



Risk-Management Programs

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Risk, in and of itself, is not bad. Investment managers have to take some risk to obtain returns in excess of a benchmark. What is bad is risk that is mispriced, mismanaged, or misunderstood. Particularly frightening is the unknown risk--the risk that something might happen that has never happened before--and the potential loss associated with that uncertainty. Recent well-publicized losses have put strong pressure on investment managers to control risk. The pressures have come from customers, boards, shareholders, and senior managers of investment firms.

An interesting side-effect of this pressure is the increasing concern for the risks associated with derivatives. Although the visible bulk of the money has been lost by public funds, hedge funds, or broker/dealers, investment management firms have suffered losses as well. While several dealers have defended their sale of complex instruments to customers and even gone to court on the issue, many investment management firms have decided to settle quietly with their customers, with the result that their losses have not received the same attention as the losses of broker/dealers.

The panic about derivatives has led to a call for increased regulations on risk management. Although most funds begin with derivatives, the investor's focus should not be on derivatives risk alone. While many firms have updated their policies with regard to derivatives few have updated policies with regard to their entire universe of investments. They for example, have put rules in place that require quotes on derivatives from three different dealers or independent verification of structured note or complex mortgage pricing. But when it comes to private placements or foreign securities, most funds pose less stringent valuation requirements. It is important to maintain a consistent view across different instruments and to not single out derivatives.

The risk issue is one that is of concern at all levels of management within an investment firm. The first line of defense, however, is the firm's board. Given the board's fiduciary responsibility, it has to know exactly what is going on. Although researchers and quantitative analysts play a vital role in risk control, the board should not rely solely on number-crunchers for information on risk. Many quantitative factors are equally important.

Risk-Management Premises

Risk management is a dynamic undertaking and often involves addressing the least likely events that may cause the most damage. In the management and control of risk, an investment management firm should include five axioms in its approach:

_ Do not rely solely on math and models. Often, people approach the subject of risk quantitatively. Although many mathematical techniques are helpful, they are by no means adequate. Many issues are nonquantitative and must be controlled through other means.

_ Ask "What if I am wrong?" It is not uncommon to find investors who have lost a great deal of money from a disastrous investment (often termed an "unfortunate situation"). Usually, the loss resulted from buying an overly complex instrument or placing a misunderstood bet. Also people have selective vision regarding investment decisions. Although they understand the outcomes under different scenarios, human nature is to believe that the worst will not happen. It is important to ask what *could* go wrong and how disastrous it might be.

_ Ensure that accountability and authority match up. For example one of the biggest problems in funds is that portfolio managers are often the equivalent of lords or knights in a feudal system; they are untouchable by the people in operations or risk management who are charged with monitoring the managers' activities. All relevant areas of the firm must get involved in monitoring the risks individual managers take and in establishing policies for controlling relevant risks. The intent is not to persecute managers but to manage overall risk. For example, senior management often wishes to make sure that not all funds depreciate simultaneously because each portfolio manager has made the same bet-intentionally or not. The increased focus on risk has led several investment management firms to turn stringent performance and risk-reporting requirements into a marketing advantage on the theory that, when considering different investment management firms with similar products, customers are likely to choose the firm with lucid reporting and clarification of the risks they are taking.

_ Do not suffer from carbon dating. Risk management is a dynamic business, so keeping up with advances is vital. What funds do not want is to have an investor or regulator to step into the shop after a blowup and discover that the last time the risk-management program was updated was years ago. Many firms have implemented risk-management programs--put the best system in place at the time and designed new reports--but then failed to realize that the systems were static while the markets and their portfolios were not. For example, measures such as ten-year equivalents or beta are capable of revealing *some* information about a portfolio, but are far below what is currently considered "best practice". Most investment managers are fiduciaries for their customers, which means they are subject to the Prudent Man rule and the pursuit of best practice. One of the challenges managers face is that prudent best practice changes with time. So, investment managers need to upgrade their systems and risk management processes accordingly.

_ Address the least likely events. Whereas pricing is often based on the most likely events, risk management must address the least likely events. The price of an instrument is its expected value, the most likely outcome for the instrument, because the most likely outcome is what investors pay for. But risk management must also be concerned with a few low-

probability events in the tail of the distribution--those events that generally cause the most regret.

Today's Risks

Risk analysis has changed greatly in the past ten years. In many financial institutions, the single key risk in the past was credit risk. As a result of changes in domestic and international financial markets, however, many new risks have been added to the galaxy of risks (Exhibit 1).

Institutions now face such risks as modeling risk, commodity risk, and contract risk. As an example of contract risk, consider a barrier option that is structured so that above an exchange rate of DM 1.65/US\$1.00, the option would have a value of about US\$40 million and below DM 1.65/US\$1.00, the option would be worth zero. The contract does not specify, however, what the payoff would be if the market closed at *exactly* DM 1.65/US\$1.00.

Another example is a swap contract with yields tied to the dollar/yen exchange rate. The floating rate is set at 100 minus the yen cross-rate; that is, the dealer would pay a fixed rate and receive payments based on 100 minus the yen crossrate. If the yen is below 100 the contract makes sense, but if the yen's rate goes above 100, the dealer ends up paying not only the fixed side of the swap but also the floating side. Contract risk is an area in which the law tends to lag behind the innovations in derivatives and the complexity of financial markets.

Many of the risks listed in Exhibit 1 can be understood from a common-sense perspective, and their measurement may not require mathematical sophistication. In many unfortunate situations we have reviewed, people often have neither thought about them nor planned for them in advance.

Risks Facing Financial Institutions

Technological	Credit	Regulatory
Basis	Market	Tax
Political	Interest Rate	Accounting
Sustainability	Prepayment	Legal
Personnel	Reinvestment	Daylight
Operational	Volatility	Capital
Concentration	Netting	Liquidity
Contract	Currency	Bankruptcy
Systems	Commodity	Collateral
Limit	Equity	Modeling
Rollover	Call	Cross-Market
Hedging	Yield Curve	Systematic
Interpolation	Curve Construction	Time lag
Extrapolation	Raw Data	Knowledge

Historical Background

The investment management business is relatively integrated, and many of the constraints on the activities of investment managers have come from customer activism and regulation. The period from 1991 to 1994 was one of incredible growth in the derivatives market. Derivatives grew in popularity as investors discovered they could be used to hedge, to

make finely tuned bets and to customize investment decisions. In addition, the favorable interest rate environment during that period and a sustained bull market made many of the specialized investment instruments extremely profitable. Encouraged by these returns, many investment managers increasingly leveraged positions using derivatives and complex securities.

This period was also one of increased awareness among corporations about hedging their international exposures and among investors about diversifying into international markets. Often, derivatives can provide international exposure in a simpler way than buying physical assets, such as all of the stocks in the MSCI (Morgan Stanley Capital International) index. They are so useful that even the current ill-repute of derivatives has not deterred many plan sponsors from, for example using futures contracts to build positions in international equity markets. Due to the advances in technology, the ability to create these instruments, price them, and trade them has become available to a broad group of investors.

Another development during this period was a rise in shareholder awareness of risk and activism. With shareholders accusing corporations of taking on too much risk, corporations needed to be able to lay off risk somewhere. Derivatives facilitated the transference of risk from risk averse parties to natural risk takers such as hedge funds and investment management firms.

Finally, from 1991 to 1993, the financial performance of investment management firms received increased attention. This careful scrutiny of performance was the result of (1) mergers and consolidation in the investment management business and (2) the payment of incentive fees. Before incentive fees, a firm could keep clients for an extended period without a direct link between fees and performance, but under incentive payment plans, an investment firm's livelihood was dependent on the quality of the product.

In 1994, a large increase in losses occurred as the bond market changed direction and investors' risk management for complex securities and derivative products failed. Most problems were caused by four types of instruments: structured notes, which injured public funds as well as investment management firms and mutual funds; engineered mortgages and leveraged CMOs; complex leveraged securities; and structures based on exotic underlyings such as foreign currencies or spreads between foreign currencies.

The year 1995 was characterized by a huge increase in lawsuits directed not only at dealers, for creating and selling derivative instruments, but also at several investment management firms. For example, mortgage derivatives, like interest-only strips ("IOs"), are sensitive to prepayments, and capital is lost when such prepayment occurs. Customers who lost capital from these instruments sued their investment managers because they perceived IOs violated the investment management agreement which said the firm would preserve capital.

In our experience, several issues are at the heart of such lawsuits. First is the issue of authority. Was the person doing the trade authorized to do the trade? For example, did certain officers at the public funds that lost money have the authority to trade? Another issue is the disclosure of risks and rewards associated with an instrument. Often, customers do not perform adequate analysis up front on what could happen to the instrument. For example, they might know the cash flows from the instrument but not how to compute its terminal price, and in the event of an early termination, find themselves at the mercy of a dealer. Price transparency is also an issue, especially as it relates to disclosure of proprietary formulas used for pricing instruments. The fourth issue at the heart of the many lawsuits is the notion of suitability. The

traditional definition of suitability under U.S. securities regulations seems to have been changed to “only things that go up in value.” An alarming number of firms have decided to quietly settle disputes regarding suitability of an instrument, providing investors with free do-overs if a complex instrument moves against them. The concern is that if enough customers get free do-overs, a precedent will be set.

The year 1995 was one for infrastructure upgrading and building. Many investment management firms bolstered current systems, put proper systems in place, or commenced investigation of proper systems to manage derivatives and other risks in their investment strategies. Risk management is at a turning point because of the increased complexity associated with the instruments used to manage risk. With the increased complexity comes the added risk of mispricing these instruments. There is increasing use of exotic and less liquid underlyings on derivative products. A recent example is a structured note we saw in which the coupon was tied to the Swedish krona interest rate minus PIBOR (Paris Interbank Offered Rate) cubed, which was then convertible into TelMex common stock.

Despite recent losses and the resulting negative publicity, derivative products have had a positive effect and managers do not have the option of abandoning them. In fact, not using derivatives can also result in lawsuits. For example, the manager of a multinational corporation who does not hedge against currency risk is likely to be thrown out by shareholders.

Specific Risks of Derivatives

Derivatives may expose investors to one or more specific risks: unexpected market moves, model risk, insufficient oversight, too much risk relative to the capital involved, fraud, counterparty lawsuits, and credit risk.

_ Unexpected market moves. Disasters, whether crashes in the equity market, unusual shifts in the bond market, or the peso halving in value, occur rarely and this infrequency may lull investors into complacency. While many believe that big losses cannot happen to them, such unexpected market moves have been a major contributor to investor losses.

_ Model risk/improper hedging. A surprisingly important contributor to risk in derivative use is model risk--the risk that the market's price will be different than the model's price for the instrument. Take, for example a currency barrier option. In an up-and-in option, the option exists if the market breaks through a certain point and does not exist if the market is below that point. In a down-and-out option, if the market falls below a certain trigger, the option disappears. A barrier option has the effect of taking a regular option and cleaving it in half, and standard option-pricing models, such as the Black-Scholes pricing model, do not work well for such options. Because the chance is fairly good that the option is not going to exist, if the market goes above or below the barrier, the number of outcomes that involve a payoff is reduced. Hence, barrier options carry lower premiums than regular options.

Two main methodologies are used to price barrier options. One is a variation of the Black Scholes model, which provides a closed-form solution; that is, it fits into a single-computation spreadsheet, so the manager can type it into a computer and get an answer within seconds. The second method is an iterative technique, in which the model's price is obtained through convergence, a computationally slow process relative to Black-Scholes based models. In situations in which an interbank dealer is asked for a quotation on an up-and-out option and

has only about 15 seconds to respond or lose the business, the dealer often uses a simple spreadsheet model even though it gives a price based on an inferior model.

Before the dollar's move, dealers wrote many barrier options, priced often by doubling the premium determined by a Black-Scholes model. The price doubling was supposed to cover the possibility that the option would hit its barrier and compensate for the approximation. This practice was almost universal, but when the dollar made its dramatic move, dealers were caught by surprise.

_ Insufficient oversight. A number of recent situations have demonstrated that managers must oversee their employees; trust is not enough, particularly when unintended errors cause losses. Thorough oversight is vital for all instruments, and daily marking to market is a good way to determine the gains and losses associated with market moves.

_ Too much risk relative to capital. This problem can arise from outright positions, through leverage, or through the hedges behind the instruments. A structured note with ten-times leverage may look innocuous in terms of face amount but can put large amounts of capital at risk. Borrowing too much can also place large amounts of capital at risk.

These factors have been relevant in many problems that have occurred with derivatives trading--from well publicized municipalities, with positions leveraged several times, to investors that created leverage by buying zero-coupon bonds up to the full amount of the account, to investors that purchased instruments with multipliers. All types of leverage have moved investors into negative territory. We have run across first-time structured note trades involving \$10 million face amount with ten or more times that much at risk which, in the first month, lost \$40 million. Needless to say, the investors failed to adequately analyze their complex trades, and learned too late that they took on too much risk relative to capital.

_ Fraud. As with other financial markets, fraud is a surprisingly small component of derivatives risks. Few people out-and-out lie, and if they do, it is difficult to prove. However, fraud happens and is one of the most difficult things to prevent. A number of actions can be taken, however, to minimize the chance of it happening. Random audits can be a major deterrent and have been effectively employed by many funds.

_ Counterparty lawsuits. A more recent reason for losses from derivatives is counterparty lawsuits. Some dealers are now actually taking reserves against the chance of being sued by a counterparty.

_ Credit risk. Credit risk remains an issue in any transaction in which a party owes cash flows. It is certainly important when one's counterparties are suspending payments because they are thinking about suing. Not only does the firm have credit (or default) risk but it also has the market risk of replacing the cashflows.

Common Problems in Managing Derivatives

The specific risks discussed above are generally exacerbated by several common problems.

_ Valuation models. The first issue involves differences and biases in the techniques used to price derivative instruments. Several issues are related to this. First, the data used to price these instruments may be from different sources. Also, two people might obtain data at two different times of day.

Another common area of disagreement in pricing instruments is the shape of the yield curve. Generally, fixed-income instruments are most impacted, but the pricing of a broad array

of instruments are impacted because it is the basic mechanism for determining today's value for something in the future. One common issue is at what point, should futures versus cash versus swaps be used to determine rates? To deal with this problem, a number of firms have mandated the use of one uniform yield curve throughout the firm, which ensures that everything gets priced on the same basis. It also eliminates the argument that everybody disagrees about the value in matters of performance evaluation and compensation. It does not mean, however, that the chosen yield curve is "right". An awareness of what the rest of the industry is doing is important. Otherwise, investors or traders may be picked off in the marketplace because they are systematically mispricing instruments.

Interpolation and extrapolation in pricing raise similar issues. What happens if a manager has prices for five- and seven-year instruments but needs a price for a six-year instrument? How should the five- and seven-year instruments be weighted in the valuation? How is the price of a 40-year U.S. dollar instrument to be calculated when the longest price from the yield curve is 30 years? Various techniques can be used to interpolate and extrapolate, but each gives a different value.

Another issue is confidence intervals, an important issue when using value at risk. What is the confidence level of the range of your predictions? What is the value-at-risk gradient at a 95 percent confidence level and at a 99 percent confidence level?

_ Marketability. Another important issue related to managing derivatives is their liquidity. For example, there may be fewer buyers for a long-maturity structure. A related issue is position size or how much of a particular asset is owned. Suppose an investor owns a tranche in a collateralized mortgage obligation (CMO). If the tranche is small, say \$40 million, and the investor owns the entire tranche, the chances of finding a willing and knowledgeable counterparty to sell the tranche to are small, which affects the liquidity of the instrument. A surprising number of people are finding that they own large pieces of certain assets and that those pieces are not very marketable. Illiquidity risk is a risk that does not show up in traditional risk analysis and is difficult to quantify.

What about exotic structures? If a securities data base has ten fields in it, the chances are that it can not adequately record the complexity and the structures of exotic instruments, leading to misunderstandings in pricing and risk management.

New structures pose another set of risks. How can a firm allow portfolio managers to continue innovating while also integrating the instruments into their pricing, checks and balances, and trading processes? Heavily engineered securities may be so complex that they do not fit into any of the firm's systems.

Finally, the definition of liquidity is debatable. What is liquid and what is not? A firm may have some experience with liquidity that can be used to determine the adverse price impacts associated with exiting from its current positions. This past experience is not enough, however, because liquidity can change drastically when market conditions change, as happened with mortgages in 1994.

_ Hedging parameters. People like to hedge--whether currency hedges, duration hedges, or equity hedges. The proper question, however, is what kind of risk should be hedged. Sometimes, eliminating one key risk might actually make another one worse because it cannot be hedged.

Another issue in the hedging decision is frequency of measurement: How often should a portfolio manager check to make sure currency risk is in line with portfolio policy? The policy

may be to carry no currency risk, but the moment an international portfolio changes value because of market movements, the manager must rebalance the currency risk. The frequency of checking is critical.

Another example of timing impact is the fact that we find almost no relationship between profit and risk, because trading and transactions occur all day long but risk snapshots are often only once per day. Measuring risk-adjusted return, for example, is not as simple as one might think, because problems with time lag often cloud the picture.

Another issue is deciding what is acceptable residual risk. Take, for example, a cross-hedge in which the currency risk associated with a German investment is hedged with Swiss franc forward contracts. This hedge will work well if the two currencies are correlated, but what happens if the currencies move away from their historical relationship?

What is acceptable in terms of netting across positions? Consider a Treasury bond bought in London and sold in Tokyo. Although this position appears to be risk neutral, it entails cross-border settlement risk. Enough settlement disruptions have occurred in the past to indicate that this risk is a real concern. A certain amount of the risk can be laid off on custodians that have guaranteed settlement agreements. Sometimes custodians will actually make good on the trade if the settlement problem is their fault--if the custodian or subcustodian did not deliver the instrument. This service is not free, but funds often find it worth the cost.

One final, curious common problem in risk management is that after all the effort spent in figuring out what their big concerns are and knowing what they are sensitive to, many firms do not have an early warning system that allows them to manage calamities. For example, consider the situation in which a firm has a CMO or another kind of collateralized bond obligation that has a very nasty feature that triggers a liquidation option. Other investors own pieces of this instrument, but this firm owns one of the riskier pieces. In this case, the action of other investors up the line can create additional risk. Therefore, if such a feature exists and if it is market sensitive, the firm should have an early warning system for it. A surprising number of securities data bases do not have those capabilities, and many portfolio managers simply have little pieces of paper with the features written on them or never even write them down. The firm may have all kinds of triggers that the senior managers may not be aware of that will substantially change the characteristics of the instruments. So, the firm needs to establish an early warning procedure for the risks that matter.

A Risk-Management Program

Many different elements are involved in the risk-management process. They are arrayed in the risk-adjusted wheel of fortune shown in **Figure 1**. Quantitative factors are shown in boldface. In a multimanager structure, the marginal impact of each manager is very important. Stress tests, risk-adjusted returns, multidimensional risk modeling or cross-sectional modeling, pricing of complex securities, and establishing limits all have quantitative dimensions that need to be understood and managed.

The nonquantitative processes are all relatively common sense. They concern, for example, guidelines, settlement procedures, and checks and balances to make sure that one person cannot decide to effect a trade, put on the trade, wire the money, and then also settle it. Timely information reporting, whether for the education and knowledge of the board or for the traders, is another important qualitative factor.

A key point is that not all management elements need to be equally strong. For example, investment guidelines do not have to be stringent and complex if other controls and limits are very strong. The wheel simply indicates all the bases that need to be touched, and the slice that is sticking out of the wheel indicates why it is important to touch all the bases. That slice represents the risks the firm can do little about: fraud, paradigm changes in market behavior, sudden market movements, regulatory changes, or acts of God. The firm cannot control these events, but by touching all the other bases, it can minimize the chance of their occurring.



Fig 1: Risk Adjusted Wheel of Fortune – Quantitative and Non-Quantitative

Investment Manager Guidelines

Guidelines for investment managers have been undergoing quite a change. In response to recent publicity about derivative products being “slipped” into portfolios, investors are concerned about the specificity of portfolio guidelines. The danger, however, is that clients may put so many constraints on what the manager can do that it restricts the manager from hedging or from including value-enhancing products in the portfolio.

Two different approaches to expanded guidelines have evolved. First, public and private pension funds have been adding a separate layer to the guidelines. In addition to a general guideline document, they add something specific for the strategy. Instead of saying something like the objective of this equity fund is to add value through stocks, the strategy statement gets into such details as whether the strategy is to be market neutral, equity growth or value, and so on; what instruments are to be used; what the hedging policies are; and what risk factors are acceptable.

Second, investment management firms themselves have been clarifying their agreements with clients. They want to specify the boundaries within which they can operate to avoid any disagreement later. People have been coming to the table from both sides. At first, the funds were concerned that investment managers, especially the successful ones, would simply say, I do not need to clarify what I do. Go take your money elsewhere. That reaction has not been common, however. In these negotiations, the approach is to have a general agreement at the

top levels (the board of trustees or board of directors) explaining the fund's overall risk and return appetite which is then written down explicit as guidelines for individual portfolio managers.

Knowing the Risks the Firm Is Taking

Investment management firms need to ask several questions to identify the risks they are taking. What variables, given a small move, will cause a large move in price? Which variables are likely to cause a large change in the value of the portfolio (not simply how much impact a variable will have, but how likely it is to move adversely)? Which exposures offset each other, especially in well-diversified portfolios?

The firm also needs to identify modeling risks it is taking: How much variance is between the results from other models and the firm's internal models? If the firm is using a complex model, what is the model's acceptance in the marketplace? The firm's process needs to be benchmarked against generally accepted processes. In addition, the model must be updated as the generally accepted processes change.

Measuring and Controlling the Risks

For a satisfactory program for measuring and controlling risks, regulators agree that five elements are necessary.

_ A value-at-risk measure. The VAR measure need not be one that all the other firms are using; it could be one developed internally. When we interviewed staff at the trading desks of one firm about how they manage risk, one of them carefully wrote "prayer" in every column of the questionnaire - not exactly what we mean when we say "internally developed!"

_ Independent risk oversight. An independent risk oversight (IRO) function is becoming increasingly important. Sometimes this function is performed by the operations area, but an independent department is preferable--a controller or an oversight person involved in risk measurement reporting. This department should provide oversight not only of in-house trading but also of external managers and the reporting of information to customers.

_ Requisite knowledge and systems. Do the top people have the requisite, detailed knowledge of the risk-management process? If the auditors and oversight people are to know what is going on, they need to understand, for example, the calculus and the graphics with which front office people deal and the front office people need to report what they are doing in ways the auditors can understand. The firm must make very clear to everyone that it needs to receive information in an understandable and timely fashion for two basic reasons. First, the firm may need to replace someone with knowledge of a specific process. Second, this information is likely to be required by regulators and client.

The board should always be aware of what managers are doing, because they are all affected by the risks. Senior managers need to become familiar with what their people are doing, and the portfolio managers need to make sure their bosses know what they are doing. Communication is a strong deterrent to covering up losses.

_ Specific written policies and controls. Everybody, including customers, regulators, and auditors, will require a written document that articulates what the firm does in each function. Many institutions rely heavily on culture. While the structure may be clear to old-timers, it is not always clear to newcomers in the firm. Specific written documents that highlight the requisite checks and balances are an important aspect of a properly functioning risk management program.

_ Daily mark to market. The process of marking to market and the frequency with which this exercise is undertaken depends on the market, instruments, and what customers are demanding. The purpose of marking to market is to avoid surprises. Daily marking to market might not be doable for some institutions; monthly or weekly marking to market may be all that is possible. If the firm is investing in private placements or instruments that are not valued frequently or if valuing the instruments on a regular basis would make no difference, daily valuations do not make sense. In mutual funds, however, or in markets that experience rapid moves, daily valuations are not only desirable, they are necessary.

_ Stress Testing and Simulation. There are many forms of stress testing and simulation. Examples of three of the most popular forms, and common pitfalls, are described below.

- (i) **Some firms evaluate single, static shock scenarios.** A common example is evaluation of the risk position given a 200 basis point parallel shift in the USD yield curve, both up and down. This type of stress testing provides a snap shot of the portfolio which reflects *only* an instantaneous move in interest rates. This may distort the true risk picture for several reasons. For example, portfolios with optional components frequently change value significantly even *without* a change in rates. Such changes are typically caused by volatility changes in the market, or the price behavior of options when they move from in-the-money to out-of-the money, or vice versa. Other items not taken into account by static shock scenario testing are movements in portfolio value due to changes in the shape of the yield curve, changes in currency rates or changes in other markets to which the portfolio's behavior is linked. For example, if the portfolio contains a structured derivative with cash flows based on PIBOR (the Paris Interbank Offered Rate) or DM LIBOR, moves in these rates would not be captured by a 200 basis point parallel shift in the USD yield curve. Thus, even when the static shock scenario indicates that risk is within acceptable levels, the portfolio may have changed value significantly.
- (ii) **Some firms evaluate multiple, static shock scenarios.** A common example is evaluation of the risk position assuming that pre-defined buckets of the USD yield curve shift 50 or 100 basis points with all else held constant. The primary advantage over single, static scenario testing is the ability to capture the impact of non-parallel shifts or twists in the yield curve. However, as with single, static scenario testing, to the degree that options, or non-USD linked positions are contained in the portfolio, reality may be obscured. Another limitation is the reality that pre-defined buckets can mask the existence of significant risks *within* buckets. For example, while a 50 basis point shift in the yield curve in the "5 to 10 year" bucket may indicate no change in the risk profile, a change within the bucket, say in the yield curve's shape between 7 and 9 years, may cause a significant shift in the risk profile. A major disadvantage of both single and multiple static shock scenarios is the inability to view risk on a dynamic basis. For example, while either approach provides the answer to how much capital may be lost at a point in time, neither provides the answer for the following time period. Unfortunately, we have seen situations in which the conclusion is that the risk position is acceptable

because “only 60% of capital” is lost in the stress scenario, without any consideration to how much could be lost under a stress scenario the following day.

- (iii) **Some firms stress test via simulation.** Simulation allows testing of multiple shock scenarios on a dynamic basis, i.e. over time. Currently, an estimated 40% of dealers use Monte Carlo or other form of simulation. Simulation by funds and other end-users is much lower. This is expected to increase given regulators’ recommendations to “regularly perform simulations to determine how their portfolios would perform under stress conditions.” It is further recommended that stress tests be designed “to measure the impact of market conditions, however improbable, that might cause market gaps, volatility swings, or disruptions of major relationships, or might reduce liquidity in the face of unfavorable market linkages, concentrated market making, or credit exhaustion.” Typically, firms conduct between 5,000 and 50,000 cases in a simulation. While simulation offers the user a *dynamic* approach to viewing risk, note that the results of simulation are only as good as the assumptions utilized in constructing the trials. To see this, imagine two simulations of the same interest rate-based derivatives portfolio. In simulation number one, interest rates are allowed to change no more than 25 basis points in any day, and no more than 3 percent in any calendar year over a 10-year period (the “interest rate bands”). In simulation number two, interest rates are allowed to change as much as 100 basis points in any day, and up to 10% in any calendar year. For virtually all portfolios, the two simulations will reveal quite different distributions of profits and losses. This illustrates the dependence that risk profiles have on their underlying assumptions. Note that many dealers and end-users learned this lesson expensively during the Gulf War and stock market crashes, as the probabilities of unfavorable outcomes were assumed away via too narrow of simulation bands for key variables.

The quality of any stress test depends on the financial engineer’s ability to select appropriate scenarios. As experienced during the Mexican Peso Crisis, it is difficult to predict key factors such as “maximum” volatility. The increasing complexity and optionality of many derivatives makes scenario selection even harder. In our experience, many portfolios experience the most stress under small market moves, and stress changes over time, for example when options expire.

Location of Risk-Management Processes

A certain amount of buck passing has been going on among portfolio managers. Pension funds have said custodians should be responsible for risk management. The custodians say, I cannot do it. You only pay me two basis points. Make your money managers do it. You pay them much more. The investment managers say, according to our contract, all I have to do is give you positions once a quarter. This answer has led to the trend--which may or may not be the right solution--of investment managers being asked to expand their reporting.

Firms with multiple layers of operations face the issue of

where each risk-management element should be carried out. If done at every layer, risk management could easily require too many additional people at a small firm.

Conclusion

The following to-do list summarizes the basic steps in risk management:

- Update the policies and controls.
- Ensure that adequate capital exists for the risks taken.
- Implement risk-adjusted reward measures; if two managers are adding the same value, is one doing it at more risk of capital than the other?
- Stress-test all variables.
- Ask, What if I am wrong?
- Increase senior managers' and the board's knowledge.
- Expand reporting to clients.
- Refine guidelines and objectives.

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Question and Answer Session

Maarten Nederlof

Question: Can compensation programs be used to bridge the gap between the board and senior management on the one hand and the performance objectives of investment managers on the other?

Nederlof: Compensation has been a hot issue in a number of businesses that take risks for direct profit. Pressure has mounted to reduce the direct link between risk takers' performance and their compensation. One problem is that investment management firms and portfolio managers are often measured against peers and their compensation is based on that performance. So, for example, in the recent sustained bull market, competition drove people to reach for ever more yield. Many of the derivative instruments they used worked well to bump up the yield, but often required them to assume additional non-obvious risks.

The net position between brokerage firms and the investment management business in 1993 and 1994 was long options by dealers and short options by investment managers. When you buy an option, you generally pay a premium and lay off some risk. When you sell an option, you are bringing in premium but you are generally taking on some kind of risk. In general, investment managers were selling options in order to bring in the yield.

A portfolio manager could conceivably ask, What is my performance right now? When am I going to get paid? How can I boost my performance right now? These questions can be answered in basically only two ways. One is to have a sudden burst of skill and time the market correctly. The second is to sell options to get an immediate premium kick. An alarming number of sales in the early 1990s, however, involved selling out-of-the-money puts, which worked fine until the market declined in 1994.

In short, tying compensation too directly to performance can create a risk. So, a trend is under way to spread out the returns portfolio managers make and their performance measurement, over three or four years. The managers will collect on their performance, but collection is delayed in such a way that if their strategy backfires in the future, their compensation can be modified. In effect, the managers' performance is being matched with clients' investment horizons. Of course, the horizon will vary; institutional clients will typically take longer windows than retail mutual funds.

Question: How do you manage a subadvisor effectively from a risk management perspective?

Nederlof: One of the most effective ways to manage a subadvisor is to require a minimum set of risk management standards and risk measurement reports. This also may include representations such as: (i) all of the subadvisor's managers meet the minimum risk management standards, (ii) all violations of the standards/limits have been promptly reported and corrected; (iii) manager guidelines are in place and no known violations exist; and (iv) random audits are allowable. In our experience, another important aspect of managing subadvisors relates to establishing common definitions for all appropriate terms. For example, terms such as "hedge" should be defined consistently by all. Simply stated, what one fund manager considers an anticipatory hedge may be considered speculation by another.

Question: Please elaborate on the settlement risks in your example of buying and selling U.S. T-bonds in Tokyo and London.

Nederlof: In general, cross-border settlement risk arises when a long and a short position are assumed to be nettable, or offset against each other, but fail to be. For example, regulators or the commercial code may prohibit netting on a practical basis even though netting has been assumed for risk management purposes. Several parties with long and short positions with different entities within the Olympia & York family of companies or within BCCI found that regulators in different countries and the commercial code did not permit the netting that they had assumed for risk management purposes. If a market badly dislocates and a position in one jurisdiction is in-the-money, and a position in a second jurisdiction is out-of-the-money, there is no guarantee that regulators will agree, for example, to share what may be less than 100 cents on the dollar for one country's depositors with depositors in another country. In sum, cross-border settlement risk arises because of the lack of global regulations to govern cross-border flows for risk management purposes.