Value-at-Risk and Derivatives Risk

The capital cost associated with operating risk is more than that due to market and credit risk. As the most relevant risk to a trading operation, operating risk is the primary reason trading operations fail–implying that emphasis on refining VaR seems to miss the point. Data suggests that trading rooms make profits primarily from market-making and not position-taking; that the internal information and incentive environment is what mainly affects equity capital; and that most high-profile problems are th results of operating risks. An optimal risk management process should work more at getting relevant risks on the radar screen than mreasuring what already appears ont eh screen more precisely.

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Value-at-Risk and Derivatives Risk

Value-at-Risk (VaR) has become an indispensable tool for monitoring risk and an integral part of methodologies that allocate capital to various lines of business. Its use is being encouraged by the Bank for International Settlements, the Federal Reserve Bank, the OCC and the Securities and Exchange Commission for just about every derivatives user. A major problem in equating VaR to risk capital, however, is that it is contradicted by how actual firms have historically "used up" their capital (i.e., defaulted) from losses due to position taking.

Consider such recent high-profile trading fiascoes as Daiwa, Metallgesellschaft, Orange County, and Barings. These were not properly calculated risks that went awry, nor were they outright fraud where an unauthorized intraday position blew up. They were the result of investors or management not fully understanding the risks that were being taken. These risks–breakdowns in information, communication, strategy, etc.–are called *operating risks*, and represent a residual of all things that are not cleanly within credit or market risks. If operating risk are the primary reason why trading operations fail, emphasis on refining VaR seemingly misses the point.

Operating risk is the neglected step-child of risk management for good reason. It is extremely difficult to quantify existing operating risks, which in turn makes it near impossible to evaluate methods of monitoring and reducing these risks. A common approach to this problem is to acknowledge operating risk by adding a safety margin to the VaR estimate,[1] or to assume that the difference between VaR and existing capital perforce is due to unmeasured operating risk.

The purpose of this article is to show that operating risk is *the* most relevant risk to a trading operation, and to outline a methodology that actively minimizes this risk. VaR is an essential part of this process, as it acts as a filter to highlight risks that otherwise exist as needles in a haystack.

The similarity between VaR and capital is often demonstrated by a futures margin analogy. To put on a costless futures position at the CME, some capital must be forwarded to the exchange in order to insure against unexpected losses. This margin is a cushion that is higher for the more volatile contracts, those with higher VaRs. What is misleading about the futures margin analogy to risk capital is that it represents the rare scenario where all the risks are precisely defined; uncertainties as to the true specifications of the contract and credit risk are virtually absent. In these cases VaR is capital. For a large trading operation, however, the completely specified positions are not of primary concern, and verifying which positions do not have such precise risk is a large portion of risk management's job.

Why VaR and Credit Risk are Not the Most Important Parts of Risk Capital

We can demonstrate that VaR is not risk capital by noting the limits of firm size. As Coase (1937) points out, it is often useful to ask what constrains firm's growth: Given the obvious costs of buying from external firms (e.g., profit margins, negotiating), why is not the whole country one big corporation? Coase's answer, a point supplemented by Oliver Williamson (1985), is that internal incentive conflicts and information asymmetries lead to diseconomies of scale. To see this mathematically, assume there exist two derivative trading firms x and y, with fully loaded profits (e.g., including transfer pricing for riskless capital) $\pi(x)$ and $\pi(y)$ and risk capital equal to VaR(x) and VaR(y).[2] In equilibrium the rate of return on these two operations will be equal, so that $\frac{p(x)}{VaR(x)} = \frac{p(y)}{VaR(y)}$. If the firms merge, the rate of return would be $\frac{p(x+y)}{VaR(x+y)}$. As is well known from portfolio theory, $VaR(x+y)<VaR(x)+VaR(y)$ as long as portfolios x and y are not perfectly correlated. Profits, meanwhile are strictly additive. Therefore $\frac{p(x+y)}{VaR(x+y)} > \frac{p(x)}{VaR(x)} = \frac{p(y)}{VaR(y)}$. That is, assuming VaR is required capital, the rate of return on the merged firm is greater than the rate of return on either of the original firms. There is an unambiguous benefit to merging all trading operations in this environment, as profits would double and required capital would less than double.

Credit risk is another well-known component of capital, but this too should be at most additive. Think of the credit exposure of two trading firms with identical VaRs and profits (though different portfolios). Assuming the portfolios have totally different customers, current credit exposure would be the sum of the two original credit exposures. Potential credit exposure, which is a function of an extreme future market move and default probabilities, would less than double. This is because the extreme market moves that generate the greatest credit exposures would most likely not be perfectly correlated between the two sets of firms.

Therefore, a Monte Carlo approach to generating potential exposure (as in Iben and Brotherton-Ratcliffe (1994)) would produce a smaller exposure in the combination of portfolios x and y as long as the market risk factor exposures for the two portfolios are not identical (in other words, with virtual certainty, potential exposure for the combined portfolio would be less than their individual sums). Also, credit risk would decrease if netting could be expanded between the two portfolios and they shared some customers. Thus credit risk, measured as a function of current and potential credit exposure, also strictly declines with size.

The existence of trading operations that could legally merge with other trading operations but do not implies that while credit and market risks are decreasing and lowering capital costs, operating risk must be increasing and raising capital costs in order to offset this benefit. Furthermore, if historically the primary cause of bankruptcy is operating risk and not market or credit risk, the average capital cost associated with operating risk is probably higher than the sum of the average market and credit capital costs (which is consistent with monotonically increasing operating risks and monotonically decreasing credit and market risks). A graph of the marginal capital cost from credit, market and operational risk is shown in Exhibit 1.

[INSERT FIGURE 1 HERE]

This returns to scale argument is relevant in analyzing the options approach to market risk capital as outlined in Merton and Perold (1994). In their analysis, both credit and market risk are considered to be completely understood by insiders of the firm. Their measure of capital implies an increase in return on capital simply by bringing all firms under one big legal entity, as in this case, profits would be strictly additive while capital would benefit from the diversification benefits outlined above. The empirical contrast, in the form of many firms in equilibrium, implies that their analysis omits a significant cost to capital.

This argument is entirely consistent with academic finance's emphasis on information and incentives. Corporate finance, for example, addresses the determinants of relative amounts of debt and equity for a firm, and consists of the following threads:

- To minimize costs from taxes and bankruptcy (Miller and Modigliani, 1962).

- To diminish the conflicts of interest among debt- and equity holders, as well as the management of the firm (the agency approach, Jensen and Meckling, 1976).
- To convey private information to capital markets and mitigate adverse selection effects (the asymmetric information approach, Myers and Majluf, 1984).
- To mitigate monitoring costs (Townsend, 1978).
- To effect corporate control (equity votes on management, debt does not, Harris and Raviv, 1988)
- To capture differences in product and input market interactions (Titman, 1984)

Most of the VaR and capital allocation literature emphasizes only the reduction in bankruptcy costs from minimizing variance, and fails to address the endogeneity of the levels of debt that give rise to these costs. Corporate finance theory looks at debt and equity as ways of solving an unavoidable information problem, part of the broader academic strains of the theory of contracts or mechanism design. The firm-value-maximizing proportion of equity is a complex function of various deviations from the perfect markets assumption, and the parameters driving these results are often quite vague when applied to real companies. Most importantly, however, volatility in itself is not the crucial friction that drives any of the above models. What is mainly affecting equity capital for a given level of expected profits is not the volatility of the business returns, but the internal information and incentive environment.

Emphasis on the more measurable aspects of risk, such as default and interest rate exposures for known positions, to the detriment of less measurable operating risks has interesting parallels within the field of macroeconomics. Most of the history of macroeconomics is concerned with predicting the long and short term growth rate for an economy with given amounts of government spending, investment, money, etc. The emphasis was on aggregate items measured most objectively, while in fact what matters most are things that are very difficult to measure other than in a qualitative way, such as the complexity and capriciousness of regulations, the enforceability of contracts, property rights, etc. The nail in the coffin for these mechanical approaches, at least as applied to long term growth, was the collapse of Communism, which definitively demonstrated the primary importance of market microstructure over aggregate measures such as “investment”.[3]

The first five Nobel Memorial Prizes in Economic Science went researchers who helped develop large-scale macro models. As evidence of a shift in priorities of the last six prizes, four have gone to economists who studied the importance of incentives under imperfect information.[4] If the field of risk management wants to avoid the fifty year learning curve that macroeconomics encountered, it would behoove practitioners to recognize the primary importance of the least-measurable aspects of risk as soon as possible.

Empirical Evidence of the Importance of Operating risk

The importance of operating risk is buttressed by observation of what risks actually affect trading operations. Because an efficient portfolio maximizes return given a level of risk, assuming that trading firms are run efficiently, one can work backward from how the returns are generated to see what risks are necessarily taken. Analyses that equate VaR with risk capital for derivative operations often come from the mistaken notion that most of traders' risk is from speculative positions in liquid instruments such as US benchmark Treasury or FX rates.

For the trader, there are clearly self-interested incentives to encourage this view: The more nebulous and complex the necessary skills of the profession appear, as in pure speculation, the harder it is for potential entrants to gain entry. Furthermore, if a trader makes most of his money betting on liquid instruments, this implies the trader earned most of this profit, while if that trader made money mainly off order flow and having access to the firm's network of brokers, the trader's value-added is smaller. As an example of this misunderstanding, Jack Schlager's *Market Wizards* is concerned mainly with how traders and floor brokers develop bullish and bearish opinions, and how they turn these premonitions into trading profits. Marcia Stigum,in her widely read book *The Money Market,* writes that the most significant way trading departments make profits is through speculating on interest rates.[5]

On the contrary, I believe the best traders and best trading departments would agree that a good trader's role is first as a pricer and second as a risk manager. The financier makes money the old fashion way, by intermediating and providing liquidity. This is nothing to be ashamed of, and still implies substantial value-added for the skilled trader, but it makes the business appear less glamorous, more like a broker of a conventional product than a wizard.

Empirical evidence that trading rooms make profits primarily from market-making and not position-taking comes from several sources. Braas and Bralver (1990) presented evidence that trading profits were mainly from order flow and not speculation. One of Europe's largest derivatives houses, Credit Suisse Financial Products, disclosed detailed information on their risk exposure in their 1995 annual report. It showed they had more risk from non-directional factors (e.g., from spreads and volatilities) than risk factors like first-order interest, currency, commodity and equity fluctuations.

Most market risks for sophisticated trading operations are therefore not straightforward sensitivities to swap, Treasury, and FX rates. Furthermore, these residual risks are necessarily estimated with large errors, as non-directional risks are considerably more non-stationary over time than interest rates (at least at the magnitudes that matter).

An anecdotal rendering of some of the derivatives stories from the past few years is instructive. Consider the companies listed in Exhibit 2. In *none* of these cases were the losses considered an unfortunate result from a calculated gamble, as implied with VaR analyses.

For example, prior to Paine Webber's losses of $268 million in their Short-Term US Government Income fund, they did an interest rate sensitivity analysis and estimated that a 200-basis point rise in rates would reduce net asset value by 2%–in reality the fund lost 10% of its value.[6]

Askin Capital Management was adopting a supposedly "market neutral" strategy when they lost $600 million with the 1994 rise in rates. The disaster was allowed to fester well after the portfolio started losing money, because the complexity of the products allowed Kidder to price the illiquid securities at unrealistically high levels for several months.[7]

After Air Products and Chemicals company lost $90 million speculating in derivatives tied to foreign interest rates, auditors noted that "swaps were entered into against compliance policy because of an error in the model used to analyze their risk."[8]

When the Wisconsin Investment Board lost $95 million in swaps in 1995, the auditors post mortem declared "obviously, there's some kind of breakdown in procedures and controls."[9]

In 1995 the Common Fund lost $137 million from a purportedly "market neutral" investment strategy that in reality involved a wayward manager who disguised a naked bearish bet on bonds.[10]

In all cases, the losses were outside the realm of expectations, not unexpected losses in the sense of lower tail occurrences from a known distribution of profit and loss.

If the primary risks facing top trading organizations are from nondirectional risks, where VaR estimates are least precise, and historical examples of bad outcomes are examples of poor controls rather than poor luck, then most of the true risk for a trading operation is not VaR, but the risks that exist outside a firm's precisely calculated VaR.

Consider an analogy from modern aviation warfare. The most lethal risks are not from highly armed conventional fighters, but from stealthy aircraft that can make pinpoint strikes because they escape detection. Knocking out an enemy's radar and having "invisible" fighters are the key to air superiority. The risks to air defenses are similar to the risks to a business in that the most pressing concerns are from things that are not seen before it is too late.

Most high-profile risks appear in retrospect to be the result of avoidable vices such as overconfidence, laziness, fraud, and gross incompetence. Yet complicating this picture is the fact that traders are notorious for continually expanding the scope of products they offer, especially because these cutting-edge products tend to have higher profit margins. This is a risk a profitable trading floor cannot avoid; by the time a product is fully understood by independent risk managers, the large margins will be gone. To confine a desk to fully understood risks is to severely handicap its operation. Thus, the directive of a good risk management function is to vigilantly monitor measured VaR, and to continually expand the scope of risk factors and instruments VaR includes.

A Methodology for Optimal Derivatives Risk Management

Derivatives risk management is difficult to model because its main concerns are securities that are not in equilibrium. Past securities that posed serious risks to a firm, such as range notes, may now have their risk precisely measured. Securities that currently pose serious risks, such as certain CMOs, can be expected in time to be adequately captured. Given the many different dimensions new securities innovate, it is impossible to provide a precise, general, practicable model of the problems they present, their current measurement uncertainty, or the speed with which they will be fully understood. Nonetheless, there are useful general rules one can use in describing an optimal risk management objective for these environments.

It is useful to delineate two types of securities that exist in a trading portfolio. The first type, "A", consists of securities where risk can be precisely defined, such as U.S. Treasury Bonds, simple options, or any security that can be confidently priced in-house. The second type of securities, "α ," consists of securities that have their risks vaguely defined, such as an unfamiliar type of asset-backed bond.

If an independent risk oversight group does not have the capability of independently verifyinga trader's pricing model on a timely basis and cannot estimate a security's price variance over the expected holding period, it should be in α. This may include instruments that theoretically are well known to the most knowledgeable in the field, but do not fit into the current trading operation's risk management system because of local systems and personnel issues. That is, the set α is different for different trading operations, depending on firm's experience and expertise. Prices for these securities are computed primarily from external sources like broker quotes, or perhaps are only known with any confidence by the trader who holds them in his portfolio. The set of officially understood securities A is constantly expanding, while the components of α are continually changing as new securities arise and are eventually moved to set A.

Most of the current risk management literature consists of ways to help to improve the precision of VaR on well-known securities. Common issues include convexity adjustments, better covariance estimates, or accounting for sampling variation. This is partly because risk personnel are often academic in their outlook, and their objective is highly influenced by making an innovation that is correct and durable, such as coming up with a new ARCH estimator of variance that might be published in an academic journal.

The correct set of priorities, however, should be on getting securities from α to A, from Greek into English. That is, cases where the securities are least understood, and controls are most imprecise, present the largest true risks, and there should be an incentive structure that encourages reducing the risks they present. This is often mundane work, rarely relevant to an academic journal, because the issues are usually too idiosyncratic or too briefly examined to be interesting to a general audience, even within the specialty of risk management. In the words of Emmanual Derman, as opposed to academia where one can spend a long time on a single issue, in the private sector quants "have to learn to do many things badly, but not too badly."[11]

Suppose the trading floor was charged for the economic capital it uses, and this capital charge was factored into trader, business unit senior management, and risk management compensation. Capital would be determined by VaR for securities within A, and would use an additive (i.e., no diversification effect) measure of risk for each of the securities within α that used a worst case scenario of the securities in α. For example, a range note's risk could be proxied by its change in value if interest rates followed a path whereby the interest rate was always outside its range.

Alternatively, one could take an extreme historic example, such as the price change of the security during the extreme interest rate movements of 1994, or the change in mortgage prepayment rates from their expected benchmark in 1993. Revaluing the securities under these scenarios gives a reasonablyconservative estimate of risk. This implies that the measured risk of a security in α should be considerably greater than the measured risk of that same security in A. And, because α and A are directly in the remuneration function of the trading desk, traders will have an incentive to help the risk manager more precisely define the instrument in order to get the security from α to A.

This is important, because traders are often the most knowledgeable people on the security and their cooperation with the risk management is extremely valuable. Instead of being an adversarial arrangement, where risk managers are cops who keep traders from stepping over the line, they become partners in helping to reduce the costs of the trading operation.

It is important to note that the capital used for charging the business line (which presumably would then be factored into individual compensation) may be different than the true amount of capital the business uses. This is because vague risks are intentionally measured consistently higher than the precise risks, leading to a bias that is positively related to the proportion of vague to precise risks in the business. Because operating risk is not a straightforward function of vagueness, this bias may be inappropriate when making strategic decisions about business performance. Nonetheless, there should still be an incentive for the traders to help risk managers get these products understood as completely as possible.

This system alone, however, is susceptible to abuse. There is a direct monetary incentive to get the risk managers to push securities from α into A in order to lower capital costs for the business unit. Furthermore, capital costs can be reduced by fraudulently underestimating the worst case scenarios for securities in α. Therefore one should invoke the following rule: If a security experiences a large deviation from it's estimated VaR or worst case scenario, culpability resides with senior managers of the business unit if that security is within α, and risk managers if it is within A.

Because it is impossible to perfectly anticipate risk, having a robust rule for dealing with failures is just as important as anticipating the known risks. The punishment can take a variety of forms, but it must be significant and not a slap on the wrist. With this rule, risk managers will only sign off on putting a security in A if they feel comfortable with it: otherwise, they would be exposing themselves to personal liability.

Unknown securities in α are given conservative risk estimates, but in some cases they too will be underestimated. By explicitly making senior management culpable for securities in α (and perhaps internally distributing a weekly listing of the offending securities to make accountability unambiguous) and holding risk management personnel responsible for securities in A, there will be a clear incentive to move securities from α to A as soon as possible, although not too soon.

For example, if a plain vanilla swap (which should be in A for every trading desk) experiences a loss much greater than its VaR, given the large literature and data on these simple instruments this is not the trader's fault. Risk management would have botched this job, or a truly unforeseeable event would have occurred. If a trader put on a LIBOR-squared swap *and* risk management admitted they could not calculate the position's VaR *and* this position's risk was calculated using a worst-case scenario that turned out to be quite wrong, senior management is at fault and should be held directly accountable. This mechanism should minimize these occurrences because it creates an environment that does not become complacent, and generates an incentive for incremental improvement in controlling all risks, especially the poorly understood ones.

It is a cliché to say that in risk management proper quantitative techniques do not imply that sound judgment is no longer necessary, but the above delineation of market risks shows why. One sign of good judgment is the ability to make wise decisions when information is incomplete. Prime examples of important senior management decisions are what securities are acceptable within α, the unknown new products, and the creation of a mechanism that discourages complacency.

Note, however, that while the above mechanism greatly mitigates the most relevant risks to a derivatives operation, it does not eliminate them all. The details of the incentive structure will vary depending on the particular situation, and in the end the incentives of the shareholders and their agents can rarely be perfectly aligned.

Conclusion

VaR can do a lot by itself to help highlight problem securities and minimize surprises. It sets a rigorous standard of understanding, and therefore the ability to monitor VaR is symptomatic of a healthy independent risk oversight process.

Delineating securities into the known and the relatively unknown takes it to the next level. Making a clear distinction between different types of securities, and adding incentives based on proper accountability when things go wrong and benefits (through capital cost reductions) when things are done right, effectively minimizes operating risks. It is important to be proactive in this fashion, because the next round of derivative failures will not appear until the next major market move, at which time there will certainly be several firms whose VaR let problems slip through their radar.

The innovation of VaR has caused risk management to refocus their objective from minimizing variance to minimizing the severity of worst-case scenarios. The popularity of this approach, I believe, comes from the ability of the extremum event to capture two important features of risky portfolios.

First, it accounts for gamma or convexity risk, in that using an extremum can reveal risks (say, from short option positions) that do not appear over small rate movements. Second, it intuitively captures what executives are most worried about: How bad can it get? That is, it seemingly addresses their target concern of historical worst case scenarios. Yet if one remembers that these historic worst-case scenarios are not tail ends of anticipated distributions, but more properly in the category of poor controls, information, and communication, VaR addresses this issue only indirectly (i.e., the problem with Robert Citron's Orange County portfolio was not that its VaR was too high, but that few people knew what the portfolio's VaR was).

An optimal risk management process works more at getting relevant risks on the radar screen than measuring what already appears on the radar screen more precisely. This does not mean simply enumerating an endless list of theoretical possibilities, but quantifying risks so that the trivial and the significant are appropriately considered. In order to do this, there must exist real incentives that come from quantifying risks, tying these measures to compensation and business unit evaluation, and proper accountability.

References

Braas, Alberic and Charles Bralver. 1990. How Trading Rooms Really Make Money? *Journal of Applied Corporate Finance*, Vol. 2, No. 4 (Winter 1990).

Coase, Ronald C. 1937. The Nature of the Firm, *Econometrica*, November 1937.

Harris, Milton and Artur Raviv. 1988. Corporate Control Contexts and Capital Structure. *Journal of Financial Economics* 20, 55-86.

Iben, Ben and Rupert Brotherton-Ratcliffe. 1994. Credit Loss Distributions and Required Capital for Derivatives Portfolios. *The Journal of Fixed Income*. Volume 4, Number 1. June 1994.

Jensen, Michael C. and William Meckling, 1976. Theory of the Firm: managerial Behavior, Agency Costs, and Capital Structure. *Journal of Financial Economics*, 3, 305-360.

Merton, Robert C. and Andre F. Perold. 1993. Management of Risk Capital in Financial Firms, in *Financial Services: Perspectives and Challenges*, ed. Samuel L. Hayes, Harvard Business School Press,.

Miller and Modigliani, Franco, and Merton H. Miller. 1962. Corporate Income Taxes and the Cost of Capital: A Correction. *American Economic Review*, June 1963. 53, 3, 433-43.

Myers, Stewart C. and Nicholas S. Majluf, 1984. Corporate Financial and Investment Decisions when Firms have Information that Investors do not Have. *Journal of Financial Economics* 13, 187-221.

Samuelson, Paul A., Economics, New York: McGraw-Hill, 1989,1992.

Schlager, Jack. 1989. *Market Wizards: Interviews With Top Traders*. NYIF. New York.

Stigum, Marcia. 1983. *The Money Market*. Dow Jones-Irwin. Homewood Illinois.

Titman, Sheridan. 1984. The Effect of Capital Structure on a Firm's Liquidation Decision. *Journal of Financial Economics* 13, 137-151.

Townsend, R. "Optimal Contracts and Competitive Markets with Costly State Verification, " *Journal of Economic Theory* 21: 265-93.

Wharton School and The Chase Manhattan Bank, N.A. 1994. Survey of Derivative Usage Among U.S. Non-Financial Firms (February 1994).

Williamson, Oliver. 1985. The Economic Institutions of Capitalism. NY: Free Press.

Figure 1

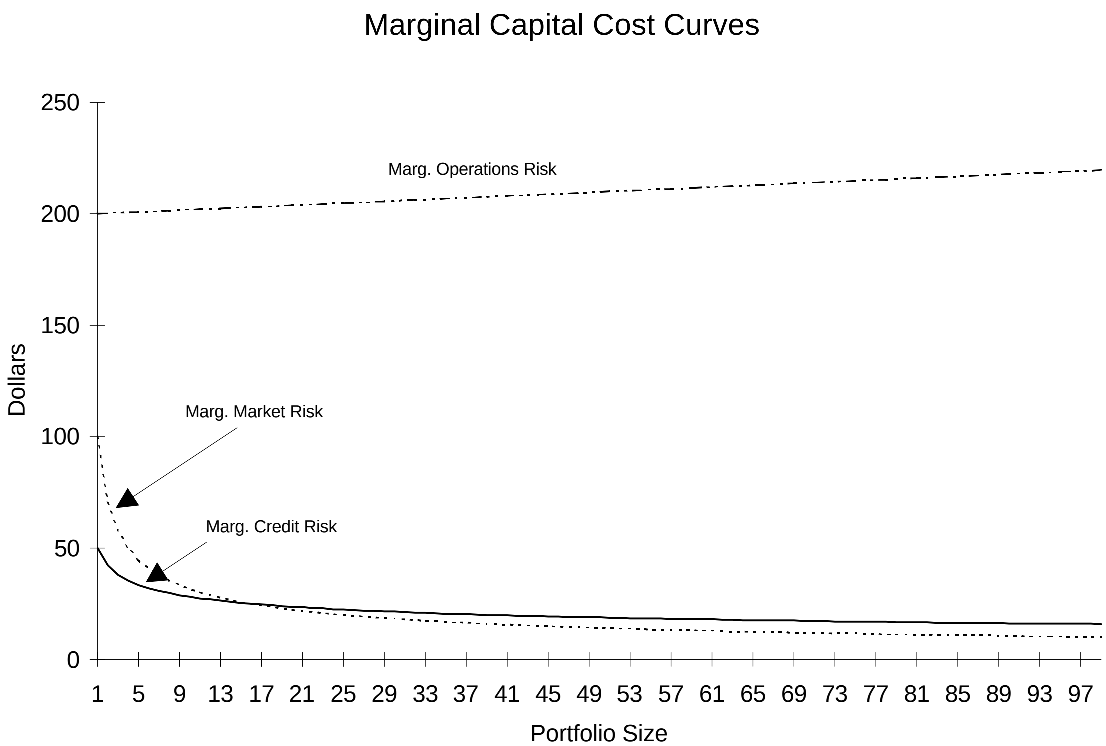
Marginal Capital Cost Curves
250
200
150
100
50
0
Dollars
Marg. Operations Risk
Marg. Market Risk
Marg. Credit Risk
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77 81 85 89 93 97
Portfolio Size

Table 1

Worst-Case Derivative Scenarios

First Reported	**Company**	**Estimated loss (millions)**
11/92	Dell	$8
2/93	Showa Shell	$1,700
7/93	Nippon Steel	$128
1/94	Metallgesellschaft	$1,300
1/94	Codelco	$200
3/94	Askin Capital Management	$600
3/94	Minnetonka Fund/Cargill	$100
4/94	Mead Corp	$7
4/94	Procter & Gamble	$157
4/94	Gibson Greetings	$23
5/94	Air Products	$69
5/94	ARCO	$22
6/94	Dell	$35
6/94	Virginia Retirement System	$66
6/94	Florida Treasurer's Office	$175
6/94	Pain Webber Bond Mutual Fund	$33
7/94	Glaxo Holdings	$100
7/94	CS First Boston Inv't Mgt.	$40
8/94	Piper Jaffray	$700
8/94	Charles County	$2
8/94	Colonia (Germany)	$76
9/94	Shoshone Indians	$5
9/94	Investors Equity Life	$90
9/94	Odessa College TX	$11
10/94	Community A Mgmt.	$44
10/94	Portage County OH	$8
10/94	Sears	$237
11/94	Todyo Securities Co.	$356
11/94	3 Farm Credit System Banks	$23
12/94	Orange County CA	$1,700
12/94	Chemica Bank	$70
2/95	Barings	$1,200
3/95	Winsconsin Inv. Board	$95
3/95	MCN Corp	$10
5/95	Five Morgan Stanley clients	$28
7/95	First Capital Strategists	$137
8/95	Postipankki (Finland)	$110
10/95	Daiwa	$1,100

[1] The BIS recommends multiplying a VaR by 3 to determine regulatory capital

[2] VaR here represents Value-at-Risk, not variance. Value-at-Risk is a linear function of a portfolio's expected standard deviation.

[3] From inception in 1948 up until the collapse of communism, Samuelson's popular Introductory Macroeconomics textbook argued that the main difference between command style economies and free-market democracies was their political freedom, not their long run growth rates. The 1989 edition had a chapter entitled "The Winds of Change: Alternative Economic Systems", which for the 1992 edition was renamed "The Winds of Change: The Triumph of the Market."

[4] The Nobel in economics was inaugurated in 1969. Frisch and Tinbergen (1969), Kuznets (1971), Hicks (1972) and Leontieff (1973) all were rewarded explicitly for their contributions to calculating explicit growth patterns from objective data. Samuelson's (1970) efforts in this type of macro modeling were only a part of his contribution to economics. In the past 6 years the emphasis have been on market microstructure issues, such as in Mirrlees and Vickey (1996), Harsanyi, Nash and Seltin (1994), North (1993), and Coase (1991).

[5] "Dealers earn really big money on position plays, that is, by taking into position huge amounts of securities when they anticipate rate rates will fall … or by shorting the market when they are bearish." Page 280, *The Money Market*.

[6] *Barron's*. August 1, 1994. page 17.

[7] *Wall Street Journal*. June 23, 1995. page 1.

[8] *ChemicalWeek*. May 25, 1994. page 14.

[9] *Pensions & Investments*. July 24, 1995. page

[10] First Capital's index arbitrage strategy was unmasked in 1995 *immediately after* it received two stellar reviews of its risk profile. Securities lending consultant Curt Kohlberg concluded that the fund "is one of the strongest, agent lending program[s] in the industry," and in the wake of the Barings debacle a more pointed review found their index arbitrage program to be relatively risk free. *Institutional Investor*. September 1995. page 161.

[11] *Derivatives Strategy*, March 1997, page 57.