"The Quantification and Trading of Credit Risk"

Wharton Financial Institutions Center

Financial Engineering Roundtable

Sponsored by Oliver, Wyman & Company
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On May 5, 2000, risk practitioners and academics from North America and Europe convened for the third annual Financial Engineering Roundtable, sponsored jointly by the Wharton Financial Institutions Center and Oliver, Wyman & Company. This year's conference, entitled "The Quantification and Trading of Credit Risk," assessed new approaches to credit and credit risk, bringing together leading academic researchers and industry practitioners to discuss the state-of-the-art and emerging quantitative approaches to valuation, risk measurement and portfolio management.

A number of forces are radically changing the management, trading and extension of credit:

- Advances in risk management technology, which facilitate more accurate risk measurement and management, in both asset-level and portfolio contexts
- Market developments, such as shareholder pressure on traditional wholesale banking business, BIS II, and tax regulatory arbitrage
- Increased liquidity, associated with new investors, new asset classes, and development of advantaged structures for transferring and holding credit risk

As lending assets become more liquid, whether directly through loan trading, or indirectly through techniques such as securitization and credit derivatives, such claims are becoming a distinct asset class in the capital market. This evolution has led to the use of more quantitative approaches in the traditionally qualitative loan market. To be an active participant, standard tools employed elsewhere, such as value-based (i.e. mark-to-market) valuation procedures and VaR techniques for risk management, are being used in the "new" credit market. In the limit, the application of these techniques will lead to the blurring or elimination of the distinction between credit risk and traditional market risk.

Keynote Address, May 4

The conference began with a keynote address to **John Mingo**, Managing Director of **Mingo & Co.,** a consulting firm specializing in the regulation and supervision of risk at large, complex banking institutions. Mingo was previously a senior advisor for the Board of Governors at the Federal Reserve. His comments centered in regulatory capital reform, particularly the Basel Accord discussions around credit risk capital allocation changes. Mingo expressed great pessimism both about the degree of sophistication the BIS would tolerate but also the speed with which any changes would be implemented. That current regulatory capital rules for credit risk are poor and subject to arbitrage by large financial institutions is not under debate. Mingo pointed out that in his experience, these large institutions in fact are eager for arbitrage motivations to be removed through better regulation. Needless to say, Mingo's insightful and provocative comments sparked lively discussion over dinner!

The Conference Day, May 5

Morning: Risk at the Asset Level

A full day of presentations and discussions took place on Friday, moderated by **Anthony Santomero**, of the **Wharton School** and director of the **Financial Institutions Center** and **Frank Diebold**, also of the **Wharton School** and the **Oliver Wyman Institute**. The morning sessions, entitled "Risk at the Asset Level: Grading, Migration, Default and Recovery," had a strong academic tone, focusing on the complexities in the modeling and empirical analysis of credit risk for a single asset. Information asymmetry, migration momentum, and uncertainty in recovery in the event of default make it difficult to accurately model credit instruments. The panel of experts for the morning session sought to shed light on some of these issues from a theoretical and empirical standpoint.

Peter DeMarzo, of the **University of California at Berkeley**, focused on the information asymmetry inherent in credit instruments and how this affects the secondary market for credit instruments. Information asymmetry leads to a "lemons" problem that results in illiquidity in the secondary market: the price of the assets sold in the secondary market is decreasing in the quantity sold. DeMarzo argued that pooling and tranching the assets can eliminate the lemons problem. Pooling "destroys asset-specific information held by the intermediary," which reduces the moral hazard incentive. If tranched asset-backed securities can be issued, it may be optimal for the intermediary to pool assets and issue a debt-like security that is back by the pool.

Haluk Ünal, of the **University of Maryland** and a senior fellow at the **Wharton Financial Institutions Center**, focused on the difficulty of modeling recovery rates. He presented a model for expected recovery rates for risky debt instruments in the event of default. The relative spread in the pricing of senior and junior debt implies an average expected recovery rate across different risk classes. Recognizing that the junior debt is a contingent claim upon payment to senior debtholders, the expected recovery rate for the junior debtholders can be expressed in terms of four factors: the mean recovery rate, the volatility of the average recovery rate, the level at which junior debtholders start sharing with senior debtholders, and the proportion of senior debt in the capital structure. Not surprisingly, data is a key challenge going forward.

Ehud Ronn, of the **University of Texas at Austin**, presented a two-factor corporate bond model for the valuation of default risk in corporate bonds. Ronn explicity models the instantaneous default spread on risk bonds, correlates that spread to the risk-free rate and links the default intensity to the prevailing instantaneous credit spread. Formal mathematical models for default events directly are hard; modeling them as contingent claim by leveraging the options pricing toolkit turns out to be more tractable, which is Ronn's approach. The model suggests that the credit spread is a mean-reverting process preventing it from becoming unrealistically large. The importance of modeling the default event explicity linked to the credit spread is underscored by the fact that credit derivatives are contingent claims on the default event.

With the difficult modeling and data availability issues in mind, **Dilip Madan**, of the **University of Maryland**, delved into pricing and model calibration for credit instruments. He began by recognizing that tractable models (such as the Merton model and the hazard rate model of default) which sacrifice consistency for simplicity may be appropriate, provided they are accurate for a wide array of instruments. Madan applies a hazard rate pricing model to coupon bonds as an example. He explicitly addressed an apparently contradiction of finance-theoretic models: their focus is on developing arbitrage-free models in the belief that no arbitrage opportunities can exist, yet in application by practitioners, these practitioners seek out (and thus eliminate) precisely these arbitrage opportunities. Specifically, practitioners need models which incorporate an error (suggesting the existence of arbitrage opportunities) rather than fit the model exactly to the observed prices. This more empirically driven models which allow for arbitrage possibilities are often more useful.

Following Madan's emphasis on model calibration ad pricing, **Stuart Turnbull**, of the Canadian Imperial Bank of Commerce **(CIBC)**, asked the quesiton, "what do we want to get out of a pricing model relative to a risk model?" His remarks set off a lively debate regarding the consistency of pricing and risk models. Turnbull argues that the models used for pricing should be the same as the models used for risk management. This presents methodological challenges, as often the pricing models differ from the risk management models, especially for illiquid instruments. As credit instruments become more liquid, risk management models can be price-based, i.e. rather than estimating default probabilities and recovery, risk can be based on price volatility, as in Value-at-Risk calculations for market risk.

The morning sessions also included several interesting insights into the empirical evidence surrounding credit models. **Reza Behar**, of **Standard and Poor's** focused on credit migration, or the transition of credit instruments from one rating to another. At the heart of the presentation was the conjecture, backed by empirical evidence, that there is a momentum in the credit migration process: instruments that have been downgraded have a great tendency to be downgraded again, and instruments that have been upgraded have a greater tendency to be upgraded. This is an extremely important observation, one that calls for thorough examination of the pricing of such instruments upon a credit change. [Strong statement: can you back up why this is so important?] It questions a fundamental working assumption in credit risk analytics, namely that transition matrices are Markov: tomorrow's credit distribution is entirely described by today's, and no information from yesterday is needed. Relaxing this assumption makes the analytics, while more accurate, much more difficult.

In another empirical study, **Marshall Blume**, of the **Wharton School**, presented the claim that a company has to continually improve its accounting ratios to maintain the same credit grade, suggesting the possibility of a decline in the credit quality of U.S. corporate debt or an increasingly stringent rating structure. Using a panel data approach, Blume and his colleagues found that trends in bond ratings are consistent with declining credit quality, but that this could be due to higher standards on the part of the rating agencies. In another interesting aspect of their work, Blume and his colleagues found that accounting ratios and market-based measures are more informative the larger the company.

Following Blume's comments, **Mark Carey**, of the **Federal Reserve Board** in Washington D.C., focused on the parameterization of credit risk models with rating data. Quantification of default probabilities from rating data is a non-trivial exercise. Actuarial methods are infeasible due to data constraints, so scoring and mapping methods are used. Questions to consider are whether or not certain methods lead to bias, whether they are stable, and whether or not the potential for gaming exists. Carey stimulates an internal rating process and finds significant bias and the potential for gaming. Still, quantification of default probabilities can be useful with the appropriate attention to measurement error.

Afternoon: Risk at the Portfolio Level

The afternoon sessions, entitled "Risk at the Portfolio Level" focused on the value of diversification in credit portfolios and the integration of market and credit risk. A different set of issues confronts the risk manager when analyzing a portfolio of credit instruments as opposed to just a single one. At the core of the problem is the understanding of correlation across the various credit instruments. The benefits of diversification crucially rely on accurate information regarding correlation, and the value of a given instrument to a bank depends largely on the other holdings of the bank.

Stuart Brannan, of the **Bank of Montreal**, began the session by stressing that the modern credit process needs to be dynamic, identifying new assets that fit the portfolio, adjusting the holdings of assets that don't fit as monitoring takes place and new information comes to light is critical. All credit decisions are portfolio dependent, and management should build and maintain an optimal portfolio by measuring contributory risk and reducing or getting paid for it. This is a difficult process, especially when loan structures must be explicitly accounted for. Diversification is the primary tool for lenders to control borrower risk, and since debt portfolios have limited upsides, a very large number of obligors is required. The diversification of these obligations is important. Brannan highlighted the fact that risks arise well before default occurs, and he warned against the construction of "bullet-proof" portfolios than can underperform.

Jose Lopez, of the **Federal Reserve Bank of San Francisco**, then discussed whether or not there was value in diversification of credit portfolios and how this value can be measured. Standard finance theory and practice supports the claim that diversification is valuable. There are several factors that contribute to the degree of diversification for a credit portfolio, and because these factors vary over time, the measurement of credit diversification is particularly challenging. Of particular note is the possibility of time-varying correlations that spike in times of crisis. Still, benchmarks for comparison are important for placing bounds on risk, and it is important to conduct quantitative comparisons such as scenario and stress tests. From the regulatory perspective, it is extremely difficult to compare internal models across different institutions, so standards must prevail, or at the very least, banks must justify their diversification assumptions to show that they are capitalizing adequately.

Thomas Wilson, of **Swiss Re**, focused on the benefits of diversification in credit portfolios. His main finding is that there is a significant difference between concentration and correlation, and the appropriate risk management strategy incorporates concerns about both. Concentrated portfolios, or portfolios in which a large percentage of the exposure is tied to a small percentage of the number of debt instruments, can lead to higher density in the loss distribution in the far-right tail, since default in the concentrated sector can lead to a significant loss. Correlation across industries within a given country is fairly high and the data indicates that a single factor can account for default behavior for a given country. Correlation across countries is much less correlated. Hence inter-industry diversification benefits are lower than perhaps expected; such benefits can be gained only by diversifying across economies. As such, Wilson advocate focus on mitigating concentration in the portfolio and diversifying across nations, where the benefits are much stronger than they are when diversification occurs across sectors in a given economy.

As risk is better understood at the portfolio level for credit instruments, the liquidity of credit instruments continues to increase. The second half of the afternoon session focused on the convergence of market and credit risk management from two entirely separate entities towards a unified approach. Several questions regarding the feasibility of such a trend were discussed.

John Drzik, of **Oliver Wyman & Company**, compared and contrasted the managment approaches used for market and credit risk. According to Drzik, traditional credit risk and market risk management approaches lie on two ends of a spectrum whose primary determinant is liquidity. As credit instruments become more liquid, a market risk approach -- or a hybrid approach for semi-liquid instruments -- will become more appropriate to the risk measurement and management inherent in those products. To enable the dynamic shifting of management approaches as liquidity changes, institutions should seek to organizationally unify risk management functions under a Chief Risk Officer, while maintaining specific expertise in measurement and management techniques for market and credit (liquid and illiquid) risks.

Gregory Hopper, of **Morgan Stanley Dean Witter**, continued with the question of whether or not the integration of market and credit risk can be achieved. Rather than focusing on the methodological challenges, however, Hopper made it clear that several other factors make this a difficult process, for not only is an integration of the models themselves necessary, but also an integration of people, data, software, marketing, etc. In short, this is a multifaceted problem. He also stressed the importance of modeling the macroeconomy as a basis for credit risk modeling and the tradeoff between accuracy and feasibility in the modeling process.

Evan Picoult, of **Citigroup**, discussed how integration of credit and market risk requires the integration of risk methodology and analytics, risk measurement and systems, and risk policies and management. Credit and market risk are inherently linked, from the issuer risk component of market risk to the market risk component of pre-settlement credit risk exposure. Thus the analysis of credit and market risk lends itself to shared elements of analysis. Still, there are differences, such as the time horizon, legal issues, etc.
Finally, **David Shimko**, of **Harvard Business School**, also focused on the inherent link between credit and market risk. He stressed the need for better collateral management as a tool for eliminating credit risk assessment problems. There is a moral hazard problem in credit instruments. It is difficult to assess counterparty risk, as we have seen in Long Term Capital Management and in the US power industry. As Shimko pointed out, "Why trade with someone who would trade with you?" Shimko stressed the need for eliminating the information asymmetry through collateral, for which there is no information asymmetry. He believes that "collateral solutions lead to credit solutions."

Summary Comments

Both the morning and afternoon sessions of the conference stimulated exciting dialogue amongst the participants. Key discussion points included the issue of separability of pricing and risk models, the feasibility and practicality of pooled credit information (through the Federal Reserve or otherwise) to improve data availability and model accuracy, and the importance of macroeconomic factors in modeling credit risk. The difficulty of diversification of a loan portfolio was highlighted again and again during the discussions, with systematic risk being so closely tied to the domestic economy. While this suggests international trading of loan exposure through credit derivatives, the lack of agreement on risk grading tools and methods will hinder the rapid development of this market.