%.

We also found that senior tranches, on average, have sustained much lower loss severity rates than the non-senior tranches. The average loss severity rate of matured senior defaulted securities was only 10% of the default date balance, while the average of non-senior defaulted securities was about 70%.

In a multi-factor regression framework, we found that tranche size, time to default, and default date balance are jointly significant in differentiating final loss severity rates. The seniority variable, however, was dropped from our framework because it was highly correlated with tranche size. In fact, all matured senior defaulted securities had tranche sizes of more than 80%.

Figure 9 shows the static multi-factor regression model. To ensure that estimates of final loss severity rates were bounded between zero and one, we applied a logit transformation[9] to final loss severity rates. The transformed loss severity rate is the dependent variable. The quadratic form associated with the time to default variable indicates a seasoning pattern similar to seasoning patterns of rating transitions and default rates.[10]

Figure 9 – A Static Multi-Factor Regression Model Of Final Loss Severity Rates

$$\log\left(\frac{LSR}{1 - LSR}\right) =$$

$$0.24 * \text{Time To Default} - 0.004 * (\text{Time To Default})^2 - 4.7 * \text{Tranche Size} - 1.5 * \text{Default Balance}$$

where LSR represents the final loss severity rate measured as a percent of the default-date balance, time to default is measured by the months from origination to default, tranche size is measured by the tranche balance at origination as a percent of total deal balance at origination, and default balance is measured by the principal balance at default over the principal balance at origination. The model is estimated using the sample of 86 matured RMBS and HEL defaults and has an R^2 of 53%. All coefficients are statistically significant at the 95% confidence level.

The static model in Figure 9 provides a simple method to project final loss severity rates for non-matured defaults. To do this, one simply needs to compute the values of three variables: tranche size, time from origination to default, and default date balance and input them into the equation in Figure 9.

The average of the static estimates of final severity rates for non-matured defaults was found to be 57.8% (as a percent of default date balance), which is lower than but close to the average final severity rate of 65.8% from matured defaults. The static estimate is on average much higher than the loss severity rate to date, which is the minimum, for non-matured defaults. The average of the static estimates of final severity rates is also close to the average of maximum severity rates (60.1%), which is derived under the assumption that these securities will lose all of their remaining principal balance.

The static estimates are likely to overestimate final loss severity rates due to survival biases. The very fact that, unlike the securities in the matured sample, the securities in the non-matured sample have not had their balances written down to zero suggests that these securities are likely to have lower final loss severities.

9. *A logit transformation on a variable x takes the form of log(x/(1-x)). The inverse of this transformation takes a value between 0 and 1.*
10. *The seasoning pattern of rating transitions in structured finance was first reported in Moody's Special Comment, "Structured Finance Rating Transitions: 1983-2002", January 2003. The seasoning pattern of default rates in structured finance was first reported in Moody's Special Comment, "Payment Defaults and Material Impairments of US Structured Finance Securities", December 2003.*

Dynamic information about loss accumulation to date and principal balance remaining can, in many cases, be used to get better estimates of these securities' ultimate loss severity rates. For example, the loss severity rate to date is typically the minimum of a defaulted security's final severity rate, while the remaining losses cannot typically exceed the remaining principal balance.[11]

Using A Dynamic Model

There are many different ways one can study the accumulation of losses after default, even with just a few variables to study such as losses to date, principal paid, time since default, and principal balances reduced since default. In studying our sample of matured defaulted securities, we found losses to date as a percentage of the principal balance reduced since default to be the most useful dynamic variable for the projection of future losses. This factor is a measure of the loss accumulation rate to date in the sense that it reflects the amount of losses accumulated per unit of principal balance reduced.

We assume that the remaining loss as a share of the current outstanding balance is a simple multiplier of the loss accumulation rate to date. This mapping is further assumed to be time invariant from the time of default until maturity. Figure 10 gives its mathematical form.

Figure 10 – A Dynamic Loss Prediction Model

$$\frac{RL_t^i}{B_t^i} = \beta * \frac{L_t^i}{B_D^i - B_t^i}$$

Note: The existence of heteroscedasticity and autocorrelation presents challenges in the estimation of this type of model. Heteroscedasticity exists in a regression where the scale of the dependent variable and the explanatory power of the model vary cross-sectionally. Meanwhile, dependent variables observed over time tend to be correlated. Such autocorrelation will be present in the disturbances across periods. For models with only heteroscedasticity, White t-statistics are widely used for computing statistical significance levels. For models with only autocorrelation, autoregressive or moving averages error models are widely used. When the two problems coexist, especially when the types of heteroscedasticity and autocorrelation are unknown with certainty, the general method of moments (GMM) has proven to be useful in the estimation. This paper uses this method with a Bartlett kernel estimator for the bandwidth function. In addition, boundaries of 0 and 1 were imposed on the dependent variable.

where RL_t^i is the amount of remaining losses at time t for defaulter i, and B_t^i is the amount of remaining principal balance at time t for defaulter i, L_t^i is the loss accumulated to time t, and B_D^i is the principal balance outstanding at the time of default D, hence $B_D^i - B_t^i$ is the principal balance reduced from default to time t.[12]

Parameter beta (ß) specifies the relationship between the rate of future loss accumulation and the rate of historical loss accumulation to date since default. While one might expect that ß would normally equal one – that losses accumulate at a constant rate over time – we find that, in fact, the pace of loss accumulation usually decelerates over time in the matured sample. We estimate that ß equals 0.39, based on 2,212 monthly loss observations from the 86 matured defaults.[13]

The equation in Figure 10 describes how, knowing ß, one can project the remaining losses as a share of the remaining principal balance. The total final loss is the sum of the estimated remaining losses, RL_t^i and the realized losses to date, L_t^i. The estimated final loss severity rate as a share of the default date balance is therefore $(RL_t^i + L_t^i)/B_D^i$. A graphical illustration of this dynamic loss prediction model appears in Figure 20 of appendix II.

The average of final loss severity rate estimates based on the dynamic model is 38%, which is about 10 percentage points higher than the loss severity rate to date, but much lower than the average of static estimates or the average of realized final severity rates on matured defaulted securities.

The simple one-factor dynamic loss prediction model we have outlined suffers from one weakness. When defaults are relatively young, if say, only a few months have passed since the default was initiated, then the loss relative to the principal balance reduced may not yet be sufficiently informative to yield a reliable prediction of the final loss severity rate. For these young defaults, static estimates may produce more reliable loss predictions. To this end, we developed a more comprehensive loss prediction model that takes into account both static and dynamic factors.

---

11. *Static estimates of final severity rates can sometimes fall out of these boundaries.*
12. *Loss of principal was the initial default event for all but one defaulter in the sample of matured defaults. The interest-shortfall defaulter was not included in the model estimation. Overall interest loss as a share of total losses averaged less than 3%.*
13. *Although the reported standard error of the estimate from the regression is small at 0.024, we know it is biased downward due the presence of multiple observations and overlapping data from the same transaction. The coefficient estimates, nevertheless, should be unbiased estimates.*

Using A Blended Model

Moody's has built a blended model that weighs both the static and dynamic severity estimates to generate a single final severity estimate. The model allows relative weights on the static and dynamic estimates to change over different stages of a defaulter's life. When the default is fairly recent, the blended model will assign more weight to the static final severity estimate than to the dynamic final severity estimate. When the default has seasoned, the dynamic severity estimate will be given more weight than the static severity estimate.

Figure 11 presents the mathematical specification of the blended model and Figure 12 shows the average final severity rate based on the blended model, compared with all other severity rate estimates for non-matured defaults and realized severity rates for matured defaults.

Figure 11 – A Blended Model

$$\frac{RL_t^i\ (blended)}{B_t^i} = \alpha(t) * \frac{RL_t^i\ (dynamic)}{B_t^i} + (1 - (\alpha(t)) * \frac{RL_t^i\ (static)}{B_t^i}$$

Note: We impose boundaries 0 and 1 directly on the remaining loss as a share of the outstanding principal balance in this model.

where RL_t^i(blended) represents the remaining losses to be estimated from this blended model, RL_t^i(dynamic) represents the remaining losses estimated using the dynamic model in Figure 11, RL_t^i(static) is the difference between the static estimate of the final loss severity rate and the realized losses to date, and a(t) is the relative weight variable.

We considered a wide variety of functional relationships between alpha and time. Based on its analysis of the sample of matured defaults, Moody's chose the following functional form for alpha:

$\alpha(t) = 0.053 * t$, if t<=12, or $\alpha(t) = 1$ if t>12,

This form states that the relative weight placed on the dynamic estimate increases over time and, after the twelfth month, no weight is given at all to the static estimate. A graphical representation of this model is shown in Figure 21 of appendix II.

The average of final loss severity rate estimates from the blended-model is about 38.8% (as a percent of default date balance), slightly higher than the average of dynamic estimates, but much lower than the average of static estimates or the average of realized final loss severity rates for matured defaults. Figure 12 summarizes all these loss severity rates.

As indicated in Figure 12, the average severity rate estimate based on the blended model is slightly higher than the loss severity rate estimate from the dynamic model. This is largely because the blended model puts positive weight on the static estimate only during the first twelve months after default. Many of these non-matured defaults have been in default for more than 12 months. The blended model uses the dynamic estimate alone to determine the remaining losses once the security has established a one-year loss record.

For comparison, Figure 12 also shows final loss severity rates measured as a percentage of original balance. As expected, overall loss severity rate levels on the basis of the original balance are lower than those measured against the default date balance, while the relationships among the estimates are similar between the two severity rate measures.

Finally, we recommend the blended model for the projection of final loss severity rates on non-matured defaults. The blended model takes into account both sets of valuable information – the static and dynamic factors. It utilizes a clear structural framework that separates the static estimate from the dynamic estimate and relies on only two key parameters – a beta (the loss deceleration parameter) and an alpha (the weight variable). Consequently, the model is easy to implement and flexible enough to allow for judgment.

Figure 12 – Comparisons Of Realized And Estimated Final Loss Severity Rates, 1988-2002

	As a Percent of Default Date Balance		As a Percent of Original Balance	
	Mean	Median	Mean	Median
Matured Defaults(1) (total 86 defaults)	65.8%	89.1%	44.7%	49.9%
Non-Matured Defaults (total 101 defaults)				
Minimum Loss Severity Rates (2) (or Loss Severity Rates to Date)	28.0%	21.8%	18.3%	12.6%
Dynamic-Model Estimates (3)	38.0%	36.8%	24.8%	25.5%
Blended-Model Estimates (4)	38.8%	37.9%	25.5%	28.2%
Static-Model Estimates (5)	57.8%	78.8%	32.2%	35.6%
Maximum Loss Severity Rates (6)	60.1%	65.7%	38.0%	46.2%
All Defaults(7) (total 187 defaults)	51.2%	52.0%	34.3%	33.0%

Notes:
(1) Realized final loss severity rates for the 86 matured defaults.
(2) Loss severity rates to date (as of 12/31/2002) for the 101 non-matured defaults. This is the minimum of a defaulter's final loss severity rate since it is almost certain that its losses are permanent.
(3) See Figure 10.
(4) See Figure 11.
(5) See Figure 9.
(6) Maximum final loss severity rates, which is the sum of loss severity rate to date and the discounted present value of the remaining principal balance (assuming all lost at the end of the study period).
(7) This combines the blended-model estimates of final loss severity rates of non-matured defaults and the realized final loss severity rates of matured defaults.

Final Loss Severity Rates Of All Defaulted Securities

With realized final loss severity rates from 86 matured defaults and estimated final loss severity rates from 101 non-matured defaults, we can now perform statistical analyses on their final loss severity rates.

By Rating

Figure 13 shows average and median final loss severity rates by rating using the entire sample.

Figure 13 – Final Loss Severity Rates By Rating, 1988-2002
(Estimates From The Blended Model Used For The Non-Matured Sample)

		Percent Of Default Date Balance				Percent Of Original Balance	
Rating At Default	Counts	Mean	Median	Rating At Origination	Counts	Mean	Median
Aaa	1	1.5%	1.5%	Aaa	12	2.3%	2.7%
Aa	5	4.1%	3.0%	Aa	25	8.1%	6.3%
A	7	25.4%	15.8%	A	15	20.2%	9.9%
Baa	21	33.3%	20.4%	Baa	66	40.9%	43.2%
Ba	41	47.2%	42.4%	Ba	32	32.2%	35.6%
B	54	59.5%	60.1%	B	37	58.3%	66.3%
Caa	38	54.0%	55.7%				
Ca/C	20	74.0%	79.8%				
Investment-Grade	34	26.4%	14.8%	Investment-Grade	118	27.4%	20.2%
Speculative-Grade	153	56.8%	58.7%	Speculative-Grade	69	46.2%	43.2%
All	187	51.2%	52.0%	All	187	34.3%	33.0%

As indicated, Moody's ratings are strongly predictive of loss severity rates given default. Ratings at default are particularly useful indicators of final loss severity rates, but ratings at origination are good predictors as well.

The only element of "non-monotonicity" in Figure 13 is that defaulted securities originally rated Baa sustained an average loss severity of about 41% as a share of their original balance, which is greater than the 32% loss severity rate averaged by securities rated Ba at origination. It should be noted, however, that our previous default study demonstrated that the default rate on securities rated Baa at origination was less than half that of securities rated Ba.

Additionally, Figure 13 shows that within investment-grade rating categories (investment-grade at time of default), the median final loss severity rates are significantly lower than the means. Within speculative-grade rating categories (speculative-grade at time of default), the means and medians are similar. Distributions of final loss severity rates of investment-grade defaults and speculative-grade defaults are shown in Figure 14 and 15, respectively.

Figure 14 – Distribution Of Loss Severity Rates Of All Investment-Grade Defaults

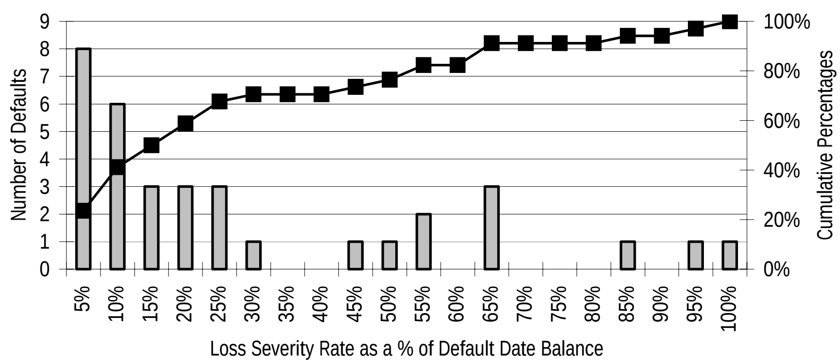
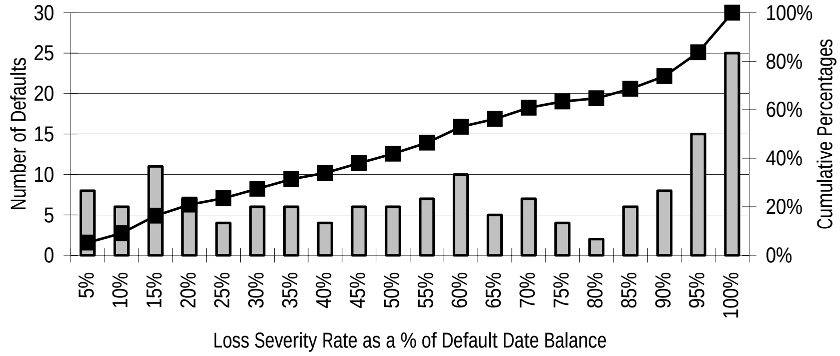


Figure 15 – Distribution Of Loss Severity Rates Of Speculative-Grade Defaults

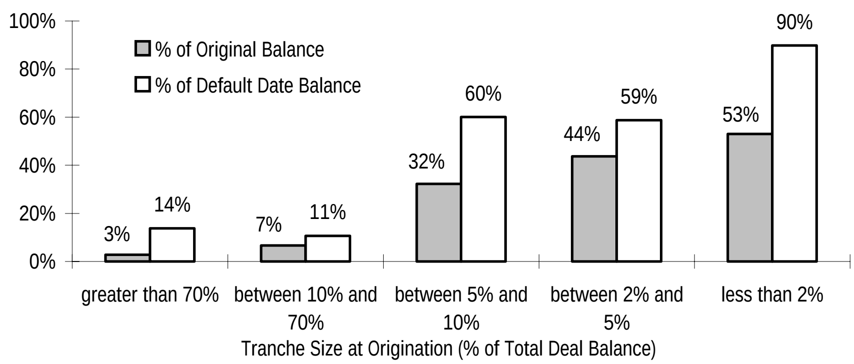


As illustrated by Figures 14 and 15, the majority of investment-grade defaults have sustained low loss severity rates with a severity rate distribution substantially skewed to the right, By contrast, the loss severity rates of speculative-grade defaults have been generally diverse and have a severity distribution slightly skewed to the left.

By Tranche Size

Figure 16 shows how loss severity rates vary by tranche size. The groupings by tranche size are the same as those reported in Moody's multi-sector collateralized debt obligations rating methodology.[14]

Figure 16 – Median Loss Severity Rates By Tranche Size, 1988-2002



As depicted, there is strong correlation between tranche size and final loss severity rate – thinner tranches in our sample typically sustained higher loss severity rates. The differences appear to be particularly significant at the 10% cut-off level in Figure 16.

14. Moody's Structured Finance Special Report, "Moody's Approach to Rating Multi-Sector CDOs," September 2000.

The inverse correlation between tranche size and the loss severity rate is generally present even after controlling for the original rating (Figure 17).

Figure 17 – Median Loss Severity Rates By Tranche Size And Original Rating, 1988-2002
Loss Severity Rates As A Percentage Of Original Balance
(Number Of Observations In Parenthesis)

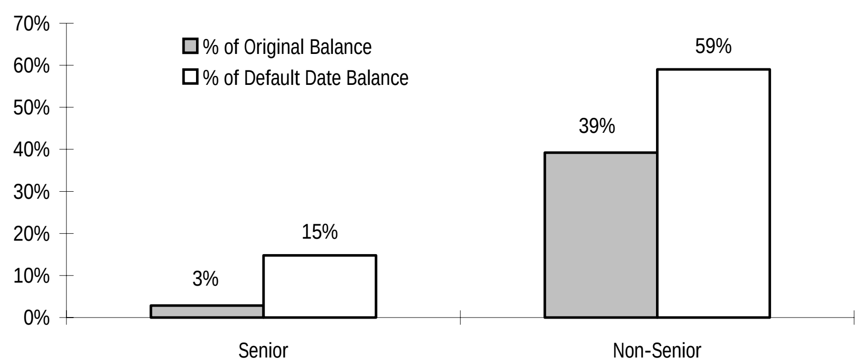
	Original Rating						
Tranche Size at Origination	**All Ratings**	**Aaa**	**Aa**	**A**	**Baa**	**Ba**	**B**
Greater than 70%	2.8% (29)	2.7% (12)	3.4% (14)	1.0% (2)		5.1% (1)	
Between 10% and 70%	6.7% (13)		5.7% (4)	5.4% (1)	14.1% (2)	28.2% (5)	3.7% (1)
Between 5% and 10%	32.3% (53)		14.8% (7)	20.9% (7)	43.2% (34)	35.0% (2)	27.5% (3)
Between 2% and 5%	43.7% (43)			9.9% (5)	44.9% (23)	41.2% (10)	58.1% (5)
Less than 2%	53.0% (49)				33.5% (7)	37.9% (14)	70.2% (28)
All	32.3% (187)	2.7% (12)	6.3% (25)	9.9% (15)	43.2% (66)	35.6% (32)	66.3% (37)

By Seniority

As expected, seniority plays a prominent role in determining final loss severity rates not only because senior tranches absorb losses only after junior tranches have been written down, but also because senior tranches tend to be thicker than junior tranches. The number of senior defaulted securities in the entire sample is 26, or approximately 14% of all defaulted securities. Loss severity rates by seniority are shown in Figure 18.

Figure 18 highlights the striking differences between senior and non-senior (including mezzanine and subordinated) defaulted securities' loss severity rates. The average loss severity rate as a percentage of original balances among senior tranches is only 7.4% of the average severity rate among non-senior tranches.

Figure 18 – Median Loss Severity Rates By Seniority, 1988-2002



The median loss severity rates by seniority after controlling for the original rating are shown in Figure 19. As illustrated, senior securities were rated either Aaa or Aa and sustained very low loss severity rates given default. In addition, within non-senior securities, the loss severity rate generally increases as the rating decreases. But there are two exceptions. Defaulted securities rated Aa at origination had a higher median loss severity rates than did those rated A, and those rated Baa at origination had a higher median loss severity rate than those rated Ba.

Figure 19 – Median Loss Severity Rates By Seniority And Original Rating, 1988-2002
Loss Severity Rates As A Percentage Of Original Balance
(Number Of Observations In Parenthesis)

	Original Rating						
Seniority	**All Ratings**	**Aaa**	**Aa**	**A**	**Baa**	**Ba**	**B**
Senior	2.8% (26)	2.7% (12)	3.4% (14)				
Non-Senior	39.2% (161)		14.6% (11)	9.9% (15)	43.2% (66)	35.6% (32)	66.3% (37)

Concluding Remarks

Moody's structured finance ratings aim to identify differing expected loss rates among structured securities. In this Special Comment, Moody's defined various measures of loss severity rates given default, developed methods to predict the final loss severity rates for defaults that have not yet matured, and studied the statistical properties of final loss severity rates based on the entire sample of 187 defaulted residential mortgage-backed securities.

Moody's findings demonstrate that its ratings are generally good predictors of differences in loss severity rates given default. Moody's also found that, larger, thicker tranches typically sustain lower loss severity rates than small, thinner tranches. Similarly, senior securities suffered lower average loss severity rates than did mezzanine or junior securities.

Moody's has developed and analyzed the results of three separate loss severity prediction models – the static, dynamic and blended models – for the purpose of predicting the final loss severity rates on defaults that had not matured at the end of sample period. By placing time-varying weights on the static and dynamic loss estimates of final loss severity rates, Moody's believes the blended model produces the best results.

Moody's views its proposed measures of loss severity rates as generally applicable to all asset classes in structured finance. The advantage of the blended loss prediction model, however, depends on principal payment and principal loss information since default. For defaulted securities in other asset types (other than RMBS or HELs) that have sustained principal losses, the model framework is generally applicable, although its parameters may need to be estimated for different asset types. The model will not work properly, however, on defaulted securities that have not yet sustained any principal losses.

The findings in this research report can be used to calculate average loss rates in conjunction with the default rates or material impairment rates reported in Moody's first structured finance default study. That will be the subject of a future report.

Appendix 1: Terminology

Payment Default

A structured finance security is in payment default if it has suffered an interest shortfall or a principal write-down. Prepayment interest shortfalls are not payment defaults.

Cured And Uncured Payment Default

A payment default is cured as of a given date if there is no more loss outstanding on that date. A default is uncured if there are losses outstanding on that date. The cure status of a payment default is defined relative to a reference date, which is typically the end of a study period. This paper focuses on uncured payment defaults.

Material Impairment

A structured security is in material impairment if it is an uncured payment default, or a Ca- or C-rated security that is not yet in payment default.

Matured And Non-Matured Defaults

A defaulted security is matured if it has no remaining principal balance outstanding as of a given date. Otherwise, it is called non-matured.

Loss Severity Rate (LGD, Loss Given Default)

The loss severity rate given default is the discounted present value of lifetime losses (both interest shortfalls and principal losses included) as of a reference date – default date or origination date. One minus the loss severity rate is the recovery rate.

Default-Date Balance And Original Balance

Default date balance is the outstanding principal balance at the time of default. Original balance is the principal balance at the time of origination.

Tranche Size

Tranche size is measured by the tranche principal balance at origination as a percentage of total deal balance at origination.

Time To Default

Time to default is the number of months from origination to default.

Static Model

The static loss prediction model refers to a multi-factor regression model that uses only static factors – tranche size, time to default and default date balance – to predict final loss severity rates. These factors are static, in the sense that they do not change with the time since default.

Dynamic Model

The dynamic loss prediction model refers to a single factor regression model that uses a dynamic factor – the ratio of principal reduced to date due to loss versus total principal reduction since default date – and a parameter "beta" to predict the future loss severity rate as a share of the remaining principal balance.

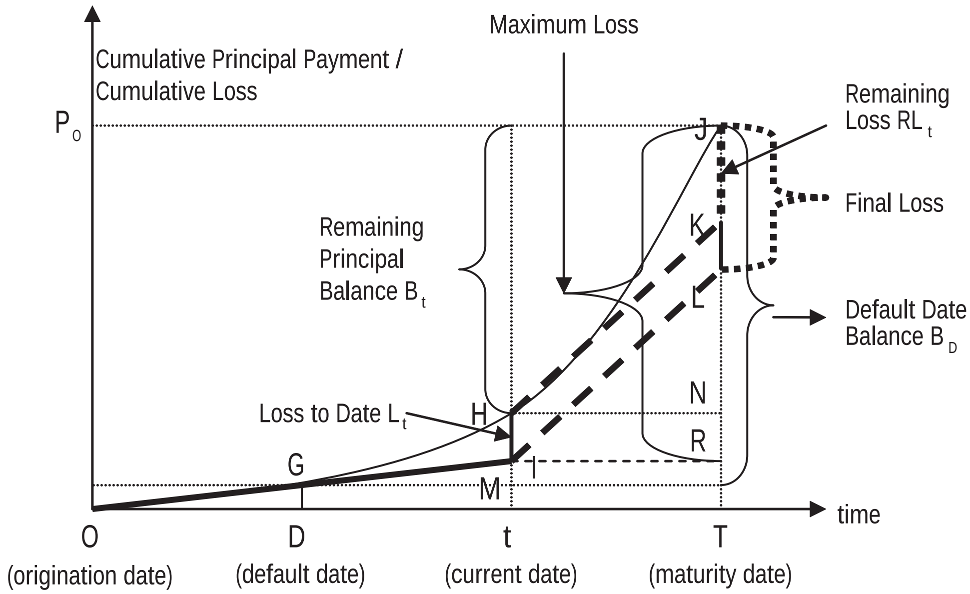
Blended Model

The blended loss prediction model mixes the static and dynamic loss predictions using a weight variable "alpha" that is time varying after default. The blended model places a larger weight on the dynamic loss severity estimate for seasoned securities but a smaller weight on the dynamic loss severity estimate for newly defaulted securities.

Appendix 2: Illustrations Of Loss Severity Prediction Models

In Figure 20, we demonstrate the concepts of the dynamic loss severity prediction model presented in Figure 10.

Figure 20 – The Dynamic Loss Severity Prediction Model – An Illustration



As illustrated, a security was issued at time O with an original principal balance of P_O. The curved line of O-G-H-J represents cumulative principal balance reduction, which is the sum of the amount of cumulative principal paid and the amount of cumulative loss.

At time D, the security defaulted resulting in a loss to date of HI, or L_t. The cumulative amount of principal paid from D to t is represented by IM.

The line segment HM is the total principal balance reduced since default, which is $B_D – B_t$. The right hand side variable in Figure 11, $L_t/ (B_D – B_t)$, is HI/HM.

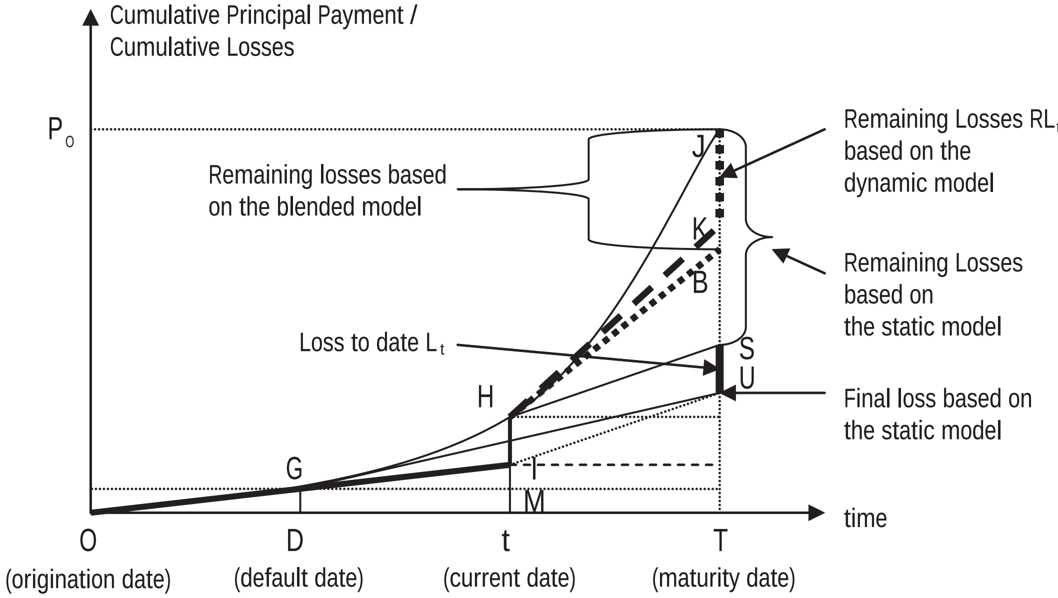
The projected remaining loss RL_t is represented by the line segment JK. Therefore, the left hand side variable in Figure 11, RL_t/B_t, is represented by JK/JN, the projected remaining loss as a percentage of the remaining principal balance. The dashed line IL, which is parallel to HK, is the projected actual principal payment line; that is, JL is the final loss amount ($L_t + RL_t$). The lines HK and IL are assumed to be straight (the first-order approximation) as our goal is to estimate the final loss level, not the loss accumulation pattern.

In addition, Figure 20 assumes that the beta in Figure 11 is less than one. In other words, HI/HM, which is the independent variable, is greater than JK/JN, the dependent variable. If beta is equal to one, the end point of the projected final loss line would be much lower than point L (the end point of the dynamic loss estimate when beta is less than 1).

The maximum amount of loss (without discounting for illustrative purposes) is represented by JR, which is the sum of L_t and B_t .

Now let's examine how the blended model weights the static loss estimate with the dynamic loss estimate (Figure 21).

Figure 21 – The Blended Model – An Illustration



First, as indicated, the static loss estimate takes only information available at time D to make a loss projection from G to end point U. In other words, the static loss model produces a loss estimate irrespective of the loss to date. In comparison, while the static model projects loss directly from point G to U (S is the end point for the projected remaining loss based on the static model with HS parallel to IU and HI=SU), the dynamic model projects loss from point H to end point K.

The blended model also projects the remaining loss from point H but to end point B, which is in between K and S, but typically is closer to K than S. It takes into account both the static estimate of remaining loss (end point S) and the dynamic estimate of remaining loss (end point K). As t moves further away from time D, the weight given to the dynamic estimate K increases while the weight given to the static estimate S decreases. Once t is 12 or more months from D, no weight is given to S.

Appendix 3: List Of Defaults Included In This Study

Tranche Name	Deal Name	Original Rating	Asset Type	Default Year.Month	Matured as of 12/31/02
4A	American Mtg Trust 1993-04	Ba2	RMBS	1996.09	YES
B-3	C-BASS ABS, LLC Trust Certificates, Series 1998-2	B2	RMBS	2002.11	
B	Citicorp Mtg Sec Inc 1991-05	Baa2	RMBS	1994.09	
B-1	Citicorp Mtg Sec Inc 1993-08	Baa3	RMBS	1996.01	
B-1	Citicorp Mtg Sec Inc 1993-10	Baa3	RMBS	2002.01	
A	ComFed Savings Bank 1988-02	Aa2	RMBS	1992.04	
A1	ComFed Savings Bank 1988-03	Aa2	RMBS	1992.05	YES
A-1	ComFed Savings Bank 1988-06	Aa2	RMBS	1992.06	YES
A-3	DLJ Mtg Acpt Corp 1992-Q07	Aa2	RMBS	1998.10	
A-3	DLJ Mtg Acpt Corp 1992-Q08	Aa2	RMBS	1998.04	YES
B-1	DLJ Mtg Acpt Corp 1992-Q08	Baa2	RMBS	1996.11	YES
B-1	DLJ Mtg Acpt Corp 1993-Q03	Baa2	RMBS	1997.12	
B-1	DLJ Mtg Acpt Corp 1993-Q06	Baa2	RMBS	1998.05	
B-1	DLJ Mtg Acpt Corp 1993-Q13	Baa3	RMBS	1998.05	
B-1	DLJ Mtg Acpt Corp 1993-Q16	Baa3	RMBS	1998.03	
B-1	DLJ Mtg Acpt Corp 1993-QE01	Baa2	RMBS	1996.12	YES
B-1	DLJ Mtg Acpt Corp 1993-QE05	Baa2	RMBS	1996.07	
B-1	DLJ Mtg Acpt Corp 1993-QE11	Baa2	RMBS	1996.08	
Cl. B-1	DLJ Mtg Acpt Corp 1994-Q12	Baa3	RMBS	2000.02	
I B-2	DLJ Mtg Acpt Corp 1994-Q13	B3	RMBS	1997.10	YES
II B-1	DLJ Mtg Acpt Corp 1994-Q13	Baa3	RMBS	1999.04	
II B-2	DLJ Mtg Acpt Corp 1994-Q13	B3	RMBS	1997.09	YES
III B-1	DLJ Mtg Acpt Corp 1994-Q13	Baa3	RMBS	1997.05	
III B-2	DLJ Mtg Acpt Corp 1994-Q13	B3	RMBS	1997.02	YES
B-1	DLJ Mtg Acpt Corp 1994-Q14	Baa3	RMBS	1998.03	
I B-1	DLJ Mtg Acpt Corp 1994-Q16	Baa3	RMBS	1998.05	
II B-1	DLJ Mtg Acpt Corp 1994-Q16	Baa3	RMBS	1996.12	
B-1	DLJ Mtg Acpt Corp 1994-QE01	Baa2	RMBS	1997.03	
B-2	DLJ Mtg Acpt Corp 1994-QE01	B2	RMBS	1997.01	YES
B-1	DLJ Mtg Acpt Corp 1994-QE02	Baa2	RMBS	1997.11	
B-1	DLJ Mtg Acpt Corp 1994-QE04	Baa2	RMBS	1997.08	
B-2	DLJ Mtg Acpt Corp 1994-QE04	B1	RMBS	1997.01	YES
A-1	DLJ Mtg Acpt Corp 1994-QE05	Aaa	RMBS	2000.04	YES
A-2	DLJ Mtg Acpt Corp 1994-QE05	Aa1	RMBS	1999.04	YES
B-1	DLJ Mtg Acpt Corp 1994-QE05	Baa2	RMBS	1997.03	YES
B-2	DLJ Mtg Acpt Corp 1994-QE05	B1	RMBS	1996.10	YES
A-1	DLJ Mtg Acpt Corp 1994-QE07	Aaa	RMBS	1999.04	YES
A-2	DLJ Mtg Acpt Corp 1994-QE07	Aa1	RMBS	1998.10	YES
B-1	DLJ Mtg Acpt Corp 1994-QE07	Baa1	RMBS	1997.03	YES
B-2	DLJ Mtg Acpt Corp 1994-QE07	Ba3	RMBS	1996.11	YES
B-1	DLJ Mtg Acpt Corp 1995-Q01	Baa2	RMBS	1998.07	
B-1	DLJ Mtg Acpt Corp 1995-Q02	Baa2	RMBS	1997.12	
B-2	DLJ Mtg Acpt Corp 1995-Q02	B2	RMBS	1997.08	YES
I B-1	DLJ Mtg Acpt Corp 1995-Q03	Baa3	RMBS	1998.10	
II B-1	DLJ Mtg Acpt Corp 1995-Q03	Baa3	RMBS	1998.05	
B-1	DLJ Mtg Acpt Corp 1995-Q05	Baa3	RMBS	1998.08	
B-2	DLJ Mtg Acpt Corp 1995-Q05	B3	RMBS	1997.06	YES
B-1	DLJ Mtg Acpt Corp 1995-Q06	Baa3	RMBS	1999.04	
B-2	DLJ Mtg Acpt Corp 1995-Q06	B3	RMBS	1997.11	YES
B-1	DLJ Mtg Acpt Corp 1995-Q08	Baa3	RMBS	1999.06	
B-2	DLJ Mtg Acpt Corp 1995-Q08	B3	RMBS	1998.02	YES
B-2	DLJ Mtg Acpt Corp 1995-Q10	Baa3	RMBS	1999.05	
B-1	DLJ Mtg Acpt Corp 1995-Q11	Baa3	RMBS	1996.11	YES
B-2	DLJ Mtg Acpt Corp 1995-Q11	B3	RMBS	1998.06	YES
A-1	DLJ Mtg Acpt Corp 1995-QE01	Aaa	RMBS	1999.03	YES
A-2	DLJ Mtg Acpt Corp 1995-QE01	Aa2	RMBS	1998.08	YES
B	DLJ Mtg Acpt Corp 1995-QE01	Baa2	RMBS	1996.12	YES
A-1	DLJ Mtg Acpt Corp 1995-QE03	Aaa	RMBS	1999.07	
A-2	DLJ Mtg Acpt Corp 1995-QE03	Aa1	RMBS	1998.11	YES
B	DLJ Mtg Acpt Corp 1995-QE03	Baa2	RMBS	1997.03	YES
A-1	DLJ Mtg Acpt Corp 1995-QE08	Aaa	RMBS	1999.09	
A-2	DLJ Mtg Acpt Corp 1995-QE08	Aa2	RMBS	1999.03	YES
B	DLJ Mtg Acpt Corp 1995-QE08	Baa3	RMBS	1997.06	YES
A-1	DLJ Mtg Acpt Corp 1995-QE09	Aaa	RMBS	2000.01	

Tranche Name	Deal Name	Original Rating	Asset Type	Default Year.Month	Matured as of 12/31/02
A-2	DLJ Mtg Acpt Corp 1995-QE09	Aa2	RMBS	1999.08	YES
B	DLJ Mtg Acpt Corp 1995-QE09	Baa3	RMBS	1997.09	YES
A-1	DLJ Mtg Acpt Corp 1995-QE11	Aaa	RMBS	1999.06	YES
A-2	DLJ Mtg Acpt Corp 1995-QE11	Aa2	RMBS	1999.02	YES
B	DLJ Mtg Acpt Corp 1995-QE11	Baa3	RMBS	1997.09	YES
B	DLJ Mtg Acpt Corp 1995-T07	Baa3	RMBS	1996.09	
B-2	DLJ Mtg Acpt Corp 1996-Q1	Baa3	RMBS	2000.01	
B-1	DLJ Mtg Acpt Corp 1996-Q2	A2	RMBS	2000.02	
B-2	DLJ Mtg Acpt Corp 1996-Q2	Baa3	RMBS	1998.06	YES
B-2	DLJ Mtg Acpt Corp 1996-Q4	A3	RMBS	1999.03	
B-3	DLJ Mtg Acpt Corp 1996-Q4	Baa3	RMBS	1998.09	YES
B-2	DLJ Mtg Acpt Corp 1996-Q5	Baa3	RMBS	1999.04	
B-3	DLJ Mtg Acpt Corp 1996-Q5	Ba3	RMBS	1998.12	YES
B-2	DLJ Mtg Acpt Corp 1996-Q6	Baa3	RMBS	1999.08	
B-1	DLJ Mtg Acpt Corp 1996-QA	Baa3	RMBS	1999.02	
B-2	DLJ Mtg Acpt Corp 1996-QA	B3	RMBS	1998.06	YES
B-2	DLJ Mtg Acpt Corp 1996-QB	Ba2	RMBS	1999.08	
A-1	DLJ Mtg Acpt Corp 1996-QE3	Aaa	RMBS	2000.03	
A-2	DLJ Mtg Acpt Corp 1996-QE3	Aa2	RMBS	1999.09	YES
B	DLJ Mtg Acpt Corp 1996-QE3	A3	RMBS	1998.04	YES
B-3	DLJ Mtg Acpt Corp 1996-QJ	Ba3	RMBS	1999.04	
Class A	DLJ Mtg Acpt Corp 1997-A	Aaa	RMBS	2002.04	
B-1	Fund America Investors Corp 1993-H	Baa2	RMBS	2000.04	YES
B-2	Fund America Investors Corp 1993-H	B3	RMBS	1996.06	YES
B	Fund America Investors Corp II 1993-A	Ba2	RMBS	1999.05	
A-2	Greenwich Capital Acpt 1991-A	Aa2	RMBS	1992.12	YES
B-1	Greenwich Capital Acpt 1991-B	Baa3	RMBS	1994.08	YES
B-1	Greenwich Capital Acpt 1992-01	A3	RMBS	1998.01	YES
B-2	Greenwich Capital Acpt 1992-01	Baa3	RMBS	1997.03	YES
B-1	Greenwich Capital Acpt 1992-LB2	Baa3	RMBS	1996.02	YES
B-1	Greenwich Capital Acpt 1992-LB5	Baa3	RMBS	1996.03	YES
B-1	Greenwich Capital Acpt 1992-LB6	Baa3	RMBS	1996.06	YES
B-1	Greenwich Capital Acpt 1992-LB8	Baa3	RMBS	1996.06	YES
B-1	Greenwich Capital Acpt 1993-LB2	Baa3	RMBS	1997.05	YES
B-1	Greenwich Capital Acpt 1994-LB3	Baa3	RMBS	1999.08	YES
B-1	Greenwich Capital Acpt 1994-LB6	Baa3	RMBS	1999.11	YES
B	Greenwich Capital Acpt 1996-B	Ba2	RMBS	2000.05	
A	Guardian S&L Assn 1989-11	Aa2	RMBS	1998.08	
A	Guardian S&L Assn 1989-12	Aa2	RMBS	1997.04	
A	Guardian S&L Assn 1990-01	Aa2	RMBS	1996.05	
A	Guardian S&L Assn 1990-03	Aa2	RMBS	1996.02	
A	Guardian S&L Assn 1990-04	Aa2	RMBS	1992.07	
A1	Guardian S&L Assn 1990-05	Aa2	RMBS	1995.04	
A-1	Guardian S&L Assn 1990-06	Aaa	RMBS	1998.07	
A	Guardian S&L Assn 1990-07	Aa2	RMBS	1995.02	
A-1	Guardian S&L Assn 1990-08	Aaa	RMBS	1997.01	
A-1	Guardian S&L Assn 1991-01	Aaa	RMBS	1995.07	
M	Housing Securities Inc 1992-9	A2	RMBS	1994.06	YES
C3	Imperial CMB Trust 1998-1	B3	RMBS	1999.05	
IIB-1	MDC Mtg Funding Corp (Greenwich/Long Beach) 1994-LB7	Baa3	RMBS	1999.06	YES
C	Morgan Stanley Capital I Inc. Series 1997-P2	B3	RMBS	2001.05	YES
A	Nomura Asset Capital Corp 1994-01	Aa2	RMBS	1997.10	
A-1	PaineWebber Mtg Acpt IV 1991-01 (Coast)	Aa2	RMBS	1992.05	YES
B-4	Pass-Through Asset Class Execution 1997-I (CWMBS 1997-4)	B2	RMBS	2001.08	
A	Prudential Home Mtg Co 1988-05	Aa2	RMBS	1992.08	
B3-1	Prudential Home Mtg Co 1992-A	A2	RMBS	1997.10	
B3-2	Prudential Home Mtg Co 1992-A	A2	RMBS	1997.10	
B3-3	Prudential Home Mtg Co 1992-A	A2	RMBS	1997.10	
B3-4	Prudential Home Mtg Co 1992-A	A2	RMBS	1997.10	
B4	Prudential Home Mtg Co 1992-A	Baa2	RMBS	1995.12	YES
B5	Prudential Home Mtg Co 1992-B	Ba3	RMBS	1993.06	
B-3	Prudential Home Mtg Co 1993-17	Ba2	RMBS	1999.06	YES
B-2	Prudential Home Mtg Co 1993-24	Ba2	RMBS	1999.02	YES
B3	Prudential Home Mtg Co 1993-F	Ba2	RMBS	1997.12	YES
B6	Prudential Home Mtg Co 1995-C	B3	RMBS	1998.01	YES
A	RFC Mtg Exchange Corp 1989-SW-1B	Aa2	RMBS	1992.02	
C-2	Ryland Mtg Sec 1993-06B	Baa3	RMBS	2001.06	

Tranche Name	Deal Name	Original Rating	Asset Type	Default Year.Month	Matured as of 12/31/02
D-2	Ryland Mtg Sec 1993-06B	Ba3	RMBS	1997.04	YES
E-2	Ryland Mtg Sec 1993-06B	B3	RMBS	1997.03	YES
B-1	Ryland Mtg Sec 1994-05	Ba2	RMBS	1997.09	
B-2	Ryland Mtg Sec 1994-05	B3	RMBS	1997.05	YES
B-2	Saxon Mtg Sec 1994-08	B2	RMBS	2000.04	YES
B-2	Saxon Mtg Sec 1994-10	B2	RMBS	1999.01	YES
Cl. 3	SBMS 1997-A	Ba3	RMBS	2001.03	
B	SBMS VII 1993-08	Ba3	RMBS	1996.09	
B-2	SBMS VII 1994-02	Ba3	RMBS	1997.12	
8-B	SBMS VII 1994-07 & 1994-08	Ba3	RMBS	2000.06	
7-B	SBMS VII 1994-07 & 1994-08	Ba3	RMBS	1996.07	
12-B	SBMS VII 1994-12	B2	RMBS	1997.05	
13-B	SBMS VII 1994-13	B2	RMBS	1997.07	
B	SBMS VII 1994-16 (Option One)	B1	RMBS	1997.03	
B	SBMS VII 1995-01	Ba2	RMBS	1998.05	
B-1	SBMS VII 1995-B (Option One)	Ba3	RMBS	1997.08	
M-2	Securitized Asset Sales Inc 1994-04	A2	RMBS	1999.06	
M-3	Securitized Asset Sales Inc 1994-04	Baa2	RMBS	1998.02	YES
B-1	Securitized Asset Sales Inc 1994-04	Ba2	RMBS	1996.10	YES
B-2	Securitized Asset Sales Inc 1994-04	B3	RMBS	1996.04	YES
I-B3	Structured Asset Sec Corp 1995-2	Baa2	RMBS	1999.06	
B4	Structured Asset Sec Corp 1996-4 (Norwest)	Ba2	RMBS	2002.12	
B5	Structured Asset Sec Corp 1996-4 (Norwest)	B2	RMBS	2001.09	
B-2	United Mtg Sec Corp 1993-01	NR	RMBS	2000.07	
B-2	United Mtg Sec Corp 1994-01	B2	RMBS	1997.03	
M-2	ContiMortgage Home Equity Loan Trust 1997-01	A3	HEL	2000.09	
B	ContiMortgage Home Equity Loan Trust 1997-01	Baa3	HEL	1999.10	YES
B-1A	ContiMortgage Home Equity Loan Trust 1997-2	Baa3	HEL	2000.07	
M-2F	ContiMortgage Home Equity Loan Trust 1997-2	A3	HEL	2001.07	
B	ContiMortgage Home Equity Loan Trust 1997-4	Baa3	HEL	2000.10	
B3	GE Capital Mtg Services Inc 1996-HE3	Ba2	HEL	2000.06	
B4	GE Capital Mtg Services Inc 1996-HE3	B3	HEL	2000.05	YES
B2	GE Capital Mtg Services Inc 1997-HE2	Baa2	HEL	2002.02	
B3	GE Capital Mtg Services Inc 1997-HE2	Ba2	HEL	2000.11	YES
B4	GE Capital Mtg Services Inc 1997-HE2	B2	HEL	2000.05	YES
B3	GE Capital Mtg Services Inc 1997-HE3	Ba2	HEL	2002.02	
B4	GE Capital Mtg Services Inc 1997-HE3	B2	HEL	2001.02	YES
B3	GE Capital Mtg Services Inc 1997-HE4	Ba2	HEL	2002.05	
B4	GE Capital Mtg Services Inc 1997-HE4	B2	HEL	2001.03	YES
B3	GE Capital Mtg Services Inc 1998-HE1	Ba2	HEL	2002.09	
B4	GE Capital Mtg Services Inc 1998-HE1	B2	HEL	2001.01	YES
B4	GE Capital Mtg Services Inc 1998-HE2	B2	HEL	2001.01	
B-2	Green Tree Home Improvement Loans 1994-CI	Baa1	HEL	1998.03	
Certificate	Green Tree Home Improvement Loans 1995-B	A3	HEL	1996.04	YES
A	Green Tree Home Improvement Loans 1996-B	A3	HEL	1999.04	
B	IMC Home Equity Loan Trust 1997-3	Baa3	HEL	2001.10	
B	IMC Home Equity Loan Trust 1997-5	Baa3	HEL	2001.03	
B-2	Impac CMN Trust 1998-1	Ba2	HEL	2000.06	
B-5	Ocwen Residential MBS Corp. Mortgage Pass-Through, 1998-R3	B2	HEL	2000.09	YES
B-3	Ocwen Residential MBS Corp. Mortgage Pass-Through, 1998-R3	Baa2	HEL	2002.07	
B-4	Ocwen Residential MBS Corp. Mortgage Pass-Through, 1998-R3	Ba2	HEL	2001.03	YES
B1-I	Residential Asset Securities Corp 1995-KS3	Ba2	HEL	1997.07	YES
B2-I	Residential Asset Securities Corp 1995-KS3	B2	HEL	1996.12	YES
B1-II	Residential Asset Securities Corp 1995-KS3	Ba2	HEL	1997.04	YES
BF-3	Saxon Asset Securities Trust 1999-1	B2	HEL	2001.10	
B	Security National Mortgage Loan Trust 1998-1	A3	HEL	2001.02	YES

Related Research

Rating Methodology:

Moody's Approach To Rating Synthetic Resecuritizations, October 2003, #SF27650

Special Comment:

Default & Recovery Rates of Corporate Bond Issuers 1920-2003, January 2004, #80989

Payment Defaults And Material Impairments Of U.S. Structured Finance Securities: 1993-2002, December 2003, #80247

Recovery Rates on Defaulted Corporate Bonds and Preferred Stocks, 1982-2003, December 2003, #80272

Structured Finance Rating Transitions: 1983-2003, February 2004, #81239

Structured Finance Rating Transitions: 1983-2002, January 2003, #77291

Special Report:

Moody's Approach to Rating Multisector CDOs, September 15, 2000, #SF9050

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

To order reprints of this report (100 copies minimum), please call 1.212.553.1658.
Report Number: 86769

Authors	Editor	Associate Analyst	Production Specialist
Jian Hu *Richard Cantor*	*Michael D'Arcy*	*Alexandra Neely*	*John Tzanos*