Investment and Actuarial Risk Considerations of Preliminary Candidate Portfolios

Actuarial Office
Asset Allocation/Risk Management

November 12, 2013

Preliminary Candidate Portfolios Reflect Investment Beliefs

All investment decisions must be grounded in our Investment Beliefs

Investment Belief 1: Liabilities must influence the asset structure

- Ensuring the ability to pay promised benefits by maintaining an adequate funding status is the primary measure of success for CalPERS

Investment Belief 6: Strategic asset allocation is the dominant determinant of portfolio risk and return

- CalPERS will aim to diversify its overall portfolio across distinct risk factors / return drivers

Preliminary Candidate Portfolios Reflect Investment Beliefs *Continued*

Investment Belief 7: CalPERS will take risk only where we have a strong belief we will be rewarded for it

- An expectation of a return premium is required to take risk; CalPERS aims to maximize return for the risk taken

Investment Belief 9: Risk to CalPERS is multi-faceted and not fully captured through measures such as volatility or tracking error

- CalPERS shall develop a broad set of investment and actuarial risk measures and clear processes for managing risk
- The path of returns matters, because highly volatile returns can have unexpected impacts on contribution rates and funding status

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Executive Summary

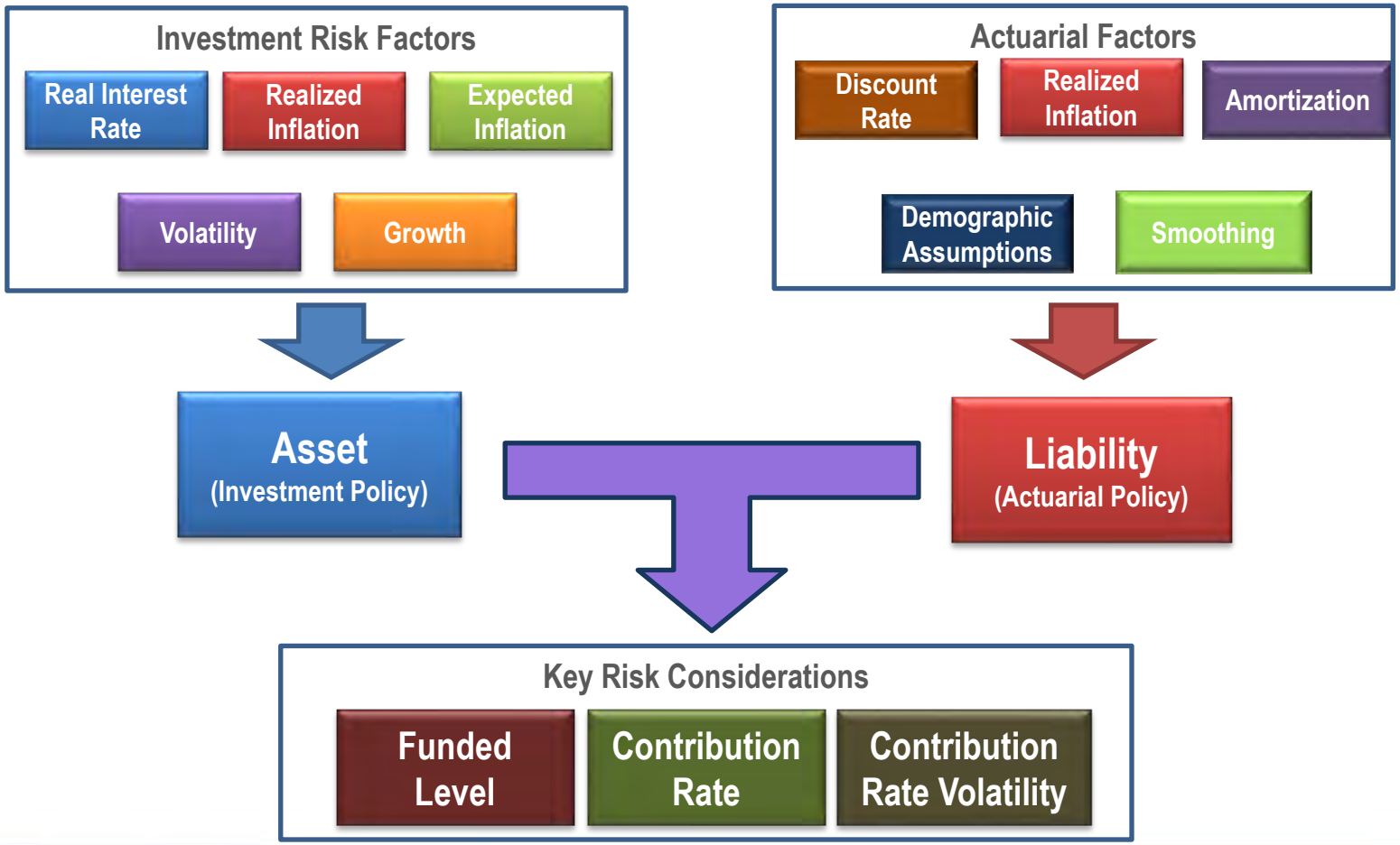
Purpose of Analysis:

- A better understanding of the impact of investment risk on the ***employer contribution rate*** and the ***funded level*** of the Public Employees' Retirement Fund (PERF)

Analysis Revealed:

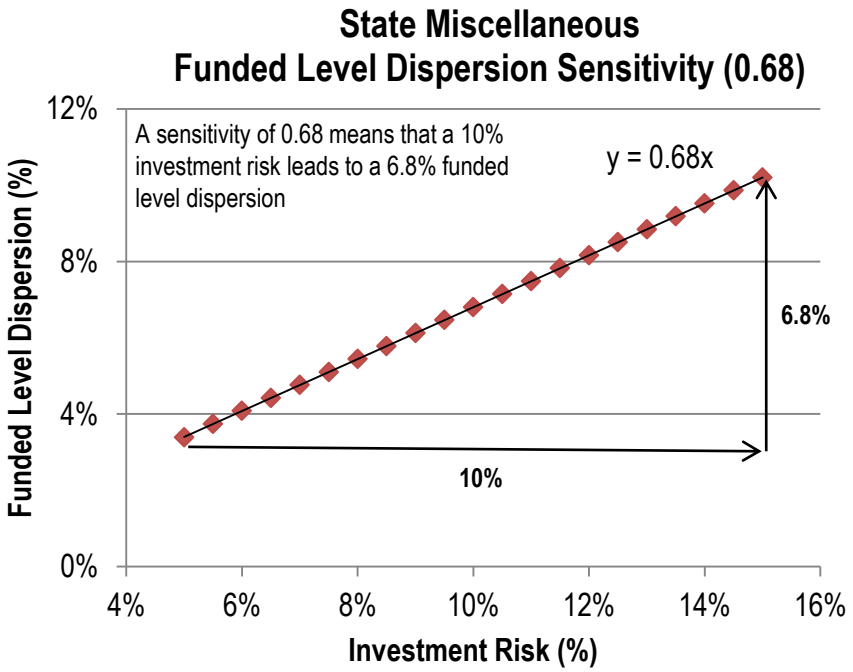
- A positive relationship between investment risk, the funded level dispersion and the contribution rate dispersion
- The sensitivity of funded level dispersion to investment risk is closely related to the current funded level
- The sensitivity of contribution rate dispersion to investment risk is closely related to the current asset-to-payroll ratio multiplied by the discount rate

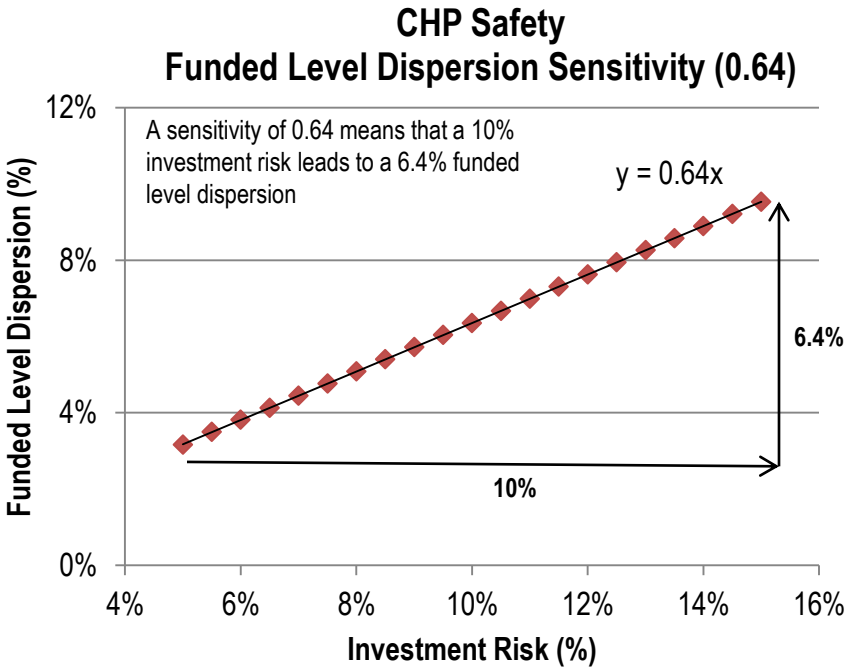
Factors and Key Risk Considerations



Sensitivity of Funded Level Dispersion to Investment Risk

Strong positive relationship between investment risk[1] and funded level dispersion[2]





[1] Investment risk is defined as the standard deviation of investment returns.

[2] The funded level dispersion is defined as the standard deviation of changes of funded level. The first year simulation data from ACTO was used to illustrate the relationship between funded level dispersion and investment risk.

Estimated Funded Level Dispersion Sensitivity

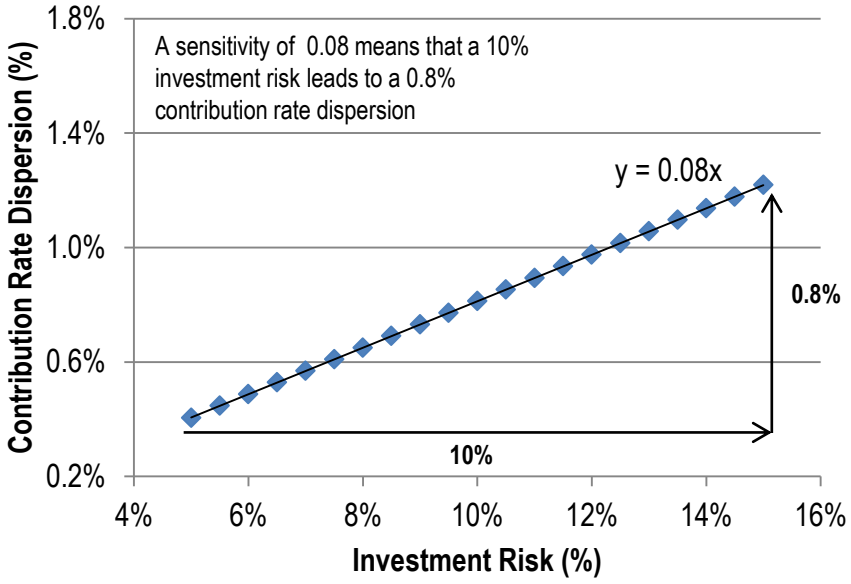
As funded level improves, the pension plan is more sensitive to investment risk

Plan	Sensitivity From Regression	Current Estimated Funded Level
State Miscellaneous	0.68	0.69
PA Miscellaneous	0.71	0.73
Schools	0.75	0.76
CHP Safety	0.64	0.64
PA Safety	0.70	0.71
POFF Safety	0.67	0.68

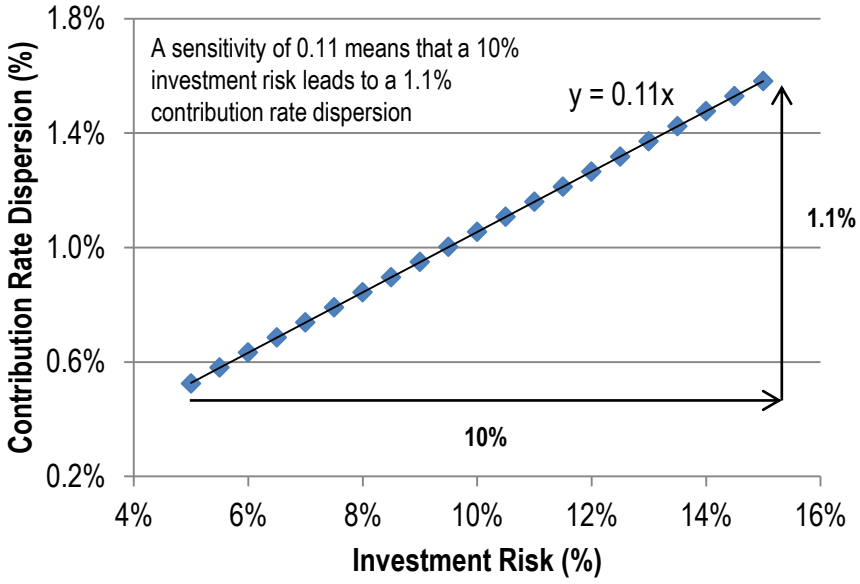
Sensitivity of Employer Contribution Rate Dispersion to Investment Risk

Strong positive relationship between investment risk and contribution rate dispersion[2]

State Miscellaneous
Contribution Rate Dispersion Sensitivity (0.08)[1]



CHP Safety
Contribution Rate Dispersion Sensitivity (0.11)[1]



[1]This estimation is only for the first year where the smoothing effect only accounts for 20% of obligation (5-year smoothing). By the fifth year, the impact will be five times this estimated value.

[2]. The contribution rate dispersion is defined as the standard deviation of changes of employer contribution rates.

Estimated Contribution Rate Dispersion Sensitivity

The contribution rate dispersion of a pension plan with a higher asset-to-payroll ratio is more sensitive to investment risk

Plan	Sensitivity From Regression	Estimated Sensitivity*	Discount Rate	Asset-to-Payroll Ratio
State Miscellaneous	0.08	0.09	7.5%	5.75
PA Miscellaneous	0.07	0.07	7.5%	4.58
Schools	0.07	0.07	7.5%	4.63
CHP Safety	0.11	0.11	7.5%	7.39
PA Safety	0.11	0.11	7.5%	7.49
POFF Safety	0.10	0.10	7.5%	6.80

* $Estimate = (0.2) \cdot [(Discount\ Rate) \times (Asset\ to\ Payroll\ Ratio)]$, where the (0.2) accounts for the current actuarial smoothing effect

Summary

Analysis Revealed

- Potential linear relationships between investment risk and the dispersion of contribution rate and funded level

Analysis Suggests

- Investment risk has direct impacts on funded level and contribution rates, especially for plans with high current funded level, which highlights the importance of de-risking

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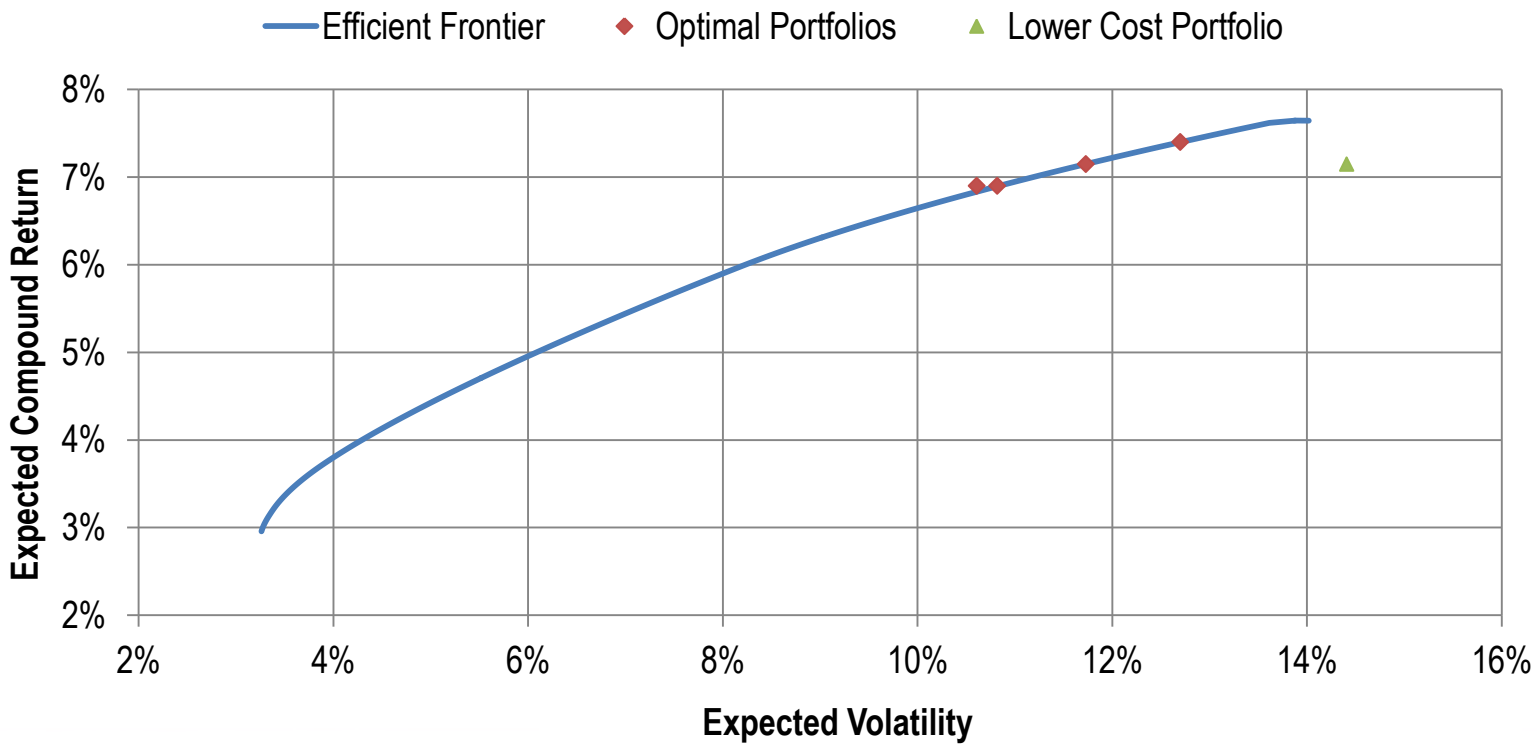
Efficient Frontier

Range of portfolio choice is narrow given the current funded level and the 2013 capital market assumptions (CMAs)



Preliminary Candidate Portfolios

Four portfolios on the efficient frontier and a public asset only portfolio to illustrate the impact of portfolio choice on the key risk considerations

Asset Allocation of Preliminary Candidate Portfolios					
Asset Class Component	Lower Risk Alt[1]	Lower Risk	Base Case	Higher Return	Lower Cost[2]
Global Equity	38.5%	40.5%	46.5%	53.0%	81.0%
Private Equity	12.0%	12.0%	12.0%	12.0%	0.0%
Fixed Income	23.5%	24.5%	18.5%	15.0%	15.0%
Real Estate	11.0%	11.0%	11.0%	11.0%	0.0%
Infrastructure and Forestland (Infra. & Forest)	2.0%	2.0%	2.0%	2.0%	0.0%
Inflation Assets	6.0%	6.0%	6.0%	3.0%	4.0%
Liquidity	2.0%	2.0%	2.0%	2.0%	0.0%
Absolute Return Strategies (ARS)	5.0%	2.0%	2.0%	2.0%	0.0%
Expected Compound Return (1-10 yrs.) :	6.90%	6.90%	7.15%	7.40%	7.15%
Blended Return (1-60 yrs.)[3] :	7.38%	7.36%	7.57%	7.77%	7.53%
Expected Volatility :	10.61%	10.82%	11.73%	12.70%	14.41%

[1]Lower Risk Alternative portfolio raised the ARS cap constraint from 2% to 5%.
[2]Lower Cost portfolio only contains public assets.
[3]Blended return is the combination of the short-term (1 to 10 year from CMAs) and the long-term (11 to 60 year from ACTO) expected returns after deducting administrative fees.

Key Risk Considerations

Key risk consideration thresholds are different for various CalPERS plans:

- Employer Contribution Rate: The payment rate made to the plan by the plan sponsor
- Employer Contribution Rate Volatility: The expected annual change of the payment rate made to the plan by the plan sponsor
- Funded Level: The market value of assets divided by the accrued liabilities

- These thresholds illustrate the impacts of portfolio choice on key risk considerations

Key Risk Consideration Thresholds						
	State Misc.	PA[1] Misc.	Schools	CHP[2]	PA[1] Safety	POFF[3]
Employer Contribution Rate	35%	35%	35%	45%	45%	45%
Employer Contribution Rate Volatility	3%	3%	3%	5%	5%	5%
Funded Level	50%	50%	50%	50%	50%	50%

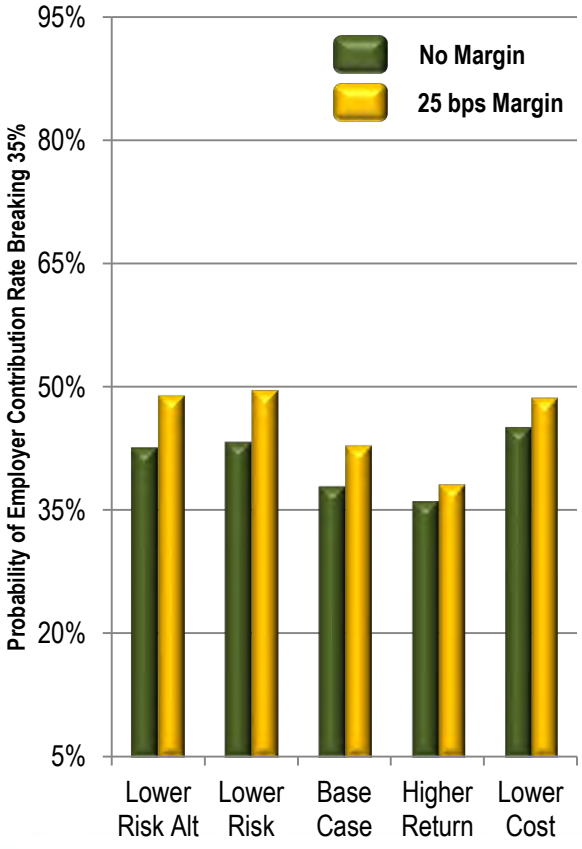
[1]Public Agency (PA)
[2]California Highway Patrol (CHP)
[3]Peace Officers and Fire Fighters (POFF)

Higher Expected Return Comes With Higher Volatility

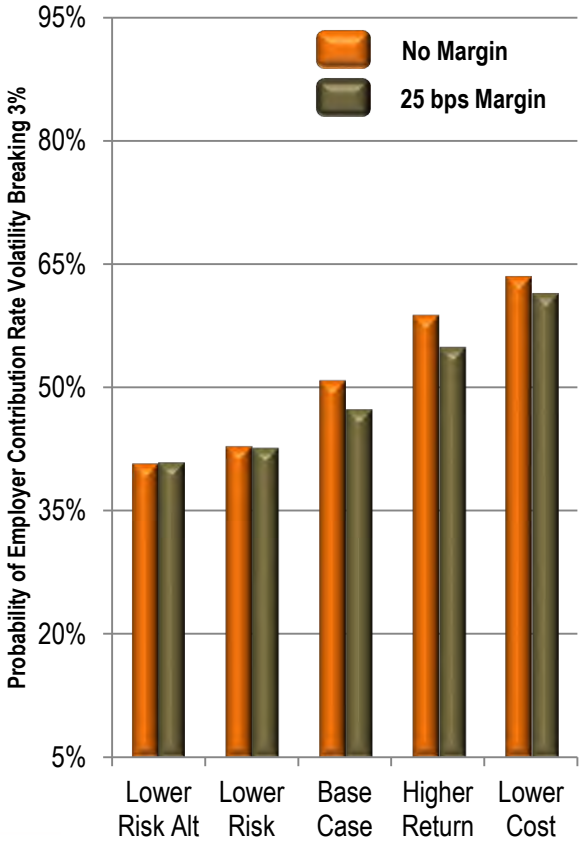
- A portfolio with higher expected return could lead to a lower employer contribution rate
- However, as expected return increases, volatility increases, which also increases the volatilities of the employer contribution rate and funded level
- Margin represents a reduction in the assumed discount rate to account for adverse events that helps protect the long-term security of our members' benefits.

State Miscellaneous

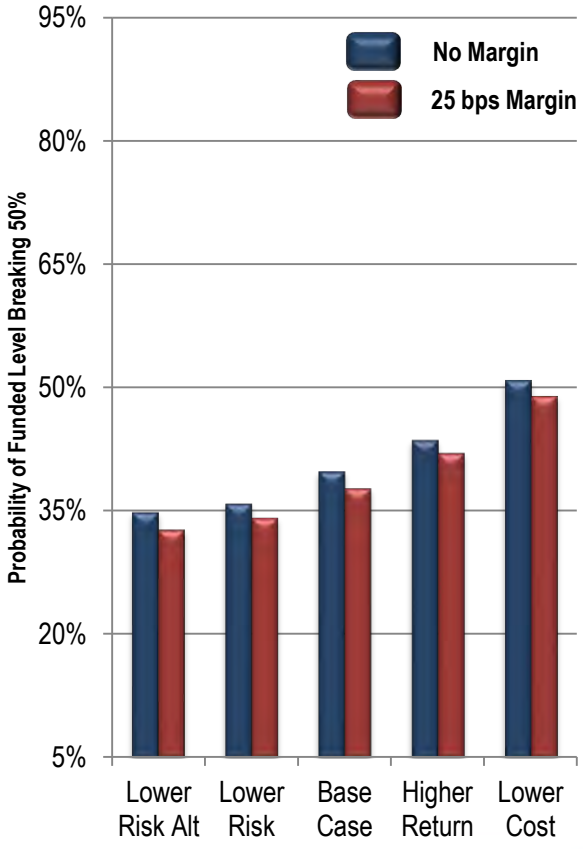
Probability of Employer Contribution Rate Exceeding 35%



Probability of Employer Contribution Rate Volatility Exceeding 3%



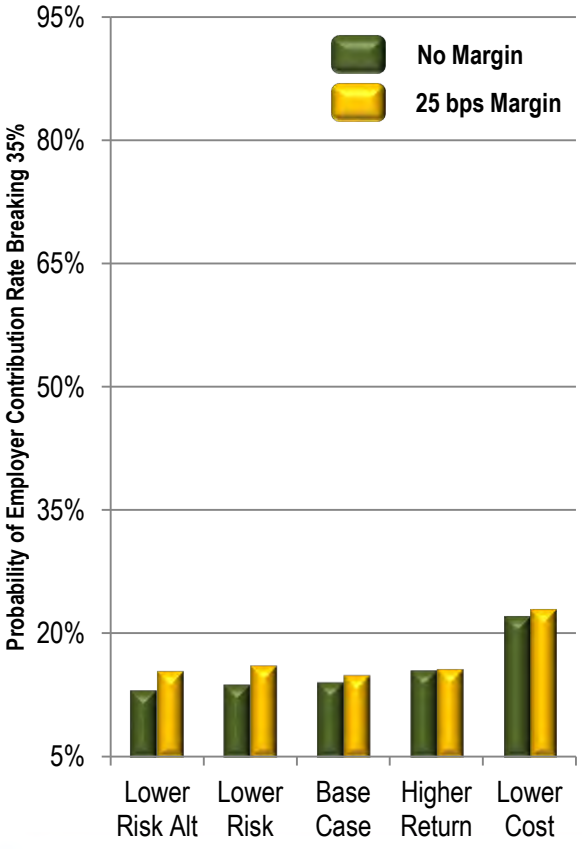
Probability of Funded Level Falling Below 50%



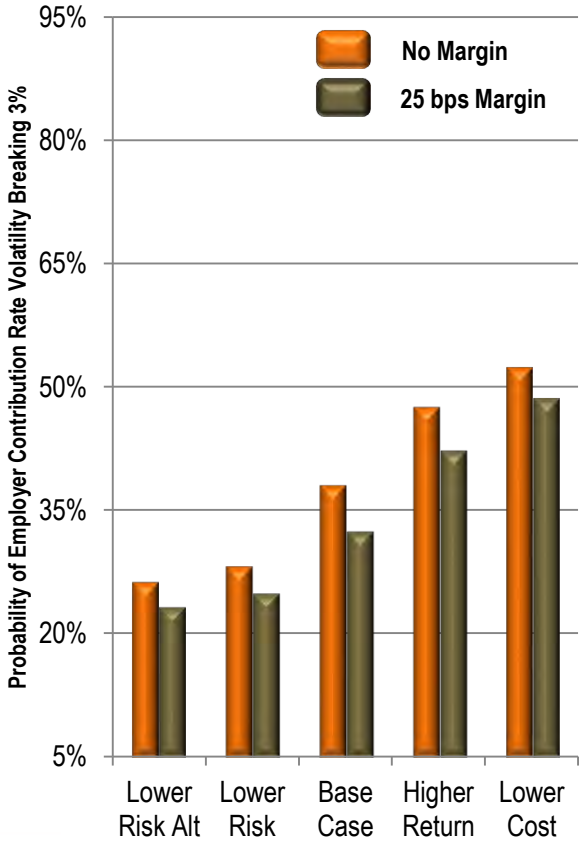
State Miscellaneous Expected Employer Contribution Rate (FY 2013-14) is 21.12%
State Miscellaneous Funded Level (as of 06/30/2012) is 66.3%
(Source: http://www.calpers.ca.gov/eip-docs/about/pubs/employer/2012-st-body.pdf)

PA Miscellaneous

Probability of Employer Contribution Rate Exceeding 35%



Probability of Employer Contribution Rate Volatility Exceeding 3%



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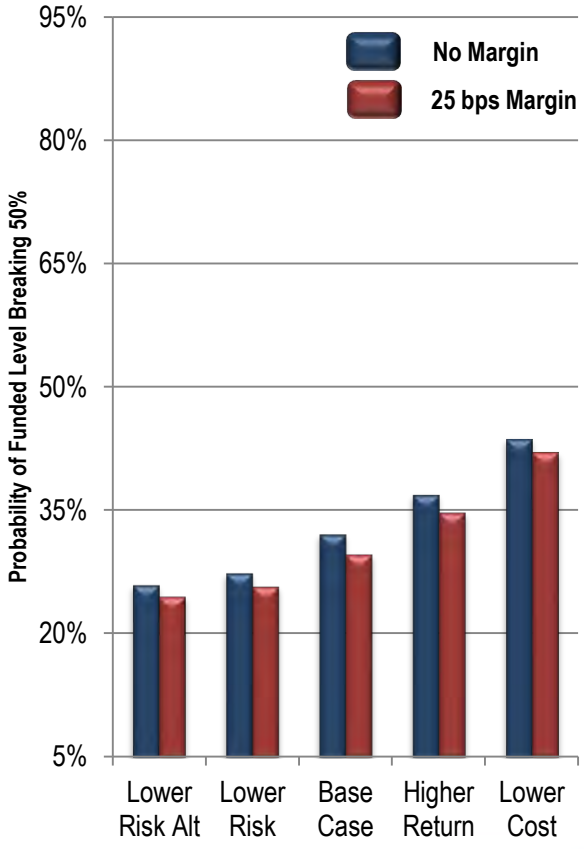
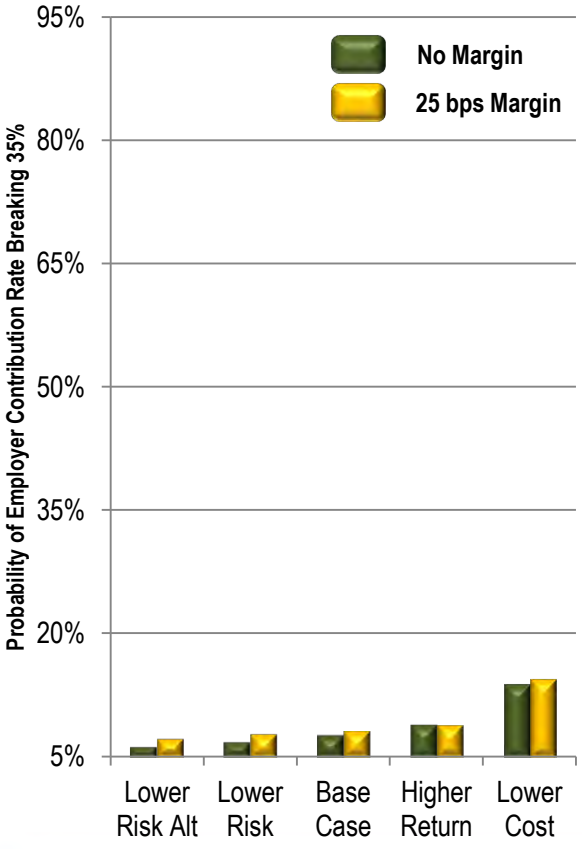


CalPERS Investment Office
Asset Allocation/Risk Management

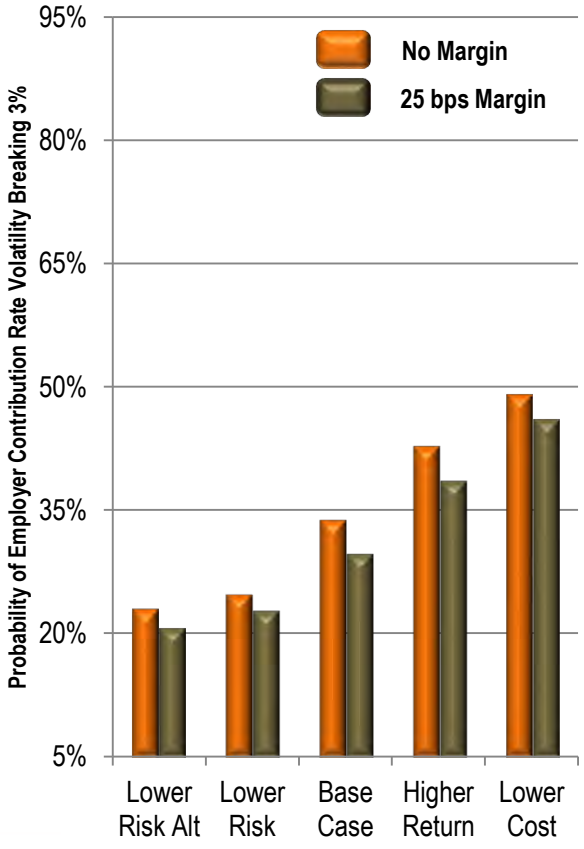
PA Miscellaneous Expected Employer Contribution Rate is 16.84%
PA Miscellaneous Funded Level is 69.0%
(Source: Projections from ACTO office because official values are not available)

Schools

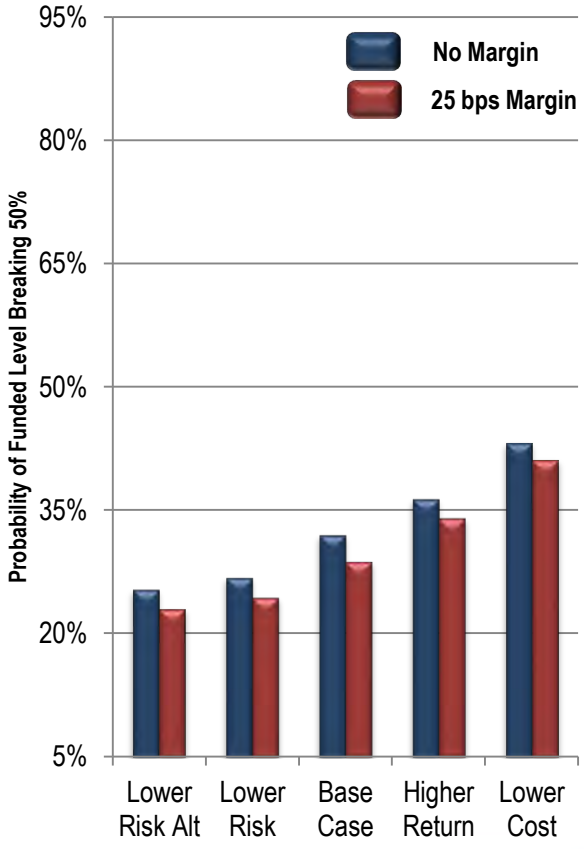
Probability of Employer Contribution Rate Exceeding 35%



Probability of Employer Contribution Rate Volatility Exceeding 3%



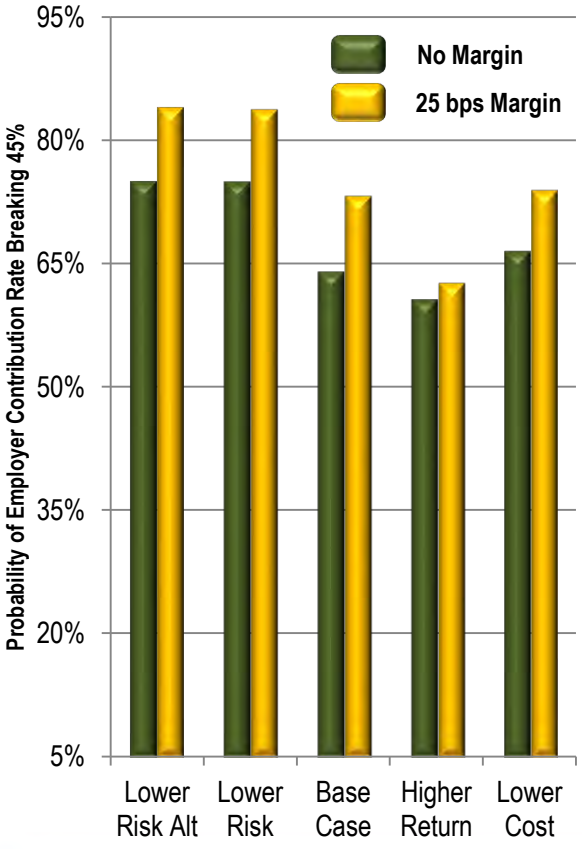
Probability of Funded Level Falling Below 50%



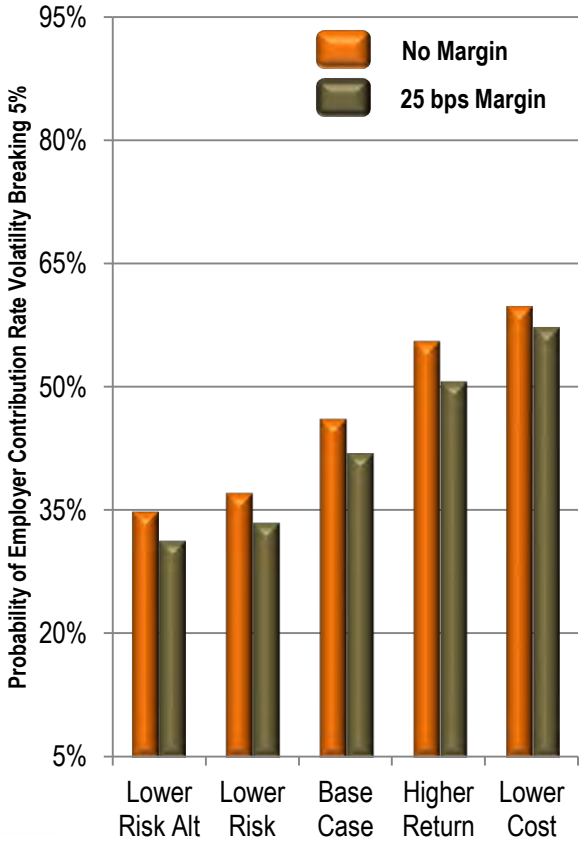
Schools Expected Employer Contribution Rate (FY 2013-14) is 11.44%
Schools Funded Level (as of 06/30/2012) is 75.5%
(Source: http://www.calpers.ca.gov/eip-docs/about/pubs/employer/2012-st-body.pdf)

CHP Safety

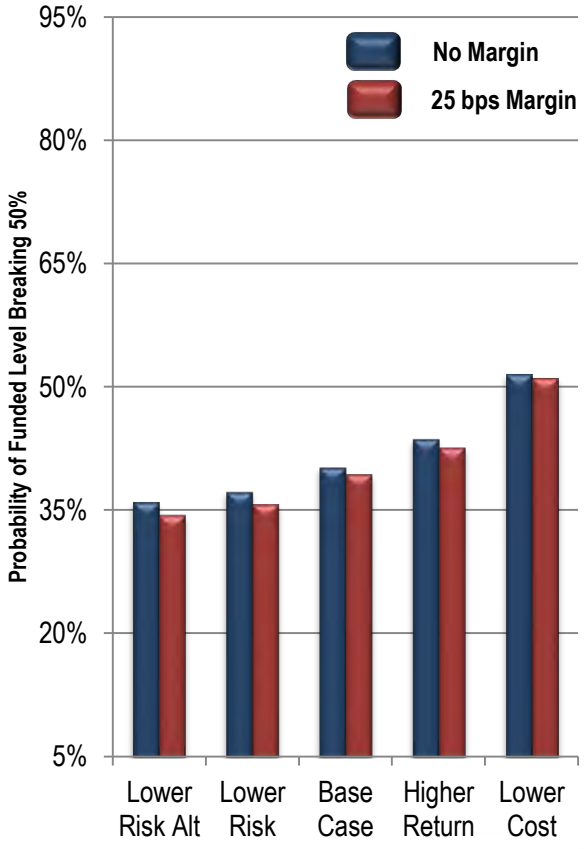
Probability of Employer Contribution Rate Exceeding 45%



Probability of Employer Contribution Rate Volatility Exceeding 5%



Probability of Funded Level Falling Below 50%

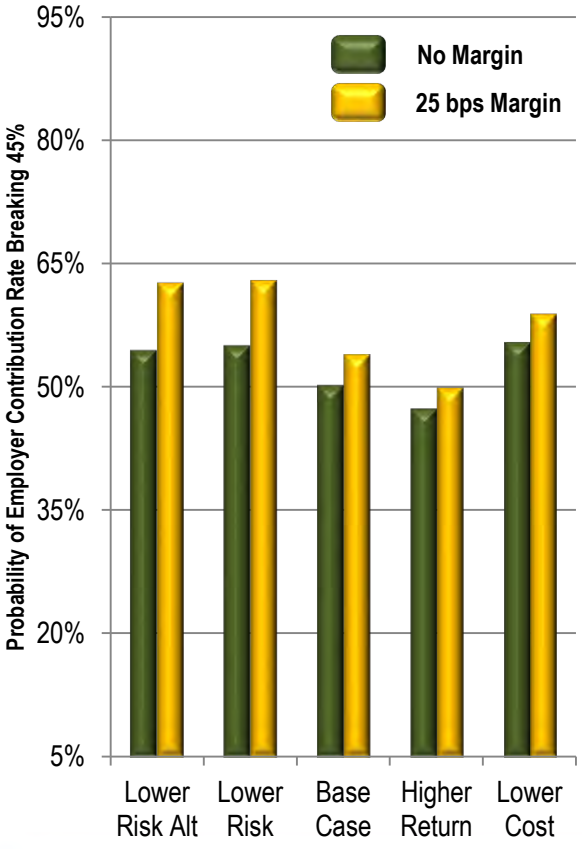


CalPERS Investment Office
Asset Allocation/Risk Management

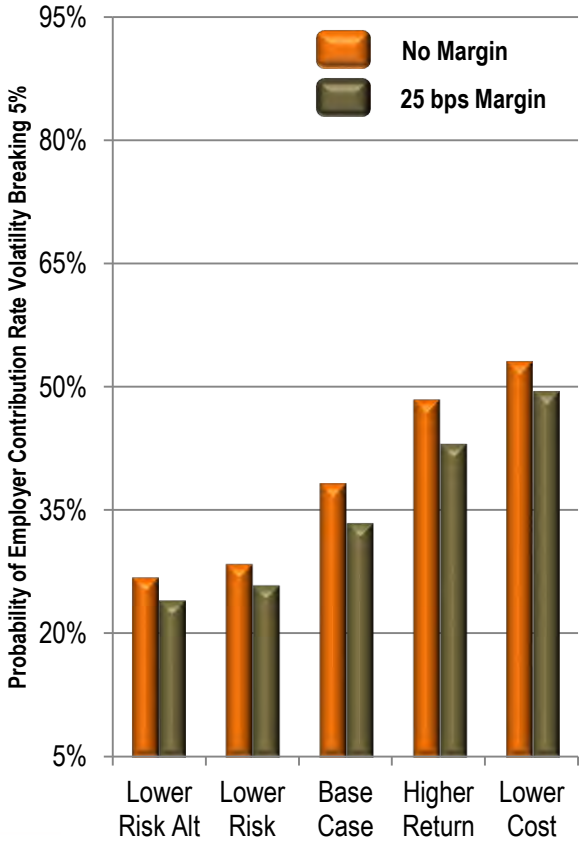
CHP Expected Employer Contribution Rate (FY 2013-14) is 34.62%
CHP Funded Level (as of 06/30/2012) is 60.3%
(Source: http://www.calpers.ca.gov/eip-docs/about/pubs/employer/2012-st-body.pdf)

PA Safety

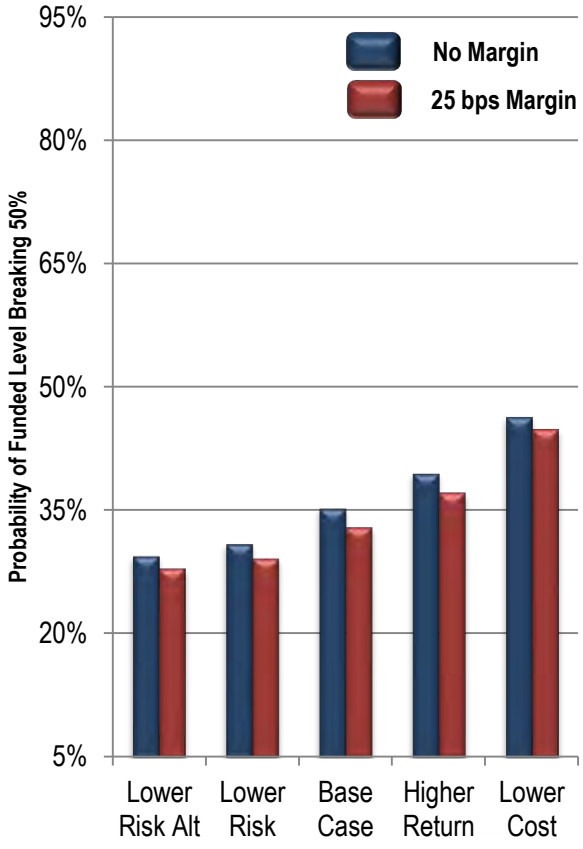
Probability of Employer Contribution Rate Exceeding 45%



Probability of Employer Contribution Rate Volatility Exceeding 5%



Probability of Funded Level Falling Below 50%

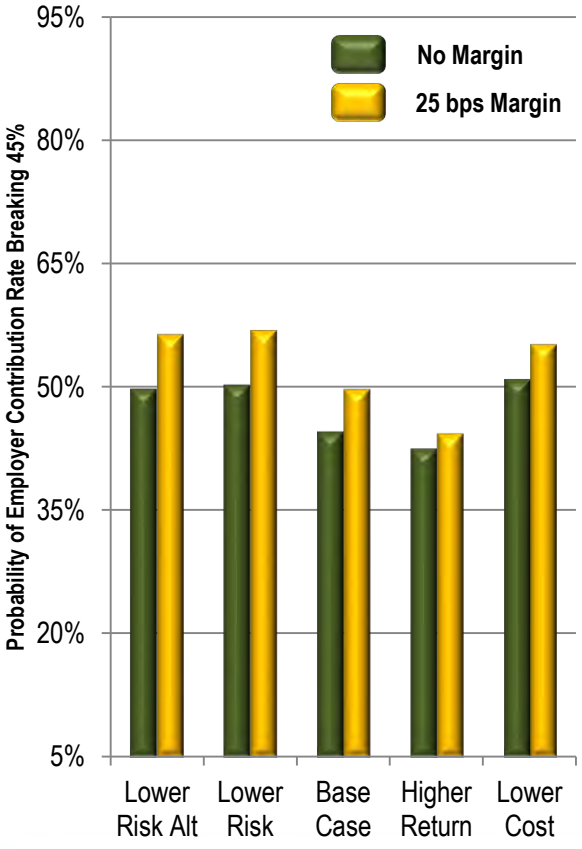


CalPERS Investment Office
Asset Allocation/Risk Management

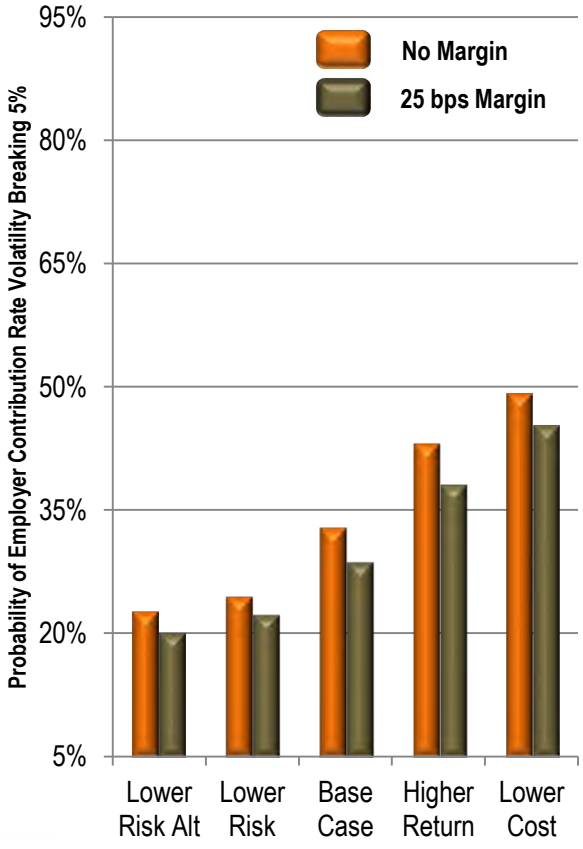
PA Safety Expected Employer Contribution Rate is 29.30%
PA Safety Funded Level is 67.9%
(Source: Projections from ACTO office because official values are not available)

POFF Safety

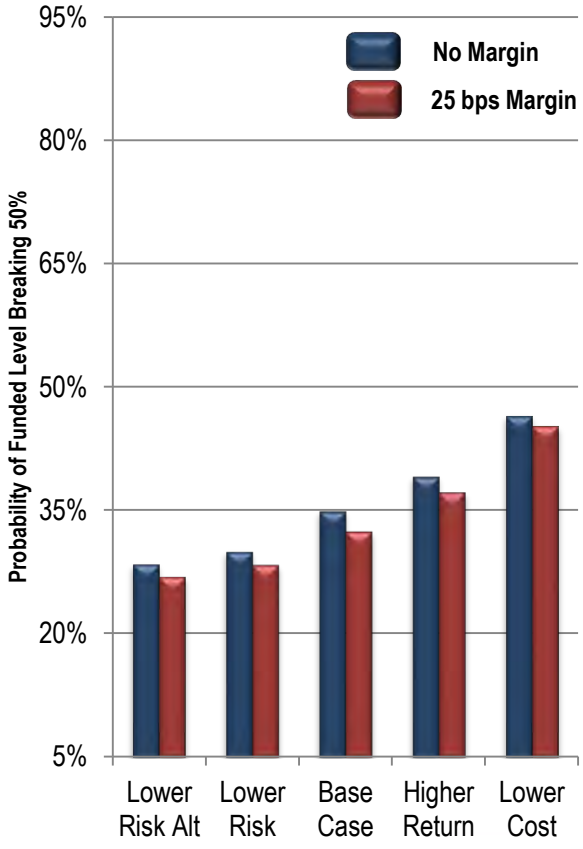
Probability of Employer Contribution Rate Exceeding 45%



Probability of Employer Contribution Rate Volatility Exceeding 5%



Probability of Funded Level Falling Below 50%



CalPERS Investment Office
Asset Allocation/Risk Management

POFF Expected Employer Contribution Rate (FY 2013-14) is 30.50%
POFF Funded Level (as of 06/30/2012) is 65.5%
(Source: http://www.calpers.ca.gov/eip-docs/about/pubs/employer/2012-st-body.pdf)

Impacts - Selecting Portfolios With Higher Expected Returns

Increasing expected return by 0.25% increases volatility by about 1%

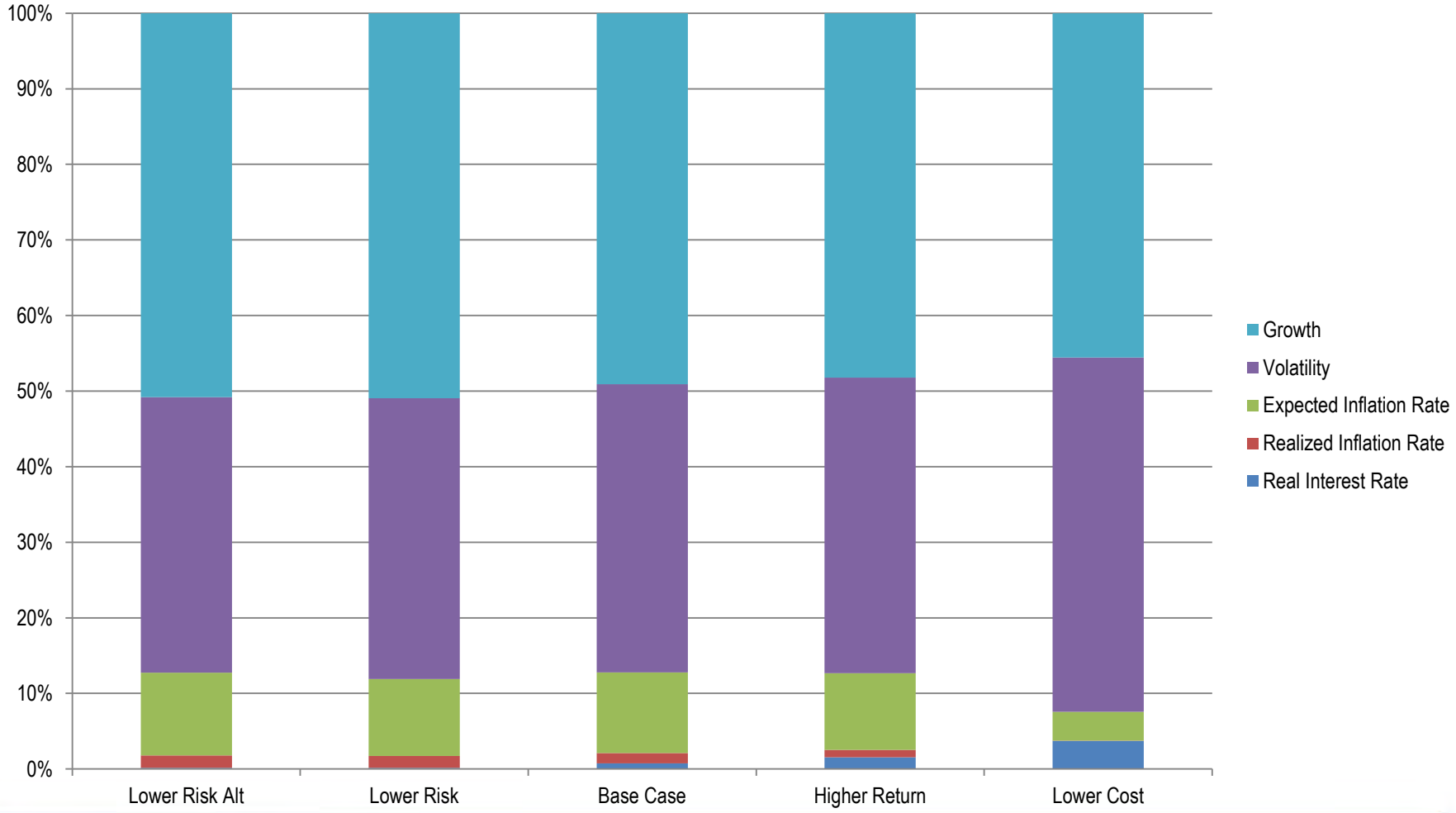
Change of probabilities of breaking thresholds with a 0.25% increase of expected return[1] (or about 1.0% increase in volatility)

	Change of Probability[1]		
Key Risk Consideration	State Misc.	PA. Misc.	Schools
Employer Contribution Rate Above 35%	-4%	+1%	+1%
Employer Contribution Rate Volatility Above 3%	+8%	+10%	+9%
Funded Level Below 50%	+4%	+5%	+5%

	Change of Probability[1]		
Key Risk Consideration	CHP	PA Safety	POFF
Employer Contribution Rate Above 45%	-7%	-4%	-4%
Employer Contribution Rate Volatility Above 5%	+9%	+10%	+9%
Funded Level Below 50%	+3%	+4%	+5%

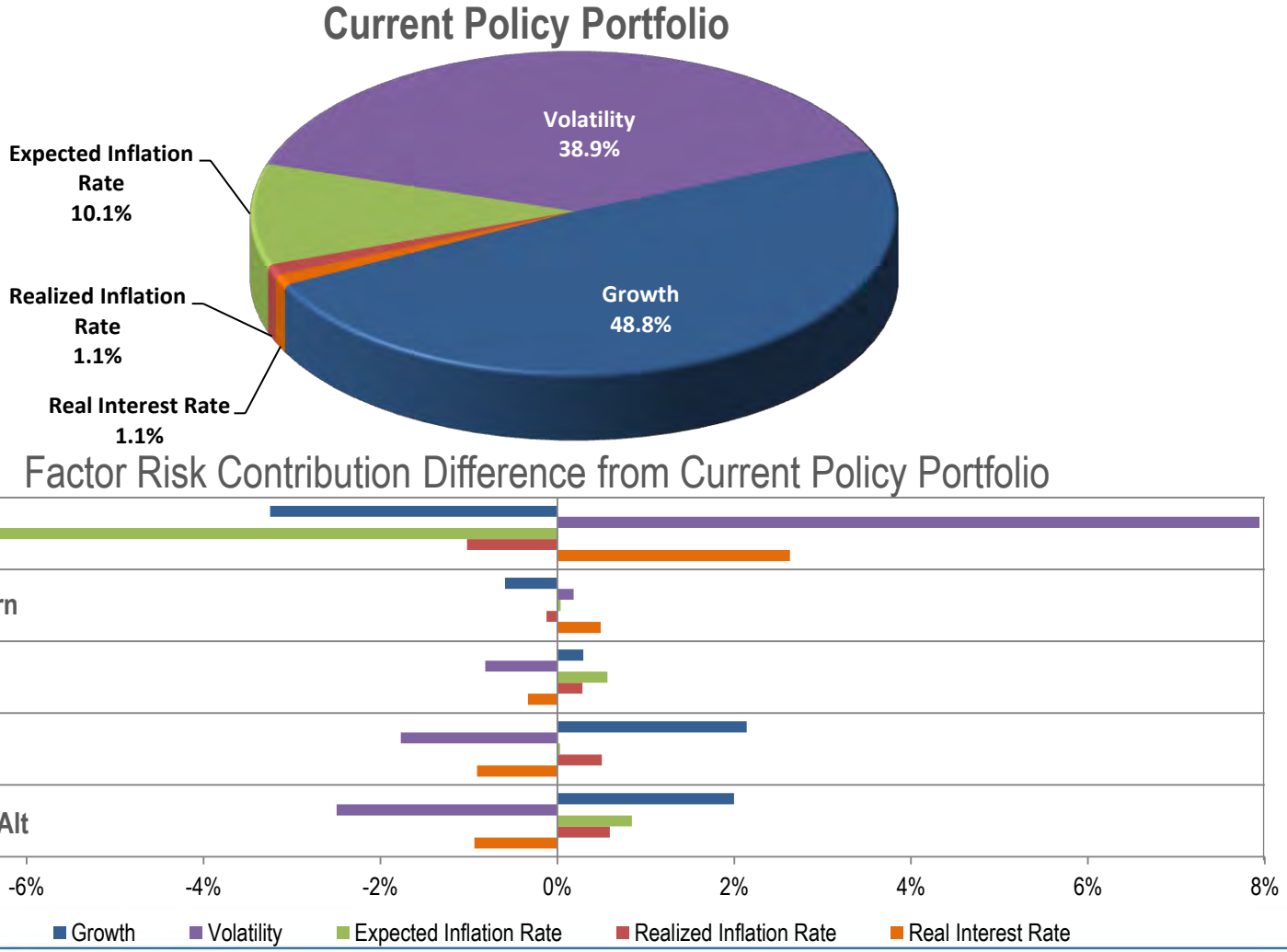
[1]The average of the change in probability between Base Case portfolio (expected return 7.15%) and Higher Return portfolio (7.40%) and the change in the probability between Lower Return portfolio (expected return 6.90%) and Base Case portfolio

Risk Factor Contributions[1]



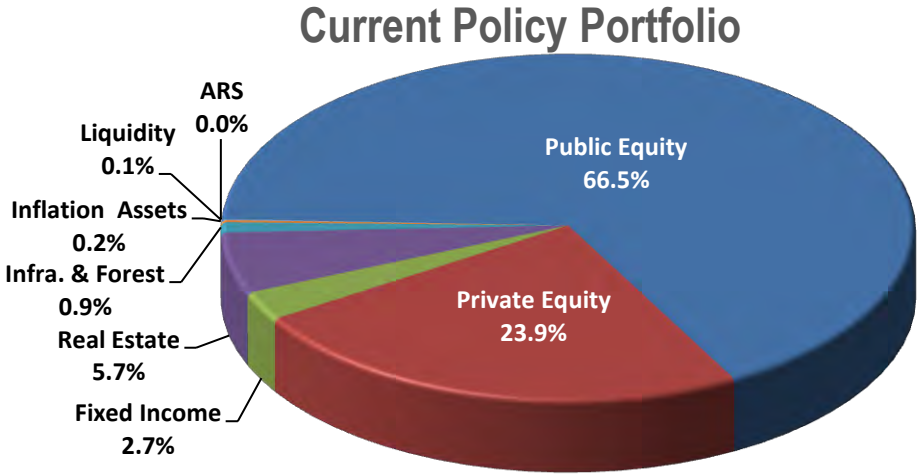
[1]Risk factor contributions exclude the unexplained risk contribution and scales the risk factor contribution so that sum is 100%

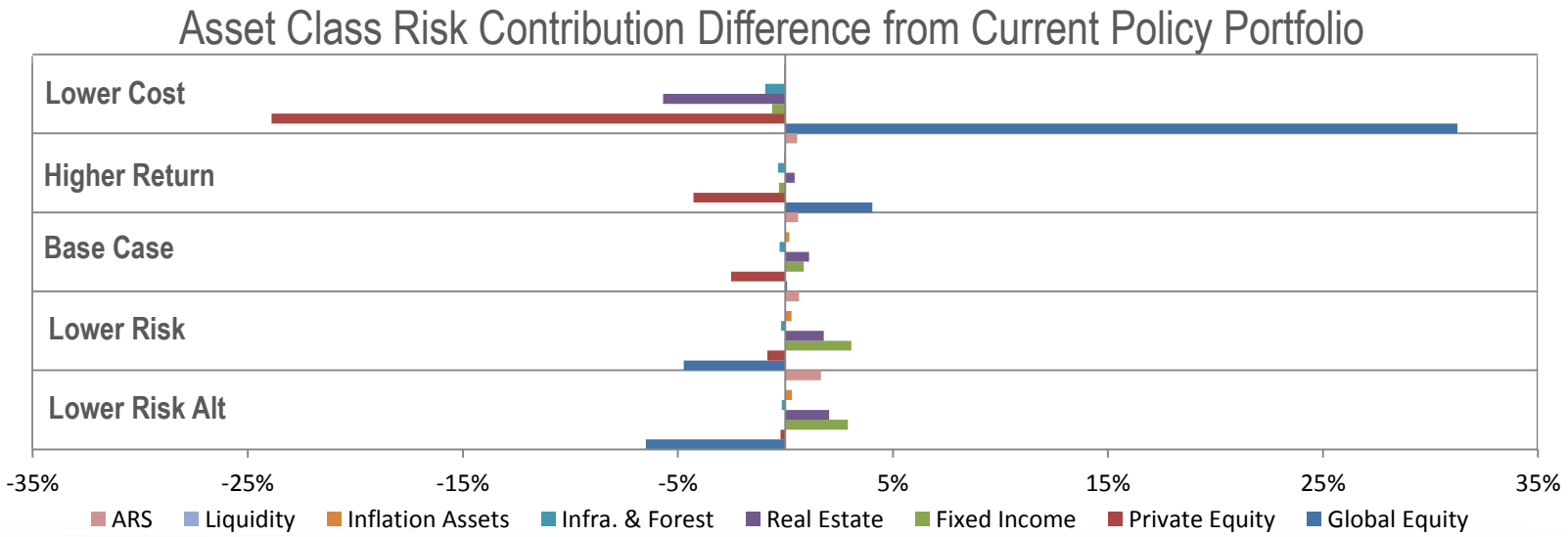
Risk Contributions From Factors[1]



[1]Risk factor contributions exclude the unexplained risk contribution and scales the risk factor contribution so that sum is 100%

Risk Contributions From Asset Classes[1]





[1]Risk contributions are calculated using 2013 Capital Market Assumptions for each asset class.

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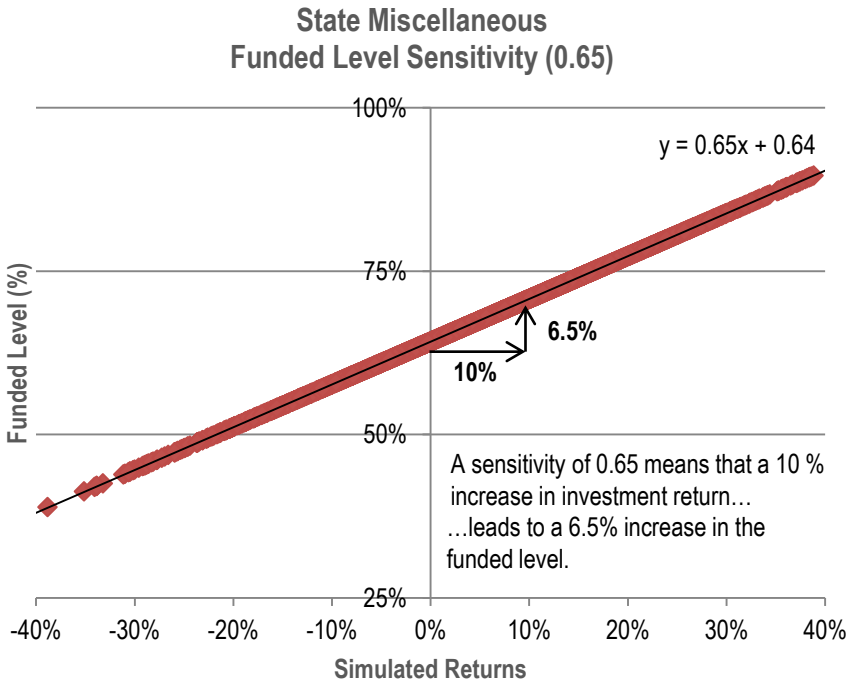
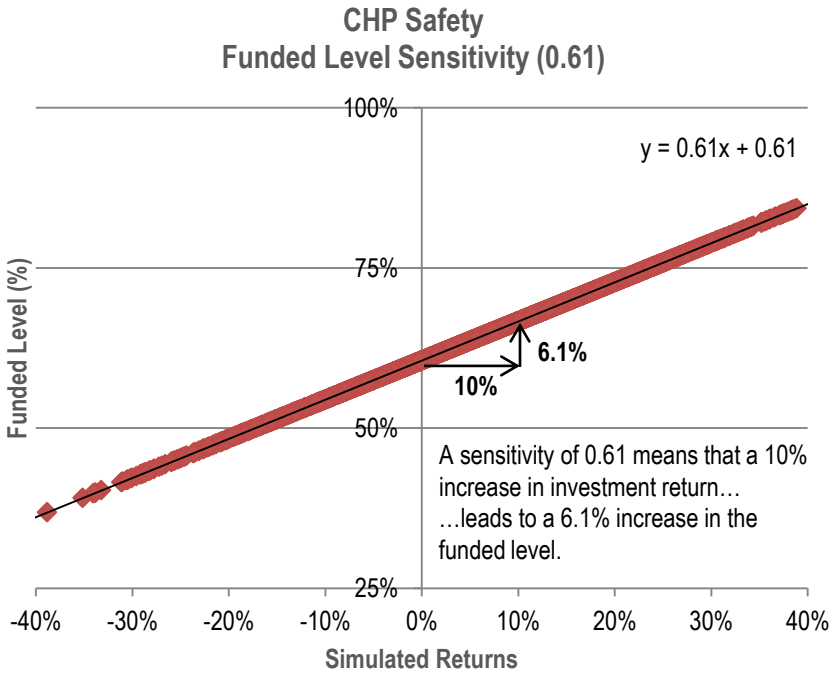
Sensitivity of Funded Level to Investment Returns

The regression results show a strong positive relationship between the investment returns and the funded level

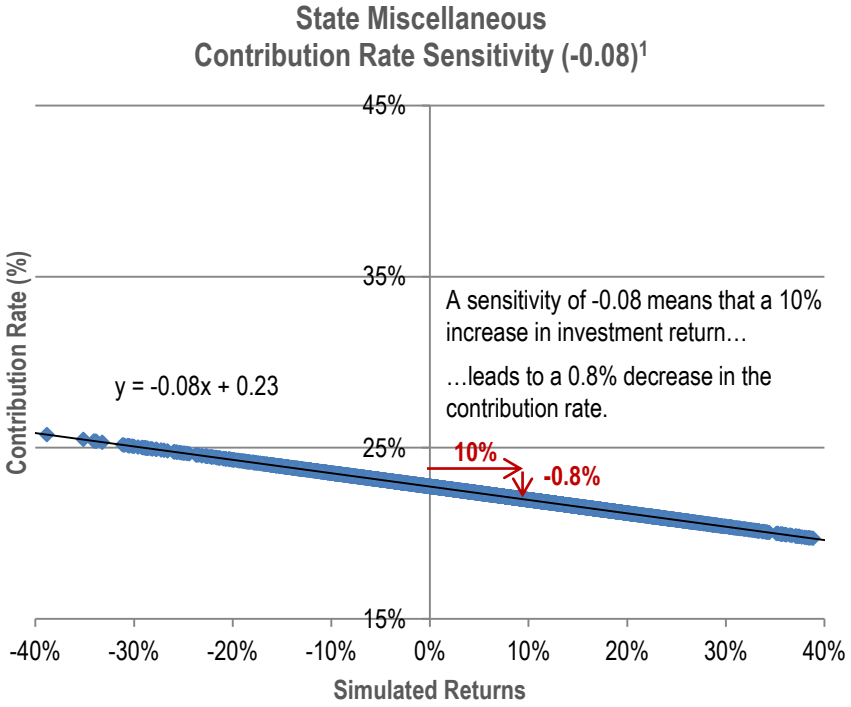


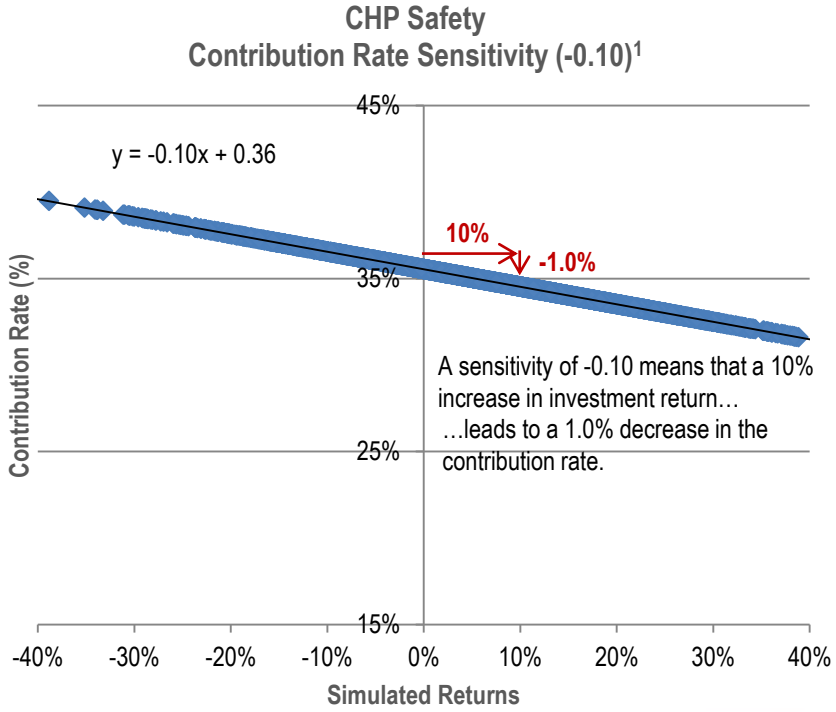


The first year simulation data from ACTO was used to illustrate the relationship between funded level and investment return.

Sensitivity of Employer Contribution Rate to Investment Returns

The regression results show a strong negative relationship between the investment returns and the contribution rates





[1]This estimation is only for the first year where the smoothing effect only accounts for 20% of obligation (5-year smoothing). By the fifth year, the impact will be five times this estimated value.

Estimated Funded Level Sensitivity

The current funded level is a close approximation of the funded level sensitivity to investment returns

Plan	Sensitivity From Regression	Current Estimated Funded Level
State Miscellaneous	0.65	0.69
PA Miscellaneous	0.68	0.73
Schools	0.72	0.76
CHP Safety	0.61	0.64
PA Safety	0.67	0.71
POFF Safety	0.65	0.68

Estimated Contribution Rate Sensitivity

The current asset-to-payroll ratio multiplied by the discount rate is a good approximation of the contribution rate sensitivity to investment return if smoothing effects are excluded

Plan	Sensitivity From Regression	Estimated Sensitivity*	Discount Rate	Asset-to-Payroll Ratio
State Miscellaneous	-0.08	-0.09	7.5%	5.75
PA Miscellaneous	-0.07	-0.07	7.5%	4.58
Schools	-0.06	-0.07	7.5%	4.63
CHP Safety	-0.10	-0.11	7.5%	7.39
PA Safety	-0.11	-0.11	7.5%	7.49
POFF Safety	-0.09	-0.10	7.5%	6.80

* $Estimate = (-0.2) \cdot [(Discount\ Rate) \times (Asset\ to\ Payroll\ Ratio)]$, where the (-0.2) accounts for the ACTO smoothing effect and the negative relationship between the contribution rate and the investment return

2013 CMAs and Investment Constraints

Asset Class	Arithmetic E(R)	Compound E(R)	Volatility (St. Dev.)	Cash Yield	Correlations								Constraints	
					Public Equity	Private Equity	Fixed Income	Real Estate	Infra. & Forest	Inflation Assets	Liquid	ARS	Floor	Cap
Global Equity	9.15	7.75	17.40	2.73	1.00	0.73	0.21	0.37	0.27	0.03	0.00	0.50	0%	100%
Private Equity	12.15	9.33	25.00	0.00	0.73	1.00	0.12	0.38	0.20	0.01	0.00	0.35	0%	12%
Fixed Income	3.73	3.49	7.00	3.70	0.21	0.12	1.00	0.13	0.20	0.25	0.50	0.06	15%	100%
Real Estate	7.91	7.00	14.00	2.00	0.37	0.38	0.13	1.00	0.50	0.10	0.05	0.27	0%	11%
Infra. & Forest.	7.56	7.00	11.00	2.50	0.27	0.20	0.20	0.50	1.00	0.20	0.20	0.20	1%	2%
Inflation Assets	3.20	2.95	7.25	0.88	0.03	0.01	0.25	0.10	0.20	1.00	0.14	0.00	2%	6%
Liquidity	2.00	1.95	3.00	2.02	0.00	0.00	0.50	0.05	0.20	0.14	1.00	0.10	2%	100%
ARS	6.12	5.89	7.00	0.00	0.50	0.35	0.06	0.27	0.20	0.00	0.10	1.00	0%	2%