CHAPTER 1

Why New Approaches to Credit Risk Measurement and Management?

In recent years, a revolution has been brewing in risk as it is both measured and managed. Contradicting the relatively dull and routine history of credit risk, new technologies and ideas have emerged among a new generation of financial engineering professionals who are applying their model-building skills and analysis to this area.

The question arises: Why now? There are at least seven reasons for this sudden surge in interest.

1. STRUCTURAL INCREASE IN BANKRUPTCIES

Although the most recent recession hit at different times in different countries, most statistics show a significant increase in bankruptcies, compared to the prior recessions. To the extent that there has been a permanent or structural increase in bankruptcies worldwide—possibly due to the increase in global competition—accurate credit risk analysis becomes even more important today than in the past.

2. DISINTERMEDIATION

As capital markets have expanded and become accessible to small and mid-size firms (e.g., it is estimated that as many as 20,000 U.S. companies have actual or potential access to the U.S. commercial paper market), the firms or borrowers "left behind" to raise funds from banks and other traditional financial institutions (FIs) are increasingly likely to be smaller and to have weaker credit ratings. Capital market growth has produced a "winner's curse" effect on the credit portfolios of traditional FIs.

3. MORE COMPETITIVE MARGINS

Almost paradoxically, despite the decline in the average quality of loans (described above), interest margins or spreads, especially in wholesale loan markets, have become very thin. In short, the risk-return trade-off from lending has gotten worse. A number of reasons can be cited, but an important factor has been the enhanced competition for lower quality borrowers, especially from finance companies, much of whose lending activity has been concentrated at the higher risk/lower quality end of the market.

4. DECLINING AND VOLATILE VALUES OF COLLATERAL

Concurrent with recent Asian and Russian debt crises, banking crises in well-developed countries such as Switzerland and Japan have shown that property values and real asset values are very hard to predict and to realize through liquidation. The weaker (and more uncertain) collateral values are, the riskier lending is likely to be. Indeed, current concerns about "deflation" worldwide have accentuated concerns about the value of real assets such as property and other physical assets.

5. THE GROWTH OF OFF-BALANCE-SHEET DERIVATIVES

Because of the phenomenal expansion of derivative markets, the growth of credit exposure, or counterparty risk, has extended the need for credit analysis beyond the loan book. In many of the very largest U.S. banks, the notional (not market) value of off-balance-sheet exposure to instruments such as over-the-counter (OTC) swaps and forwards is more than 10 times the size of their loan books. Indeed, the growth in credit risk off the balance sheet was one of the main reasons for the introduction, by the Bank for International Settlements (BIS), of risk-based capital (RBC) requirements in 1993. Under the BIS system, banks have to hold a capital requirement based on the mark-to-market current value of each OTC derivatives contract (so-called current exposure) plus an add-on for potential future exposure (see Chapter 14).

6. TECHNOLOGY

Advances in computer systems and related advances in information technology—for example, the development of historic loan databases by the Loan Pricing Corporation and other companies—have given banks and FIs the opportunity to test high-powered modeling techniques. A survey conducted by the International Swaps and Derivatives Association (ISDA) and the Institute of International Finance (IIF) in 2000 found that survey participants (consisting of 25 commercial banks from 10 countries, with varying sizes and specialties) used commercial and internal databases to assess the credit risk on rated and unrated commercial, retail, and mortgage loans.[1] For example, besides being able to analyze loan loss and value distribution functions—and (especially) the tails of such distributions—FIs can move toward actively managing loan portfolios based on modern portfolio theory (MPT) models and techniques.[2]

7. THE BIS RISK-BASED CAPITAL REQUIREMENTS

Despite the importance of these six reasons, probably the greatest incentive for banks to develop new credit risk models has been dissatisfaction with the BIS and central banks' post-1992 imposition of capital requirements on loans, so-called BIS I. The current BIS approach has been described as a "one-size-fits-all" policy; virtually all loans to private-sector counterparties are subjected to the same 8 percent capital ratio (or capital reserve requirement), irrespective of the size of the loan, its maturity, and, most importantly, the credit quality of the borrowing counterparty. Thus, loans to a firm near bankruptcy are treated (in capital requirement terms) in the same fashion as loans to an AAA borrower. Further, the current capital requirement is additive across all loans; there is no allowance for lower capital requirements because of a greater degree of diversification in the loan portfolio.

At the beginning of 1998, in the United States (1997, in the European Community), regulators allowed certain large banks the discretion to calculate capital requirements for their trading books—or market risk exposures—using "internal models" rather than the alternative regulatory ("standardized") model. Internal models have had certain constraints imposed on them by regulators and are subjected to back-testing verification; nevertheless, they potentially allow for (1) the Value at Risk (*VAR*) of each tradable instrument to be more accurately measured (e.g., based on its price volatility, maturity, and so on) and (2) correlations among assets to be taken into account. In the context of market risk, *VAR* measures the market value exposure of a financial instrument in case tomorrow is a statistically defined "bad day." For example, under the BIS market risk regulations, when banks calculate their *VAR*-based capital requirements using their internal models, they are required to measure the bad day as the one bad day that happens every 100 business days. (See Appendix 1.1, in this chapter, for a summary of basic *VAR* concepts.)

Much of the current interest in fine-tuning credit risk measurement models has been fueled by the proposed BIS New Capital Accord (or so-called BIS II), which would more closely link capital charges to the credit risk exposures for individual retail, commercial, sovereign, and interbank credits. Controversy regarding this proposal (discussed at length in Chapter 3) is evident from the one-year delay in finalization and implementation of BIS II (now proposed to be implemented in 2005). This delay occurred because of difficulties in: agreeing on how credit risk should be modeled, technical problems arising from the nontradability of loans compared to marketable instruments, and the lack of deep historic databases on loan defaults. For this reason, BIS II offers three alternative approaches to the calculation of capital requirements for regulatory purposes: a standardized approach (which utilizes external credit ratings to assess risk weights for capital charges) and two separate internal ratings-based approaches (which utilize the bank's internal database to assess a loan's default probability and loss given default). The internal ratings-based approaches are patterned after the market risk capital regulations using internal models, such that the capital required is calibrated to cover a "bad credit period," defined to be the worst year out of 1,000 years.[3]

Regardless of whether internal models are used to set bank capital requirements, the new models have contributed to the lending process. Specifically, internal models potentially offer better ways to value outstanding loans and credit-risk-exposed instruments such as bonds (corporate and emerging market), as well as better methods for predicting default risk exposures to borrowers and derivative counterparties. Moreover, internal models (1) allow (in many cases) the credit risk of portfolios of loans and credit-risk-sensitive instruments to be better evaluated and (2) can be used to improve the pricing of new loans, in the context of an FI's risk-adjusted return on capital (RAROC), as well as the pricing of relatively new instruments in the credit-derivatives markets, such as credit options, credit swaps, and credit forwards. Finally, the models provide an opportunity to measure the privately optimal or economic amount of capital a bank (or FI) should hold as part of its capital structure.

Before we look at some of these new approaches to credit risk measurement, a brief analysis of the more traditional approaches will heighten the contrast between the new and traditional approaches to credit risk measurement.

APPENDIX 1.1: A BRIEF OVERVIEW OF KEY *VAR* CONCEPTS

The Role of Capital

Banks hold capital (mostly equity and long-term subordinated debt obligations) as a cushion against losses stemming from adverse credit, market, and operational circumstances. By absorbing these losses, capital protects the bank from insolvency. Bank regulators set minimum capital requirements so as to reduce the likelihood of bank insolvencies that are costly to the economy. To determine how much capital should be required, two questions must be answered. First, what is the acceptable probability of bank insolvency? It is neither practical nor desirable to completely indemnify the banking system against all insolvencies; instead, an "acceptable" level of risk is necessary to prevent moral hazard considerations that would encourage banks to take on excessive risk exposures. The proposed BIS II Internal Ratings-Based model sets this risk threshold at the 99.9 percentile; that is, the capital charge is sufficient to cover losses in all but the worst 0.1 percent of adverse credit risk events. Stated directly: There is a 0.1 percent chance that adverse credit conditions will cause bank insolvency.

Measuring Expected and Unexpected Losses

The second input into capital regulations is a methodology for measuring losses in the event of adverse market conditions called *credit events*. Losses are defined as the change in the security's (loan's) value over a fixed period of time ("the credit horizon period"). Typically, the credit horizon period is chosen to be one year. Thus, losses are calculated as the impact of a credit event on the security's market value,[4] less any cash flows received during the one-year credit horizon period. Losses may be negative (that is, there are gains) if the security's value increases over the year and if a credit event does not occur.

Figure 1.1 illustrates a loss distribution that relates all possible values of securities' losses/gains to the probability of occurrence for each value (determined by the likelihood that a credit event will occur). The area under the probability distribution of security losses must sum to one. The probability distribution in Figure 1.1 is a normal distribution, which suggests that losses or gains are symmetrically distributed around the mean value. Two important loss concepts are illustrated in Figure 1.1. Expected losses (EL) are estimated by the mean of the distribution, and unexpected losses (UL) are measured by the chosen percentile cutoff of extreme losses. If the loss percentile cutoff is set at 0.1 percent (as in BIS II proposals), then UL is the value that just marks off the shaded area in Figure 1.1, which comprises

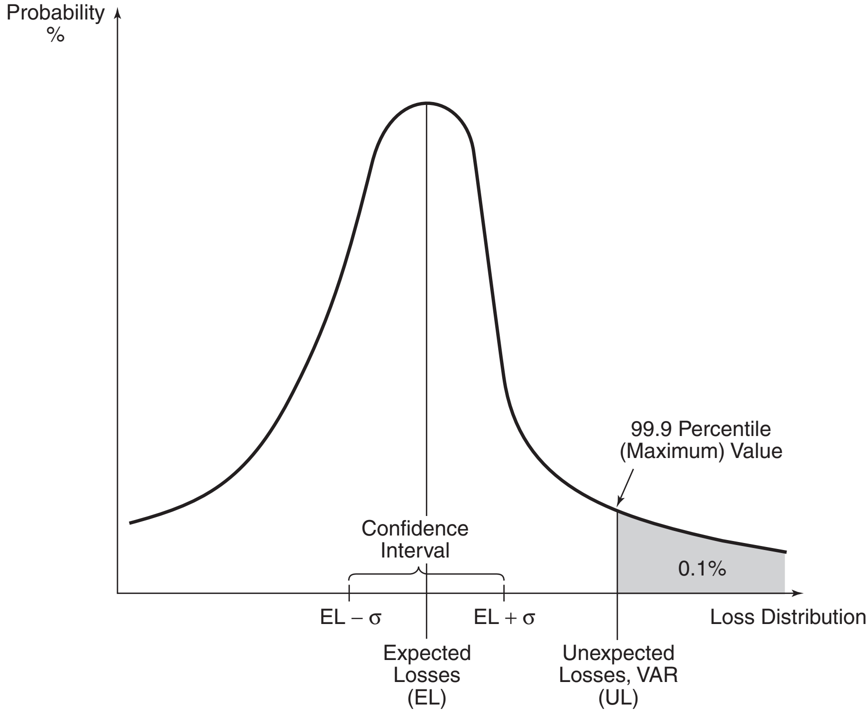

FIGURE 1.1 Normal loss distribution.

0.1 percent of the area under the entire loss distribution. That is, there is only a 0.1 percent likelihood that losses will exceed UL. The UL is considered the measure of Value at Risk (*VAR*).

The standard deviation, denoted σ, is a commonly used measure of risk because it measures the loss dispersion around EL weighted by the likelihood of occurrence. For the normal distribution, there is approximately a 67 percent probability that losses will fall within the region from EL−σ to EL+σ, which is called the *confidence interval.*

The loss distribution shown in Figure 1.1 is normal, although most financial loss distributions are skewed with fat tails; that is, there is a greater likelihood of extreme outcomes than is shown by the normal distribution. Figure 1.2 shows a skewed loss distribution with the loss measures EL and UL. We can solve for the σ of the loss distribution in Figure 1.2, but because it is not normal, we cannot specify the likelihood that losses will fall within the EL−σ to EL+σ confidence interval unless we have information about the particular shape of the distribution, for example, its skewness (lack of symmetry) and its kurtosis (the probability of extreme loss outcomes).

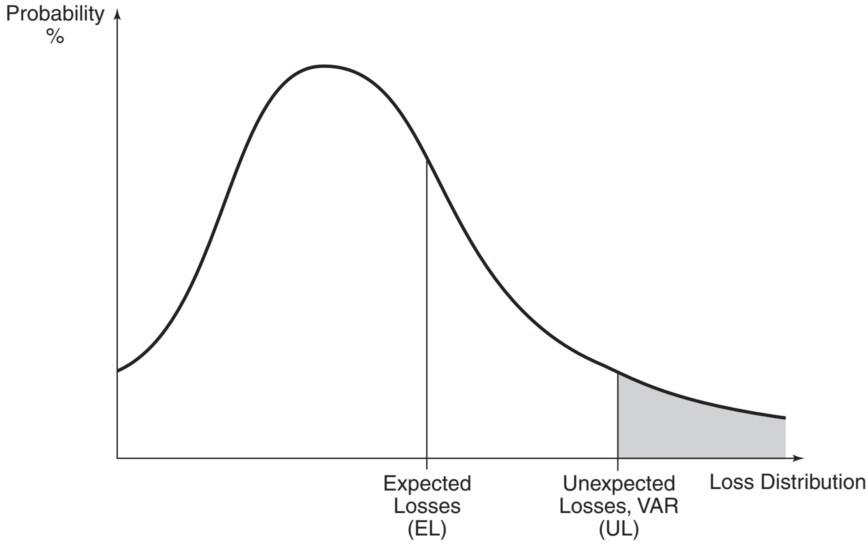

FIGURE 1.2 Skewed loss distribution.

Figures 1.1 and 1.2 are loss distributions for individual security (loan) investments. However, diversification across different securities causes the risk of a portfolio to be lower than the risk of individual security investments. The lower the correlation between pairs of securities, the greater the benefits of diversification in reducing the risk of the portfolio. The correlation coefficient, denoted ρ, measures the comovement between pairs of securities on a scale of –1 to +1: –1 for perfectly negatively correlated (the securities' values move in exactly opposite directions), 0 for uncorrelated, and +1 for perfectly positively correlated (the securities' values move together in lock step). Most securities are positively correlated (thereby preventing the elimination of risk through simple portfolio creation), but not *perfectly* positively correlated (thereby providing substantial benefits to diversification).

As we will see in later chapters (for example, Chapter 6), estimating UL (or *VAR*) for credit risk is challenging. Not only do volatilities and correlations have to be estimated for both probability of default (*PD*) and the loss given default (*LGD*), but the definition of a credit event must also be determined. A credit event may be defined only as default, as in default mode (DM) models. However, mark-to-market (MTM) models define a credit event to be any migration in credit quality, including, but not limited to, default. Thus, if a particular loan or bond is downgraded from an A to a B rating, the adverse change in the bond's price would be included in the loss distribution of an MTM model, whereas it would not be included for a DM model. Moreover, since credit events (particularly default) are somewhat rare events, historical loss rates may not provide accurate estimates of future exposures such as EL and UL. Finally, data availability problems plague credit risk measurement models, in contrast to the market risk *VAR* models that can use series of daily price databases. The challenge, for the modern models of credit risk measurement, is to compensate for these problems.