TEACHERS' RETIREMENT BOARD

INVESTMENT COMMITTEE

SUBJECT: Risk-Based Asset Investment Strategies – Part I ITEM NUMBER: 6

CONSENT: ____ ATTACHMENT: 1

ACTION: ____ DATE OF MEETING: September 7, 2011 / *45 mins*

INFORMATION: X PRESENTERS: Christopher J. Ailman and Steven Tong

---

POLICY

This item is governed by CalSTRS' Investment Policy & Management Plan and addresses the first objective on the Investment Committee (Committee) Work Plan for 2011-12 fiscal year.

BOARD STRATEGIC PLAN GOAL

Goal 4: Ensure a financially sound retirement system.

- **Objective A**: Ensure a financially sound retirement system through optimal investment returns.
- **Objective B**: Develop a portfolio-wide risk measurement system with regular executive summary reports to the Investment Committee.

HISTORY OF THE ITEM

During the 2010-11 fiscal year, Pension Consulting Alliance (PCA) and staff presented three reports reviewing risk-based asset allocation theories. At the February 2011 meeting, the Committee adopted a comprehensive risk overlay concept for CalSTRS. This new framework will help CalSTRS monitor and measure its investment portfolio sensitivities to changes in the macroeconomic and market environment. In June 2011, the Committee voted and decided that "risk management strategies" for the Total Fund is the Investment Committee's top objective for the 2011-12 fiscal year. This report is the first in a series of discussions on risk management strategies.

PURPOSE

This agenda item is intended to help the Committee understand how a risk-based asset allocation strategy may improve CalSTRS' investment process and potentially enhance the overall risk-return characteristics of the portfolio over time. The attached paper discusses how the strategy might be applied to help mitigate the impact of a severe macroeconomic or market event.

BACKGROUND

Modern Portfolio Theory (MPT) is the backbone of CalSTRS' investment philosophy and policies. The key risk mitigation tool of MPT is diversification across asset classes that have low or no correlation. Originally, correlation was measured over a historical period and input into a model as a single static statistic. As the world has become more global and information is instantaneous to market participants, correlations have gradually increased. During the internet bubble crash of 2001 and then again during the sub-prime debt crisis of 2008, the core asset classes all performed similarly and their correlations approached a value of one. As a result, the tool of diversification was ineffective to reduce risk. The institutional investment industry has now accepted that correlations are not static and cannot be effectively measured as a single number in our modeling tools.

The CalSTRS Investment Policy and Management Plan was originally drafted around 1984 and has served the System well during the high growth and low inflation economic environments of the 1980's and 1990's. During these decades, the stock market generally trended higher and the core tenant was to be fully invested to capture the beta exposure to each asset class. Tight adherence to asset class allocation targets and frequent rebalancing was the optimal strategy. However, during the volatile decade of the 2000's, CalSTRS realized that more flexibility and nimbleness was needed to properly navigate the financial markets. Tight adherence to capitalization weighted indexes forced investors to buy higher valued industries and sell lower valued industries, the opposite of the buy low and sell high tenant of investing. The excess and then implosion of the TMT (telecom, media and technology) industries in 2000 and the financial industry in 2008 resulted in unsuitable losses to nearly all institutional investors, including CalSTRS. These experiences demanded that CalSTRS develop additional risk tools to compliment the main tool of diversification during periods of volatile market behavior.

DISCUSSION

"The future is already here– it's just not evenly distributed"

—William Gibson, quoted in *The Economist*, December 4, 2003[1]

The frequency of market turmoil in recent history may lead us to believe these types of events will be the norm in the future. However, if history is our guide, this environment of higher volatility will subside over time and then re-occur without much warning. CalSTRS needs an investment policy that allows it to operate optimally during both periods. The key will be to properly recognize each period. Today, CalSTRS has a very effective investment policy for "traditional" or "normal" periods. These periods are exemplified by the decades of 1900's, 1920's, 1940's, 1950's, 1980's and 1990's. However, there will be circumstances in the future when CalSTRS needs more flexibility to manage the portfolio. Historically, these would be decades such as the 1910's, 1930's, 1960's, 1970's and, most recently, the 2000's.

Obviously the financial markets don't move in discrete decades nor do institutional investors invest in such a manner. However, looking back beyond our personal experience helps us develop a plan and policy to work in multiple environments. To address that flexibility, staff and

[1] William Gibson is a American – Canadian speculative fiction novelist who coined the term "cyberspace"

PCA are recommending a second set of tools and policy rules for periods of market "turbulence." During the majority of time, staff would follow traditional policy but expand policy during periods of high volatility or turbulence.

The overall goal is to better manage risk. The proposed turbulence policy would authorize the use of more risk tools and allow the investment portfolio to be more nimble when markets are highly volatile. Periods of disruptions also present periods of unusual opportunity, so the policy would also allow the investment managers to be more opportunistic during these periods. An example would be CalSTRS creation of the ER (Equity Return) committee in the fall of 2008 to take advantage of distressed debt opportunities across the financial markets. The key to the policy extension will be to distinguish between periods of long-term turbulence and short-term market volatility. This will primarily be based on the six CalSTRS risk factors, the PCA risk charts, and possibly other measures such as, the CBOE's (Chicago Board Options Exchange) S&P500 VIX index, which reflects the market estimate of future volatility.

The "Veritas," or contrarian, opinion has been that the idea of other risk tools is still fairly unproven. During the presentations in the winter of 2011, staff presented reports on its peers that are developing similar plans. To date, none have been fully tested over time. Another view is that it is difficult to correctly identify periods of market turbulence. By definition, extreme left hand tail risk events are difficult to nearly impossible to predict and identify until they are well under way. All of these points need not be fully vetted for staff or PCA to consider recommending policy changes; but it is quite clear that some adjustments will need to be made to allow CalSTRS to adapt to periods of volatile markets.

CONCLUSION

Staff concurs with PCA's assessment that the current "best practice" for portfolio construction and management is to incorporate risk-based approaches into the investment decision-making process. After thorough research and analysis, staff has reaffirmed that risk-based asset allocation can serve a useful role in the CalSTRS Total Fund as a tool to help reduce the Total Portfolio's potential exposure to negative market shocks impacting investment performance.

Next Steps: Staff will make a follow-up presentation at the November 2011 Investment Committee meeting and, at that time, make a formal recommendation regarding policy language for the Investment Policy and Management Plan. This will include recommendations on which tools should be added, the appropriate bands for each asset class and the delegation of authority.

Prepared by:

Steven Tong
Director of Innovation and Risk

Prepared by:

Christopher J. Ailman
Chief Investment Office

This page left blank intentionally.

CALSTRS
HOW WILL YOU SPEND YOUR FUTURE?

Risk-Based Asset Investment Strategies – Part I

Investments – Innovation & Risk

INTRODUCTION

During the 2010-11 fiscal year, the Investment Committee (Committee) directed Pension Consulting Alliance (PCA) and staff to study risk-based asset allocation. PCA and staff presented their initial findings to the Committee in three presentations (September 2010, November 2010 and February 2011). After review and analysis of the agenda material, as well as oral testimony from PCA and staff, the Committee adopted the following:

- Acknowledgement that asset classes are exposed to common risk factors in varying degrees;
- Identification of six specific macroeconomic/market risk factors;
- Integration of the six macroeconomic/market risk factors into the risk management process. The status of each these factors should be reported to the Committee on a regular basis; and
- Direction to staff to present a comprehensive risk-based asset allocation framework to the Committee in the 2011-12 fiscal year.

The first step in the process was to define and measure the six macroeconomic/market risk factors. In this paper, staff will take the next step and provide the Committee with an overview of a risk-based asset allocation framework to help guide CalSTRS through various economic and market conditions as well as introduce some of the strategies currently being considered to protect the portfolio from significant loss in value during future turbulent periods. In November 2011, staff will identify and provide a more detailed analysis of the potential tools and strategies that should enable CalSTRS to better manage risk. Ideally, these strategies should provide staff with the ability to proactively shift the asset allocation in response to expected changes in the financial market environment. Finally, staff will recommend potential policy revisions necessary to implement these strategies.

The risk-based asset allocation framework should be designed to allow CalSTRS to identify factors that explain the past as well as the potential future investment performance of the Total Portfolio. It should capture factors related to growth risk, interest rate risk, and inflation risk, as well as other attributes that have a direct bearing on the expected performance of individual asset classes. Exposures and sensitivities to these risk factors would be critical inputs into the asset allocation construction process, which seeks to maximize return per unit of risk for the Total Fund.

Development of a risk-based asset allocation is being driven by CalSTRS' desire to:

- Meet the long-term risk and return parameters set out by the CalSTRS Board
- Retain a material portion of the total portfolio value when negative events occur
- Participate in market rallies
- Reduce total portfolio volatility during turbulent market conditions

PERFORMANCE

The Committee has set forth long-term performance goals for the Investment portfolio. Over the long-term, the CalSTRS Portfolio is expected to deliver a return of 7.75 percent. Staff has been delegated certain portfolio management discretion to hire investment managers and to make tactical investment decisions in the pursuit of active management returns. The long-term expectation from pursuit of this active management return is an additional 0.60 percent (60 basis points) on average per year.

Investors have long believed that portfolio diversification is essential to preserving the economic value of a portfolio during dramatic market shifts. While asset class diversification is necessary, it has not proven to be sufficient. In extreme market conditions, such as the credit crisis in 2008, it is possible for nearly all asset classes to move down at the same time. Following this traumatic event, risk management has become a visible subject for institutional investors. As part of the management of risk, protection against event risk has become a focal point of discussions. This topic will be explored in further details later on in this paper.

Measured risks are taken by investors in order to generate a return above the risk free rate. While these risks provide opportunity for return, they come with volatility. As return volatility increases, the compound (geometric) return is reduced. Higher volatility may act as a drag on investment performance. Given this potential "volatility drag," investors seek to allocate to assets with increased risk that are expected to be rewarded by sufficient expected return. However, as the 2008 crisis highlighted, certain events can cause investment risks to exceed expectations, thwarting the expected return-to-risk tradeoff.

A risk factor-based asset allocation process should help CalSTRS to better ascertain when and how major macro events might impact the investment portfolio, allowing CalSTRS to prepare accordingly to preserve the expected return-to-risk tradeoff. This is an important step for CalSTRS to develop a more robust asset allocation decision-making process. A risk-based asset allocation strategy should increase the probability of achieving the long-term return objective established by the Investment Committee, within the Committee's risk tolerance.

RISK

CalSTRS' core belief is that performance for each asset class can be attributed to risk factors. Preliminary analysis of output from the risk model constructed by PCA confirms that the majority of the variation in CalSTRS' total portfolio return can be explained statistically by CalSTRS' risk factors. While it is impossible to identify all the factors that have and will impact returns, CalSTRS has identified a set of factors that explain a significant portion of past performance variance of the total portfolio as well as each asset class. These risk factors are present in each asset class to some degree and, as a result, price movement of each class will vary amongst each other and, over time, due to the changes in sensitivity to each of the risk factors.

The policy portfolio is an important factor in determining returns for the portfolio. According to a study by Brinson, Singer and Beebower [1991], more than 90% of the variance in a typical plan sponsor's total return is explained by the policy portfolio. The Investment Committee has charged the CIO with implementing the policy portfolio by hiring investment managers that can achieve return expectations within certain risk parameters. Diversification among the asset classes serves to dampen return volatility while enhancing the overall portfolio return.

The policy portfolio is often used to gauge the success or failure of the investment portfolio as well as gauge the relative risk of the actual portfolio. A risk-based asset allocation strategy should allow staff to better assess and manage the shifting risks of the policy portfolio.

CalSTRS RISK FACTORS

During the 2010-11 fiscal year, PCA introduced to the Committee the concept of a risk-based asset allocation. Under this approach, an investor examines the perceived macroeconomic environment and adjusts the asset mix of the policy or actual portfolio to account for the likely scenario. For example, if the investor expects high growth and low inflation, one would tilt the asset mix towards stocks (an asset that should benefit from such an environment).

After consultation with PCA and industry experts, CalSTRS identified six risk factors to help us better understand the performance of the portfolio and how it varies with changes in the market and economic environment. The risk factors are as follows:

- Growth Risk/Uncertainty
- Inflation Risk/Uncertainty
- Market Liquidity Risk/Uncertainty
- Interest Rate Risk/Uncertainty
- Leverage/financing Risk
- Regulatory/Governance Risk/Uncertainty

These risk factors should help CalSTRS gain an understanding of how market and economic uncertainty impacts each asset class, as well as the aggregate portfolio. The goal is to identify the exposure of each asset class and Total Portfolio to each of the risk factors, and how a change in a risk factor might impact the return of an asset class and Total Portfolio. By modeling these risks, staff should be able to determine how well assets are diversified among different risk exposures and where risk redundancies might exist. These risk factors should help CalSTRS understand the relative contribution of each type of risk to portfolio volatility.

In late spring of 2011, staff engaged PCA to assist in designing and building a multifactor risk model which incorporates the six risk factors. Staff also consulted other leading industry experts including State Street Associates (SSA) and Bank of America Merrill Lynch about approaches in designing the models. The factors chosen for the risk model must be: 1) well defined, 2) easily observable, 3) robust, and 4) widely monitored. Over the past several months, PCA was able to identify twelve market-based risk measures that have explained the majority of the investment results of CalSTRS' Total Fund. In selecting the factors, PCA focused on macroeconomic and/or market measures that are largely accepted by the investment community as gauges for different types of investment risk. Over time, PCA and/or staff may decide to modify this initial set of measures by replacing existing ones or adding new measures. Table 1 displays how the measures have been organized along the lines of CalSTRS' six risk factors:

Table 1: Risk Factor Measures

CalSTRS' Risk Factors	Macroeconomic and Market Measures
Growth Risk	Change in high-quality corporate bond risk Change in low-quality corporate bond risk Equity market uncertainty
Inflation Risk	Inflation uncertainty Gold price uncertainty Oil price uncertainty
Interest Risk	Change in the general level of interest rates Interest rate uncertainty Change in yield curve slope Change in interest rate sensitivity
Liquidity Risk	Change in short-term market liquidity risk Money supply uncertainty
Leverage Risk	TBD
Regulatory Risk	TBD

To date, four of six risk factors have been modeled utilizing the combination of one or more of the market-based measures. The preliminary results indicate that the model has significant explanatory value. R-squared (R2) measures how well the PCA/CalSTRS model explains the historical behavior of the portfolio. The model has a historical R2 ranging from approximately 50 percent to 90 percent, which indicates that the model is effective in most time periods of explaining more than half of the total portfolio's movement.

NEXT STEPS IN DEVELOPMENT OF THE RISK MODEL

During the next phase of the model building, PCA and staff will attempt to incorporate the remaining two factors; leverage/financing and regulatory/accounting rule change. From a modeling perspective, the linkage between these two factors and the return of the asset classes may be less straightforward as the risks associated with these factors are not easily quantifiable. However, we expect these factors to provide qualitative insight into market risks.

From a macroeconomic viewpoint, there have been several market regime changes and global shocks over the past couple of decades. Table 2 contains a partial list of these events.

Table 2: Macroeconomics and Market Events Over the Last 20 Years

Recessions	Global Shocks
July 1990 – March 1991 March 2001 – November 2001 December 2007 – June 2009	• US equity market crash, October 1987 • US interest rate hike, February 1994 – December 1994 • Latin American crisis, December 1994 – March 1995 • Asian crisis, September 1997 – January 1998 • Russian debt crisis, August 1998 • Technology meltdown, March 2000 – March 2001 • 9/11 terrorist attacks, September 2001 • Corporate fraud crisis, June 2002 – September 2002 • Financial crisis, June 2007 – March 2009

Source: Goldman Sachs and Morgan Stanley

This should enable staff to analyze the model output and determine what factors contributed to the returns of the portfolio during these scenarios. This examination should provide a better understanding of the behavior of risk factors overtime and how they affect asset class returns.

After building the model, staff expects to build a dashboard and display each factor's current condition and trend. This information may help CalSTRS better understand the portfolio's exposure to a set of major risk factors and gauge the potential impact.

CHALLENGES

Models are indicative, at best, and need to be analyzed with a degree of caution. Investors must be careful in their use of models and complement them with an appropriate understanding of fundamental valuation of assets and market sentiment data. A reliable risk model should be able to explain dramatic changes in systematic risks. Markets can act irrationally for an extended period of time, affecting risk model calibration and decreasing its signals. In addition, changes in regulations or market structures may affect the risk premium of each factor. A reliable risk model should capture these increases in systematic risks and dramatic events that happen during a market crisis. In addition, the risk model needs to address the risks throughout the business cycle.

During and after the recent financial crisis, investors widely criticized risk models for their failure to predict or model the left-tail events. The repeated occurrences of extremely turbulent market events and portfolio value drawdowns require such event risk to be acknowledged, and hopefully, contained and managed. A successful risk framework should help CalSTRS gain a better grasp on the impact of such events. Industry experts continue to debate the extent to which an investor can avoid extreme events. Nonetheless, one goal of a risk management framework is mitigation of the impact from such extreme events.

That expected returns for asset classes vary over time is another challenge for investors. This may be attributed to the time-varying behavior of the risk factors. Due to this variation in return over time, historical averages of returns can mislead the investor. Backward examination of returns should be analyzed within the context of the market regime to be useful.

Lastly, two asset classes that have similar average return and risk (standard deviation) characteristics may still have very different return distributions. A typical measure of risk (standard deviation) is not sufficient in specifying the risk of an asset class which is not normally distributed, or will not be a normally distributed in the future. Additionally, measuring historical risk over an investment horizon (e.g., 3, 5 or 10 years) is also inadequate. This view of risk considers the distribution of returns within historical period. In analyzing the new asset's probability of loss, staff must care about the exposure to potential loss on a forward looking basis. Investors must estimate the probability and degree of loss over different economic and market environments.

APPROACHES IN PROTECTING PORTFOLIO FROM LOSS

The following section summarizes approaches being contemplated by CalSTRS for maximizing the risk-adjusted return of the portfolio, as well as protecting it from significant loss in value. PCA and staff will research and review the merits and risks associated with each of the approaches and determine whether CalSTRS should begin implementing the approach. Staff will present any new approach to Committee for review and approval prior to implementation.

1. Dynamic Risk-Oriented Asset Class Allocation Decisions

The ability to move partially in and out of stocks is one of the important strategies which can be used by staff to minimize economic loss. The plan is exposed to significant drawdown risk during downward equity market movements. This approach has been discretionary and, as a result, can cause the plan sponsor to be exposed to timing risk.

Over time, as the asset classes produce different returns, they will drift from the target asset allocation. The Committee approved tolerance bands whereby if an asset class actual weighting is outside of the band, rebalancing would be required. The bands determine the maximum deviation of asset class actual allocation from its strategic weight. In "normal" markets, academics and consultants agree that tight asset allocation "bands" is an effective risk tool and optimal portfolio management discipline. However, during turbulent markets, adherence to the +/-3 percent asset allocation bands may not be optimal in managing the portfolio against extreme downside risk. The tighter asset allocation bands result in close correlation between the portfolio and policy benchmark in periods when it may not be desirable to do so. CalSTRS discovered during the financial crisis that the +/-3 percent did not provide CalSTRS staff with enough discretion to mitigate loss. As a result, adherence to these bands was suspended by Board action.

To enhance investment flexibility, staff and PCA believe the bands should be widened systematically when volatility rises significantly. Table 3 below suggests appropriate tolerance bands during different market volatility regimes. The tolerance bands allow CalSTRS to preserve the portfolio's long-term risk and return characteristics while providing flexibility during turbulent market regimes to accommodate severe changes in the financial market environment.

Table 3: 2011-12 CalSTRS Policy Targets and Ranges

	Target Allocation	Current Bands	Proposed Bands During Expected "Normal" Markets	Proposed Bands During Expected "Non-Normal" Markets (Turbulent)
Cash	1%	+/- 3%	+/- 3%	- 2%/+10%
Global Equities	53%	+/- 6%	+/- 3%	+/- 9%
Fixed Income	20%	+/- 3%	+/- 3%	+/- 6%
Real Estate	12%[1]	+/- 3%	+/- 3%	No Band
Private Equity	12%[1]	+/- 3%	+/- 3%	No Band
Inflation Sensitive	2%	+/- 3%	+/- 3%	+/- 6%

[1] Strategic target allocation adjusted to actual (round to nearest percent) at beginning of each quarter; Global Equities and Fixed Income are offset on a pro-rata basis to accommodate increase or decrease to Real Estate and/or Private Equity

2. Alternatives to Capitalization Weighted Equity Indexes

Institutional investors primarily invested in cap-weighted indexes that are broad representation of a specific segment of the market. The cap-weighted market portfolio is CalSTRS' core structure for the global equity asset class. This structure minimizes the risk of underperforming the market by closely tracking the constituents in the stock market index. Critics often argue that cap-weighted indexes systematically overweight overvalued securities and underweight undervalued securities. As a result, the investor will maintain an exposure to sectors and industries that could be extremely overvalued. In basic terms, it forces the investor to act opposite of what is desired in a core discipline approach.

Recently, the major index providers and investment managers have developed alternative-weighted indexes. These indexes are intended to complement the cap-weighted indexes and potentially provide higher risk adjusted performance than the cap-weighted indexes. The various weighting schemes generally fall into one of the following categories:

- Minimum volatility
- Fundamental
- GDP
- Equal weight
- Other

CalSTRS study on internal versus external management in the 2010-11 fiscal year addressed a few of the strategies that fall into the categories noted above. However, the benefits of such strategies are incremental, and don't effectively change the major risk exposures of an asset class portfolio.

3. Strategies for Building More Robust Portfolios

Since the financial crisis, investors have developed a desire to build more robust portfolios. Investors have taken two primary approaches: 1) identify and add investment strategies which have consistent, uncorrelated return profiles and 2) hedge existing portfolio assets.

In late 2008, the Committee established an Equity Return (ER) Committee. The Committee members include the CIO, directors and selected portfolio managers from each asset class and are tasked with identifying, assessing and approving investment opportunities in dislocated markets. The ER Committee invested in distressed debt funds, structured mortgage opportunities and stressed real estate. These opportunities are expected to produce equity-like returns as the economy recovers. The ER Committee will focus on new opportunities during turbulent market regimes.

In 2009, the Investment Committee established an Innovation program. Its purpose is to find and test strategies that are new to CalSTRS. Such strategies are selected on the expectation that they might improve the Total Portfolio's risk and return characteristics. Currently, CalSTRS is adding global macro hedge funds and commodities to its portfolio. Other strategies being added to the portfolio are inflation sensitive securities (e.g., TIPS and infrastructure). In the future, CalSTRS may consider absolute return strategies.

4. Ongoing Event Risk Hedges

Hedging is another strategy investors use to protect the portfolio against large losses. During and after the financial crisis of 2008-09, owing to the large losses in stocks, investors demand for downside protection rose. Investors are considering an array of event-risk hedging strategies to help protect the portfolio against such market dislocations. Hedging strives to limit potential losses from a depreciating portfolio while preserving the gains should the portfolio start to appreciate. These tools avoid the movement in or out of stocks, and mitigate the investor's exposure to timing risk. Unfortunately, the cost of buying ongoing portfolio insurance is large, resulting in a significant drag on long-term performance. In order to minimize costs, an investor can forgo upside potential in addition to the downside risk, but potentially incur a large upside opportunity cost. The investor is faced with a difficult choice of deciding on whether to bear the explicit costs to protect the portfolio from potential declines in the portfolio value, but also give up gains if market performance moves sharply upwards.

5. Risk Allocation, Hedging, and Crisis Planning

The purpose of the risk measurement and management tools being developed by staff and PCA is to make better decisions regarding risk allocation, hedging, and crisis planning. The first step in managing risk is to recognize each distinct portfolio risk, where it resides, and its potential impact on the portfolio. With this information, the expected reward for bearing each risk can be weighed against its downside risk, and risks can be allocated to, or from (hedged), or insured, as appropriate. As discussed above, the cost of an ongoing event risk hedging program (insurance) is expected to reduce long-term portfolio volatility and returns commensurately. However, informed opportunistic tail hedging can provide valuable protection (enhance long-term returns), if the cost of insurance is low relative to potential loss. Finally, regardless of whether the risk assessment tools provide accurate or early warning as to an impending crisis, planning for specific

actions to be taken during a crisis (crisis protocol) to reduce portfolio systematic risk exposures when market volatility spikes, should reduce portfolio losses when such a crisis inevitably occurs.

INVESTMENT POLICY AND MANAGEMENT PLAN CONSIDERATIONS

When implementing the above-referenced risk mitigation strategies, CalSTRS' allocation to asset classes may deviate from the target policy weights within the prescribed ranges approved by the Committee. The Committee dedicates the authority to deviate from the target weight to the CIO. As described earlier, the result of over/under-weighting an asset class will have an impact on the total return. Therefore, this flexibility to deviate from policy is an important tool in helping CalSTRS manage risk and minimize loss in the portfolio. Additionally, the large allocation to illiquid asset classes (long-term allocation target: 15 percent real estate, 12 percent private equity and 2.5 percent infrastructure) may limit staff's ability to implement risk-driven decisions. Due to these liquidity constraints, CalSTRS could be limited in its ability to mitigate risk exposures of these illiquid asset classes which may have a negative impact on the plan.

Under the California Constitution, California Education Code and Teacher Retirement Law, the Board has the sole and exclusive fiduciary responsibility over the assets of the retirement system. The Board/Committee delegates to the CIO the authority to deviate from the target weight. Further, the Board authorizes the CIO to utilize derivative instruments to maintain/adjust exposures. The policy will need to be revised to allow the CIO to expand the use of derivatives (e.g., futures, options, swaps) to hedge risks in the portfolio. In addition, because some hedging strategies have explicit costs, as well as opportunity costs, the policy might need to be revised to better define acceptable parameters.

CONCLUSION

In the spring of this year, PCA and staff identified six risk factors that they believe are key drivers for each asset class, four of which are reviewed in this paper. Focusing on these factors should enable staff to better identify beta exposures across the portfolio and therefore, unintended beta exposures and redundancies. Presently, staff is in the process of developing a system to measure and monitor the portfolio's exposures and sensitivities to these factors. The next step is to research the tools to mitigate downside risks and maximize return for the portfolio in light of these sensitivities. This analysis may potentially assist staff in:

- making more informed dynamic asset allocation decisions;
- diversifying the portfolio across macroeconomic risks in conjunction with asset class diversification;
- adding new strategies that help to diversify the portfolio's risk factor exposures;
- potentially allocating to alternative indexes; and
- hedging event risks and potentially protecting capital.

Finally, PCA and staff will follow-up and recommend revisions to the Investment Policy and Management Plan.

This page left blank intentionally.

GLOSSARY

ACTIVE MANAGEMENT – Portfolio manager attempts to outperform the market by making decisions to buy or sell individual securities

ALTERNATIVE WEIGHTED INDEXES – Indices in which constituents are weighted by economic fundamental factors

CAP-WEIGHTED INDEXES – Market index whose constituents are weighted according to their market capitalization

CORRELATION – Measure of the strength or direction of a relationship between two assets.

DERIVATIVE – A financial instrument whose value is based in part upon a another security

DIVERSIFICATION – A risk management technique to reduce risk by investing among a variety of assets within a portfolio.

EQUAL WEIGHT INDEX – Equal weight of stocks selected for inclusion in the index

FUNDAMENTAL INDEX – Use fundamental measures of a company to construct the index

FUTURE – A contract to make or take delivery of a specified amount of a certain security on a specified date in the future at a predetermined price

GLOBAL GDP GROWTH – measure of expected global economic activity and corporate profits

HEDGING – A strategy to defend against financial loss

ILLIQUID ASSET CLASS – An asset class that is not readily convertible into cash

INFLATION – Rate at which the general level of prices for goods and services in rising

INTEREST RATE – Rate at which interest if paid by a borrower for the use of money that they borrow from a lender

LEVERAGE/FINANCING – Degree to which an investor is utilizing borrow money

MACROECONOMIC – Focus on the overall movements and trends in the economy

MARKET LIQUIDITY – Accessibility of an investment

MARKOWITZ MEAN VARIANCE – quantitative tool which allows an investor to optimally allocate its investments between different asset classes

MINIMUM VOLATILITY INDEX – Seeks to minimize the volatility of the index by using a risk model and an optimization algorithm to select stock weights

OPTION – A contract giving the owner the right (not obligation) to buy or sell an asset at a fixed price on or before a specific date

RECESSIONS – A business cycle contraction

REGULATORY/ACCOUNTING GOVERNING RULE CHANGE – changes in accounting rules, tax codes, governance rules and financial regulations and enforcement

RISK – Inability to maximize probability of obtaining long-term performance objectives

R-SQUARED – Proportion of the total performance variation explained by all risk factors taken together

STANDARD DEVIATION – A statistical measure of the variability of a distribution of returns. It is one measure of the investment's riskiness.

SWAP – Arrangement between two entities to exchange one asset for another

TAIL RISK – The risk that a large movement in a portfolio's value is greater than what is implied is implied by traditional risk management measurements

VOLATILITY – Fluctuations in value of security, asset class or portfolio