RISK MANAGEMENT AND
REGULATION IN BANKING
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PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON RISK MANAGEMENT AND REGULATION IN BANKING (1997)

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The birth of finance as a modern academic discipline can be dated from the publication, in 1952, of Harry Markowitz's pathbreaking article on the risk return tradeoff and portfolio selection. Subsequently, the Nobel Memorial Prize in Economics was awarded to six scholars—Franco Modigliani, Harry Markowitz, Merton Miller, William Sharpe, Robert Merton, and Myron Scholes—all of whom have provided seminal insights into risk analysis and contributed to the development and recognition of finance as an academic discipline capable of fruitful application in practice. (We sadly note, as did the 1997 Nobel Committee, that Fischer Black did not live to share the honor.)

The period following the publication of the Markowitz article has been characterized by far-reaching innovations that have reshaped our understanding of financial theory and its application to the real world. Few professions have experienced greater change in so short a period of time as has risk management, which originally dealt with the implementation of corporate safety procedures, the avoidance of litigation, and the purchase of insurance. Although the hedging of risk has been around for a long time, a veritable arsenal of new and often sophisticated tools and techniques for risk management has been forged, in no small measure due to the work of the above-mentioned scholars and their disciples. And while numerous cases of the successful mitigation of risks can be cited, the public is all too aware of the widely publicized instances in which both banks and corporations sustained very large losses due to poor risk management.

Similarly, the vigorous regulation of banking and financial institutions has been
with us for a considerable time, at least since the Great Depression of the 1930s. However, here too we have witnessed in recent years, far-reaching changes in regulatory climate and practices across the globe. The EEC edicts on the harmonization of financial markets and the Basle Accord on the capital requirements of banks are two cases in point.

In view of these fundamental changes and their world-wide impact on banking and financial intermediaries, Israel’s Banking Supervision Department and the Hebrew University’s School of Business decided to invite an outstanding group of academics and practitioners to an international conference on risk management and regulation in banking. The conference, which was jointly sponsored by five of Israel’s leading banks (Hapoalim, Leumi, Discount, Mizrachi, and First International), was convened in Jerusalem on May 18, 1997. This volume of selected conference papers is a result of that conference.

The first two articles, by David Pyle and Anthony Santomero, respectively, provide a broad overview of risk management in banking. In his paper, Pyle addresses the question of why bank risk management is needed and then goes on to examine the theoretical bases for bank risk management. He emphasizes that meeting regulatory requirements does not appear to be the most important reason for establishing a sound risk management framework. In today’s world, reliable measures of market risk, credit risk, operational risk, and performance risk, as well as the ability to monitor positions and create incentives for prudent risk-taking, are a *sine qua non* for efficient management.

Santomero presents a summary of major findings from the comprehensive study of risk management in the financial sector carried out by the Wharton Financial Institutions Center with support from the Sloan Foundation. He reports on the state of risk management techniques employed by a sample of relatively sophisticated banks in the United States. Santomero outlines and evaluates the standard practice and then offers a critique of current risk management policies by pointing out shortcomings in the methodology used to analyze risk and the elements that are missing in risk management and control.

The next three papers examine and evaluate alternative techniques for the management of market risk. In his paper, “Introduction to VaR,” Zvi Wiener describes the concept of Value-at-Risk and shows how it can be used for supervision and internal control. Several alternative methods for the measurement of Value-at-Risk are discussed. The nonparametric approach is represented by historical simulations and Monte-Carlo techniques. Variance-covariance and some analytical models are used to demonstrate the parametric approach. The paper concludes with a brief comment on the backtesting required by the Basle regulations.

The primary purpose of the 1988 Basle Accord and its 1996 amendment was to set minimum international capital guidelines that link banks’ capital requirement to both market risk and credit risk. In the first of their two papers, Michel Crouhy, Dan Galai, and Robert Mark compare the two alternatives to assess market risk as proposed by BIS. The first uses the standardized approach, which sets factors as determined by BIS for various financial instruments. The alternative internal model
I. Introduction

The approach is based on the proprietary models of individual banks to value securities and the probability distributions for changes in the value of claims. The two methods, and the BIS rules and guidelines for approving internal models, are critically examined and evaluated. The authors conclude their paper with a numerical example illustrating the potential savings in capital requirement due to the use of internal models rather than the standardized approach.

In their second paper, Crouhy, Galai, and Mark employ the option-pricing approach, pioneered by the two 1997 Nobel laureates and Fischer Black, to the problem of credit risk. The authors present a model in which the credit spread on a corporate bond is the product of the probability of default. They present this as a put option, and a numerical example is used to illustrate the application of option pricing theory to the assessment of credit risk.

Stephen Schaefer introduces an approximation method to estimate the market risk of nonlinear financial instruments. The increasing use of derivatives by financial institutions emphasizes the need to recognize their special features and their influence on the risk exposure of the bank. Schaefer suggests a computationally convenient method to combine derivatives in the VaR estimation.

The next two articles deal directly with the implementation of the 1996 Basle Accord on market risk. In a thought-provoking paper, Giorgio Szego offers an outspoken critique of the Basle capital regulations. Citing recent troubles and crises that have plagued the world’s banking system, Szego casts some doubts on the meaningfulness of prudential regulation, the effectiveness of supervision, the underlying rationale of solvency ratios, and the very survival of traditional banks as financial intermediaries.

Clifford Smout, Head of the Foreign Exchange Division at the Bank of England, discusses problems relating to the implementation of the Basle Accord on Market Risk in the UK. He suggests that smaller banks in the UK are likely to use the standardized approach but expects larger firms with diversified portfolios to opt for the Value-at-Risk approach. After an examination of the numerous problems confronting the implementation of an internal VaR model, he urges that we not lose sight of the very real advantages of the VaR approach: reduction of compliance costs, greater flexibility and ease of adjustment, greater accuracy in dealing with hedged and partially hedged positions, and an even-handed treatment (at least in theory) of different types of risk.

The next two papers deal with financial regulation in general, an area in which traditional approaches and practices have been significantly affected by financial theory. John Heimann, Chairman of Global Financial Institutions at Merrill Lynch and former U.S. Comptroller of the Currency, draws upon his experience, both as regulator and as practitioner, to examine the role of risk management in today’s volatile world. He notes that due to the globalization of finance, risk and therefore risk management have become world-wide phenomena. Confronted by the complexities of some of the newer financial techniques and models, Heimann offers top management a simple rule of thumb, “if you don’t understand it, don’t do it.” He stresses the need to organize for risk management, starting at the top with the
board of directors and the need to ensure that compensation does not become a one-way street in which traders are rewarded for successful risk taking but are not penalized for loss.

From a somewhat different viewpoint, Brian Smouha, Senior Partner at Deloitte & Touche, takes a long look at bank fraud, in general, and at Banco Ambrosiano and the Bank of Credit and Commerce International (BCCI) crises, in particular. Using insights gained when he served as lead liquidator for the collapsed Banco Ambrosiano and for BCCI, which had the world’s largest and most complex bank liquidation in history, Smouha presents a cogent discussion and analysis of the biggest and most frightening of all risks: fraud.

The final section of the book contains two papers dealing with risk management in Israel. Yoram Landskroner, David Ruthenberg, and David Zaken set out the approach to risk management that has evolved at the Bank Supervision Department at the Bank of Israel. They present an internal model based on a portfolio approach, which takes the covariances of the different risks into account. The estimation of overall market risk considers a bank’s total balance sheet (including off-balance sheet items), not only its trading portfolio. Their proposed risk-adjusted capital requirement standard is comprised of an objective factor derived empirically from money and capital market data, and a subjective factor that reflects the degree of risk tolerance of the Bank Supervisor (or of a bank’s management, if the model is used for internal risk control).

The book concludes with a paper by Yair Orgler, Chairman of the Tel Aviv Stock Exchange, on risk management with derivatives traded at the TASE. The objective of the paper is to describe the financial derivatives available at the TASE and those planned for introduction in the near future. Orgler discusses the main features of all these derivatives and provides data on those presently traded. In addition, he provides insights on the perplexing question of why certain contracts did not take off.

Finally, it is a pleasant duty to thank Prof. Arie Melnik; Prof. Jacob Paroush; Mr. Arie Shapiro; Prof. Itzhak Swary; Prof. Ben-Zion Zilberfarb, who chaired the various conference sessions; the former supervisor of Israel’s banks, Mr. Zeev Abeles; and the senior executives of four leading banks of Israel: Mr. Gidon Lahav, Mrs. Galia Maor, Mr. Amiram Sivan, and Mr. Shlomo Peutrokovsky, who served as participants in the panel discussion that concluded the conference; as well as the other members of the organizing committee: Prof. Dan Galai, Prof. David Ruthenberg, and Dr. Ben Schreiber.

Marshall Sarnat
II. RISK MANAGEMENT IN BANKING: AN OVERVIEW
INTRODUCTION

Not too many years ago, the then Chairman of the U.S. House Banking Committee told me it was out of the question to require banks and savings and loans to mark their assets to market. Would anyone responsible for financial regulatory oversight have the temerity to be similarly dismissive today? I suspect the answer is yes. However, the increased attention that formal, scientific appraisal of bank risk has received since then is gratifying to most financial economists. The fact that contemporary bank-risk management employs many of the important theoretical and methodological advances in our field is a source of collective pride. My role on this program is to outline some of the theoretical underpinnings of contemporary bank-risk management. I shall begin with a discussion of why bank-risk management is needed. Then I shall provide some of the theoretical bases for bank-risk management with an emphasis on market and credit risks.

WHY IS RISK MANAGEMENT NEEDED?

Recent financial disasters in financial and nonfinancial firms and in governmental agencies point to the need for various forms of risk management. Financial misadventures are hardly a new phenomenon, but the rapidity with which economic entities can get into trouble is. The savings and loan (S&L) crisis in the United States took two decades, plus serious regulatory ineptness and legislative cupidity, to develop into the debacle it became. The manager of the Orange County...
Investment Pool (OCIP) took less than three years to increase that quasibank's potential one-month loss from a significant but perhaps manageable 1.8% to a disastrous 5% of its investors' deposit-like claims. Anyone who is aware of the leverage inherent in various interest-rate derivatives knows he could have done this faster and even more ruinously had he set his mind to it. To their credit, most regulatory authorities appear to recognize that the core of the problem is not derivatives per se but inadequate risk management.

Banks and similar financial institutions need to meet forthcoming regulatory requirements for risk measurement and capital. However, it is a serious error to think that meeting regulatory requirements is the sole or even the most important reason for establishing a sound, scientific risk management system. Managers need reliable risk measures to direct capital to activities with the best risk/reward ratios. They need estimates of the size of potential losses to stay within limits imposed by readily available liquidity, by creditors, customers, and regulators. They need mechanisms to monitor positions and create incentives for prudent risk-taking by divisions and individuals.

Risk management is the process by which managers satisfy these needs by identifying key risks, obtaining consistent, understandable, operational risk measures, choosing which risks to reduce and which to increase and by what means, and establishing procedures to monitor the resulting risk position.

WHAT ARE THE KEY RISKS?

Risk, in this context, may be defined as “reductions in firm value due to changes in the business environment.” Typically, the major sources of value loss are identified as

- **Market risk** is the change in net asset value due to changes in underlying economic factors, such as interest rates, exchange rates, and equity and commodity prices.
- **Credit risk** is the change in net asset value due to changes in the perceived or actual ability of counter-parties to meet their contractual obligations.
- **Operational risk** results from costs incurred through mistakes made in carrying out transactions such as settlement failures, failures to meet regulatory requirements, and untimely collections.
- **Performance risk** encompasses losses resulting from the failure to properly monitor employees or to use appropriate methods (including model risk).

With the exception of model risk, financial theory does not have a lot to say about the latter two types of risk, although as the managers of various firms have discovered to their regret, they can be highly important. Consequently, in what follows, I focus on the theoretical underpinnings of market risk management with a few comments on credit risk.

MEASURING MARKET RISK

Significant differences exist in the internal and external views of what is a satisfactory market risk measure. Internally, bank managers need a measure that allows active, efficient management of the bank's risk position. Bank regulators want to be
sure a bank’s potential for catastrophic net worth loss is accurately measured and that the bank’s capital is sufficient to survive such a loss. Consider the differences in desired risk measure characteristics that these two views engender.

**Timeliness and scope**

Both managers and regulators want up-to-date measures of risk. For banks active in trading, this may mean selective intraday risk measurement as well as a daily measure of the total risk of the bank. Note, however, that the intraday measures that are relevant for asset allocation and hedging decisions are measures of the marginal effect of a trade on total bank risk and not the stand-alone riskiness of the trade. Regulators, on the other hand, are concerned with the overall riskiness of a bank and have less concern with the risk of individual portfolio components. Nonetheless, given the ability of a sophisticated manager to window dress a bank’s position on short notice, regulators might also like to monitor the intraday total risk. As a practical matter, they probably must be satisfied with a daily measure of total bank risk.

The need for a total risk measure implies that risk measurement cannot be decentralized. For parametric measures of risk, such as standard deviation, this follows from the theory of portfolio selection (Markowitz, 1952) and the well-known fact that the risk of a portfolio is not, in general, the sum of the component risks. More generally, imperfect correlation among portfolio components implies that simulations of portfolio risk must be driven by the portfolio return distribution, which will not be invariant to changes in portfolio composition. Finally, given costly regulatory capital requirements, choices among alternative assets require managers to consider risk/return or risk/cost tradeoffs, where risk is measured as the change in portfolio risk resulting from a given change in portfolio composition. The appropriate risk scaling measure depends on the type of change being made. For example, the pertinent choice criterion for pure hedging transactions might be to maximize the marginal risk reduction to transaction cost ratio over the available instruments while the choice among proprietary transactions would involve minimizing marginal risk per unit of excess return.

**Efficiency**

Risk measurement is costly and time consuming. Consequently, bank managers compromise between measurement precision on the one hand and the cost and timeliness of reporting on the other. This tradeoff will have a profound effect on the risk measurement method a bank will adopt. Bank regulators have their own problem with the cost of accurate risk measurement, which is probably one reason they have chosen to monitor and stress test bank risk measurement systems rather than undertaking their own risk measurements.

**Information content**

Bank regulators have a singular risk measurement goal. They want to know, to a high degree of precision, the maximum loss a bank is likely to experience over a
given horizon. They then can set the bank's required capital (i.e., its economic net worth) to be greater than the estimated maximum loss and be almost sure that the bank will not fail over that horizon. In other words, regulators should focus on the extreme tail of the bank's return distribution and on the size of that tail in adverse circumstances. Bank managers have a more complex set of risk information needs. In addition to shared concerns over sustainable losses, they must consider risk/return tradeoffs. That calls for a different risk measure than the tail statistic, a different horizon, and a focus on more usual market conditions. Furthermore, even when concerned with the level of sustainable losses, the bank manager may want to monitor on the basis of a probability of loss that can be observed with some frequency (e.g., over a month rather than over a year). This allows managers to use the risk measurement model to answer questions such as:

Is the model currently valid? For example, if the loss probability is set at 5%, do we observe a violation once every 20 days on average?
Are traders correctly motivated to manage and not just avoid risk? How often does Trader I's position violate his risk limit relative to the likelihood of that event?

**Market risk measurement alternatives**

There are two principle approaches to risk measurement, scenario analysis and value-at-risk analysis.

*Scenario analysis:* In scenario analysis, the analyst postulates changes in the underlying determinants of portfolio value (e.g., interest rates, exchange rates, equity prices, and commodity prices) and revalues the portfolio given those changes. The resulting change in value is the loss estimate. A typical procedure, often called stress testing, is to use a scenario based on an historically adverse market move. This approach has the advantage of not requiring a distributional assumption for the risk calculation. On the other hand, it is subjective and incorporates a strong assumption that future financial upsets will strongly resemble those of the past. Given the earlier discussion, it should be clear that stress testing can provide regulators with the desired lower tail estimates but is of limited utility in day-to-day risk management. It should also be clear that meaningful scenario analysis is dependent on having valuation models that are accurate over a wide range of input parameters, a characteristic that is shared to a considerable extent by value-at-risk models. Pioneering research on capital asset pricing (Sharpe, 1964), option pricing (Black and Scholes, 1973; Merton, 1973), and term structure modeling (Vasicek, 1977) has provided the basis for reliable valuation models, models that have become increasingly accurate and applicable with subsequent modification and extension by other researchers.

*Value-at-Risk (VaR) analyses* use asset return distributions and predicted return parameters to estimate potential portfolio losses. The specific measure used is the loss in value over X days that will not be exceeded more than Y% of the time. The Basle Committee on Banking Supervision's rule sets Y equal to 1 percent, and X