# Measuring the Risk of Securitized Products

*October 2010*

## *Breaking the Credit Rating Cartel*

The use of poor risk measurement for securitized products was one of the chief culprits behind the credit bubble and burst.  Reliance, for instance, on misleading ratings, weighted average collateral statistics and *rep line* assumptions led to pervasive underestimation of risks and overestimates of value.  Outsized demand for both loan collateral and structured securities caused prices to be bid up to levels where their associated yields were wholly inadequate to compensate for investor's risk.  Troubles in the credit markets were impelled by an unlikely source: the Government-sponsored oligopoly called Nationally Recognized Statistical Rating Organizations ("NRSRO" or "Rating Agencies").  The SEC's official sanctioning of NRSROs and their ratings -- reinforced by accounting authorities, industry and supranational associations -- had the unintended consequence of encouraging complacency and widespread outsourcing of essential credit analytical functions.  Had investors been aware, through more rigorous fundamental research, loan-level modeling and well-designed analytics (especially for the risky *affordability* products marketed by over-zealous issuers), many RMBS defaulting today would not have been funded in the first place.[1]  Yet even with a mountain of evidence, conventional ratings still reflect profound methodology shortcomings and insufficiently explain the risk of securitized products.  And they remain a key eligibility stipulation for mutual funds and institutions and the basis for risk-based capital charges.  Lately, several specialty NRSROs have cropped up, but their methodologies appear to be just improved versions of old school ratings.

The purpose of this note is to highlight critical weaknesses in conventional ratings and suggest ways to improve risk metrics for investors and those responsible for credit oversight.  It is not a conclusion of this report, however, that there exists any single modeling convention or diagnostic investors can slavishly rely upon.   An important lesson from the credit crisis is the need for investors to take greater responsibility over their decisions, perform research, analysis and due diligence commensurate with the complexity of these assets, and demand that if issuers want to borrow in the capital markets adequate transparency and disclosure is the price of admission.

THE NRSROS

The Rating Agencies became a critical element of structured product issuance.  They offered convenient third-party review, broad coverage, published criteria, exclusive review of confidential issuer information, and their simple measures purported to homogenize very disparate risks.  These advantages, however, were in some respects also the curse of the system.

Conventional Ratings – Letter-grade rating criteria designed to support the relatively simple credit measurement structure of the NRSROs fails to address the potential for extreme volatility associated with geographic concentrations in asset pools, broad adverse market trends, and varying degrees of leverage embedded in securitized products.

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[1] In the first quarter of 2007, RangeMark's credit model forecasted cumulative losses of about 20% for sub-prime mortgage loans; far in excess of loss levels sustainable for RMBS issued, and rated investment grade, during 2007.

The approach, borrowing methods for rating straight corporate debt, is overly-simplistic in its representation of the risks of RMBS, CMBS and certain ABS. The requirement that ratings homogenize risk measurement across extraordinarily different risks asks more than is possible, and more indeed than the agencies claimed themselves. These static, one-dimensional metrics ultimately proved inadequate in describing the risk profile of complex structured securities backed by non-uniform collateral pools. At the height of the bubble, products backed by various asset types had identical ratings and traded at microscopically different yield spreads, yet widely divergent risk distributions. It is only by quantifying potential losses for the full range of possible scenarios that one can appreciate risk and determine fair compensation. A final shortcoming of conventional ratings that became apparent following precipitous price declines of legacy RMBS is their inability to measure risk to investors who carry securities at prices other than par.

*Danger of Applying Historical Defaults or Roll Rates*
Rather than measure intrinsic risk derived from a forward-looking analysis of obligor behavior, conventional ratings for RMBS are based on historical performance that may have little relevance for specific securities or current circumstances. Metrics developed through such a rear-view-mirror approach will produce misleading measures and are poor guides to risk taking when underlying factors driving default behavior change. It takes a forward-looking analysis that considers the fundamental characteristics of underlying assets and captures the interplay between economic factors, collateral performance and legal structure to measure intrinsic risk effectively.

*Failure to Consider Tail Risk*
Conventional ratings correspond with *expected* outcomes. A single baseline representation of collateral performance and consequent security pay-out insufficiently captures the risk profile of a security. Because borrower performance depends on a range of factors, each uncertain in and through time, security performance forecasts are most properly represented by a distribution of outcomes. Prudent risk/return decisions cannot be based simply on the outcome considered most likely to occur. Beyond estimating expected performance, proper metrics need to consider *worst-case* events – such as when liquidity disappears and markets become highly correlated or localized credit troubles becoming systemic. Credit metrics derived from stochastic scenario analysis are less subjective, more comparable and account for tail (low probability, high loss) outcomes.

*Obligor Data: Building Block of Credit Analysis*
Investors not only need adequate analytical tools but also essential underwriting information about underlying collateral assets to make informed, prudent risk decisions. To accurately measure intrinsic risk, models should be based on actual individual obligor characteristics where data will support such analysis. A better approach is to identify the risk drivers associated with the collateral performance and quantify relationships between such factors and performance. This means a bottom-up approach; applied at the obligor rather than deal level. Model factors must be based on a rigorous study of actual obligor behavior, and the model must be applied at the obligor level to develop excellent decision-making analytics. The ability to model collateral performance at the obligor level holds the potential for generating a realistic performance profile for a securitized investment across a range of potential projections for key underlying drivers.
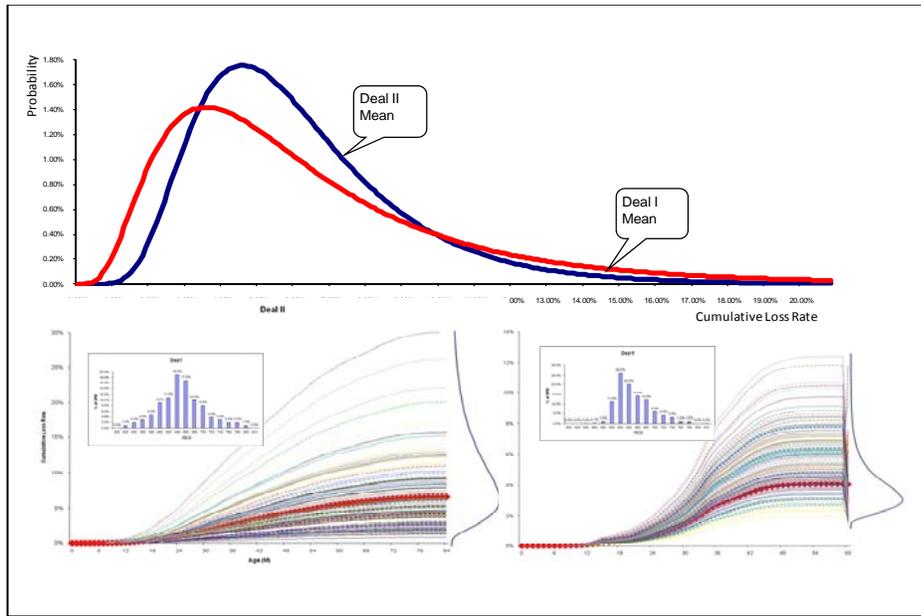
Collateral composition directly impacts the shape of loss distribution. Securities with similar enhancement and identical weighted average statistics (WAM, WAC, WA FICO, etc.) may have materially different risk profiles due to variations in the distribution of loan attributes. The pools in Exhibit A have similar weighted average FICOs but the composition in FICO buckets is quite different. Though projected aggregate cumulative loss rates for the two may be similar, the *potential* loss for Deal I is greater. Projecting credit performance at the obligor level enables true quantitative measurement of layered and tail risk. Reliance on weighted average assumptions or simplified scenarios will dampen the distribution of outcomes, leading to an underestimation of risk and overestimation of value of certain securitized products.

The more granular the data used for developing and applying a credit model, the richer and potentially more accurate will be the assessment of pool performance. Loan-level analytics cannot be performed without loan-level disclosure. Performance trends cannot be considered unless relevant data are provided. One reason investors outsource credit homework to rating agencies is the common practice among issuers to restrict important disclosures to the Rating Agencies alone; arguing their right to protect their "secret sauce". However, an investor is simply a lender. No prudent lender extends credit without access to information sufficient to predict borrowers' ability and inclination to make good on their contractual obligations.

*Dynamic Assets – Dynamic Risk*

A common complaint is rating instability. While it is true Rating Agencies failed to adequately monitor transactions, these criticisms reflect both a fundamental shortcoming of conventional ratings and a misunderstanding of securitized products. Traditional credit ratings are intended to be *life* or *through-the-cycle* measures. But changes in risk should be expected and static ratings are inappropriate. Modeling approaches need to adapt as information is updated and conditions change.

**Exhibit B: Risk Evolves over Time**
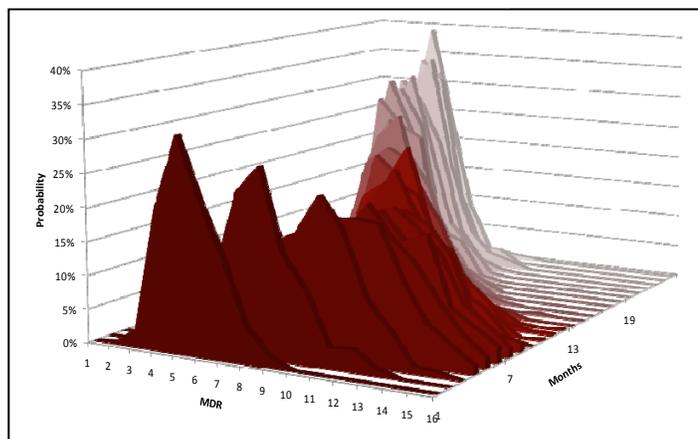
The risk profile of securitized investments is subject to the nature of individual collateral assets, changing pool composition and movements in key risk drivers. As illustrated in Exhibit B, certain of the changes and their results are virtually assured. Amortization reduces principal outstanding, shortens duration and changes the composition of the collateral pool, for instance. Others are conditional (risk factors), such as the impact on prepayments and borrower performance due to changes in interest rates or home prices. Investors need to anticipate borrowers' response to changing risk drivers. Exhibit C illustrates how collateral performance involves complex inter-relationships that affect not only mean outcomes but the dispersion of outcomes as well. The loss distribution of this RMBS pool changes with the baseline HPA assumption. The dark area represents a baseline national HPA forecast and a range of HPAs scenarios. Note that as the HPA scenario becomes more drastic, the loss dispersion and the corresponding tail risk widens dramatically. Given this dynamic nature of securitized investments, changes in performance profile occur over time and prudent investors will monitor such changes.

**Exhibit C: Risk is Sensitive to Modeling Assumptions**
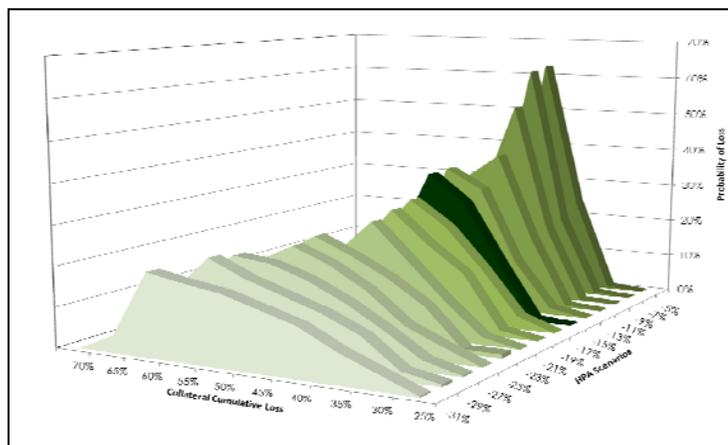


Conflict of Interests - A fatal flaw in the system was increased dependence, on the part of the major NRSROs, on fees paid by issuers rather than investor subscription payments. This resulted in important conflicts of interest that impaired the integrity of the process and the ratings. The Rating Agencies became subject to explicit pressures from issuers and their bankers who exploited inter-agency competition. Volume-driven processes emphasizing speed of turn-around replaced more deliberative procedures involving broader committees and prudent judgment. Issuer pressures also meant resources tended to be applied to the ratings execution process with inadequate investments applied to surveillance and feedback loops between surveillance and new ratings. Consequently, RMBS rating criteria failed to evolve in the face of rising early delinquencies and adverse economic trends, particularly in the relationship between home prices and personal income.

PUBLIC OUTCRY

It has recently become popular to scold the Rating Agencies. Yet, the problems of applying conventional credit rating methodology to securitized products have existed for some time, and were apparent in several more isolated rating failures (e.g. franchise loans, 12-B 1 fees). But it took the devastating malfunction associated with the issuance of RMBS backed by non-conforming mortgage loans to get everyone's attention. Those casting stones correctly identify certain deficiencies of the system such as the compensation mechanism, and inadequate due diligence and surveillance. The few alternative solutions which have been suggested, however, don't address some of the most fundamental defects of conventional ratings.

Dodd-Frank - The recently enacted *Wall Street Reform and Consumer Protection Act* (the "Act") requires Federal authorities to search regulations for NRSRO ratings-based requirements and to replace such requirements with other standards. The Act reflects deep disillusionment and loss of trust with existing Rating Agencies and the systems built around them. It addresses the conflict associated with linking profits to the quantity of ratings and provides for greater standard of care and liability for poor due diligence and performance and more public disclosure of internal operations. It seeks to promote independent risk analysis on the part of regulated entities. However, the Act leaves to the regulatory bodies the problem of devising the methods to be used in place of NRSRO ratings. Alternative approaches for deriving bank capital charges for securitization exposures suggested in the recently published *Advanced Notice of Proposed Rulemaking Regarding Alternatives to the Use of Credit Ratings* in the Risk-Based Capital Guidelines of the Federal Banking Agencies all have serious problems. The suggestions either: 1) charge capital through reference to capital structure or other credit support characteristics without any detailed analysis of specific asset pool risks, or 2) charge capital based on the gross notional of the bank's position in a securitization as well as all exposure in the securitization capital structure that is senior to the bank's position. In the first case, .even within somewhat refined asset categories (e.g. prime credit card, prime auto loan, student loan, sub-prime residential mortgage) enormous variations in loan pool quality (with associated variability in expected loss and loss volatility) do occur. In the second case, no account is given to the enormous variability in the likelihood of loss given a proportionate subordination as well as the enormous variability in volatility of the loss associated with not only asset quality but certain structural features such as cash-diversion triggers and tranche size.

Any serious and responsible approach to risk measurement or setting capital charges for securitization exposures requires a detailed modeling of the prospective distribution of asset performance given the particularities of the collateral and the detailed analysis of the effects of varying obligor performance projections through time on prospective security cash-flows via a cash-flow model that embeds the vital elements of the exposure structure including, subordination, overcollateralization, priority of payments rules and cash-diversion triggers.

NAIC Upgrade – Given the extraordinary failure of the NRSROs in rating the risks of RMBS and CMBS at issuance and the ongoing wide discrepancies between the rating agencies concerning the extent of downgrade for previously highly rated securities, state insurance regulators, working through the National Association of Insurance Commissioners (NAIC), recently abandoned NRSRO ratings as a mechanism for determining credit risk capital charges for RMBS and CMBS exposures on insurance company books. They adopted a program based on loan-level scenario analysis and security level cash-flows to determine security-specific charges using existing NAIC risk categories. The approach is an improvement in that risk measures are derived from a forward-looking analysis of the *intrinsic* nature of subject assets in connection with market and economic drivers and the particularities of each security's specific legal structure. The approved method, using expected loss as the guiding measurement, maps RMBS and CMBS securities to established NAIC categories for capital charge purposes.

The NAIC is on the right track. However, their approach suffers from a critical shortcoming. Risk is still being measured by expected loss (the first moment of the distribution) without regard to the dispersion of potential outcomes. Two bonds that share the same proportional loss expectation but have different dispersions around their common mean do not have the same risk, but are treated equally under the new system. Moreover, because expected losses are estimated from a limited number of arbitrarily selected scenarios there is no way to scientifically assign weights for the likelihood of each scenario occurring.

How is it possible to fit a curve knowing the order of four points on the curve but not the distance between each?  Likewise, it's not possible to fully understand the credit profile of an asset or portfolio without simulating the full range of possible outcomes.  Do any of my scenarios represent a tail event?  . As with conventional ratings, securities with disparate characteristics may appear similar.  The results of a handful of deterministic scenarios does not provide enough information to judge whether a bond's yield is fair compensation for risk, or whether strategies relating to funding or hedging are appropriate.

DEVELOPING IMPROVED RISK ANALYTICS

Analytics summarize performance projections based upon actual risk characteristics and potential real-world economic scenarios.  Better than basing risk measures on a few deterministic scenarios, stochastic simulations analysis enables metrics derived from a continuous performance distribution.  Objective credit metrics and capital requirements can be derived in a quantitative, disciplined manner.

It is reasonable to apply stochastic analysis both to the evolution of model feeds (interest rates, home prices, etc.) since the future course of these feeds is not certain, as well as to the representation of obligor behavior given a set of feeds.  The evolution of an obligor's performance is usefully represented in a probabilistic fashion since different individuals may react differently to a common set of circumstances. For example, not all obligors with underwater mortgages will cease to perform; as the value of the home relative to all loan payments diminishes however, it is more likely that borrowers hand in their keys.

   Risk Analytics – Aggregate obligor performance over time for a collateral pool must be related to the cash-flow performance of securities the pool supports.  Results of obligor credit modeling must be tied to the specific contractual features determining payments to securities backed by their pool.  But neither a single baseline representation nor loss projections from a small set of subjective deterministic scenarios are sufficient to capture the risk characteristics of a securitized investment.  Because collateral performance depends on a spectrum of factors, each of which is uncertain in and through time, security performance forecasts are most properly represented by a distribution of outcomes.

This distribution will also be affected by the specific contractual features defining payment priorities to allocate collateral cash flows to investors.  Contractual features can compound the effects of loan quality distributions.  Moreover, the relevance or importance of structural features may also be time and/or time-path sensitive. Contractual features may serve to broaden or narrow security performance volatility relative to collateral performance volatility.  All of this detail is essential not only to calculate such aspects as average outcomes and tail risk, but are also critical components of mean valuation since the dispersion of outcomes is a critical risk factor and consequently a driver in determining an appropriate discount.

**Exhibit D: Tale of Two Tails**

|  | SASC 2006-BC5 A5 | RASC 2006-EMX8 2A |
|---|---|---|
| Bond Type | Senior Floater | Senior Floater |
| Original Credit Support | 25.00% | 23.75% |
| Current Credit Support | 23.82% | 20.70% |
| 60+ Delinquency | 47.90% | 51.98% |
| Original Rating | Aaa/AAA | Aaa/AAA |
| Current Rating | C/CCC | Ca/CCC |
| Expected Writedown | 5.60% | 5.10% |
| 99th Percentile Writedown | 98.50% | 12.80% |
| Current WAL | 7.54 Years | 2.19 Years |
| Market Indicative Price | 18 | 60 |

Why Tail Risk Matters – It is not the expected amount but the maximum amount of losses likely to be sustained (consistent with a certain confidence level) that measures credit risk. The Worst Case indicates the amount of capital necessary to cover credit losses under a wide range of scenarios. This amount, referred to as Economic Capital, enables investors to determine adequate compensation (spread), managers to monitor position limits, and regulators to determine capital adequacy. Another useful measure is the amount of losses likely to be sustained during a *perfect storm* scenario (outside of statistical confidence level). This should be of interest to regulators concerned about aggregate exposure to systemic risk.

Structured securities having nearly identical credit enhancement and weighted average statistics may have markedly different risk profiles due to variations in the distribution of collateral or structural attributes. Also, securities with similar *Expected Losses* can have very different cash-flow and credit profiles. Only through an examination of the dispersion of simulated performance results can an investor seriously evaluate the contingent risks and rewards of a security.

The two RMBS described in Exhibit D were issued in the same year. Both are backed by sub-prime mortgage loans, both are from the senior classes within the capital structure, and were originally rated triple-A. Their current ratings now reflect considerable distress. The original and current credit support of each RMBS is similar. The Expected Principal Write-downs determined by 300 stochastically simulated scenarios for each RMBS are also very similar. If one was to create a capital charge based either upon credit enhancement (original of current), position in the capital structure, or current expected loss, one would be inclined to establish similar charges for each bond.

Yet the risk characteristics of the two securities are very different. The first is a relatively thin (at issuance, roughly 4.2% of the total capital structure), slow pay senior tranche with a principal payment window, deferred by payment priority conditions which divert principal receipts first to other tranches, estimated to begin in July of 2017. While low losses are projected in most cases, collateral losses at the tail of the distribution would be sufficient to wipe out all or nearly all the bond principal. Moreover, even after principal receipts begin, the timing of principal payments shows a very large dispersion. The second bond is a relatively thick tranche (about 32.4% of the total capital structure at issuance). Unlike the SASC, the RASC has been receiving principal from the start and now has only 37% of its original principal remaining. While losses are projected with a very high degree of probability, the dispersion of potential proportional losses is rather tight because of the relatively thick original tranche size and the rapid projected principal pay-down. The coupon spread on both RMBS is very low, but because the RASC bond receives its cash-flows quickly and the projected proportional losses are modest and have a modest dispersion, the indicative market price presented by market agents is much higher than that of the SASC bond with its deferred principal cash-flows and its wide dispersion of loss outcomes.

Establishing Appropriate Capital Charges - Exhibit E illustrates how measures of risk are derived from the loss distribution of an actual RMBS. The *Expected Loss* is the probability weighted sum of all the loss (including zero loss) outcomes. Here, the loss outcomes are calculated as the projected principal writedowns for the entire tranche. Using the loss distribution determined by the RangeMark RMBS model the Expected Loss on the security is $17,000,000. However, the cumulative principal writedown for the security could exceed this amount.

*Worst Credit Loss* (WCL) represents the loss that will not be exceeded with some level of confidence. In the example, the 95% Worst Credit Loss is $22,000,000 meaning the likelihood of losing more than $22,000,000 is 5%. Economic Capital is typically determined by reference to some tail threshold. The advantage of determining capital charges in this fashion is the protection which is offered against tail events and disincentives which are consequently presented against accumulating risks with material probabilities of extreme outcomes. The specific threshold would be a matter of policy to be decided by regulators.
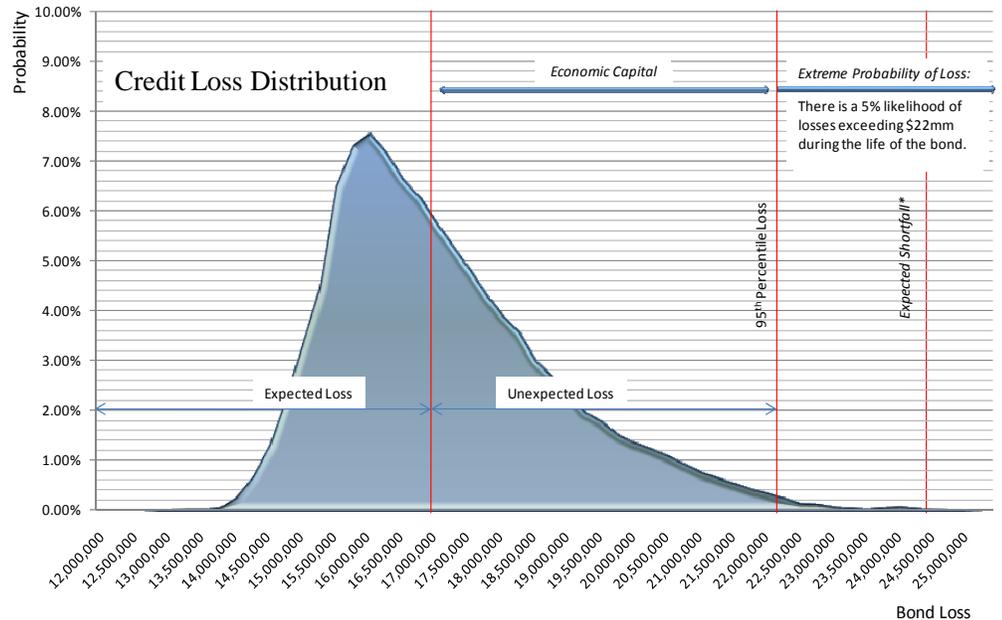
*Expected Shortfall* (ES) represents the expected amount of loss in the event that a loss occurs beyond the threshold used to determine economic capital. It is established by determining the probability of a loss event conditioned on all events exceeding the WCL threshold and then taking an expectation across the distribution of events in that tail. In the example above, the Expected Shortfall is $24.5mm. Regulators should be interested in knowing the gap between the Economic Capital reserve and what could be lost on the position in the event Economic Reserve threshold has been breached. This framework can be adapted to generate risk and valuation measures for a wide range of purposes, including BASEL 3 capital requirement, fair value estimates (FAS 157-e), OTTI calculation (FAS 115-a/124-a, EITF 99-20-b), and establishing appropriate reserve requirements for financial guarantees (FAS 163).

**Exhibit E: Deriving Risk Metrics**



INTEGRATED MODELING SYSTEM

To generate a distribution that is a reasonable representation of potential outcomes, a modeling system must integrate essential driver variables with a representation of individual obligor performance conditioned on those drivers. For RMBS, what's needed is a system: 1) with .predictive models of individual borrower behavior associated with key homeowner and loan characteristics, 2) that links those determining variables and behavior to projections of fundamental economic factors (e.g. market interest rates, home price movements, unemployment, personal income, housing vacancy/capacity), and 3) generates a distribution of simulated input sets complete enough to develop a reasonable range of possible outcomes and associated probabilities.

At the core of RangeMark's intrinsic risk and valuation analytics is a system comprised of several behavioral models. Such models predict borrower performance over a range of individual and macroeconomic circumstances, lenders' response to homeowner decisions and the outcome of foreclosure.

The task is not limited to estimating the propensity of a borrower to continue or cease making contractual interest and principal payments. Borrowers may also decide to make an early principal payment…all or part…or instead may decide to make payments slowly. Systems with unlinked credit and prepayment



**Exhibit F: RangeMark Credit Modeling System**

models will generate misleading results. Borrower payment decisions, subsequent lender action, and timing and proceeds from the liquidation from foreclosed homes are highly interrelated. These decisions and behaviors are connected by common global and local factors such as interest rates, local economic circumstances, and housing market conditions. Integrating the behavioral models – payment, prepayment, default, and severity – is accomplished by identifying a set of common key factors (home prices, housing capacity and vacancy, personal income, unemployment, and interest rates) that shape such behavior. Econometric models that predict trends and changes in the key factors are linked to the mathematical functions describing obligor performance and lender behavior -- delinquencies, defaults, severity, prepayments, foreclosure, repossession and loss. While we can't predict these variables with certainty, history gives us clues as to their central tendency and volatilitywhich may be reviewed periodically and updated as evidence changes.

Dynamic - Because key determining factors are not constant through time, it is sensible to require that behavioral representations evolve dynamically in any modeling projection. Macro and Regional Economics – GDP growth, interest rates, and home price movements (global drivers and region specific manifestations) effect probabilistic individual borrower behavior through changes in employment and income growth but also affect behavior through changes in obligor monthly payments, and obligor specific combined loan to value (CLTV). These dynamic drivers not only affect the propensity of an obligor to become delinquent or default, they will affect the level of recovery upon foreclosure and hence the loss given default (LGD). Furthermore, because key determining factors are not constant through time, it is sensible to require that behavioral representations evolve dynamically in any modeling projection. A non-stationary transition framework is an effective framework for modeling payment patterns and borrower default timing probabilities.
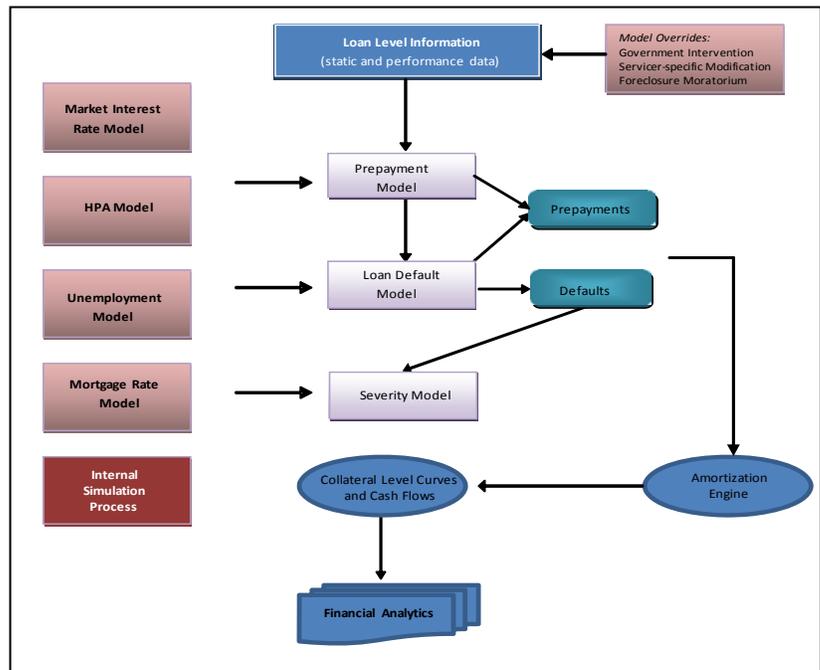
What's needed, both for working through the current problems and the long run, is encouraging a culture of transparency, responsibility, discipline and accountability. Every actor involved in the markets, directly or indirectly, needs to rethink and institute appropriate practices and culture, infrastructure, policies and procedures, methods of assigning and monitoring responsibilities, internal controls and disciplinary guidelines. Particularly relevant are practices relating to risk measurement and valuation.

Professional Accountability - Certainly the breaches of faith by some have been more serious than the laziness others are guilty of, but no single party or group is solely responsible for the troubles stemming from the credit crisis. Through regulatory oversight, the banking and securities industries need to hold managers accountable for their actions or inaction. As for corporate governance, management should be rewarded for their attention, and held accountable for inattention of risk management and valuation duties. Committees should be formed, processes developed, responsibilities assigned, guidelines clearly articulated and enforced. If internal know-how or technology is insufficient for dealing with current or prospective holdings, management needs to make and implement a plan to change this…or get out of the market. In the future, management needs to ensure appropriate risk and valuation tools and policies are in place *before* underwriting or acquiring assets. Moreover, the state of institutions' capabilities should fully be disclosed for investors within financial statements.

Harsh punishments should apply for fraudulent practices of all parties in the lending-securitization chain: issuers, borrowers, arrangers, placement agents.

Transparency and Standardization - Grossly inadequate transparency hampers investors' ability to gather data, and perform the analyses necessary to make prudent, well-informed decisions. Capital charge rules must exist in a broader regulatory framework in which the information necessary to make informed investment decisions is generally and readily available. Lack of transparency is no excuse for making a bad investment. If an issuer or its placement agent refuses to furnish information necessary to make a prudent purchase decision or follow-on surveillance…just don't do it. This concept is at the root of regulatory safety and soundness standards. Implementation must transform the concept into reality.

Greater Investor Responsibility - Internal investment guidelines and regulatory risk-based capital calculations having NRSRO credit ratings as the sole or primary diagnostic must be changed. Provisions based on simple credit ratings must be supplemented or replaced by risk measures that capture the complete distribution of risk. Regulators and other constituents should do everything possible to encourage the development of internal know-how and quantitative tools. In the end, however, it is the investor's responsibility.