TEACHERS' RETIREMENT BOARD

INVESTMENT COMMITTEE

SUBJECT: 2012 Asset Liability Study – Step 2: Approach to Risk Factor   ITEM NUMBER: 5
         Allocation Part 2

CONSENT: _____   ATTACHMENTS: 2

ACTION: _____   DATE OF MEETING: December 6, 2012 / *60 mins.*

INFORMATION: __X__   PRESENTERS: Allan Emkin
                                                     and Neil Rue, PCA

POLICY

This item is covered by the CalSTRS Board Policy Manual, Section 1000, Page A-1: Investment Policy & Management Plan, (IPMP).

HISTORY OF THE ITEM

CalSTRS reviews our asset allocation targets once every three years through a full asset / liability (A/L) study. The 2012 study will transpire over several Investment Committee meetings in the next fiscal year:

Preliminary Agenda for 2012 Asset-Liability Project

September	Investment Return Objectives, Investment Objectives and Philosophy
November	Introduction of risk allocation across asset types
December	Continued discussion of risk class allocation across asset types
January 2013	Review of risk allocations and introduction of Capital Market assumptions and asset class constraints
February	Discuss and approve asset classes, capital market assumptions, and asset class constraints Review objectives - decision factors
April	Presentation of CalSTRS A/L Model Interactive sensitivity analysis of objective / decision factors
June	Approve factor weightings, select policy portfolio and set allowable ranges
July	Formally adopt the strategic asset class targets into the Investment Policy & Management Plan

PURPOSE OF THIS AGENDA ITEM

The purpose of this step is to continue the brief discussion from the November Committee meeting regarding risk class exposures and potential portfolio structures by risk classes.

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BACKGROUND

CalSTRS has enhanced its normal asset / liability study to include analysis of its investments by their expected risk factors. This effort is fairly new to the institutional investment industry and has been closely followed by the industry press. The 2012-2013 Asset / Liability study will be a multi-dimensional effort, looking at investments by (i) their exposures to macroeconomic risk factors (ii) their impact upon specific system-level objectives and concerns (i.e., using "decision factors"), and (iii) through a traditional Modern Portfolio Theory framework. When using Modern Portfolio Theory (MPT), an investor views risk as principally defined by one term, standard deviation (or total volatility); the risk factor approach will help the Investment Committee view risk across several key macroeconomic risks and consider additional allocation opportunities to several sub-asset class sectors.

The beginning of the 2012-2013 study has been devoted to the new risk class perspective. Starting with this meeting and subsequent meetings, the traditional MPT approach will be woven into the process. As the A/L study draws to the conclusion, various asset mixes could be viewed in traditional MPT terms as well as from a risk class perspective. The challenge will be optimizing an asset mix in MPT versus a balanced risk factor approach.

CALSTRS RISK STRUCTURE

In the fall of 2010, the Investment Committee heard several presentations on risk-oriented asset allocation; this included agenda items at the September and November meetings, (the hyperlinks connect to the past agenda items). This effort culminated in CalSTRS adopting six risk factors and then incorporating them into the overall Investment Policy and Management Plan.
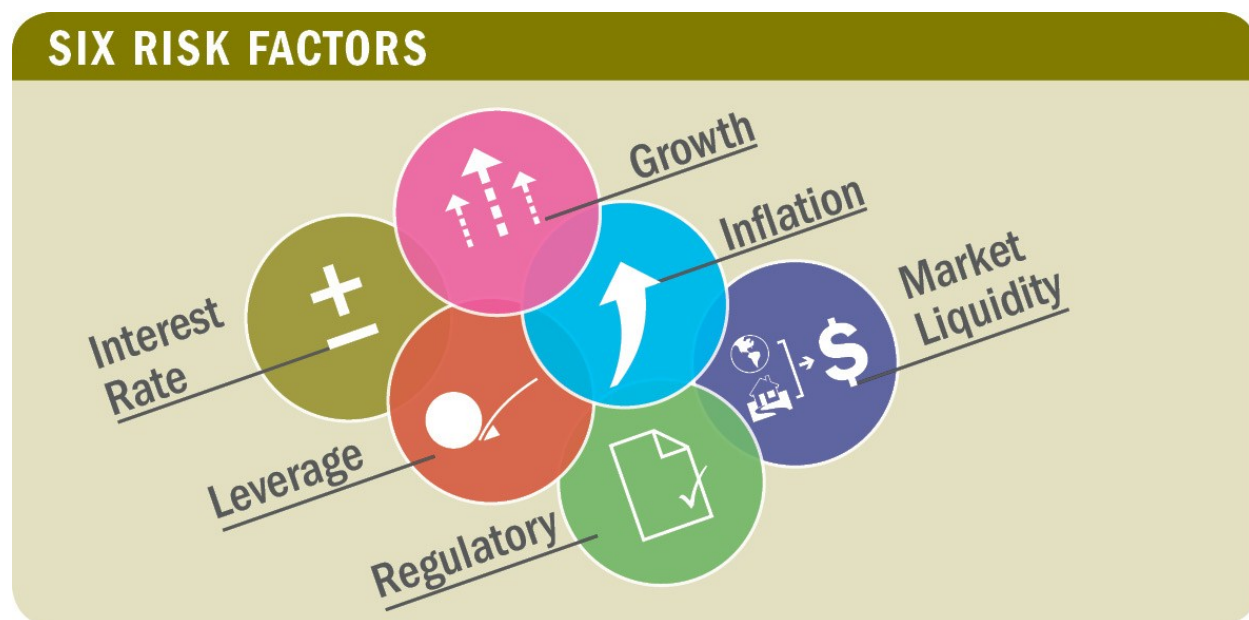
Commencing in the 3rd Quarter of 2012, the Investment Branch now publishes the investment portfolio's exposure to these factors in the Quarterly Reports. The information is included in the quarterly Chief Investment Officer's Market update and Asset Allocation report.

DISCUSSION

At the November meeting, Pension Consulting Alliance (PCA) presented several charts looking at the investment portfolio from a risk allocation framework. They showed that returns can vary dramatically based on different macroeconomic environments of high and low GDP growth and periods of high and low inflation.

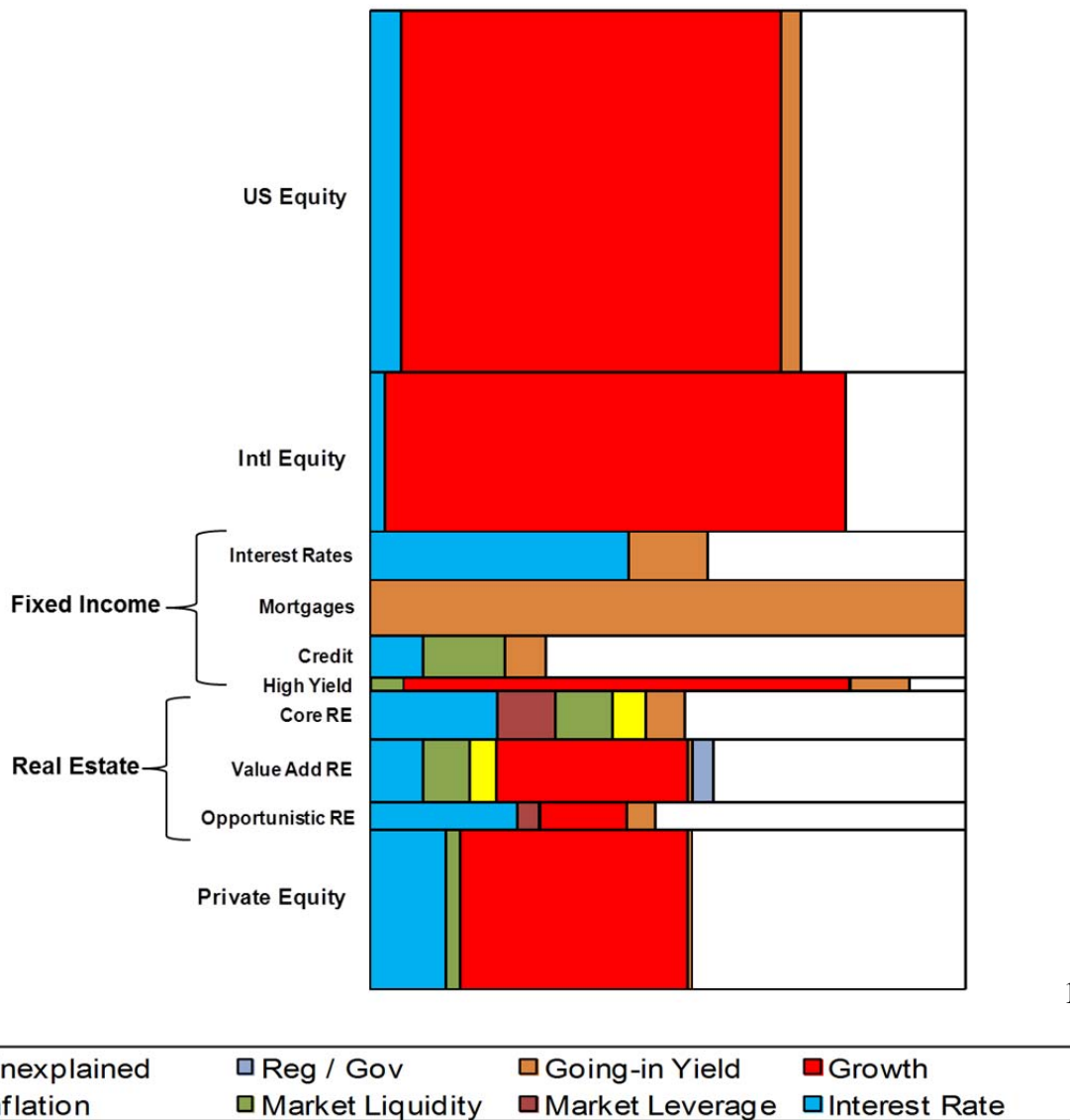|	Class	Full Horizon Assumptions*			Inflation & Growth Regime Assumptions**							
					High Inflation High Growth*		High Inflation Low Growth*		Low Inflation Low Growth*		Low Inflation High Growth*	
		Exp Geo	Expected Risk	History (years)	Exp Geo	Expected Risk	Exp Geo	Expected Risk	Exp Geo	Expected Risk	Exp Geo	Expected Risk
Strategic Classes	Public Equity	8.2%	18.5%	42	12.7%	14.9%	2.9%	19.2%	4.4%	23.6%	12.5%	15.2%
	Fixed Income	2.8%	4.5%	42	3.3%	4.8%	3.6%	6.8%	2.9%	3.3%	1.6%	3.4%
	Private Equity	10.0%	26.0%	42	13.7%	24.3%	7.7%	29.5%	5.4%	29.4%	12.9%	23.6%
	STRS Real Estate	7.8%	18.2%	42	11.8%	6.4%	13.0%	14.1%	-1.9%	24.0%	8.9%	12.3%
Major Components	US Equity	8.0%	18.0%	42	7.7%	16.9%	6.3%	20.5%	5.3%	23.2%	12.6%	11.1%
	Intl. Equity	8.1%	21.0%	42	15.3%	17.2%	0.0%	18.4%	4.0%	24.3%	12.7%	21.9%
	Interest Rates	1.5%	2.5%	42	1.7%	2.6%	2.9%	2.9%	1.0%	2.2%	0.6%	2.1%
	Mortgages	1.7%	3.7%	42	2.3%	3.6%	2.5%	6.4%	1.2%	2.1%	0.7%	2.0%
	Credit	4.0%	6.5%	42	4.9%	6.1%	3.8%	10.2%	4.8%	5.6%	2.5%	4.3%
	High Yield	4.2%	11.7%	42	3.1%	8.9%	2.3%	13.2%	7.4%	16.3%	3.3%	5.6%
	Core RE	6.9%	14.3%	42	10.6%	8.0%	10.0%	16.0%	0.7%	19.6%	7.7%	9.9%
	Value Added RE	7.1%	20.0%	42	12.7%	11.2%	11.5%	22.4%	-2.0%	27.4%	8.4%	13.9%
	Opportunistic RE	9.0%	20.8%	42	14.8%	15.3%	13.5%	23.2%	-0.5%	28.4%	10.4%	14.4%

*Capital market assumptions are preliminary and subject to change after 12/31/2012.

**Regime assumptions determined by adjusting historical time series to forward looking assumptions and then arranging the modified time series into periods of high and low inflation/gdp growth with "high" meaning above-median of entire history and "low" meaning below-median of entire history.

PCA also demonstrated that our asset classes are exposed to a variety of our risk factors. Importantly, asset classes do not represent "pure" exposures to a specific type of macroeconomic risk. One asset class can be "infected" by numerous risk factors, some of which may be unintended.

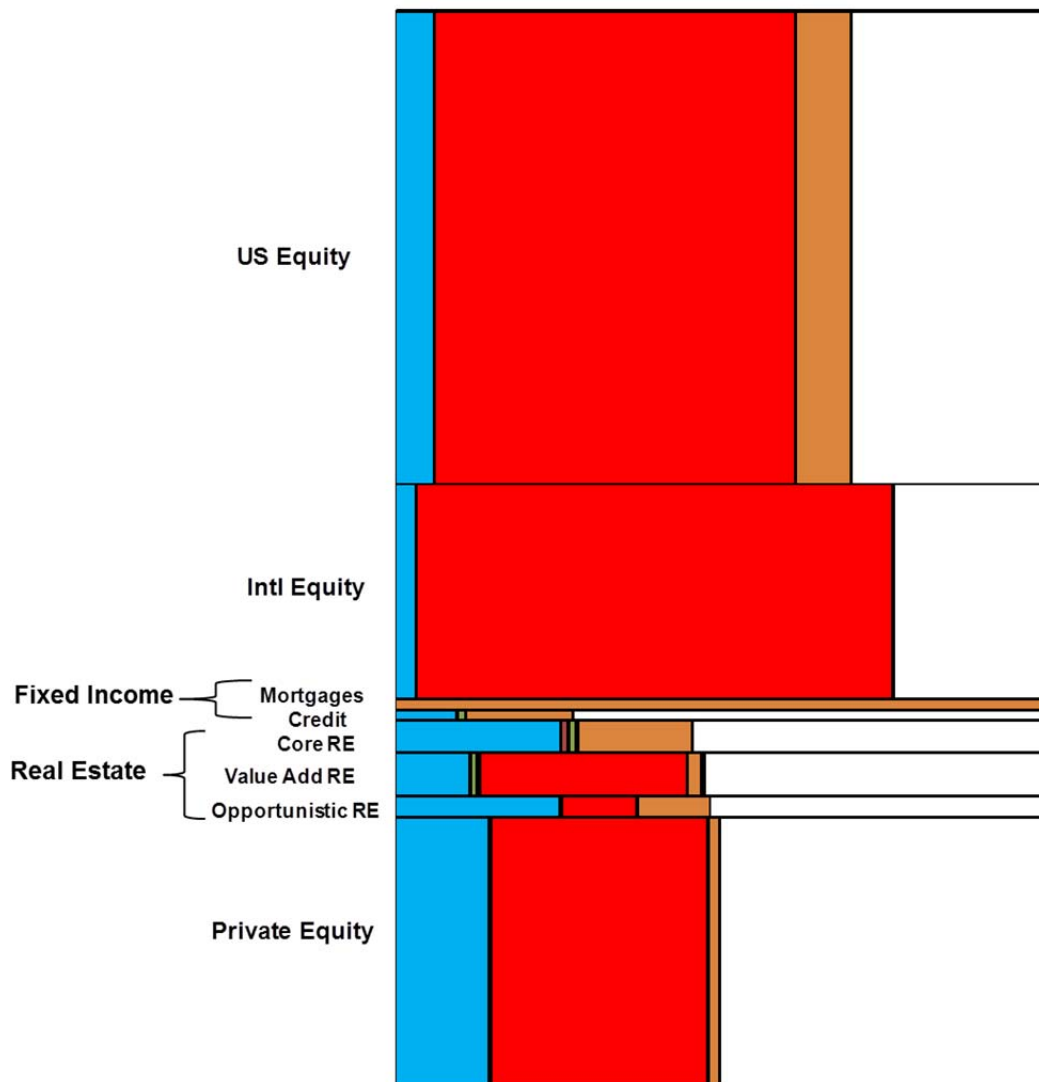Individual Class Risk Exposures, Stand-Alone Basis
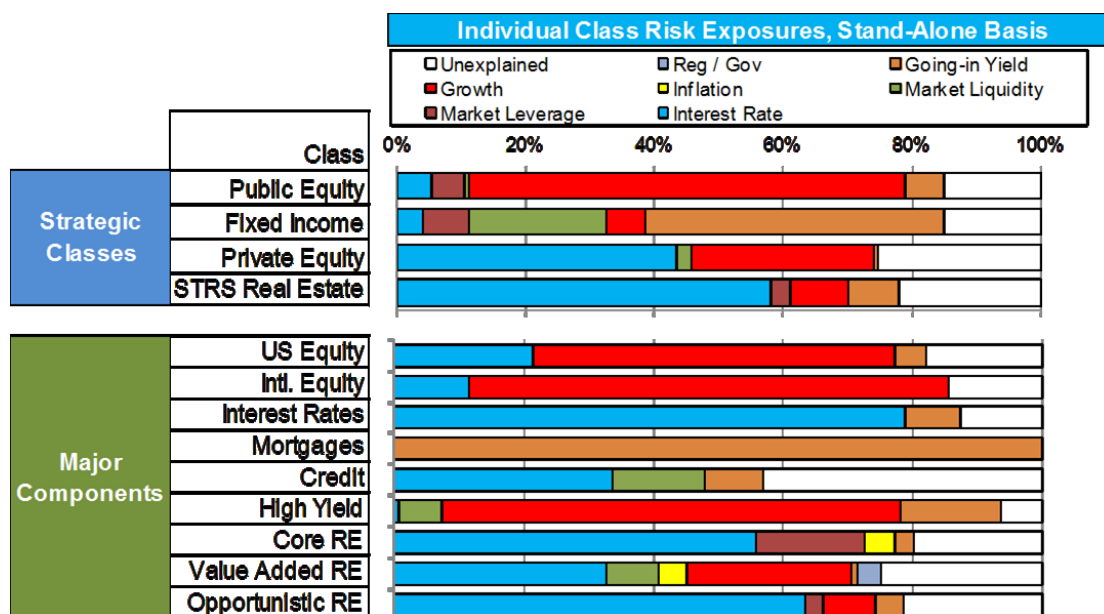
When the asset classes are viewed by the amount of dollars allocated (represented by the height of the box) and their core risk factor exposure (represents by the respective colors) the portfolio appears to have a modicum of balance across the risk factors.

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| ☐ Unexplained | ☐ Reg / Gov | ☐ Going-in Yield | ■ Growth |
| ☐ Inflation | ■ Market Liquidity | ■ Market Leverage | ■ Interest Rate |

However, when PCA reconfigured the assets by their contribution to overall portfolio risk, that schematic exhibited some key shifts. The result, which is displayed on the next page, shows that the Fixed Income and Real Estate areas, which exhibit different types of risk exposures, are now smaller due to their inherently lower levels of volatility. The resulting picture shows a more realistic view of portfolio's true risk exposure and heavy tilt toward economic growth followed by interest rates. As discussed at the meeting, staff has noted several times that the CalSTRS Portfolio does extremely well during high and moderate GDP growth and the two-decade-long decline in interest rates. This served the Fund well in the decade of the 80's, 90's, and the middle

1 Source PCA PowerPoint November 9, 2012 CalSTRS Investment Committee

of the 2000's, but causes severe underperformance during economic recessions or when interest rates increase.

CalSTRS Strategic Allocation by Risk Contribution

Source: PCA

This analysis shows that the investment portfolio has very little exposure to the other risk factors and several of the asset classes do not contribute to the overall macro risk diversification. Modern Portfolio Theory tells us that we have achieved diversification based on past correlations and standard deviations, but as the vast majority of institutional and individual investors experienced in 2008, correlations are not static and in a global crisis the diversification disappears.

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For the December meeting, PCA has developed Attachment 1, which looks at various strategic classes designed to capture different market risk environments:

- Strong economic growth
- Volatile risk environment
- Poor equity market
- Rising interest rates
- Volatile interest rates
- Inflation

In addition, PCA's presentation will provide an initial analysis of preliminary optimal portfolios formulated under both the asset class and risk class frameworks. At this point of the study, the optimizations do not explicitly account for CalSTRS' liabilities. They do, however, provide an initial indication of the merits and efficacy of the risk class approach. Optimizations are examined under two versions of risk: (i) the traditional standard deviation (total volatility) measure and (ii) a downside risk measure. Under the assumption of normal (i.e., symmetric) distributions both measures would produce the same optimal portfolios. Over the course of this asset-liability study, however, PCA does not rely on the normal distribution assumption. Instead, PCA's assumptions reflect the *actual behavior* of each investment class (asset-based or risk-based) overlayed with forward-looking long-term views about the expected return-and-risk tradeoffs of each class. PCA then applies simulation procedures to project expected class and portfolio behavior as well as determine optimal portfolios given certain return/risk criteria. For this specific presentation, PCA determines optimal portfolios using the return-and-risk characteristics of CalSTRS' current policy portfolio as the baseline reference point.

From this analysis, there is evidence that utilizing a risk class-based framework for structuring portfolios may yield better risk-adjusted portfolios than the traditional asset class-based framework. These initial findings are in addition to the more qualitative benefits of having a portfolio strategy that more directly reflects specific macroeconomic risks.

Caveats on the report:

While there are several caveats to the data, this paper was developed for illustrative purposes to help advance our discussion and to understand the efficacy of various investments in certain high risk environments.

Estimations - The report also shows estimates of geometric return, standard deviation and the best and worst annual returns for the various portfolios. These are estimates based on market behavior from 1970 through 2011. The following investment areas do not have return data for the entire period, so the returns were developed using the available history and then modeling procedures were utilized to back-fill the remaining period: Inflation Linkers (TIPS); Convertible Bonds; Bank Loans; Infrastructure; Emerging Market Debt; Agriculture; Hedge Funds and High Yield Bonds.

Recent period emphasis – the risk class portfolios and their risk exposures are strongly influenced by the last five years of actual history. Each portfolio's risk exposures will likely fluctuate in the future.

Sub-Asset Class Sectors – Several of the sub-asset class investments utilized in the report were just added as approved investments for the STRS portfolio in the last four years. As a result,

many are just starting up and have very small allocations given the mega size of the CalSTRS portfolio. While inflation linked bonds (TIPS) and infrastructure have begun to approach $1 billion of assets under management apiece, areas such as convertible bonds, commodities, and Global Macro hedge funds are limited to the Innovation portfolio, which by design is constrained to small investment amounts. Currently, Oil and Gas investments are part of the Private Equity and Global Equity portfolios but they are seeking equity-like returns that are linked to economic growth. Additionally, Bank Loans have a small allocation within the Fixed Income portfolio. Lastly, one of the portfolios has an allocation to Agriculture, which is one of several investment areas being researched by the Innovation team.

SUMMARY

As Allan Emkin of PCA has stated several times to the Investment Committee, if you seek to minimize risk you will reduce your return accordingly. As expected, the portfolio that seeks to generate the most positive results across all the risk environments and exhibits the lowest volatility, has one of the lowest expected geometric average returns. However, there do appear to be certain risk class-based optimal portfolios that outperform their asset class counterparts on a risk-adjusted basis. This finding begins to have intuitive appeal when there is recognition that actual investment portfolios do not necessarily conform to their mean-variance assumptions and, instead, can be driven (or at least influenced) by trending macroeconomic factors that can dominate the investment environment.

During 1Q 2013, PCA and staff expect to further analyze and incorporate the risk class structure into the asset-liability process. The outcome is likely to be the use of additional risk classes during the final stages of the asset-liability process occurring during 2Q 2013. If it is determined that additional risk classes do warrant allocation of assets, staff would begin working with the Investment Committee to implement the new classes. Such implementation would likely extend into 2014.
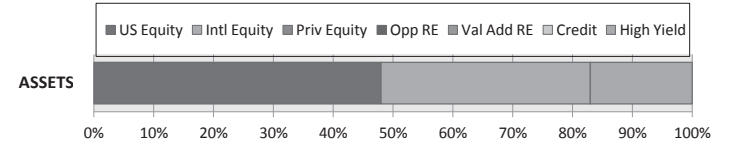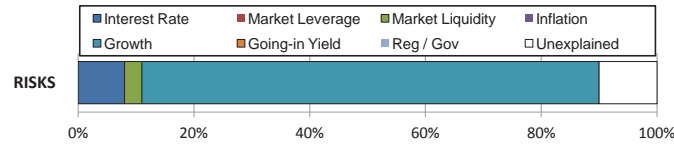
CONCLUSION

Senior Investment Staff and PCA will present and discuss findings of strategic allocation under a risk class-based framework, specifically in comparison to the traditional asset-based framework. This item allows the Committee to debate what type of framework to utilize going forward as well as which types of investments to include and exclude from the asset allocation study.

CalSTRS Custom Risk Classes - Unconstrained Optimization

Risk Class Growth Risk Oriented
Optimization Risk Factors
Constraints None
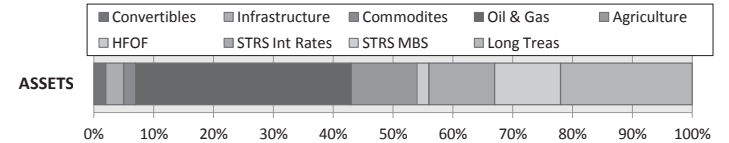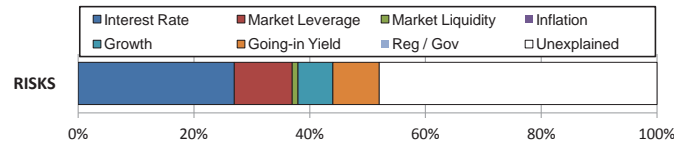**Assets Included** US Equity Intl Equity High Yield

Class heavily dependent on economic growth prospects.

RISKS
Legend: Interest Rate, Market Leverage, Market Liquidity, Inflation, Growth, Going-in Yield, Reg / Gov, Unexplained

ASSETS
Legend: US Equity, Intl Equity, Priv Equity, Opp RE, Val Add RE, Credit, High Yield

Class Modeled Exp: Geo. Ret: **7.5%** Vol (SD): **16.8%** Best Yr: **1985 36.1%** Worst Yr: **2008 -39.4%**

Risk Class Absolute Return Oriented
Optimization Risk Factors
Constraints None
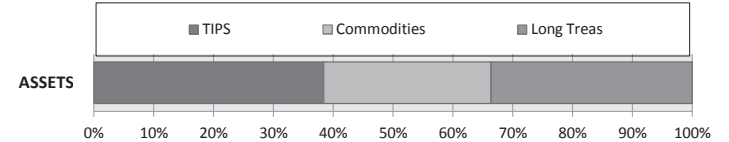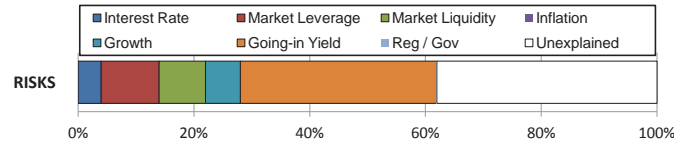**Assets Included** US Equity Intl Equity High Yield

Designed to produce positive returns regardless of risk environment.

RISKS
Legend: Interest Rate, Market Leverage, Market Liquidity, Inflation, Growth, Going-in Yield, Reg / Gov, Unexplained

ASSETS
Legend: Convertibles, Infrastructure, Commodites, Oil & Gas, Agriculture, HFOF, STRS Int Rates, STRS MBS, Long Treas

Class Modeled Exp: Geo. Ret: **4.5%** Vol (SD): **4.9%** Best Yr: **2005 14.4%** Worst Yr: **2008 -8.4%**

Risk Class Equity Risk Diversifying
Optimization Risk Factors
Constraints None
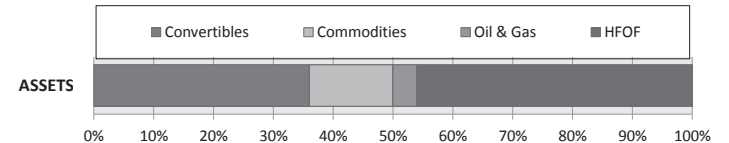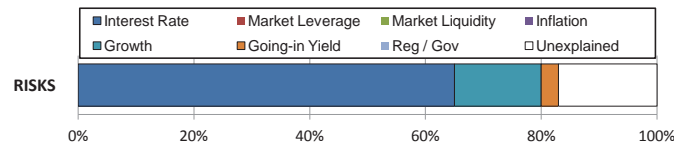**Assets Included** US Equity Intl Equity High Yield

Designed to produce positive returns when equities are performing poorly.

RISKS
Legend: Interest Rate, Market Leverage, Market Liquidity, Inflation, Growth, Going-in Yield, Reg / Gov, Unexplained

ASSETS
Legend: TIPS, Commodities, Long Treas

Class Modeled Exp: Geo. Ret: **3.2%** Vol (SD): **6.9%** Best Yr: **1973 19.5%** Worst Yr: **2008 -11.3%**

Risk Class Interest Rate Participation
Optimization Risk Factors
Constraints None
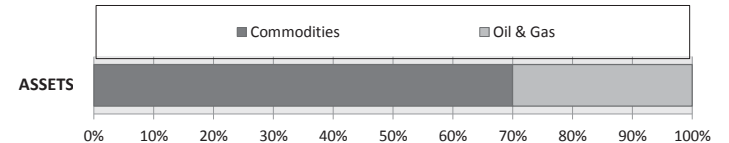**Assets Included** US Equity Intl Equity High Yield

Designed to produce positive returns when interest rates are rising.

RISKS
Legend: Interest Rate, Market Leverage, Market Liquidity, Inflation, Growth, Going-in Yield, Reg / Gov, Unexplained

ASSETS
Legend: Convertibles, Commodities, Oil & Gas, HFOF

Class Modeled Exp: Geo. Ret: **6.3%** Vol (SD): **9.2%** Best Yr: **1999 27.8%** Worst Yr: **2008 -30.9%**

Risk Class Interest Rate Risk Participation
Optimization Risk Factors
Constraints None
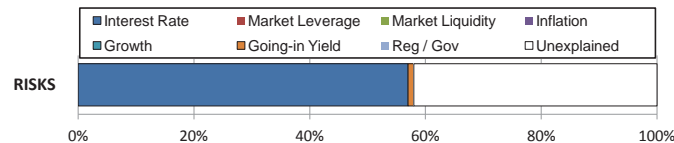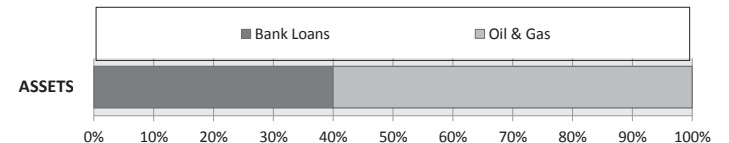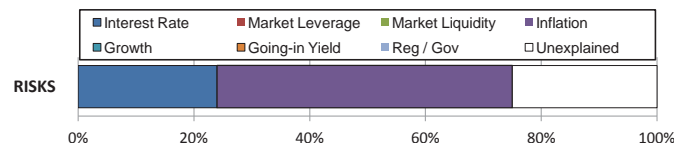**Assets Included** US Equity Intl Equity High Yield

Designed to produce positive returns when the interest rates environment is volatile.

RISKS
Legend: Interest Rate, Market Leverage, Market Liquidity, Inflation, Growth, Going-in Yield, Reg / Gov, Unexplained

ASSETS
Legend: Commodities, Oil & Gas

Class Modeled Exp: Geo. Ret: **6.3%** Vol (SD): **17.5%** Best Yr: **1973 42.7%** Worst Yr: **2008 -45.6%**

Risk Class Inflation Risk Participation
Optimization Risk Factors
Constraints None
Assets Included US Equity Intl Equity High Yield

Designed to produce positive returns when inflation uncertainty is high.

RISKS
Legend: Interest Rate, Market Leverage, Market Liquidity, Inflation, Growth, Going-in Yield, Reg / Gov, Unexplained

ASSETS
Legend: Bank Loans, Oil & Gas

Class Modeled Exp: Geo. Ret: **7.2%** Vol (SD): **11.3%** Best Yr: **1975 26.5%** Worst Yr: **2008 -29.5%**

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