



CAPSA Guideline

Leverage and the Effective Management of Associated Risks

Date: June 9, 2022

All rights reserved.

If this document or any portion of it is reproduced or used in any manner whatsoever, it should be appropriately cited and referenced.

Table of Contents

1. Context	4
2. Objectives	4
2.1 Sound Leverage Risk Management and Plan Governance	4
2.2 Guidance.....	5
3. Leverage Use by Pension Plans.....	5
3.1 Working Definition of Leverage and Scope of This Guideline	5
3.2 Types of Leverage	6
3.3 Impact of Leverage on Risk	6
3.4 Implications of Leverage for Risk Management	7
3.5 Why Some Pension Plans Use Leverage	7
4. Risks Associated with Leverage	7
4.1 Market Risk.....	8
4.2 Liquidity Risk.....	8
4.3 Counterparty Risk	9
4.4 Other Risks	9
5. Leverage Risk Management Practices for Pension Plan Administrators.....	10
5.1 Prudent Use and Oversight of Leverage	11
5.2 Documentation.....	12
5.3 Risk Management and Mitigation.....	13
5.4 Stress Testing and Scenario Analysis.....	14

APPENDIX A: Metrics for Measuring Leverage	16
1. Financial Leverage Ratio (FLR)	16
1.1 Investment Assets and Liabilities	17
1.2 Adjusted Investment Assets and Liabilities	17
1.3 Additional Considerations for Incorporating Investment Assets and Liabilities.....	17
Non-recourse Debt vs. Recourse Debt	17
Repurchase & Reverse Repurchase Agreements	17
Embedded Financial Leverage	18
1.4 Numerical Example	18
1.5 FLR Strengths and Limitations	18
2. Marginal Value at Risk (mVaR).....	18
2.1 Additional Considerations for mVaR Calculation.....	19
Approaches for calculating VaR with no leverage.....	19
2.2 Numerical Examples	20
2.3 mVaR Strengths and Limitations.....	22
3. Marginal Stress.....	23
3.1 Numerical Example	23
3.2 mStress Strengths and Limitations	24
4. Additional Considerations Regarding the Model-Based Metrics, mVaR and mStress	25
5. Summary of Metrics	25
APPENDIX B: Principles and Considerations for Developing and Validating Sound Leverage Measurement Capabilities	26

1. Context

This Guideline provides guidance on sound practices for managing risks associated with the use of leverage in pension plan investments.

It is up to the administrator¹ of each plan to determine, in the best interests of plan members and other beneficiaries:

- whether to use leverage;
- for what purposes leverage should be used;
- how much leverage to use; and
- what forms that leverage should take.

Pension plans can employ leverage for a variety of purposes. It is generally associated with more complex investment strategies and products and can expose a plan to a wide range of risks and have implications for plans' operational requirements.

These implications need to be well understood and managed by the plans that choose to employ leverage.

2. Objectives

2.1 Sound Leverage Risk Management and Plan Governance

CAPSA's expectations with respect to effective risk management around the use of leverage by pension plans focus on:

- **plan governance** including establishing the plan's risk tolerance, investment policies and procedures as well as decision-making, reporting and oversight structures;
- **expertise** with respect to supporting investment activities and their effective oversight;
- **documentation** relating to the plan's use of leverage; and
- **risk management** including establishment of appropriate investment strategies and risk limit(s); timely and accurate risk measurement; monitoring and reporting of investment exposures; and oversight of investment risks.

¹ The individual, group, body, or entity that is responsible for the oversight, management and operations of the pension plan and pension fund.

2.2 Guidance

This Guideline is intended to assist plan administrators in establishing policies and procedures to identify and manage risks associated with the use of leverage. It outlines the factors that CAPSA expects plan administrators to consider when developing policies and procedures, such as:

- identifying risk factors and economic exposures, including approaches for their measurement, monitoring and mitigation;
- describing the use of leverage in a Statement of Investment Policy and Procedures (SIPP);
- determining the content of a risk management framework, including the roles and responsibilities of key stakeholders, risk monitoring, reporting and oversight;
- establishing appropriate risk guidelines and controls; and
- stress testing and scenario analysis.

3. Leverage Use by Pension Plans

3.1 Working Definition² of Leverage and Scope of This Guideline

For the purposes of this Guideline, leverage exists when any technique or strategy is used to adjust a pension plan's economic exposure to investment assets that is different from what the plan could achieve by simply investing its capital (or net assets) in securities or other financial assets. In other words, leverage is a means of achieving economic exposure greater or lesser than the capital invested.

² Definitions of leverage often characterize leverage as a technique or strategy to increase economic exposure. As this Guideline includes examples of leverage used to take investment risk and hedge investment risk, the definition of leverage in this Guideline refers more broadly to a technique or strategy that adjusts (increases or decreases) economic exposure.

3.2 Types of Leverage

Common types of leverage for pension plans include:

- **Financial leverage**, which involves a plan accessing additional funds to invest. The funds may appear as liabilities on the plan's balance sheet or be associated with specific investments, such as mortgages on real estate.
- **Synthetic leverage**, which occurs when a pension plan enters into derivatives contracts that, for example, may allow the plan to increase exposure to fixed income or return-seeking assets.
- **Embedded leverage**, which includes any form of leveraged investment exposure acquired indirectly through a plan's holdings of third-party managed investments (i.e., leverage not directly created at the pension fund or pension plan level). Embedded leverage is the most common type of leverage for most plans.³

Various types of leverage differ with respect to their terms and conditions. One important distinction is whether the leverage is 'recourse' or 'non-recourse':

- **Non-Recourse** generally limits the plan's exposure to the amount invested.
- **Recourse** refers the possibility that a counterparty may demand that the plan pay additional amounts from the fund to cover losses that exceed the amount invested.

This distinction has important implications for the level of risk linked to the leverage and how these risks are managed by the plan.

3.3 Impact of Leverage on Risk

Leverage can be associated with higher risks. It can amplify the potential gains and losses on investments and increase exposures to other investment-related risks. (See [Section 4](#) for additional information on the risks associated with leverage.) However, leverage may also be used in strategies intended to mitigate the various risks that pension plans face.

Leveraged strategies can be complex. Any meaningful assessment of the potential benefits and risks of a particular pension plan's use of leverage cannot be made by looking at the

³ This is because most pension plans invest predominantly in pooled funds rather than directly, and do not employ financial leverage or engage heavily in derivatives transactions at the plan level to increase economic exposure.

immediate types and application of leverage alone. The assessment must also consider the role of leverage in the plan's overall investment strategy.

3.4 Implications of Leverage for Risk Management

Using leverage increases the importance of managing related risks. Understanding the interaction of different risks requires sophisticated and effective risk management processes. (See [Section 5](#) for discussion of leverage risk management practices.)

Plans may have exposure to leverage through products managed by third parties. For example, leverage may be employed by investment funds in which the plan invests. Plan administrators remain accountable for and should understand these indirect sources of leverage.

3.5 Why Some Pension Plans Use Leverage

Some common purposes for which pension plans are known to use leverage include:

- **Implementing Liability Driven Investment (LDI) strategies.** In these strategies, leverage is used to increase a pension plan's exposure to assets that behave like the plan's liabilities.
- **Increasing exposure to return-seeking assets.** For example, this may be achieved using balance sheet leverage or 'synthetic' leverage using derivatives contracts.
- **Seeking investment efficiencies and opportunities available through leverage.** Examples include increased diversification and the ability to take larger positions in low-volatility asset classes.

4. Risks Associated with Leverage

This Section describes key risks that need to be considered in the context of a plan's use of leverage. These risks are described individually. However, plan administrators need to be aware of how these risks may interact with each other.

4.1 Market Risk

Market risk is the risk of financial loss arising from adverse changes in the market value of an asset. Market risk can be influenced by many factors⁴.

Leverage can increase market risk by amplifying losses. Leveraged investment strategies can also change how market risk impacts other risks to which the plan may be exposed. For example, in certain leveraged strategies, short-term changes in the value of assets may increase liquidity risk⁵.

Pension plans must measure and monitor their market exposures closely to ensure that they are:

- consistent with the level and types of risk that plan administrators are willing to accept (risk tolerance or risk appetite); and
- within any risk guidelines or limits established by the plan.

In general, the potential impact of leverage on market risk needs to be considered from both the perspective of the plan's assets as well as the plan's liabilities.

4.2 Liquidity Risk

Liquidity risk is the risk that the pension plan may not be able to meet short-term financial obligations. These obligations include those arising from the use of leverage. This usually occurs due to the inability to convert assets to cash without losses.

Pension plans that employ leverage need to understand how it impacts liquidity requirements and risk. This will depend on the types of leverage involved and the purposes for which it is used. For example, liquidity management is critical to certain LDI strategies that employ leverage using derivatives⁶. Since margining agreements associated with leverage strategies often require the maintenance of a certain level of liquid assets, an increase in market volatility or credit deterioration, may cause liquidity pressures on plans employing leverage.

⁴ Such factors include changes in prices or valuations, interest rates or credit spreads, and/or foreign exchange fluctuations.

⁵ For example, when a pension plan uses repurchase agreements to obtain additional funds to invest, changes in the quality of the pledged securities can make it more difficult to roll over the agreements and impact the plan's liquidity needs.

⁶ As these strategies require a sufficient supply of eligible and unencumbered collateral instruments to allow the plan to meet calls for additional collateral as required.

Pension fund assets should be assessed from the point of view of their impact on liquidity. Plan administrators should ensure the plan maintains appropriate liquid assets, taking into account the plan's use of leverage.

4.3 Counterparty Risk

Leverage achieved using certain instruments, such as derivatives or repurchase agreements, involves contractual relationships with other parties (i.e., counterparties). Counterparty risk is the risk of loss due to a counterparty's unwillingness or inability to meet its contractual obligations.

Mechanisms exist to mitigate the risk of loss in such circumstances. These include 'global netting agreements' with parent companies that allow the set-off of obligations across a parent and its subsidiaries⁷. Employing these types of mechanisms is part of the prudent management of counterparty risk.

Care should be taken to ensure that any assumptions about a pension plan's ability to reduce counterparty risk reflect the terms of the legal agreements that are in place.

4.4 Other Risks

Other risks may apply to pension plans exposed to leverage. Some examples are:

- **Operational risk:** The risk of loss resulting from the actions of people, inadequate or failed internal processes and systems, or external events. Complexity in leverage strategies can increase operational risk.
- **Refinancing risk:** The risk that a plan will incur a financial loss as a result of being unable to replace an existing debt obligation required to maintain its leveraged investment positions. A pension plan can experience refinancing risk from internal factors (e.g., the deterioration of its credit rating) or external factors (e.g., adverse interest rate movements or tightening credit market).
- **Model risk:** The risk associated with a plan not accurately capturing and quantifying various exposures to leverage within its risk metrics.

⁷ For example, pension plans should strive to have global agreements with each parent counterparty that allow for netting with all its subsidiaries, rather than bilateral agreements with each subsidiary individually. In the absence of global agreements, the plan may have difficulty settling offsetting amounts in a market or credit event.

- **Performance measurement risk:** The risk that the increased volatility of returns and resulting tracking errors caused by leverage may not be appropriately captured by a plan's performance and risk benchmarks. For example, as a result of overstated performance results, the fund may allocate assets without reflecting the potential risk implications of the fund's use of leverage This could lead to:
 - inaccurate decision-making (e.g., regarding strategies or compensation); and/or,
 - inaccurate information disclosure (e.g., to plan members).

5. Leverage Risk Management Practices for Pension Plan Administrators

Plan administrators must fulfill their fiduciary duties in administering the pension plan and fund. This includes acting with care, diligence and prudence with respect to all aspects of the pension plan's investment strategy.

If a pension plan uses leverage, then fulfilling these duties requires a sound understanding of how leverage affects both investment risks and potential rewards. It also requires that the plan administrator oversee the prudent use of leverage. This means putting in place an effective risk management framework that includes:

- setting appropriate risk tolerances for the plan;
- adopting investment objectives and approaches that are consistent with those risk tolerances;
- establishing oversight procedures that effectively identify, measure, monitor and manage exposures and risks; and
- ensure reporting of same to those responsible for governance, e.g., senior management and the board of directors/trustees.

The processes and procedures that a plan administrator puts in place for managing these risks must reflect the types of leverage involved. This includes whether leverage is at the pension plan or fund level or embedded in pooled funds or other investments.

- **Leverage is at the pension plan or fund level:** The pension plan's risk management framework must include the operational controls necessary to manage the plan's use of leverage. In this regard, see Appendix B: Principles and Considerations for Developing and Validating Sound Leverage Measurement Capabilities.

- **Leverage is embedded in pooled funds or other investments:** The plan administrator is expected to have sufficient information and understanding of the leverage used by the funds in which the pension plan invests. The information should be sufficient to assess the impact on the plan's risks and manage them effectively.

5.1 Prudent Use and Oversight of Leverage

A high degree of complexity is involved in implementing leveraged strategies. Plan administrators that do not have the required expertise may seek advice from external experts when assessing, implementing, and managing leveraged strategies. A plan administrator that relies on external experts is not discharged of its oversight responsibilities and it must assess its capacity and competency to oversee its use of and exposures to leverage. Plan administrators should consider CAPSA Guideline No. 6 with respect to prudent investment practices, including delegation

Decisions about use and type of leverage must be consistent with the plan administrator's investment objectives and risk tolerance. If leverage is used, the plan administrator should:

- fully understand the strategies, objectives, exposures, and risks associated with its use; and,
- ensure that the plan has in place the policies and procedures needed to effectively monitor and manage such risks.

This includes understanding what types of scenarios may materially impact the pension plan and assessing whether the risks should be mitigated.

The rationale behind leverage-related decisions should be thorough and well-documented. These include:

- decisions about whether to use leverage;
- setting appropriate guidelines and controls;
- the type(s) of leverage used; and,
- the purposes for which it is used.

These decisions must be consistent with the plan administrator's fiduciary duties and the prudent person rule governing pension plan investments. The plan administrator should understand the impact of the use of leverage on the risk and return profile of the pension

plan. The plan administrator should also ensure the use of leverage is consistent with the plan's SIPP.

Metrics that specifically measure the amount of leverage and/or its effects can provide plan administrators with additional insights for the prudent use and oversight of leverage. [Appendix A](#) sets out three illustrative metrics for leverage measurement for plan administrators to consider if their pension fund is exposed to a significant amount of leverage. CAPSA recognizes that no single metric provides a comprehensive measure of all dimensions of leverage risk, that the measurement of leverage is complex and that approaches to understanding and measuring leverage continue to evolve. Accordingly, the illustrative metrics are not the only suitable methods to measure leverage but are offered as helpful options for plans to consider and to facilitate a more critical understanding of leverage measurement issues and techniques.

For such plans that adopt leverage measurement metrics, the plan administrator should ensure that:

- the plan's investment manager(s) that use leverage are familiar with leverage measurement issues and techniques, including the illustrative metrics in Appendix A; and,
- that the plan actuary or risk management team can quantify the plan's risk exposures, including leverage.

5.2 Documentation

The use of leverage should be documented in the plan's SIPP⁸. The SIPP should describe the plan's objectives in using leverage, in relation both to:

- the plan's overall investment strategy; and
- specific investment strategies and activities, where appropriate.

The SIPP should establish appropriate guidelines and controls related to the use of leverage. These should be aligned with the plan's overall risk tolerance (risk appetite) and risk management framework. The guidelines should describe the process for identifying, monitoring and reporting the risks associated with leverage. Controls should include strategies for managing or mitigating identified risks. The SIPP should broadly describe:

- the objectives of using leverage, with respect to risk and expected return;

⁸ It is a statutory requirement for the plan administrator to establish a written SIPP, which must include key elements identified in the applicable legislation. For pension plans that use leverage, the expectation expressed here is that a plan's use of leverage be referenced in their SIPP and described in easy-to-understand terms.

- how leverage is to be used to achieve the plan's objectives;
- the types of leverage the plan will or may use and the plan's guidelines that apply to its use;
- how leverage affects and fits into the plan's broader investment approach, its strategic asset allocation, and other aspects of the investment portfolio; and
- how the plan administrator will effectively oversee the use of leverage. This includes monitoring and controlling various risks that may arise or be impacted by its use.

Additional operational details regarding the plan's use of leverage and the various controls in place⁹ may be addressed in other supporting documents.

Employing leverage may be part of a broader investment strategy. If so, the SIPP should address these related objectives and describe the plan's use of leverage. For example, the plan could document the plan's expected risk and return both with and without the use of leverage.

5.3 Risk Management and Mitigation

Plan administrators should put in place appropriate systems to effectively monitor and manage:

- the use of leverage; and
- how leverage affects the risks facing the plan.

Risk management considerations should be factored into the plan administrator's decisions about:

- whether and how leverage is used;
- how risks arising from leverage are to be measured and monitored; and
- what controls ought to be put in place.

Plan administrators must establish appropriate policies and procedures for managing risk. It is also important that the plan administrator foster an appropriate risk-management culture

⁹ For example, the escalation and authorization protocols for the use of leverage.

that supports and reinforces those policies and procedures. Ultimate responsibility for risk management and oversight rests with the plan administrator.

Effective risk management requires that risks be properly monitored and measured, be identified in a timely manner and that concerns be escalated where appropriate. For plans with separate risk and investment management functions, effective risk management can also require the ability to effectively challenge investment decisions at the working level.

Expectations for risk management may be different for administrators of plans that use leverage directly compared to indirectly.

A plan invests in a pooled fund that employs leverage. The plan administrator should understand how leverage is being employed by the pooled fund. A good practice for plan administrators is to identify, in the plan's processes for monitoring the use of leverage, material instances of embedded leverage and its effects on associated risks. At a minimum, the pension plan's investment risk metrics should reflect any risks to the pension plan implied by the pooled fund's leverage.

Performance and risk benchmarks should incorporate and reflect the use of leverage to promote a more informed and consistent measurement of these parameters.

Appropriate measures should also be taken to mitigate risks associated with investment strategies that involve the use of leverage. Examples include the mitigation of counterparty and market risks through:

- robust netting agreements;
- the use of central counterparties; and
- the posting of collateral.

5.4 Stress Testing and Scenario Analysis

How leverage affects the various risks facing pension plans depends on many factors, including:

- the purposes for which leverage is used;
- the types of leverage; and
- how well its impact is understood and managed.

Stress testing and scenario analysis provide mechanisms for understanding and managing the implications of leverage for the plan's broader investment approach and the funding of its liabilities.

Stress testing generally evaluates the impact of statistically defined possibilities or shocks relevant to understanding the risks associated with a strategy or position.

Scenario analysis evaluates the impact of specified scenarios that simulate a specific event considered to be unlikely but plausible.

Stress testing and scenario analysis can help pension plans establish appropriate parameters and limits on investment risk generally. They can also help establish parameter and limits on specific investment activities and strategies, including those using leverage.

Pension plans should conduct stress testing of their portfolios, including leveraged strategies, under various market conditions and scenarios. The full impact of the use of leverage, including resulting investment risks, should be incorporated into the plan's stress testing.

Administrators of plans that use leverage should also consider enhancing their stress testing to incorporate a 'reverse stress test'. A reverse stress test identifies extreme but plausible scenarios that would cause a pension plan to suffer material losses that jeopardize its ability to deliver benefits.

APPENDIX A: Metrics for Measuring Leverage

This Appendix presents three illustrative metrics for measuring leverage and its effects.

The Financial Leverage Ratio (FLR) measures the amount of financial leverage. The Marginal Value at Risk (mVaR) and the Marginal Stress (mStress) metrics measure the effect of leverage (financial and/or synthetic) on, respectively, investment and funding risks. While the FLR is an accounting-based metric that can be calculated without complex models, the mVaR and mStress metrics require complex modelling capability and detailed financial records.

The intent of providing these illustrative metrics is to equip plan administrators with examples of metrics that they can:

- i. choose to implement into their risk management practices if they are considering measuring leverage, or
- ii. use to develop their critical understanding generally of leverage measurement issues and techniques, including with respect to any of their existing leverage risk management practices. Plan administrators may find that a combination of different metrics (e.g., an accounting-based metric with one or more model-based metric) can facilitate a deeper understanding of the various dimensions of leverage and its effects.

1. Financial Leverage Ratio (FLR)

The objective of the FLR is to measure the amount of financial leverage used by a pension plan. As it is an accounting-based metric, it can be calculated using the plan's financial statements. It is expected that most pension plans would be capable of calculating this metric.

The FLR is defined as the ratio of the adjusted investment liabilities to adjusted investment assets.

$$\text{Financial Leverage Ratio (FLR)} = \frac{\text{Adjusted Investment Liabilities}}{\text{Adjusted Investment Assets}}$$

The technical details of the individual components of the FLR are discussed in the following sub-sections.

1.1 Investment Assets and Liabilities

Investment assets and liabilities are those as defined under relevant accounting standards. For the FLR calculation, non-investment-related assets and liabilities of the plan (i.e., assets and liabilities relating to plan administration) are excluded; the FLR aims to capture the amount of financial leverage used for investment purposes.

1.2 Adjusted Investment Assets and Liabilities

From a financial accounting perspective, all derivatives are recognized on the balance sheet as either assets or liabilities. They are measured at fair value. While there are differing views on whether derivatives should be included or excluded from an accounting-based metric such as the FLR, the FLR described in this Appendix excludes derivatives. The fair value accounting of derivatives on financial statements may not give a full picture of the potential implications of the derivative positions. Excluding derivatives from the adjusted assets and liabilities also removes the effect of potential volatility in derivative asset valuation from period to period from the ratio calculation. Accordingly, the derivative assets and liabilities are excluded in the FLR calculation (see numerical example in [Section 1.4](#)). In other words, the investment assets and liabilities are adjusted to provide a view of the amount of financial leverage used by removing the potential effect of synthetic leverage.

1.3 Additional Considerations for Incorporating Investment Assets and Liabilities

Non-Recourse Debt vs. Recourse Debt

As noted in the Guideline, non-recourse debt is generally defined as loans which can only be enforced against the borrower up to the value of the collateral posted. In the FLR calculation, non-recourse debt should be capped by the value of the designated collateral. For recourse debt, the obligation is not limited to the collateral value, and the full value of the loan would be applied in the FLR calculation.

Repurchase & Reverse Repurchase Agreements

Repurchase agreements (or repos) and reverse repurchase agreements (or reverse repos) are generally covered by global master repurchase agreements with netting terms like ISDA Master Agreements. Accordingly, transactions under such agreements are typically netted in the consolidated balance sheets if they meet the contractual netting and offsetting criteria. In that regard, the net amounts (instead of gross amounts) presented in the consolidated statement of financial positions should be used in the FLR calculation.

Embedded Financial Leverage

Often pension plans invest in external funds or investment products that use financial leverage in their investment strategies. However, there are data challenges and operational complexities in terms of doing a look-through analysis for each investment holding and then having that embedded financial leverage reflected in the FLR calculation. Plans may need to exclude embedded financial leverage from adjusting the assets and liabilities due to limitations in obtaining the information.

1.4 Numerical Example

A hypothetical example of how the FLR is calculated is presented in the table below. Financial leverage includes leverage obtained from borrowing funds from a financial institution or raising funds through a repo transaction. The FLR is adjusted to exclude the derivative assets and liabilities. Using the hypothetical example, the FLR is 15%, meaning that some financial leverage has been deployed.

Financial Leverage Ratio – Calculation Example ¹ in CAD billions	
Balance Sheet Items	Value
Investment Assets (A)	\$105
Investment Liabilities (L)	\$25
Derivative Assets (DA)	\$5
Derivatives Liabilities (DL)	\$10
Financial Leverage Ratio =	= (\$25 - \$10)/(\$105 - \$5)
(L-DL)/(A-DA)	15%

1.5 FLR Strengths and Limitations

Strengths	Limitations
Can be calculated by most pension plans	Does not capture synthetic leverage and the associated impact on investment and/or funding risks
No internal models are needed for the calculation and are not subject to model risk	

2. Marginal Value at Risk (mVaR)

The objective of mVaR is to measure the impact of financial and/or synthetic leverage on investment risk. It is important to note that pension plans need to have a detailed record of

how each derivative transaction is used to measure mVaR accurately. Also, some technical assumptions or adjustments (e.g., treatment of embedded synthetic leverage in levered pooled funds, treatment of cash to offset any risk exposure) may need to be specified by the plans to produce a more meaningful mVaR metric.

mVaR is defined as the difference between the VaR of a portfolio with leverage (which includes all leverage positions) and the VaR of a hypothetical portfolio without leverage (in which leverage positions have been removed). In other words, VaR with leverage is the VaR of the current portfolio.

$$\text{Marginal Value at Risk (mVaR)} = V_{wl} - V_{nl}$$

where:

V_{wl} = VaR with leverage (Current portfolio) and

V_{nl} = VaR with no leverage (Current portfolio excluding leverage positions)

The VaR methodology could be based on historical simulations, Monte Carlo simulations, or other approaches. The confidence level (e.g., 99% VaR) and time horizon (e.g., 1-year) should be specified to enable the mVaR calculation. If mVaR is positive, the Plan's investment risk has increased due to the use of leverage. Conversely, if mVaR is negative, the Plan's investment risk has decreased due to the use of leverage.

2.1 Additional Considerations for mVaR Calculation

Approaches for calculating VaR with no leverage

VaR without leverage is a metric for a hypothetical investment portfolio when all the synthetic leverage positions have been taken out. There are two approaches for calculating VaR without Leverage (V_{nl}) of the hypothetical portfolio:

1. With the same asset mix as the current portfolio (the assets remain the same and only the leveraged positions are removed); and
2. With a different asset mix so that the investment return objective can be met in the hypothetical portfolio without the use of financial and/or synthetic leverage.

Approach	Pros	Cons
1. Same Asset Mix	<p>Helps isolate the pure impact of leverage on investment risk without introducing an additional variable.</p> <p>Relatively easy to compute using the existing VaR model.</p>	<p>V_{nl}, as an interim metric, reflects a hypothetical portfolio that may not be useful on its own.</p>
2. Different Asset Mix	<p>Takes into account the second-order effect to asset mix if leverage is not allowed in the investment strategy.</p>	<p>Could be operationally difficult because the asset liability management (ALM) study that would generate the optimal mix, given the complexity, may be run on a different cadence (e.g., annually depending on the plan), than is desired for the mVaR.</p> <p>mVaR no longer shows the pure impact of leverage on the investment risk.</p>

Each of the two approaches has its own respective strengths and limitations, and they are reflected in the above table. The above considerations can also be given to the Marginal Stress calculation (covered in [Section 3](#)). For the purpose of illustrating the mVaR and mStress calculations through the numerical examples in the following Sections, the first approach (with the same asset mix) will be used.

2.2 Numerical Examples

Two hypothetical examples are provided below to illustrate these mVaR concepts. Pension Plan A uses leverage for an overall hedge of investment risk, and Pension Plan B uses leverage to take investment risk. Based on the formula above, one would expect mVaR to be negative for Plan A and positive for Plan B.

Both plans use financial leverage to fund part of their position.

Plan A – Example of uses of leverage with an overall reduction or hedge of investment risk

- Invests \$100 in public equities.
- Leverage consists of:
 - \$25 of financial leverage through the use of short-term debt (e.g., an overnight loan) to increase the equity position from \$75 to \$100
 - Synthetic leverage of short \$50 of S&P futures.
- Assume a VaR of \$4 for the equity position, VaR of $-\$2^{10}$ for the short futures position, and minimal VaR of \$0 for the overnight loan.
- Assume that the hedging instrument (i.e., short S&P futures) and the exposure (i.e., owns equity) are perfectly correlated.

¹⁰ Positive VaR reflects an estimated loss. A negative VaR represents a reduction in the estimated loss.

Plan A	Plan A Current Portfolio	Vwl	Plan A adjusted to exclude leverage	Vnl	mVaR
Equity	\$100	\$4	\$75	\$3	\$1
SPX Futures	\$50	-\$2	\$0	\$0	-\$2
Short-term Debt	\$25	\$0	\$0	\$0	\$0
Total VaR		\$2		\$3	-\$1

The current Plan A portfolio holds an equity position of \$100 with an individual VaR of \$4 and a short \$50 S&P futures position with an individual VaR of -\$2. If the portfolio is hypothetically adjusted to remove leverage, the equity position is reduced to \$75, which has a VaR of \$3. Comparing the current and hypothetical portfolios shows that, by using financial leverage, the resulting increase in the equity position from \$75 to \$100 incurs a \$1 increase in VaR. However, the use of synthetic leverage through the short futures position reduces VaR by \$2. As a result, the total VaR of the portfolio, including both financial and synthetic leverage, is \$2. Compared to the VaR of \$3 of the portfolio without leverage, the VaR of the portfolio with leverage has decreased by \$1, resulting in a mVaR of -\$1. This means that the marginal impact of leverage has reduced the overall investment risk.

The use of leverage resulted in an overall reduction of 33% in the investment risk as measured by VaR.

Plan B – Example of Uses of Leverage to Take Investment Risk

- Invests \$100 in public equities.
- Leverage consists of:
 - \$25 of financial leverage through the use of short-term debt (e.g., an overnight loan) to increase the equity position from \$75 to \$100
 - Synthetic leverage of long \$50 of S&P futures.
- Assume a VaR of \$4 for the equity position and a VaR of \$2 for the long futures position, and minimal VaR of \$0 for the overnight loan.
- Assume that the hedging instrument (i.e., long S&P futures) and the exposure (i.e., owns equity) are perfectly correlated.

Plan B	Plan B Current Portfolio	VwI	Plan B Uadjusted to exclude leverage	VnI	mVaR
Equity	\$100	\$4	\$75	\$3	\$1
SPX Futures	\$50	\$2	\$0	\$0	\$2
Short-term Debt	\$25	\$0	\$0	\$0	\$0
Total VaR		\$6		\$3	\$3

The current Plan B portfolio holds an equity position of \$100 with an individual VaR of \$4 and a long \$50 S&P futures position with an individual VaR of \$2. Similar to Plan A, if the portfolio is hypothetically adjusted to remove leverage, the equity position is reduced to \$75, which has a VaR of \$3. Comparing the current and hypothetical portfolios shows that, by using financial leverage, the resulting increase in the equity position from \$75 to \$100 incurs a \$1 increase in VaR. Since the use of synthetic leverage through the long SPX futures contract increases VaR by \$2, the total VaR of the portfolio with leverage is \$6. Compared to the VaR of \$3 of the portfolio without leverage, the VaR of the portfolio with leverage has increased by \$3, resulting in an mVaR of \$3. This means that the marginal impact of leverage has increased the overall investment risk.

Plan B use of leverage has doubled the investment risk as measured by VaR.

2.3 mVaR Strengths and Limitations

Strengths	Limitations
It may be relatively easy to compute when there are existing VaR model processes and infrastructure. VaR models are commonly used to measure investment risk at pension plans and their investment managers.	mVaR only captures the plan's asset side or pension investments and, unlike the mStress described below, does not consider both the asset side and pension benefit liabilities (i.e., it may not give the full picture of leverage and its risk implications when leverage is primarily used to implement a Liability Driven Investment strategy).
Interpretation of the metric is intuitive. The positive or negative sign of the mVaR indicates the directional impact of leverage on investment risk so the user can quickly tell whether leverage is used to hedge risk or take risk for the overall investments.	As it is subject to the limitations of any VaR models, it could be difficult to compare mVaR among plans using different VaR methodologies.
	Using a hypothetical asset mix to calculate VaR without leverage, because it is not the reality of the plan, could overestimate or underestimate the risk.

3. Marginal Stress

The objective of mStress is to measure the impact of financial and/or synthetic leverage on the plan's funding ratio under a stress scenario, which could be either an historical scenario (such as the 2008-09 Global Financial Crisis) or a forward-looking hypothetical scenario. The calculation could be performed on a solvency basis or a going-concern basis.

The mStress metric measures the difference between the stressed funding ratio of a portfolio with leverage (which includes all positions) and the stressed funding ratio of a hypothetical portfolio without leverage (in which leverage positions have been removed). If the mStress is positive, it means that the plan's stressed funding ratio has improved with leverage (i.e., the adverse impact of the shock on the plan's funding ratio is reduced as a result of the leverage strategies). Conversely, if the mStress is negative, it means that the plan's stressed funding ratio has deteriorated using leverage.

$$\text{Marginal Stress (mStress)} = SFR_{wl} - SFR_{nl}$$

where:

SFR_{wl} = Stressed Funding Ratio with Leverage (Current portfolio) and

SFR_{nl} = Stressed Funding Ratio with no leverage

(Current portfolio excluding leverage positions)

SFR_{wl} is the stressed funded ratio of the current portfolio. The SFR_{nl} is the stressed funded ratio for the hypothetical portfolio. As with the mVaR, there are two approaches (i.e., with the same or a different asset mix) to calculating stressed funding ratio without leverage (SFR_{nl}). For the purpose of illustrating the mStress calculations through the numerical examples in the following Section, the first approach (with the same asset mix) is used.

3.1 Numerical Example

A hypothetical example is provided below to illustrate the mStress concept, where the plan uses synthetic leverage to hedge pension liability (and the associated interest rate risk). In the example below, a 10-yr T-Bond futures contract is used to hedge the pension liability, which could be used as part of a LDI type strategy.

Plan C – Example of the use of synthetic leverage to hedge pension liability and the associated interest rate risk

- Invests in \$100 of public equities
- Leverage consists of synthetic leverage of long 10-yr T-Bond futures with a contract value of \$120 and a mark-to-market value of \$0

- Assume a pension liability of \$90 with a 10-year duration
- Assume an equity shock of -30% and an interest rate shock of -100 bps

Investment	CURRENT PLAN C (INCLUDES LEVERAGE)				PLAN C EXCLUDING LEVERAGE				mStress ($SFR_{wl} - SFR_{nl}$)
	Base MTM ¹¹	Stress Shock	Stress Impact	SFR_{wl}	Value	Stress Shock	Stress Impact	SFR_{nl}	
Equity	\$100	-30%	-\$30	\$70	\$100	-30%	-\$30	\$70	
10 Year T-Bond Futures (Contract Value \$120)	\$0	-100 bps	\$12	\$12	\$0	-100 bps	\$0	\$0	
Total Assets	\$100	-	-\$18	\$82	\$100	-	-\$30	\$70	
Pension Liabilities	\$90	-100 bps	\$9	\$99	\$90	-100 bps	\$9	\$99	
Funded Ratio	111%	-	-	83%	111%		-	71%	12%

The current Plan C portfolio invests in a long 10-yr T-Bond futures (synthetic) leverage position to offset the funding risk from the pension benefit liability, which could be used as part of a LDI-type strategy. With a fall in interest rates of 100 bps, the bond price will increase, and the long position in the futures contract will be marked to a profit of \$12. On the other hand, the interest rate drop of 100 bps will cause pension liabilities to increase by \$9. The T-Bond futures position (an interest rate hedge) more than offsets the increase of pension benefit liability under a stress scenario where interest rates drop by 100 bps.

Given the shocks, the assets for Plan C (with leverage) fall by \$18 (-\$30 from Equity position + \$12 from Bond futures position). The result is SFR_{wl} of \$82 (\$100-\$18).

The T-Bond futures causes the funding ratio to improve from 71% (with no leverage) to 83% (with leverage) under the defined stress scenario. Hence, the mStress is +12%, meaning that synthetic leverage positively impacts the funding ratio under stress.

3.2 mStress Strengths and Limitations

Strengths	Limitations
The mStress calculation takes into account both investment assets and pension benefit liabilities of the plan.	The mStress calculation could be computationally intensive as it involves not only investment assets but also pension benefit liabilities of the plan.
The mStress can be a useful risk-metric that summarizes the impact of the use of leverage to funding ratios under a stress scenario (historical or forward-looking).	

¹¹ Mark to market for valuation purposes.

4. Additional Considerations Regarding the Model-Based Metrics, mVaR and mStress

Notional Amount

Consideration has been given to whether the notional amount of derivatives (gross or net) could be used to calculate the total amount of leverage being used. However, the derivative notional amount over-simplifies the true risk and return profile, and any leverage ratio based on the notional amount will give an inaccurate indication of the amount of leverage or risk taken by the plan. Therefore, the notional amount of derivatives is not included to capture synthetic leverage in the measure of leverage set out in this document.

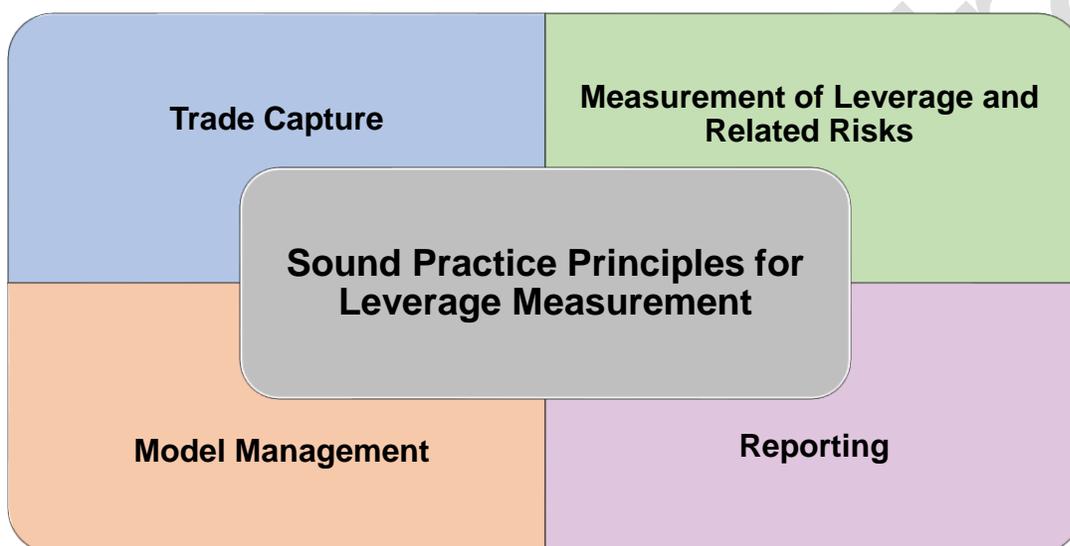
5. Summary of Metrics

The table below provides a high-level comparison of the three-leverage metrics, highlighting their key similarities and differences.

Metric	Metric Type	Leverage Type	What it Measures	Formula	Computational Intensity	Includes Pension Liabilities
Financial Leverage Ratio (FLR)	Accounting-Based	Financial	Amount of financial leverage used	$FLR = \frac{\text{Adj. Inv. Liabilities}}{\text{Adj. Investment Assets}}$	Low	No
Marginal VaR (mVaR)	Model-Based	Financial and/or Synthetic	Impact of leverage on investment risk	$mVaR = V_{wl} - V_{nl}$	Moderate	No
Marginal Stress (mStress)	Model-Based	Financial and/or Synthetic	Impact of leverage on funding risk	$mStress = SFR_{wl} - SFR_{nl}$	High	Yes

APPENDIX B: Principles and Considerations for Developing and Validating Sound Leverage Measurement Capabilities

Principles and considerations that plan administrators may adopt to strengthen their leverage measurement capabilities are categorized into the four key areas: trade capture, measurement of leverage and related risks, model management, and governance. Best practices for their implementation are presented below:



Trade Capture

- Plans should capture in their investment records all the key factors or variables for existing or new levered investments and derivative positions for investment and risk management purposes. Any missing factors or simplifications need to be identified and addressed appropriately.
- Any leverage (financial and/or synthetic) used in the investments, directly and indirectly, needs to be identified. The impact of leverage on various risks (e.g., market risk, liquidity risk and counterparty credit risk) and how these risks interact with each other using leverage need to be well-understood.

Measurement of Leverage and Related Risks

- Plans should ensure that they have a comprehensive suite of metrics that capture different dimensions of leverage and its implications for other risks. These potential metrics include but are not limited to the amount of leverage used and the impact on other risks (e.g., market risk, liquidity risk and counterparty credit risk) resulting from leverage.
- Plans should conduct stress testing to measure the implications of leverage for investment performance and associated risks resulting from the use of leverage under extreme but plausible scenarios. These scenarios need to be carefully and strategically designed to truly uncover potential risks resulting from the use of leverage at different levels of the investment process (e.g., at the individual product, asset class or overall investment portfolio level).

Model Management

- Plans should independently validate the key models (valuation, risk and decision-making models) at the inception of an investment/leveraged position and periodically thereafter.
- Key assumptions, data used for modelling, methodologies for leverage measurement and limitations of the models need to be included in the scope of the model validation process.

Reporting

- Leverage and related risk metrics should be monitored against applicable limits and reported as key metrics to those individuals responsible for governance of the administrator, e.g., senior management and the board of directors/trustees.
- A well-designed profit and loss analysis that attributes the investment performance to various forms of leverage could enhance the understanding of how leverage (financial or synthetic) contributes to investment performance and potential risks.