American SECURITIZATION FORUM

ASF Securitization Institute:
Securitization 201: Analytics for Cash Securitizations

I. *Introduction*

- This module covers the analysis of risk and value in cash (not synthetic) structured securities and addresses the following topics:
    - Payment characteristics of default-free fixed income obligations, illustrated with zero coupon and corporate bonds, and level-pay consumer loans;
    - Collateral-level risk measurement as an input to securitization analysis;
    - A taxonomy of structural mechanisms: their impact on the profile of risk and return;
    - Valuation and pricing of structured securities issued from amortizing and revolving structures; and
    - Relative value opportunities in structured securities.

- The objective of this module is to present the framework of rating and pricing analysis for most types of cash structured securities.

II. *Properties of Default-Free Fixed Income Assets in Organized Markets*

- In a structured security, like other fixed income obligations, the lender "rents out" a capital sum (principal) to a borrower for a pre-specified period of time at a contract rate of return.
    - The "rent" is called interest, payable to the lender in accordance with a pre-established payment pattern.

- Interest may be charged explicitly, or implicitly.
    - If charged explicitly, it is treated as a separate income stream.
    - If charged implicitly, it is capitalized at the contract rate of return and returned as a principal gain.

- If, willfully or involuntarily, the borrower returns less than the contract rate of return to the lender, this is **default**. Under the law a lender can sue the borrower for the difference.

- The theoretical price of a fixed income asset is a function of time, and of the prevailing rates of return. Rates of return are determined by forces of supply and demand around key pricing benchmarks, which are usually taken to be the rate on a *default-free* (or very low-risk) asset class selected by the market.
    - The ensemble of rates of return across the term structure of the market (with interpolations in-between) is called the **yield curve**. It extends as far out as the rate on a benchmark risk free or low-risk, long-dated asset class.
    - Risky bonds, with a non-zero probability of default, have characteristic yield-spread curves for each risk class, which has an associated yield-spread curve—a yield curve reflecting a market-required markup over the risk free rate consisting of three components: the **risk-free rate**; the **risk premium** for that rating class; and a **liquidity term**.

III. *Pricing Bonds with Certain Cash Flows (Optional)*

- The fair value of a bond is the sum of the contractual cash flows in each period, discounted by the opportunity cost of the investment capital required to obtain those cash flows.

<u>*Zero-Coupon and Coupon Bond Math*</u>

- The mathematical relationship between price and yield can be expressed as a geometric function of time. Generalizing from the one-period to the multiple period case at the same periodic rate, 5%, for a bond that pays no coupon (*zero-coupon*), the present value of $1 received in n periods is ($1/$1.05)^n.

- For a zero-coupon bond, price as a function of yield and discrete time periods is expressed as $B_0 = B_t\left(\frac{1}{1+r}\right)^{-T}$, where r is the periodic interest rate, t the time step and T, periods to maturity. With continuous compounding, price is $B_0 = B_t e^{-rt}$.

- On bonds that pay coupons, price is the present value of the sum of the principal and interest income streams:

$$B_0 = \sum_1^t K\left(\frac{1}{1+r}\right)^{-t} + B_T\left(\frac{1}{1+r}\right)^{-T}$$

    - The size of the coupon affects the present value of the bond because it accelerates the repayment of cash to the lender, so that a coupon bond is worth more than a zero-coupon at 0<t<T.

- Although "risk-free" bonds have minimal default risk, they are still vulnerable to interest rate risk. When the current interest rate moves away from the contract rate of return, pricing adjusts so that the yield differential on interest income is made up in the bond price. Thus when interest rates drop below r, the yield rises and carries the price Bt higher, but when interest rates rise above r, the yield falls below the coupon and the price Bt drops below par.

- Yield can also be found from price, as the geometric mean of the future value of the sum of bond cash flows over T periods (or, for a yield-to-call, C periods) minus principal:

$$YTM = \left[\frac{B_T}{B_0}\right]^{\frac{1}{T}} - 1$$

- To find the total return on a bond-equivalent basis, multiply YTM by the number of periods per year, *n*. On an annual interest-rate basis, total return is: $(1+YTM)^n - 1$.

<u>*Level-Pay Loan Math*</u>

- In contrast to the zero- and corporate bond payment patterns, an amortizing bond repays a portion of principal as well as interest income at each cash flow date.
    - Principal amortization in each period is calculated by discounting the future value of the loan amount by the cost of funds.
    - Cumulatively the amount of principal amortization increases each period as time-to-maturity gets shorter until the balance is fully amortized.
    - Interest as a portion of the level pay amount decreases, so that the sum of the two is always equal to the level-pay amount.

- Mathematically, the level pay amount, M, is defined as: $\frac{rB_0}{[1-(1+r)^{-T}]}$.

- This follows from the definition of interest applied to the balance at closing: $M[1-(1+r)^{-T}] = rB_0$.

- Let p represent the principal portion of M, and the remainder, 1-p, represent the interest portion. At any time, t, p is always equal to $(1+r)^{t-1-T}$ and 1-p is always equal to $[1-(1+r)^{t-1-T}]$. (The exponent is t-1-T, not t-T because payment is in arrears.) In each period, the principal cash flow is $M(1+r)^{t-1-T}$; the interest cash flow is $M[1-(1+r)^{t-1-T}]$.

- Partitioning interest and principal this way gives the fair value of principal, $M(1+r)^{t-1-T}$ when $t \le T$. Note that expanding these terms and simplifying them gives the level pay amount, M.

IV. *Pricing Structured Securities*

Adjusting to a New Paradigm

- Structured securities are "**bankruptcy-remote**," but they are not necessarily default-free. Default and prepayment by the ultimate obligors must be factored into the analysis. Key value drivers are:
  - The timing and magnitude of shortfalls on scheduled cash receipts, and
  - The quantity and certainty of capital available to cushion these shortfalls.

- Many structured securities are backed by pools of amortizing, not bullet-repay instruments. These price at the **average life**, not the maturity.

- Historically, pricing has been heavily conditioned on rating agency valuation norms.
  - The structured rating also has a numerical meaning that does not apply to ratings on other security types.

- A structured security is a portfolio analysis where value may be very sensitive to asset composition and capital structure.

Value in the Structured Paradigm

To understand value in structured securities, it is useful to consider the components of the rating agency analysis by disaggregating the levels of analysis behind the rating decision and examining each separately:

(1) There is a construct or hypothesis (a "**model**") that generalizes how cash flows deviate from the payment schedule. The construct may be as elementary as an average historical pattern, or as complicated as a macroeconomic model of individual borrower behavior.

(2) A decision is made as to what scenarios to consider in using the hypothesis, and how to weight them.

(3) A scoring algorithm is applied to the outcomes of levels (1)-(2) that maps them to a rating, and these ratings become the basis of security prices.

Constructs of Portfolio Value (1) - The Asset Side Analysis

In cash securitizations, **cash flow modeling** has emerged as the norm in valuation. It has many implementations, but the widely accepted and used conventions about default and prepayment behavior express defaults, losses and prepayments as a changing percentage of principal balance over the time-to-maturity.

The Cumulative Loss Curve

- In ABS and MBS, the main construct for analyzing credit deterioration is the **cumulative loss curve**. It represents the accumulation of periodic losses of principal as a percentage of the initial principal balance.
    - Losses reduce the contractual dollar amount and the contract rate of return received by investors. As a guide to the timing and magnitude of cash flow deviations, the importance of the loss curve derives from the sensitivity of capital structure not only to loss but also to changes in XS, a cardinal form of credit enhancement that only materializes if losses and prepayments are within expected bounds.

- The cumulative loss curve develops more slowly than the default curve and terminates slightly after maturity due to lagged recovery times, but both have the characteristic "S" shape of a birth-to-death cycle.
    - The default process begins slowly with only the accounts of bankrupt borrowers appearing in the first few months. All other accounts in the static pool must pass through delinquency states from current to defaulted before defaults materialize. Within a few months, defaults (or losses) establish a trend and accelerate. In this portion of the curve, periodic liquidations represent a growing proportion of the periodic total amortizations. The trend continues until burn-off sets in and incremental defaults (losses) decrease.

- The loss curve in a cash flow model may be realistically drawn from idealized **static pool data** or a logistic regression function. Uncertainty surrounding its precise shape or endpoint, the expected loss, can be simulated and the impacts analyzed.
    - In conservative treatments, parsimonious assumptions are made about the curvature of the loss curve and it tends to look like a prepayment "hockey stick" that is front-loaded and reaches an early maximum. This approach demands more capital for the same rating levels than a loss curve that "describes" the real pattern of performance.
    - The difficulty of generalizing from past experience has led some large institutions to move from a loss curve approach to a delinquency transition matrix approach in estimating collateral credit. This approach is more numerically demanding.

- Going forward, <u>with mandatory disclosure of static pool history in ABS registration under Regulation AB, more static pool history will come into the public domain</u>, and methods that describe the curve with as much accuracy as possible are likely to gain in favor.

<u>Prepayment Curves</u>

- A **prepayment** is an early retirement of a loan. A reduction of interest income caused by prepayments also means less **excess spread** (XS), which may adversely affect the credit of certain tranches paying interest and principal and certainly will adversely affect interest-only tranches, which are only titled to receive interest distribution.

- Several conventional prepayment models are used in structured securities. It is well to bear in mind that, in contrast to loss curves, the familiar hockey-stick shape of the prepayment curve that describes a ramp-up and steady-state phase is marginal (periodic) not cumulative.
    - **Absolute Prepayment Speed** (APS) for asset-backed securities (auto loans in particular) measures prepayments as a percentage of original loan balance.
    - The **Conditional Prepayment Rate** (CPR, often used for home equity or student loans) measures prepayments as a percentage of current loan balance.
        - In 1985, The Bond Market Association transformed the CPR into a standardized model called the PSA (Prepayment Speed Assumptions) wherein 100 PSA represents a base curve with a ramp-up at 0.2% until the 30th month, when a CPR of 6% is reached.
    - The HEP, **Home-Equity Prepayment Curve**, rises monthly from a 2% CPR and plateaus in month 10 at 20% CPR.

  - The MHC, **Manufactured Housing Curve**, plateaus in month 24, rising 0.1% from a base of 3.7% to a maximum 10%.

- As the market matures, prepayment data becomes more available and the mortgage-component of the ABS continues to rise, the prepayment analysis in ABS has begun to attract more serious attention.

- On the other hand, the large institutions that manage large mortgage portfolios perform very sophisticated prepayment assessments. These touch on several related aspects of macroeconomic volatility driven behavior on unscheduled payments.

<u>Default-Scoring Bond Portfolios</u>

- Unlike ABS or MBS, a corporate bond does not **amortize**; and unlike consumer collateral, which has its own index of performance—the loss curve—a similar "self-generated index of health" does not exist for portfolios of corporate exposures.

- Also unlike ABS and MBS pools, which tend to be well-diversified, corporations in a portfolio may exhibit correlated responses to macroeconomic factors, and these correlated responses can stress portfolio cash flow in a downturn.
  - Changes to the composition of the portfolio over time (as exposures pay off and are substituted, or not) can alter the correlation structure.

- As a result, a different set of measurement constructs has developed for the CDO analysis. The metric of value in the CDO analysis is the **corporate rating**, a cumulative default rate on corporate bonds of the same remaining maturity.

<u>Revolving Structures</u>

- Structured securities that are issued from revolving, not amortizing pools of collateral, tend to fall into one of four categories:
  - Credit Card Series
  - Asset-Backed Commercial Paper
  - Collateralized Debt Obligations (loan or bond)
  - Takeouts of funding warehouses

<u>Constructs of Portfolio Value (1) - The Liability Side Analysis</u>

- Structured securities that are motivated by a cost of funds arbitrage have two natural forms of credit enhancement: XS and **subordination**
  - A wide range of additional structural features also exists, including internal credit enhancement in the form of over-collateralization, reserve funds, spread accounts, yield enhancement accounts, cash collateral accounts, collateral investment accounts; and also including transaction triggers, and contingent capital from counterparties in the form of surety bonds, swaps, letters of credit or insurance policies from multilateral insurance companies.

- "Structuring" the transaction means choosing the right combination from this universe of possibilities to achieve a global goal: <u>minimize the all-in cost of funds in a liquidity-maximizing liabilities arrangement</u>.
  - Liquidity often means choosing a transaction format with which the investor public is already familiar.
  - The cost-of-funds minimum solution is found by running the cash flows and gauging the impact on each beneficial interest in the capital structure, so that the amount of capital is precisely proportional to the risk for a desired rating outcome.

- Credit risk containment is a key function of capital structure in the world of structured securities but for collateral types where the key risk is high prepayments, capital structure can also play a role in mitigating shortened maturities through a combination of reserving mechanisms, classes with notional amortization schedules and companion classes.

- **Cash flow analysis**, which simulates the impact of collateral and structural choice upon value through time, produces results that are very different from, and more accurate than, a liquidation type of analysis.
  - The **liquidation analysis** assumes that all losses occur instantaneously, and that the losses are allocated from the bottom up. In real life, the reverse is true: cash flow is collected at the end of the period and redistributed from the top down, and it is difficult to second-guess how the tranches will weather macroeconomic stresses, or in what degree.

- In cash flow analysis, constructs of how losses and prepayments occur are modeled along with scheduled payments to generate the "available collections" in each period.
  - These collections are "passed through" the hierarchy of payments as they come due until the assets "amortize" down.
  - Cash "inflows" to each of the beneficial interest holders are tabulated and analyzed.
  - These results feed back data on the efficiency of the structure, so that it may be modified and improved upon, and ultimately marketed and sold.

Risk Measurement Frameworks and Risk Scoring (2)&(3)

- Two parallel risk measurement systems have evolved within the rating agency world for securitization, one focused on defaults, the other focused on loss or yield. And so there are at least three types of scores at use in today's market:
  - **Defaults**: the cash runs out and the investor is not paid in full;
  - **Expected Losses**: the shortfall by which the initial bond price exceeds the present value of cash flows to the investor, discounted at the promised level of yield; or
  - **Reductions of Yield**: the shortfall by which the contract rate of return exceeds the internal rate of return.

- Structuring a transaction means selecting the metric by which to rate the deal, obtain cash flow results from different scenarios, and use the score as an internal feedback to develop a final transaction structure.
  - External client feedback is a second source of data in this process.

- Two traditions of scenario analysis have developed alongside the two philosophies of risk scoring.
  - In one tradition, stresses are developed based upon a consensus determination of what severity means in historical terms, and they are used to make the structure bullet-proof.
  - In the other tradition, a microstructure of risk is ascribed to the collateral, and a simulation of the impact of the asset risk microstructure on liability cash flows is examined in a simulation framework.

- In general, the market is moving towards a simulation-based examination of risk, in which the cash flow model reproduces the transaction structure in as much detail as is practical, and every ratable tranche in each iteration is scored, be it as a default, an expected loss, or a reduction of yield.

V. *Relative Value*

Corporation vs. Securitization Debt

- The experimentation with structure that produced the **Real Estate Mortgage Investment Conduit** (REMIC) in the mid-1980s and revolving structures in the late 1980s and drove the expansion of method to new collateral types through the mid-1990s attests to growing investor confidence in the viability and attractiveness of securitization as a value proposition.

- The relative value play in the early days of experimentation—a little more yield for a little more uncertainty—turned out well for investors.

- Vis-à-vis corporation debt, securitization has survived and flourished because on average it has held up well, sometimes better than the corporate sector, both in terms of defaults and on the way down (or up) in terms of spreads.

- A key reason for subordinated investors is the possibility of upside. Upside is an unusual feature in fixed income but a norm for a well-structured securitization, due to the interaction of three factors:
    - The existence of a legally binding payment waterfall in a structured transaction;
    - The high standard of ongoing data disclosure relative to corporation finance; and
    - The orderly transition of certainty in bond performance with the passage of time, from less certain to highly certain.

- Regardless of whether or not this orderly transition is directly reflected in the alphanumeric rating, it can be found by a simple recalculation of the ratio of capital to remaining expected loss at each point in time.

- If all goes well, an investor can invest in a tranche; receive the risk-neutral, rating-implied rate of return; and go on receiving it after the worst has passed. Preliminary studies also suggest that the chances of deterioration for a given rating level may also be less in securitizations.