

Valuation of TruPS CDOs

Technical Summary of Approach



RANGEMARK

September 2008

The information contained herein is intended for the exclusive use of the party to whom it has been directly given. It should not be considered sales or marketing materials for any security or similar product, and should not be construed as investment advice. Reference may be made to the potential value or performance of certain financial assets. Such information is intended as a basis for discussion. They are based upon assumptions of current and future market conditions and, as such, the results presented are unlikely to occur due to factors such as market volatility, product availability and changes in economic environment. Moreover, the deviation between actual results and projections tends to increase with time.

Valuation of TruPS CDOs

September 2008

Technical Summary of Approach

PRODUCT OVERVIEW

Trust Preferred Securities (TruPS) are long-dated subordinated securities with deferrable interest features issued by banks, insurance companies, and Real Estate Investment Trusts (REIT) as a way to bolster statutory equity. Typically, these securities have a call date at an intermediate term to make them more attractive to investors. About five years ago, TruPs began to be securitized into Collateralized Debt Obligations (CDO), and several originators emerged to specialize in the aggregation of TruPs collateral and the structuring of CDO transactions. CDOs finance the acquisition of assets by means of issuing term securities with tranches ordered by priorities of repayment. TruPS CDOs serve as buy-and-hold financing vehicles of TRUPS issuers. Though billions of dollars of TruPS and TruPS CDO were issued between 1996 and 2007, neither the CDO tranches nor the underlying loans have traded with much frequency. It is important to note that, unlike CLOs or ABS CDOs, TruPS CDOs commonly do not disclose the particular companies to which they have exposure, creating significant informational challenges to the analysis of these securities.

MODELING AND VALUATION METHODS

TruPS are typically analyzed more like corporate debt and loans, as opposed to structured products. The three common approaches to such *fundamental* analysis of corporate debt collateral within CDOs are: 1) applying a generic pool default curve for the collateral, 2) making credit-specific default assumptions, and 3) market-implied default probability and correlation models (structural and reduced-form models).

Method 1: Generic Default Curves - In the simplest analysis, a default curve (for example, 2% annual defaults, or historical bank defaults experienced during a certain period) is applied to the entire collateral pool. The CDO's waterfall then prescribes how cash flow is distributed to note holders and preferred shareholders. Once cash flows have been modeled, they are discounted back to determine a present value of the position and a price. Risk-adjusted cash flows can be discounted at a risk-free rate to measure intrinsic value, but "Fair Value" requires the yield take the market's liquidity premium into account as well.

The advantage of the generic default curve approach is its simplicity of application and interpretation of results. Generic default curves quickly can be applied to many transactions with little effort and need for processing power. Historical default data is easy to obtain, and curves can be compared to historical default levels. Sensitivity analysis, in which results are reviewed under an array of possible default scenarios is readily applicable and can improve the utility of the study by showing the sensitivity of outcomes to default rate assumptions. These advantages are, however, outweighed by the methodology's disadvantages. It is only as good as the default rate assumption, and historical data have shown limited effectiveness in predicting future default rates. Generic default curves ignore a substantial amount of market data relating to individual companies (CDS spreads, equity prices, etc.). Ad hoc adjustments to default curves based on changing market information are difficult. For example, a change in monetary policy might decrease a bank's chance of defaulting, but by an amount that is unclear.

Method 2: Credit-Specific Assumptions - A more in-depth analysis involves looking at each individual issuer and assessing the probability that each asset defaults. This framework enables more complex sensitivity analysis; different scenarios can be run using different stresses and different timings of deferral or default.

The advantages to the credit-specific approach are: i) credit analysis can capture information as it becomes public and associated adjustments can be made to the stress runs; ii) analysis can capture idiosyncratic risk that may be difficult to incorporate in more general quantitative models (i.e. negative headlines, current deferrals, announcements of regulatory action, etc.); iii) the analysis can be focused upon individual institutions. The disadvantages of the approach are: i) great requirements for substantial ongoing credit work on non-public companies; ii) analyst's assumptions need to be more accurate than those embedded in the market; iii) though risk of individual pieces of collateral can be captured nicely, systematic risk falls outside the purview of the approach.

Method 3: Market-Implied Default Probability and Correlation - The most sophisticated, and our preferred approach, is to use market information to deduce issuer specific Expected Default Probability (EDP) and default correlations. EDP and correlations can be calculated from a number of different data sources, including stock prices, option prices, CDS levels, index levels and reported balance-sheet data. Once EDP and correlations are derived, stochastic simulation is employed to ascertain how the portfolio cash flows would behave over many probabilistic scenarios. Once the cash flow outputs are generated, an analysis of the value of the position under the simulated scenarios is used to generate a price.

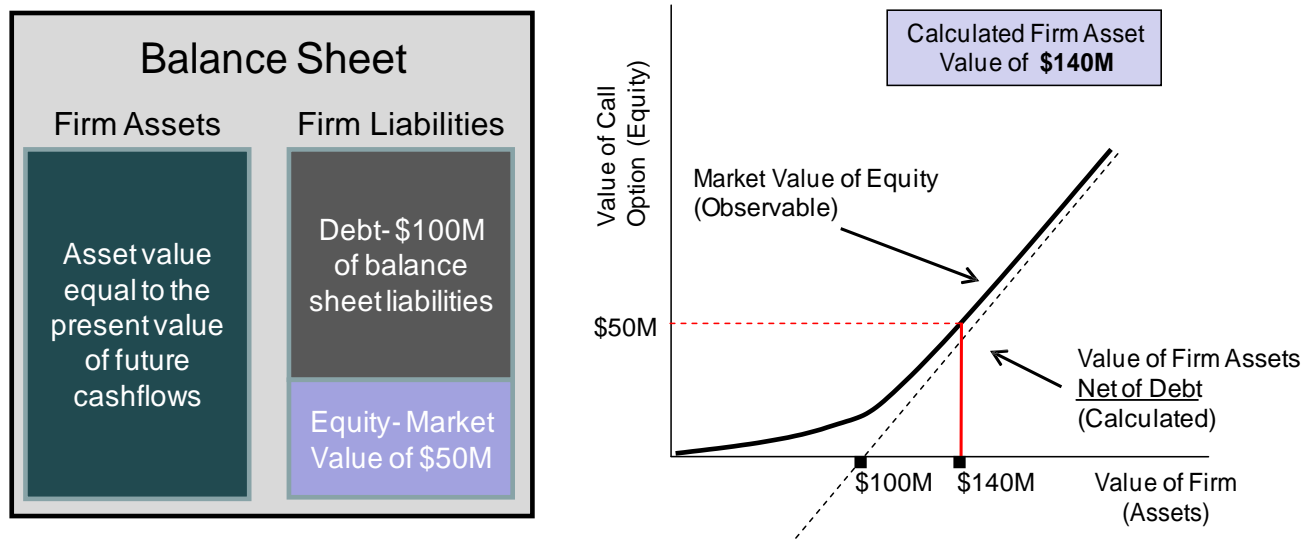
There are several advantages to this market-based methodology. First, it draws on publicly available market data to value the credit quality of a company or position which is potentially a more accurate measure of risk than more conventional name-by-name credit analysis (i.e., credit ratings, scores, etc.). Such a market approach handles both idiosyncratic and systematic changes in a pool's risk quickly and accounts for the inter-connected or correlated performance of companies in similar industries. Finally, results are more objective as fewer exogenous assumptions are made, and the approach can be supported by volumes of research and academic literature. There are two disadvantages associated with applying this approach. First, simulation models can be time-consuming, expensive to build, and require gathering and analyzing large amounts of data. Second, the collateral for many TruPS CDOs are issues of companies having no publicly traded securities or CDS. This requires developing benchmarks or proxy valuations. Introducing assumptions potentially reduces the accuracy of the results.

MERTON CREDIT MODEL

When valuing complex structured credit assets, it is vital to use a framework that makes the greatest use of market information. The shortcoming of a simple structural model for purposes of valuation is it doesn't incorporate anything about current market circumstances. Furthermore, accurate and up-to-date financial statements are unavailable for small and private companies. The insight behind structural models is, shareholders have the right to liquidate the firm and pay off its debt, while their liability is limited to the amount invested to buy the equity. The company's stock, then, is equivalent to holding a call option on the assets or value of the firm. In our modified structural approach, data on equity prices and volatilities are used to infer probability of default. Share prices summarize all available information about issuers, including the market's perception about their asset value.

Consider a company with one debt issuance having face value of \$100M, and one class of equity with market value of \$50M. Figure 1 describes the balance sheet of such a company. Its market cap. is the present value of the company's future earnings. The value of the firm can be calculated using options pricing techniques: \$40M here

Figure 1: Theoretical Balance Sheet and Call Option Value



Time projections of performance of TruP collateral assets are generated by means of a correlated simulation of each firm's behavior.

ANALYTICAL PROCESS

The steps used to obtain a value for the TruPS CDO tranche are: 1) gather portfolio data, 2) calculate asset price volatility, 3) calculating market value of assets, 4) simulate credit performance of underlying issuers, 5) create default schedules, 6) simulating tranche performance, and 7) discount cash flows to establish value.

Gathering Portfolio Data - Portfolio Data comes from a number of different sources. We endeavor to use all available market and financial statement data. Inputs that need for each issuer are:

a. *Face Value of Debt*

The amount of liabilities that each Underlying Credit has outstanding is first taken from its FDIC filings. For public Underlying Credits that do not file information with the FDIC (insurance companies, REITs, etc.) liabilities as listed in their SEC filings are used. For companies that are neither FDIC filers nor public, estimations or proxies for leverage are used.

b. *Market Value of Equity*

The market value of the equity for any public company is taken by multiplying a recent equity price by the number of shares outstanding. For non-public companies that file information with the FDIC, the book value of the equity is used as an estimate of the market value. This assumption is used based on the relatively close correlation between the market value of a performing bank's equity and the book value. For companies that are neither FDIC filers nor public, estimations or proxies for leverage are used.

c. *Volatility of Equity*

The volatility of each publicly traded underlying credit's equity returns is calculated for using daily closing equity prices since the end of 2004. For non-public companies, the volatility is calculated using indexes provided by SNL Financial.

For non-public underlying credits that are banks, equity volatility was determined by looking at the average of two indexes: 1) an SNL Financial index of banks that are approximately the same size as the underlying credit, and 2) an SNL Financial index of banks in the same region as the underlying credit. For non-bank, non-public underlying credits, an index that most closely tracked the underlying credit's primary industry was used to estimate the equity volatility.

Calculating Asset Volatility - Asset volatility is derived endogenously from the system of Black-Scholes equations described below.

Calculating the Market Value of Assets - Deriving the market value of assets is the most mathematically difficult portion of this valuation process. Following the reasoning of Robert Merton, an equity position in a company is equivalent to holding a call option on its assets and the theoretical value of the company can be found using options pricing techniques

The equity value of a firm satisfies:

$$E = V\Phi(d_1) - e^{-rT}F\Phi(d_2)$$

Here E is the market value of the firm's equity, F is the face value of the firm's debt, r is the instantaneous risk-free rate, Φ is the cumulative standard normal distribution function, and d1 and d2 are familiar from the Black-Scholes model:

$$d_1 = \frac{\ln\left(\frac{V}{F}\right) + (r + 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}$$

$$d_2 = d_1 - \sigma_V\sqrt{T}$$

Assuming that the value of a firm follows a generalized Weiner Process and that the value of equities follow a Weiner Process of the same form, Ito's Lemma may be applied to determine a relationship between the equity volatility and the volatility of firm assets which may be expressed as:

$$\sigma_E = \left(\frac{V}{E}\right) \frac{\partial E}{\partial V} \sigma_V$$

Notice that $\frac{\partial E}{\partial V} = \phi(d_1)$. Through the use of this equation, the unobserved σ_V may be inferred using empirical observations which generate a σ_E .

Using the two non-linear equations for E and σ_E , Newton's Method may be applied to solve jointly for the unknowns σ_V and V.

$$f_1(x, y) = 0, \quad f_2(x, y) = 0$$

Suppose we have two equations: , the Jacobian Matrix is defined as:

$$J \equiv \begin{pmatrix} \frac{\partial f_1}{\partial x} & \frac{\partial f_1}{\partial y} \\ \frac{\partial f_2}{\partial x} & \frac{\partial f_2}{\partial y} \end{pmatrix}$$

$$f_1 = E - V\Phi(d_1) + e^{-rT}F\Phi(d_2)$$

$$f_2 \equiv \sigma_E - \left(\frac{V}{E}\right) \frac{\partial E}{\partial V} \sigma_V$$

σ_V

And x is V, y is

Start from an initial guess of (x,y), and by the formula $\begin{pmatrix} x_{n+1} \\ y_{n+1} \end{pmatrix} = J^{-1} \begin{pmatrix} x_n \\ y_n \end{pmatrix}$, till $\begin{pmatrix} x_n \\ y_n \end{pmatrix}$ converges, i.e.

$$\| (x_{n+1}, y_{n+1}) - (x_n, y_n) \| \rightarrow 0,$$

then we get the value of x and y from the two equations .

Simulating Performance of Underlying Credits - Once we have the initial value of an issuer's assets and its volatility (σ_E and V), we estimate the market value for each month by applying the Merton pricing model. The market value of an underlying credit's assets is assumed to follow a geometric Brownian motion (percentage changes in price characterized by a random-walk function) per each unit time $\sqrt{\Delta t}$ scaled to that credit's asset volatility. A discrete form of the relationship which can be applied in simulations is:

$$V(t_{k+1}) = [1 + \mu\Delta t + \sigma_V\epsilon(t_k)\sqrt{\Delta t}]V(t_k)$$

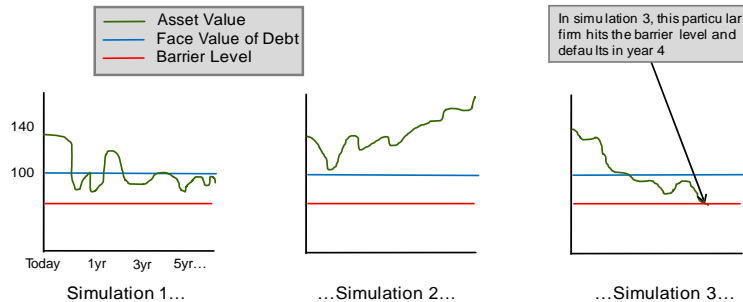
Where V is the market value of assets and σ_V is the volatility, $\epsilon(t_k)$ is the output of the random walk generation (also known as the standard Weiner process), and μ is the expected continuously compounded return on V (which is set to zero as a conservative estimate of the growth of each underlying credit's assets), which allows us to further simplify this equation to:

$$dV = \sigma_V V dB_t$$

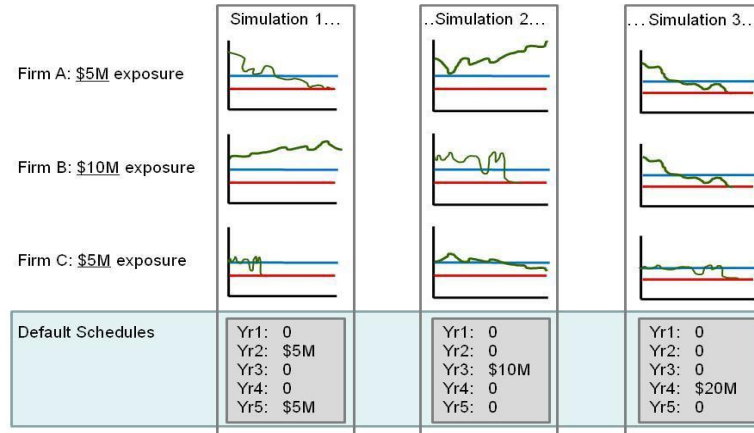
The change in value, dV , is added to (or subtracted from) the previous period's value, V, to give the next month's value of the underlying credit's assets. This process can be done for 120 or 360 months, for each underlying credit, for each simulation in the Monte Carlo model. The output for each underlying credit is a time-path projection of the market value of its assets. Simulation is performed on a joint pool correlated basis. Random draws from a Gaussian distribution are transformed into a correlated set of shocks by means of a linear system. The coefficients of the system are determined as the Cholesky decomposition of an empirically determined correlation matrix. Correlations are derived from observations on equity price movements.

Creating Default Schedules - With the forecasted performance of each underlying, we establish a barrier for default for each credit as a percentage of that company's debt. This number is set using empirical default data based on how underwater companies historically have been before defaulting on their debt. The barrier is different for industries and information from academic studies is used to set the predicted default level going forwards.

Based on research done for the FDIC and academic studies, the barrier for this model has been set at 86% of total liabilities for banks and 68% of total liabilities for other TruPS issuers. This means that once a bank's assets are forecast to be less than 86% of its liabilities, it is assumed to have defaulted on its debt.



For each simulation (columns in the figure below), the timing of the defaults is determined by a breach of the barrier level in the simulated firm value time-path. The output from the simulation is a time-path of respective asset defaults (see charts below), which can then be fed into a model of the CDO liabilities to simulate the payments that can be expected by the tranche-holder.



Simulating Tranche Performance - The default schedules generated for each simulation are then fed through a cash-flow model of the CDO's liability structure (including, in particular, the details of the priority of tranche payments), either built independently or provided by a third party such as Intex. The purpose of this is to transform the cash flow to the CDO into cash flow to the particular tranche being analyzed. The output of this step is a set of cash flows to the tranche being analyzed for each simulation (100-10,000 times).

Discounting and Valuation - Once the set of simulated cash flows (100-10,000) is generated, valuation can be based on the mean present value of the potential cash flow. Discounting can be done at any number of rates.

However, under the Statement of Financial Accounting Concepts No. 7, it suggests the proper rate can either be the risk-free rate or “a rate that incorporates a risk premium for the systematic risk inherent in the expected cash flows.” (FASB Board Meeting minutes 8/27/2003). We generally use a modified Capital Asset Pricing Model (CAPM) to determine a fair discount rate on risky cash flows. However, a minimum spread of 400 basis points may be applied based on recent transactions of comparable assets.

CONCLUSION

There are several approaches to valuing CDOs backed by TruPS. When selecting among these varying methodologies, institutions must weigh the various costs and benefits of each. Although complex and computationally intensive, a modified structural model that projects expected defaults strikes the best balance; maximizes the use of amount of market information while avoiding the potentially significant cost of doing asset-by-asset credit work.