MORNINGSTAR®

U.S. CMBS Subordination Model

Morningstar Credit Ratings
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Contents

Editor's note: There are no substantive changes from the methodology published in February 2017. This methodology, which supersedes the methodology published in February 2017, takes effect immediately.

Introduction

The Morningstar CMBS Subordination Model uses a number of assumptions based on proprietary and third-party empirical data whenever robust data is available and defaults to industry experience and intuition when it is not. This paper discusses the concept behind the assumptions.

Basic Concept

The Morningstar CMBS Subordination Model derives the credit-support levels needed at each rating for a single loan or a portfolio of commercial real estate loans collateralizing a commercial mortgage-backed securities transaction. Several factors influence credit-support levels, including Morningstar's assessment of each property and the loan it backs, our assessment of the relationship between certain loan- and portfolio-level metrics, such as debt service coverage and loan to value, and most importantly, the portfolio's recovery prospects when defaults occur. The model also accounts for various portfolio-level characteristics and concentration risks that result in justifiable differentiation in credit-support across heterogeneous portfolios.

The first step of Morningstar's rating process is to analyze the collateral. In the case of multiple loan transactions, all or a representative sample of the loans is analyzed. Morningstar determines the sustainable net cash flow and typically values each property using the direct capitalization method. We then derive the sustainable debt service coverage ratio and beginning and ending loan-to-value ratios for each corresponding loan. A comprehensive description of Morningstar's loan analysis approach is beyond the scope of this paper. For those loans not analyzed, Morningstar applies a stress assumption to the loan originator's underwritten NCF to arrive at an estimation of the sustainable NCF.

Morningstar then subjects the sustainable NCF and capitalization rate for each property, along with the corresponding loan characteristics, to stresses in the CMBS model to derive the required credit support at each rating category. Each set of stresses gauges the likelihood of loans to default during the term and at the balloon date commensurate with economic environments represented by the rating categories.

Each set of stresses includes the following:

- NCF declines during the term of the loan and at the balloon date that reflect worsening economic conditions;
- Capitalization-rate increases that reflect deteriorating demand for commercial real estate investments;
- Balloon-loan constants to reflect restrictive lending conditions when the existing loan needs to be refinanced;
- Time-to-default assumptions that limit the amortization credit to loans by assuming that loans experience a term default;
- Loan liquidation time assumptions that affect the aggregate special-servicer fees and accrued interest on principal and interest advances; and
- Interest-rate assumptions on interest due the servicer for P&I advances.

The combination of these stresses creates tiering by rating category with the most onerous set of stresses commensurate with the highest rating category to reflect extremely stressed economic, commercial real estate market, and lending environments. The stresses associated with the lowest rating category, while substantially less onerous than those at the highest rating level, still reflect declines in loan performance. The model, therefore, discounts the positive performances observed in the empirical data. Several of the stresses also differ across property types, as explained later in this document.

The model also penalizes loans that comprise a substantial proportion of the portfolio, as measured by the outstanding principal balance, with an additional NCF reduction. The magnitude of this penalty increases nonlinearly with the proportion. For example, all else being equal, the additional NCF reduction applied to a loan that represents 20% of the portfolio is more than twice the reduction applied to a loan that represents 10% of the portfolio.

Determining Probability of Default and Loss Severity

Morningstar's CMBS Subordination Model derives the required credit-support level at each rating level by computing the probability of default and loss severity for each loan to arrive at the expected loss. We perform this separately for term and balloon default events. We then use a conditional formula based on the logic that term default occurs before balloon default to arrive at the overall expected loss for each loan.

We discuss the model's treatment of these two potential default events separately.

Term Default

The model determines the likelihood of a term default for each loan by following six steps:

(1) First, we subject Morningstar's sustainable NCF for the loan to a stress that simulates the potential decline in net effective rent over the term of the loan. The magnitude of this decline represents the maximum assumed decline in NCF on the property during the loan term.

(2) We then further reduce the Morningstar sustainable NCF by a loan concentration haircut that penalizes loans that comprise a substantial portion of the portfolio.

(3) Next, we reduce the resultant NCF by a property type concentration haircut that penalizes loans backed by property types that comprise a high proportion of the overall portfolio.

(4) Morningstar then reduces the resultant NCF by a geographic concentration haircut that penalizes loans backed by properties in regions that comprise a high proportion of the overall portfolio.

(5) We then use the resultant stressed NCF and the terms of the loan to determine the loan's stressed DSCR. This DSCR is the lowest coverage ratio projected by the model for the subject rating category.

(6) Finally, we derive the loan's probability of default during its term by translating this "low-point" DSCR into a probability of default benchmarked against a Morningstar empirical study of the correlation between DSCR and the probability of default.

The other component Morningstar uses to compute the expected loss during the term of the loan is loss severity, which consists of two sources: lost principal and special-servicer costs. In practice, a special servicer has a number of tactics to maximize the recoveries on problem loans, including modifying the terms of the loan, foreclosing on the loan, and selling the loan. The model simplifies these actions by assuming that the special servicer forecloses on all loans that experience a term default. We believe this is a conservative assumption that leads to higher projected principal losses.

Lost principal is the difference between the outstanding loan balance at the time of default and the stressed property value. The model computes the loan balance based on empirically based time-to-default assumptions and the terms of the loan. We arrive at the stressed property value by using the stressed NCF and a ratings-adjusted capitalization rate.

Servicing costs include the fees earned by the special servicer, interest on any P&I advances that the servicer makes, and the liquidation fees due the special servicer for selling the foreclosed property. The special-servicer fees are dependent upon the length of time the loan is specially serviced. The model uses assumptions of this time period tiered by rating category. We then calculate the expected loss for a loan during its term as the product of its probability of default and the loss severity.

Balloon Default

The overwhelming majority of loans in CMBS deals to date do not fully amortize by their maturity dates. As such, most loans have a balloon date. Borrowers are required to secure take-out financing for the remaining principal balance by this date. Failure to do so triggers a default event, and the loan becomes specially serviced. Balloon default is therefore a binary event.

Using the model, Morningstar tests the ability of each loan to get refinanced at its balloon date by comparing the loan's stressed refinance DSCR and LTV with assumed refinancing threshold requirements. We stress the sustainable NCF and cap rate and then apply a stressed refinance loan constant to arrive at the loan's refinance DSCR and LTV. We project the loan will be refinanced with no loss if the DSCR and LTV metrics pass this test. If they do not, we assume the loan has defaulted and estimate the loss severity. Note that the model conservatively assumes the borrower is either unable or unwilling to infuse equity at the refinance date.

Details on the Model Assumptions

In this section, we discuss the details of the underpinnings of the model and the assumptions used in arriving at the credit-support levels. We cover each of the model's primary concepts and features, which include the following:

a) NCF Reduction Stresses
b) Cap-Rate Adjustments
c) Loan-Concentration Adjustments
d) Property-Type-Concentration Adjustments
e) Geographic-Concentration Adjustments
f) Translating DSCR to Probability of Default
g) Differentiating Across Loan Terms
h) Time-to-Default Assumptions
i) Refinance Loan Constant
j) Liquidation Period
k) Special-Servicing Costs
l) Overall Expected Loss

(a) NCF Reduction Stresses

The model applies a base stress to the Morningstar sustainable NCF. We stress the tiers by property type and rating category. We base the NCF stresses on a combination of empirical data of average annual vacancy rate and effective rent declines for different property types in the United States at the national level, and qualitative subjectivity. We also used regional and metropolitan statistical area level performance for guidance into how much worse future performance could get. Morningstar's analysis of this data looks at the annual net effective rent, which is the product of occupancy rate and effective rent. Because our focus is on determining the magnitude of NCF stress at the various rating levels, we concentrate on the periods of declining net effective rent.

The empirical data show that certain property types such as hotels experienced greater NCF volatility than others. This is reflected in the model. It should be noted, however, that the NCF stresses are not solely based on empirical data. We also give consideration to the possibility of extreme or unprecedented future events. For instance, though retail properties at the national level have experienced only three minor net effective rent drops over any 10-year window (the largest was -1.1%), the model's base NCF stresses reflect our view that changes in consumer-spending behavior will negatively affect retail performance more than evidenced in the data.

We use two sets of base NCF stresses: one for defaults during the term of the loan and the other for defaults at the loan balloon payment date. The stresses for term default are generally more severe than those for balloon default. Details of these approaches follow.

Term Default NCF Stress

We benchmark the NCF decline assumptions for term default against the worst drops in net effective rents at the national level from the peak of the market to the bottom in the period analyzed. Because most of the loans have 10-year maturities, we limited the period of decline to 10 years or less. In many instances, the largest observed declines occurred over a few years. Thus, the peak-to-trough declines are often markedly more severe than declines over full 10-year spans.

The empirical data also show that certain property types have demonstrated a propensity for greater negative NCF volatility than others. Of the more traditional property types, office and hospitality properties have experienced substantially greater NCF declines than retail and multifamily properties. Accordingly, the model applies base NCF declines by property type to reflect this observed distinction.

By using these severe and often short-term drops as the NCF stress, the model projects how low the DSCR for each loan could get in each rating category and translates this into the loan's probability of default.

The base NCF decline assumptions are tiered by rating category with the worst observed peak-to-trough decline used as the benchmark for the A rating stress.

Balloon Default NCF Stress

Morningstar benchmarks the base NCF stress assumptions used in the model's balloon default projections against the worst observed drops in net effective rents over 10-year periods in the period analyzed.

As in the case with the peak-to-trough observations, empirical data support the view that certain property types have a propensity for greater negative NCF volatility than others over 10-year periods. This, too, is reflected in the model's base assumptions for balloon default NCF stresses.

The base NCF decline assumptions for balloon default projections are tiered also by rating category, with the worst observed 10-year decline used as the benchmark for the A rating stress.

For loans with terms less than 10 years, we may adjust the stresses to reflect the relevant time exposure.

(b) Cap-Rate Adjustments

Morningstar's loan analysis process includes the valuation of each property using a cap rate that takes into account the current commercial real estate environment. The model stresses this cap rate at each rating category to reflect Morningstar's belief that the balance between sellers and buyers in the commercial real estate market shifts along with the economic environments. Accordingly, higher rating categories are stressed with a higher base-cap rate adjustment to reflect more restrictive property transaction environments.

This adjustment results in more severe principal losses at the higher rating categories because such losses are computed as the difference between the outstanding loan balance and Morningstar's stressed value.

(c) Loan-Concentration Adjustment

While a typical fusion/conduit transaction provides diversity benefits that mitigate the impact of one or a few loan defaults, the inclusion of large-balance loans introduces event risks that can have a heightened negative impact on the transaction. Morningstar addresses this risk by further adjusting the NCF downward on each property using a sliding scale tied to the loan's beginning balance as a percentage of the aggregate portfolio beginning balance. Under this approach, the base NCF adjustment on a single

loan that accounts for 20% of the portfolio is greater than the collective adjustments on two loans that each represents 10% of the portfolio.

A nonlinear equation is used to size the NCF adjustment to provide increasingly punitive adjustments as the loan concentration increases. In contrast to a linear function, it applies small reductions on the NCF of smaller loans and much higher reductions on loans that represent substantial portions of the portfolio. Contrasted with an exponential function, it imposes slightly larger reductions on smaller loans but the increase in penalty on larger loans does not increase as rapidly.

The nonlinear equation applies adjustments on loans that represent more than an immaterial percentage of the portfolio balance. Examples of the adjustment amount are provided below.

Loan-Concentration Adjustment

Formula is f(x)=a* x ^b, where x is the loan size as a percentage of the portfolio balance and the coefficients are:

Coefficients	Values	Examples: X	Haircut
a	1.0110	1.0	5.4
b	0.6342	5.0	15.1
		10.0	23.5
		20.0	36.4

It is important to point out that this loan concentration adjustment is applied as a percentage of the NCF reduction. For instance, if the NCF reduction is 45% and the loan concentration adjustment is 5%, then the reduction to the unstressed NCF is 5% of 45%, or 2.25%. On a property with a Morningstar sustainable NCF of $10 million, this loan concentration reduction is $225,000.

Because the base NCF reductions generally vary by property type, the model also tiers the concentration adjustment across property types and rating categories. Less-stable property types, such as hotels, are affected more, and the adjustment at the higher rating categories is greater.

(d) Property-Type-Concentration Adjustment

Economic factors and world events affect the performance of each property type to different degrees. For instance, the combination of the dot-com recession and 9/11 terrorist attacks generally had a greater impact on hospitality properties than on multifamily properties. High concentrations of any property type in a deal would thus subject the deal's performance to additional risks.

The majority of fusion/conduit transactions are typically well diversified across most or all the major property types. Some deals, large loan transactions in particular, might have more concentration in one or more types and are therefore more exposed to property-type-concentration risk.

The type of property concentration also matters. For instance, we view a pool composed of 70% office properties as riskier than one with 70% multifamily properties.

Morningstar addresses the risks inherent in portfolios with high property-type concentrations in the following two ways:

- First, the model's base NCF stresses differ across property types. When a portfolio contains a high concentration of the more volatile property types (office or hospitality for example), the differences in NCF stresses results in higher credit-support requirements.
- Second, we apply a property-type-concentration adjustment to further stress the NCF of those properties with high concentrations. This affects both concentrations in the more-volatile and less-volatile property types.

The magnitude of the property-type-concentration adjustment increases as the overall exposure to the property type increases via a linear function. For instance, each property of the type that represents 50% of a portfolio would be stressed harder than if the type represented 35% of the overall balance. We apply the adjustment to all loans backed by properties with high concentrations, not just the incremental excess above the threshold.

As in the case of the loan-concentration adjustment, we apply the property-type-concentration adjustment as a percentage of the base NCF reduction, so the concentration adjustment is also tiered by property type and rating category. We adjust the relatively volatile property types (such as office, hospitality, and healthcare) downwards further than the less volatile types (such as multifamily, retail, and industrial).

(e) Geographic-Concentration Adjustment

We benchmark the model's base NCF stresses against historical declines at the national level. Geographic concentrations therefore introduce additional risk. Morningstar addresses this risk by applying a geographic-concentration adjustment to the stressed NCF of the properties in highly concentrated regions.

We apply the geographic-concentration adjustment to those properties in regions with high concentrations. The magnitude of the adjustment is the same for each region and grows as the degree of concentration increases. Again, as in the case of the loan-concentration adjustment, we apply the geographic-concentration adjustment as a percentage of the NCF reduction.

Morningstar breaks up the U.S. into 10 regions: New England, Mid-Atlantic, Southern Atlantic, Southern East Coast, Southern West Coast, Midwest-Eastern, Midwest-Western, Northwestern, West-Mountain, and Western-South Pacific.

(f) Translating DSCR to Probability of Default

After we apply all the relevant NCF adjustments to the Morningstar sustainable NCF in the term default analysis, the model calculates the DSCR for each loan, and uses this to determine the loan's probability of default. In the case of partial interest-only loans, we calculate the DSCR ratio based on the loan's amortization phase.

Once we compute the DSCR, the model translates this ratio into a probability of default for the loan using an equation derived from an internal regression analysis of loans in conduit/fusion CMBS transactions. The analysis allows us to quantify the correlation between the DSCR on a loan and its default probability, by property type. Two loans with identical DSCR ratios will have different probabilities of default if they are backed by different property types.

(g) Differentiating Across Loan Terms (Amortizing versus Interest-Only Loans)

The model takes each loan's financing terms into account, differentiating among amortizing loans, interest-only loans, and partial interest-only loans. This directly affects the calculations that lead up to loss severity for both term and balloon defaults.

Amortizing loans get credit for the reduced loan balance up to an assumed time of default in the term default computations. Because loss severity (in dollar terms) is the amount by which the loan balance exceeds the property value, with all else being equal, amortizing loans experience lower losses following default.

Conversely, because of the lower debt service payments, the model gives favorable treatment to interest-only loans in the probability of default calculation for term default. This could partly counterbalance the higher loss severity. This is, however, not the case in balloon default analysis because the model assumes that at the balloon date, the interest-only loan is refinanced by an amortizing loan, often at a higher loan constant.

(h) Time-to-Default Assumptions

The model's calculation of a loan's balance at the time to default is predicated on assumptions of the time lapsed from the CMBS transaction's origination date to the projected loan default date. The model affords credit to the amortization on loans based on this timing. Interest-only loans receive no such credit and partial interest-only loans only receive credit to the extent the interest-only period has lapsed prior to the assumed default date.

The model calculates loss severity as the amount by which the property value falls short of the outstanding loan balance. In the term-default analysis, credit given for amortization lowers the loan balance which, in turn, lowers the lost severity and ultimately culminates in lower credit-support requirements.

We benchmark the assumptions for time to default in the model against an internal analysis of defaulted loans in CMBS transactions tracked by Morningstar. This analysis defines loans experiencing 60-plus days delinquency as defaulted loans. It uses the CMBS issuance date as the starting point (instead of the loan origination date) and the time the loan first became 60-plus days delinquent as the proxy for the default date. The analysis was broken out by property type and cumulatively recorded loan defaults.

The assumptions used are accordingly segregated by property type and tiered by rating category. This tiering is tied to the percentage of observations that occurred by the assumed time frame as shown below:

Rating Category	% of Observations
AAA	10
AA	20
A	25
BBB	30
BB	40
B	50
B-	50

For example, the AAA assumption for time to default is the number of months within which approximately 10% of the recorded defaults occurred. We believe this assumption is conservative because 90% of the time the defaults occurred later and we thereby give minimal credit for amortization. The BBB assumption reflects the number of months within which 30% of the defaults occurred. Here we give more amortization credit.

(i) Refinance Loan Constant

The model assumes that the lending environment at a loan's balloon date will typically be more restrictive than when the loan was initially originated. This is achieved by tiering loan constants by rating category. These constants are benchmarked against an internal study of loan constants on loans in CMBS transactions. Note that there are historical periods where the loan constants were higher than the loan constant used in the model.

(j) Liquidation Period

After the property backing the foreclosed loan becomes a real estate owned property, Remic rules give the special servicer three years to sell the property. The model's assumption for the time it takes to complete the sale is tiered by rating category, with 18 months assumed for the AAA scenario and quicker sales moving down the ratings scale. A longer sales period has the effect of incurring more special-servicing fees and interest on any P&I projected advances.

(k) Special-Servicing Costs

When a loan experiences a default either during its term or at the balloon date, the model assumes that it is transferred to the special servicer and costs associated with such servicing activities are borne by the trust. The model specifically accounts for three such costs:

- Special-Servicing Fee
- Interest on P&I Advances
- Liquidation Fee

Special-Servicing Fee

While a loan is classified as a "specially serviced loan," a fee is earned by the special servicer. This fee is an annual rate, as dictated by the deal's pooling and servicing agreement, based on the outstanding principal balance. There is often also a minimum monthly fee. The model applies an estimated special-servicing fee but allows the user to override it by entering a fee rate and minimum monthly amount. It uses the default event as the time when the loan becomes specially serviced.

In the event of either a term default or balloon default, the model assumes the servicer forecloses on the loan and sells the property. The special-servicing fee is calculated over an assumed liquidation period commensurate with the rating category. The principal balance used in the fee calculation is the outstanding balance at the time the model projects the default event. It does not account for any amortization that may occur after the default event, and the fee calculated is likely higher than it should be.

Interest on P&I Advances

The servicer is required to advance on any shortfalls on the monthly loan payments that the borrower is not able to cover, subject to a recoverability standard. The model uses the stressed NCF as the proxy for the amount of funds available to cover loan payments. It assumes that the borrower is unable or unwilling to cover any shortfalls.

We determine an appraisal reduction as part of the calculation of the amount the servicer advances. The purpose of this reduction is to protect the trust against advances that might not be recoverable. Thus, though there is a loan payment shortfall, the appraised value of the property might be low enough that the servicer would not cover any or a portion of the shortfall.

In practice, an appraisal is ordered as part of the appraisal reduction exercise. For modeling purposes we use the calculated stressed value as the proxy for the appraisal amount. Morningstar bases the appraisal reduction on a percentage of this appraisal amount. This percentage is dictated by the deal's PSA and is often consistent with an industry standard. The model applies an estimated percentage based on the industry standard.

For both term default and balloon default, the stressed NCF falls short of the loan payment due and the special servicer forecloses on the loan. The advance is made over the assumed liquidation period commensurate with the rating category.

The interest due on the P&I advance accrues at an interest rate dictated by the deal's PSA. It is typically based on an interest-rate index. The model uses assumed interest rates tiered by rating category in its calculation of the interest accrued. The model assumes this interest is paid to the servicer when the loan is liquidated.

Liquidation Fee

The special servicer is due a fee for realizing recoveries upon liquidation of the loan or when the loan has been refinanced after it has been specially serviced. We compute this liquidation fee by applying an industry standard rate to the net liquidation proceeds. The model uses the stressed property value determined by the model as the proxy for net liquidation proceeds. This results in a higher calculated fee and partially compensates for liquidation expenses that are not addressed by the model.

The model assumes no change in the value of the property from the time foreclosure is initiated to the time the loan is liquidated. Given the onerous assumptions used in the model leading up to the default event, this assumption is likely conservative.

It should also be noted that deals typically contain a purchase option that allows the holder of this option to purchase the loan. In some situations, there is a mezzanine loan on the property and that lender has the option to purchase the loan held in the CMBS trust. If either sale were to occur, the special servicer is not due the liquidation fee. The model ignores this possibility, thus making the approach more conservative.

(I) Overall Expected Loss

Having separately calculated expected losses for a loan in the term and balloon default analyses, the model then computes the loan's overall expected loss. This calculation uses a conditional equation based on the logic that:

- A loan could experience a term default or a balloon default;
- The probability of a loan experiencing a term default or a balloon default are independent of each other; and
- A term default would occur first and a balloon default is possible only if a term default does not occur.
- The conceptual equation is as follows.

$$EL = ELt + [ELb * (1-PDt)]$$

Where, EL is the overall expected loss,
ELt is the term expected loss,
ELb is the balloon expected loss, and
PDt is the term probability of default

The weighting between the term and balloon scenarios might be adjusted if it is determined that the weighting does not properly reflect the overall risk of the loan.

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