

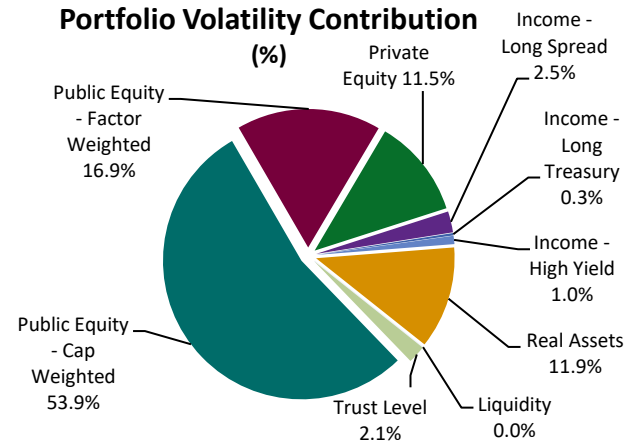
CalPERS Trust Level Review Risk Management Summary



Period Ending June 30, 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.

Total Fund Forecast Volatility Trends (%)				
	Policy Limit	Current 6/30/2019	Last Qtr 3/31/2019	Last Year 6/30/2018
Total	n/a	7.7	8.2	7.6
Benchmark	n/a	7.9	8.1	7.4
Tracking Error	< 1.5	0.5	0.5	0.5
Allocation	< 0.75	0.2	0.1	0.0
Selection	n/a	0.4	0.4	0.5



Comments:

Forecast Total Volatility of the PERF increased by 13 bps over the last year. This increase is primarily a reflection of an increase in market volatility slightly offset by a decrease in volatility from portfolio exposure.

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).

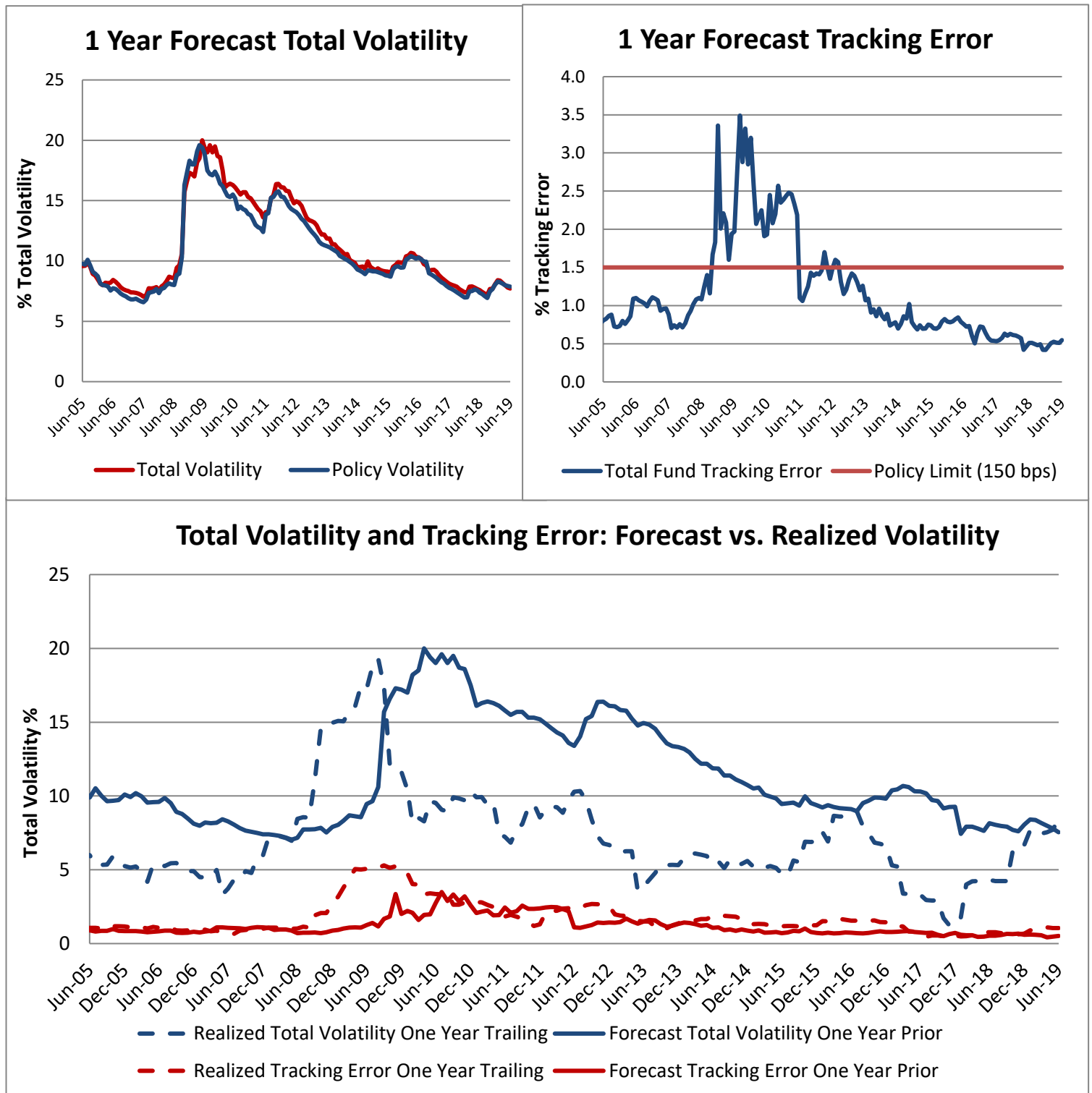
Asset Class	Market Value ¹ (\$millions)	Total Forecast Volatility (%)	% Contribution to Total Volatility	Tracking Error (%)
Public Equity	\$ 185,586	11.2%	70.7%	0.2%
Cap Weighted	\$ 131,359	12.2%	53.9%	0.3%
Factor Weighted	\$ 54,227	9.2%	16.9%	0.0%
Private Equity	\$ 26,472	14.8%	11.5%	4.3%
Income	\$ 106,335	4.6%	3.7%	0.2%
Long Spread	\$ 56,705	4.1%	2.5%	0.3%
Long Treasury	\$ 37,834	7.2%	0.3%	0.3%
High Yield	\$ 11,796	3.6%	1.0%	0.1%
Real Assets	\$ 40,866	11.1%	11.9%	2.1%
Liquidity	\$ 3,781	0.1%	0.0%	0.0%
Trust Level²	\$ 7,127	8.7%	2.1%	1.8%
TOTAL FUND	\$ 370,168	7.7%	100.0%	0.5%

¹Market values could be different from other documents, due to differences in pricing methods in risk and performance systems

²Trust Level includes Multi Asset Class, Absolute Return Strategies, and other Total Fund level portfolios

Source: BarraOne / CalPERS

RISK MANAGEMENT TIME SERIES



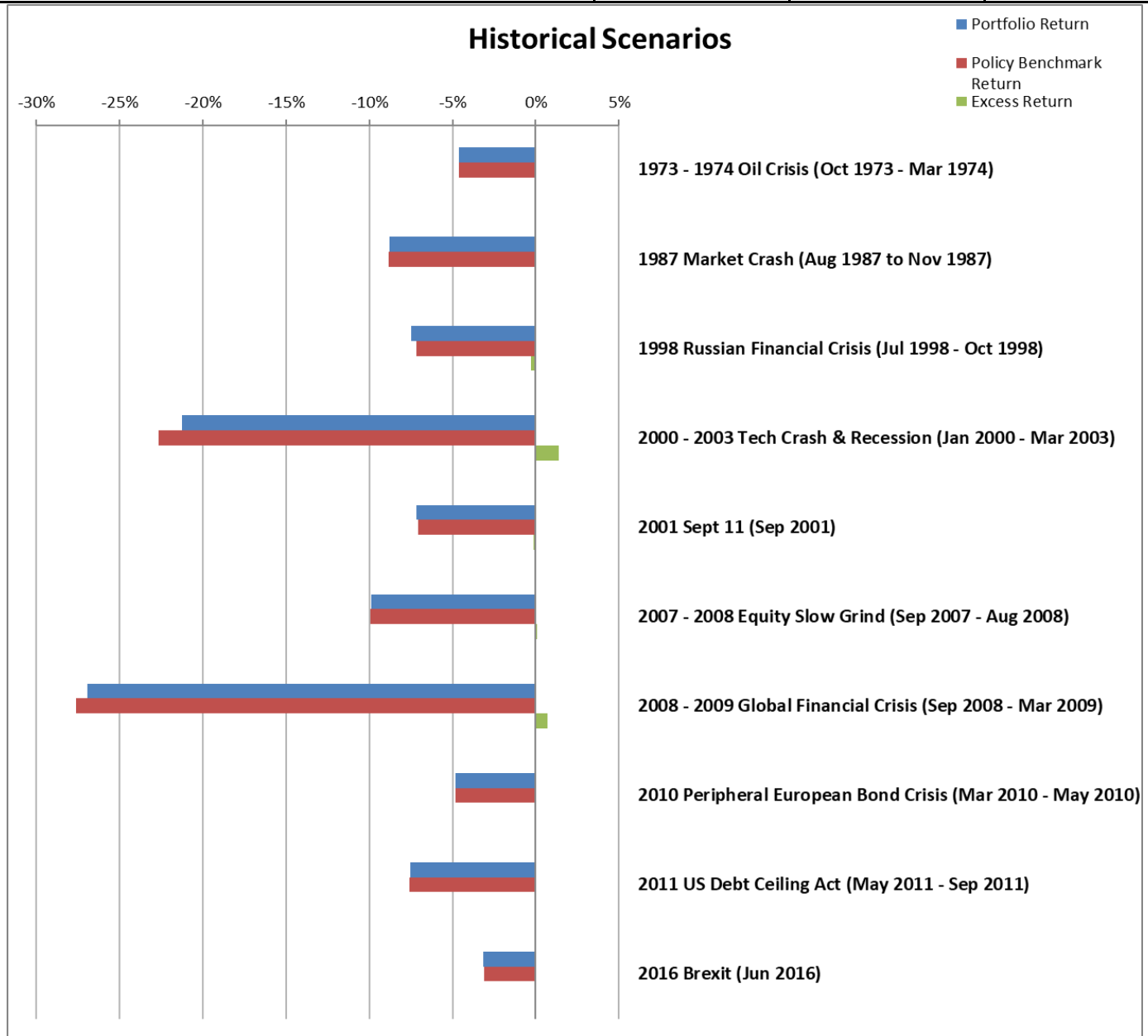
The bottom chart plots the Forecast Total Volatility and Tracking Error for the Total Fund one year prior to each date vs. the Total Volatility and Tracking Error realized for that date. The graph highlights potential deviations between risk model estimates and subsequent realized volatility, due to 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.

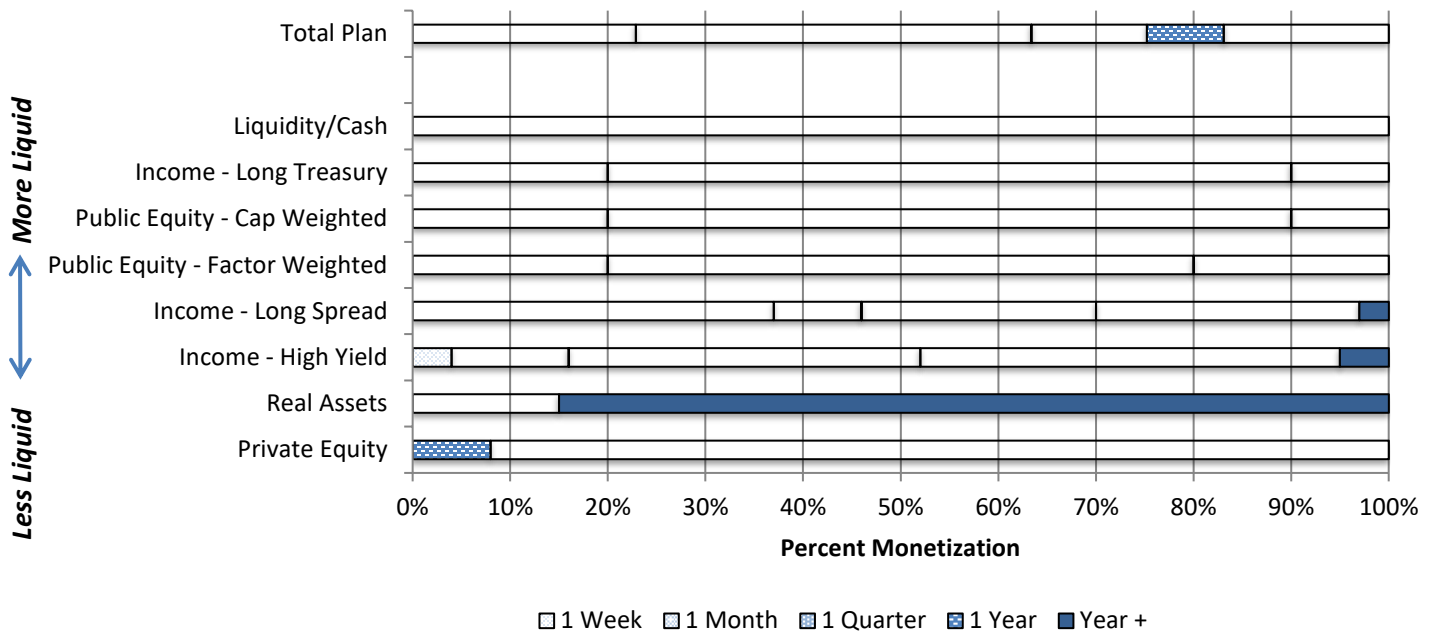
Scenario	Portfolio Return	Policy Benchmark Return	Excess Return
2016 Brexit (Jun 2016)	-3.2%	-3.1%	-0.1%
1973 - 1974 Oil Crisis (Oct 1973 - Mar 1974)	-4.6%	-4.6%	0.0%
2010 Peripheral European Bond Crisis (Mar 2010 - May 2010)	-4.8%	-4.8%	0.0%
2001 Sept 11 (Sep 2001)	-7.2%	-7.0%	-0.1%
1998 Russian Financial Crisis (Jul 1998 - Oct 1998)	-7.5%	-7.2%	-0.3%
2011 US Debt Ceiling Act (May 2011 - Sep 2011)	-7.5%	-7.6%	0.0%
1987 Market Crash (Aug 1987 to Nov 1987)	-8.8%	-8.8%	0.0%
2007 - 2008 Equity Slow Grind (Sep 2007 - Aug 2008)	-9.9%	-9.9%	0.1%
2000 - 2003 Tech Crash & Recession (Jan 2000 - Mar 2003)	-21.3%	-22.7%	1.4%
2008 - 2009 Global Financial Crisis (Sep 2008 - Mar 2009)	-26.9%	-27.6%	0.7%



Source: BarraOne, CalPERS

LIQUIDITY

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*

PERF LIQUIDITY SNAPSHOT

As of June 30, 2019

	Expected Cash Flows for 1 Month (\$M)		
	Normal Conditions	Extreme Stress	
a Cash Equivalents (< 30 days)*	\$13,447	\$9,782	
b Sources Total (cash flow in)	\$8,024	\$12,065	
c Uses Total (cash flow out)**	(\$7,709)	(\$15,052)	
Expected Cash Equivalents (Period End)	\$13,762	\$6,794	
Liquidity Coverage Ratio	279%	145%	= (a+b)/(-c)
* Includes borrowed liquidity i.e. cash available in asset classes and cash collateral from securities lending ** Includes contingent cash demands from derivatives positions, securities lending, and fund level liabilities; assumes no incremental borrowing			

Liquidity Coverage is computed from estimates of future cash inflows and outflows up to a 1-year horizon. In this table, the 1-month forward period is shown with Liquidity Coverage ratios for a normal environment and for a selected stress period (Global Financial Crisis). The Liquidity Coverage ratios could be interpreted as how many times (2.79 times in normal market conditions) available cash / cash equivalents could cover projected cash needs over a 1-month forward period. A ratio of less than one does not imply coverage is inadequate, as there are opportunities to raise cash through asset sales and incremental borrowing.

Source: BarraOne, SSB, CalPERS

LEVERAGE**Total Fund Leverage Report**

as of 06/30/19

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:

"L1" captures exposures with full recourse to the total plan, and is most relevant from an immediate liquidity perspective.

"L2" includes non-recourse borrowing, which can amplify risk and returns for a given \$ invested.

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

		L1: Portfolio Leverage - Full Recourse					L2: Portfolio Leverage w/Non-Recourse			
Asset Class/ Program	Net Market Value (\$Billions) (A)	Sources of Leverage ¹			Gross Market Exposure (B)	Portfolio Leverage (B/A) - 1	Additional Sources of Leverage	Gross Market Exposure (C)	Portfolio Leverage (C/A) - 1	
		Derivatives	Recourse Debt	Other						
Public Equity - Cap Weighted	131.4	11.5			2.5	6.9%		140.4	6.9%	
Public Equity - Factor Weighted	54.2	0.3		1.6	1.7	0.2%		54.3	0.2%	
Private Equity	26.5		1.7 ³		0.0	6.4%		28.2	6.4%	
Income - Long Spread	56.7	4.9			2.5	4.2%		59.1	4.2%	
Income - Long Treasury	37.8	1.0			0.3	2.0%		38.6	2.0%	
Income - High Yield	11.8				0.4	-3.0%		11.4	-3.0%	
Real Assets	40.9		0.0 ⁴		0.5	-1.2%	19.6	60.0	47.4% ⁵	
Liquidity	3.8				3.8	N/M		0.0	N/M	
Trust Level	7.1	0.4		0.0	0.6	-3.1%		6.9	-3.1%	
Securities Lending ⁶	0.0			4.0	4.0	N/M		0.0	N/M	
Total Fund	370.2	\$18.1	\$1.7	\$5.6	\$16.2	\$379.3	2.5%	\$19.6	\$398.9	7.8%

Embedded Leverage in Asset Classes

	Implied Leverage ⁷
Public Equity	1.54
Private Equity	2.22
Real Estate	1.28

Unfunded Commitments

	Net Market Value (\$B)	Unfunded Commitments (\$B) ⁸	% of Total Fund
Private Equity	26.4	17.6	4.8%
Real Assets	40.3	7.9	2.1%

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. Subscription financing and other liabilities at the fund level (as of 12/31/2018) are shown as recourse, while defined non-recourse for policy definition.

4. As of 3/31/19 there is no Recourse Debt in Real Estate. This amount is down \$4.5M since 09/30/18.

5. Policy leverage for Real Assets is measured as a Loan-to-Value ratio and will differ from figure shown in table. LTV leverage as of 3/31/19 for Real Estate, Infrastructure and Forestland are: 31%, 44%, and 1%, respectively.

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

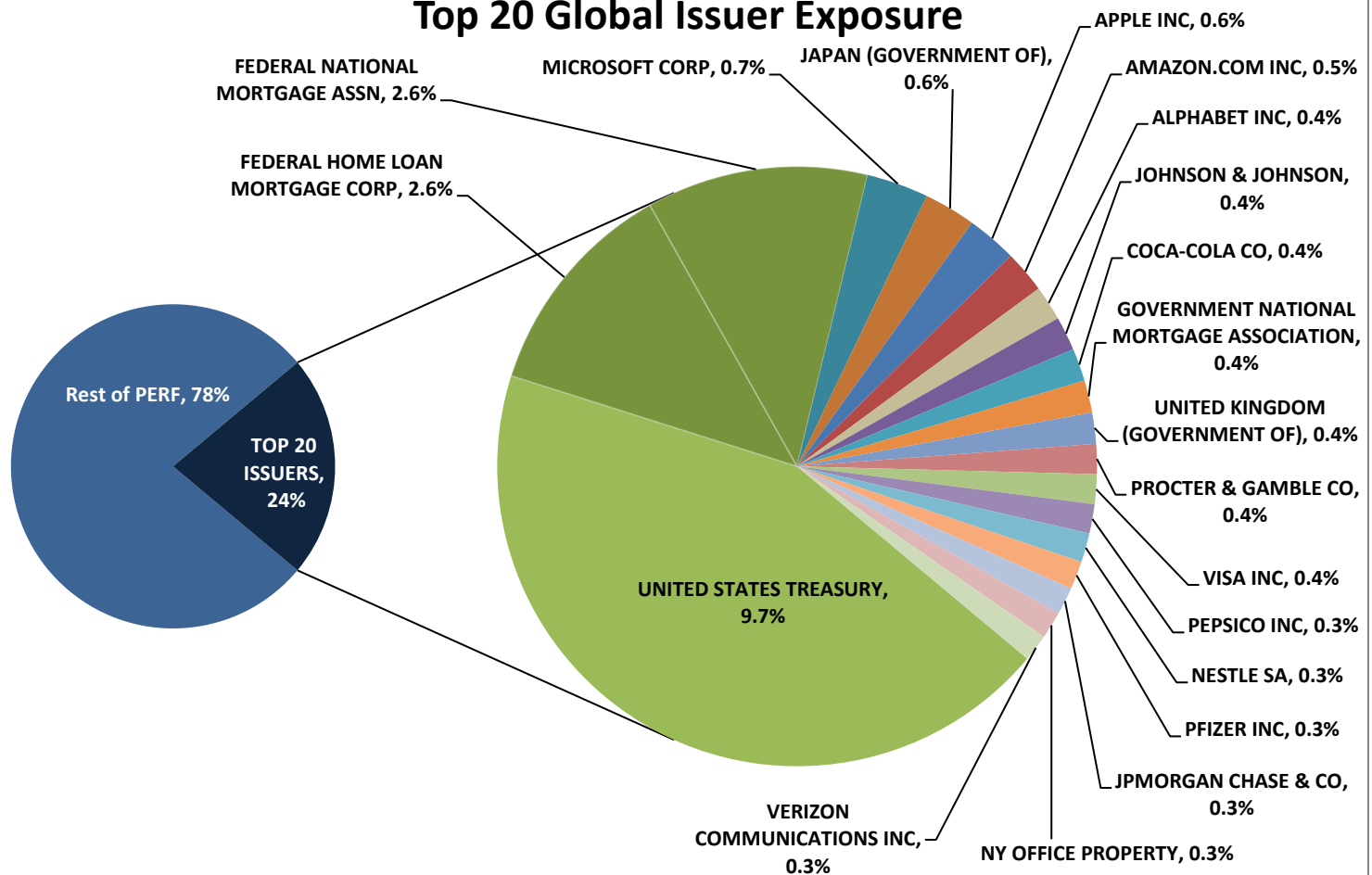
7. Implied leverage is estimated from either asset class benchmark data or industry research. It represents the Enterprise Value to Equity ratio.

8. Unfunded commitments are as of 12/31/2018 for Private Equity and 3/31/2019 for Real Assets. 97% of Real Asset unfunded commitments are revocable at CalPERS' discretion.

Source: BarraOne, SSB, Factset, CalPERS

CONCENTRATION REPORT

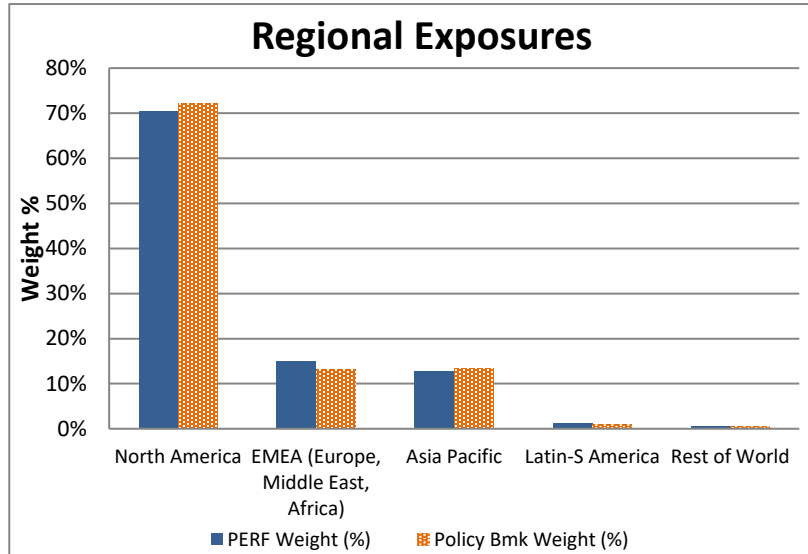
Top 20 Global Issuer Exposure



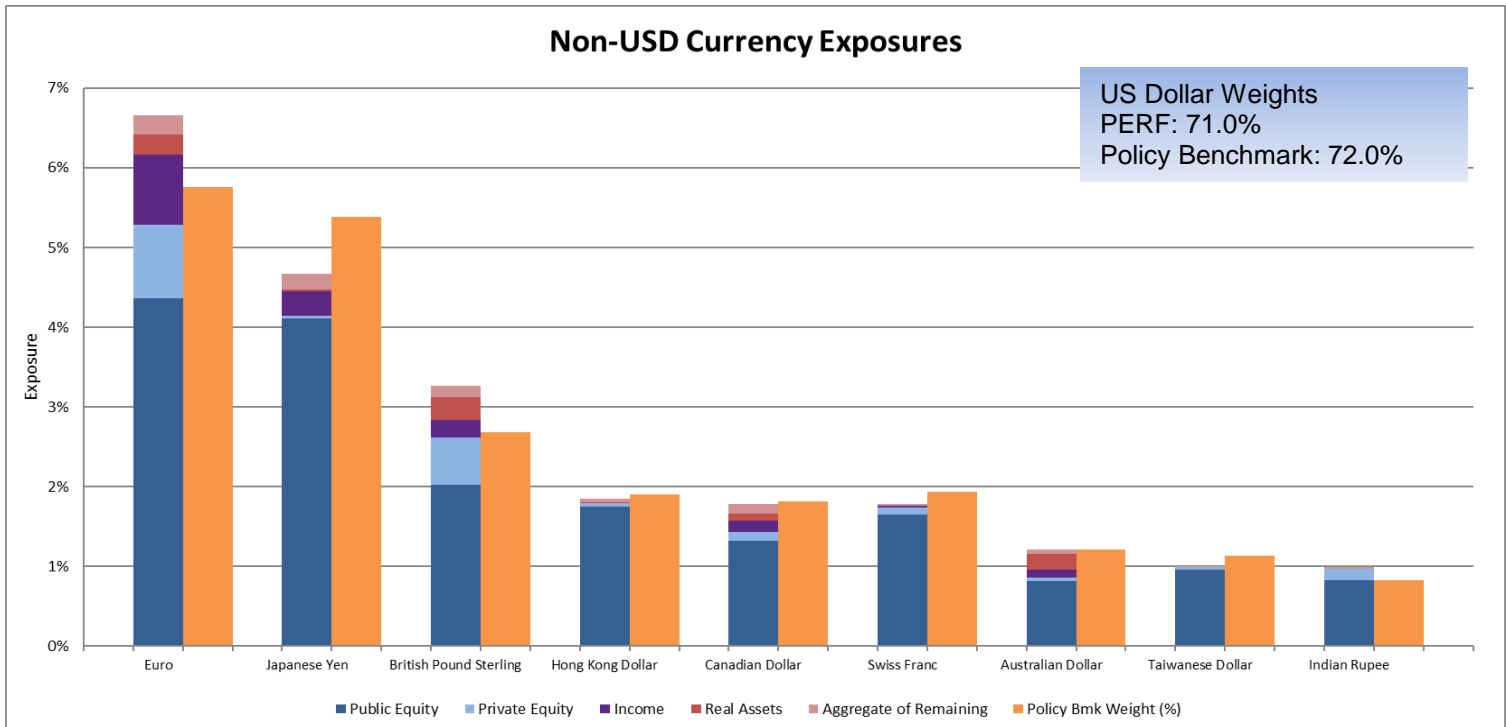
Top 10 Industry Exposure

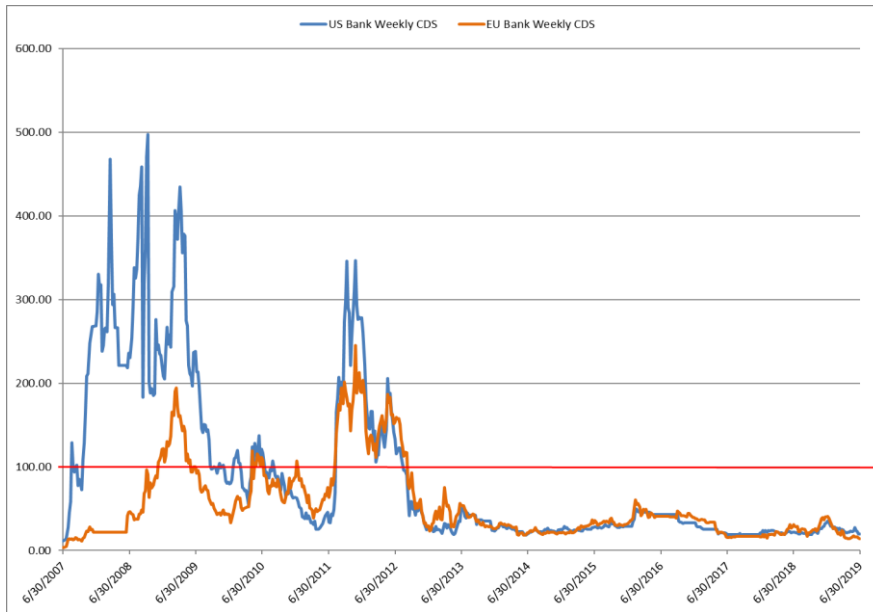


CONCENTRATION REPORT



Country	PERF Weight (%)	Policy Bmk Weight (%)	Active Weight (%)
United States	68.8%	70.3%	-1.5%
Japan	4.7%	5.5%	-0.7%
United Kingdom	3.7%	2.9%	0.7%
Canada	2.2%	2.2%	0.0%
France	1.9%	1.8%	0.1%
Germany	1.8%	1.7%	0.1%
Switzerland	1.8%	2.0%	-0.2%
Australia	1.2%	1.2%	0.0%
China	1.0%	1.1%	-0.2%
India	1.0%	0.8%	0.2%



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.

<u>Counterparty</u>	<u>NET MTM FORWARDS</u> (\$)	<u>Net MTM OPTIONS</u> (\$)	<u>Net MTM SWAPS</u> (\$)	<u>CalPERS Exposure</u> (\$)	<u>Counter Party Exposure</u> (\$)	<u>Net MTM Total</u> (\$)	<u>Collateral Posted</u> (\$)*	<u>Net Credit Net Exposure</u> (\$)
Australia and New Zealand Banking	1,180,645			1,782,329	(601,684)	1,180,645	(1,190,000)	(9,355)
Bank of Montreal	(618,370)			3,656	(622,026)	(618,370)	650,000	31,630
Bank of America	(1,436,695)	(1,560,891)	13,501,429	19,104,688	(8,600,845)	10,503,843	(10,507,669)	(3,826)
BNP Paribas	598,344	951,514		4,002,376	(2,452,518)	1,549,858	(1,700,000)	(150,142)
Barclays	236,549		(5,394,160)	3,687,711	(8,845,322)	(5,157,611)	5,200,000	42,389
Citigroup	(11,585,144)		5,415,027	10,844,162	(17,014,279)	(6,170,117)	6,180,000	9,883
Credit Suisse International	(19,012)		(562,662)	-	(581,674)	(581,674)	600,000	18,326
Deutsche Bank	(1,945,871)	(3,202,050)		1,655,460	(6,803,381)	(5,147,921)	5,150,000	2,079
Goldman Sachs Intl.	33,117,510	(4,181,043)	3,200,220	41,401,991	(9,265,304)	32,136,687	(32,171,000)	(34,313)
HSBC	18,750,196		(2,337,611)	22,896,319	(6,483,734)	16,412,585	(16,450,000)	(37,415)
JPMorgan Chase Bank	(1,047,239)	548,191	768,956	4,208,812	(3,938,904)	269,908	(270,000)	(92)
Morgan Stanley Capital Service	7,922,579	(4,728,042)	414,011	20,083,797	(16,475,249)	3,608,548	(3,650,000)	(41,452)
RBC Capital Markets	(3,783,784)	(691,946)		14,752	(4,490,482)	(4,475,730)	4,480,000	4,270
Standard Chartered Bank	12,847,423			13,695,400	(847,977)	12,847,423	(12,865,011)	(17,588)
Societe Generale	7,106,415	(140,516)	134,429	8,522,543	(1,422,215)	7,100,328	(7,110,000)	(9,672)
State Street	6,812,774			7,132,431	(319,657)	6,812,774	(6,820,000)	(7,226)
Toronto Dominion	1,873,760			2,479,831	(606,071)	1,873,760	(1,880,000)	(6,240)
UBS AGG	1,248,217	47,314	4,295,243	6,885,831	(1,295,057)	5,590,774	(5,600,000)	(9,226)
Grand Total	71,258,297	(12,957,469)	19,434,882	168,402,089	(90,666,379)	77,735,710	(77,953,680)	(217,970)

*As of 6/30/19 CalPERS posted 100mm to Counterparties which includes Internal Collateral

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	444,241,406
BOFA SECURITIES INC	109,236,172

*As of June 30, 2019

Appendix

1. How to interpret the OTC Counterparty Risk Exposure section

OTC Derivative Counterparty Exposure Report								
<u>Counterparty</u>	<u>NET MTM FORWARDS</u> (\$)	<u>Net MTM OPTIONS</u> (\$)	<u>Net MTM SWAPS</u> (\$)	<u>CalPERS Exposure</u> (\$)	<u>Counter Party Exposure</u> (\$)	<u>Net MTM Total</u> (\$)	<u>Collateral Posted</u> (\$)	<u>Net Credit Net Exposure</u> (\$)
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