PART One

Managing Risk

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CHAPTER 1

Risk Management versus Risk Measurement

Managing risk is at the core of managing any financial organization. This statement may seem obvious, even trivial, but remember that the risk management department is usually separate from trading management or line management. Words matter, and using the term *risk management* for a group that does not actually manage anything leads to the notion that managing risk is somehow different from managing other affairs within the firm. Indeed, a director at a large financial group was quoted in the *Financial Times* as saying that ''A board can't be a risk manager.''[1] In reality, the board has the same responsibility to understand and monitor the firm's risk as it has to understand and monitor the firm's profit or financial position.

To repeat, managing risk is at the core of managing any financial organization; it is too important a responsibility for a firm's managers to delegate. Managing risk is about making the tactical and strategic decisions to control those risks that should be controlled and to exploit those opportunities that can be exploited. Although managing risk does involve those quantitative tools and activities generally covered in a risk management textbook, in reality, risk management is as much the art of managing people, processes, and institutions as it is the science of measuring and quantifying risk. In fact, one of the central arguments of this book is that risk management is not the same as risk measurement. In the financial industry probably more than any other, risk management must be a central responsibility for line managers from the board and CEO down through individual trading units and portfolio managers. Managers within a financial organization must be, before anything else, risk managers in the true sense of managing the risks that the firm faces.

[1] Guerrera and Larsen (2008).

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Extending the focus from the passive measurement and monitoring of risk to the active management of risk also drives one toward tools to help identify the type and direction of risks and tools to help identify hedges and strategies that alter risk. It argues for a tighter connection between risk management (traditionally focused on monitoring risk) and portfolio management (in which one decides how much risk to take in the pursuit of profit).

Risk measurement is necessary to support the management of risk. Risk measurement is the specialized task of quantifying and communicating risk. In the financial industry, risk measurement has, justifiably, grown into a specialized quantitative discipline. In many institutions, those focused on risk measurement will be organized into an independent department with reporting lines separate from line managers.

Risk measurement has three goals:

1. Uncovering known risks faced by the portfolio or the firm. By *known* risks, I mean risks that can be identified and understood with study and analysis because these or similar risks have been experienced in the past by this particular firm or others. Such risks are often not obvious or immediately apparent, possibly because of the size or diversity of a portfolio, but these risks can be uncovered with diligence.
2. Making the known risks easy to see, understand, and compare—in other words, the effective, simple, and transparent display and reporting of risk. Value at risk, or VaR, is a popular tool in this arena, but there are other, complementary, techniques and tools.
3. Trying to understand and uncover the unknown, or unanticipated risks—those that may not be easy to understand or anticipate, for example, because the organization or industry has not experienced them before.

Risk management, as I just argued, is the responsibility of managers at all levels of an organization. To support the management of risk, risk measurement and reporting should be consistent throughout the firm, from the most disaggregate level (say, the individual trading desk) up to the top management level. Risk measured at the lowest level should aggregate in a consistent manner to firmwide risk. Although this risk aggregation is never easy to accomplish, a senior manager should be able to view firmwide risk, but then, like the layers of an onion or a Russian nesting doll, peel back the layers and look at increasingly detailed and disaggregated risk. A uniform foundation for risk reporting across a firm provides immense benefits that are not available when firmwide and desk-level risks are treated on a different basis.

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1.1 CONTRASTING RISK MANAGEMENT AND RISK MEASUREMENT

The distinction I draw between risk management and risk measurement argues for a subtle but important change in focus from the standard risk management approach: a focus on understanding and managing risk in addition to the independent measurement of risk. The term *risk management,* unfortunately, has been appropriated to describe what should be termed *risk measurement:* the measuring and quantifying of risk. Risk measurement requires specialized expertise and should generally be organized into a department separate from the main risk-taking units within the organization. Managing risk, in contrast, must be treated as a core competence of a financial firm and of those charged with managing the firm. Appropriating the term *risk management* in this way can mislead one to think that the risk takers' responsibility to manage risk is somehow lessened, diluting their responsibility to make the decisions necessary to effectively manage risk. Managers cannot delegate their responsibilities to manage risk, and there should no more be a separate *risk management* department than there should be a separate *profit management* department.

The standard view posits *risk management* as a separate discipline and an independent department. I argue that *risk measurement* indeed requires technical skills and often should exist as a separate department. The risk measurement department should support line managers by measuring and assessing risk—in a manner analogous to the accounting department supporting line managers by measuring returns and profit and loss. It still remains line managers' responsibility to manage the risk of the firm. Neither risk measurement experts nor line managers (who have the responsibility for managing risk) should confuse the measurement of risk with the management of risk.

1.2 REDEFINITION AND REFOCUS FOR RISK MANAGEMENT

The focus on managing risk argues for a modesty of tools and a boldness of goals. Risk measurement tools can go only so far. They help one to understand current and past exposures, which is a valuable and necessary undertaking but clearly not sufficient for actually managing risk. In contrast, the goal of risk management should be to use the understanding provided by risk measurement to manage future risks. The goal of managing risk with incomplete information is daunting precisely because quantitative risk measurement tools often fail to capture unanticipated events that pose the

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greatest risk. Making decisions with incomplete information is part of almost any human endeavor. The art of risk management is not just in responding to anticipated events, but in building a culture and organization that can respond to risk and withstand unanticipated events. In other words, risk management is about building flexible and robust processes and organizations with the flexibility to identify and respond to risks that were not important or recognized in the past, the robustness to withstand unforeseen circumstances, and the ability to capitalize on new opportunities.

Possibly the best description of my view of risk management comes from a book not even concerned with financial risk management, the delightful *Luck* by the philosopher Nicholas Rescher (2001):

> *The bottom line is that while we cannot* control *luck [risk] through superstitious interventions, we can indeed* influence *luck through the less dramatic but infinitely more efficacious principles of prudence. In particular, three resources come to the fore here:*
>
> 1. Risk management: *managing the direction of and the extent of exposure to risk, and adjusting our risk-taking behavior in a sensible way over the overcautious-to-heedless spectrum.*
> 2. Damage control: *protecting ourselves against the ravages of bad luck by prudential measures, such as insurance, "hedging one's bets," and the like.*
> 3. Opportunity capitalization: *avoiding excessive caution by positioning oneself to take advantage of opportunities so as to enlarge the prospect of converting promising possibilities into actual benefits. (p. 187)*

1.3 QUANTITATIVE MEASUREMENT AND A CONSISTENT FRAMEWORK

The measurement of risk, the language of risk, seemingly even the definition of risk itself—all these can vary dramatically across assets and across the levels of a firm. Traders may talk about DV01 (dollar value of an 01) or adjusted duration for a bond, beta for an equity security, the notional amount of foreign currency for a foreign exchange (FX) position, or the Pandora's box of delta, gamma, theta, and vega for an option. A risk manager assessing the overall risk of a firm might discuss the VaR, or expected shortfall, or lower semivariance.

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This plethora of terms is often confusing and seems to suggest substantially different views of risk. (I do not expect that the nonspecialist reader will know what all these terms mean at this point. They will be defined as needed.) Nonetheless, these terms all tackle the same question in one way or another: What is the variability of profits and losses (P&L)? Viewing everything through the lens of P&L variability provides a unifying framework across asset classes and across levels of the firm, from an individual equity trader up through the board.

The underlying foundations can and should be consistent. Measuring and reporting risk in a consistent manner throughout the firm provides substantial benefits. Although reporting needs to be tailored appropriately, it is important that the foundations—the way risk is calculated—be consistent from the granular level up to the aggregate level.

Consistency provides two benefits. First, senior managers can have the confidence that when they manage the firmwide risk, they are actually managing the aggregation of individual units' risks. Senior managers can drill down to the sources of risk when necessary. Second, managers at the individual desk level can know that when there is a question regarding their risk from a senior manager, it is relevant to the risk they are actually managing. The risks may be expressed using different terminology, but when risk is calculated and reported on a consistent basis, the various risks can be translated into a common language.

An example will help demonstrate how the underlying foundations can be consistent even when the language of risk is quite different across levels of a firm. Consider the market risk for a very simple portfolio:

- $20 million nominal of a 10-year U.S. Treasury (UST) bond.
- €7 million nominal of CAC 40 Index (French equity index) futures.

We can take this as a very simple example of a trading firm, with the bond representing the positions held by a fixed-income trading desk or investment portfolio and the futures representing the positions held by an equity trading desk or investment portfolio. In a real firm, the fixed-income portfolio would have many positions, with a fixed-income trader or portfolio manager involved in the minute-to-minute management of the positions, and a similar situation would exist for the equity portfolio. Senior managers would be responsible for the overall or combined risk but would not have involvement in the day-to-day decisions.

Desk-level traders require a very granular view of their risk. They require, primarily, information on the exposure or sensitivity of a portfolio to market risk factors. The fixed-income trader may measure exposure using

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TABLE 1.1 Sample Exposure Report

Yield Curve (per 1 bp down)		Equity (beta-equivalent notional)	
10-year par yield	$18,288	CAC	$9,100,000

duration, DV01 (also called basis point value [BPV] or dollar duration), or 5- or 10-year bond equivalents.[2] The equity trader might measure the beta-equivalent notional of the position.

In all cases, the trader is measuring only the exposure or sensitivity—that is, how much the position makes or loses when the market moves a specified amount. A simple report showing the exposure or sensitivity for the fixed-income and equity portfolios might look like Table 1.1, which shows the DV01 for the bond and the beta-equivalent holding for the equity. The DV01 of the bond is $18,288, which means that if the yield falls by 1 basis point (bp), the profit will be $18,288.[3] The beta-equivalent position of the equity holding is €7 million, or $9.1 million, in the CAC index.

Market P&L and the distribution of P&L are always the result of two elements interacting: the exposure or sensitivity of positions to market risk factors and the distribution of the risk factors. The sample reports in Table 1.1 show only the first, the exposure to market risk factors. Desk-level traders will usually have knowledge of and experience with the markets, intuitively knowing how likely large moves are versus small moves, and so already have an understanding of the distribution of market risk factors. They generally do not require a formal report to tell them how the market might move but can form their own estimates of the distribution of P&L. In the end, however, it is the distribution of P&L that they use to manage their portfolios.

A more senior manager, removed somewhat from day-to-day trading and with responsibility for a wide range of portfolios, may not have the

[2] Fixed-income exposure measures such as these are discussed in many texts, including Coleman (1998).

[3] Instead of the DV01 of $18,288, the exposure or sensitivity could be expressed as an adjusted or modified duration of 8.2 or five-year bond equivalent of $39 million. In all cases, it comes to the same thing: measuring how much the portfolio moves for a given move in market yields. The DV01 is the dollar sensitivity to a 1 bp move in yields, and the modified duration is the percentage sensitivity to a 100 bp move in yields. Modified duration can be converted to DV01 by multiplying the modified duration times the dollar holding (and dividing by 10,000 because the duration is percent change per 100 bps and the DV01 is dollars per 1 bp). In this case, $20 million notional of the bond is worth $22.256 million, and $8.2 \times 22{,}256{,}000/10{,}000 = \$18{,}288$ (within rounding).

TABLE 1.2 Volatility or Standard Deviation of Individual Market Yield Moves

Yield Curve (bps per day)		Equity (% per day)	
10-year par yield	7.15	CAC	2.54

TABLE 1.3 Portfolio Sensitivity to One Standard Deviation Moves in Specific Market Risk Factors

Yield Curve (yield down)		Equity (index up)	
10-year par yield	$130,750	CAC	$230,825

same intimate and up-to-date knowledge as the desk-level trader for judging the likelihood of large versus small moves. The manager may require additional information on the distribution of market moves.

Table 1.2 shows such additional information, the daily volatility or standard deviation of market moves for yields and the CAC index. We see that the standard deviation of 10-year yields is 7.1 bps and of the CAC index is 2.5 percent. This means that 10-year yields will rise or fall by 7.1 bps (or more) and that the CAC index will move by 2.5 percent (or more) roughly one day out of three. In other words, 7.1 bps provides a rough scale for bond market variability and 2.5 percent a rough scale for equity market volatility.

The market and exposure measures from Tables 1.1 and 1.2 can be combined to provide an estimate of the P&L volatility for the bond and equity positions, shown in Table 1.3.[4]

- Bond P&L volatility $\approx \$18{,}288 \times 7.15 \approx \$130{,}750$
- Equity P&L volatility $\approx \$9{,}100{,}000 \times 0.0254 \approx \$230{,}825$

These values give a formal measure of the P&L variability or P&L distribution: the standard deviation of the P&L distributions. The $130,750 for the fixed-income portfolio means that the portfolio will make or lose about $130,750 (or more) roughly one day out of three; $130,750 provides a rough scale for the P&L variability. Table 1.3 combines the information in Tables 1.1 and 1.2 to provide information on the P&L distribution in a logical, comprehensible manner.

[4] Assuming linearity as we do here is simple but not necessary. There are alternate methodologies for obtaining the P&L distribution from the underlying position exposures and market risk factors; the linear approach is used here for illustration.

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A report such as Table 1.3 provides valuable information. Nonetheless, a senior manager will be most concerned with the variability of the overall P&L, taking all the positions and all possible market movements into account. Doing so requires measuring and accounting for how 10-year yields move in relation to equities—that is, taking into consideration the positions in Table 1.1 and possible movements and co-movements, not just the volatilities of yields considered on their own as in Table 1.2.

For this simple two-asset portfolio, an estimate of the variability of the overall P&L can be produced relatively easily. The standard deviation of the combined P&L will be[5]

$$\begin{aligned}\text{Portfolio volatility} &\approx \sqrt{\text{Bond vol}^2 + 2 \times \rho \times \text{Bond vol} \times \text{Eq vol} + \text{Eq vol}^2} \\ &= \sqrt{130{,}750^2 + 2 \times 0.24 \times 130{,}750 \times 230{,}825 + 230{,}825^2} \\ &\approx \$291{,}300\end{aligned} \tag{1.1}$$

Diagrammatically, the situation might be represented by Figure 1.1. The separate portfolios and individual traders with their detailed exposure reports are represented on the bottom row. (In this example, we have only two, but in a realistic portfolio there would be many more.) Individual traders focus on exposures, using their knowledge of potential market moves to form an assessment of the distribution of P&L.

Managers who are more removed from the day-to-day trading may require the combination of exposure and market move information to form an estimate of the P&L distributions. This is done in Table 1.3 and shown diagrammatically in the third row of Figure 1.1. Assessing the overall P&L requires combining the distribution of individual portfolios and assets into an overall distribution—performed in Equation 1.1 and shown diagrammatically in the top row of Figure 1.1.[6]

The important point is that the goal is the same for all assets and at all levels of the firm: measure, understand, and manage the P&L. This is as true for the individual trader who studies bond DV01s all day as it is for the CEO who examines the firm-wide VaR.

[5] How volatilities combine is discussed more in Chapter 8. The correlation between bonds and the CAC equity is 0.24.

[6] For more complicated portfolios and for risk measures other than volatility (for example, VaR or expected shortfall), the problem of combining multiple asset distributions into an overall distribution may be difficult but the idea is the same: Combine the individual positions to estimate the variability or dispersion of the overall P&L.

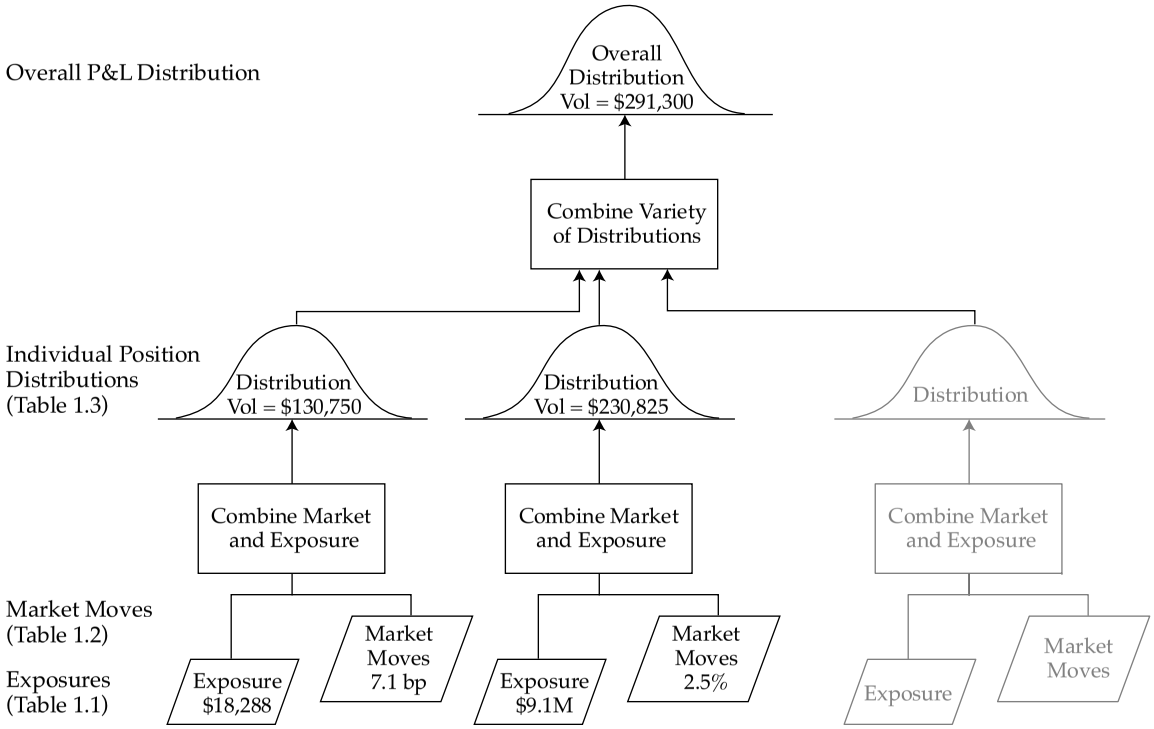

FIGURE 1.1 Representation of Risk Reporting at Various Levels
Note: M = million.

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The portfolio we have been considering is particularly simple and has only two assets. The exposure report, Table 1.1, is simple and easy to comprehend. A more realistic portfolio, however, would have many assets with exposures to many market risk factors. For example, the fixed-income portfolio, instead of having a single DV01 of $18,288 included in a simple report like Table 1.1, might show exposure to 10 or 15 yield curve points for each of five or eight currencies. A granular report used by a trader could easily have 30 or 50 or 70 entries—providing the detail necessary for the trader to manage the portfolio moment by moment but proving to be confusing for anyone aiming at an overview of the complete portfolio.

The problem mushrooms when we consider multiple portfolios (say, a government trading desk, a swap trading desk, a credit desk, an equity desk, and an FX trading desk). A senior manager with overall responsibility for multiple portfolios requires tools for aggregating the risk, from simple exposures to individual portfolio distributions up to an overall distribution. The process of aggregation shown in Figure 1.1 becomes absolutely necessary when the number and type of positions and subportfolios increase.

Building the risk and P&L distributions from the bottom up as shown in Figure 1.1 is easy in concept, even though it is invariably difficult in practice. Equally or even more important, however, is going in the opposite direction: drilling down from the overall P&L to uncover and understand the sources of risk. This aspect of risk measurement is not always covered in great depth, but it is critically important. Managing the overall risk means making decisions about what risks to take on or dispose of, and making those decisions requires understanding the sources of the risk.

Consistency in calculating risk measures, building from the disaggregate up to the aggregate level and then drilling back down, is critically important. It is only by using a consistent framework that the full benefits of managing risk throughout the firm can be realized.

1.4 SYSTEMIC VERSUS IDIOSYNCRATIC RISK

There is an important distinction, when thinking about risk, between what we might call *idiosyncratic risk* and *systemic risk*. This distinction is different from, although conceptually related to, the distinction between idiosyncratic and systemic (beta or market-wide) risk in the capital asset pricing model. Idiosyncratic risk is the risk that is specific to a particular firm, and systemic risk is widespread across the financial system. The distinction between the two is sometimes hazy but very important. Barings Bank's 1995 failure was specific to Barings (although its 1890 failure was related to a more general crisis involving Argentine bonds). In contrast, the failure of

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Lehman Brothers and AIG in 2008 was related to a systemic crisis in the housing market and wider credit markets.

The distinction between idiosyncratic and systemic risk is important for two reasons. First, the sources of idiosyncratic and systemic risk are different. Idiosyncratic risk arises from within a firm and is generally under the control of the firm and its managers. Systemic risk is shared across firms and is often the result of misplaced government intervention, inappropriate economic policies, or exogenous events, such as natural disasters. As a consequence, the response to the two sources of risk will be quite different. Managers within a firm can usually control and manage idiosyncratic risk, but they often cannot control systemic risk. More importantly, firms generally take the macroeconomic environment as given and adapt to it rather than work to alter the systemic risk environment.

The second reason the distinction is important is that the consequences are quite different. A firm-specific risk disaster is serious for the firm and individuals involved, but the repercussions are generally limited to the firm's owners, debtors, and customers. A systemic risk management disaster, however, often has serious implications for the macroeconomy and larger society. Consider the Great Depression of the 1930s, the developing countries' debt crisis of the late 1970s and 1980s, the U.S. savings and loan crisis of the 1980s, the Japanese crisis post-1990, the Russian default of 1998, the various Asian crises of the late 1990s, and the worldwide crisis of 2008, to mention only a few. These events all involved systemic risk and risk management failures, and all had huge costs in the form of direct (bailout) and indirect (lost output) costs.

It is important to remember the distinction between idiosyncratic and systemic risk because in the aftermath of a systemic crisis, the two often become conflated in discussions of the crisis. Better idiosyncratic (individual firm) risk management cannot substitute for adequate systemic (macroeconomic and policy) risk management. Failures of risk management are often held up as the primary driver of systemic failure. Although it is correct that better idiosyncratic risk management can mitigate the impact of systemic risk, it cannot substitute for appropriate macroeconomic policy. Politicians—indeed, all of us participating in the political process—must take responsibility for setting the policies that determine the incentives, rewards, and costs that shape systemic risk.

This book is about idiosyncratic risk and risk management—the risks that an individual firm can control. The topic of systemic risk is vitally important, but it is the subject for a different book—see, for example, the classic *Manias, Panics, and Crashes: A History of Financial Crises* by Kindleberger (1989) or the more recent *This Time Is Different: Eight Centuries of Financial Folly* by Reinhart and Rogoff (2009).