

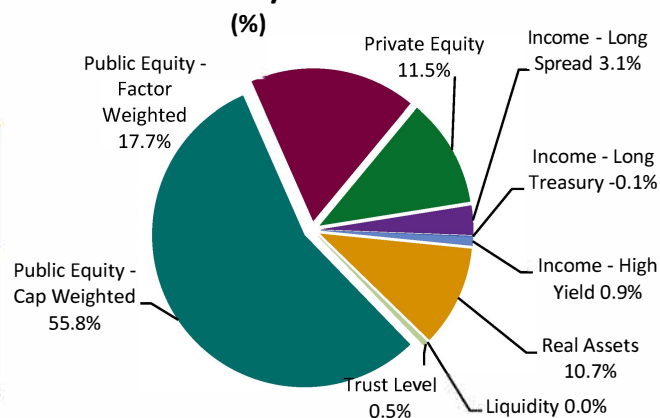
# CalPERS Trust Level Review Risk Management Summary



Period Ending December 31, 2019

**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.

## Portfolio Volatility Contribution



	Policy Limit	Current 12/31/2019	Last Qtr <sup>1</sup> 9/30/2019	Last Year <sup>1</sup> 12/31/2018
Total	n/a	9.7	9.5	9.9
Benchmark	n/a	9.4	9.5	9.9
Tracking Error	< 1.5	0.9	0.9	0.9
Allocation	< 0.75	0.0	0.1	0.0
Selection	n/a	0.8	0.8	0.9

### Comments:

Forecast Total Volatility of the PERF decreased by 26 bps over the last year. This decrease is primarily a reflection of recent low market volatility.

Rapid shifts in volatility regime can occur and would not be predicted by this model. The best interpretation of this estimate is as an indicator of the plan's volatility given the current market environment.

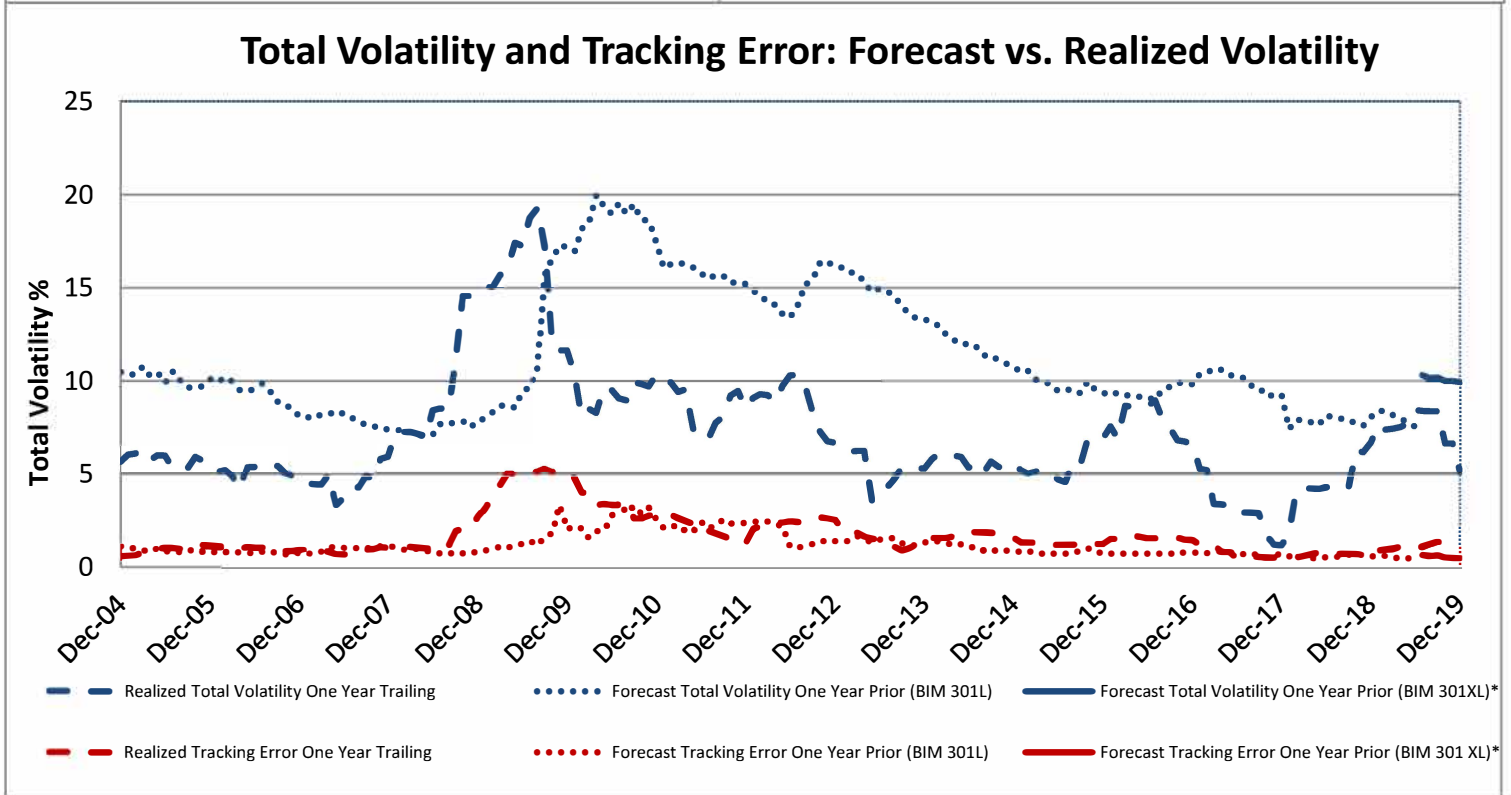
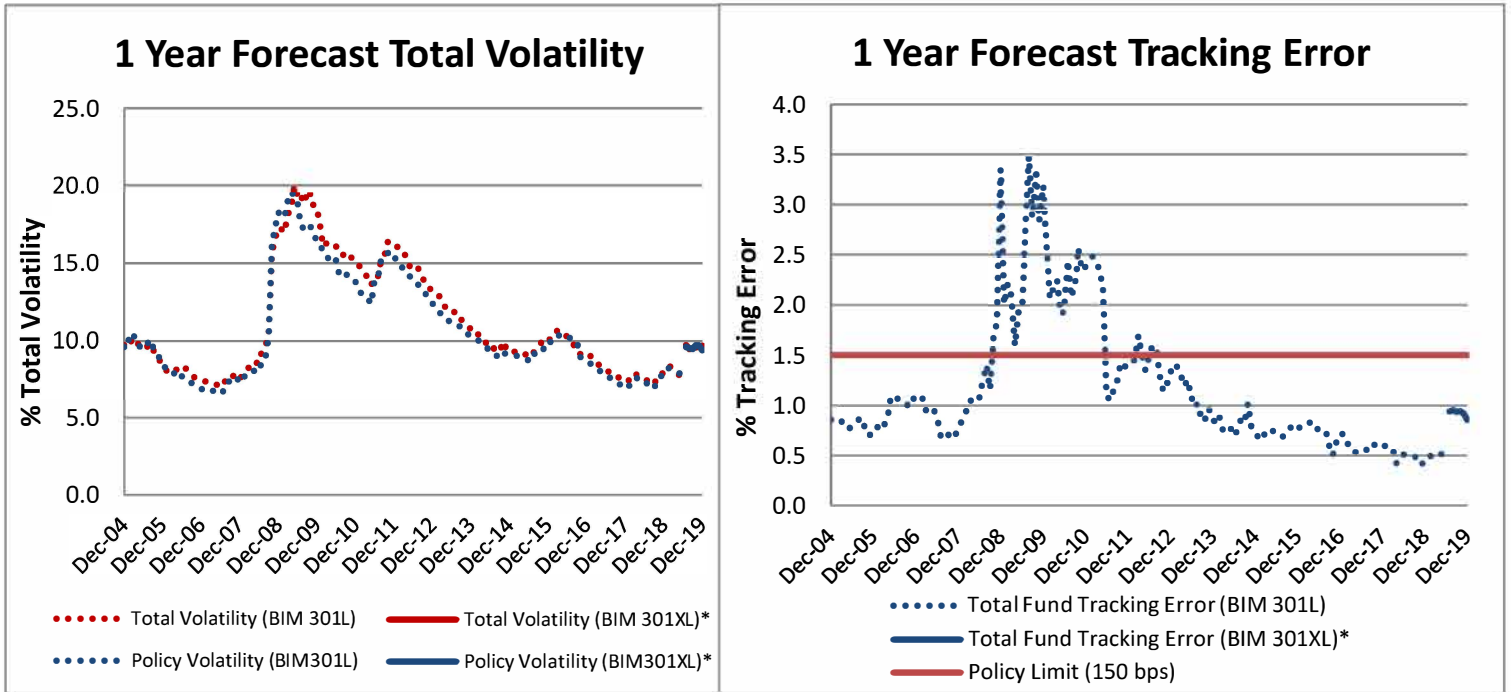
The pie chart above gives a visual representation of portfolio volatility contribution by asset classes (in percent).

Asset Class	Market Value (\$millions)	Total Forecast Volatility (%)	% Contribution to Total Volatility	Tracking Error (%)
<b>Public Equity</b>	<b>\$ 205,891</b>	<b>14.0</b>	<b>73.4</b>	<b>0.1</b>
Cap Weighted	\$ 143,758	15.0	55.8	0.1
Factor Weighted	\$ 62,133	11.8	17.7	0.1
<b>Private Equity</b>	<b>\$ 26,104</b>	<b>20.3</b>	<b>11.5</b>	<b>11.8</b>
<b>Income</b>	<b>\$ 113,384</b>	<b>6.7</b>	<b>3.9</b>	<b>0.3</b>
Long Spread	\$ 58,374	5.7	3.1	0.3
Long Treasury	\$ 43,219	11.0	-0.1	0.4
High Yield	\$ 11,790	4.7	0.9	0.3
<b>Real Assets</b>	<b>\$ 43,513</b>	<b>12.5</b>	<b>10.7</b>	<b>2.3</b>
<b>Liquidity</b>	<b>\$ 3,882</b>	<b>0.1</b>	<b>0.0</b>	<b>0.1</b>
<b>Trust Level<sup>2</sup></b>	<b>\$ 2,070</b>	<b>9.4</b>	<b>0.5</b>	<b>6.1</b>
<b>TOTAL FUND</b>	<b>\$ 394,844</b>	<b>9.7</b>	<b>100.0</b>	<b>0.9</b>

<sup>1</sup>PERF Risk model changed to a longer horizon model (from Barra 301L to 301XL). 12/31/2018 and 9/30/2019 risk values have been restated.

<sup>2</sup>Trust Level includes Multi Asset Class, Absolute Return Strategies, and other Total Fund level portfolios.

Source: BarraOne, SSB, CalPERS



\*PERF Risk model changed to a longer horizon model (from Barra 301L to 301XL). Risk values from 7/31/19 onward are reported under 301XL.

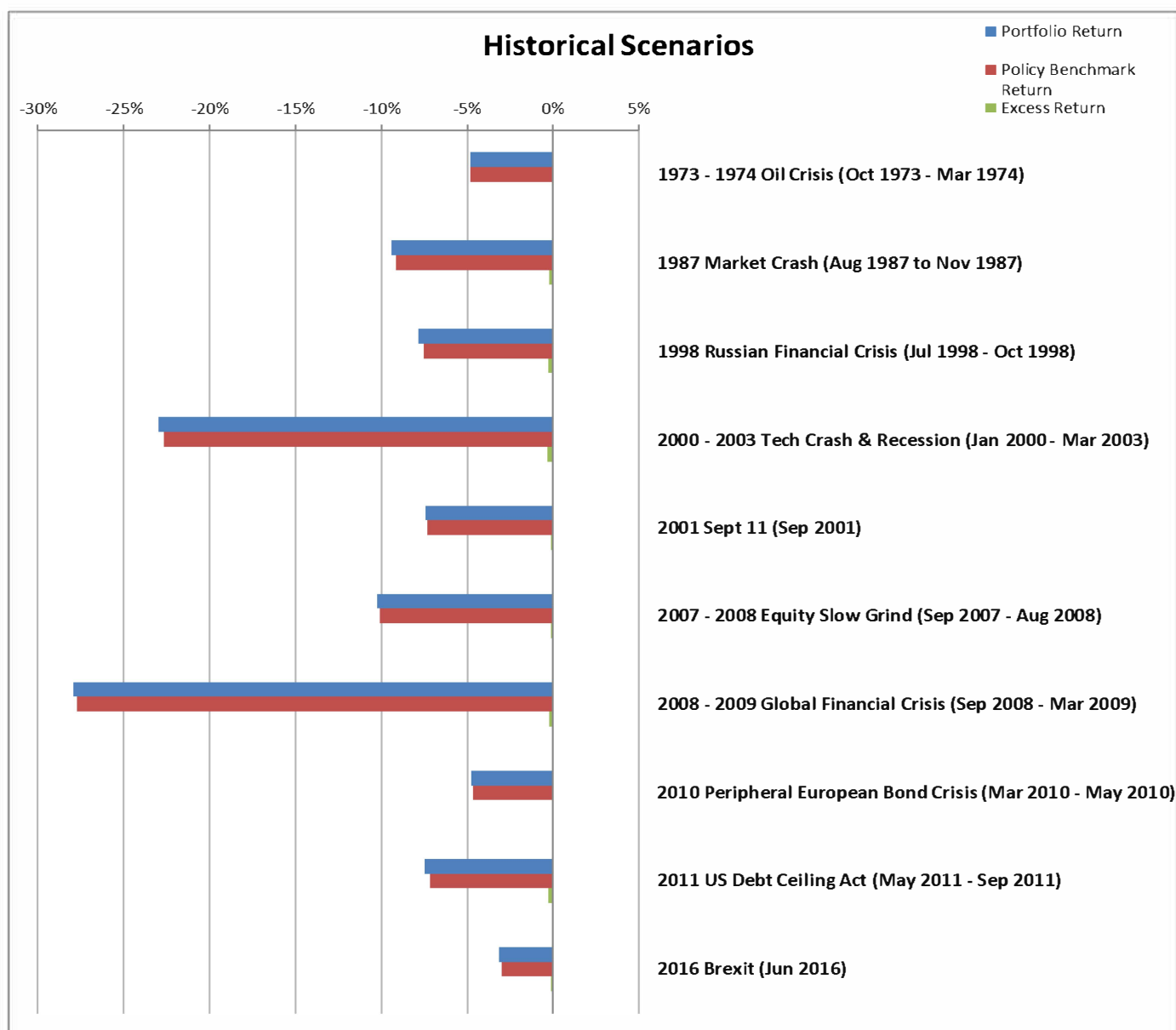
The bottom chart plots the Forecast Total Volatility and Tracking Error for the Total Fund one year prior to each date vs. the Total Volatility and Tracking Error realized for that date. The graph highlights potential deviations between risk model estimates and subsequent realized volatility, due to the lagged and smoothed nature of risk models. In particular, modeled volatility forecasts tend to lag changes in regimes, for example the rapid increase in volatility during the period of the global financial crisis, and similarly the persistent decline in market volatility in the last few years.

Source: BarraOne, SSB, CalPERS

## STRESS TESTING

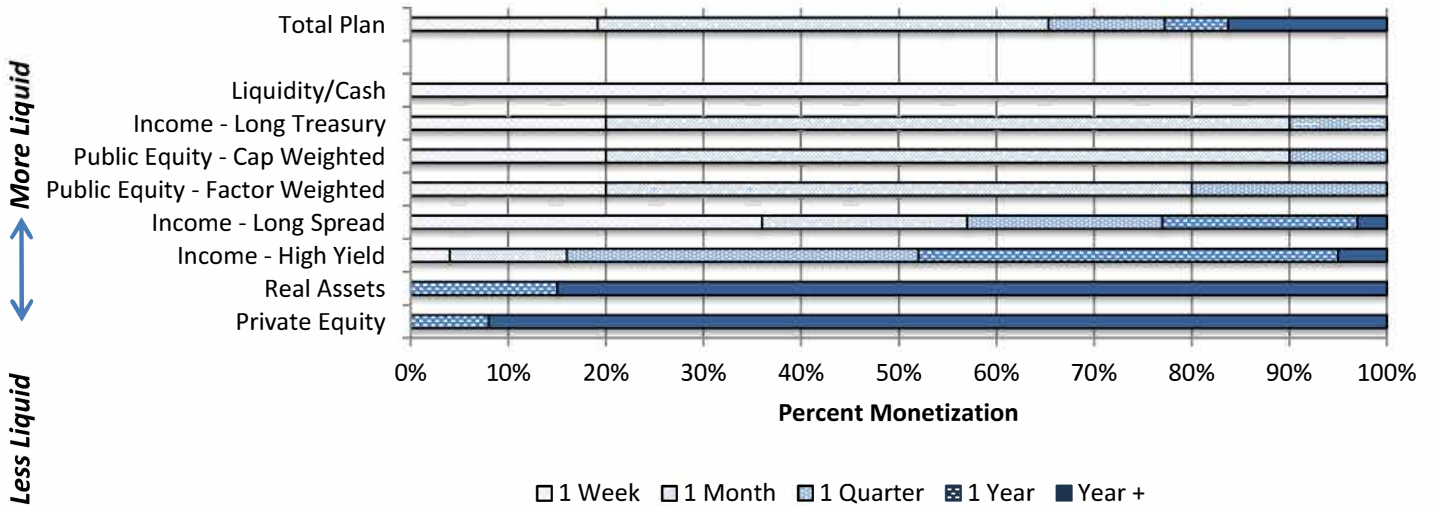
Historical scenarios highlight the sensitivity of the portfolio to past economic regimes or specific events. The scenarios can be used as a "what if" gauge of current portfolio positioning to understand the potential impact if a similar event or regime were to repeat.

Scenario	Portfolio Return	Policy Benchmark Return	Excess Return
2016 Brexit (Jun 2016)	-3.2%	-3.0%	-0.1%
2010 Peripheral European Bond Crisis (Mar 2010 - May 2010)	-4.8%	-4.7%	-0.1%
1973 - 1974 Oil Crisis (Oct 1973 - Mar 1974)	-4.8%	-4.8%	0.0%
2001 Sept 11 (Sep 2001)	-7.4%	-7.3%	-0.1%
2011 US Debt Ceiling Act (May 2011 - Sep 2011)	-7.5%	-7.2%	-0.3%
1998 Russian Financial Crisis (Jul 1998 - Oct 1998)	-7.8%	-7.5%	-0.3%
1987 Market Crash (Aug 1987 to Nov 1987)	-9.4%	-9.2%	-0.2%
2007 - 2008 Equity Slow Grind (Sep 2007 - Aug 2008)	-10.2%	-10.1%	-0.1%
2000 - 2003 Tech Crash & Recession (Jan 2000 - Mar 2003)	-23.0%	-22.7%	-0.3%
2008 - 2009 Global Financial Crisis (Sep 2008 - Mar 2009)	-27.9%	-27.7%	-0.2%



Source: BarraOne, CalPERS

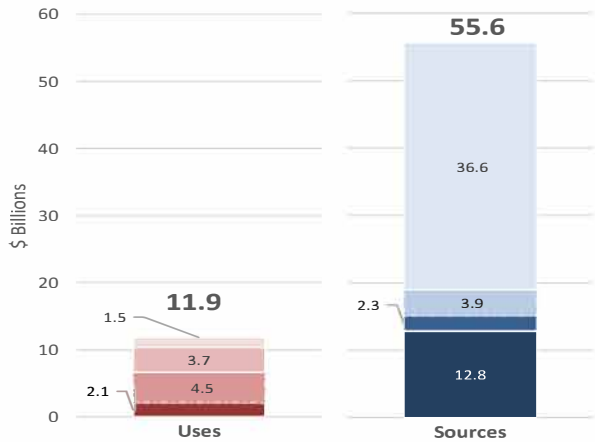
## Liquidity Analysis: Total Plan



Transactional liquidity is estimated for each asset class/strategy based on the current market environment while also accounting for legal structures or other factors that may impact liquidity. *Source: SSB, CalPERS*

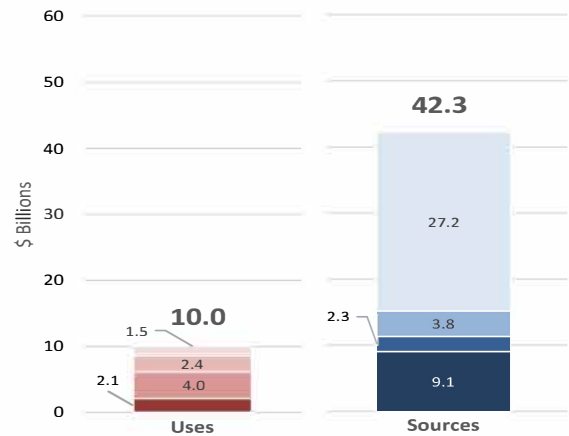
### Stress (Current Regime)<sup>1</sup>

Tier 1 30 Day Liquidity Coverage Ratio = 4.7x



### Historical Worst<sup>2</sup>

Tier 1 30 Day Liquidity Coverage Ratio = 4.2x



- Others
- Contingent
- Private Asset Funding
- Pension Benefits
- Liquidity on Demand
- Internal Funding
- Pension Contribution & Other Inflows
- Cash Equivalents

<sup>1</sup> **Stress (Current Regime)** - Regime-dependent scenario to capture a "worst contemplated" outcome across liquidity uses and sources given current market conditions.

<sup>2</sup> **Historical Worst** - Historical experience for the 30 day period: 9/28/08-10/27/08 (the worst equity drawdown in the past 20 years) applied to current portfolio.

Liquidity Coverage is computed from estimates of future cash inflows and outflows. In this table, the 1-month forward period is shown with Liquidity Coverage ratios for a stress scenario and for a historical worst experience. The Liquidity Coverage ratios could be interpreted as how many times available cash / cash equivalents could cover projected cash needs over a 1-month forward period. A ratio of less than one implies the Fund could be forced to sell assets to meet liquidity needs in the given scenario.

Source: BarraOne, SSB, CalPERS

## Total Fund Leverage Report

as of 12/31/19

Leverage changes a portfolio's risk profile through both impact on liquidity and amplification of returns volatility. As a metric, leverage has the benefit of being relatively straightforward to calculate, making it a good backstop to more nuanced but complex perspectives on risk that could suffer from model errors or flawed assumptions. However, since the leverage metric implicitly treats all assets as equally risky, and because it does not capture the interrelationships between assets (diversification), leverage should always be viewed in conjunction with other perspectives. For example, a low leverage portfolio could easily be more risky than a better-diversified moderate leverage portfolio.

### Portfolio View of Plan Leverage:

Total portfolio leverage as defined in the Total Fund Investment Policy.

### Company Embedded Leverage:

Some Fund assets embed leverage by their nature (i.e., private and public companies). In this case, leverage is not a portfolio management decision, but does contribute to the assets' inherent riskiness.

### Unfunded Commitments:

Represent potential draws on Fund liquidity, but are contingent in nature.

### Portfolio View of Plan Leverage

Asset Class/ Program	Net Asset Value (\$Billions)	Sources of Leverage <sup>1</sup>			Cash <sup>2</sup>	Gross Asset Exposure	Gross Asset Exposure % of NAV	Benchmark Asset Exposure % of NAV	Exposure over Benchmark <sup>3</sup>
		Derivatives	Recourse Debt including Repos	Non Recourse Debt					
Public Equity - Cap Weighted	143.8	3.3			3.9	143.2	36.3%	35.0%	
Public Equity - Factor Weighted	62.1	0.5			0.4	62.2	15.8%	15.0%	
Private Equity	26.1		1.7 <sup>4</sup>		0.0	27.8	7.1%	8.0%	
Income - Long Spread	58.4	0.0			0.5	57.9	14.7%	15.0%	
Income - Long Treasury	43.2	13.6	2.1		1.9	57.0	14.4%	10.0%	
Income - High Yield	11.8				0.0	11.8	3.0%	3.0%	
Real Assets	43.5		0.0 <sup>5</sup>	19.8	0.7	62.7	15.9%	16.6%	
Liquidity	3.9				3.9	0.0			
Trust Level	2.1				0.1	1.9	0.5%		
Securities Lending <sup>6</sup>	0.0		3.3		3.3	0.0			
<b>Total Fund</b>	<b>394.8</b>	<b>\$17.4</b>	<b>\$1.7</b>	<b>\$19.8</b>	<b>\$14.7</b>	<b>\$424.5</b>	<b>107.5%</b>	<b>102.6%</b>	<b>4.9%</b>

### Embedded Leverage in Asset Classes

Asset Class	Implied Leverage <sup>7</sup>
Public Equity	1.56
Private Equity	2.22
Real Estate	1.28

### Unfunded Commitments

Asset Class	Net Market Value (\$B)	Unfunded Commitments (\$B) <sup>8</sup>	% of Total Fund
Private Equity	26.1	18.6	4.7%
Real Assets	43.5	10.8	2.7%

1. FX Forwards used for hedging and fixed income duration shifting are not counted as leverage. Options are included based on delta adjusted notional value.

2. Cash is defined as assets meeting Liquidity program guidelines.

3. Asset class contribution to total plan leverage includes program-level leverage and the difference between actual and target SAA allocation adjusted for benchmark leverage.

4. Subscription financing and other liabilities at the fund level (as of 6/30/2019) are shown as recourse, while defined non-recourse for policy definition.

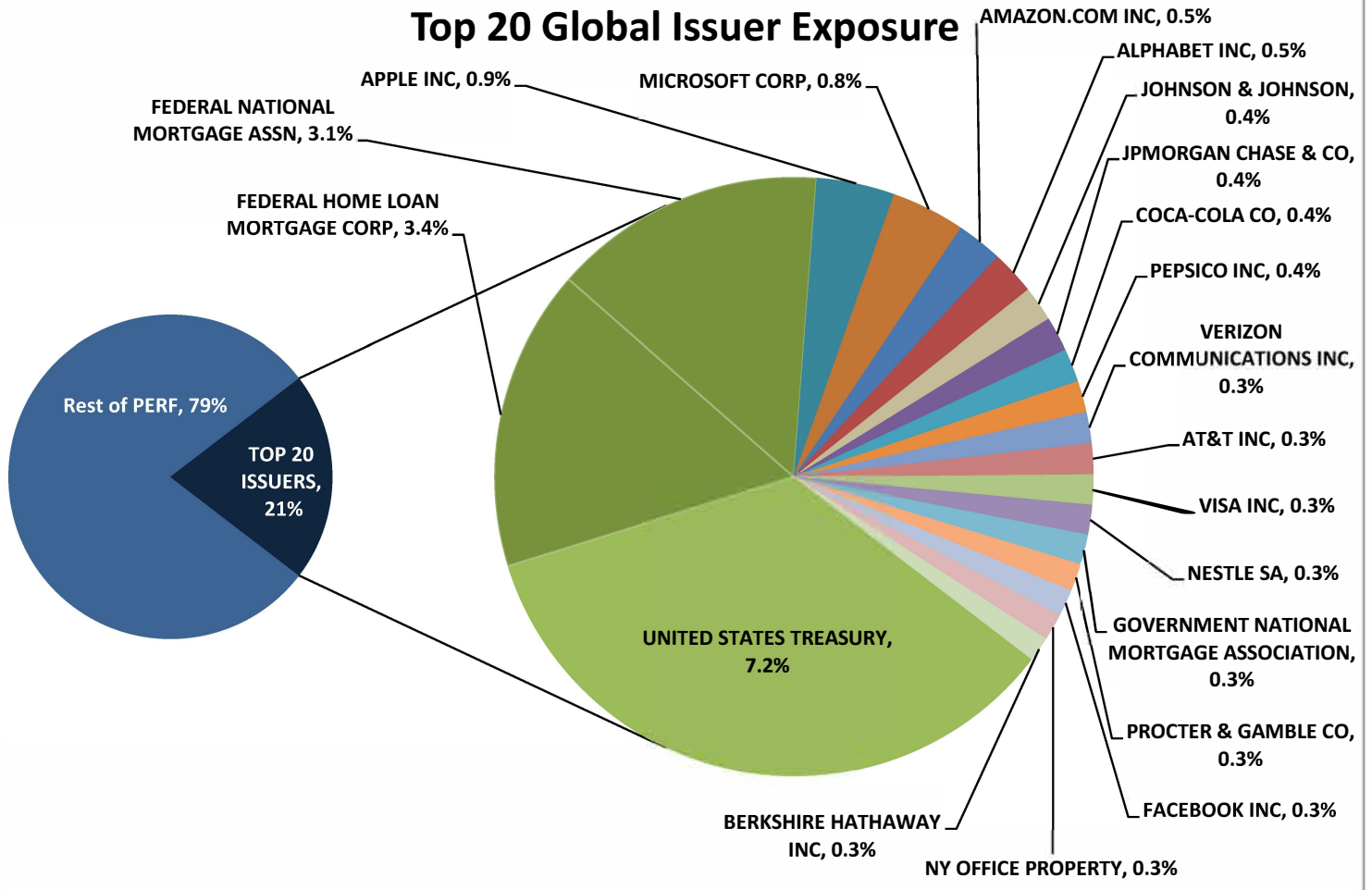
5. As of 9/30/19 there is no Recourse Debt in Real Estate. There has been no change from the last reported date of 3/31/19.

6. Securities lending includes only securities lent for cash collateral (which creates a source of financing).

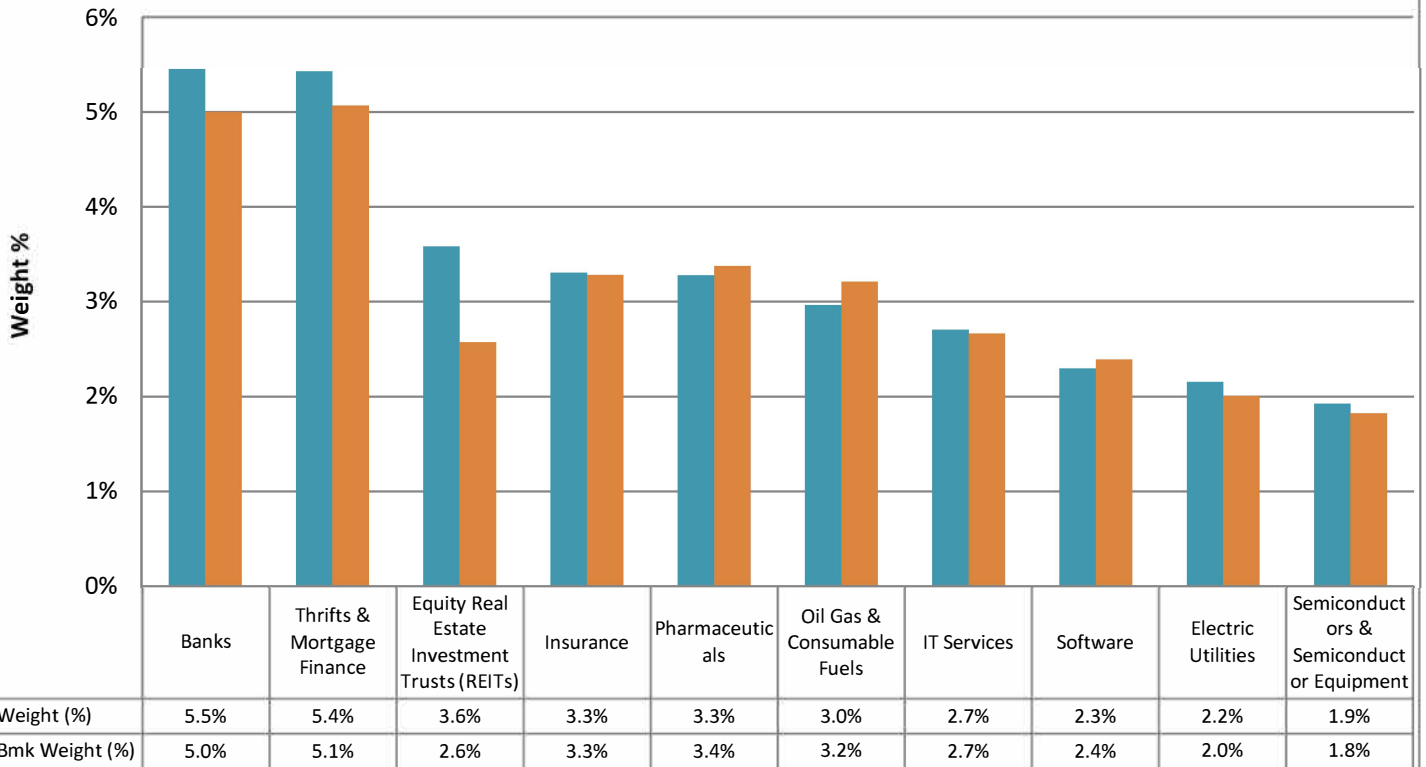
7. Implied leverage is estimated from either asset class benchmark data or industry research. It represents the Enterprise Value to Equity ratio.

8. Unfunded commitments are as of 12/31/2019 for Private Equity and 9/30/2019 for Real Assets. 77% of Real Asset unfunded commitments are revocable at CalPERS' discretion.

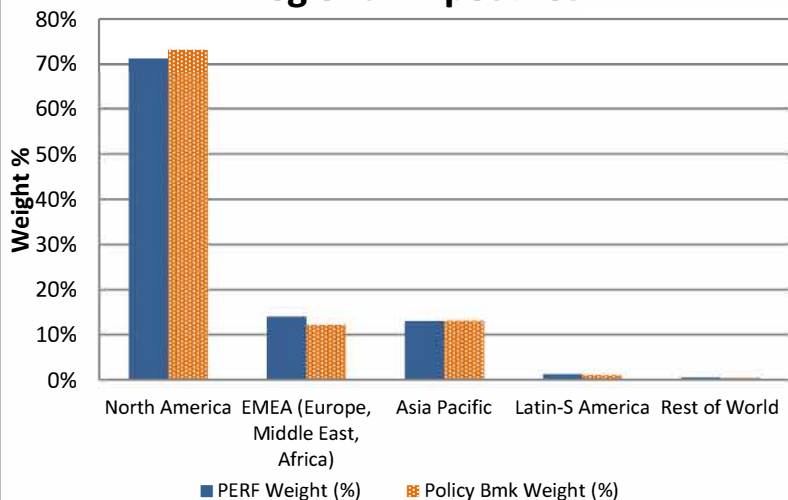
### Top 20 Global Issuer Exposure



### Top 10 Industry Exposure

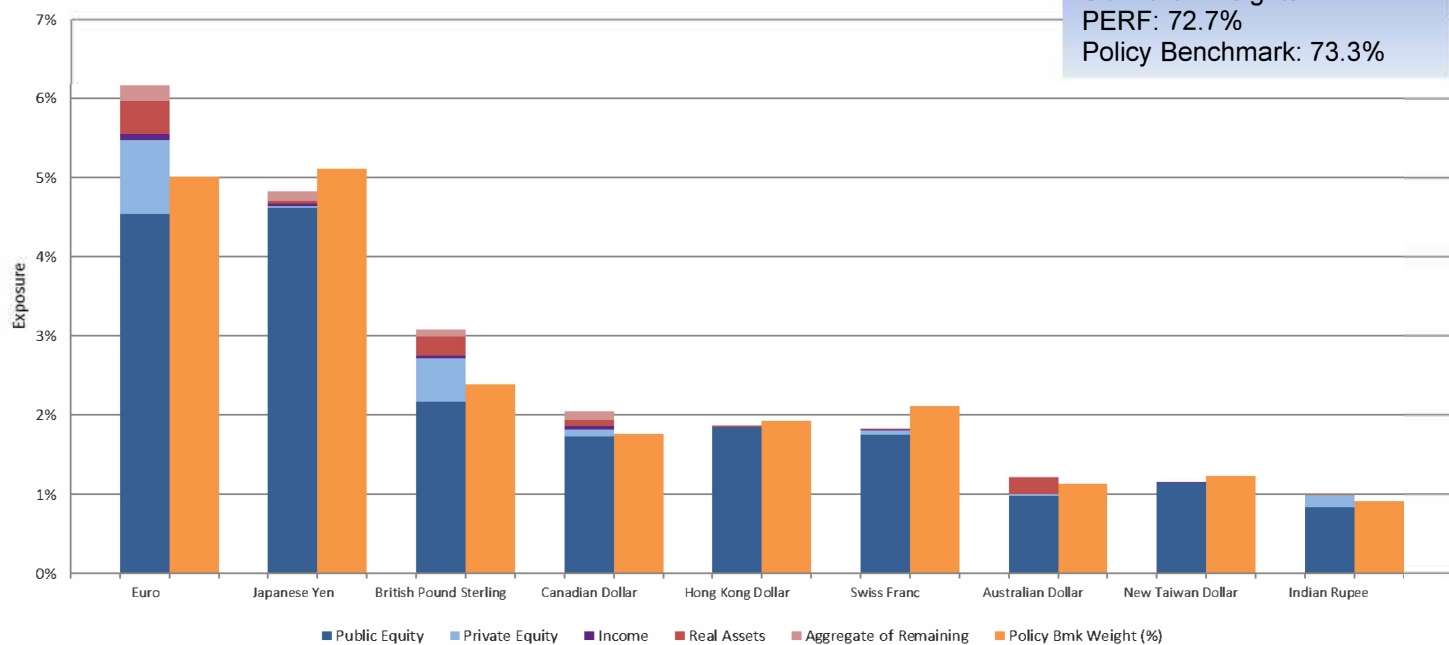


### Regional Exposures

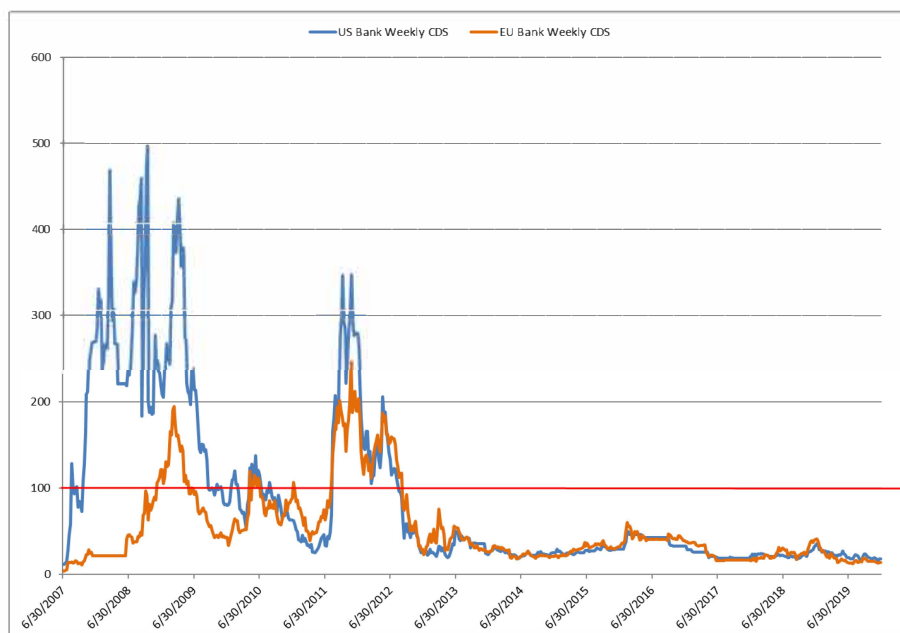


Country	PERF Weight (%)	Policy Bmk Weight (%)	Active Weight (%)
United States	68.7%	71.0%	-2.3%
Japan	4.9%	5.2%	-0.3%
United Kingdom	3.3%	2.6%	0.7%
Canada	2.6%	2.2%	0.3%
China	2.0%	1.8%	0.1%
Switzerland	1.8%	2.0%	-0.1%
France	1.8%	1.6%	0.2%
Germany	1.6%	1.5%	0.2%
Australia	1.3%	1.2%	0.2%
Taiwan	1.2%	1.2%	-0.1%

### Non-USD Currency Exposures



## COUNTERPARTY RISK



CDS spreads and other metrics are regularly monitored for individual CalPERS counterparties. In addition, when aggregate spreads rise above 100 bps additional oversight measures are taken.

Counterparty	NET MTM FORWARDS (\$)	Net MTM OPTIONS (\$)	Net MTM SWAPS (\$)	CalPERS Exposure (\$)	Counter Party Exposure (\$)	Net MTM Total (\$)	Collateral Posted (\$)*	Net Credit Net Exposure (\$)
Australia and New Zealand Banking	19,214			19,214		19,214		19,214
Bank of Montreal	31,507			31,507		31,507		31,507
Bank of America	2,526,463		5,797,420	9,160,433	(836,550)	8,323,883	(8,329,604)	(5,721)
BNP Paribas	(3,641,154)			2,585,864	(6,227,018)	(3,641,154)	3,700,000	58,846
Barclays	(595,117)			1,009,025	(1,604,142)	(595,117)	600,000	4,883
CommonWealth Bank of Australia	328,334			328,334		328,334	(350,000)	(21,666)
Citigroup	(22,610,561)			5,799,874	(28,410,435)	(22,610,561)	22,620,000	9,439
Canadian Imperial Bank of Commerce	199,509			199,509		199,509	(130,000)	69,509
Credit Suisse International	36,499		396,720	447,956	(14,737)	433,219	(450,000)	(16,781)
Deutsche Bank	3,264,744			3,264,744		3,264,744	(3,270,000)	(5,256)
Goldman Sachs Intl.	50,641,443			117,326,497	(66,685,054)	50,641,443	(50,671,000)	(29,557)
HSBC	10,216,223		24,844,915	41,431,764	(6,370,626)	35,061,138	(35,100,000)	(38,862)
Morgan Stanley Capital Service	(890,787)		1,507,017	16,738,228	(16,121,998)	616,230	(650,000)	(33,770)
RBC Capital Markets	(171,934)			375,897	(547,831)	(171,934)	180,000	8,066
Standard Chartered Bank	19,426,289			19,426,289		19,426,289	(19,428,903)	(2,614)
Societe Generale	4,226,100		205,039	6,914,615	(2,483,476)	4,431,139	(4,440,000)	(8,861)
State Street	1,952,037			2,007,478	(55,441)	1,952,037	(1,959,170)	(7,133)
Toronto Dominion	(186,112)				(186,112)	(186,112)	190,000	3,888
UBS AGG	(1,830,199)		6,217,511	6,217,699	(1,830,387)	4,387,312	(4,400,000)	(12,688)
WestPac Bank	545,761			545,761		545,761	(650,000)	(104,239)
Grand Total	63,488,259		38,968,622	233,830,688	(131,373,807)	102,456,881	(102,538,677)	(81,796)

\*As of 12/31 Counterparties posted 130mm to CalPERS which includes Internal Collateral

#Internal Threshold Limit

**Above:** Total market value exposure and net credit exposures are monitored for all of our OTC (over-the-counter) positions.

Source: Blackrock, CalPERS

**Below:** FCM (Futures Commission Merchant) exposures are monitored for how much margin we have posted with our FCM. Source: CalPERS

FUTURES COMMISSION MERCHANT EXPOSURE	
Futures Commission Merchant	Collateral Posted*
CITIGROUP GLOBAL MARKETS INC	341,774,464
MERRILL LYNCH PIERCE FENNER & SMITH INCORPORATED	25,196,758

\*As of December 31, 2019



### 1. How to interpret the OTC Counterparty Risk Exposure section

OTC Derivative Counterparty Exposure Report								
Counterparty	NET MTM FORWARDS (\$)	Net MTM OPTIONS (\$)	Net MTM SWAPS (\$)	CalPERS Exposure (\$)	Counter Party Exposure (\$)	Net MTM Total (\$)	Collateral Posted (\$)	Net Credit Net Exposure (\$)
Counterparty 123	10,386,714.00	(84,745.00)	11,735,283.00	27,147,091.00	(25,475,215.00)	1,671,876.00	(1,525,000.00)	146,876.00

**NET MTM BY PRODUCT TYPE**

- Columns reflect the net mark to market (MTM) of all OTC trades by product type with a Counterparty
- + amount = CalPERS has a gain on the positions
- amount = CalPERS has a loss on the positions

**Directional Exposure**

- The exposure columns reflect an un-net profit or loss (P&L) grouping across product type and is equivalent to the directional unwind exposure at a point in time
- Trades with positive P&L are bucketed together = CalPERS Exposure
- Trades with negative P&L are bucketed together = Counterparty Exposure

**NET CREDIT EXPOSURE**

- The net credit exposure column reflects the open uncollateralized credit exposure risk if a Counterparty were to default with no change in mark to market prices
- + amounts reflect open credit risk where CalPERS is owed money

**NET MTM TOTAL**

- The net market to market column reflects the total current net profit or loss position across all open OTC trades with a Counterparty
- + amount = CalPERS is owed money
- amount = CalPERS owes money

**COLLATERAL POSTED**

- The collateral posted column reflects the dollar amount of collateral that is either posted to CalPERS or that CalPERS has posted to a Counterparty to offset credit risk
- + amount = CalPERS has posted money out
- amount = Counterparty has posted money to CalPERS