GARP | Global Association of Risk Professionals

September 21, 2016

Secretariat of the Financial Stabiliy Board
Financial Stability Board
c/o Bank for International Settlements
CH – 4002 Basel
Switzerland

Re: Consultative Document for Proposed Policy Recommendations to Address Structural Vulnerabilities for Asset Management Activities (Consultative Document)

Dear Sir or Madam:

The membership of the Global Association of Risk Professionals (GARP) includes a large number of individual risk managers[1] who work in asset management organizations and who deal every day with the issues raised in the Consultative Document. As an education-based organization, GARP does not engage in lobbying related or consulting activities. As such, we are not submitting this letter in support of, or against any proposed recommendation, nor are we making specific recommendations to address possible structural vulnerabilities in asset management.

The comments included herein were developed by the GARP Buy Side Risk Managers Forum Leverage Committee (Committee)[2] and represent the collective knowledge of over 30 asset management risk management professionals from 19 different asset management firms. The individuals that participated on the committee presented their personal views in the course of developing this paper, which may not necessarily be the views of their firms. Our members' firms may comment on the specifics of the Consultative Document separately.

In the course of discussing calculation methodologies for various measures of leverage as discussed in full in the detailed paper attached to this letter, as well as the strengths and limitations of each, the Committee found itself coming back to several key observations and insights that are worthwhile for consideration by risk managers and regulators alike.

For starters, the idea of leverage is intuitive to most – leverage is a magnification of a security or portfolio of securities relative to some baseline (unlevered portfolio). Leverage can be used to magnify risk and/or to achieve a higher or different type of return than is possible on an unleveraged basis. Leverage can be obtained through borrowing, the use of derivatives, or in some cases through the embedded characteristics of portfolio holdings themselves.

[1] GARP's membership consists of individuals in their individual capacity only, it does not have corporations or other entities as members.
[2] Individuals from the following asset management firms participated on the committee: TIAA CREF, Alliance Bernstein, AQR, Barings, BlackRock, Deutsche Asset Management, Dreyfus, BNY Mellon, JP Morgan Asset Management, Lazard, MFS, Neuberger Berman, Nuveen, Oppenheimer Funds, Putnam, T. Rowe Price, Vanguard, Wells Fargo, and Western Asset Management.

Unfortunately, straightforward intuition does not translate into simple or uniform measures of leverage that appropriately capture the risks associated with leverage for all portfolios. This situation stems from a number of challenges when looking at leverage in asset management portfolios, most notably:

1. *Individual measures of leverage, when used in isolation, lack context*. Regardless of calculation method, the amount of leverage in a portfolio is often referenced in a standard way; for example “leverage of 2x” or “the portfolio is levered 2 times”. The question that needs to be asked about this standard reference is 2 times what? Without context of what the baseline is, it is impossible to discern the implications of leverage or whether leverage results in an overly risky portfolio. In other words, the baseline (or unlevered portfolio) against which leverage is measured is important and the fact that some baselines are more risky than others needs to be considered.

2. *Investment strategies employed by asset managers are not homogenous*. Unlike in the banking context, where there is some level of consistency among the risks to which a bank is subject allowing measures of leverage to be somewhat comparable across banks, this is simply not the case for asset management portfolios. As demonstrated by the fact that members of the Committee look after hundreds of different investment strategies, including completely different asset classes (i.e., fixed income, equities, alternatives – with significant variation in each category), the risks to which asset management portfolios may be subject vary widely. As a result, there is no standard baseline that is sensible for all investment strategies or portfolios.

3. *There is no single measure of leverage that can accurately capture all the potential risks associated with leverage.* Leverage can magnify or add a number of risks to a portfolio. In this paper, we will focus on three categories of risk associated with leverage: (i) market risk, (ii) credit risk, and (iii) other operational (non-economic) risks. Each of the methods reviewed in this paper captures some of these risks, but misses others. Not all forms of leverage create all three risks, making it important to identify which risks one is interesting in analyzing, in order to determine the measures of leverage that are appropriate.

While leverage and risk are not the same thing, the above discussion highlights the interaction between leverage and risk. From the asset management risk manager’s perspective, this interaction is very significant because it provides the context necessary to discern whether the use of leverage is in line with the portfolio’s risk tolerances or parameters.

This brings us to a second key insight of the paper, which is that measures of leverage are most informative when considered alongside measures of potential loss. A key responsibility of risk managers is to assess potential losses that could arise from the investment strategies used to generate returns, including the use of leverage, and to ensure that potential losses do not exceed client risk tolerances or expectations. Looking at measures of leverage in isolation is not sufficient to analyze the potential losses to the portfolio that could arise as a result of leverage or other components of the investment strategy. In this regard, the use of risk measures including both absolute and relative value-at-risk (VaR), as well as stress testing, can be quite informative and provide a more holistic view of potential losses to which a portfolio may be subject.

GARP Leverage Letter in Response to Referenced Consultative Document

The chart below summarizes the measures of leverage reviewed in this letter. The quick message is that the best systems combine a notional-based leverage measure with a risk-based one in order to get the best coverage of all three risks. If a single measure has to be chosen, only potential loss measures (like VaR or stress testing) alongside leverage measures function for all three types of risk.

Summary of Measures of Leverage and Risk

	Market	**Credit**	**Operational**
Gross notional	None	None	Better
Risk-adjusted gross notional	Good	None	Best
Economic leverage	Better	None	Good
Accounting leverage	None	Good	None
Measures of potential loss alongside measures of leverage	Best	Best	Best

In sum, all measures of leverage have at least some limitations, no one measure of leverage captures all the risks, and measures of leverage are best paired with potential loss measures in order to have meaning and context. The Committee highlights four key conclusions from its exploration of leverage in investment portfolios:

1. When used in isolation without consistent adjustment for risk, individual measures of leverage do not provide a meaningful indication of the risk associated with the use of leverage for the vast majority of portfolios.
2. Measures of leverage when reviewed alongside measures of risk provide a more complete picture of the risks associated with a portfolio's use of leverage.
3. All measures of leverage have at least some limitations for at least some investment strategies.
4. There is a spectrum of leverage measures that adjust or correct for limitations of other measures of leverage. This contributes to the substantial variation in measures of leverage employed by risk managers across the industry based on the nature of the portfolios and investment strategies for which they are responsible.

This collaborative effort among risk managers and practitioners across the asset management industry demonstrates that, while there is certainly room for improvement with respect to existing and proposed regulatory measures of leverage, there is also a level of complexity to this topic for which there is simply no substitute for informed judgement and discretion on the part of risk managers.

We want to thank you for allowing us this opportunity to comment on this issue. Should you require any additional information, or have any inquiries, please feel free to contact me at: Rich.Apostolik@garp.com, or +1 201 719-7250.

Yours Truly,

/s/ Richard Apostolik
President and CEO

GARP Detailed Response to Consultative Document for Proposed Policy Recommendations to Address Structural Vulnerabilities for Asset Management Activities (Consultative Document)

Introduction

This letter focuses specifically on the use of leverage by investment funds. The Consultative Document indicates that the FSB is interested in better understanding the use of leverage by investment funds and developing methodologies to measure leverage. This letter responds to that request. In addition, we have recently observed several other regulatory bodies around the world reviewing leverage-related issues in their individual jurisdictions.[3]

Considering the above, we believe that this collective of GARP members, working in asset management firms that collectively manage over $6 trillion in assets, and who work daily in a global and interconnected marketplace managing the risks associated with their client's assets, can provide an important contribution to this dialogue about measuring and monitoring leverage in the funds managed by their firms by exploring the various existing methodologies that risk managers use.

Risk Management Principles for Measuring Leverage in Investment Funds

The GARP Buy Side Risk Managers Forum began its work on leverage earlier this year when it submitted a letter to the Securities and Exchange Commission ("SEC") dated March 21, 2016, which objectively laid out eleven universally accepted risk management principles related to the use of derivatives and leverage by retail investment funds.[4]

The eleven principles described in that letter are as follows:

1. When vanilla derivatives are used to gain market exposure, all means of gaining the market exposure should be treated equally.
2. When vanilla derivatives are used to hedge positions, the hedge should be evaluated at the position level, not the portfolio level.
3. When vanilla derivatives are used to adjust market exposure, the risk should be evaluated on an absolute basis, not relative to a portfolio without derivatives.
4. Dual purpose risk regulations can lead to unnecessary complexity and pro forma compliance.
5. Liquidity and potential derivative losses are portfolio concepts and should not be regulated at the position level.
6. Derivatives, financial commitment transactions and senior securities should be treated similarly to avoid regulatory distortion of the risk manager's judgment.
7. Risk-based amount calculations need further specifications in terms of time and likelihood.

3 https://www.treasury.gov/initiatives/fsoc/news/Documents/FSOC%20Update%20on%20Review%20of%20Asset%20Management%20Products%20and%20Activities.pdf; https://www.sec.gov/rules/proposed/2015/ic-31933.pdf

4 https://www.sec.gov/comments/s7-24-15/s72415-104.pdf

8. Portfolio liquidity is what matters, not cash.
9. Leverage need not multiply exposures, and exposures can be multiplied without leverage.
10. Gross notional exposure (GNE) is not leverage.
11. Leverage limits should be risk based.

While these principles were developed in the context of the SEC's Proposed Rule: "Use of Derivatives by Registered Investment Companies and Business Development Companies", and were, therefore, specific to the regulatory framework for US registered mutual funds, the principles have relevance for a broad range of portfolios beyond US mutual funds. As such, we view our comments in this letter as an extension of our previous work.

In this paper, we explore in detail a variety of leverage calculation methodologies with examples of how these methodologies might be applied to a variety of portfolios following different investment strategies. In addition, we discuss the conceptual and theoretical foundation upon which various measures of leverage are based.

We do not seek to make specific recommendations with respect to what the FSB or other regulators should or should not do. Instead, in the course of discussing the content of this letter, the group made several observations with respect to leverage in the asset management context that are worthwhile to highlight. These insights are noted below, and are expanded upon throughout the letter:

1. When used in isolation, individual measures of leverage do not provide a meaningful indication of the risk associated with the use of leverage for the vast majority of portfolios.
2. Measures of leverage when reviewed alongside measures of risk provide a more complete picture of the risks associated with a portfolio's use of leverage.
3. All measures of leverage have at least some limitations for at least some investment strategies.
4. There is a spectrum of leverage measures that adjust or correct for limitations of other measures of leverage. This contributes to the substantial variation in measures of leverage employed by risk managers across the industry based on the nature of the portfolios and investment strategies for which they are responsible.

In sum, all measures of leverage have at least some limitations, no one measure of leverage captures all the risks, and measures of leverage are best paired with potential loss measures in order to have meaning and context.

Leverage and Risk

Discussions of leverage are necessarily linked to discussions of risk. In other words, when we think about leverage, we are generally less concerned about the leverage itself and more concerned about the potential ramifications of that leverage to the risk profile of the fund.

The need to be concerned with risk stems directly from the fiduciary responsibility that comes with managing other peoples' money. This requires risk managers and portfolio managers to think carefully about the risks they are taking and ensure that those risks are in line with client expectations. From a regulatory perspective, the FSB and other regulators rightfully extend their concerns about leverage to include not just the risks associated with individual funds and investors, but also to the potential risks leverage may present to the financial system as a whole.

That said, while leverage necessarily leads to a discussion of risk, *risk and leverage are not the same thing*. And, risk can present itself in multiple forms. As such, it is important to be precise about what risks we are concerned about in order to determine which measures of leverage and/or risk would be helpful in studying a given risk.

What is Leverage?

Commonly used both as a noun and a verb, 'leverage' represents a magnification of some characteristic of a security, set of securities or a portfolio. Risk leverage generally describes the magnification of risk attributes (e.g. volatility, which is a measure of dispersion of portfolio outcomes, or tracking error, which is a measure of dispersion around a benchmark), generally to achieve a higher or different type of return than is possible on an unleveraged basis.

Given the definition of the term 'leverage' as a magnification of risk characteristics, the measurement of leverage requires identification of the risk characteristics to be magnified and of the standard baseline portfolio to be used.

Leverage Creation Techniques

There are a range of techniques with which we can create risk leverage. These techniques generally fall within one of three categories, which can create additional risk to a security or portfolio:

1) **"true borrowing"** (external leverage) of funds from a financial counterparty to purchase additional assets and risk beyond the baseline, that appear as a liability on the balance sheet (E.g., fund borrows $100 to purchase $100 in equities. The $100 in borrowed funds is carried as a liability on the balance sheet, with the $100 in equities listed as an asset. (See Example 1 below.);
2) **"security leverage"** (external leverage) which generally comes from the use of derivatives (swaps, futures, options, etc.), whose returns are 'derived' from easily-available reference data, securities or indexes; and
3) **"internal leverage"** created within a security or within a portfolio without the use of derivatives or borrowing. (E.g., using an inverse floater where the portfolio purchases a bond whose coupon rate acts inversely to the benchmark rate and its maturity masks its true duration. If the interest rate increases the coupon payment will go down as the interest rate is deducted from the coupon rate).

Internal leverage is sometimes known as 'embedded' leverage, while 'external' leverage may be known as 'contractual' leverage due to the contractual requirements used in the engagement of counterparties in derivative and funding transactions.

Ways to Assess the Use of Leverage

- **Context:** The <u>context within which leverage is used is important to understand</u>, as multiple uses of leverage in different situations may be difficult to reconcile. For example, a highly-leveraged fixed income portfolio may be less risky than an unleveraged equity portfolio. Or the fixed income portfolio's returns may be magnified (leveraged) when compared against a specific unleveraged baseline portfolio of fixed income securities. As such, for a given situation, the characteristics of a selected 'baseline' portfolio or security are the standard against which portfolio or security leverage is to be measured.

- **Magnification**: Applications of leverage to a portfolio may magnify that portfolio's risk characteristics such as volatility, value-at-risk (a measure of potential loss over a given time horizon at a given confidence level) or tracking error, relative to a baseline measure (e.g., an unleveraged index, custom benchmark or model portfolio, or a set of specified baseline characteristics). Given this understanding, we reference the amount of leverage contained within a portfolio in a standard way: 1x, 2x, 3x portfolio leverage *versus the baseline* to reflect the magnification of risk and potential return versus the baseline. And, the *amount* of leverage or magnification employed may be calculated as the difference between one or more risk characteristics of a security or a portfolio and its baseline.

- **Risk Character:** The risk properties exposed via leverage taken is a very important choice and consideration. For example, using leverage to magnify small-cap equity risk differs greatly in its distribution characteristics (such as volatility) from using leverage to magnify 10yr Treasury risk, even if the amount of leverage is similar.

- **Directionality**: Leverage can result in either a positive or negative magnification of risk. For example, the inclusion of "risk-free" securities in a portfolio designed to fully reflect a risky fully-invested benchmark may be regarded as an addition of negative leverage to the portfolio relative to that benchmark. Managers may also use the addition of short Treasury futures positions into a fixed income portfolio to 'de-lever' (or hedge) a portfolio's sensitivity to Treasury rate volatility relative to its benchmark's sensitivity to that volatility.

Leverage Types

'External' leverage involves the creation of leverage through the use of facilities or instruments external to a security or portfolio. One or all of a portfolio's characteristics may be leveraged via the addition of derivative securities added to a portfolio ("security leverage") or through direct funding of additional cash securities through borrowing or the issuance of debt ("true borrowing"). A security's characteristics can also be leveraged with the addition of an associated derivative or funding transaction used to purchase more of the security.

- Note: While other derivatives or other non-cash synthetic sources of risk may be used to create leverage, not all derivatives use creates leverage in a portfolio**.** For example, the use of synthetic replication techniques to construct a specific security may not be leverage if the replica is very close to the intended security baseline.

Example 1: External Leverage Examples

Unlevered portfolio:
Portfolio owns $100 of U.S. bonds, no borrowing: $100 in portfolio equity

Security leverage:
Portfolio owns $99 of U.S. bonds, $1 in cash encumbered as margin, long bond futures contracts with notional value of $10: $100 in portfolio equity

True borrowing:
Portfolio owns $110 of U.S. bonds, borrows $10; $100 in portfolio equity

Single security leverage:
Portfolio owns $99 or U.S. bonds, $1 in cash encumbered as margin, long a total return swap on Bond A with notional value of $10; $100 in portfolio equity

Internal leverage may be created within a security or within a portfolio without the use of derivatives or borrowing. For example, a structured mortgage tranche may be thought of as employing leverage to magnify mortgage risk relative to simple pass-through securities[5]. The tranche requires no external leverage to achieve this, i.e., securitization rules are used to create a magnification of mortgage pass-through P&I within the security.

Portfolios may also employ leverage relative to their benchmarks' characteristics through the use of portfolio construction techniques resulting in long or short sector or factor exposures versus the benchmark, without the use of derivatives or funding.

Example 2: Amplified Relative to a Benchmark

Bond Fund A: This fund's benchmark has a duration of 3 years, and only 10% of its securities are rated lower than single A. The fund has a duration of 6 years, and holds 30% in securities rated lower than single A. Both choices have amplified the risk of Fund A with respect to its benchmark.

Equity Fund B: This fund's benchmark is a U.S. Large Cap Value-oriented benchmark. It has invested 25% of the portfolio in U.S. Small-Cap stocks with a growth tilt, and 5% in emerging market stocks. Both choices have amplified the risk of Fund B with respect to its benchmark.

[5] This security might, as an example, bear twice the potential maximum level of credit losses relative to another tranche in the same securitization, thereby levering its exposure to credit risk two times vs the comparison tranche.

Some Benefits and Dangers of Leverage

As noted above, leverage or 'leveraging' has many different facets. Leverage expands the potential set of return outcomes for a portfolio or security and therefore their risk, which takes account of such dispersion, for a portfolio or security. However, leverage, if used appropriately, can reduce risks, trading costs and materially increase the efficiency of markets by allowing market participants to focus their positioning on a significantly larger variety of perceived market opportunities.

But the many facets of leverage and its implementations (both embedded and contractual) can also be problematic when managed inappropriately. For example, the 'netting' of derivative exposures across counterparties may create unintentional increased risk due to the addition of credit risk from each counterparty. And, further, the use of leverage can magnify small nonlinearities in risk characteristics into significant contributors to risk in portfolios during stressful periods. The terms and conditions of the leverage itself can add risks to the portfolio – such as long-term, fixed rate borrowings. The components of contractual leverage, e.g., collateral pools, counterparties, among others, and the need for these components' management and renewal in the financial markets may bring unintended risks to the portfolio.

The task of the risk manager is to understand the forms of amplification and how each form impacts the risk assessment of the security, set of securities or portfolio. A lack of understanding of leverage can lead to losses that are out of line with clients' expectations and/or the portfolio manager's intent, possibly caused by, among other things, a reasonable market move whose effect is unexpectedly amplified by leverage or by operational concerns, such as cash management or counterparty risks.

Measurement of Exposure and Leverage

Definitions Associated with Leverage Use

Before we examine the effects of leverage on risk levels, other definitions associated with the use of 'leverage' are required.

An **'exposure'** is defined as a characteristic of a security or portfolio which represents a sensitivity to a financial stimulus, such as a change in the market environment. This exposure to a change in the market results in changes to one or more different security or portfolio characteristics.

Example 3: Duration Exposure

The '**duration**' exposure of a portfolio is simply defined as a sensitivity of percentage changes in the portfolio market value to changes in interest rates (typically, risk-free interest rates). Because of this exposure, a change in rates will drive a change in market value, another characteristic of the portfolio. The magnitude of this percentage market value change is dependent on the magnitude of the change in the environment (rates) and the level of sensitivity of the portfolio. We refer to this sensitivity level as the **'size'** of the exposure.

The change in rates is a '**driver**' of the percentage market value change due to this exposure. If the changes to portfolio or security market value resulting from sensitivities to variable market drivers (rate volatility for example) represent the potential for variable portfolio outcomes (represented as a distribution of portfolio market value gains and losses), or amount of 'risk', these characteristics are called **'risk characteristics'**, and the drivers are called '**risk drivers**'.

A metric which describes the size of a portfolio exposure is called an '**exposure measure**'. Given that leverage represents a magnification of one or more portfolio or security characteristics, the application of leverage results in an increase (or decrease) in an exposure measure for a portfolio or security.

Example 4: Exposure Measure

A portfolio might experience a 2% change in market value for a + 100bp change in 2 year rates. If leverage is used to double the size of this exposure, the portfolio will sustain a 4% change in market value for the same change in 2 year rates.

Commensurate with a change in exposure measure is a change in the sensitivity of percentage change in the portfolio market value to a given driver, a change in the potential variation of percentage changes of portfolio market value driven by 2yr rate volatility, and thus a change in risk level.

A magnification of the size of an exposure due to an application of leverage represents the amount of leverage used. In Example 4 above, 2x leverage of the 2yr duration exposure was applied according to a convention which calculates the magnification as the size of the magnified (or leveraged) exposure divided by the unmagnified (or unleveraged) exposure. A given leverage measure describes the magnification of a particular portfolio exposure due to leverage, e.g., '2yr duration leverage'. Duration leverage describes the amount of magnification of the duration characteristic of a portfolio due to leverage.

Given the many different types and sensitivities of portfolio exposures (beta, duration, a specific security's price, among others) and the presence of their drivers (for example, price volatility of a reference security or portfolio, rate volatility), the creation of, for example, beta leverage, duration leverage, results in a complex and magnified distribution of portfolio outcomes.

A risk manager may study risk within the body of the resulting portfolio gain/loss distribution or in the tails of that distribution where the type of leverage may result in counter-intuitive outcomes. The choice of exposures to leverage and the exposures' associated risk drivers influences the risk manager's approach to the assessment of risk due to that leverage.

Gross Notional Amount and Leverage

Gross Notional Amount is a measure of the representative amount of a security or portfolio. The ambiguity associated with defining the 'representative amount' underlies the challenges in using gross notional amount as an exposure measure driven by risk drivers to create risk. For example, there are challenges to defining the drivers and their sensitivities as they relate to the gross notional amount.

Also, questions remain as to what risks result in the application of those drivers, the leverage applied to the gross notional amount and how the magnification of that exposure affects the portfolio's risk.

Absent any information about the sensitivity of the gross notional amount to various risk drivers, the use of gross notional amount as an exposure measure to which leverage can be applied (e.g. to create 0.5x, 2x, 3x gross notional amount leverage, per our definitions above) and from which portfolio risk due to multiple risk drivers can be calculated is extremely limited to portfolios of securities with the same assumed sensitivity to a given driver, i.e., it is only appropriate when comparing similar portfolios within a homogenous asset class.

Example 5: Portfolio Leverage Using Simple Gross Notional Amount Exposure

For long-only stock portfolios it is meaningful to say that a portfolio with $100 of stock has a gross notional exposure of $100, that is, that it owns $100 of stocks. That represents the maximum amount of money it could lose, the amount of assets that must be traded to liquidate, and the exposure of the portfolio to market movements. The gross notional amount exposure measure contains no information about the sensitivity of the portfolio to any risk drivers (except to changes in the stock's spot price). Therefore, an analysis of the risk of this unleveraged portfolio using gross notional amount as the risk exposure is limited to an analysis of the price risk of the stock involved. The application of gross notional leverage resulting in a multiple of the original portfolio exposure magnifies risk level of the portfolio. The increase in sensitivity in this case is linear: 2x the stock portfolio's gross notional leverage results in 2x the risk level of the portfolio, as evaluated via changes in the portfolio's stock spot price.

Example 6: Portfolio Leverage Example Using Adjusted Gross Notional Exposure

Working with the above unleveraged stock portfolio of $100, the addition of the stock B gross notional amount adds a new dimension to the original stock portfolio risk analysis. The Stock B gross notional amount represents a sensitivity to a different risk driver from stock A. stock B may have zero sensitivity to changes in the stock A spot price, and vice versa. And, most importantly, the additional gross notional amount of stock B may be added through 1) the purchase of $50 of stock B by selling some or all of stock A and reducing stock A's gross notional amount, or 2) through the addition of $50 of stock B's gross notional amount via a non-cash derivative based on stock B's gross notional amount or borrowing of funds to purchase stock B via the use of debt, both of which do not require the addition of equity capital to the portfolio.

In 1), the sale of stock A represents an application of 'negative leverage' resulting in stock A's gross notional leverage of 0.5x (relative to the original portfolio) or $50. The purchase of stock B represents the establishment of a 'baseline' stock B gross notional amount in the new portfolio – stock B gross notional leverage is 1x, at $50. Although the total gross notional of the portfolio is equal to the original portfolio, the risk of the portfolio has changed due to the different sensitivities of the stock A and stock B gross notional amounts. *Without taking into account these differences, total gross notional amount by itself cannot be used to distinguish the portfolio risk of the original portfolio from the one with both stocks A and B*. Also note that the amount of stock A gross notional leverage is different from the amount of stock B gross notional leverage (relative to the original stock A portfolio), even though the amount of gross notional exposure in each stock is the same.

In 2), the use of a stock B gross notional derivative establishes a 'baseline' stock B gross notional amount in the new portfolio, with stock B gross notional leverage of 1x. However, the total gross notional amount has increased from $100 to $150, and thus the total gross notional leverage is 1.5x. Similarly to 1), without knowledge of the sensitivities of the stock A and stock B gross notional amount, the overall change to total gross notional amount does not allow for the calculation of portfolio risk. When a full specification of stock A and stock B gross notional amount sensitivities and identification of risk drivers are given, a more detailed portfolio risk analysis may be created.

Complex Portfolios: *For more complex portfolios, standing alone, a gross notional leverage metric is not meaningful.* The more heterogeneous the portfolio—whether in blending different asset classes, or blending fixed income instruments of different maturities-- the more complex it becomes, and the less its risk relates to a gross notional measure. For example, two portfolios with equal gross notional leverage may respond to market volatility in very different ways. Because a simple gross notional leverage metric measures the leverage of assets of widely differing riskiness equally, and does not consider whether the portfolio's characteristics are magnified in the same or opposite directions, using a simple gross notional metric can result in a misleading leverage assessment. Also, a simple gross notional leverage does not say anything about how leverage is obtained, rendering its use invalid for evaluating the take-on of credit risk in certain leverage implementations.

An asset class for which unadjusted gross notional measures are particularly misleading are short term fixed income portfolios, as shown in Example 7.

Example 7: Gross Notional Measures for Similar Fixed Income Portfolios

Portfolio 1: Owns $100 in 5 year government bonds, goes short $20 notional in 5 year government futures. Gross notional exposure: $120. Duration exposure 3.8 years

Portfolio 2: Owns $100 in 5 year government bonds, goes short $400 notional in 3 month LIBOR futures. Gross notional exposure: $500. Duration exposure 3.8 years

These portfolios are relatively similar in terms of their exposure to rising rates—but their leverage measures differ because portfolio 2 has used particularly low sensitive instruments as its interest rate hedge and, therefore, needs to use more of them than portfolio 1 in order to achieve the same reduction of interest rate sensitivity.

Measurement of Derivatives Gross Notional Amount: Gross notional is measured by adding the value of cash securities to the absolute notional value of derivative products. This is complicated by the fact that the notional amount is not defined in a meaningful way for many derivatives. For example, with cash assets the notional amount represents the amount of the asset owned. But, for some derivatives the notional amount is the theoretical amount of an asset or assets used to create the derivative exposure, which may be significantly different from the economic exposure of the derivative.

The following are examples where the notional amount of a derivative can be significantly different from the derivative exposure which creates the leverage.

- Fixed for Floating Swap: Quantitatively, one of the most important examples is in fixed-income derivatives. Consider a three-year fixed for floating swap with $1,000,000[6] notional. This is not a swap on $1,000,000, but on three years of net interest payments on $1,000,000; representing something more like $50,000. Recognizing the inconsistency of a simple gross notional calculation for fixed-income derivatives of this nature, which are among the most popular and useful derivatives, would vastly overstate the gross notional calculations and lead to misleading unadjusted gross notional leverage metrics in many portfolios[7].
- Total return swaps: The notional of the swap typically reflects the notional of the underlying economic asset.
- Duration adjusted fixed-income securities: Fixed-income instruments can be duration-adjusted. A $200,000 CME two-year treasury future has very similar risk profile to a $100,000 CME five-year treasury future. Their margin requirements are about the same, as are their volatilities and tail risks, and the two are highly correlated. However, since the two-year future has twice the gross notional amount of the five year, the gross notional amount measure is misleading as a measure of risk associated with the exposure.

[6] Examples throughout this document refer to "dollars" and use the currency symbol "$" for simplicity; all examples are extensible to other currencies.
[7] It should be noted that this is equivalent to borrowing $1 million in 3 month LIBOR based borrowing, and investing $1million in 2-year fixed rate bonds.

Below are additional examples which relate to the complexity of the portfolio and in which the theoretical notional amount of an asset can change due to market factors or whether a portfolio has bought or sold the derivative.

- Credit Default Swaps create derivative exposures where the notional amount may vary depending on which side of the trade you're on. If you sell $100 of five-year credit protection at 50 basis points, it makes sense to define the notional amount to be $100. That's the maximum amount you might have to pay under the contract. However, the buyer of that protection also cannot pay more than $2.50, so the $100 notional amount overstates the risk.
- A call option represents the appreciation over the strike price of a given amount of underlying assets, but has a notional amount which equal to the full value of the underlying assets. A delta-adjustment of the notional amount of the derivative would more precisely represent the change in notional exposure of the derivative as the underlying asset value approaches the strike price.
- For exotic instruments, such as variance swaps, there is no theoretical underlying asset and thus no definition of gross notional amount that is comparable to what may be defined as the notional amounts of simple assets like stocks or bonds.

Other Considerations: While duration, beta and similar adjustments can improve the accuracy of gross notional exposure calculations, the exposure calculation will inherently rely on assumptions about the relationship between the theoretical asset and the derivative exposure created which can create complications as it relates to gross notional metrics. The relationship assumptions can change in unexpected ways in stress environments. For instance, if the U.S. government were to default on debt payments, the $200,000 two-year Treasury Note future described above may have twice the exposure of the $100,000 five-year future. Also, with regard to options transactions, option deltas can change suddenly in crises.

Currency Risk: Currency risk and currency hedging pose a particular challenge for gross notional principal measures. An international equity fund has full exposure to international equity prices, and full exposure to currency rates. If its investors want to eliminate currency risk, the portfolio manager will typically sell currency forward contracts covering 100% of the portfolio's net assets. If there are no adjustments made in the leverage measure for hedging, the portfolio will appear 2x levered, when instead it has reduced the risk of the original investment portfolio substantially.

Accounting Exposures and Leverage

Accounting leverage is defined to be total assets divided by total assets minus total liabilities.

Accounting impacts of derivatives are contingent on exercise or delivery in addition to mark to market valuation. Until those contingencies are realized, only the mark to market valuation of the contract affects the balance sheet. This makes accounting leverage measures state dependent. They provide little insight into the future risk or leverage of the entity. Accounting leverage works reasonably well for assets financed with cash borrowing.

Example 8: Accounting Leverage

Start with $100 in cash:

- Buy $100 in 5-year Treasury Notes. Assets = $100, Liabilities = $0, Accounting leverage is 1 to 1.
- Buy $200 in 5-year Treasury Notes, borrowing $100. Assets = $200, Liabilities =$100, Accounting Leverage is 2 to 1. For strategies of borrowing cash and investing in cash assets, accounting leverage does a reasonably good job of telling the total leverage, *but does not accurately describe the market, credit or operational risk*.
- Buy $100 in 5-year Treasury Notes, go long $100 notional of 5-year Treasury futures. Assets = $100, liabilities = 0, Accounting Leverage is 1 to 1. (We ignore margin deposits and assume no market movement, meaning no P&L on the futures contract). *When derivatives are used to gain leverage, accounting leverage does a poor job of measuring leverage, in addition to its shortcomings in capturing market, credit and operational risk.*
- Buy $100 in 5-year Treasury Notes and pay the fixed rate on $100 of 5-year interest rate swap. Bond markets rise, increasing the value of 5-year bonds by 5% and creating $5 of negative mark-to-market (a liability) on the swap. Assets = $105, Liabilities = $5, Accounting Leverage is 1.05. In this case, the leverage measure gives some insight that the swap's mark-to-market has increased leverage, *but no forward looking insight into how the exposure created by the swap could create additional changes in market value, and no insight into credit, market or operational risk*.

Leverage and Economic Exposures

Another means of measuring leverage is to convert all non-leverage and leverage exposures into equivalent exposures related to economic risk factors like interest rates, equities, commodity prices and so on, i.e., economic leverage. Economic leverage can be defined as a comprehensive measure of the magnification of economic exposure obtained from the use of leverage that: 1) incorporates borrowings and derivatives; and is 2) risk-based and, ideally, consistent globally (across products and jurisdictions).

A transformation into economic risk factor exposures of cash assets, derivatives and other leverage sources creates consistent economically-equivalent exposures across these assets which support a consistent calculation of the magnification of these exposures, or economic leverage.

As stated above, economic leverage measurement is based on the transformation of the investments made to create leverage into the same economic exposures as the initial portfolio or security. This transformation should encompass (1) the risk factor distribution properties (proxied via volatilities of and correlation across factors) and (2) P&L behavior (proxied via sensitivities to risk factors).

There are numerous methodologies that could be used to calculate economic leverage which may vary in complexity, precision and operational cost from a calculation and implementation perspective.

Economic exposure and leverage calculations differ by the choice of:

1) the unit measure to compare both leveraged and non-leveraged positions similarly (e.g. underlying market value of cash instruments, sensitivities, risk),
2) the economic return drivers (and their proxies: risk factors),
3) the actual calculation and adjustment method to measure the economic exposure of the leveraged and non-leveraged portfolio (e.g. simple market value or notional of underlying, adjustment for sensitivities, adjustment for risk factor distribution, etc.)
4) how netting and hedging is reflected, and
5) the baseline to which the leveraged economic exposure figure is compared.

Estimation of the risk factor characteristics of the unleveraged and leveraged portfolio requires complex calculation of both joint correlation of multiple factors and translation of risk factor effects into P&L estimates. This comes at a cost of high requirements respecting data, modeling framework, estimation robustness and daily calculation processes. But, depending on the leverage strategy employed, even with extreme detail and complex economic leverage calculation models, this will not automatically provide additional risk transparency.

Whether a certain economic leverage calculation is useful in making the risk of the leverage strategy transparent depends on the portfolio strategy itself and the level of complexity used to capture the above two mentioned building blocks of portfolio risk measurement. (Risk factor distribution properties and P&L behavior). A simplified measure of economic leverage may be sufficient to make the risk of the leverage strategy transparent.

A simplified example of economic leverage appears below as Example 9 and illustrates one style of this measure. In this example, the economic exposure of a portfolio of bonds, stocks and cash is compared with, and without, its derivative positions. This stylized example includes a portfolio with a small number of risk factors. Derivatives are delta- and duration-weighted, and those that perform hedging functions have been designated as hedges. In practice, the model would need to include a full range of granular risk factors that properly captures risk, including basis risk, in portfolios. In addition, a practical implementation of such an approach would appropriately weigh positions differently depending on differing levels of volatility; this is not done in this example.

Example 9: Economic Leverage

10 Year Equivalent Bond:										
Duration: Price Sensitivity to change in risk free rate				9.05						
Spread Duration: price sensitvity to change in credit spread				9.05		RATES	CREDIT	EQUITY	CURRENCY	TOTAL
	Notional Value	Market Value	Sensitivity to +1 b.p. Risk Free Rate Change, in Years (Designated Hedges are Negative)	Sensitivity to +1 b.p. Credit Spread Change, in Years (Designated Hedges Are Negative)	Delta (Designated Hedges Are Negative)	10 Year Equivalent Rate Position (Notional x Duration/ Equivalent Bond Duration)	10 Year Equivalent Spread Position (Notional x Spread Duration / Equivalent Bond Spread Duration)	Delta Equivalent Equity Position (Delta x Notional)		
30 year Corporate bond	50	50	22.62			124.97	124.97			
Pay fixed 5 year int rate swap	50	0	(4.61)			(25.47)				
Sell protection Corporate CDS	10	0		2.90			3.20			
ABC Foreign Stock	45	45						45.00	45.00	
Sell Covered Call on ABC Foreign Stock	25	0			-45%			(11.25)	(11.25)	-
Buy equity future	10	0						10.00		-
Cash & Margin	5	5	0.00			0.00				
Total With Derivatives	195	100				99.50	128.18	43.75	33.75	305.18
Total Without Derivatives	100	100				124.97	124.97	45.00	45.00	339.94
Derivative Leverage Impact										**(34.77)**

We note that the AIFMD Commitment Leverage approach (shown below in Example 10 below and described in Appendix B) provides a sound conceptual foundation for any economic leverage methodology and is already employed by investment management firms with private funds and hedge funds domiciled in Europe. While the approach has some limiting assumptions that preclude certain derivatives hedges from being excluded from leverage, it captures leverage from borrowings and derivatives with offsets for derivative positions that are offsetting or hedging positions and is a good theoretical starting point when measuring economic leverage.

Example 10. AIFMD Leverage Measure

Portfolio 1 owns $100 million in market value of a 6 year government bond. It has paid fixed on a 6 year interest rate swap with a notional amount of $13 million. A gross notional approach would treat this portfolio as having exposure of $113 million, but the AIFMD approach, because it takes into account the hedging effect of the swap, would show the portfolio as having exposure of $87 million

Portfolio 2 owns $100 million in market value split between government bonds of different maturities (30% in a 14 year security, 70% in a 2 year security). It additionally has received fixed on an interest rate swap with a notional value of $13 million.

Gross notional for Portfolio 2, just like Portfolio 1, would be 113%. The AIFMD approach also weights the leverage exposure here as 113%, acknowledging that, unlike Portfolio 1, the derivative instrument has been used to increase, rather than decrease, risk.

Advantages/Disadvantages of Economic Exposures as a Basis for Leverage Calculations

The advantage of using economic exposures as metrics for measuring leverage is that economic exposures are a common 'language' spoken by both derivatives and cash assets. A common representation of exposures provides an excellent means of assessing the effect of leverage on increased exposure (and risk from that exposure) in portfolios of cash assets, derivatives and other leverage sources.

The disadvantage of using economic exposures is that there is no 'translation' for non-economic legal or process implementation and execution risk, which may accompany various implementations of leverage, and any other risk not considered in the process of identification of the dominant risk factors. E.g., a portfolio manager who wants to liquidate an OTC derivative position might instead put on an offsetting position with another dealer to get a better price. The combined positions have zero economic leverage and no market risk. But in an unwind situation, the two may pose operational risks that may need to be addressed[8].

Economic Exposures and Risk

The economic metrics discussed here are all attempts to assess portfolio exposure. As stated earlier, the choice of economic metrics should serve as the foundation of the relationship between leverage and risk. Leverage is a magnification of these exposures and thus is a magnification of the potential risks associated with them and their drivers. Calculation of risk metrics for leveraged portfolios should follow from the choice of exposure metrics common to the cash assets and leverage sources. Proper construction of these risk metrics is essential to the risk manager tasked with building a governance framework for portfolio risk management.

Approaches and Tools for Measuring Risk in Leveraged Portfolios

Measuring risk in leveraged portfolios can be a challenging task and existing approaches and tools must all be applied carefully as their shortcomings can lead to misleading results in some contexts. Identification and calculation of the most descriptive exposure and leverage measures is critical for complex portfolios. Across the globe, regulatory approaches to measuring exposures and leverage highlight the need to utilize multiple approaches to get a more reliable estimate of portfolio risk (see Appendix B for more details).

VaR and Stress Testing for Leveraged Portfolios

To this point, we have discussed a range of measures of leverage exposure that vary in sophistication, from the simplest (e.g., gross notional) to those that adjust for elements such as hedging and duration sensitivity (e.g., economic leverage). Exposure metrics, even when adjusted as discussed, do not necessarily speak to loss potential. If a portfolio with $100 in net asset value borrows $100 and invests the proceeds in Treasury bills, its gross notional principal exposure is $200, but its risk of loss is very low.

[8] As an example, if the counterparty to the first position needed to close that position, the portfolio would need to unwind the second position nearly simultaneously to avoid open risk exposure and loss.

If it borrows $100 and invests the proceeds in local currency, emerging markets, short term fixed income, its gross notional leverage measure would again be $200, but its risk of loss would be significantly higher, with its additional credit risk and currency risk. Even a duration-adjusted leverage measure might not sufficiently distinguish between these two portfolios. For this reason, risk managers typically pair leverage measures with potential loss measures, such as value at risk and/or stress tests.

A portfolio with low potential loss measures may be permitted to have higher measures of leverage, and those with higher degrees of potential loss may be required to have very low measures of leverage. In this section, we examine potential loss measures, and how they may be used in combination with measures of leverage.

A key risk manager goal is to assess overall portfolio potential loss arising from the portfolio strategies used to generate return. A leverage strategy may be combined with other fundamental or quantitative strategies. The approach for calculating portfolio risk must properly account for the magnification of baseline portfolio risk and for the potential addition of new tail risk characteristics resulting from the use of complex derivatives.

Three common approaches for estimating a portfolio's potential loss are:

- **Absolute VaR (value-at-risk)**,
- **Relative VaR**
- **Stress Testing**

VaR models and stress testing are designed to describe the losses that could come out of all the variabilities and covariances in a portfolio, whether they arise from derivatives or cash instruments. They help place into context how much leverage matters.

Absolute VaR Calculation for Assessing Risk in Leveraged Portfolios

Absolute VaR estimates a portfolio's worst loss over a given time horizon with a given level of confidence. For example, if a portfolio's 1-month VaR with a 99% confidence Interval were 20%, it means one would expect only a 1% chance that the portfolio will lose more than 20% of its value over a 1-month period. Because VaR is a model-based concept, one must always consider the possibility of model risk arising from, among other things, improper specification or invalid statistical assumptions. In addition, because the model may be fitted to historical market data, it may be a poor predictor of results if markets change in historically important ways.

A strength of the absolute VaR approach is that the way it captures leverage arising from the use of derivatives differentiates between positions that add to the portfolio's risk and those that reduce risk. Moreover, by focusing on the tail losses and making precise quantitative statements that can be validated through backtesting, it can capture risks not obvious in day-to-day portfolio management.

For example, consider a portfolio that is composed of 95% equities similar in composition to equity index "ABC" and 5% cash. If the portfolio manager were to use ABC equity index futures to obtain additional market exposure, the absolute VaR of the portfolio with the futures would be higher than the

VaR of the original portfolio that did not include the futures position. Conversely, if the portfolio manager were to start with the original portfolio and then shorted ABC index futures, this would act as a hedge and the VaR of the new portfolio would be less than that of the original portfolio that did not hold futures.

Gross notional based methods for assessing the leverage arising from derivatives use do not explicitly distinguish between the two scenarios the way the absolute VaR approach does. In other words, the absolute VaR approach can distinguish between derivatives being used to add risk and those being used to reduce risk.

Example 11. Absolute VaR for Portfolios Using Fixed Income Hedges

Recall these two portfolios from Example 7:
Portfolio 1: Owns $100 in 5 year government bonds, goes short $20 notional in 5 year government futures. Gross notional exposure: $120. Duration exposure 3.8 years

Portfolio 2: Owns $100 in 5 year government bonds, goes short $400 notional in 3 month LIBOR futures. Gross notional exposure: $500. Duration exposure 3.8 years

These two portfolios have very similar interest rate and credit sensitivity—but portfolio 2 has greater sensitivity to the short end of the yield curve where interest rates are more volatile, whereas portfolio 1 is not meaningfully sensitive to the short end of the yield curve. This difference is reflected in the modestly different Value at Risk for the two portfolios (measured as the potential loss in 1 month at 99% confidence, and expressed as a percent of the portfolio's net asset value):

Portfolio 1 VaR: 1.9%
Portfolio 2 VaR: 2.2%

Note: while these differ, the magnitude is significantly less than the difference between their respective gross notional principal measures—and the potential loss on these portfolios is very low, given their investment in short term, high credit quality fixed income instruments, and their use of derivatives to hedge rather than magnify risk.

Relative VaR Calculation for Assessing Risk in Leveraged Portfolios

Relative VaR estimates a portfolio's risk relative to some benchmark. The benchmark could be a market index representing a specific segment of the investible universe, or cash. As an example, if the portfolio's VaR were 20% and the benchmark's VaR were 10%, then the relative VaR would be 2. The specific time horizon and confidence Interval are less important in this context since it is the ratio of the portfolio and benchmark VaRs that is the focal point, and the numerator and denominator of this ratio are affected similarly by those assumptions, reducing their significance.

Relative VaR is sometimes used instead of absolute VaR to counter the difficulty posed by finding the "right" maximum level of absolute VaR to fit all investment strategies. Relative VaR can be used to limit portfolio VaR to no higher than a given multiple of the fund's benchmark, or some recognized typical asset class ("VaR after leverage should not be higher than 1.5x the VaR of the S&P 500").

Not all investment strategies use a benchmark (other than cash), so relative VaR is not relevant to all portfolios. It can, however help establish the general reasonableness of the use of derivatives in the portfolio—if the risk of the portfolio, inclusive of all derivatives, remains lower than a reasonable benchmark for its broad asset class, or is significantly higher, this measure can help to place the derivatives use into proper context.

Example 12: Relative VaR for Two Equity Funds

Cash Equitizer Portfolio: Invests $95 in equities similar to its S&P 500 Index benchmark, holds $5 in cash including margin, purchases S&P 500 equity futures contracts with $5 in notional value.

Gross notional:	105%
Portfolio VaR: (1 mo. 99%):	7.9%
Benchmark VaR:	7.9%
Relative VaR:	1.00

Levered Long Equity Fund: Invests $95 in equities similar to its Russell 1000 benchmark, holds 5% in cash including margin, purchases Russell 1000 futures contracts with $20 in notional value.

Gross notional:	120%
Portfolio VaR:	9.6%
Benchmark VaR:	8.0%
Relative VaR:	1.20

The Relative VaR measure in both cases helps isolate the degree to which the derivative strategy has magnified risk. Where gross notional identifies the Cash Equitizer as having some kind of magnified risk, the Relative VaR measure reflects that this is not the case, that the derivative is a well matched hedge.

Example 13: Relative Risk for Total Return Bond Fund

This portfolio uses the Barclays Aggregate Bond Index as its benchmark, and invests in a range of cash and derivative holdings, including cash, Treasuries, investment grade and high yield corporate bonds, municipal bonds, asset backed securities, collateralized loan obligations, credit default swaps, futures, foreign exchange, and to-be-announced mortgage back securities. The tables that follow compare the gross notional of this portfolio for its various sectors, to the VaR measures arising from these sectors, to the VaR of the portfolio relative to its benchmark, with and without derivatives:

Market Value Allocation (%)		
	Fund	Benchmark
Cash and Bonds	64	67
Securitized/CLO	36	33
Derivatives	12	0
Total	112	100

VaR Allocation (Percent of total 1 mo 99% VaR)		
	Fund	Benchmark
Cash and Bonds	58	85
Securitized/CLO	14	15
Derivatives	28	0
Total	100	100

VaR as % of Market Value		
	With Derivatives	Without Derivatives
Fund	2.2%	1.8%
Benchmark	2.0%	2.0%
Relative VaR	113.3%	93.9%

A benefit of a relative VaR limit, particularly when the benchmark is a good match to the strategy of the portfolio, is that an overall rise in volatility will be the same for the portfolio and the benchmark, reducing the problem of procyclicality discussed above with respect to absolute VaR limits.

A drawback of a relative VaR limit is that the reference benchmark might decrease in VaR because of volatility changes in the market—which may have little to do with the strategy of the portfolio. This could cause a portfolio limited by relative VaR to have to rebalance its portfolio for no other reason than a decline in the volatility of the benchmark index. Conversely, as volatility rises for the benchmark, it might permit increased risk taking in the portfolio.

The table below summarizes the benefits and drawbacks of using limits and measures on absolute VaR and relative VaR to control the effects of leverage:

VaR Type	Pros	Cons
Absolute VaR	Provides a risk-based view on leverage due to the use of derivatives in the portfolio	In isolation, it does not provide insight into the level of leverage coming from derivative positions
	Differentiates between derivatives that add synthetic exposure and those that hedge exposure – i.e., risk increasing leverage and risk reducing leverage	Would be difficult to set a one-size-fits-all limit that would be appropriate for all investment strategies
	Can be used with any portfolio	Can drive pro-cyclicality, forcing asset sales in volatile markets
Relative VaR	Provides a risk-based view on leverage due to the use of derivatives in the portfolio	Usefulness is limited to portfolios with market index benchmarks
	Differentiates between derivatives that add synthetic exposure and those that hedge exposure – i.e., risk increasing leverage and risk reducing leverage	Will not necessarily reflect derivatives positions that move the portfolio closer to the benchmark as being risk reducing in the benchmark relative sense
	May be able to offer more insight into the reasonableness of the overall portfolio relative to the market segment to which it is meant to provide exposure, which facilitates limit setting	Can require unwanted portfolio changes only because of a decline in the volatility of benchmark that has low relevance to the strategy; or can allow excessive risk taking if the benchmark's volatility has increased
	Where the portfolio is a good match to the benchmark, a relative VaR measure may lessen procyclicality, since the same changes in volatility that affect the portfolio will affect the benchmark	

Stress Testing for Assessing Risk in Leveraged Portfolios

VaR has many valid criticisms, including that it can miss the unique characteristics of highly stressed markets. It is not the only available potential loss measure. Stress testing is another complementary approach that can be used for estimating potential losses.

Stress testing is a scenario analysis that models extreme but plausible market moves in the underlying assets with a goal of estimating potential losses in the portfolios under stressed market conditions.[9] It can capture a variety of risks: directional, basis, concentration, credit, operational and liquidity.

[9] Importantly, the stress tests discussed in the section are not liquidity stress tests. They consider the impact of stress scenarios on portfolio asset values. They do not consider redemption scenarios or the impact of redemptions on the portfolio.

The stress shocks can be informed by the historical market dislocations or they can be hypothetical, addressing specific vulnerabilities in the portfolios. The stresses can be applied as a series of thematic macro scenarios such as Credit Crisis, Bonds Collapse, Emerging Markets Selloff, Europe Crisis, etc. Credit Crisis, for example, may model a dramatic credit spread widening, combined with interest rates easing and equities selloff, all occurring at the same time.

Alternatively, they can be designed as a series of comprehensive micro scenarios targeting concentrations or basis risks, with portfolio loss defined as the worst loss from a single stress. Concentration stresses may include largest single name, sector or country shocks, while basis stresses can capture long/short equity, bond/CDS, calendar spreads, etc. A combination of the two approaches can provide the most complete picture of risk.

Measuring Leverage Risk Using Stress Testing

Directional stresses allow for position netting by asset class, product type, region and maturity and use granular stresses for each of these categories. They are useful in measuring the risk of levered portfolios that do not have meaningful basis risk, i.e., where gross and net exposures are roughly the same. Basis stresses, in particular, can provide an additional dimension not captured by directional stress or VaR for portfolios with highly correlated, but not identical offsetting positions. While these correlated positions may track very closely during the VaR look back period, specific market conditions can cause their values to diverge well beyond the historical bands. Basis is not normally distributed and the fat tails are best captured via stresses that examine events throughout the whole available history and make educated assumptions regarding potential extreme moves.

Example 14: Portfolio Examples Using Stress Tests

These examples include portfolios where basis risk is the key risk, and that also tend to have higher leverage include various arbitrage strategies across all asset classes:

1. Statistical arbitrage: portfolio of long and short stocks that are net flat equity delta but highly levered.
2. Credit Derivatives Index Arbitrage: long protection on single name CDS components of the index vs short protection on CDX.
3. Calendar spreads in commodities: Long March vs Short June natural gas futures.
4. Interest rate curve steepener: long 2yr and short 10yr maturity in US interest rates via interest rate swaps or futures, duration weighted.
5. Convertibles arbitrage: long convertibles while hedging equity, credit and volatility risks using equities, CDS and options on the same underlying issuer.
6. Volatility arbitrage: short near term VIX future contracts vs long VIX futures further down the curve.

In the examples above, basis stress would mean applying the shock to only the long or short side of the statistical arbitrage portfolio, only the convertibles side in the convertible arbitrage portfolio and only the CDX index leg of the index arbitrage portfolio. For instruments with term structure, such as interest rate swaps, credit default swaps, or commodity futures, a different variation of basis stress, such as curve flattening or steepening can be applied to capture the spread risk.

In terms of implementation, basis stress can be used as an add-on to the more widely used directional stresses. Unlike directional stress, basis stress allows netting positions only with the same exact underlying and within defined maturity buckets. For simple long / short equities portfolios, basis stress can be applied to the minimum absolute long or short side of the portfolio and added to the directional stress that is applied to the net position.

For example, assume a basis stress scenario of -10% and a directional stress scenario of -30% for 150/50 long/short equities portfolio. The basis stress would be calculated as 50 (minimum of longs and shorts) * -10%, or -5%. It is then aggregated with a directional shock of 100 (net position) * -30%, for a combined stress of -35%. If the leverage is higher but the portfolio is net flat, for example, 300/300 long/short, directional stress would be 0, while the basis stress would be 300 * -10%, or -30%.

Identical derivatives positions on the same instruments held with different counterparties can be fully netted for market risk, or only netted by counterparty for credit and operational risk estimation. Stresses can be run in absolute terms or relative to a benchmark, highlighting risk and leverage in excess of the benchmark portfolio.

The stress method produces risk-based results and mitigates the tendency of VaR to underestimate risk in a low volatility environment or when positions are highly correlated with their approximate hedges. Basis stress scales up with the leverage of the portfolio, and can be tailored to specific asset classes and position types using both historical and hypothetical scenarios. It can be used to supplement directional stress, thus adequately capturing risk for portfolios with both high and low net and gross exposures. Stress has additional flexibility of being used for absolute and relative vs benchmark strategies. It can also be successfully applied to measuring various types of risk, including market, credit and operational risks.

Conclusion

This paper, as developed by the Forum's risk management professionals, provides objective practice-driven and educational focused analysis and discussion on the use of multiple methodologies to calculate exposure, leverage and risk. Each methodology can complement the other, providing a more comprehensive assessment of leveraged portfolio strategies than any one measure or model approach used in isolation. Used in isolation, each measure has drawbacks for one or another investment strategy. Any one used as a portfolio limit could introduce unwanted investment distortions. Each such limit would be too conservative for some strategies, and too lax for others. Seemingly disparate results from different measures (e.g. significant gross notional exposure in short duration fixed income portfolios may not equate to significant portfolio risk) highlights the limitations of individual and stand-alone measures and the need for a toolbox of methodologies to deal in and respond to the diverse market served by risk managers and regulators alike.

Appendix

Appendix A: Further Discussion of Exposure Calculation, Leverage and Risk

There is no single perfect measure of leverage because risk managers measure leverage for three different reasons. Each of the methods above captures some of these reasons for some portfolios, but misses others.

Consider two portfolios each funded with $100 of equity. One buys $100 of stocks and is unlevered. The other borrows an additional $100 and buys $200 of stocks and is levered 2 times (some people would call this levered 1 time, but we'll use the convention of exposure divided by equity equals leverage ratio).

The levered portfolio is subject to twice the market risk of the unlevered portfolio, it will go up and down twice as much when stock prices change. The levered portfolio also creates credit risk, it may default on its borrowings, or the fact that it borrowed may cause it to lose control of its assets. Another aspect of credit risk is funding risk, if funding disappears or becomes more expensive, the portfolio may be forced to quickly sell assets.

Portfolio 1 (unlevered)	**Portfolio 2** (levered)
Exposures: Stocks: $100	**Exposures:** Stocks: $200 *Portfolio 2 has 2x the market risk of portfolio 1.*
Borrowings: $0	**Borrowings: $100** *Portfolio 2 has funding and credit risk.*
Equity: $100	**Equity: $100**
Leverage: $100/$100 = 1x	**Leverage:** $200/$100 = 2x

Finally, the levered portfolio creates operational risks. If equities decline 10%, the portfolio's leverage will increase to 2.25 times. If it does nothing, it has uncontrolled leverage which can cause the portfolio to be exposed to unwanted additional risk. If it trades, selling $20 of stocks to get back to 2 times leverage, it is counting on market liquidity which may be expensive. Moreover, the fate of the portfolio can depend on bid/ask spreads and can be subject to other market participants opportunistically trading against it. . Another operational risk is model risk. With complex levered portfolios the models controlling leverage may be faulty, preventing the portfolio from controlling leverage.

Not all forms of leverage create all three types of risk. Going long one CME two-year Treasury note future ($200,000 notional) with $100,000 of equity has 2 times leverage. The leverage doubles market risk compared to buying $100,000 of two-year treasuries, but creates negligible credit or operational risk. On the other hand, hedging a convertible bond with equity, credit and interest hedges can have four times the leverage of the unhedged position. The hedges dramatically reduce the market risk, but can create significant credit and operational risks.

Portfolio 3 (levered)	**Portfolio 4** (unlevered)
Exposures: CME 2yr Treasury Note Futures: $200,000 notional *Portfolio 3 has 2x the market risk of portfolio 4.*	**Exposures:** 2yr Treasuries: $100,000
Borrowings: $0	**Borrowings: $0**
Equity: $100,000	**Equity: $100,000**
Leverage: $200,000/$100,000 = 2x	**Leverage:** $100,000/$100,000 = 1x

Appendix B: Regulatory Applications of Leverage Measures

This table describes some common leverage calculation methodologies in the terms used in this letter. It does not cover every detail of the methodologies, only the main approaches. The intent is to show how these methods work in current practice. It also illustrates that the actual measures mix different theoretical approaches, demonstrating that no single theory is adequate for regulation.

Leverage Calculation	Type
AIFMD 1. Gross Method **And** 2. Commitment Method	The AIFMD Gross Method uses the sum of the absolute values of all positions (excluding cash and cash equivalents, converting derivative positions into the underlying equivalent exposures and including exposure resulting from the reinvestment of borrowings and collateral), divided by fund NAV. It provides a summary measure of a fund's borrowings and off-balance sheet notional exposure gained via derivatives use, without taking into account netting or hedging. The AIFMD Commitment Method is similar to the AIFMD Gross Method, but it provides a more comprehensive framework for calculating the value of economic exposure obtained through leverage. The AIFMD Commitment Method addresses some of the issues inherent in gross methods by allowing for some netting and hedging and employing duration netting rules. **Combining these two methods allows one (the Gross Method) to highlight where derivatives are used in a fund and another (the Commitment Method) to measure actual economic leverage.**
UCITS 1. Commitment Method **Or** 2. VaR	The UCITS Commitment Method uses the sum of the absolute values of all derivatives positions (converted into the underlying equivalent exposures and including exposure resulting from the reinvestment of collateral), divided by fund NAV. Similar to the AIFMD Commitment Method, the UCITS Commitment Method allows for some specific netting and hedging arrangements, including interest rate duration netting, in an effort to provide a measure of economic leverage. The VaR approach is used for UCITS that engage in complex investment strategies representing a significant portion of a fund's investment policy, or where the Commitment method does not adequately capture the market risk of the portfolio. Depending on the portfolio type, a fund can use a **Relative VaR** (99% 20-day VaR that cannot exceed two times the VaR on a comparable benchmark portfolio or derivatives-free portfolio) or an **Absolute VaR** (99% 20-day VaR cannot exceed 20% of a fund's NAV).
Leverage Calculation	**Type**
SEC Investment Company Act of 1940	

1. Coverage Requirements SEC Proposed Methods 1. Qualifying Coverage Assets for Derivatives Exposure 2. Gross Notional Exposure **Or, if fund has GNE > 150%** 3. VaR Test	The 40 Act defines "coverage," which is $\frac{1}{1-\frac{1}{leverage}}$ so the 300% coverage requirement translates to a leverage limit of 1.5 times. Leverage is defined in accounting terms, except that derivatives are sometimes treated in accounting terms (mark to market value), sometimes in gross notional terms and sometimes in absolute risk terms (such as "cost to close"). The SEC has proposed that funds maintain qualifying coverage assets (cash and cash equivalents only) equal to the sum of the fund's aggregate mark-to-market coverage amounts (amount payable by a fund if it were to exit its derivatives transactions) and risk-based coverage amounts (estimate of the potential amount payable by a fund if it were to exit its derivatives transactions under stressed conditions). Additionally, the SEC has proposed that a fund's aggregate GNE cannot exceed 150% of the value of the fund's net assets. GNE is defined as the sum of the aggregate notional amounts of the fund's derivatives transactions, the aggregate financial commitment obligations of the fund, and the aggregate indebtedness with respect to any senior securities transaction entered into by the fund. Alternatively, a fund can obtain a GNE limit of 300% if its full portfolio VaR is less than its securities (ex-derivatives) VaR. This VaR test must be conducted using a 99% confidence interval at a time horizon between 10 and 20 trading days.
Basel III Leverage Ratio	Basel III defines the leverage ratio as capital divided by exposures, which is the inverse of the usual definition. Its 3% minimum leverage ratio translates to 33.33 times leverage. Basel takes an accounting approach with limited netting for on-balance sheet, non-derivative exposures, including securities financing transactions. Derivatives are treated using absolute risk based measures. Off-balance sheet exposures are converted to equivalent credit exposures, and then measured using accounting rules.
Market Risk Potential	This is a relative risk-based method, typically the Value-at-Risk ("VaR") of a portfolio is constrained to be no greater than 120% of the VaR of a benchmark portfolio.