The Future of Risk-Adjusted Credit Pricing in Financial Institutions

by Scott D. Aguais and Lawrence R. Forest Jr.

The current tool of choice for many institutions opting for risk-adjusted credit pricing, RAROC, doesn't reconcile the prices of loans with those of similar instruments available in the market, such as bonds, other loans, or credit derivatives. Thus, it can't assess arbitrage situations arising from relative price mismatches. The future is in improved credit valuation engines.

Financial institutions today face major hurdles in mitigating credit risks ("playing defense"), and simultaneously pursuing risk-adjusted profitability ("playing offense"). Nowhere is this harder than in large corporate lending, where, by most accounts, adequate risk-adjusted returns are hard to achieve.

To support these conflicting objectives, there has been a decade of rapid development of both in-house and commercially available credit risk and performance measurement tools. Broadly, these tools have included:

- Sophisticated, empirical default models used in establishing credit risk ratings for both public and private borrowers.
- Risk-adjusted performance measurement tools, such as risk-adjusted return on capital (RAROC), used in pricing individual loans and assessing risk-adjusted profitability.
- Portfolio management models used in measuring systematic portfolio concentrations with the assistance of correlation analysis.

In this push to implement better credit risk analytics, decision-support models for risk-adjusted pricing have received less emphasis. The reasons for this are varied, but they probably stem from the view that solving the "portfolio problem" was the next key priority after implementing better credit ratings. After all, big concentrations of risk in Texas in the 1980s, real estate in the early 1990s, and Asia most recently have gotten the big headlines.

Another reason for the slow progress on the pricing front relates to the implementation requirements. The development and maintenance of production-quality, desktop decision-support analytics for pricing loans is an

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enormous task. Across a large financial institution, this requires training and support for hundreds, if not thousands, of relationship and credit officers. After all, isn't it easier to train and support a small handful of portfolio management analysts working in the middle office than a much larger number of users bank-wide?

Yet another reason relates to the approach taken in negotiating loans in an increasingly competitive domestic loan market. Most participants in the large-corporate market focus primarily on the credit spread and fees offered and less on the other, more subtle structural features of the loan. Because of this, bankers often ask why they need a pricing model when the market sets the price.

Finally, and perhaps most important, secondary loan sales and other forms of market-based credit-risk transfer until recently have been severely limited. Consequently, market data on credit risk, especially loans, has been extremely scarce, making it hard to calibrate market-based, risk-adjusted credit pricing models. While the literature on credit-risk pricing models has advanced substantially over the years, the applied work has lagged far behind in large measure because of inadequate data.[1]

With loan trading, credit derivatives, CDOs and other forms of market-based credit risk transfer becoming far more prevalent, the future of risk-adjusted pricing looks much more interesting. Some of the developments that will influence the use of risk-adjusted pricing tools are summarized below.

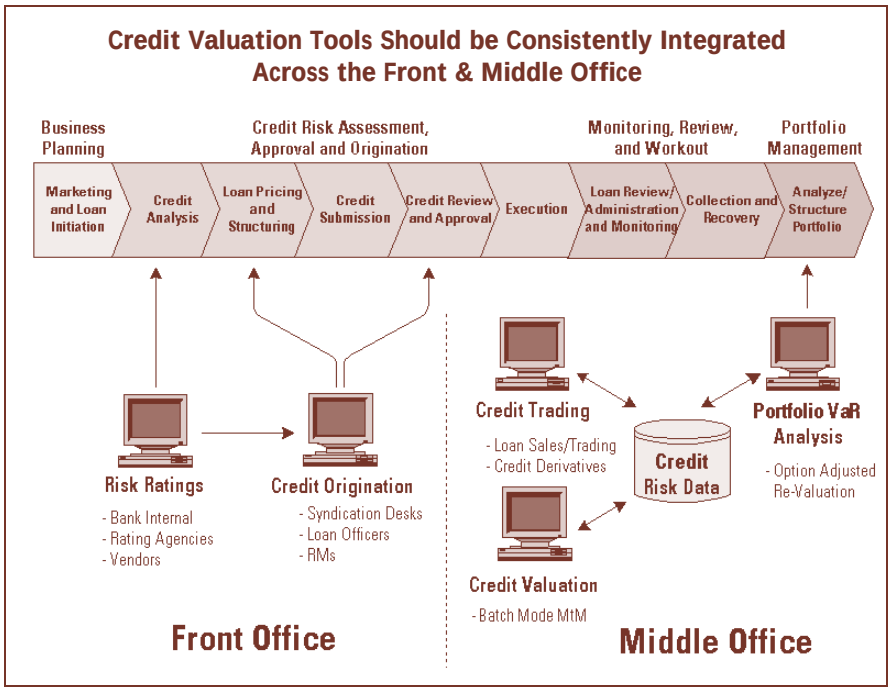
Reasons to Implement Better Credit Pricing Models

To control the credit business and have an opportunity to make money for shareholders, financial institutions providing or investing in credit must have a way of accurately measuring the value conveyed by a loan, bond, credit derivative or any other credit contract. Credit providers who lack this critical capability are essentially trying to run a business without knowing how to measure profits.

Alarmingly, most institutions today use rudimentary credit-pricing procedures that ignore many of the value adding and subtracting features of credit contracts. The inevitable consequence: Lenders are originating or acquiring many credit instruments that they shouldn't and are turning down many that they should take on.

Furthermore, the damage caused by inadequate pricing tools is surely rising. In today's credit market, valuation is becoming more complicated because instruments are becoming increasingly complex, with more instances of embedded credit options.[2] Bonds, for example, are beginning to look more like large corporate loans. For instance, two key Euro-bond issues in 2000 have included "step-up and step-down" coupons that are strippable and tradable separately.[3] In the syndicated loan market, loan facilities regularly include the prepayment option, performance-based pricing resets (grid pricing), term-out provisions, detailed covenants, the drawdown option, and multi-instrument-option features.

These complex structures are also migrating into middle-market lending. Unfortunately, current pricing approaches in financial institutions are mostly blind to these characteristics. Thus, the



existing tools will likely miss the mark in determining appropriate risk-adjusted values, and they will fail to reveal any arbitrage opportunities created by mis-valuation of the embedded options in complex loan and bond agreements. In addition, inaccuracies in valuation produce errors in determining credit Value-at-Risk, which leads to improper portfolio decisions.

Lenders and portfolio managers can, however, take steps to deal with these complexities of credit pricing. Recent advances in credit-risk modeling and credit-risk data make it possible for most institutions to improve dramatically upon their current methods of estimating the value in complex credit agreements and the Value-at-Risk in aggregate credit portfolios. To be sure, the methods and data remain imperfect, but this shouldn't stop an institution from making valuable improvements. With wholesale bank loans, corporate bonds, and credit derivatives accounting for more than $30 trillion in exposures worldwide, better valuation and risk management hold the potential for enormous business benefits.

NPV Methods Compared with RAROC

The more sophisticated approaches to credit valuation—labeled NPV methods here—extend to credit the no-arbitrage framework familiar to the market-risk arena. Since their initial application in the early 1970s, no-arbitrage techniques have become fundamental to the valuation and risk management of the trading and investment books of financial institutions. No-arbitrage, option valuation techniques stand central to the processes of pricing and hedging such securities as bonds and derivatives, marking-to-market portfolios, and building models for measuring and managing risk.

The first real application of extending no-arbitrage techniques to loans was Citibank's pioneering work of the mid-1990s in the Portfolio Strategies Group.[4] Additional progress has been reported in the financial literature, but so far, most financial institutions have been slow in applying these techniques to their loan books.[5] Most institutions today manage the credit risk of the banking book in fairly simple and basically static ways. Perhaps the most prevalent method for pricing applies the concept of RAROC. RAROC isn't a no-arbitrage technique. It doesn't attempt to reconcile the prices of loans with those of similar instruments available in the market, such as bonds, other loans, or credit derivatives. Thus, it can't assess arbitrage situations arising from relative price mismatches. Similarly, it can't identify the natural hedges that often motivate the creation of new credit instruments.

While many of the financial principles behind RAROC seem sound, there are many limitations in its implementation. For example, the RAROC approach typically:

- Neglects the state contingency of the cash flows of most complex credit agreements.
- Uses parameters that are highly subjective and involve a static view of credit risk.
- Considers an arbitrary fixed horizon in pricing credit risk.

State Contingency of Cash Flows

Most loans, credit derivatives, and bonds include embedded options and other features that cause the associated cash flows to vary with changes in credit ratings, interest rates, and credit spreads. To model these state dependencies, lattice or Monte Carlo methods need to be applied in determining values. A wide range of credit grades—not just default and nondefault—should be explicitly modelled in addition to random changes in interest rates and spreads.

As usually implemented, the RAROC approach avoids these complexities and applies the simple two-state (default/nondefault) credit risk model with interest rates and spreads viewed as deterministic. Consequently, the RAROC approach generally treats loans as if they had no embedded options or other structural features, such as prepayment and grid pricing, that create state-contingent cash flows. Especially for high-risk loans, this can lead to large valuation errors of potentially 50 bps or more.

Subjective Parameters Involve a Static View of Credit Risk

The more familiar RAROC implementations basically ignore current credit spreads and give little weight to current experience in quantifying credit risk. Instead, they identify credit risk with the average historical experience of the different credit grades.

This approach has merit for some credit ratings systems that are specifically designed to produce consistent indicators of risk at all times. Unfortunately, the

grading systems of most financial institutions and those of the ratings agencies don't appear to conform to this standard. Instead, credit spreads and default rates for bank and agency ratings categories exhibit long excursions from historical average values. This suggests that the grades connote different amounts of risk at different times. Thus, in determining accurate valuations and risk assessments using such grades, the view of the risk inherent in such risk ratings must be dynamically adjusted.

In calibrating to market prices, however, the no-arbitrage NPV approach makes this dynamic adjustment with the accuracy of the adjustment depending on the efficiency of the market. So under this approach, a credit contract is profitable as long as it provides a return in excess of the market norm.

By contrast, the profitability standard under RAROC is static, implied by historical average experience. When spreads are high, RAROC signals that almost all loans are profitable; when spreads are low, RAROC implies that almost all loans are unprofitable. This approach creates an incentive to originate loans most abundantly when the market signals that risk stands high. However, this seems a rather dubious approach to risk management and risk-adjusted performance assessment.

Arbitrary Fixed Horizon

Again, to avoid lattice or Monte Carlo methods, the RAROC approach mostly uses an arbitrary one-year, single-step horizon. The important effect on risk of the term of the agreement gets little attention or gets treated artificially in a mostly deterministic framework. For most loans, risk goes up substantially with term. Thus, a one-year analysis typically will provide an overly optimistic outlook for multi-year loans.

Practitioners implementing market-based credit-risk pricing today will still find themselves hampered by weak data. The U.S. bond market provides the best source. The U.S. syndicated loan market provides a secondary source. Credit derivatives pricing information is just becoming available.

Unfortunately, the data on actual trades is still mostly proprietary, creating doubts about the reliability of the available pricing information that may involve the use of matrix method extrapolations. Further, the observed prices reflect the details of individual issues. To get consistent and understandable credit-risk indicators, there needs to be an adjustment to a common, known structure, such as a zero-coupon instrument.

Perhaps because of the errors caused by these difficulties, those who supply data on indicative spreads usually don't provide the information organized by the risk-rating, term, and sector detail needed for calibrating market-based pricing tools. Practitioners find themselves filling holes in the more limited data that market participants are willing to provide.

Despite these challenges, credit providers need to find the best, current solutions to the data limitations and, on this basis, apply the modern methods of risk-adjusted pricing for credit risk. As time passes and more data become available, reasonable calibration will become far simpler. Nonetheless, now is the time to adopt the NPV approach, since the alternative to ignoring market signals and credit instrument complexity is far more dangerous.

Implementing Risk-Adjusted Pricing Decision Support

The future of risk-adjusted credit pricing will evolve toward one consistent valuation framework that can be implemented throughout the front and middle-office functions of financial institutions. This framework will be structured to supply information on credit risk valuations to credit originators, credit officers, credit traders, portfolio managers, and line management. Credit risk in loans, bonds, and credit derivatives will be analyzed on a transaction-by-transaction basis, in batch mode to undertake mark-to-market valuation and on a portfolio-wide basis using scenario-based simulation methods. Ultimately, the credit valuation engine that powers this framework will provide credit risk information that can be leveraged across financial organizations on an enterprise-wide basis.

With Internet and Web-based applications rapidly evolving into true production-quality decision support, one of the barriers to bank-wide implementation of sophisticated credit analytics will fall by the wayside. This is because the Web provides an efficient way to roll out front-office decision-support applications. First, it makes remote use of sophisticated models much easier.

Using a browser and a laptop computer, a relationship manager in the field can undertake a credit valuation on a new loan using an engine running on an application server back at headquarters. All of the number crunching can take place on "server farms" that are centrally maintained to manage operating costs more closely.

A second strong reason for using Web-based applications to support credit pricing analysis is the control and convenience provided by centralized management of the analytic parameters. Sophisticated valuation using the NPV approach requires substantial calibration, including data on detailed default migrations; loss factors by collateral type; and credit spread information and volatilities by rating, term, and sector. In addition, detailed behavioral logic is needed for such modeling options as prepayment, revolver utilization, grid pricing, and covenants. Interest rate risk models are needed for fixed-rate instruments, such as bonds. All of the NPV valuation calculations then take place in a lattice-based decision tree that represents multiple decision nodes at multiple time steps.

The beauty of the centralized engine is that all of these parameters can be easily updated and controlled by the credit policy or portfolio management team. This makes the valuation framework much easier to roll out across the front office for hundreds of users, while still maintaining centralized control over the models. As credit risk becomes even more liquid in the future, better market-based credit information will support more frequent model calibration, capturing the true dynamics of different credit markets. For this step, automated data feeds of credit spread information from bonds, loans, and credit derivatives will be analyzed and used to update the calibrated credit risk factors on an almost real-time basis.

Moving beyond in-house implementation of credit valuation applications, the Application Service Provider (ASP) business model has the potential to influence substantially how credit pricing decision-support is distributed. The ASP model is just now in its infancy in terms of supporting risk management, but the future looks quite interesting. Imagine that a bank doesn't even need to purchase and manage its analytic software in house. Rather, it is outsourced, and when credit officers need to evaluate a new transaction, they just sign on to an application server on someone else's "server farm." Outside of the largest financial institutions, the ASP model has the potential to make industry-best analytics for risk-adjusted credit pricing much more widely available without requiring substantial software investments and technology implementation. In the ASP model, these smaller institutions that outsource the software implementation will still be able to leverage their own proprietary risk information to support their calibration objectives.

Supporting Both the Front and Middle Office

For financial institutions considering where risk-adjusted valuation plays a key role within their organizations, there are at least four specific areas to consider using greatly improved risk-adjusted valuation approaches. The current inconsistency in the use of credit pricing decision support comes from different approaches being used in different parts of the organization. Implementing one consistent NPV valuation approach for risk-adjusted assessment supports an enterprise-wide view on credit risk that breaks down internal arbitrage opportunities resulting from inconsistent measurement of credit risk across functions.

Front-office origination. Here, relationship managers and credit officers need to price, value, and structure newly originated syndicated loans, bilateral commercial loans, and loans for the middle market. As part of the approval and origination process, detailed risk-adjusted valuation provides signals on which loans are profitable and which aren't. It also provides a detailed tool for understanding risk-adjusted NPV in relation to changes in loan structure, helping the officer reach the best risk-adjusted outcome for the lender.

Credit sales and trading. To support traders, the credit valuation framework needs to take a market-based view that helps identify under- and over-valued credits, both inside and outside the bank's portfolio. Here, a market-based calibration is key. In addition, the approach needs to support valuation of all credit-risky instruments, including relative value analysis across loans and bonds and credit derivatives, if risk/reward is to be managed on an

aggregate basis. This requires the analysis of both market risk and credit risk, and a few leading banks have begun to use credit trading operations to manage bond portfolios side by side with loan portfolios. In addition, for seasoned credits, there may be "stories" in the marketplace that influence valuations, so decision-support applications for traders must provide a little more flexibility for changing certain parameters to support these "story" valuations.

Middle-office mark-to-market. While mark-to-market valuation is not yet required for the banking book, it will be required in the not-too-distant future. One leading bank, however, is already carrying out weekly mark-to-market analysis for its lending products. Analyzed in batch mode, mark-to-market valuation has the potential to put lending products on the same footing as the trading book in terms of identifying the P/L implications of changes in current credit quality.

Portfolio management. Portfolio management has clearly come of age as a large group of financial institutions have implemented credit portfolio applications. What many people pay less attention to, however, is that most portfolio models also use embedded credit valuation analytics to re-value credit instruments under various credit event scenarios in assessing Value-at-Risk. The credit valuation models used in portfolio applications tend to be more simplified, abstracting from most of the structure and embedded optionality. This means that most estimates of Value-at-Risk from a majority of models could be refined by using improved credit valuation engines in conjunction with the portfolio model. Not incorporating the impact of embedded optionality leads to an overstatement of credit Value-at-Risk during portfolio simulations, all other things being equal.

Risk-adjusted credit valuation will play an increasingly important role in financial institutions. It will support risk management, credit trading, risk-adjusted performance assessment and portfolio management. These tools will help determine which assets to hold, which to sell, and which to package into credit securitzations. It will be used to support transfer pricing and ALM and will become the key to driving risk-adjusted incentive structures.

The good news in the fast-changing world of e-commerce is that these sophisticated analytic applications will become much more cost effective to implement; this is especially important as front and middle-office decisions for origination and portfolio management become more integrated. Those institutions that move the quickest will reap the largest business benefits. ❐

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Notes

1 For a review of the advanced credit risk modeling literature, see Jarrow and Turnbull 1995, Jarrow, Lando and Turnbull, 1997, and Duffie and Singleton, 1999.

2 Elliot Asarnow (1994) and Bruce Stevenson (1996) were two of the first to point out the key role that embedded optionality and structure played in analyzing and valuing loan instruments.

3 See, Gregory-Costello, (2000).

4 See Ginzburg, et. al., (1994) for a discussion of the initial work at Citibank applying NPV valuation approaches using lattice-based methods to loan instruments.

5 Aguais, et. al., (1998), Aguais and Santomero (1998) and Aguais, et al, (2000) also describe an NPV valuation approach applied to credit instruments using lattice-based valuation methods that was developed at KPMG in the late 1990s.

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