IMPROVING
COUNTERPARTY RISK MANAGEMENT
PRACTICES

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Counterparty Risk Management Policy Group
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Appendix A:  
Risk Measurement, Liquidity Risk and Leverage Estimation

Introduction

Many commentators have characterized leverage as a contributor to firm instability and as a source of systemic risk. Indeed, the President’s Working Group has concluded that the central public policy issue raised by the LTCM episode is how to constrain leverage more effectively.

Leverage exists whenever an institution is exposed to changes in the value of an asset over time, without having first disbursed cash equal to the value of that asset at the beginning of the period. As the main Policy Group report suggests, funds and their creditors should not focus strictly on the nominal level of leverage, however measured, but rather on how leverage amplifies market risk, funding risk and asset liquidity risk. This Appendix offers an analysis of the relationships among these risks, first describing various measures and identifying their respective strengths and weaknesses. The intent is not so much to prescribe better technical measures of leverage, but to suggest a better framework for analysis.

Traditionally, leverage measures have related a notional or gross exposure to equity. This treatment helps to measure the degree to which a change in the value of a portfolio would affect the value of equity (Net Asset Value), but does nothing to illuminate the probability of change occurring, or the likely magnitude of change in portfolio value. By contrast, risk measures are intended to estimate potential adverse change based on the specific characteristics of the portfolio. Two portfolios of like size may have quite different risk. For a given portfolio or strategy, higher leverage implies higher risk. However, evaluating the risk of the portfolio is a necessary first step because a leveraged portfolio of low risk assets may have less aggregate risk than an unleveraged portfolio of high-risk assets. The framework for risk analysis which follows attempts to reflect the underlying risk of the positions in a portfolio, and the economic and funding structure of the portfolio as a whole.

The analysis takes as a starting point the observation that, broadly speaking, there are two ways in which highly leveraged financial institutions fail:

1. They become insolvent – that is, their liabilities exceed assets (“capital insolvency”). While historically some highly leveraged institutions— for example, savings and loans in the early 1980s— continued to operate with mark-to-market negative equity, today most leveraged institutions would find it difficult, if not impossible, to continue in business if their net asset value approached, let alone dipped below, zero. We define risk measures which attempt to estimate the potential risk of NAV becoming negative as measures of leverage.

2. They run out of cash and are unable to raise new funds, even though, on an economic basis, they still have positive capital. This is the cause of financial distress far more frequently than actually becoming capital insolvent, although ultimately the reluctance of credit providers to extend more financing may often be traced to a fear of impending capital insolvency. Most of the hedge funds which experienced distress during the fall of 1998 did so because they were unable to meet margin calls in a timely fashion, even though their mark-to-market NAV appeared to be well above zero. We define measures which attempt to estimate the potential of an institution running out of cash as measures of funding liquidity. Because most highly leveraged institutions obtain much of their financing on a mark-to-market basis, the greater the size of a portfolio of assets relative to an institution’s funding sources, the greater its
funding liquidity risk (a given percentage change in the price of the assets will deplete the funding faster). Broadly speaking, funding sources scale with an institution’s capital, so increased leverage amplifies funding liquidity risk.

A more leveraged portfolio may accumulate larger positions for a given amount of capital. These positions, if they need to be liquidated, may take longer to wind down, or may cause greater market impact during liquidation. Moreover, the presence of greater leverage makes it more likely that such a liquidation will have to occur, as the institution either approaches capital insolvency or has to meet margin calls in an adverse market environment. We refer to the risk that the liquidation value of assets may differ significantly from their current mark to market value as asset liquidity risk.

Because some of the leverage and funding liquidity measurement frameworks we describe are based on value at risk (VAR) and stress tests, the following section describes the evolution of market risk measures and some of their shortcomings. Next, the section on liquidity discusses how the interaction of leverage with asset liquidity can make simplistic uses of VAR and stress tests break down; it then suggests some funding liquidity risk measures. The final section describes a series of leverage measures, shows how traditional balance sheet measures fail to reflect the true risk of insolvency, and suggests improved leverage measures.

Risk Measurement

Prior to the advent of risk quantification, the most commonly used figure for measuring the size of a loss contingency which might be sustained by a financial institution was the total assets of the firm. This is not to say that everyone thought all assets were equally risky; it was simply that the tools for distinguishing risk were not well established. The Basel Accord in 1988 promulgated a set of the risk distinctions: three in terms of counterparty quality (0% for sovereigns, 1.6% for OECD banks, and 8% for all other counterparties) and one in terms of collateral quality (4% for mortgages). The total for each asset class was multiplied by its respective percentage, and these risk amounts were summed across the bank’s entire loan portfolio. The resultant “risk weighted assets” number quickly supplanted “total assets” as a more meaningful measure of the risk of a bank, although US banks are still held to a simple leverage ratio requirement as one test of capital adequacy. The Basel Committee also took great care to insist that the percentages were not indicative of default probability, potential asset deterioration or any other particular contingency. The Accord included capital charges for OTC derivatives, using current exposure plus add-ons (reflecting potential future exposure) as a loan-equivalent surrogate. The risk weights applied to derivative current exposure were allowed to be half of the risk weight of an unsecured loan to the same counterparty; the rationale was that only high-quality counterparties were engaged in derivatives business. In July 1994, the Accord was amended to include bilateral netting agreements, substituting net for gross replacement value in the calculation of current exposure and reducing the add-ons for potential future exposure.

The reduced credit exposure of swaps and options (current exposure averaging between 1.5% and 2.5% of notional value) was ultimately accompanied by additional charges for market risk as set forth in the Market Risk Amendment to the Accord in January 1996. This amendment split each bank’s portfolio into two segments—the investment book and the trading book. The investment book continued to be capitalized under the original provisions of the Accord covering credit risk; banks were urged to measure the interest rate risk on their investment books but were not required to assign capital explicitly to it. The trading book, containing nearly all of the securities and derivatives positions, was required to be marked-to-market daily and to be capitalized for market
risk at a minimum of three times the Value at Risk (VAR) calculation for a 2-week holding period, with a 99%-confidence interval. (The credit risk charge for OTC derivatives remained unchanged, and a “specific risk” charge for the credit risk of securities was introduced.) The volatilities and correlations underlying the VAR model, as well as the choice of aggregation method (variance-co variance, historical simulation, or Monte-Carlo simulation), was left to each individual firm. Models were to be validated by back-testing: if the daily P&L variation forecast by the model understated the actual P&L on more than a handful of days per year, the multiplier put to the basic VAR number would rise from three to four or even five. At present, all major international banks have implemented this regime.

Much of the discussion of market risk since this Capital Amendment was adopted has centered on stress-testing, which was a qualitative requirement in the Amendment but not included in the capital computation. In contrast to VAR, which weights each outcome by its probability and then sums these increments across a portfolio, stress-testing considers the consequences of particular outcomes, without regard to their forecast probability of occurrence. VAR’s strength is in measuring the 99%-probability “boundary”; VAR is less useful for saying how great the loss will be for outlier events beyond that boundary. For example, if a firm’s risk profile leaves it fatally vulnerable to a potential market shock, it is of scant comfort to predict that such a shock will happen on average “only” once per year. However, attempting to fix capital requirements at such “worst-case” figures is generally considered unrealistic, as it would lead to a severe contraction in financial intermediation. Nevertheless, banks must be aware of their potential vulnerability to market shocks and many consider placing limits on their aggregate exposure to potential stress events.

The evolution of risk measurement techniques – from balance sheet totals, to risk weights, to inclusion of off-balance sheet products, to netting, to marking-to-market, to market risk VAR, to stress-testing, to more rigorous credit risk weights, and ultimately to a VAR which captures both market and credit risk – is, in essence, the search for increasingly precise delineation of the distribution of future returns (or values) of a given portfolio. The value of any portfolio of tradable assets (including off-balance-sheet liabilities) will fluctuate over time. Understanding the range of possible variations and the probability of each is equivalent to capturing the risk profile of that portfolio. Although the full depiction for any portfolio of the distribution of future returns over a given time period is still years in the future, it is already clear that there are three fundamental components to this analysis. These three methods of examination correspond to the three basic parameters of a probability distribution: the mean, the standard deviation, and the downside tail.

Valuation. Techniques of valuation seek to uncover the mean of the distribution of future returns in a portfolio. Marking-to-market is an accepted tool of valuation because efficient market prices have proven to be far better predictors of future value than historical-cost or accrual-accounting figures. Marking-to-model may have similar advantages to the degree the model can be anchored against market prices. The recent development of applying counterparty default probability to the amount owed by that counterparty and then summing across counterparties to an “expected credit loss” for the entire portfolio, is an overt attempt to forecast the mean of the distribution of future credit losses. A lively debate is in progress over whether all current valuation information should be imported into the financial accounts of an institution; skeptics argue that doing so will only exacerbate market shocks when they occur. However, valuation methods will continue to evolve, even if the results are not required to be shown in the financial accounts, because discovering the mean is the first result of a successful investigation into the details of any distribution.
**Value at Risk.** Measuring the *standard deviation* of a distribution is the most helpful step in understanding the possible future variation of a portfolio. (Valuation deals essentially with historical risk, that which a portfolio has already endured.) Indeed, the ascendance of market risk VAR in the 1990’s was due to its accuracy in assessing the ordinary changes in value of a trading portfolio. Efforts are now being made to translate VAR concepts into the realm of credit risk. These attempts to calculate the potential “unexpected losses” in a credit portfolio show much promise but face unique validation challenges. VAR is often used in management accounting to attribute “economic” or “risk” capital and the costs of that capital to a particular business activity. Supervisors rightly chose VAR as the basis for regulatory capital because a firm must be able to withstand the ordinary variation in its positions. Moreover, the best practices in the industry included using VAR measures, and supervisors recognized the advantages of harmonizing internal processes for risk management with supervisory standards. (The analogy with “initial margin” on a futures exchange, which is also a VAR-style calculation, is evident. If listed futures exchanges required initial margin large enough to cover every conceivable contingency, the initial margin would approach the notional size of the contract itself.)

**Stress-Testing.** The purpose of stress testing is to learn more about the *downside tail* of a return distribution. All styles of VAR rely at some point on explicit or implicit forecasts of the volatility (standard deviation) and correlation of underlying market factors. The distributions of these financial factors are rarely bell-curves; the frequent arrival of new information distinguishes the financial marketplace from truly random settings. In addition, the correlations of these factors are notoriously non-stationary. One of the benefits of normal (bell curve) distributions with stationary correlations is that once the standard deviation is computed, the entire distribution can be specified. For example, one can conclude that, in a normal distribution, a move larger than three-standard-deviations has a 1% chance of occurring. However, in less well-behaved distributions, it is very dangerous to reason from the standard deviation to any conclusion about tail probabilities. Further, because the standard deviation and all “confidence interval” analyses are probability-weighted, the sizes of individual outcomes in the downside tail are hidden, because they only contribute to the calculation after being multiplied by their (small) probabilities.

In other words, VAR does not yield information about whether a particular downside event might be catastrophic for the firm in question; that can only be ascertained by examining the events individually. The challenge here is choosing a set of events for intensive analysis (i.e. stress-testing) from the nearly infinite universe of possible events. At present, firms are only beginning to share information on how they determine which events are simulated in stress testing, and no consensus has yet emerged: some simulate historical market shocks, some distill market risks to a manageable set of independent factors and shock the factors individually and in combinations, and some stress the factors underlying their major risk positions, some stress those factors which show the most current volatility in the market. As progress is made in the art and science of stress-testing, the results are increasingly being used for setting risk limits, and, in some judgmental fashion, are a factor in determining internal capital allocation. (Using stress-test results exclusively or mechanically for capital allocation would be the rough equivalent of requiring every resident of an earthquake zone to conduct daily activities as if the earthquake were occurring today; ordinary business would come to a standstill.)

The real benefit in stress-test analysis comes from studying the correlation of risks that in ordinary times appear independent, for instance, market and credit risk. This type of knowledge

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1 The variance (i.e. the square of the standard deviation) is mathematically equal to the sum of the probability of each outcome multiplied by the square of the difference between that outcome and the mean.
can assist a firm in creating an integrated limit structure across all risks (analogous to speed limits on certain roads which are one level when the pavement is dry and a lower level when wet).

Recent events have demonstrated beyond doubt that stress limits must cover all types of risk in order to be effective.

In applying this framework of risk measurement to leveraged investment funds, it is important to note that they are not generally counterparty credit providers; rather, such funds are generally sources of counterparty credit risk. Hence, the total risk of a hedge fund is dominated by its market risk and liquidity risks, with relatively little additional counterparty credit risk. (Of course, a number of funds hold significant positions in credit sensitive instruments, the risks of which are broadly subsumed within their market and liquidity risks.) The measures of market risk are relatively well-developed compared with measures of credit risk, and many have been adopted voluntarily by a significant number of funds. For example, the calculation of periodic NAV and its dissemination to credit providers has been a standard in the industry almost since its inception. VAR methods and stress tests have been used internally for risk management purposes, even when confidentiality concerns made funds reticent to share that information with credit providers. The central issue going forward is to link the dissemination of NAV information with equivalent information about the risk profile; indeed, it is now clear that NAV information without contemporaneous risk information is incomplete at best. This is why the Policy Group recommends that financial institutions and large trading counterparties should prepare regular, comprehensive estimates of their market risks, applied systematically across their trading portfolios. These estimates should include both VAR and stress-testing results. Further, they should be prepared to share with key credit providers information on the methodologies employed and periodic updates on the level of market risk. The detail of this information sharing will depend on the nature of the credit relationship.

**Liquidity**

Liquidity has two dimensions – asset liquidity (ability to sell or unwind positions), and funding liquidity (ability to meet obligations when due) – in both cases focusing on stress environments rather than on normal market environments. The concepts are closely related, in that a leveraged institution that is unable to sell positions in a timely manner, or for which short-term sales could cause large gaps in prices, will need to ensure its funding is appropriately structured.

**Asset Liquidity**

Value at risk and stress tests generally apply standard estimates of risk to positions by asset class. That is, for each underlying asset class – interest rate, equity market, foreign currency, and so on – users estimate by how much that asset might move either in the form of a volatility estimate for VAR, or a stress move for stress testing, and calculate the results of such a move on the value of positions sensitive to that asset class. In the case of a VAR calculation, the user also calculates a total risk measure by using correlations among the various asset classes; in the case of stress tests, the correlations are implicit in the way stress moves in different asset classes are combined into one or more stress scenarios. The implicit assumption in each case is that positions could be liquidated before the underlying asset classes had moved by more than the amounts estimated. In fact, in VAR calculations the liquidation assumption may be even more explicit, since the calculation often starts with annual volatilities, which are scaled to some assumed liquidation horizon (two weeks in the case of the BIS calculation). Generally, the same time horizon is applied to all asset classes and hence positions, regardless of the nature of the underlying asset
class, the size and nature of positions sensitive to changes in that asset class, and the economic and funding structure of the entity holding those positions.

There are four potentially serious problems with this approach:

1. Even normally liquid asset classes may undergo transient shocks to their liquidity due to unexpected economic or political news, sudden supply shocks, or policy changes. While liquidity will return to these markets in due course, in the interim transactions may be harder to execute, take longer to complete, and have greater market impact than before. This makes estimation of appropriate volatility inputs to a VAR calculation, and of stress moves for a stress test, quite challenging. An institution liquidating positions in such an environment, whether due to a depletion in capital requiring reduction in risky positions or because of a need to raise funds to meet margin calls, may be unpleasantly surprised by the proceeds the liquidation generates.

2. Some asset classes are inherently more liquid than others. A $1 billion position in on-the-run Treasury notes could be liquidated with relatively little impact on prices in all but the most difficult of market conditions. The same is not true of a $1 billion position in high-yield corporate bonds, even in normal markets and especially in disrupted markets. Some very illiquid asset classes such as real estate show relatively little volatility in historic time series of their prices, partially because infrequent trading makes it hard to obtain reliable, frequent price data points. Two week VAR measures based on historical volatility would make investments in such assets look rather safe. As we will see in the section on leverage below, one of the possible uses of VAR estimates is to compare them with economic capital to assess the risk of an institution becoming capital insolvent. The idea is to measure the risk that, in an adverse market, the institution’s positions could not be liquidated before its NAV had become negative. Such a risk would be understated if liquidation would take longer than the time horizon used in the VAR measure.

3. Very large positions, even in normally liquid asset classes, could take significantly longer than the standard assumed period to liquidate. Alternatively, efforts to liquidate the position within the assumed time horizon could cause tremendous market impact, invalidating risk estimates based on the normal volatility or perhaps even an assumed stress move for that time horizon. Similarly, highly structured positions such as exotic options, even if their value is derived from a liquid asset, may be significantly less liquid and harder to dispose of than the underlying asset.

4. In an adverse market, the greater a leveraged institution’s risk of insolvency or the less adequate its sources of funding, the sooner it will be forced to liquidate positions as its NAV declines or as it is required to post collateral on mark-to-market losses. This liquidation will have an impact on the prices received as positions are liquidated. This means that not only the liquidity of the asset and the size of the position should be taken into account in assessing risk, but also the overall risk profile of the institution. In fact, this can lead to circular arguments: if we use VAR estimates adjusted for asset liquidity to measure risk, but the results of those risk measures themselves affect the liquidity adjustments used in the VAR calculation, it will not be possible to arrive at a final estimate of risk.

One useful way to address this is to measure risk by assuming that positions are being liquidated in an adverse market, even if the institution is actually structured such that it would not have to. This will produce overly conservative risk measures for less leveraged or more prudently funded
institutions, but these measures will still indicate clearly that the risk of their becoming insolvent is negligible.

In order to correct for these problems, the simple, single horizon VAR measure can be adjusted by scaling each asset class's volatility by the time it would take to liquidate the actual positions held in that asset class.\(^2\) For example, a position in an asset class with a volatility of 10% which would take three times as long as the standard two week time horizon to liquidate would receive a volatility of 30% in the VAR calculation. Stress tests can be similarly scaled. As mentioned before, such an approach arguably penalizes institutions that would not have to liquidate in an adverse market. Since others might well be forced to liquidate similar positions, however, the observed market prices for the underlying asset classes would still be depressed, leading to a mark-to-market loss for the institutions purportedly able to ride out the adverse market. As long as this loss were still small compared to their NAV, and as long as their liquidity needs calculated using this assumption were adequately covered by their available sources, their claim to be able to withstand bad markets would be corroborated.

**Funding Liquidity**

Poor funding or liquidity management may threaten the viability of a counterparty, even if it is solvent on a mark-to-market basis. Failure is ultimately triggered by an inability to meet obligations (payments, delivery of collateral, etc) when due. Following an event of default, creditors may close out positions and liquidate collateral. In order to understand a leveraged institution's liquidity risk, one needs to understand not only what cash and near-cash resources are available during a period of market stress, but also what demands may arise for those resources. The demands can arise from variation margin requirements due to position losses, mismatches in the contractual requirements for delivery of or receipt of collateral, unwillingness of lenders to extend financing positions, desire by lenders to increase collateral requirements, or permitted withdrawals of capital by investors. Creditors may also discontinue financing based on breaches of agreed financial covenants. The potential losses, mismatches and margin increases should be conservatively measured assuming periods of market stress and relative position illiquidity.

Funding liquidity and leverage are closely related elements of risk and, in general, an institution with a high level of leverage would be likely to have lower liquidity coverage. This is because leverage is generally provided to financial institutions on a mark-to-market basis. That is, as the institution's positions lose money, the institution is required to post cash to cover these losses to the relevant counterparty. An institution that runs the risk of losing large amounts relative to its capital base will also have large funding needs relative to its capital base. Its funding sources are in turn likely to be scaled relative to capital. One would therefore expect to see a correlation between leverage and liquidity.

Within that broad relationship, however, there can be wide variations between the two elements of risk. For example, two institutions with the same capital might take the same position in an underlying asset, one through margin loans, and the other through leveraged notes. The leverage, properly measured, of each institution will be the same, because the same decline in the value of the underlying assets will reduce their capital equally. The first institution however, has

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\(^2\) If asset class returns are independently, identically distributed the scaling should actually be by the square root of time, not directly proportional to time. But extensive research indicates this is a dangerous assumption. In particular, the liquidation of a large position, even if the liquidator is attempting to do so at a “normal” rate, is likely to depress the market. For further discussion of this issue see for example “Scale Models”, *RISK Magazine*, January 1998
significantly greater liquidity needs because it will be required to post mark-to-market losses on the underlying assets. At the same time, the second institution has essentially no extra demands on liquidity. This could have a significant effect on other counterparties’ credit assessments of the two institutions.

The following is a (by no means exhaustive) list of the factors that can cause liquidity stress. The examples are intended to highlight the differences in liquidity needed to sustain otherwise economically equivalent positions.

Haircuts

Haircuts (also referred to as initial collateral requirements) are the proportion of an underlying asset’s value that a counterparty is required to commit in order to gain economic exposure to that asset through a transaction with a credit provider. The transaction can be a simple margin loan or reverse repurchase agreement, where the credit provider lends the counterparty some proportion of the asset’s value, or a derivative, such as a total return swap, where the counterparty posts initial collateral. A leveraged note implicitly incorporates a haircut in the form of the price of the note relative to the value of the underlying asset(s) to which its return is linked. A leveraged note can also result in higher funding costs to the extent creditors feel more exposed to risk and lack the protection of potential collateral payments from the note issuer.

Haircuts limit the amount of leverage a counterparty can obtain since they ultimately limit the value of the underlying assets, and hence losses, to which it can be exposed. Because they are set at the time a transaction is executed they would not appear to be sources of unexpected liquidity stress. But, different transactions have different rules affecting whether a credit provider can raise haircuts after the transaction has been executed. For example, a total return swap or term repurchase agreement typically has a set haircut for its entire life, while a margin loan is subject to a daily change in haircut. For this reason, counterparties need to be aware of those transactions that are subject to unilateral increases in haircuts, and of the amount by which the haircuts might reasonably be expected to rise in a stress market environment.

The possibility that haircuts may be raised also affects the potential sources of liquidity. Unpledged assets are typically thought of as potential sources of liquidity because they could be sold for cash or borrowed against. In a stress market the assets’ prices may have dropped, however, and credit providers may have increased the haircuts they require, reducing these assets’ value as sources of funds whether sold or used as collateral for borrowing.

To mitigate this risk, institutions should consider entering into longer term secured financing arrangements with fixed haircuts for the term of the financing. In addition, they may wish to consider arranging back up, secured financing facilities from high quality credit providers with predetermined haircuts on pre-specified collateral.
Mark to market

Most credit is provided to highly leveraged institutions on a mark-to-market basis. This means that once a counterparty has agreed to provide exposure to a particular asset with the counterparty putting up less than the full asset value at the time the transaction is entered, the counterparty will be required to post cash to cover declines in the value of the underlying asset over the life of the transaction. Counterparties need to ensure that they have funds available to cover potential declines in the asset’s value under stressed market conditions. (As noted above, declines in mark-to-market value will also reduce the value of currently unleveraged assets as potential sources of funds.)

Mismatch in terms

Transactions with essentially the same economic exposure may have radically different credit terms. For example, a counterparty may have entered into a swap with one institution on a two-way mark-to-market basis, and an identical, offsetting swap with another institution on a one-way mark-to-market basis (the counterparty posts to the institution but not vice versa). If the first swap declines in value to the counterparty, it will be required to post mark-to-market collateral but will not be receiving it on the second swap. Even if both swaps are transacted on a two-way mark-to-market basis, there exists the risk of a delay in receiving collateral because of operational error or pricing disputes. The latter risk also exists if a different transaction with similar economics is used as a hedge. For example, a swap might be hedged with futures contracts: futures contracts require daily posting of variation margin with no opportunity for disputes, while swap contracts typically allow for delays in collateral posting, along with minimum transfer amounts and thresholds that may differ significantly from those of futures exchanges.

Stability of funding sources

Although different sources of funding have different levels of stability, the differences are not always apparent. Equity is generally thought of as “permanent capital and funding” that may not be withdrawn. However, many leveraged funds permit regular withdrawals by investors, thus reducing the reliability of this source of funds. Some funds mitigate this risk by restricting withdrawals for extended periods, or by providing for distributions in kind (withdrawals are met by distributing a share of the fund’s positions, though this presents a problem if the fund has large indivisible positions such as over-the-counter derivatives). Funds and their credit providers should analyze carefully the permitted frequency, size, and terms of equity withdrawals. Term debt may, under these circumstances, actually be a more stable funding source than equity. Credit providers and users need to bear in mind, however, that many debt covenants contain NAV triggers, which again make this source of funding potentially unreliable in a stress market environment.

For those reasons leveraged institutions need to structure their funding so as to provide a core level of non-callable funding consistent with the risk and funding requirements of their positions. This core level of funding would include committed credit lines and locked-in equity financing.
Set forth below are three calculations that credit providers and their counterparties could perform to improve their understanding of the potential risk that an institution might run out of cash to meet short term obligations. The calculations are increasingly aggressive in terms of the sources of cash for which they give an institution credit. In each case they attempt to compare sources of cash with potential uses. In this regard, the definitions are similar to the leverage definitions which follow, in that they compare the amount of cash a fund can raise with the amount it might need to raise (as opposed to “the amount a fund can lose versus the maximum amount it can afford to lose”). The examples noted below illustrate how the definitions might work in practice.

Cash Liquidity

We define Cash Liquidity as:

Unencumbered cash and cash equivalent /VAR adjusted for timing mismatches and potential changes in terms.

The numerator in this fraction is straightforward. It includes only actual cash and high quality short term instruments readily saleable for cash. The denominator needs some elucidation. Basically, it attempts to reflect the fact that the cash a fund might be required to raise in the short term is a function of the potential decline in value of positions on which it is required to post variation collateral, along with any increase in initial collateral requirements which its counterparties are entitled to demand. One implication is that unsecured transactions present no additional liquidity risk. Another is that transactions where the mark-to-market arrangement is one-way, with the leveraged institution posting to its credit provider but not vice versa, present significant liquidity risk. If the institution enters two identical transactions on a one-way mark-to-market basis with different counterparties, it will have no economic risk but will be required to post mark to market collateral to one or the other counterparty as one or the other transaction moves into the money.

The matrix below illustrates how the cash liquidity ratio would be calculated for five hypothetical leveraged investment funds, each pursuing an identical, very closely hedged strategy where each fund is long a ten-year swap with one dealer and short a ten-year swap with another. The economic risk (and VAR leverage) for each fund is quite low. But the cash liquidity ratios are different, reflecting both the unencumbered cash available to each fund and the terms of the swaps. Example 5 has the highest cash liquidity ratio: both swaps are on a two-way mark-to-market basis and its assets consist of cash and unleveraged securities. Therefore, its only liquidity needs would arise from delays in receiving mark-to-market collateral from the counterparty against whom the swap happened to move on any given day, while the fund is being required to post the same amount of collateral to the other counterparty, in whose favor the trade would have moved on the same day. The fund would also have to consider whether either counterparty might have the right to move them onto an initial collateral basis (e.g., as a result of declines in net asset value), and take this into account in their calculation.

Example 1 has a much lower cash liquidity ratio, reflecting the fact that the Fund’s swaps have asymmetrical credit terms. Its potential cash needs are essentially the potential change in value of the swap transacted on a mark-to-market basis. If this swap moves against the fund, it will have to use available cash to post collateral because the counterparty to the swap moving in the fund’s favor is not required to post collateral. The denominator of the fraction is the same for the other three examples as for Example 1 because they also have asymmetrical credit terms. In each case, however, they have invested half of their cash in securities, resulting in a lower cash liquidity ratio than in Example 1.
Buying Power Liquidity

Buying power liquidity again compares potential sources of cash with potential cash requirements. The potential requirements are calculated as described above to determine cash liquidity, giving the same denominator. However, the numerator in this approach now includes a more conservative estimate of the cash a fund could borrow against unleveraged assets.

We define **Buying Power Liquidity** as:

\[ \text{Cash Liquidity Numerator} + \text{Buying Power / VAR adjusted for timing mismatches and potential changes in terms} \]

The estimate of buying power should be based on commitments from lenders to lend against securities at a predetermined haircut, even in a stress market environment. In addition, the estimate of buying power needs to recognize that, in a stress market environment, the value of the security against which the institution is borrowing may well have already declined. Buying power should therefore be calculated using the committed haircut against a security value, decreased by an amount consistent with the assumptions used in the VAR calculation.

In the examples, different funds generate different buying power liquidity depending both on how much of the asset side of their balance sheet is invested in securities, and at what haircut they could borrow against those securities. Thus, examples 2 and 3 give different results in spite of the fact that their balance sheets are the same since Example 3 is assumed to be able to borrow at only a 40% haircut rather than a 25% haircut.

Credit Line Liquidity

**Credit Line Liquidity** again uses the same denominator as the other liquidity measures, but gives credit for committed unsecured undrawn credit lines as potential sources of cash.

We define **Credit Line Liquidity** as:

\[ \text{Buying Power Liquidity Numerator} + \text{Committed Unsecured Undrawn Credit Lines / VAR adjusted for timing mismatches and potential changes in terms} \]

Users of this measure need to be extremely careful in assessing the extent to which credit lines are firmly committed. Many credit lines contain contingencies and covenants which are sufficiently broad to call into question whether an institution will be able to draw on them when they are most needed. Accordingly, this measure of liquidity should be seen as the most aggressive. A credit provider would probably wish to be circumspect in extending credit to an institution whose liquidity profile was weak based on the first two measures, even if it appeared adequate based on credit line availability.

Example 4 produces a significantly lower result for this measure than the other examples since it has no credit line available.

Note that the above calculations help measure funding risk without reliance on liquidation of core, longer-term, or relatively illiquid holdings.
Any reduction in equity (through losses or withdrawal of investor capital) or increase in borrowing (whether or not secured) will increase leverage and may increase risk. Rather than use cash or increase borrowings to meet new cash demands, funds may choose to liquidate core holdings or longer-term positions. In fact, funds seeking to maintain a given level of leverage or risk relative to capital may be required to liquidate longer-term assets as they experience valuation losses. With greater leverage, there is a greater likelihood that losses or withdrawals will trigger a need to sell core holdings. Thus it is important to examine asset liquidity risk. For this reason, all the VAR calculations used in the liquidity measures (both as they pertain to mark-to-market losses which need to be funded, and to losses in value of assets which could be used as collateral) should be carried out on an asset liquidity adjusted basis, with volatilities scaled for the likely liquidation horizon for a position. As with leverage, market participants should also examine the impact of stress scenarios on their liquidity position.
<table>
<thead>
<tr>
<th>Assets</th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
<th>Example 4</th>
<th>Example 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Securities 10 year Govts</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>TOTAL ASSETS</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities &amp; Equity</th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
<th>Example 4</th>
<th>Example 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Securities sold short 10 year Govts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Liabilities</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Equity</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL LIABILITIES &amp; EQUITY</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

| Derivatives Notionals        | 90        | 90        | 90        | 90        | 90        |
| Derivative Credit Terms      | Dealer 1  | Unsecured | 2Way MTM  | Unsecured | 2Way MTM  |
|                             | Dealer 2  | Unsecured | 2Way MTM  | Unsecured | 2Way MTM  |
| Buying Power                 | 25%       | 25%       | 40%       | 40%       | 40%       |
| Credit Line                  | 10        | 10        | 10        | 0         | 0         |

<table>
<thead>
<tr>
<th>Liquidity Ratios</th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
<th>Example 4</th>
<th>Example 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Liquidity</td>
<td>3.38</td>
<td>1.78</td>
<td>1.78</td>
<td>1.78</td>
<td>29.25</td>
</tr>
<tr>
<td>Buying Power Liquidity</td>
<td>3.38</td>
<td>3.08</td>
<td>2.82</td>
<td>2.82</td>
<td>46.24</td>
</tr>
<tr>
<td>Credit Line Liquidity</td>
<td>6.77</td>
<td>6.64</td>
<td>6.38</td>
<td>2.82</td>
<td>46.24</td>
</tr>
</tbody>
</table>
Leverage

*Leverage* may be used to increase or offset exposure to a financial asset. In a simple example, an investor may obtain funding from a lender to acquire a financial asset. With the size of borrowing obligation independent of the asset’s performance, the investor can enhance its return on equity (or increase its loss) for a given gain or loss in the financed asset. An investment, and by extension, a portfolio of investments, is said to be *highly leveraged* when a relatively large proportion of invested funds are borrowed. It follows that leverage can be directly observed by calculating the ratio of invested funds (assets) to investor funds (equity).

Financial measures of leverage vary widely. The PWG notes two different definitions - balance sheet (assets-to-net worth) and risk-based (economic risk relative to capital). The latter concept, which we will later define as Value at Risk Leverage, can be alternatively described as “the amount a fund can lose versus the maximum amount it can afford to lose.” The Basel Supervisors Committee in its recent report took this approach by defining leverage as the ratio of risk to capital but did not discuss how the risk measure might be constructed.

As stated, we define measures of leverage as estimates of the risk of an institution’s mark-to-market net worth becoming negative. Traditional measures of leverage attempted to estimate this risk by making the implicit assumption that the amount of money an institution could lose was a function of its total on-balance-sheet assets, and that its capital was simply the book value of its equity. This on-balance-sheet test of leverage has been widely used. It gained favor in part because it is relatively straightforward to calculate based on data presented according to fairly objective (but not economically consistent) accounting rules. An independent outside auditor periodically validates the data. The advent of modern financial products, many of which are carried off-balance sheet (such as swaps) or carry embedded leverage (such as structured notes), has made this approach inapplicable for complex leveraged institutions.

For reference we offer a spectrum of existing and suggested leverage definitions – expanding on those used by the PWG – with examples to demonstrate their various strengths and weaknesses. *It should become clear that the utility in applying the tests lies not in pinpointing riskiness but in raising questions about the nature of underlying assets, liabilities and capital that, when answered, will help to illuminate performance risks more fully.* The Policy Group does not suggest any single formula, or group of formulas, as the “best” definition of leverage, but rather seeks to encourage financial intermediaries and their counterparties to focus on the relationship between real risk of loss and the capital available to absorb it, as opposed to simplistic and misleading accounting based measures.

**Gross On-Balance-Sheet Leverage**

This is the ratio of on-balance-sheet assets to equity. This is the simplest leverage ratio to compute because it requires only GAAP data from an institution’s balance-sheet, which is normally readily available.

We define **Gross On-Balance-Sheet Leverage** as:

**Total On-Balance-Sheet Assets/Equity**

Some of the problems with this measure were noted above: it does not take into account the risk of off-balance sheet items such as swaps and forwards, it does not correctly reflect the risk of on-balance sheet items such as leveraged notes which carry embedded leverage, it ignores risky
liabilities, it does not give credit for the fact that certain assets, such as matched book assets, may be perfectly hedged with offsetting liabilities, and it fails to distinguish between assets with the same balance sheet value, but widely differing risk.

Examples 1, 2, and 5 in the table below show some of the implications of using this measure. Example 1 is an institution which is long and short ten year Treasury bonds, and also has a substantial matched book. Example 2 illustrates an institution pursuing a similar strategy, but through the swap market rather than the cash bond market. Example 5 is an institution following a so-called directional strategy involving a long position in ten-year swaps. Each institution has the same amount of capital. It should be clear that the real risks in Examples 1 and 2 are very similar, while the risk in Example 5 is much higher because the potential for a significant adverse move in ten year interest rates is much higher than for an adverse change in the relationship between two almost identical ten-year instruments. However, as the Leverage Ratios at the bottom of the table show, the gross on-balance sheet leverage ratio tells a different and rather misleading story. Example 1 shows the highest ratio of assets/equity because its investment strategy is carried out through instruments carried on the balance sheet, and its large matched book is included, even though this has essentially no market risk (it does have counterparty credit risk). Further, Examples 2 and 5 give the same result even though the underlying risk in Example 5 is higher.

Net On-Balance-Sheet Leverage

We define **Net On-Balance-Sheet Leverage** as:

\[
\frac{(Total\ Assets - Matched\ Book\ Assets)}{Equity}
\]

We refer to the numerator in this fraction as Adjusted Assets. This measure is also fairly simple to calculate, but, other than the removal of some perfectly hedged assets, suffers the same shortcomings as Gross On-Balance-Sheet Leverage. This is the measure favored by some analysts (and by rating agencies).

Example 1 gives a lower value for Net On-Balance-Sheet Leverage than for Gross On-Balance Sheet Leverage because its large matched book is no longer included. However, it still shows substantially more leverage than Examples 2 and 5 because of the presence on its balance-sheet of instruments with effectively the same level of risk as positions carried off-balance-sheet by the latter two examples. And, once again, Examples 2 and 5 appear equally leveraged even though Example 5 carries substantially more risk relative to its capital.

Gross Economic Leverage

We have noted that the accounting rules used to present balance sheet data treat financial products with similar economic performance characteristics quite differently. For instance, a loan secured by marketable securities (e.g., a margin loan) will be included on-balance-sheet at full loan value while a total return swap on the same securities will be included at its comparatively small mark-to-market value. To correct for these, the non-economic differences between different financial products can be adjusted by substituting the full contract or notional value for the market value of any listed futures or over-the-counter derivatives.
We define *Gross Economic Leverage* as:

\[(\text{Risky Assets} + \text{Risky Liabilities} + \text{Gross Off-Balance-Sheet Notional})/\text{Equity}\]

The resulting leverage calculation will provide a more useful though still suboptimal measure of risk because it treats on- and off-balance-sheet positions similarly. Note that this measure looks at both sides of the balance sheet, including all assets other than cash, and all liabilities other than short-term borrowings.

With this risk measure, Example 2 no longer appears unleveraged because the notional amounts of the swaps are included. However, it still appears less risky than Example 1 because of the latter's matched book. Example 3 appears more leveraged than Example 2, because the combined notional of the long and short swaps is higher. However, its true risk is lower because the difference in notional between the long and short swap is less than in Example 2, to which it is otherwise identical. Example 4 shows the same gross economic leverage as Example 2, even though its true risk is higher (the short swap has a five-year tenor as opposed to ten-years for the long swap, and the potential for a sizable difference in performance between a ten- and five-year swap is larger than for two ten-year swaps, though it is lower than for a ten-year swap alone). Finally, Example 5 shows gross economic leverage about half of that of Examples 2 and 4, even though, as discussed, its true risk is the highest.

It should be clear that while gross economic leverage addresses the simple shortcomings of balance sheet leverage measures – their failure to take into account off-balance sheet risk-producing activities – it has serious problems of its own. In addition to the issues illustrated by these examples, as a practical matter it is difficult to decompose instruments such as options and structured notes into notional equivalents. If credit providers were to use gross economic leverage, a detailed set of guidelines for conversion of off-balance sheet positions into notional amounts would be needed. A further shortcoming of this measure is the significant subjectivity with which different institutions designate assets and liabilities as matched. Different firms may have different standards as to how great a difference between the maturity of the asset and matching liability may exist before they are deemed to be unmatched, making matched book comparisons between firms difficult at best.

*Net Economic Leverage*

Many leveraged institutions choose to reduce the risk of an open position (whether cash or derivatives) by establishing an exactly offsetting position with a different counterparty or dealer. As Example 3 showed, such a transaction would actually increase Gross Economic Leverage. As the combination of the offsetting positions poses no market risk, the Economic Leverage measure can be refined to eliminate these offsetting positions. To be comfortable that market risk is fully mitigated, the offsetting positions must have identical underlying, quantity and maturity. The remaining Net Economic Leverage calculation will then more fairly present open risk positions, whether directional or relative value, in relation to equity.

We define *Net Economic Leverage* as:

\[(\text{Risky Assets} - \text{Matched Book Assets} + \text{Risky Liabilities} - \text{Matched Book Liabilities} + \text{Gross Off-Balance Sheet Notional} - \text{Hedges})/\text{Equity}\]
In practice, however, the identification and segregation of exactly offsetting positions may prove difficult.

As the examples show, this measure does a better job of correctly ordering the institutions in terms of their true riskiness. The very substantial extent to which Examples 1, 2, and 3 are hedged is reflected in their low net economic leverage numbers. However, Example 4 still appears more risky than Example 5 because only exactly offsetting positions are netted. The fact that the values of the ten- and five-year swaps included in Example 4 are likely to move together, even though their maturity is not identical, is not reflected in the leverage measure. Again, it is also important to note that credit providers would need rather detailed and robust data from their counterparties to calculate this measure themselves.

It is also worth noting that net economic leverage ignores the counterparty risk of offsetting positions, and the possibility that margin or collateral terms on economically equivalent positions can be different, creating liquidity stress for the institution.

**VAR Leverage**

Each of the preceding economic leverage measures provides, in combination, some insight into the size of positions relative to equity. However, the calculations alone still say nothing about actual risk. As noted, Example 5 shows lower Net Economic Leverage than Example 4, although the risk that its capital could be wiped out by adverse market moves is higher. To take an even more extreme example, a fund with a single large position in an illiquid emerging market equity and a different fund with a like amount of 3-month Treasury bills, each using 25% equity and 75% debt, would have identical Net Economic Leverage calculations. Yet the risk of those positions, and therefore the likelihood of default of the funds, is quite different. To better assess risk relative to capital, funds and creditors should use a better measure of risk. We suggest, with caveats, Value at Risk. Users should evaluate appropriate confidence levels and time horizons (BIS uses 99% confidence level over two weeks) and fully understand the inputs (correlations, volatilities) to the VAR model.

We define **VAR Leverage** as:

**Correlated VAR/Equity**

It should be noted that the optimal definition of equity is the mark to market net asset value of the institution, with explicit recognition of the time horizon over which capital withdrawals may occur.

Since VAR both ignores non-economic product distinctions and provides market-based insight into potential losses, VAR leverage is an improvement on the more blunt balance sheet or notional calculations discussed above. However, even the most robust VAR models have their limitations, since they may not adequately measure the impact of infrequent or never-experienced extreme adverse market events. Thus, VAR must be supplemented by stress-testing (as discussed earlier). Also, as described in the section on Asset Liquidity, it is dangerous to use a standard time horizon in VAR calculations. For a mark-to-market institution, the question is whether its positions could be unwound before its NAV becomes negative, or even declines to a liquidation threshold. If it would take far longer than the assumed horizon to complete such an unwind, the positions could undergo adverse moves significantly greater than the VAR calculation would indicate, making it much more likely than estimated that the fund would become insolvent in the meantime.
For the most part, VAR leverage correctly reflects the relative risks in the examples. The most closely hedged institution – Example 3, where the notional amounts for two otherwise identical swaps differ by only 3 – shows the lowest VAR leverage. Examples 1 and 2 are next lowest; the sizes of their long and short positions are different by 5 in both cases, and the VAR leverage is almost identical for the two funds (the small difference reflects the differences in volatility between cash and swap markets). Example 4 shows substantially greater leverage, reflecting the greater potential for a large difference in performance between a five-year and a ten-year instrument, as opposed to two ten-year instruments. Example 5 shows the greatest VAR leverage reflecting the directional nature of its portfolio. However, Example 6, which is identical to Example 1 but ten times larger, misleadingly shows the same VAR leverage as Example 1 because of the use of the standard two-week time horizon. In reality, liquidating positions ten times larger would take longer (resulting in more time for market deterioration) and/or have greater market impact, making it more likely that the proceeds would not cover all the fund’s liabilities.

It is important to stress that the limitations of VAR probably make it more useful as a measure of relative risk among institutions pursuing reasonably similar strategies, rather than as a measure of absolute risk. The many assumptions a VAR calculation requires are each subject to their own uncertainty, which affect the final result. However, using consistent assumptions across counterparties can give a better picture of their relative riskiness than the easily distorted balance sheet measures, or other measures which ignore the true riskiness of different assets.

Asset Liquidity Adjusted VAR Leverage

As discussed under Asset Liquidity, the assumption that all positions could be liquidated within in the same period is unrealistic and potentially very dangerous. Moreover, some institutions will be forced to liquidate more quickly than others, impacting the market for the positions being liquidated. For this reason, risk to capital should be measured taking into account the liquidity of the different positions, and assuming that in an adverse market some forced liquidation is taking place, leading to mark-to-market losses even for institutions that are conservatively positioned with regard to leverage and funding.

We define Asset Liquidity Adjusted VAR Leverage as:

\[
\text{Correlated VAR with liquidation horizon scaled volatilities/ Equity}
\]

The results of this calculation in our examples are identical to the VAR Leverage calculation, except that Examples 3 and 6 now show higher results. This is because we assume that it would take at most two weeks to liquidate positions of the size held by the other funds. Example 6 produces a result ten times larger than Example 1 because its positions are ten times larger, resulting in 100 times as much Asset Liquidity Adjusted VAR (ten times as large positions which take ten times as long to liquidate) but has only ten times as much capital. Example 3, although better hedged economically than Example 2, has gross positions in ten year swaps of 403 versus 185. The calculation therefore assumes that it would take just over twice as long to liquidate the positions. Because the fund in Example 3 is better hedged, however, the potential loss is less than twice as large (the rate of loss during liquidation is lower).

In addition to these leverage measures, funds and their credit providers should use stress tests to further investigate the adequacy of capital to cover losses under stress market scenarios.
Appendix B: Counterparty Credit Exposure and Risk Estimation

Introduction

As the volume and complexity of traditional bank lending, OTC derivatives trading, and other credit intensive activities continues to grow dramatically, most Financial Intermediaries (FI's) have developed systems to more quickly and accurately measure and manage credit risk. Such models are meant to aid FI's in quantifying and managing risk across counterparty, product, portfolio, and geographic lines. Comprehensive and accurate credit risk modeling is one of the more challenging aspects of credit risk management in that it requires the combination of 1) complex and highly quantitative risk estimation which captures the broad range of potential value outcomes in a portfolio with 2) in-depth counterparty credit analysis which measures the probability of credit deterioration and default.

Because of these difficulties and challenges, no one universally accepted approach to counterparty credit risk modeling has been developed to date. There are a number of policy initiatives addressing the various credit risk modeling alternatives, including the Group of Thirty’s 1993 report, “Derivatives: Practices and Principles” and, most recently, the Basle Committee on Banking Supervision’s April 1999 paper entitled, “Credit Risk Modeling: Current Practices and Applications.” A review of market practices indicates two different, but not competing, processes – risk utilization and capital allocation – have emerged as the primary tools used for these purposes.

The purpose of this appendix is to outline the two processes in practical application and to identify and discuss issues associated with the use of each.

Alternative Approaches to Credit Risk Estimation

Credit risk measurement and management processes have evolved partly as a function of the type of business executed by an FI. For example, institutions with a historical trading emphasis have tended to focus on “worst case” Potential Future Exposure (PFE) combined with individual counterparty credit analysis as their primary risk measurement tool. Such firms engage in risk utilization, that is, they allocate capital based on measures of trading risk, set Potential Exposure (PE) limits according to a counterparty’s creditworthiness, and measure risk based on PE to the counterparty. Institutions that have historically emphasized direct lending (and its associated regulatory and capital requirements), in contrast, have tended to focus on the risk characteristics of the aggregate portfolio of exposures across different products. Such firms engage in capital allocation, that is, they manage exposure by allocating capital to trading desks (and other business units) and then charge for the capital according to the creditworthiness of a counterparty and how well the transaction fits with the existing portfolio. FI’s using risk utilization have tended to focus on credit risk from a counterparty perspective while FI’s using capital allocation have focused on credit risk from a firmwide portfolio perspective.

Before discussing the methods and issues of risk utilization and capital allocation, it is important to address briefly the terminology of exposure common to both processes. As mentioned above, both methodologies have strengths and weaknesses but they generally complement each other. The most notable commonality between the two is their use of a modeled estimate of PFE. Models which use PFE focus on two particular exposures: Potential and Expected:

1. Potential Exposure (PE) is an estimate of the future credit exposure of derivative transactions using statistical analysis based upon broad confidence intervals over the remaining terms of the transactions
2. *Expected Exposure (EE)* is an average future exposure. When combined with expected
default rates, an estimate of *Expected Loss* can be derived.

3. Usually models calculate PE and EE net of margin. *Collateralized Exposure (CPE, CEE)*
measures the future credit exposure of a portfolio, giving effect to collateral terms
applied to a portfolio.

While PFE looks at what may happen, exposure measures which look at what has happened
are useful, too:

4. *Current Exposure (CE)* is the measure of the current value of a portfolio today, taking
into account current netting and margin information

5. *Notional Exposure* is used less and less as a primary risk management tool, although it is
still used for reporting. Notional amounts may also be useful at the level of the
individual counterparty as an indicator of volume.

**Risk Utilization.** As stated above, the fundamental building blocks of risk utilization are PE
combined with individual counterparty credit analysis. PE is an exposure measure which is
typically calculated on a counterparty basis. Calculating PE can be a five-step process: 1)
Detailed trade information from various front and back office systems is aggregated into a
portfolio. 2) Distinct risk factors used to price the trades in the portfolio are compiled. 3)
Risk factors are simulated using the appropriate model, with particular attention paid to
modeling of dominant risk factors. 4) Instruments in the portfolio are priced for multiple
simulations of the underlying risk factors for the duration of the portfolio. 5) Instrument
prices are used to calculate exposures for distinct counterparty portfolios, giving affect to
legally enforceable netting and offsetting trade positions. PE is best represented graphically
as a time-sequenced line graph of potential exposure at a selected confidence interval or
intervals for the life of the portfolio. CPE is an exposure measure that incorporates collateral
terms with a counterparty to measure exposure giving affect to collateral held in future
exposure scenarios.

While PE, as an exposure measurement tool, does not easily facilitate the aggregation and
comparison of risk measures across products and counterparties, it does enable managers to
measure, pinpoint, stress, and limit risk factors in a portfolio against individual
counterparties. Furthermore, when combined with individual counterparty credit analysis, PE
can be used as a limit setting tool, in which a firm’s credit department rations capital to
trading desks in the form of PE. That rationing or allocation process is based primarily on
counterparty creditworthiness but can be adjusted on a case by case basis depending on trade
profitability, trade risk, trade risk mitigants or other factors.

**Capital Allocation.** Managing credit risk from a firmwide perspective requires a firm to
compare and aggregate exposures arising from different products and counterparties. An
appropriate measure of credit risk is economic capital. Economic capital is defined as
potential for unexpected losses estimated at some confidence interval (e.g. 99.97%)

Some firms have adopted portfolio methodologies and various analytical tools to
translate the individual exposure numbers into marginal economic capital contributions.
The sum total of these marginal economic capital contributions is approximately the
total economic capital consumed by the credit portfolio. The marginal economic capital
number enables the use of a single measure to be used in various decision-making
processes such as:

1. Limit setting
2. Risk charging/reserving
3. Economic/profitability analysis
4. Allocating capital equitably between market and credit risk
5. Measuring concentration risk

While there are a number of different capital allocation methodologies available, the following is meant to be a generic description of these methodologies in order to illustrate the typical data requirements and results.

In general, a firm's credit portfolio comprises of traditional credit products, credit exposures from OTC derivatives, and hedges including individual credit default swaps and portfolio hedges. The portfolio analysis tools estimate the annual loss distribution of the portfolio due to defaults and possible downgrades. In addition, the marginal contribution to the portfolio loss distribution is tabulated for each counterparty in the portfolio.

Portfolio tools fall into two general categories depending on whether they include the risk of downgrades in estimating the annual loss distribution. The default-only models evolve default scenarios at the end of the risk horizon (say, one year). The loss in case of default is then determined from the assigned recovery value. The second category of models incorporates the risk of downgrade by evolving both default scenarios as well as rating change scenarios at the end of risk horizon. For each year-end rating scenario, the potential mark-to-market (MTM) impact is calculated for each exposure. This MTM calculation requires credit spreads (to value in the non-default states) and recovery values (to value in case of default). The spread risk is not separately included in the computation because the models typically take a longer-term view of credit risk and implicitly capture the default probability element of spreads in the estimation of downgrade risk. The inclusion of losses on downgrades fully accounts for the NPV of credit losses beyond the first year, so it is not necessary to simulate losses past the first year in these models. The default-only models, on the other hand, are often run to the stated maturity of the deals.

The default-only models rely on historical or modeled default rates to propagate the default scenarios. Models incorporating downgrade risk rely on transition matrices that incorporate both historical default rates as well as historical rating change rates. In addition, credit spreads are an integral part of these latter models. The credit spreads are generally derived from bond, asset swap, and credit default swap markets. Spread grids are prepared for different region/industry pairs. Recovery rates are critical for both kinds of models. These rates are derived from a combination of published studies and a high degree of internal experience/judgement. These rates can be set anywhere between 20% and 100% based on seniority type, region, and industry.

For OTC derivatives, it is important to consider both CE as well as PE due to market moves. This exposure profile is further adjusted upwards for a premium that reflects the dynamic nature of the exposure (also determined judgmentally). Once the scaling of the exposures has been done, the exposure profile is converted into equivalent loans. As many equivalent loans result as there are time bands. These equivalent loans are then incorporated in to the portfolio analysis. Thus the best estimate of the expected exposure profile is used for OTC derivatives, including any “wrong way” effects.

Since historical default and rating change data are limited, the default and rating migration correlations are generally implied from asset correlations. The rationale here is that default and rating migrations are driven by the asset value of the firms. Therefore asset correlations drive the joint likelihoods of default or rating migration. Again, there is room for judgement here due to lack of adequate historical data.

Capital grids derived from the portfolio tool can then be used to assess properly the marginal capital consumed by potential new transactions. These grids are updated
periodically and are obtained by combining hypothetical standardized transactions with
the credit portfolio. The marginal capital grids are obtained for different regions,
ratings, and maturities. In addition, these grids are also produced for different asset
types (i.e., traditional loan products, OTC derivatives, and credit default swaps). This is
because these asset types differ in recovery assumptions and therefore warrant different
levels of capital. Also, the credit default swaps grids are different from the other two
since they include the risk of swap counterparty defaulting as well.

Issues Associated with the use of Risk Utilization and Capital Allocation

There are myriad operational, theoretical, an practical issues related to the use of either type
of model. In the paragraphs below, we discuss those issues which appear to have the greatest
impact on the productive use of either process. There are issues common to both Risk
Utilization and Capital Allocation and there are issues specific to each. We address the
issues common to both first.

1. **PE versus replacement cost.** While the CE definition itself is self-explanatory, there is
an important issue related to the concept: CE does not equal true replacement cost.
Contract replacement cost in declining or illiquid markets will usually be materially
different from measured CE. Position replacement cost and collateral values should be
measured both at current market prices and at the prices that a firm anticipates receiving
in the case of liquidation of its positions and collateral with the counterparty.
Liquidation value should reflect both the adverse price movement which may occur with
respect to positions and collateral during the period until the decision to liquidate is
taken, as well as the market impact of liquidating the specific positions and collateral
involved. For any counterparty, a comparison of market and liquidation calculations
yields useful information with respect to the sensitivity of a firm's exposure to that
counterparty to adverse market price movements and the liquidity characteristics of the
underlying positions and collateral.

2. **Appropriate confidence levels of PE.** PE is often displayed as a curve which shows
potential exposure out to a certain confidence level, say 97%. Determination of the
appropriate confidence level used in the measurement of future exposures is an
institution specific decision that will encapsulate the institutions philosophy on credit risk
management. Measuring PE out to too low a confidence level may provide a false sense
of security in that it can portray unrealistically low risk levels, whereas measuring PE out
to too high a confidence level can cause management to reduce the business levels to
protect the FI from very bad, but highly improbable outcomes. PE can be illustrated
using a single curve or two curves, which would have the effect of demonstrating the
sensitivity of the portfolio to moderate and extreme scenarios.

3. **Material events not captured in the models.** Simulations used to produce future
exposures and possible defaults will not always capture rare events caused by structural
social, economic, or political changes. Management will be required to use judgement in
the decision process to include potential events not captured in historical data. In order
to make informed judgements, management must understand the assumptions behind the
PE measurements.

4. **Systems and complexity risk.** The introduction of new trade types and products can be
difficult operationally and theoretically. From an operational standpoint, the integration
of additional back office systems increases the risk that information is not captured or
displayed in a manner that can be properly handled by existing exposure calculation
infrastructure. Very often, new complex trades and products that cannot be modeled, due
to simulation and pricing limitations, entail the most credit risk and are, arguably, the
most critical to measure exposure for. Incorrectly modeled trades are also an issue.
While most systems can identify unmodelled trades, they cannot point out incorrectly modeled trades. Also, limit setting and monitoring credit risk can be systems intensive and complex. Understanding the impact of new trades on risk or exposure measures is also a complex process. Providing “What If” calculators to traders, sales people, and credit professionals is integral in managing exposure.

5. **Use of collateral.** Using collateralized measures implies the acceptance of collateral as a credit substitute. As a result, it is prudent to calculate both collateralized and uncollateralized measures. Since CPE assumes there is no limit to the amount of liquidity that a counterparty will be able to provide over the life of a portfolio, it is important that exposure is calculated on an uncollateralized basis to provide information about the level of liquidity that a counterparty would have to provide.

6. **Operational and legal issues associated with collateral.** The use of collateralized measures highlights other operational and legal issues. The assumptions about collateral collection and close-out periods are essential to an accurate representation of exposure. Legally, enforceability of collateral is not always clear; uncertainty varies by country, type of legal entity, and type of asset held. Similarly, close-out periods and legal rights may not be clear. Operational issues such as making and tracking calls, mark-to-market calculations, and reconciliation are all issues that need to be recognized as a user of CPE to understand potential limitations.

7. **Wrong way trades.** There can be a correlation between worst case exposure and probability of default. Unlike loans, swaps and other forward trades have uncertain credit exposure that will depend on the movement of market rates. Where there is strong correlation between market rates and the solvency of counterparties, “wrong way” trades can occur. The collapse of the Ruble that accompanied the defaults on Russian debt is an example of wrong way risk. Other general examples of wrong way trades include buying a put option on an emerging market bond from a sovereign or financial institution of the same country, or arranging a foreign exchange forward contract (paying the foreign currency receiving USD) with a central bank or other financial institution of the same country. Wrong way features in trades can have an enormous impact on both expected exposure and loss. In such cases, the PE method (as well as other methods) can lead to a gross underestimation of exposure and expected loss. Extreme worst cases may generate suitability issues as well. While it may be possible to model correlations to identify wrong way trades, wrong way trades will typically be identified in the course of trade and counterparty analysis. Pricing for wrong way trades should be adjusted to account for much higher potential for sizable exposure in the event of a loss.

In addition to those issues addressed above, there are also issues specific to Risk Utilization:

1. **Comparability.** PE measures are not always comparable across counterparties. For example, given two sets of exposures where the first set contains a $100mm PE to a AA-rated counterparty and a $100mm PE to a BB-rated counterparty and the second set contains exposures to the same counterparties but in $190mm and $10mm proportions respectively, in both cases the total exposure amount is $200mm but set one is obviously more risky because of greater exposure to the lower credit quality counterparty.

2. **Ability to aggregate.** Because peak PEs occur at different times for different trades and/or portfolios within different counterparties the ability to aggregate PE measures is limited. For example adding the $10mm peak PE of a 5 year interest rate swap (occurring in year 3) to the $10mm peak PE of a 10 year cross-currency swap (occurring in year 10) to calculate that the peak PE of the portfolio as $20mm is meaningless. This problem is valid only if PE is produced as a single number rather
than as a time sequenced curve. Furthermore, because the risk factors of trades in portfolios will invariably differ, the scenario resulting in a specific confidence level will be different for different counterparties. For example, it is meaningless to add a 95% confidence exposure arising from an increase in rates with a 95% confidence exposure arising from a decrease in rates. One way to calculate the potential exposure of a portfolio is to simulate the exposure of the entire portfolio using the same set of scenarios. Even when that is done, the usefulness of that number is limited because we would be adding exposures with different default risks. Firms can also simulate exposure to portfolios of similar credit quality, but then comparability is limited to a subsection of the entire portfolio.

Finally, there are issues specifically related to capital allocation:

1. **Precision of PE.** As mentioned above, in a portfolio risk calculation, OTC derivative expected exposures are adjusted upwards for a premium that reflects the dynamic nature of the exposure. This calculation is not an exact science and may obscure the fact that some exposures are extremely sensitive to underlying market rate moves and therefore may not capture risks which lie at the outer limits of the probability spectrum. A joint credit/market risk model would address this problem, and would effectively incorporate the full range of potential exposures in to the loss distribution.

2. **Data availability.** Default models require a great deal of data - transition matrices, correlations, credit ratings, spread data, and recovery rates. The quality and completeness of the data tends to vary by region.

3. **Ability to aggregate.** The capital allocation model assumes that total economic capital can be aggregated directly by adding marginal economic capital contributions. While this is generally true, this approximation may produce results significantly different from true total economic capital for volatile and less well diversified portfolios. In an extreme case, given a firm portfolio of 2 counterparties of the same credit quality but with directionally opposite positions, true economic capital will equal the economic capital of each counterparty while direct aggregation of the two will produce economic capital of twice that amount.

**Conclusions**

As stated at the outset of this appendix, risk utilization and capital allocation are both rigorous and widely used methods of credit risk measurement although neither should be considered fully comprehensive on a stand-alone basis. To summarize, the capital allocation process, by combining the measurement of credit exposure with credit migration and default risk models, generally permits:

1. The aggregation of comparable exposures across products and counterparties,
2. the ability to charge business units for capital usage, thus facilitating profitability analysis and,
3. the ability to limit trading by pricing capital according to risk and portfolio constraints.

At the same time, the risk utilization method, by combining sophisticated PE modeling with intensive trade and counterparty credit analysis, permits:

1. More accurate forecasts of PE and CPE,
2. the ability to more readily identify potential large exposures, correlations, wrong way trades and suitability issues and,
3. the ability to ration capital to business units on a specific trading counterparty basis.

Put another way, because of its counterparty focus, the risk utilization method does not readily facilitate comparability of exposure measures or aggregation of exposures on a firmwide portfolio basis, as the capital allocation model does. Nor does it facilitate profitability analysis. However, risk utilization’s intense focus on trade and counterparty specifics makes the model valuable in its ability to identify potential large exposures and protect firms against catastrophic loss, while providing a framework for risk utilization and management.

As FT’s further refine their credit risk measurement processes and continue to allocate resources to the development of credit risk models, they will have to balance the strengths and weaknesses of each process against the needs of the FT’s broad range of credit requirements. Firms should make a continuing effort to combine the best practices of both processes into their credit risk modeling systems.
Appendix C:
Model Regulatory Report Formats and Definitions

1. The Large Counterparty Exposure Report would provide aggregate credit risk information for counterparties whose positions meet specific exposure size thresholds.

2. The report would be submitted by reporting firms to their primary regulator on a consolidated basis.

3. The report would cover all activities with a counterparty and reflect the replacement cost of derivative contracts, repo agreements, stock borrow and loan agreements, margin loans and non regular-way settlement trades (i.e. forward or extended settlement trades), as well as the market value or stated value, as appropriate, or other financial instruments such as loans and securities in respect of which the counterparty is the obligor or issuer. Any material exception to this list should be identified and described.

4. Counterparties would be grouped in two credit classes based on internal ratings or, by default, external ratings: investment grade (or equivalent) and below investment grade. For each counterparty listed, relevant external ratings, if any, would also be shown.

5. Counterparties to be reported are those ranking among the top 10 counterparties of their credit class in any of the following measures:

   (a) **Current Replacement Cost**, measured at market, including the benefit of netting agreements if legally enforceable with high confidence but before consideration of any relevant collateral.

   (b) **Current Net of Collateral Exposure**, measured as Current Replacement Cost minus the market value of collateral in respect of which there is high confidence about enforceability and perfection of security interest.

   (c) **Current Liquidation Exposure**, measured as Current Net of Collateral Exposure where market values are replaced by estimated liquidation values. Liquidation value should consider the adverse price movement which may occur with respect to positions and collateral during the period until the decision to liquidate is taken, the market impact of liquidating the specific positions and collateral involved and general market illiquidity risk.

   (d) **Potential Exposure**, measured, for OTC derivatives, as peak potential exposure over the tenor of the positions with the counterparty, using a confidence level of at least 95%, adjusted for collateral rights, threshold agreements, optional unwind rights, as well as the shorter timeframes these rights imply. For non-regular-way settlement trades, potential exposure should also be calculated at a confidence level of 95% or higher.

6. Market value is derived, as appropriate, from observable transactions or from the present value of cash flows evaluated at current market prices, interest rates and foreign exchange rates.

7. When aggregating exposures across instruments, negative replacement costs and excess collateral are ignored, unless enforceable set-off rights exist.

8. Further refinements, such as incorporation of recovery rates, could also be included.
9. It is acknowledged that given the complexities of exposure measurement yet the need for simplicity, there is inevitably a certain amount of arbitrariness in the proposed classification and the suggested product exposure definitions (see Annex). Reporting firms are encouraged to provide explanatory footnotes. Even with such notes, care must be employed when interpreting this report and the different exposure measures presented should be viewed together rather than separately.
Appendix D: Glossary of terms used in report
Italicized terms defined elsewhere in Glossary.

Affirmation The process by which parties to a transaction verify that they agree with each other on the terms of the transaction.

Basis risk Normally, risk associated with differences in changes of two related prices or with imperfect matching between hedge and underlying risk. In the context of this report, also refers to risks arising from inconsistencies across standard forms of industry documentation.

Close-out Steps taken by a non-defaulting party to accelerate and terminate a contract prior to its maturity when the other party fails to perform according to the contract’s terms.

Confirmation One or more documents exchanged between two counterparties acknowledging a transaction and setting forth its terms.

Credit event A defined occurrence that can trigger action under a financial contract between two parties. See event of default.

Credit exposure The amount of receivable or payable on a contract, consisting of current exposure and potential exposure.

Credit provider An entity that has extended credit to another and that holds itself out as being in the business of making credit available to other entities.

Credit risk The degree of uncertainty surrounding a counterparty’s ability to fulfill its contractual obligations. It encompasses both the probability of loss and the probable size of the loss net of recoveries and collateral.

Credit user The client or counterparty of a credit provider.

Cross-default provision Contractual terms between two parties specifying that a default by one of the parties on its obligations to a third party will be treated as a default between the two parties to the contract. For example, a contract between A and B provides that a default by B against C will be treated as if it were a default by B against A.

Current exposure The amount of receivable or payable on a contract; the simplest measure of current exposure is current mark-to-market value.

Delivery versus payment (DVP) Settlement in which cash payment occurs at the same time as delivery of a purchased instrument.

Disclosure Information that an entity makes available to the public.

Economic capital Amount available to absorb losses. In the context of credit risk, providing protection up to a specified probability of insolvency (e.g., probability of insolvency of an AA-rated firm). Also called risk capital.
Event of default An occurrence, defined in a master agreement, that entitles the non-defaulting party to terminate all transactions covered by the agreement. Cf. termination event.

Exception A decision by senior management to waive or delay the application of certain policies to a specific transaction or counterparty, even though the policies would normally apply to similar situations.

Exemption A decision by senior management to release an activity, transaction, or counterparty from the obligation to comply with certain policies.

Expected loss The amount a firm can expect to lose in an average year on a transaction or portfolio over a period of time. In its simplest form, expected loss is equal to the probability of loss times the exposure net of recovery.

Financial intermediary (FI) An entity that is in the business of bringing together providers and users of financial resources and managing the associated risks.

Information sharing The exchange of information between two private counterparties to facilitate credit decision-making.

Leverage The amplification of return (positive or negative) that occurs when a party takes on exposure that is not completely funded by the party’s own equity. Leverage can exist when: (a) financial assets exceed capital; (b) the change in value of a position can exceed the amount paid for it; or (c) a position’s price volatility exceeds that of the underlying market factor (embedded leverage).

Liquidation exposure Current exposure adjusted for the expected realizable value of collateral and liquidity-adjusted contract replacement cost.

Liquidity The ability to raise cash easily, with minimal delay and little or no loss of capital. Asset market liquidity is the ability to transact business in necessary volumes without unduly moving market prices. Funding liquidity is the ability of an entity to fund its positions and meet, when due, the cash and collateral demands of counterparties, credit providers, and investors.

Loss Method One of the alternative measures of damages under a master agreement. The Loss Method assigns values to terminated transactions based on a party’s good faith determination of the amount it lost or gained as a result of the termination. Loss does not require that a determining party obtain quotations from other dealers to calculate termination value. Cf. Market Quotation Method.

Mark-to-market value The most recent price at which a firm could buy or sell a financial instrument in normal size. Mark-to-market value might equal current market value or present value of expected cash flows.

Market Quotation Method One of the alternative measures of damages under the ISDA Master Agreement. The Market Quotation Method assigns values to terminated transactions based upon quotations from other dealers for replacement transactions.

Master agreement An agreement between two counterparties that specifies many of the terms of transactions they will conduct with each other subject to the agreement.

Master-master agreement An agreement pursuant to which two parties agree to net out the termination values determined under other master agreements in order to net all offsetting exposures between the two parties.
Net asset value (NAV) The market value of an investment fund’s assets minus the market value of its liabilities; NAV per share divides NAV by number of shares outstanding.

Netting Combining offsetting obligations between two or more parties in order to reduce them to a single net payment or receipt for each party. Close-out netting combines offsetting credit exposures between two parties under a master agreement. Cross-product netting allows positive and negative mark-to-market values to offset each other across trades in different financial instruments. Collateral netting combines exposures subject to collateral under a master agreement. Payment netting is the process of reducing all payments due on the same date and in the same currency to a single net payment.

Non-deliverable forward (NDF) contract A synthetic currency forward contract that does not involve actual delivery of both currencies. Instead, the parties settle any appreciation or depreciation in a currency by means of a compensating net payment in terms of the fully convertible currency. NDFs are typically used to hedge currencies for which local forward markets do not exist or to which access by foreign entities is restricted.

Potential exposure An estimate of the additional receivable or payable beyond current replacement cost over the life of a contract; also called potential future exposure (PFE). Expected future exposure (EE) is an estimate of the average of non-negative market values over the remaining life of a transaction. Potential peak exposure (PE) is a statistical estimate of the maximum exposure over the remaining life of a transaction based on a specific confidence interval.

Regular-way trades Transactions that settle within timeframes that are normal for a specific contract.

Replacement value Current exposure adjusted to reflect the cost of replacing a defaulted contract; also called replacement cost. Replacement value normally is equal to the mark-to-market value of a transaction calculated at either the bid or offer side of the market, depending on where the non-defaulting party would be able to obtain a replacement transaction, plus any adjustment for illiquidity in the markets for the underlying or for pledged collateral.

Set-off In a termination or liquidation, the practice of allowing obligations under a master agreement and those not covered by the agreement to offset each other.

Stress test A simulation of the potential loss to a portfolio resulting from a hypothetical extreme market event or credit event or both.

Termination event An occurrence, defined in a master agreement, that entitles one party to the agreement to terminate transactions, prior to their scheduled maturity, that are covered by the agreement and affected by the event (cf. event of default). In a termination, one party pays the mark-to-market value of the contract to the other, in exchange for which the contract is extinguished.

Transparency The availability of reliable, timely, and easily understood information regarding an entity’s financial condition and performance, business activities, risk profile, and risk management practices.

Unexpected loss A measure of the range of possible losses on a contract or portfolio beyond the expected loss.

Unwind A negotiated cancellation of a contract prior to its scheduled maturity. Unwind can take the form of termination, assignment of rights and obligations under the contract, or entering into an offsetting contract.
Value at Risk (VaR)  A statistical estimate of the potential mark-to-market loss to a trading position or portfolio from an adverse market move over a given time horizon (holding period). VaR reflects a selected confidence level, so actual losses during a period are not expected to exceed the estimate more than a pre-specified number of times.

Wrong-way risk  Correlation between potential exposure of a contract and the probability of counterparty default.

Abbreviations used in report:

BBA               British Bankers Association
EMTA             Emerging Market Traders Association
FEOMA            Foreign Exchange Options Master Agreement
FMLG             Financial Markets Lawyers Group
FXG              Foreign Exchange Group
GMRA             Global Master Repurchase Agreement
IBMMA            International Bond Markets Association
ISDA             International Swaps and Derivatives Association
ISMA             International Securities Markets Association
PSA              Public Securities Association (now IBMA)
TBMA             The Bond Market Association