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Advanced Financial Risk Management:

Tools and Techniques for Integrated Credit Risk, Market Risk, Liquidity Risk and Interest Rate Risk Management

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Part 5: Portfolio Strategy and Risk Management

Chapter 39:
Managing institutional default risk and "safety and soundness"

In 2003, the Basel Committee on Banking Supervision proposed the New Capital Accords as a way to insure the safety and soundness of financial institutions around the world. Since then, such a volume of documents has poured forth from the Basel Committee that few risk managers known to the authors admit to having read every page of even one Basel Committee document. Insiders at the Bank for International Settlements have revealed an indirect confirmation of why the Basel II and III regulations have evoked such a yawn from real risk managers: inside the BIS, as of this writing, there is not a single piece of evidence that the Basel ratios (in any variation) are statistically significant in predicting financial institution failure. For that reason, we focus on methods for controlling default risk in this chapter in which both the statistical evidence and economic logic are strongly supportive of the risk "levers" we discuss.

In Chapters 36 through 38, we showed how modern risk management technology allows a much different approach to ensuring the safety and soundness of financial institutions. In this chapter, we discuss the implications of a more modern approach to risk management for the safety and soundness of a given institution from both a shareholder value perspective and from a regulatory perspective.

Step 1: Admitting the Possibility of Failure

Step 1 in using a more modern approach to risk management is for management to admit the

unthinkable—that the institution they manage has a probability of failure that is not zero. It is a rare management team that can make this admission, but a failure to acknowledge this fact is to deny reality and doom the risk management exercise at the institution to 'common practice' at best. Even up through 1996, the authors were often told in the Tokyo market that "no Japanese bank has failed since the end of World War II," a phrase intended to convey that the future was riskless as well. Within a few years, 7 of the top 21 banks in Japan had failed. Even after the savings and loan crisis in the late 1980s and early 1990s in the United States, banking CEOS were in denial about the risk of their own firms. One of the authors was explicitly forbidden to discuss the bank's own default risk by the CEO himself in the mid-1980s. After the author left the bank, it failed because of an over-exposure to commercial real estate loans. Prior to the credit crisis of 2007 to 2010, one major bank with more than $500 billion in assets labeled its default data base for the U.S. securities industry a "low default portfolio" that was so hard to model they used judgmental default probabilities of 2-3 basis points for U.S. securities firms, less than 3 years prior to the failure of Lehman Brothers and Bear Stearns in 2008 and the rescues of Merrill Lynch and Morgan Stanley by the U.S. government.

With the 2007 to 2010 credit crisis squarely in the rear view mirror, few objective analysts have to be convinced that the probability of financial institutions failure is not zero; even at the CEO level, those who proclaim their firms have zero risk are often subjected to shareholder lawsuits for inaccurate disclosure. Figure 1, provided by Kamakura Risk Information Services, shows that the one year Kamakura Default Probabilities ("KDP") for Bank of America and Citigroup peaked at about 20% and 40% respectively in March 2009, five months after the U.S. government injected $45 billion into the merged Merrill Lynch and Bank of America and $25 billion into Citigroup. Clearly major financial institution default risk isn't zero.

Figure 1

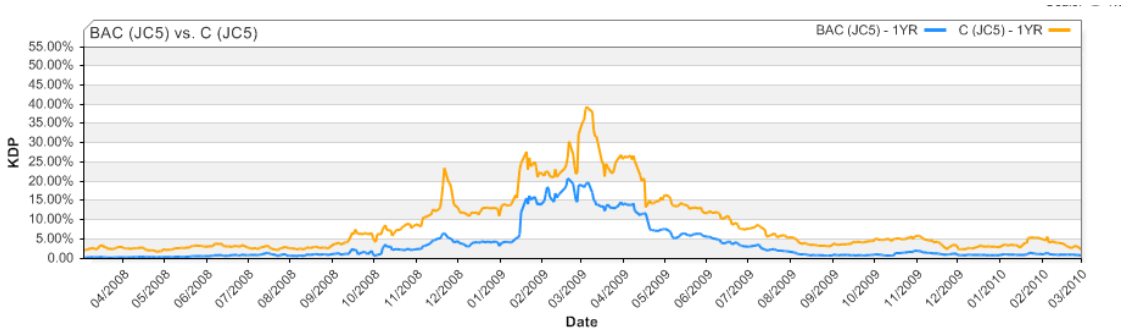
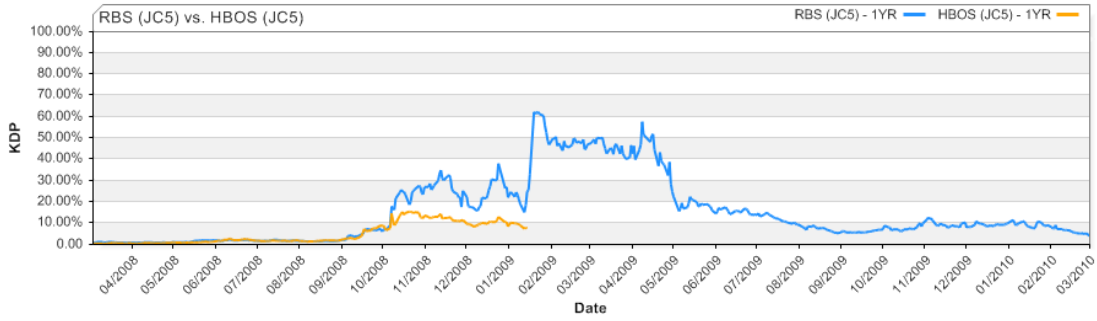


Figure 2 shows 1 year default probabilities over the same period for the Royal Bank of Scotland Group and HBOS (until its rescue/merger early in 2009). The evidence is similar: even the largest and most prestigious financial institutions have not been "too big to fail." In the recent crisis, they've simply been "too big not to bail out when they fail."

Figure 2



Both graphs make it clear that default probabilities in troubled times can show a very high degree of correlation.

Managing the Probability of Failure: Are Ratings a Useful Guide?

In this section, we ask the question "Can an institution's own credit rating be a proper risk index to be managed by the firm?" One of the hardest aspects of using credit ratings for such a role is that ratings have no specific maturity and no specific default probability associated with them. Indeed, there has been a long debate in the risk management industry about whether traditional credit ratings are intended to be "point in time" ratings or whether they are intended to be "through the cycle" credit indicators. The reason that such a debate occurs is the vagueness of the maturity and default probabilities associated with a given rating for a specific company at any point in time. When viewed in the context of a modern quantitative default probability model, the debate about "point in time" versus "through the cycle" is a distinction without a difference. This section explains the reason why.

Even after more than 100 years of experience with traditional credit ratings, practical credit portfolio managers still don't have clear answers to a number of critical questions:

- What is the default probability associated with a specific rating for a specific company over a given time horizon on a specific date?
- What is the default probability associated with the same issuer over different time horizons?
- How do the ratings and default probabilities associated with them change when macro-economic factors change?
- Put differently, how does the default probability associated with a given rating change as the company moves through various points in the business cycle?

Because the rating agencies have been unable to articulate clear answers to these questions, two other questions are often asked and debated:

- Is a given credit rating a "point in time rating," an index of risk that prevails today but (by implication) not necessarily tomorrow?
- Is a given credit rating a "through the cycle rating" intended to measure the average level of credit risk for a given company over an unspecified but presumably long period of time that extends "though the cycle" both for the current business cycle and presumably many others?

A precise answer to these questions only becomes more muddled if one poses it to senior people at the rating agencies. In February 2003 at a well-lubricated dinner in mid-town Manhattan, one of the authors posed this question to the head of corporate credit ratings at one of the two leading rating agencies: "What would your agency do with respect to a company's rating if the company was a long run risk level of BBB/Baa but faced 60 days of CCC/Caa risk?" His answer, consistent with the benign credit conditions of the time, was this: "We can't afford to damage our firm's reputation by letting a BBB/Baa rated company default, so we'd set the rating at CCC/Caa." This comment contrasts with more recent statements by other senior rating executives who argue that they have a special obligation to avoid 'type 1' error that overly harshly rates companies, because such type 1 error might trigger margin calls that would bankrupt a firm that would not have failed without the mistaken rating. If the first quote is accurate in reflecting rating agency thinking, it means that a rating on any given date reflects the worse of (a) the short term risk of the company or (b) the long run risk of the company. From this view, the rating is neither "point in time" nor "through the cycle." A little reflection in a default modeling context makes the muddled semantics much more clear and transparent.

How does a modern quantitative default model differ from ratings? The differences are very great and very attractive from a practice use point of view:

- Each default probability has an explicit maturity
- Each default probability has an obvious meaning. A default probability of 4.25% for a three year maturity means what it says: there is a 4.25% (annualized) probability of default by this company over the three year period starting today
- Each company has a full term structure of default probabilities at maturities from 1 month to 10 years, updated daily.

What does "point in time" mean in this context? All of the default probabilities for Morgan Stanley, for example, prevailing on November 28, 2008 (about 6 weeks after the failure of Lehman Brothers) are default probabilities at that are "point in time" for Morgan Stanley. Default probabilities at a different point in time, say January 25, 2009, will change if the inputs to the default models are different on January 25 than they were on November 28. What does "through the cycle" mean with respect to the default probabilities for Morgan Stanley on November 28, 2008? "Through the cycle" implies the longest default probability available on the term structure of default probabilities because this maturity does the best job of extending through as much of the business cycle as possible. For Morgan Stanley, the longest default probability available is the 10 year default probability, 0.83% (annualized basis). This is quite different from the high risk Morgan Stanley faced in the short run in the aftermath of the Lehman failure, because Morgan Stanley's annualized 1 month default probability at the same time was 8.96%. If the default probability for Morgan Stanley on November 28 is 0.83% at ten years, it means that the "through the cycle" default probability for Morgan Stanley prevailing on November 28 is a 0.83% (annualized) default rate over the 10 years ending November 28, 2018. This is explicit and quite a contract to the vagueness of the ratings concept.

To summarize, all of the default probabilities prevailing for Morgan Stanley on November 28, 2008 are the "point in time" default probabilities for Morgan Stanley at all maturities from 1 month to 10 years. The "through the cycle" default probability for Morgan Stanley on November 28 is the longest maturity default probability, the 10 year default probability. The 10 year default probability is also obviously a point in time default probability because it prevails on November 28, 2008, the "point in time" we care about. On the next business day, all of the point in time default probabilities for Morgan Stanley will be updated, including the 10 year default probability, which has a dual role as the "through the cycle" default probability.

There is no uncertainty about these concepts: all default probabilities that exist today at all maturities are "point in time" default probabilities for Morgan Stanley, and the longest maturity default probability is also the "through the cycle" default probability.

How can these default probabilities be mapped to ratings, and what rating would be "point in time" and what rating would be "through the cycle"? An experienced user of quantitative default probabilities would ask in return "Why would you want to go from an explicit credit risk assessment with daily updates and with a known maturity and 10,000 grades (from 0 basis points to 10,000 basis points) to a vague credit assessment with no known maturity, only 20 grades, and updates that occur randomly at about one year intervals?"

For these reasons, ratings are not a "best practice" risk lever for managing an institution's own default risk.

Managing the Probability of Failure: Are CDS Spreads a Useful Guide?

As we discussed in Chapter 20, it was once thought that a competitive credit default swap market with a strong depth of trading would emerge to provide new market-based measures of the cost of default insurance, an alternative to the put option prices we used for Citigroup in Chapter 36. Enthusiasm for the CDS market was so high, in fact, that an academic writing in the Financial Times on December 28, 2011, said, "How can the FDIC determine the correct price for its insurance? The answer is to use the large and active market in bank insurance via credit default swaps."

Unfortunately, there are several very practical reasons why the credit default swap market cannot be used as suggested and why it is not a proper index of "own default risk" that should be an objective of risk management.

1. There is no "large and active market" in bank credit default swaps. Using data reported by Depository Trust & Clearing Corporation, during the 77 weeks ending December 30, 2011, there were credit default swaps traded on only 13 reference names among U.S. banking firms:

   ALLY FINANCIAL INC.
   AMERICAN EXPRESS COMPANY
   BANK OF AMERICA CORPORATION
   CAPITAL ONE BANK (USA), NATIONAL ASSOCIATION
   CAPITAL ONE FINANCIAL CORPORATION
   CITIGROUP INC.
   CITIGROUP JAPAN HOLDINGS CORP.
   ISTAR FINANCIAL INC.
   JPMORGAN CHASE & CO.
   METLIFE, INC.
   MORGAN STANLEY
   THE GOLDMAN SACHS GROUP, INC.
   WELLS FARGO & COMPANY

   These 13 reference names represent 11 consolidated corporations, four of which would not be considered banking firms by most observers prior to the 2007 to 2010 credit crisis (American Express, Goldman Sachs, MetLife, and Morgan Stanley). During the 77 weeks of data on all live

trades in the DTCC credit default swap trade warehouse, there were no other trades on any other of the 6,453 banks insured by the FDIC in the United States as of March 31, 2011.

2. Even on the firms listed above, there was an average of only 2.3 non-dealer credit default swap trades per day during the 77 weeks ended December 30, 2011. None of the banks listed above averaged more than 5 non-dealer trades per day over the 77 week period studied.

3. Six of the 11 firms listed are in a conflict of interest position as major dealers in the credit default swap market: Bank of America, Citigroup, JPMorgan Chase, Morgan Stanley, Goldman Sachs, and Wells Fargo. Dealer-dealer trades made up 81.68% of live trades in the DTCC over the 77 week period studied. The dealers would be setting deposit insurance rates for themselves if the proposal in the Financial Times was adopted.

4. Credit default swaps, to the extent they trade, represent supply, demand, probability of default and the probability of rescue, not the probability of failure alone. A Kamakura blog posted September 29, 2009 "Comparing Default Probabilities and Credit Default Swap Quotes: Insights from the Examples of FNMA and Citigroup" showed how credit default swap quotes for both firms were far below their probability of failure because senior debt holders correctly anticipated that the depositors of Citibank and the senior debt holders of Citigroup and FNMA would be rescued by the U.S. government. This rendered the credit default swap spreads on both failing firms' severe underestimates of their probability of failure.

5. Because of the thinness of non-dealer trading and the very small number of dealing firms world-wide, there is high risk of collusion. Indeed, on April 29, 2011 the European Union launched an investigation of possible collusion among dealers in the credit default swap market. The lawsuit by Charles Schwab in 2011 accuses 12 firms of colluding to manipulate U.S. dollar libor, naming 3 of the banks on which CDS were traded: Bank of America, Citigroup and JPMorgan Chase. Nine of the 12 firms named in the lawsuit are also dealers listed by DTCC in single name credit default swaps:

   A January 3, 2012 Reuters article by Cate Long summarizes the repeated legal violations stemming from collusion in the market for municipal bonds in the United States, including 5 of the 11 firms above. Six of the 8 firms named as "serial offenders" are also dealers in single name CDS that were listed by DTCC in 2010.

For these reasons, proposal to use credit default swaps to price deposit insurance would not work given current market conditions and the lack of competition in the market for credit default swaps. For the same reasons, the CDS pricing on a given financial institution is not a proper risk management index that should be a focus of management. There are many superior tools available, and we turn to them now.

Managing the Probability of Failure Using Quantitative Default Probabilities

Earlier in this book, we discussed the concept of the safety zone for interest rate risk, those interest rate risk positions where the probability of failure is zero. When we ignore credit risk, match-funding all assets except those funded by equity leaves a financial institution free to invest the equity in

securities of any maturity without leaving the safety zone. Once we allow for default of the financial institution's borrowers, there is no safety zone for any financial institution that borrows money to make loans. That means management has to deal practically with a non-zero probability of failure. Just as importantly, we should note that the probability of failure has a term structure just like interest rates, as we showed for Morgan Stanley in Figure 3, which shows the default probabilities out to ten years.

In Chapter 36, we listed four primary questions that management and Boards of Directors should be able to answer in a simple and powerful "pass fail test." We also listed a supplemental list of 26 questions which add value to the risk management process. From that list of 30 questions, these questions very specifically focus on credit risk:

From the 4 question pass/fail test:

Question 2: Using an insider's knowledge of the assets and liabilities of the firm, both "on balance sheet" and "off balance sheet," what is the best estimate, monthly for the next ten years, of the probability that the firm will fail in each of these 120 monthly periods?
Question 3: Using only information available to an outsider, what is the best estimate of the probability of the failure of the firm in both the short run and the long run?
Question 4: If the firm is able to answer Questions 1, 2, and 3, what hedging position is necessary to insure that the macro factor sensitivity of the firm and default probability of the firm reach the target levels set by the Board of Directors?

From the list of 26 supplemental risk management questions:

How do regulatory capital ratios like the Basel II risk measures vary over the business cycle and to what extent are they correlated with the firm's actual risk of default?
What 10 macro factors represent the highest threat to the safety and soundness of the institution, from highest to lowest?
What risk limits should the firm have in place with respect to these 10 macro factors?
Looking backwards in time, which macro factors had the largest historical impact on the firm's market capitalization and default risk?
Is the firm's self-assessment of its own risk level consistent with the pricing on put options on its common stock and credit default swaps?
If the answer is no, what is the reason for the inconsistencies?
If the market prices of puts and CDS are overly pessimistic, what investor education campaign is necessary to more effectively communicate the true risk of the institution?

Note that, in the latter 3 questions, we have implicitly assumed that there is actual trading in the credit default swaps of the firm in question. CDS prices based on quotes, not traded prices, are unusable for all of the reasons listed in the previous section, and even traded prices have severe problems.

Management needs to set a target for the amount of failure risk that creates the maximum amount of shareholder value. For most financial institutions, this means targeting a one year default probability in the 10 to 35 basis point range. This default probability level will ensure that the firm has continuous access to capital markets and the confidence of its policy holders (in insurance) and depositors (in banking). Unlike ratings, as we saw in Figure 3, default probabilities for all maturities

rise and fall during the course of the business cycle. Figure 4 shows the 1 year and 5 year default probabilities for Wells Fargo from January 1990 through December 2006, and Figure 5 shows the credit crisis experience from January 2007 through August 2012:

Figure 4

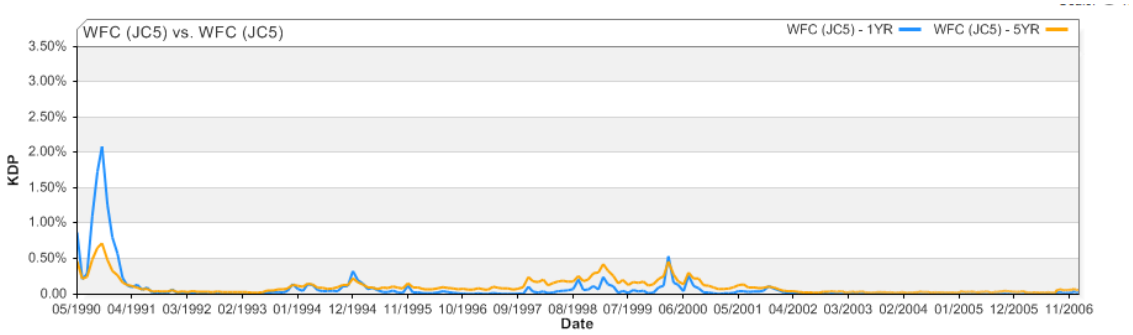
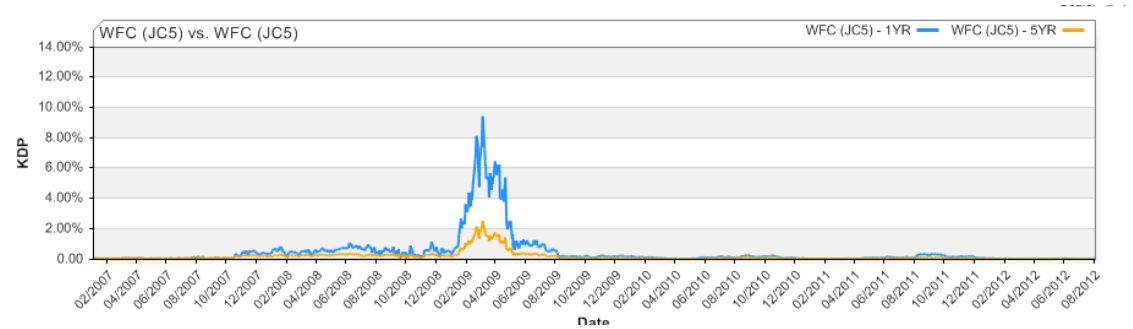


Figure 5



Both the five-year default probability for the Bank (the yellow line) and the one year default probability (the blue line) rise considerably during the worst part of the credit cycle, but the one year default probability responds more sharply. This is identical to the behavior of one year and five year interest rates during the business cycle, and the analogy is strong.

Controlling the Probability of Failure Through the Credit Cycle

What do we do next once management recognizes that its own credit quality varies over the credit cycle because of the cyclicality of the credit worthiness of its borrowers? A parallel question is this: "What do we do next once management recognizes that the cost of risk protection via the Jarrow-Merton put option prices (see Chapter 36) varies over the credit cycle because of the cyclicality of the credit worthiness of its borrowers?" The next step in best practice enterprise risk management is to put a number of measurement and monitoring technologies to work regarding the credit quality of the financial institution itself. There is no reason for this not to be a daily discipline. A best practice report would include the following:

- Current reduced form default probabilities for the company, as discussed in Chapter 16.
- Current put option prices, expressed as a percent of current stock price, at all strike prices and maturities available as discussed in Chapter 36.
- Current credit default swap quotes on the company (if and only if the bank is one of the rate institutions on which trading has occurred); quotes with no trading volume are worthless.

- Current primary (new issue) bond credit spreads for the company.
- Current secondary market bond credit spreads for the company.

For the most technical layer of senior management, the reporting should also include:

- The internally generated time series of monthly default probabilities that stem from a macro-factor driven Monte Carlo simulation as discussed in Chapter 36.
- The internally generated risk neutral cost of the Jarrow-Merton put option that would eliminate integrated credit risk, market risk, foreign exchange risk, and interest rate risk, as discussed in Chapter 36;
- The internally generated risk-neutral cost of the line of credit which would eliminate liquidity risk, as discussed in Chapter 37;
- The 'delta' of shareholder value and the Jarrow-Merton put option with respect to changes in:
    - home prices
    - commercial real estate prices
    - stock price indices;
    - interest rates;
    - oil prices
    - commodity prices
    - foreign exchange rates;
    - other relevant macro factors.

This kind of reporting discipline provides a framework for the practical action that is the ultimate measure of a risk management process—What's the hedge?

Hedging Total Risk to Maximize Shareholder Value

Once management has set a target range for the risk of failure and has measured the financial institution's sensitivities to the macro factors which cause risk, management has three complementary choices for managing default risk/put option levels:

- Management can directly hedge the integrated risk caused by the macro factors using exchange traded derivatives and selected over the counter derivatives. *Note: the disclosures of JPMorgan "hedging losses" beginning in May 2012 are a classic example of what NOT to do. These revelations make it clear that the JPMorgan positions were speculation, not a hedge, and that their overwhelming reliance on over the counter credit default index swaps left JPMorgan subject to the kind of market manipulation that we warned of in earlier sections of this chapter.*
- Management can adopt a more conservative liability structure to reduce the risk of failure.
- Management can issue (or buy back) common stock to change the risk of failure

Since we know the deltas of default risk (see the logistic formula in Chapter 16), shareholder value and the Jarrow-Merton put option with respect to the key macro factors driving risk, we can directly calculate how much hedging we need to do to put the risk of failure in the target range. Using the technology outlined in Chapter 36, we can show the high degree of correlation between the hedging instruments and the cash instruments being hedged, as required by Financial Accounting Standard 133 in the U.S. and by International Accounting Standard 39.

Liability structure can also be managed as long as management takes action early enough when credit quality starts to deteriorate. The safest incremental strategy is to issue more equity and use it to pay down short-term liabilities. This 'buys time' for any problems the institution may have to be corrected over the remainder of the business cycle. If all liabilities were paid down, obviously, the financial institution would find it almost impossible to fail.

In any event, management knows when it needs to take action and it knows which actions to take because of the risk management analysis outlined in Chapters 36 and 37. This knowledge and action orientation is good for shareholders and good for regulators.

Implications for Basel II, Basel III, and Solvency II

As van Deventer and Imai [2003] note, the New Basel Capital Accords were intended to improve the safety and soundness of financial institutions. The credit crisis of 2007 to 2010 makes it clear that this objective was not achieved. These regulations were well intentioned and constrained by the lowest common denominator-level risk analytics that are typical of government regulations. The Basel II Accords, for example, don't specifically provide for, or recommend, Monte Carlo simulation of risks in spite of the fact that this can be done at minimal expense in common spreadsheet software.

The Basel Accords suffer in another couple of dimensions when compared to the procedures that we have outlined in the first 38 chapters of this book:

- **Omitted variables**. The Basel Accords capital ratios effectively are a credit model which omits key explanatory variables that have been proven to be statistically important in predicting default: accounting ratios, common stock prices, macroeconomic factors, and so on.
- **No valuation framework**. The Basel Accords don't provide a consistent valuation framework that is essential to marking-to-market our current position and in simulating our potential default in the future.
- **No hedge**. The Basel Accords fail the most basic test of a risk management approach—they don't tell us the hedge we need to solve the problem.

For these reasons, the Basel Accords have to be regarded as a modest supplement to the tools of Chapters 1 through 38, not the core of a sophisticated risk management effort.

Simulating Our Own Probability of Default

Our greatest advantage in analyzing the risk of our own institution is a complete knowledge of all assets and liabilities we own now and a very good knowledge of what kind of assets and liabilities we are likely to own in the future. In that sense, we have an information advantage that Professor Jarrow has noted is one of the key reasons why the reduced form modeling approach is most consistent with the behavior of market participants who don't have the same information we do.

By better understanding our own risk (Chapter 36) and the timing of a credit-related liquidity event (Chapter 37), which would reveal our problems, we can take action promptly. At worst, we can take action as the market comes to similar realizations, and at best, we can avoid a problem and prevent it from becoming a public issue.

If we do not do so, we risk the needless destruction of our financial institution's franchise that has taken years or decades to build. The shareholders of Northern Rock PLC, Lehman Brothers, Bear Stearns, FNMA, and FHLMC learned this lesson the hard way. We turn back to this issue in Chapter 41, but first we turn to the information technology practices that are most likely to result in a timely, efficient and cost-effective implementation of this risk management technology.