Board of Investments - Investment Update

Report on Retirement System Trust Fund Investments and Benefits

Pursuant to Section 17-6-230, MCA

Provided to Legislative Services Division

Information as of December 31, 2017

MONTANA
BOARD OF INVESTMENTS

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- **The Unified Investment program for public funds must be administered by the Board of Investments in accordance with the "prudent expert principle,"** defined as:

  1) discharging its duties with the care, skill, prudence, and diligence, under the circumstances then prevailing, that a prudent person acting in a like capacity with the same resources and familiar with like matters exercises in the conduct of an enterprise of like character with like aims;

  2) diversifying the holdings of each fund to minimize the risk of loss and maximize the rate of return, unless under the circumstances it is clearly prudent not to do so; and

  3) discharging its duties solely in the interest of and for the beneficiaries of the funds managed.

- **Investment performance is measured by three integrated long-term return objectives:**

  1) Actuarial expected investment return (7.75%)

  2) Investment performance benchmarks

  3) Peer comparison

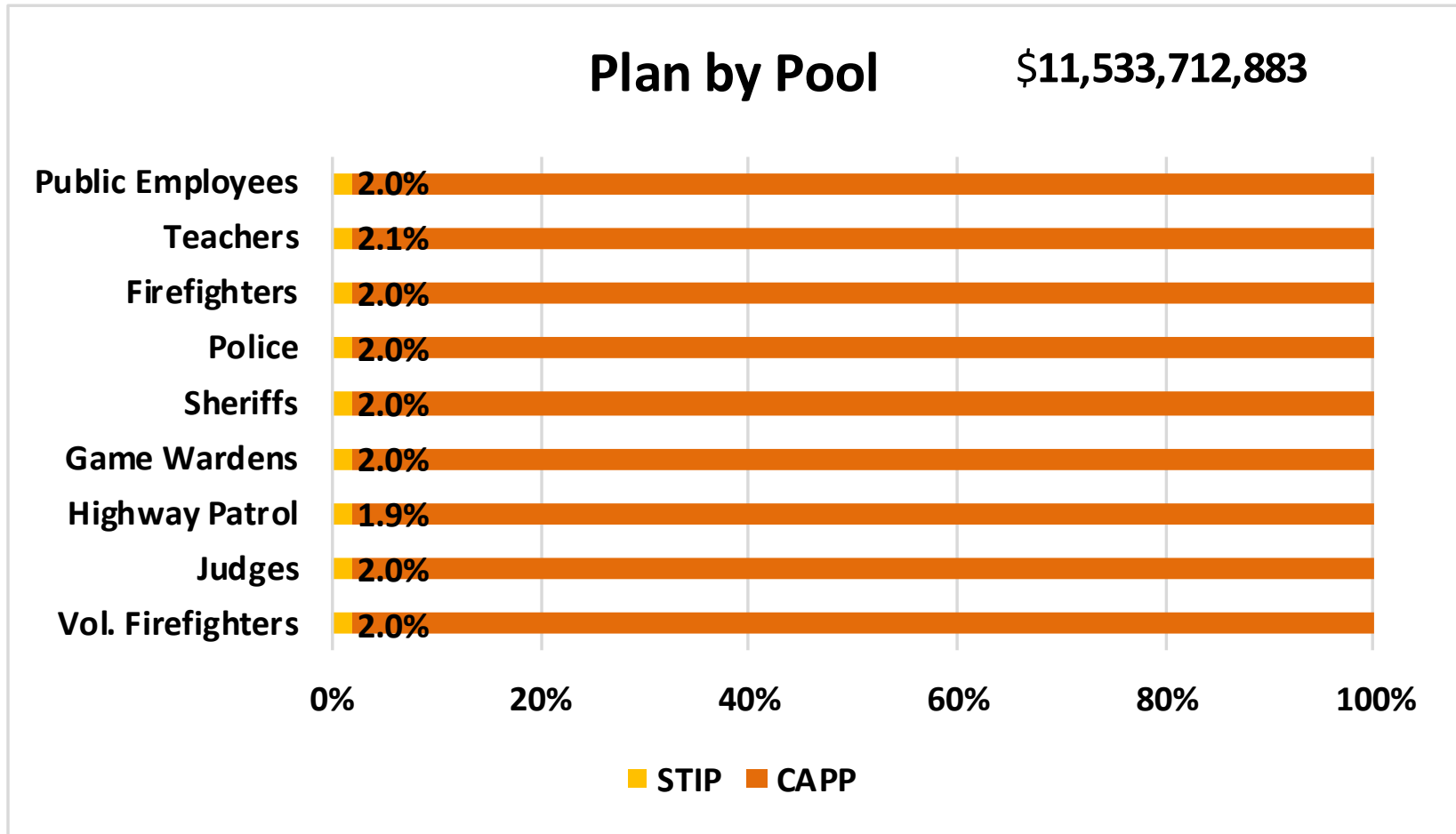**Montana Board of Investments Functional Organization Chart**

Approved April 5, 2017

December 31, 2017

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BOARD OF INVESTMENTS

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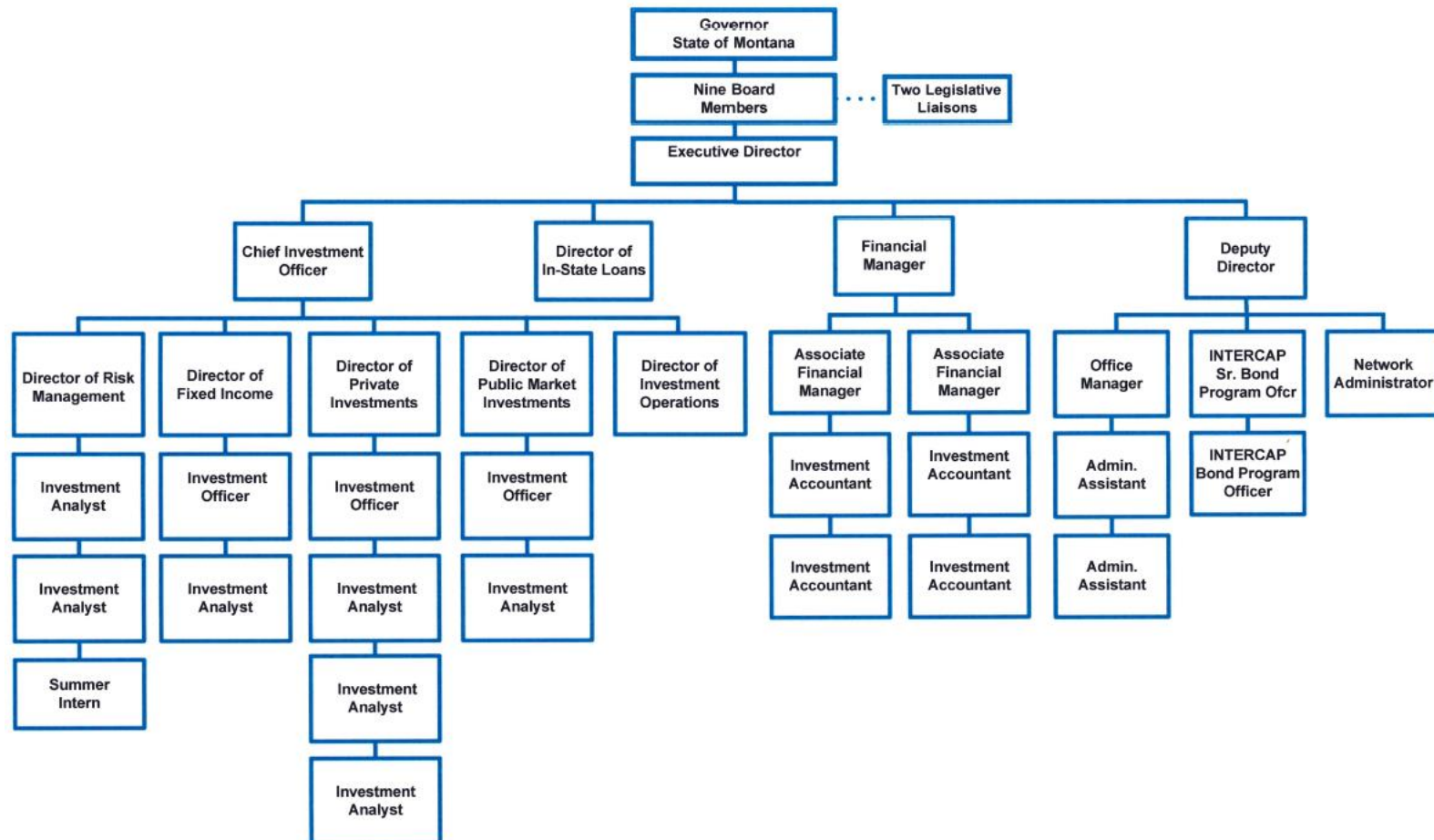
- Asset Allocation is the Primary Driver of Returns

- Capital Market Assumptions Drive Expected Return Outcomes
  - Returns, Volatility, and Correlations

- Return Assumptions provided by the investment consultant of MBOI have been on a declining trend in recent years

- Volatility of Returns Reduces Expected Compound Returns

- Liquidity must be available to provide the funding for a growing Net Cash Need to meet retirement plan benefit payments.

- Multiple Approaches to Asset Allocation
  - Mean Variance Analysis, Monte Carlo Analysis, Liquidity Analysis

- The recommended asset allocation should consider the funding objectives, the current characteristics of the retirement plan, any anticipated changes in the benefits and contribution policies for each plan individually, and the opportunity set of investments.

- Currently, the asset allocation process results in an expected return that is below the current actuarial return expectation. However, this shouldn't be viewed as a new event, unique to the Montana pension plans, nor necessarily permanent.

- Asset Allocation reviewed/approved by MBOI Board at least annually

- Changes during most recent Asset Allocation review (November 2017)
  - Increase to top range of International Equities (18% to 24%)
  - Decrease to bottom range of Broad Fixed Income (1% to 0%)

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Plan by Pool $11,533,712,883

Pool	STIP	CAPP
Public Employees	2.0%	
Teachers	2.1%	
Firefighters	2.0%	
Police	2.0%	
Sheriffs	2.0%	
Game Wardens	2.0%	
Highway Patrol	1.9%	
Judges	2.0%	
Vol. Firefighters	2.0%	

Legend: ■ STIP   ■ CAPP

Asset Class	Market Value	% of Total	Board Approved Range
Domestic Equity	4,003,924,115	35.4%	24% - 38%
International Equity	2,041,108,151	18.1%	12% - 24%
Private Equity	1,158,087,065	10.2%	9% - 15%
Natural Resources	259,993,915	2.3%	0% - 6%
Real Estate	785,720,964	7.0%	4% - 12%
TIPS	384,132,519	3.4%	0% - 4%
Broad Fixed Income	249,766,393	2.2%	0% - 3%
US Treasury & Agency	1,083,499,322	9.6%	5% - 14%
Investment Grade Credit	376,018,338	3.3%	2% - 6%
Mortgage-Backed	463,393,123	4.1%	2% - 8%
High Yield	319,051,408	2.8%	1% - 5%
Cash	176,742,322	1.6%	1% - 6%
Total	**11,301,437,635**	**100.0%**	
Total Fixed income	**2,875,861,103**	**25.4%**	**15% Minimum**

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Name	1 Year	3 Year	5 Year	10 Year	20 Year	Since Inception (23.5 Years)
Public Employees	14.80	7.86	9.74	5.89	6.47	7.84
Teachers	14.76	7.86	9.74	5.90	6.48	7.85
Firefighters	14.79	7.86	9.75	5.89	6.38	7.68
Police	14.79	7.86	9.75	5.87	6.37	7.69
Sheriffs	14.80	7.87	9.74	5.89	6.42	7.72
Game Wardens	14.81	7.87	9.73	5.89	6.40	7.73
Highway Patrol	14.79	7.86	9.74	5.89	6.41	7.71
Judges	14.82	7.87	9.74	5.90	6.42	7.73
Vol. Firefighters	14.79	7.83	9.73	5.87	6.67	7.51

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Asset Class Benchmark Returns

1 YR	5 YR	10 YR	15 YR	20 YR
MSCI ACWI ex USA IMI 27.19%	MSCI US IMI 15.63%	MSCI USA SMALL CAP 9.62%	MSCI USA SMALL CAP 12.14%	MSCI US REIT 8.90%
MSCI US IMI 21.22%	MSCI USA SMALL CAP 14.44%	MSCI US IMI 8.74%	MSCI US REIT 10.83%	MSCI US IMI 7.58%
MSCI USA SMALL CAP 15.16%	MSCI ACWI ex USA IMI 10.41%	BARC US HY 8.09%	MSCI US IMI 10.44%	BARC US HY 6.83%
PERS 14.80%	PERS 9.74%	MSCI US REIT 7.44%	BARC US HY 8.97%	PERS 6.47%
MSCI AC World Commodity 13.70%	MSCI US REIT 9.34%	PERS 5.89%	MSCI ACWI ex USA IMI 8.15%	BARC US Corp Inv Grd 5.38%
BARC US HY 7.50%	BARC US HY 5.78%	BARC US Corp Inv Grd 4.82%	PERS 7.91%	BARC US Agg 4.98%
MSCI US REIT 5.07%	BARC US Corp Inv Grd 2.68%	BARC US Agg 4.01%	MSCI AC World Commodity 7.46%	BARC US MBS 4.87%
BARC US Corp Inv Grd 3.92%	MSCI AC World Commodity 2.26%	BARC US MBS 3.84%	BARC US Corp Inv Grd 4.72%	BARC TSY 4.07%
BARC US Agg 3.54%	BARC US Agg 2.10%	MSCI ACWI ex USA IMI 3.46%	BARC US Agg 4.15%	LIBOR 1 MONTH 2.28%
BARC US MBS 2.47%	BARC US MBS 2.04%	BARC US TIPS 2.83%	BARC US MBS 4.05%	
BARC US TIPS 1.90%	BARC TSY 0.91%	BARC TSY 2.75%	BARC US TIPS 3.80%	
LIBOR 1 MONTH 1.15%	LIBOR 1 MONTH 0.44%	LIBOR 1 MONTH 0.58%	BARC TSY 3.02%	
BARC TSY 1.14%	BARC US TIPS 0.09%	MSCI AC World Commodity -0.56%	LIBOR 1 MONTH 1.50%	

Legend

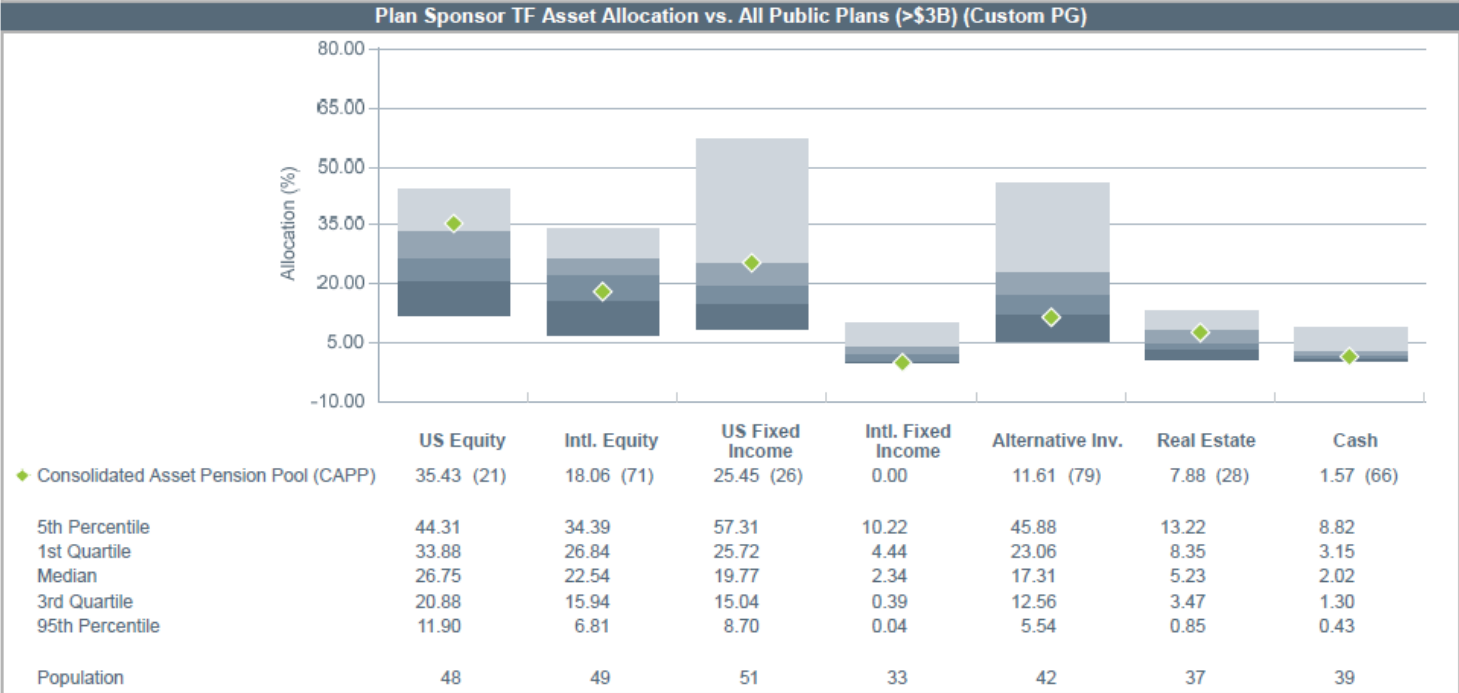|	
Private Equity	Cash Equivalents
Domestic Equity	US Treasury/Agency
International Equity	Broad Fixed Income
High Yield	Mortgage-Backed
Real Estate	Natural Resources
Investment Grade Credit	TIPS

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	% of Total	12/31/2017	12/31/2016	Change
Public Employees	49.9%	5,760,143,926	5,152,552,658	607,591,267
Teachers	35.8%	4,126,435,523	3,719,420,728	407,014,795
Firefighters	3.6%	416,202,177	359,807,468	56,394,709
Police	3.5%	403,202,754	350,663,661	52,539,092
Sheriffs	3.1%	352,474,021	309,155,919	43,318,102
Game Wardens	1.6%	188,555,799	161,719,376	26,836,423
Highway Patrol	1.3%	147,418,705	131,685,137	15,733,568
Judges	0.9%	102,091,047	90,276,230	11,814,817
Vol. Firefighters	0.3%	37,188,931	33,475,503	3,713,428
Total	100.0%	11,533,712,883	10,308,756,681	1,224,956,202

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Peer Comparisons

Comparative Performance - Retirement Plans

	QTD	FYTD	CYTD/ 1 Year	3 Years	5 Years	7 Years	10 Years	20 Years	2016	2015	2014	2013	2012	Since Incep.	Inception Date
Public Employees' Retirement - Net	3.51	7.01	14.80	7.86	9.74	9.11	5.89	6.47	7.32	1.86	8.07	17.38	13.24	7.84	07/01/1994
Public Employees' Benchmark	3.89	7.77	15.35	8.46	10.42	9.74	6.26	N/A	9.09	1.40	9.08	17.94	14.88	N/A	
Difference	-0.38	-0.76	-0.55	-0.60	-0.68	-0.63	-0.37	N/A	-1.77	0.46	-1.01	-0.56	-1.64	N/A	
Public Employees' Retirement - Gross	3.65	7.27	15.34	8.35	10.26	9.64	6.44	6.79	7.78	2.31	8.61	17.96	13.83	8.12	07/01/1994
All Public Plans > $3B Total Fund Median	3.74	7.66	16.08	7.95	8.84	8.16	5.87	6.95	7.94	0.54	6.76	14.47	13.32	8.33	
Rank	64	68	64	24	3	1	9	71	55	8	7	5	33	67	
Teachers' Retirement - Net	3.50	6.99	14.76	7.86	9.74	9.11	5.90	6.48	7.33	1.86	8.09	17.38	13.24	7.85	07/01/1994
Teachers' Benchmark	3.89	7.76	15.32	8.45	10.42	9.74	6.26	N/A	9.08	1.40	9.11	17.94	14.89	N/A	
Difference	-0.39	-0.77	-0.56	-0.59	-0.68	-0.63	-0.36	N/A	-1.75	0.46	-1.02	-0.56	-1.65	N/A	
Teachers' Retirement - Gross	3.65	7.25	15.31	8.35	10.26	9.64	6.44	6.80	7.80	2.32	8.63	17.96	13.84	8.13	07/01/1994
All Public Plans > $3B Total Fund Median	3.74	7.66	16.08	7.95	8.84	8.16	5.87	6.95	7.94	0.54	6.76	14.47	13.32	8.33	
Rank	64	68	65	24	3	1	9	70	55	8	7	5	32	66	

Plan Sponsor TF Asset Allocation vs. All Public Plans (>$3B) (Custom PG)

	US Equity	Intl. Equity	US Fixed Income	Intl. Fixed Income	Alternative Inv.	Real Estate	Cash
◆ Consolidated Asset Pension Pool (CAPP)	35.43 (21)	18.06 (71)	25.45 (26)	0.00	11.61 (79)	7.88 (28)	1.57 (66)
5th Percentile	44.31	34.39	57.31	10.22	45.88	13.22	8.82
1st Quartile	33.88	26.84	25.72	4.44	23.06	8.35	3.15
Median	26.75	22.54	19.77	2.34	17.31	5.23	2.02
3rd Quartile	20.88	15.94	15.04	0.39	12.56	3.47	1.30
95th Percentile	11.90	6.81	8.70	0.04	5.54	0.85	0.43
Population	48	49	51	33	42	37	39

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- Strong absolute returns during recent years

- Time weighted return of 7.84% since July 1, 1994

- Peer performance differences primarily explained by Asset Allocation differences

- The actual results measured over shorter periods will deviate from the long-term assumptions. Any deviation between short-term returns and long-term assumptions doesn't imply the long-term assumptions are wrong.

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The length and strength of expansions
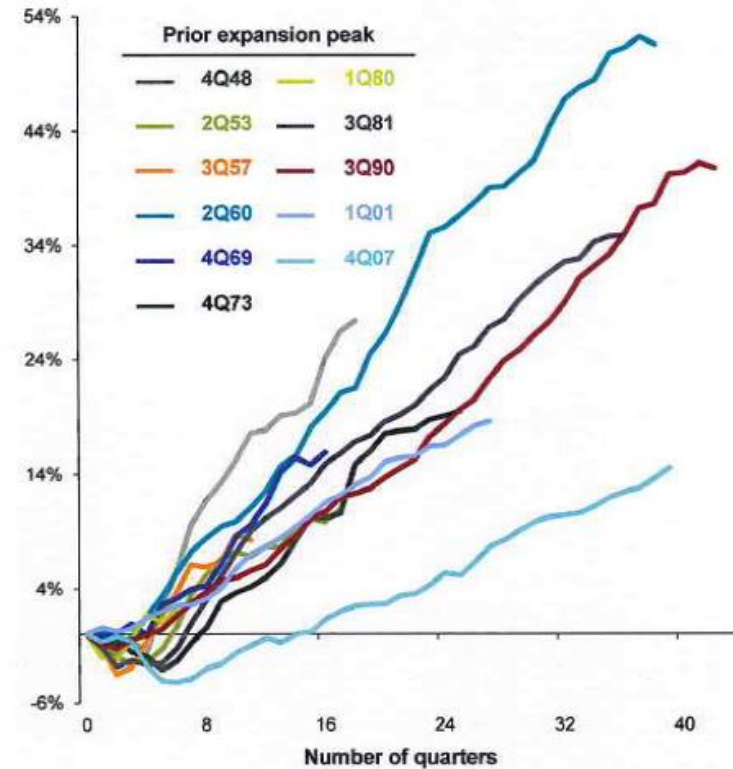
Length of economic expansions and recessions
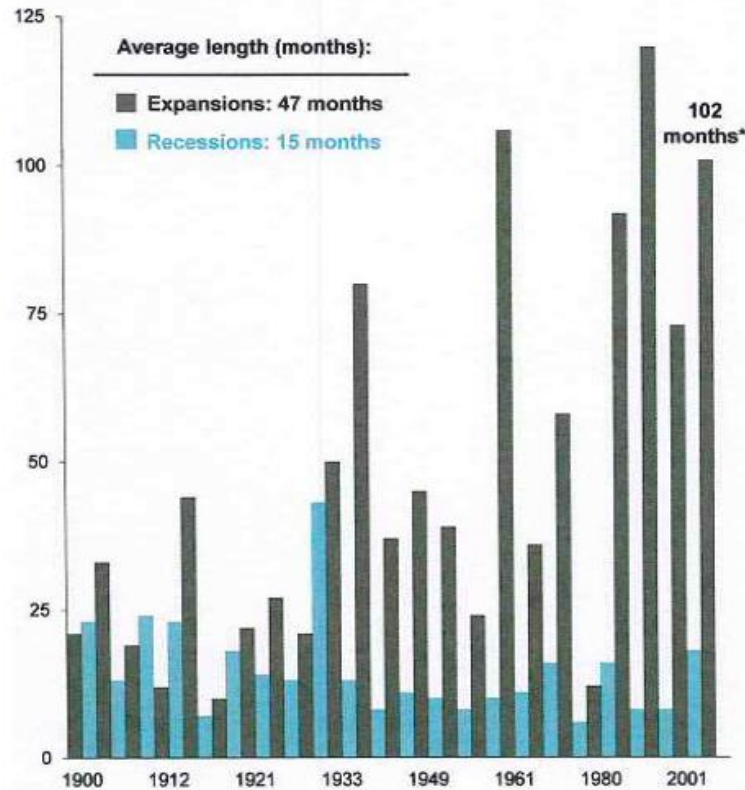
Strength of economic expansions
Cumulative real GDP growth since prior peak, percent

Average length (months):
- Expansions: 47 months
- Recessions: 15 months

102 months*

Prior expansion peak
- 4Q48
- 2Q53
- 3Q57
- 2Q60
- 4Q69
- 4Q73
- 1Q80
- 3Q81
- 3Q90
- 1Q01
- 4Q07

Number of quarters

Source: BEA, NBER, J.P. Morgan Asset Management. *Chart assumes current expansion started in July 2009 and continued through December 2017, lasting 102 months so far. Data for length of economic expansions and recessions obtained from the National Bureau of Economic Research (NBER). These data can be found at www.nber.org/cycles/ and reflect information through December 2017. Past performance is not a reliable indicator of current and future results.
Guide to the Markets – U.S. Data are as of December 31, 2017.
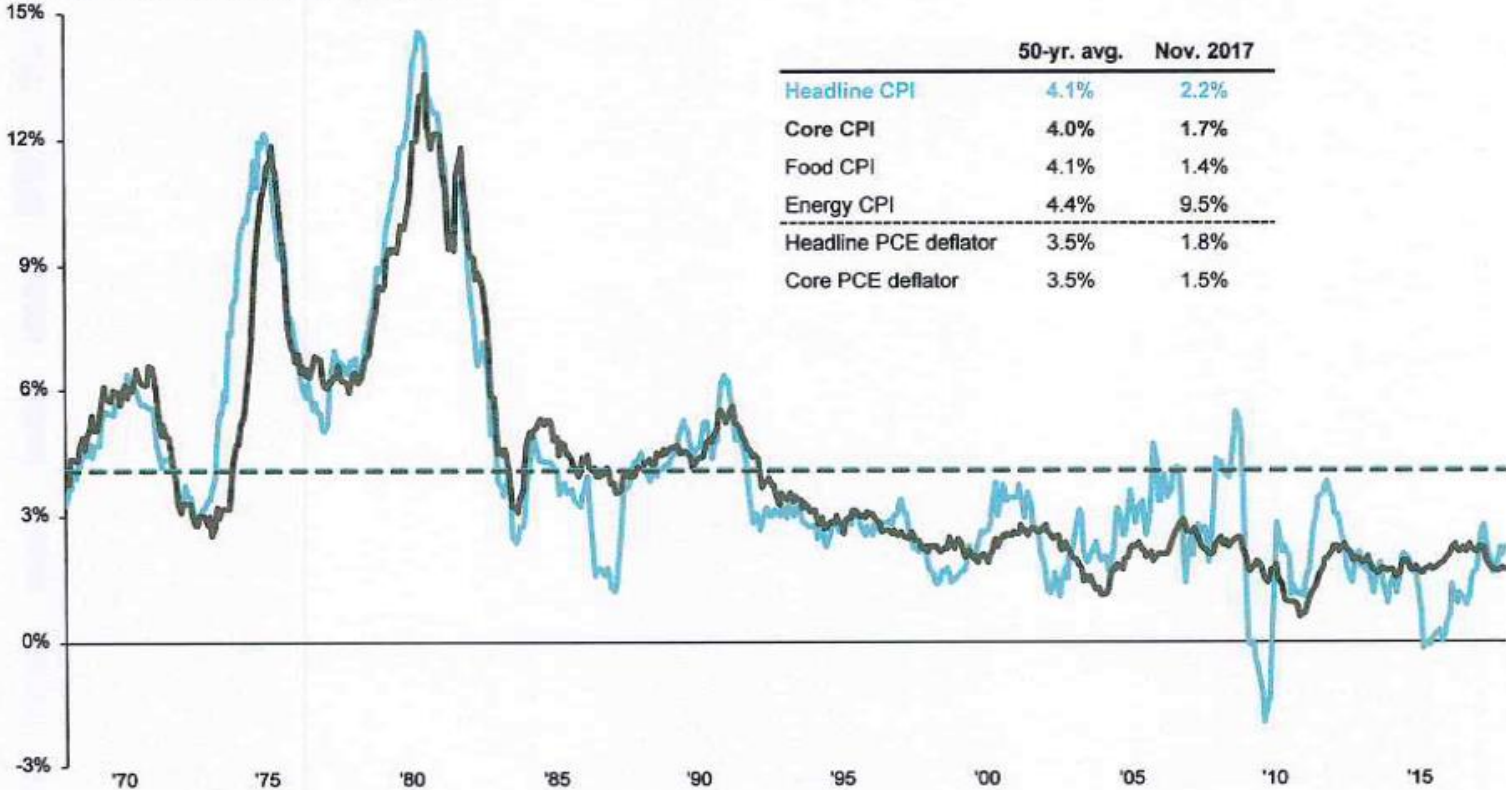
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Unemployment and wages   GTM – U.S. | 24

Civilian unemployment rate and year-over-year wage growth for private production and non-supervisory workers
Seasonally adjusted, percent
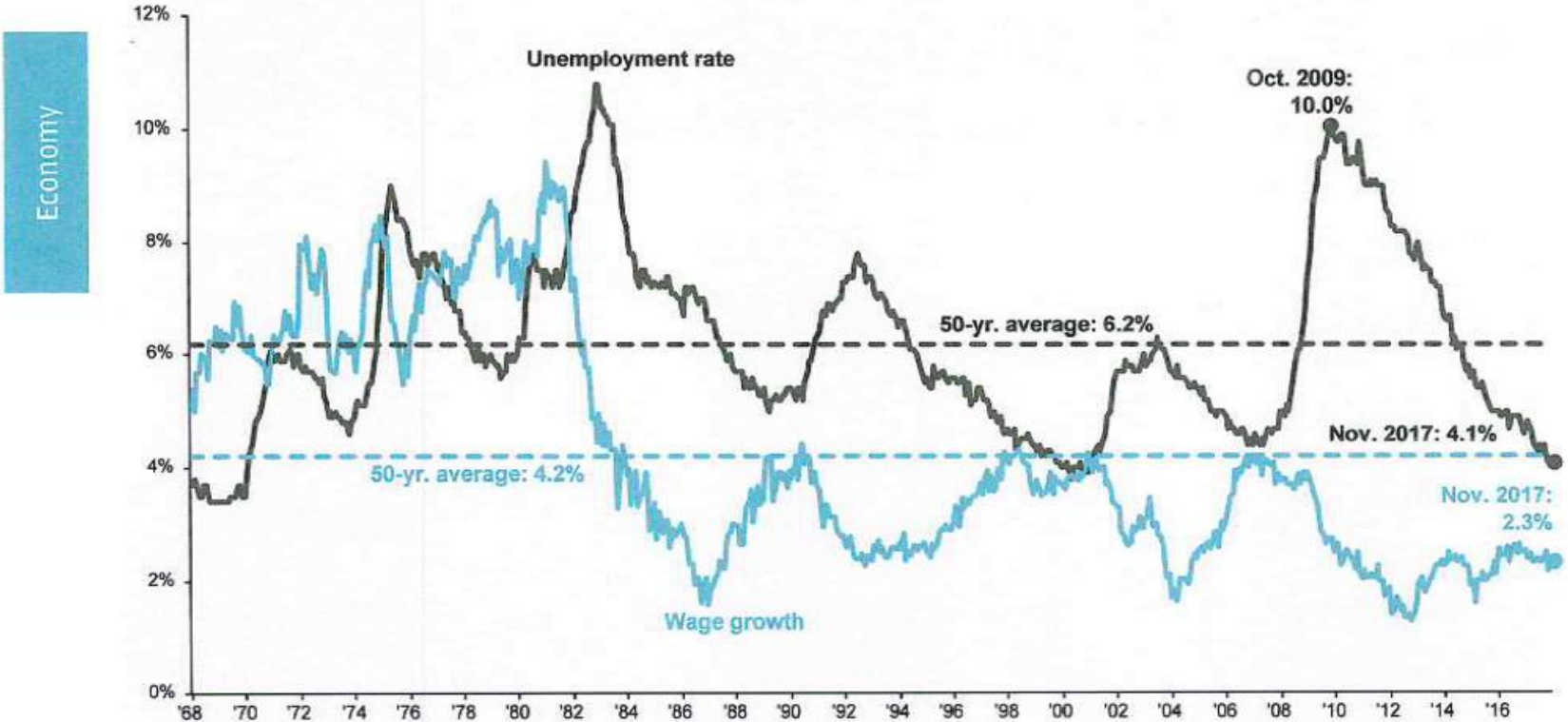
Source: BLS, FactSet, J.P. Morgan Asset Management. Past performance is not a reliable indicator of current and future results.
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Inflation

CPI and core CPI
% change vs. prior year, seasonally adjusted

	50-yr. avg.	Nov. 2017
Headline CPI	4.1%	2.2%
Core CPI	4.0%	1.7%
Food CPI	4.1%	1.4%
Energy CPI	4.4%	9.5%
Headline PCE deflator	3.5%	1.8%
Core PCE deflator	3.5%	1.5%

Source: BLS, FactSet, J.P. Morgan Asset Management.
CPI used is CPI-U and values shown are % change vs. one year ago. Core CPI is defined as CPI excluding food and energy prices. The Personal Consumption Expenditure (PCE) deflator employs an evolving chain-weighted basket of consumer expenditures instead of the fixed-weight basket used in CPI calculations. Past performance is not a reliable indicator of current and future results.
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- From an economic viewpoint, the baseline assumptions are that:
    - the global economic growth will remain modest
    - Near full employment levels
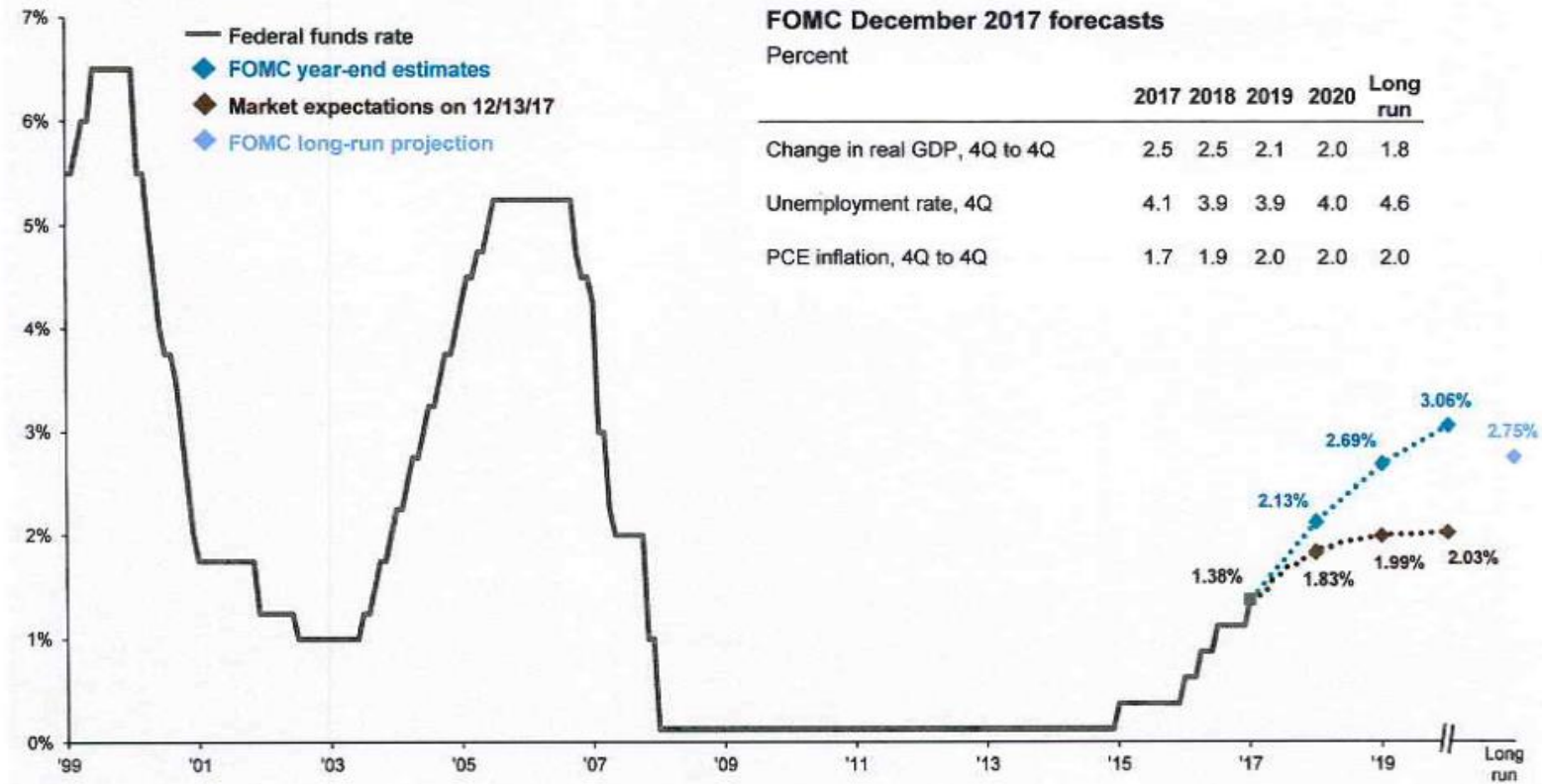   - inflation will be near levels targeted by the Federal Reserve.

The Fed and interest rates

Federal funds rate expectations
FOMC and market expectations for the fed funds rate

Fixed income

- —— Federal funds rate
- ◆ FOMC year-end estimates
- ◆ Market expectations on 12/13/17
- ◆ FOMC long-run projection

FOMC December 2017 forecasts
Percent

	2017	2018	2019	2020	Long run
Change in real GDP, 4Q to 4Q	2.5	2.5	2.1	2.0	1.8
Unemployment rate, 4Q	4.1	3.9	3.9	4.0	4.6
PCE inflation, 4Q to 4Q	1.7	1.9	2.0	2.0	2.0

Source: FactSet, Federal Reserve, Bloomberg, J.P. Morgan Asset Management.
Market expectations are the federal funds rates priced into the fed futures market as of the date of the December 2017 FOMC meeting.
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S&P 500 Index at inflection points

Equities

S&P 500 Price Index

Characteristic	Mar. 2000		Oct. 2007		Dec. 2017
Index level	1,527	➔	1,565	➔	2,674
P/E ratio (fwd.)	27.2x	➔	15.7x	➔	18.2x
Dividend yield	1.1%	➔	1.8%	➔	2.0%
10-yr. Treasury	6.2%	➔	4.7%	➔	2.4%

Dec. 31, 2017
P/E (fwd.) = 18.2x
2,674

Mar. 24, 2000
P/E (fwd.) = 27.2x
1,527

Oct. 9, 2007
P/E (fwd.) = 15.7x
1,565

+295%

+106%

+101%

-49%

-57%

Dec. 31, 1996
P/E (fwd.) = 16.0x
741

Oct. 9, 2002
P/E (fwd.) = 14.1x
777

Mar. 9, 2009
P/E (fwd.) = 10.3x
677
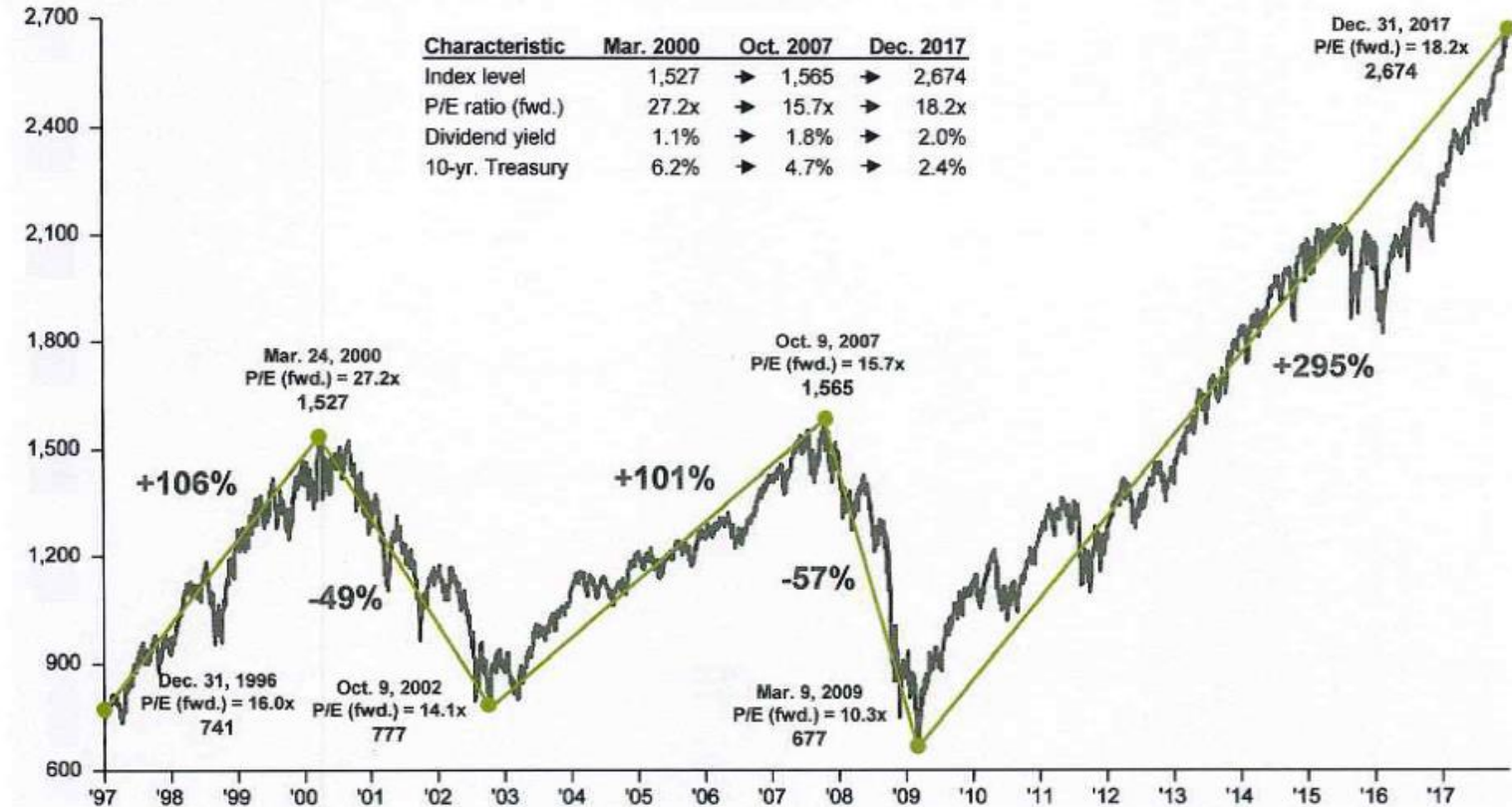
Source: Compustat, FactSet, Thomson Reuters, Federal Reserve, Standard & Poor's, J.P. Morgan Asset Management.
Dividend yield is calculated as consensus estimates of dividends for the next 12 months, divided by most recent price, as provided by Compustat.
Forward price to earnings ratio is a bottom-up calculation based on the most recent S&P 500 Index price, divided by consensus estimates for
earnings in the next 12 months (NTM), and is provided by FactSet Market Aggregates. Returns are cumulative and based on S&P 500 Index price
movement only, and do not include the reinvestment of dividends. Past performance is not indicative of future returns.
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S&P 500 valuation measures — GTM – U.S. | 5

S&P 500 Index: Forward P/E ratio

Valuation measure	Description	Latest	25-year avg.*	Std. dev. Over-/under-Valued
P/E	Forward P/E	18.2x	16.0x	0.7
CAPE	Shiller's P/E	32.4	26.4	1.0
Div. Yield	Dividend yield	2.0%	2.0%	0.1
P/B	Price to book	3.1	2.9	0.2
P/CF	Price to cash flow	12.8	10.7	1.1
EY Spread	EY minus Baa yield	1.3%	-0.2%	-0.8

+1 Std. dev.: 19.2x

25-year average: 16.0x
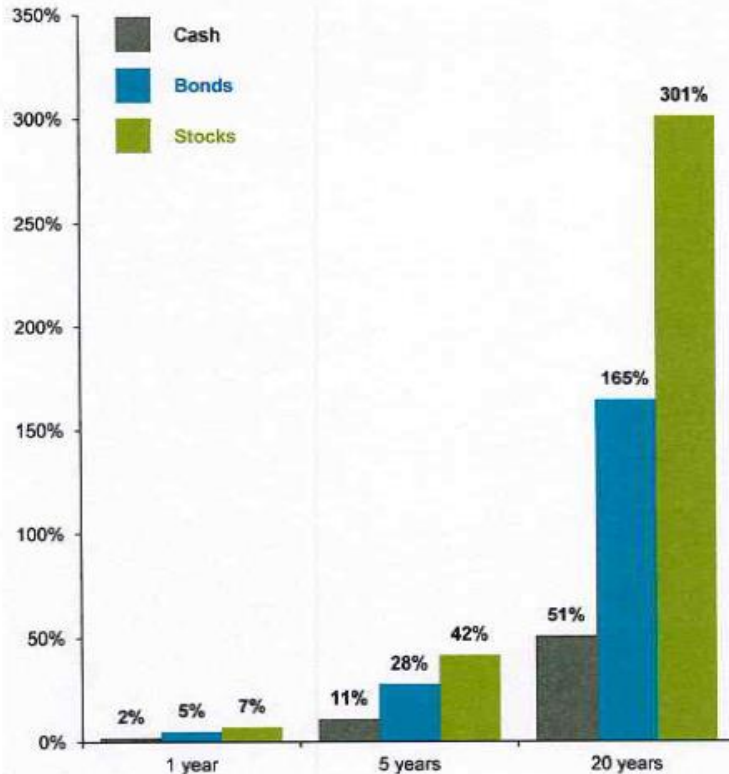
-1 Std. dev.: 12.8x

Current: 18.2x

Source: FactSet, FRB, Thomson Reuters, Robert Shiller, Standard & Poor's, J.P. Morgan Asset Management.
Price to earnings is price divided by consensus analyst estimates of earnings per share for the next 12 months as provided by IBES since December 1989, and FactSet for December 31, 2017. Average P/E and standard deviations are calculated using 25 years of FactSet history. Shiller's P/E uses trailing 10-years of inflation-adjusted earnings as reported by companies. Dividend yield is calculated as the next 12-month consensus dividend divided by most recent price. Price to book ratio is the price divided by book value per share. Price to cash flow is price divided by NTM cash flow. EY minus Baa yield is the forward earnings yield (consensus analyst estimates of EPS over the next 12 months divided by price) minus the Moody's Baa seasoned corporate bond yield. Std. dev. over-/under-valued is calculated using the average and standard deviation over 25 years for each measure.
*P/CF is a 20-year average due to cash flow data availability.
Guide to the Markets – U.S. Data are as of December 31, 2017.
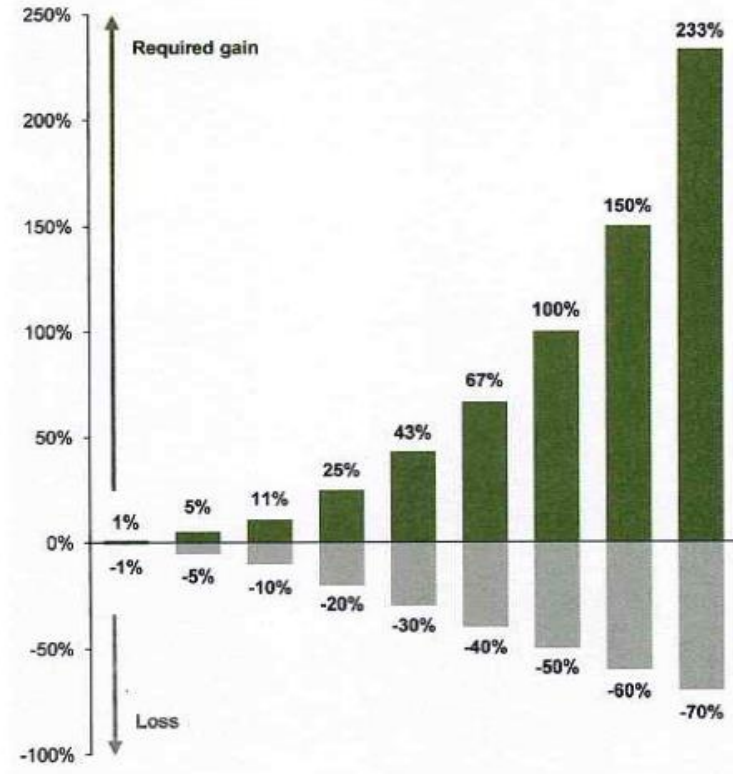
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The importance of staying invested and limiting losses

Investing principles

The power of compounding
Cumulative return by holding period

Legend: Cash, Bonds, Stocks

Holding period	Cash	Bonds	Stocks
1 year	2%	5%	7%
5 years	11%	28%	42%
20 years	51%	165%	301%

Gain required to fully recover from a loss
Loss and subsequent gain necessary for full recovery of value

Required gain / Loss

Loss	Required gain
-1%	1%
-5%	5%
-10%	11%
-20%	25%
-30%	43%
-40%	67%
-50%	100%
-60%	150%
-70%	233%

Source: J.P. Morgan Asset Management, BLS, FactSet, Standard & Poor's
Cumulative returns are calculated using historical data. Stock returns are based on the S&P 500, bonds returns are based on the Barclays U.S. Aggregate Index and cash returns are based on 3-month U.S. Treasury Bills. 1-year returns are 20 year average annualized return from 12/31/1997-12/31/2017 for each asset class. 5- and 20-year returns are cumulative over that time period based on the annualized return. Past performance is not indicative of future returns.
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- Asset Allocation Ranges

- Valuations Matter

- Given current valuation levels of different asset classes, the asset allocation must continue to improve its diversification to help protect against surprises.

- Long-term strategy is to continue to maintain Equity Bias.

- Asset Allocation remains critical to the pension plans' long-term success.

- MBOI's investment management of retirement plan assets requires adherence to the Prudent Expert Principle.

- There is no asset allocation that is "right" for every plan and every situation. Individual plan specifics matter and the expected return and potential risk for a particular asset allocation changes over time.

- MBOI website for more information
    - http://investmentmt.com/

- Questions?

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