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Moody's Mortgage Metrics - A Model Analysis of Residential Mortgage Pools (Moody's Special Report)

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Moody's Mortgage Metrics: A Model Analysis of Residential Mortgage Pools

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SUMMARY: CONSISTENT RISK TARGETS FACILITATE AUTOMATED APPROACH FOR "A" POOLS

From the market's inception in 1987, Moody's has employed quantitative tools and qualitative assessments in rating nearly \$2 trillion of nonconforming one-to four-family residential mortgage-backed securities (MBS). With razor-thin profit margins in the conforming and, more recently, the Jumbo "A" markets, efficiency and size have become the lenders' mantras. Toward that end, technology has come to dominate all aspects of "A" residential mortgage finance, starting with the solicitation of business and carrying through credit approval, closing, and servicing. As a consequence, lenders are producing pool after pool of loans with virtually identical aggregate risk characteristics. Further, qualitative differences under different programs or across different originators are having more predictable impacts on pool performance. These developments triggered Moody's to update our approach to rating conforming and Jumbo "A" residential MBS.

As in the past, this update not only addresses the fundamental market shifts that have occurred over the past few years, but also incorporates up-to-date performance information for jumbo loans. Our analysis benefits from the public availability of performance information from Loan Performance, Inc. (LPI, formerly known as Mortgage Information Corporation) on over 500,000 Jumbo "A" loans. With this information, sophisticated survival analysis can be applied to loan characteristics for the frequency of default calculation. Further, the cause-and-effect relationship of macroeconomic variables can be assessed precisely. The analysis of loan loss severity stress cases is also improved. **The end product of this process is our latest RMBS model, Moody's Mortgage Metrics™.**

This article summarizes Moody's current thinking about the analysis of traditional "A"-quality and "Alternative-A" residential mortgage securitizations. The analytic process adjusts to new products and patterns that emerge in the marketplace, but our goal is to analyze these developments within a consistent analytic framework.



MARKET OVERVIEW

Shifting Origination Practices Warrant a New Approach

Tightening spreads, and the resulting consolidation of originators in the Jumbo A market, has brought efficiency to the forefront of the mortgage lending process. Industry best practices are being adopted and modified by all of the major participants, with standards for the huge conforming mortgage market often serving as a benchmark. Among other things, originators are deploying technology to rapidly assess borrower quality, loan risk, and appraisal accuracy, with mortgage insurers similarly standardizing their risk assessment processes for higher-LTV loans.

These streamlined processes, and improved technology infrastructure, ensure tighter control over originations and servicing. Lenders striving to produce pools of uniform risk are able to succeed consistently. Although Moody's continues to believe that differences in originator practices and loan programs have the potential to have a large influence on loan performance, beyond that predictable by any quantitative model¹, we also believe that lenders' efforts toward best practices and uniform risk across deals will create a large subset of pools that can be assessed through a largely quantitative model. **Specifically, Moody's has refined its RMBS model for that set of large, geographically diverse Jumbo A and Alt-A pools from established originators and rated servicers to the point of delegating the bulk of the determination of these credit support levels to the model.** The home equity market has not progressed sufficiently to so delegate those rating decisions.

Key Refinements to the Rating Approach

Credit support levels, particularly for higher-rated securities, are determined with a view toward protecting investors against collateral losses beyond those that would result in an average economy. **The principal analytic refinement in Moody's revised RMBS model is a stronger emphasis on evaluating the direct sensitivity of loan and pool performance to specific economic stresses.** Moody's Mortgage Metrics software establishes parameters for quantifying the causal links between local economic shifts and loan- and pool-level defaults, and severity of loss upon default.

The availability of full payment histories on our development sample facilitated detailed conclusions on these complex quantitative linkages.

- The expansion of LPI's database, and lengthening of observations for existing pools, offers key additional insights into loan performance. In addition to the increased level of detail, this information is publicly available, enabling Moody's greater freedom in publishing our conclusions.
- The detailed performance histories offer the opportunity to examine with increased precision the causal links between economic stresses and loan behavior. These examinations replace reliance on expected pool loss distributions to examine behavior in stress scenarios, greatly increasing the precision with which we can predict loan behavior in stress situations.
- Advanced time-series analysis increases predictive power, and enables extraction of meaningful conclusions from even moderately short-lived vintages.

The Rating Process Evolves

Moody's rating process still begins with a review of an originator's and servicer's policies and practices. Next comes an analysis of the characteristics of the loans in the pool. Pools fitting traditional "A" or "Alt-A" parameters, from originators and servicers that are followed by Moody's analysts, will be evaluated by Moody's Mortgage Metrics. Optimally, securitizations proffering the model's indicated credit support levels will be assigned corresponding ratings.

¹ See "Moody's Approach to Rating Residential Mortgage Pass-Through Securities," *Moody's Special Report*, November 8, 1996.

A NEW MODEL AS AN ELEMENT OF THE RATING PROCESS

Mechanics of Moody's Mortgage Metrics

Simulating Pool Performance

Moody's Mortgage Metrics was developed to produce sensitive simulations of outcomes for "A" and "Alt-A" pools through a variety of economies. The development focus was on geographically diversified, "A" borrower, first lien pools, including loans with nonconforming characteristics that would be originated under an "Alt-A" program; the current version of Moody's Mortgage Metrics will generate results only for those pools.

Moody's Mortgage Metrics provides an interface for "cleaning" loan level data and compiling loan pools or sub-pools. **Once a pool is selected, the performance of each loan in the pool is simulated quarterly through each of over 1,000 economies.**

- The simulated interest rate and local unemployment and real estate market movements serve as crucial inputs in determining the probabilities of a loan defaulting, prepaying, or remaining active in any quarter.
- Loan-specific information, as detailed below, is also incorporated.
- Performance of "survivors" (loans not allocated as having prepaid or defaulted) continues to be simulated in future quarters. Thus, loss analysis is time and history dependent—early prepayment spikes, such as would occur in a declining rate environment, will reduce later defaults, and Moody's Mortgage Metrics captures this effect.

Loan loss severity is also a function of loan characteristics and the local economy. The interaction of market movements and loan loss severity is complex. Moody's continues to reject the notion that a uniform severity level applies to every loan in a pool for a particular stress; rather, Moody's Mortgage Metrics incorporates the rich experience of loss levels and volatility into the modelling process.

The economic scenarios used in our modeling represent a "universe" of potential scenarios. Moody's has long recognized the superiority of considering a distribution of future economic stresses rather than relying on a single historical economy as a presumed "worst possible" scenario. Because the proper evaluation of geographic diversity is key to analyzing a pool of mortgages, the economic simulations capture not only the range of distributions of interest rate, unemployment, and real estate market movements, but also the correlations of these movements across states. Diverse pools will suffer lower losses in virtually all stress scenarios, which is reflected in Moody's Mortgage Metrics when loan results are compiled with those of other loans in each economic scenario. See *"Impact of the Economy—Economic Simulations Capture Stresses,"* below.

Credit Support Levels

The model's result after simulating loan performance is a pool loss vector, aggregating individual loan results into pool losses for each economy. With the lifetime pool loss distribution in hand, we can analyze the cash flow to the securitization structure and determine the "expected" loss to any supported tranche. Moody's does this by calculating loss due to credit risk for each tranche, a technique that appeals to the way in which investors conceptualize and price for credit risk.

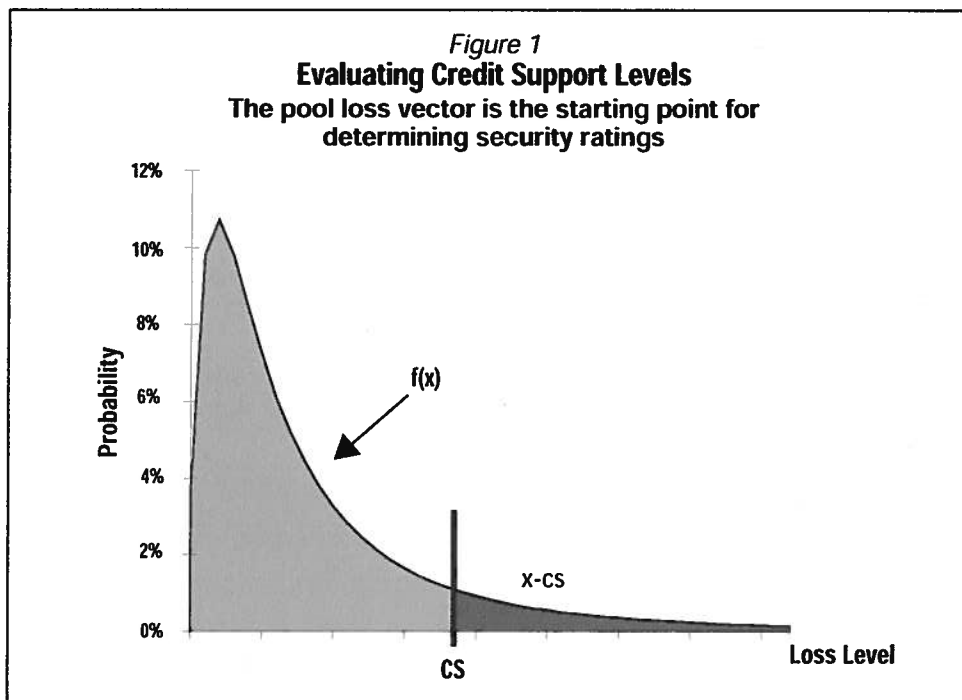


Figure 1 shows the probability density function $f(x)$ for a hypothetical pool of mortgage loans. Suppose a pool is assigned a credit support level, CS , expressed in dollar terms. For lifetime pool losses X (also in dollar terms), if in excess of the credit support level, we examine the difference $X-CS$, which we could term "unsupported losses." The expected dollar loss for the supported tranche is the average of unsupported losses for the given pool loss vector and CS . By dividing this expected dollar loss by the size of the supported tranche, we have an estimate of lifetime losses, in percent terms. We also have a basis by which we can compare loss potential across security types.

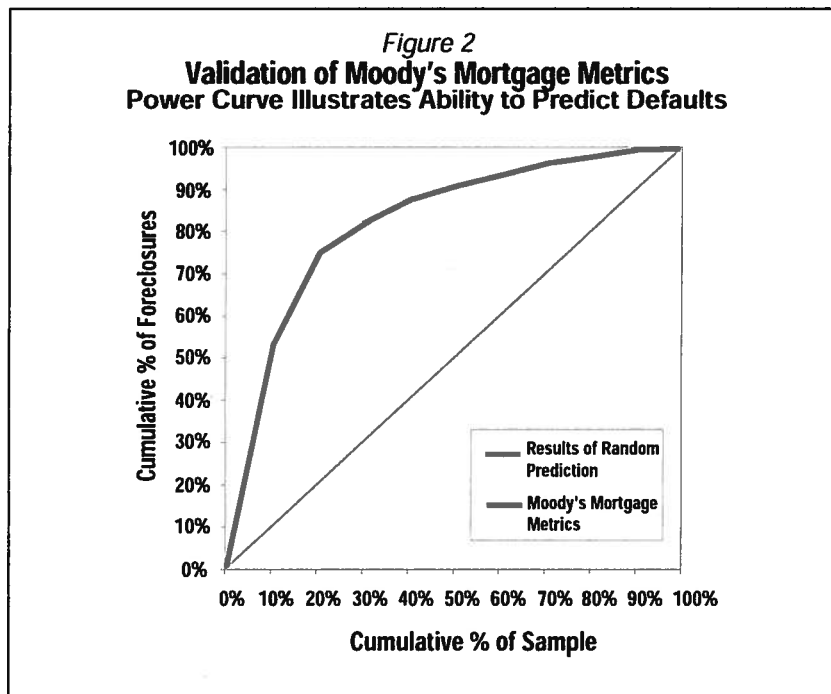
To achieve consistency with loss potential on all rated corporate bonds, we compiled a schedule of basis point losses paired with corresponding rating categories. Knowing the rating desired for the supported tranche, we can back into the credit support needed to achieve that rating. For Jumbo "A" and "Alt-A" securitizations, the support will typically depend on subordinated tranches.

Analytic Advances

Predicting Default Frequency

Although our current model incorporated ground-breaking techniques for evaluating mortgage pools, Moody's Mortgage Metrics is able to achieve even greater precision. Moody's chose to analyze the likelihood of foreclosure status as the measure of "default" for "A" loans. Analyzing only loans suffering a loss would have eliminated too much information content from our analysis, particularly for loans with deep mortgage insurance, which often generate no net loss to certificateholders even if the property is liquidated.

One means of measuring the predictive power of a model is to graph a "power curve"—comparing the model's prediction of default frequency to the cumulative observations of default. Optimally, the observed defaults will be concentrated among those loans with the highest predicted levels of default, and the plot line would represent a concave curve that bulges toward the upper boundary of the graph. A model with no predictive power would produce a 45-degree straight line from 0% to 100%; in that instance, observed defaults would be evenly distributed, regardless of the predicted default levels. Figure 2 shows the strong results of Moody's Mortgage Metrics' prediction of default frequency.



Time Series Analysis

Advanced time-series analysis increases predictive power, and enables extraction of meaningful conclusions from even moderately short-lived vintages and newer product types.

Loan pools have a natural distribution of defaults over time. Early on, the underwriting process proves strong at assessing borrower behavior and property values, and defaults are low. After a number of years, payments have been made and equity has built up, so defaults are also low. The intervening years (between years 3 and 6) prove most risky. **However, these underlying dynamics are greatly influenced by the economy.** High unemployment rates or declining market values trigger meaningful defaults outside of this time band. Likewise, interest rate-driven prepayment spikes mute the incidence of later defaults. **Only by performing time series analysis in the development phase and analyzing new pools using a time series model can pool performance accurately reflect the interactions of economic influences on the "natural" default pattern.**

In addition, the exact shape of the economic path is a crucial element of loan performance. Two economic simulations might both end up with a property value increase of 5% after 10 years and a 2% improvement in employment rates. Yet defaults would be wildly different if one simulation reflected constant incremental increases while the other experienced a drop for 5 years followed by sharp improvement. Capturing these influences and the causal links between economic stresses and loan behavior requires examining loan behavior and the economic environment through time, not just on a cumulative basis.

Pinpointing Economic Measures

Borrower behavior is driven by a complex interaction of factors. Performance during any quarter is influenced not only by economic measures during that quarter, but also by trends leading up to that period. A borrower is more likely to have suffered job loss after three years of high unemployment, for example, than upon a short-term spike. Moody's has applied sophisticated analysis of local economies, including the development of auxiliary variables to capture trends, to find the factors and time periods most important to predicting defaults and severity of loss upon default. **Broadly speaking, a full three-year economic history is best at predicting performance in any quarter, with the most recent quarters naturally having the greatest influence.**

Severity measures are improved by likewise considering market movements between origination and foreclosure, as well as from foreclosure through liquidation.

Complex Functional Forms

Moody's 1996 revision of its RMBS model isolated relationships among loan characteristics and performance. These relationships are complex, and of necessity we could no longer provide a simple multiplicative "factor" to represent the increased risk attributable to any loan characteristic.

Moody's Mortgage Metrics is even more complex. The appropriate mathematical tool to evaluate which factors influence a binary decision (default or not, prepay or not, etc.) over time is time series analysis, the form of which involves an exponential function and normalization of variables. Moody's Mortgage Metrics utilizes this format for its frequency and prepayment calculations.

This sophistication doesn't prevent transparency, however. *Appendix A* illustrates loan characteristics for 2 sample pools and shows how changes in these loan features would have translated into changes in **Aaa** levels for a pool originated in the 4th quarter of 2002.

Truncated Severity Data

Loss severity continues to be best predicted by its component parts—equity at origination, loan characteristics, property value decline, and carrying costs through liquidation. Additionally, mortgage insurance strongly influences net losses on high-LTV loans. Research outside of the LPI database proved essential to analyzing these features, because the database did not strictly break out severities into these components, nor report gross severities where mortgage insurance covered the losses.

Moody's Mortgage Metrics's resulting computations proved quite predictive of net severity. Formulaic components include loan features, market moves, state foreclosure times, periodic carrying costs (primarily driven by interest rate), and servicer ratings.

EVALUATING CREDIT RISK ELEMENTS OF RESIDENTIAL MORTGAGE LOANS

In this section we discuss the various credit risk components of Jumbo "A" and "Alt-A" residential mortgage pools. Our research for developing Moody's Mortgage Metrics led us to refine our risk assessment of various loan characteristics, but few overarching changes are called for.²

At the individual loan level, prospective loss outcomes have two components: frequency and severity.

- **Default frequency** refers to the probability that a homeowner will default on a mortgage obligation. This is the probability that the mortgage will reach foreclosure status.
- **Default severity** is defined as the amount of loss, if any, once a default occurs.

Each input variable or risk factor detailed below contributes to an estimate of either a loan's default frequency or its default severity or acts to alter the "shape" of the pool loss distribution by changing sensitivities to economic stresses. Most factors play at least some role in both frequency and severity estimates.

Loan-to-Value Ratio Remains Key

Borrower equity is an important buffer against default risk and a cushion against loss where a default occurs. In a distress situation (death, divorce, or unemployment), a homeowner with a large equity stake will typically sell the home (and pay off the loan) rather than face loss through a foreclosure proceeding. But negative homeowner equity does not automatically portend default where borrower capacity and credit measures indicate a willingness to preserve a strong credit record. *Appendix A* illustrates the hypothetical impact shifting LTV levels would have on pool performance. Note that the practice of using increasing levels of mortgage insurance on high LTV loans mitigates the actual impact.

At best, the LTV ratio captures the initial effective borrower equity in a property. Equity changes through time as a result of scheduled amortization, partial prepayment of principal, and changes in home price. Moody's Mortgage Metrics evaluates loan performance quarterly through a thorough sampling of economic scenarios, including permutations of local home price movement vectors, providing an improved analysis of the impact of equity on default frequency and severity.

Borrower Quality Stays at Center Stage

Borrower character and capacity to pay play a central role in our rating approach, even though the quality range for Jumbo A pools is somewhat tight. While there are many ways to assess a borrower's credit history, under-

² See "Moody's Approach to Rating Residential Mortgage Pass-Through Securities," *Moody's Special Report*, November 8, 1996.

writers increasingly rely on automated approaches, usually a credit scoring system. Other factors considered by originators when categorizing borrowers include the frequency, duration, and time since any mortgage delinquencies, performance on consumer credit loans, length of employment, and income history. The post-mortgage debt service to income ratio (DTI) is also important.

The credit scoring system developed by Fair, Isaacs & Co. (FICO) produces statistically significant predictions of default frequency on Jumbo A loans. Reliance on reported information from previous creditors necessarily introduces a source of error; and a borrower's reported FICO scores can vary widely across the 3 major reporting agencies. Yet, although imperfect, Moody's Mortgage Metrics utilizes FICO scores at loan origination to maximize its predictive power for pool losses.

Our research has shown FICO scores to be most predictive of defaults shortly after origination. This is consistent with Fair, Isaacs' traditional 2-year testing time period. As mortgages age, FICO at origination becomes a less material default predictor relative to other loan and economic characteristics. **Moody's Mortgage Metrics effectively assigns decreasing weights to the FICO score as the quarter-by-quarter simulations are performed to reflect our research results.** The majority of "A" loan defaults occur well past the peak predictive times for FICO scores, but while such scores are still among the best predictive factors. *Appendix A* shows an across-the-board 20 point decrease in FICO scores raising **Aaa** default levels on the sample pools by approximately 8%. These results are sensitive to a number of factors, including the base FICO average for the pool, as well as the FICO distribution. Across a broader sample of A and Alt-A pools, a 20 point decrease in FICO could raise **Aaa** default levels by up to 15%.

Originator and Servicer Practices and Loan Programs Continue to be Captured

The predictive power of borrower quality measures and LTV depends in part on the accuracy of the information submitted. Therefore, it is important to examine the quality of originator practices, particularly efforts to verify data through appraisals, credit checks, and other means. Likewise, servicer quality affects the roll rate of delinquent loans as well as severity of loss upon default. One way to assess the quality of an originator's and servicer's practices is to monitor the past performance of its loans. **Indeed, the high variability in historical loan performance across originators and servicers cannot be explained solely by differences in reported underlying loan characteristics.** For periods where originator and servicing practices change little, appropriate originator-related adjustments can be determined statistically; however, corporate practices are dynamic, and Moody's continues to rely on both quantitative means as well as qualitative reviews to assess originator and servicer quality and their impact on pool performance. These assessments form an integral part of Moody's Mortgage Metrics's credit support calculations.

Moody's considers numerous factors when determining the quality and performance of the originator and servicer, including:

- Past performance of the originator's loans;
- Underwriting guidelines for the mortgage loans and adherence to them;
- Loan marketing practices;
- Credit checks made on borrowers;
- Appraisal standards;
- Experience in origination of mortgages;
- Collection practices; and
- Loan liquidation procedures.

Loan Term

A loan's term determines the scheduled pace of principal retirement and borrower equity accumulation. The interest component of a fully amortizing loan is extremely high in the early years of loan life, which means that very little principal is initially retired. With seasoning, principal retirement increases substantially.

The shorter the loan maturity, the faster the rate of amortization. For example, a 10% mortgage with a 15-year term pays down nearly 5.5 times as much principal in the first five years as does a 10% 30-year mortgage. The faster accumulation of equity means that the incentive to avoid default is increased, and any recovery upon foreclosure would be higher.

Monthly payments are also higher for shorter-term mortgages. Borrowers with sufficient disposable income to qualify for a higher-payment mortgage present a lower risk. The difference in **Aaa** levels for our sample pools with virtually all 30-year loans vs. all 15-year loans is approx. 25%. See *Appendix A*. MBS investors should also note that the recent 15-year pools of major originators have had substantially stronger pool characteristics than their 30-year pools, including higher FICO scores and lower LTVs.

Time to Foreclosure and Carrying Cost

Moody's Mortgage Metrics severity calculation captures all of the elements of loan loss. Accrued interest, the major component of carrying cost in the event of default, is a key element of loss severity. Securitization servicing standards give certificate holders uninterrupted cash flows even in the face of serious delinquencies, but liquidity advances are reimbursed from liquidation proceeds and thus contribute to ultimate loss levels.

The size of the servicer's claim for liquidity advances is related to the defaulted loan's coupon rate and the amount of time it takes to foreclose on and dispose of the property. The time to foreclose on a property varies substantially among states because of economic conditions, statutory notice requirements, limitations regarding the sale of foreclosed property, and rights of redemption. Average time-to-foreclosures range from five months to almost 18 months, depending on the particular state.

Disposition periods of real estate owned (REO) are more consistent from state to state, averaging approximately six months. Servicer strategies to reduce disposition times, such as by encouraging short sales³, are one element of the Servicer Ratings, which influence Moody's Mortgage Metrics' severity calculations.

Interest Rate

Analysis shows that a loan's interest rate has a material impact on performance, with Moody's Mortgage Metrics assigning a corresponding benefit for low-rate loans. These observations likely reflect a combination of forces.

First, as noted above, carrying costs are a material element of loan loss severity. Over a 2-year liquidation horizon, a 3% interest rate benefit would cut the average loss severity by one-quarter.

Further, the lower the coupon rate, the faster the rate of amortization. A 30-year mortgage with a 6% coupon pays down twice as much principal in the first five years as does one with a 10% coupon.

To a lesser degree within the "A" market, coupons reflect underwriting assessments of risk; high coupons could reflect that little or no "points" were paid, or that certain standard criteria have not been satisfied.

The nature of the interest rate calculation is also important, with fixed rate loans proving safer than ARMs, even within the "A" market. The downside risk of higher interest payments in a rising rate environment is higher than the benefit of falling interest payments in a declining rate environment. A rate rise from 6% to 8% would boost a resetting monthly payment on a \$100,000, 30-year mortgage from \$599 to \$734. For ARMs, we adjust the default frequency estimate upward to capture the added risk of payment shock. See *Appendix A*.

Moody's Mortgage Metrics' economic simulations measure the impact of macroeconomic movements on loan performance. To the extent high rate loans are more likely to experience a high-prepayment environment, the model will reflect a corresponding drop in absolute foreclosures for those scenarios, offsetting the higher default frequency and severity influences of a high mortgage rate. However, loans for which a prepayment opportunity was missed are at higher risk, possibly reflecting a weak borrower or underperforming property, and would experience higher incremental default rates.

Property Type

Property types can range from single-family detached homes to co-ops and condominiums. Compared to stand-alone structures, attached housing and multi-unit properties tend to experience greater loss severity in the event of default. A higher severity results because these property types are less liquid than stand-alone homes and might have to remain on the market for a longer time. In a distress situation, this illiquidity could lead to higher carrying costs. Consequently, an adjustment is made for this added risk. Moody's Mortgage Metrics also reflects the higher default frequency of attached and multiunit housing. As illustrated in *Appendix A*, condominiums add approximately 5% to the overall risk level.

³ A "short sale" is an expedited process where a home is sold for less than the outstanding loan balance.

Home Value

A proxy for a property's liquidity is its price; the higher its price, the more difficult it may be to sell (at a fair price) under stress situations. Illiquidity, in turn, negatively impacts default severity and, potentially, default frequency. To date, markets participants have differed on whether the best measure of this liquidity is a property's absolute value or its value relative to the local market. Moody's Mortgage Metrics applies an optimized combination of factors based on both absolute and relative home values in projecting the impact of this illiquidity on loan performance.

High value homes are also more likely to prepay in a declining rate environment. The variable-cost savings (lower interest payments) are more likely to offset the fixed costs of refinancing for high-balance loans. Under many of the simulated economic scenarios, the higher incidence of high-value home prepayments reduces the impact of the high-value home's increased conditional default risk.

Loan Purpose

Residential mortgage loans can be made to purchase a property, to refinance an existing mortgage, to release equity under an existing mortgage, to improve the home or for many other purposes. Because of differing historical performance patterns, we differentiate loans based upon their purpose. We have found that loans to purchase a home or to refinance at a lower rate have the lowest default frequency. Conversely, when equity is released through a cash-out refinance, default frequency rises. In these cases, the determination of property value is made solely by an appraiser. Borrowing against equity in a home may also indicate that the borrower's actual income stream or other debt burdens are placing a greater strain on the borrower's overall finances than was anticipated at the time of original purchase of the home.

Owner Occupancy

Intuitively, the primary residence provides a greater housing service to the owner than does a rental or second home and is therefore less likely to be subject to loss. Investor or rental properties rely on cash flows from parties who may not have the credit profile of the borrower, increasing the risk of default. Moreover, under financial stress, a borrower is likely to place retention and upkeep of the primary residence above that of other financial commitments, helping to limit the frequency of default and severity of loss in the event of default.

Most "A" originators tighten underwriting standards for non-owner occupied homes. Where Moody's determines such safeguards to be adequate, Moody's Mortgage Metrics applies a minor net adjustment for occupancy status.

The Presence of Mortgage Insurance

Most high LTV loans are made conditional upon some form of mortgage insurance. While not affecting the borrower's inclination to default, mortgage insurance will decrease the severity of loss in the event of default. Underwriting standards might also be tighter for loans with mortgage insurance.

Mortgage insurance covers not only a portion of amounts payable under the mortgage and interest expense, but also reasonable expenses to gain title to and sell the property (including legal and real estate expenses). The amount of insurance coverage purchased frequently is higher for loans with small amounts of borrower equity. The benefit to investors of mortgage insurance is a function of the amount of coverage and the credit quality of the mortgage insurer.

Moody's Mortgage Metrics incorporates the insurance coverage level directly into the loss severity calculation.

The computation of mortgage insurance benefit is a complex one. Although the amount of coverage often results in 100% protection to the certificateholders, there is wide volatility of recovery shortfalls from liquidated properties. Moody's research demonstrates that pools will contain loans that experience loss severities beyond MI coverage even in economies where average insurance levels would otherwise cover the average loss severity. Moody's Mortgage Metrics uses a distribution of severities to reflect these factors, facilitating analysis of traditional pools as well as those with lender-paid mortgage insurance.

Concentration Issues

Pool size plays an important role in shaping the pool loss distribution. The smaller the pool, the less certain we can be that the outcome will fall within a tight band around our expectations. Likewise, if a particular loan is unduly large relative to the pool, the results can be unpredictable due to chance. Similarly, we face increased uncertainty when all loans in a pool originate within a single area. Moody's employs a case-by-case re-evaluation of the results of Moody's Mortgage Metrics for pools with fewer than 100 loans, or where state or metropolitan statistical area (MSA) concentrations are too high, to adjust for the effects of high concentrations.

IMPACT OF THE ECONOMY

Economies Drive Performance

Mortgage default decisions in the "A" and "Alt-A" markets are driven by income levels and property values. Sound income levels generally ensure that the mortgage will be paid. Borrowers increasingly consider the mortgage payments to represent payment for their housing "service", and, if able, tend to continue to pay even if property values decline.

Property value plays a larger role when the income stream is interrupted, as through death, divorce, or unemployment. Decisions in these circumstances tend to be economically rational. Homes are rarely surrendered to lenders when realizable value exceeds the loan amount; instead, the home might be sold, or the equity tapped to meet monthly expenses.

Pool performance is likewise linked to local real estate market movements, local unemployment rates, and prevailing interest rates. Moody's Mortgage Metrics has quantified the relationship between these factors and loan performance (both frequency of default and severity of loss) through time.

Economic Simulations Capture Stresses

Moody's has long recognized the superiority of considering a distribution of future economic stresses rather than relying on a single historical economy as a presumed "worst possible" scenario. Moody's Mortgage Metrics's loan-by-loan, quarter-by-quarter simulations involve sophisticated processes that capture the following elements:

- Macroeconomic factors are linked. Prevailing interest rates influence employment trends and home prices, for example.
- Economic measures are autocorrelated—the present state of the economy influences future states. Movements in employment, home prices, and interest rates reflect the starting point as well as being influenced by results in preceding periods. For this reason, Moody's Mortgage Metrics is updated quarterly with new economic projections.
- Employment and real estate results are local, but are influenced by national trends. For each of the 1,250 economic "simulations", Moody's Mortgage Metrics actually applies 50 state-level unemployment paths and 50 state-level home value paths.
- State-level economic features have measurable correlations to the features in other states, influencing the benefit of geographic diversity. Moody's takes these correlations into account when generating the state-level economic paths.
- Home price movements historically follow seasonal trends, and broadly trend upwards at approximately 4% per year on average.

APPENDIX A

Sensitivity of Aaa Credit Support Levels to Loan Attributes

	Sample Pool A*		Sample Pool B*	
	Aaa Credit Support (%)	Change from Base	Aaa Credit Support (%)	Change from Base
Base Pool	3.17		2.57	
LTV+5	4.28	35%	3.52	37%
LTV-5	2.32	-27%	1.85	-28%
FICO+20	3.02	-5%	2.49	-3%
FICO-20	3.42	8%	2.75	7%
All Cashout, Neutral				
Appraisal Quality	4.68	48%	3.91	52%
All Purchase	2.62	-17%	2.15	-16%
All Investor	3.69	16%	2.99	16%
All 15-year Term	2.42	-24%	1.93	-25%
All Adjustable Rate	3.47	9%	2.81	9%
All Condo	3.31	4%	2.68	4%
All Alt. Documentation	3.35	6%	2.78	8%
Property Value+300K, LTV Constant	3.80	20%	3.10	21%

*Key characteristics:
Pool A: LTV 67, FICO 732, CashOut 19%, Purchase 21%, Single Family 89%, Owner 98%, FullDoc 75%, 30 YearTerm 98%, Fixed Rate 100%
Pool B: LTV 65, FICO 744, CashOut 17%, Purchase 21%, Single Family 89%, Owner 96%, FullDoc 95%, 30 Year Term 98%, Fixed Rate 100%

Note: To isolate the impact of individual loan attributes on Aaa level, we only change one attribute at a time while keeping other attributes constant. This may not result in a realistic combination of loan attributes. For example we do not change MI coverage accordingly when LTV is changed.

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