Wisconsin Retirement System

34th Annual Actuarial Valuation of Retired Lives

December 31, 2016

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Gabriel Roeder Smith & Company
Consultants & Actuaries
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Operation of the System

	Core Annuities	Variable Annuities
Investment Return Hurdle to Trigger Annuity Adjustment	Returns over/under 5%	Returns over/under 5%
Ratio of Assets to Liabilities	If > 0.5%, dividend may be granted If <-0.5%, prior dividends reduced	If > 2%, variable annuity increased If <-2%, variable annuity decreased
Increase/Decrease Rounding Conventions	Rounded to nearest 0.1%	Truncated, carried to next year
Adjustment Effective Date	April following 12/31 valuation	April following 12/31 valuation

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Smoothing Mechanisms - Core

- Undesirable for retirees to experience wide swings in monthly benefits from year to year (especially downward swings)
- Mitigated in Core division by asset smoothing process and portfolio mix
- Asset smoothing has worked well historically, but could not prevent negative dividends in 2009-2013

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Smoothing Mechanisms - Variable

- Variable fund is marked to market each year and subject to wide swings
- Dropping fractions from the percent is a form of smoothing
- Usually has very little effect due to the magnitude of the gains and losses

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Summary of Results – December 31, 2016

$ Millions

	Core	Variable
Number of Annuitants	197,647	40,647
Annual Amount	$ 4,523.1	$ 363.6
Fund Balance	51,972.0	3,792.0
Actuarial Reserve	50,941.4	3,645.1
Ratio	**1.020**	**1.040**

Core published effective earnings rate (MRA) = 7.9%, dividend = 2.0%. Variable published effective earnings rate (Market Value) = 10.0%, and the variable adjustment = 4.0%.

 (Report- Cover Letter & Page 7)

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Summary of Results

- Due to smoothing via Market Recognition account, as of December 31, 2016 there are approximately $3 billion in unrecognized losses in the Core fund
  - Will be recognized over the next 4 years
  - Roughly ½ of loss applies to the annuitant reserve, the other half shared by active members and employers
  - Will put downward pressure on dividends in the coming years

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Primary Sources of Core Dividend

	% of APV
1. SWIB net of fee investment return	8.29%
2. MRA adjustment	(0.39)%
3. Published effective earnings rate	7.90%
4. Adjustment to relate earnings to average core annuity fund balance	(0.36)%
5. Earnings rate based on average balance	7.54%
6. Expected dividend before adjustments: 1.0754/1.05-1	2.42%
7. Adjustment to relate average asset to ending liability	0.02%
8. Carryover from last year due to timing of dividend accounting adjustments and rounding	0.18%
9. Experience study/mortality reserve adjustment	(0.55)%
10. Experience and other effects	(0.05)%
11. Statutory adjustment to round to nearest one-tenth percent	(0.02)%
12. Computed average dividend rate: (6)+(7)+(8)+(9)+(10)+(11)	**2.0%**
13. Adjustment for members at or near the statutory floor	0.0%
14. Final maximum computed dividend rate: (12)+(13), if greater than 0.5% of core annuities, otherwise 0%	**2.0%**

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Liability Attributable to Dividends

Valuation	Liability for Dividend Remaining (billions)	Liability for Dividend Adjustment (billions)
12/31/2010	$7.2	$(0.3)
12/31/2011	6.4	(1.7)
12/31/2012	4.5	(1.3)
12/31/2013	3.0	2.0
12/31/2014	4.6	1.3
12/31/2015	5.5	0.2
12/31/2016	5.4	1.0
12/31/2017 (est)	6.0	

- Liability for dividend remaining represents the value of all previously granted dividends (=$9.2B at 12/31/2008)
- If a market event similar to 2008 were to occur, the complete depletion of the dividend could occur
- Potential implications of such an event continue to be explored

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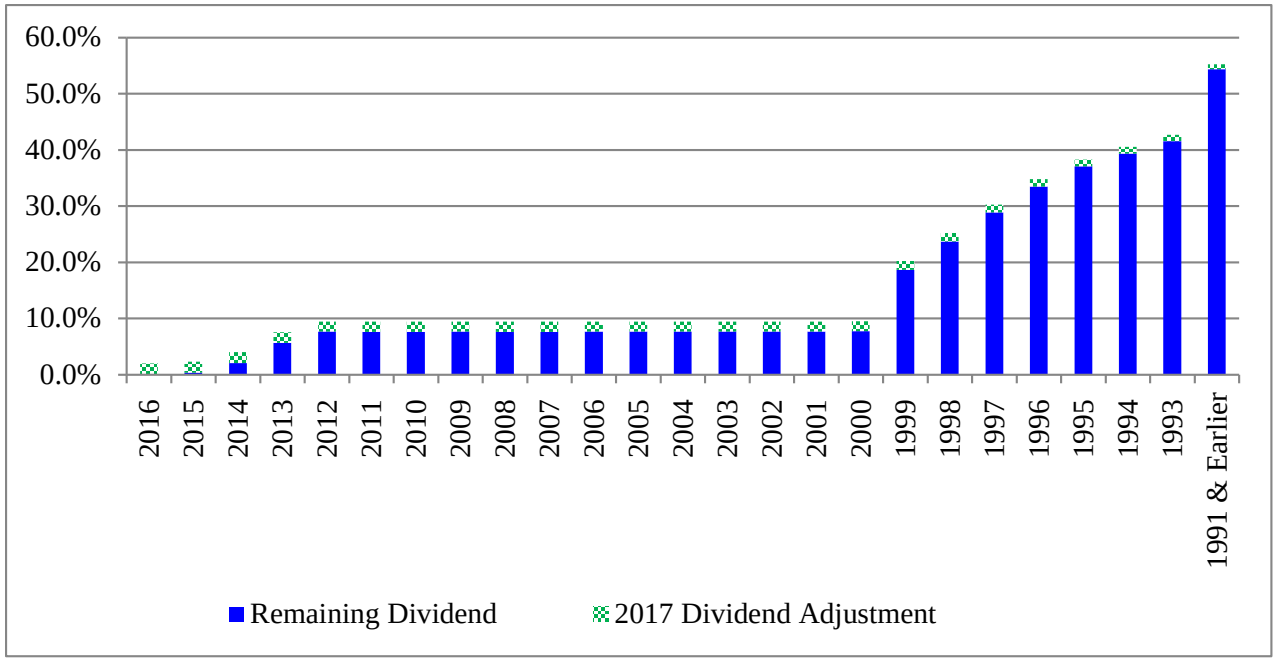
Dividend Remaining (as a Percentage of Total Benefit) by Year of Retirement



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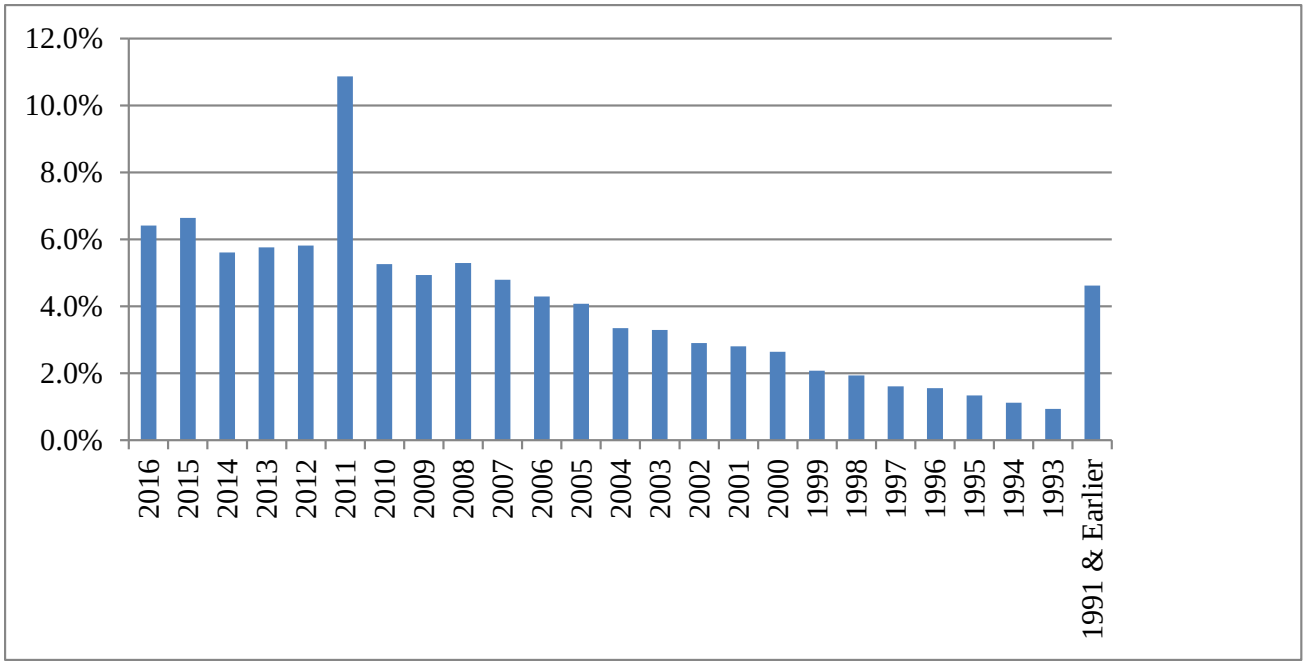
Liabilities (as a Percentage of Total) by Year of Retirement



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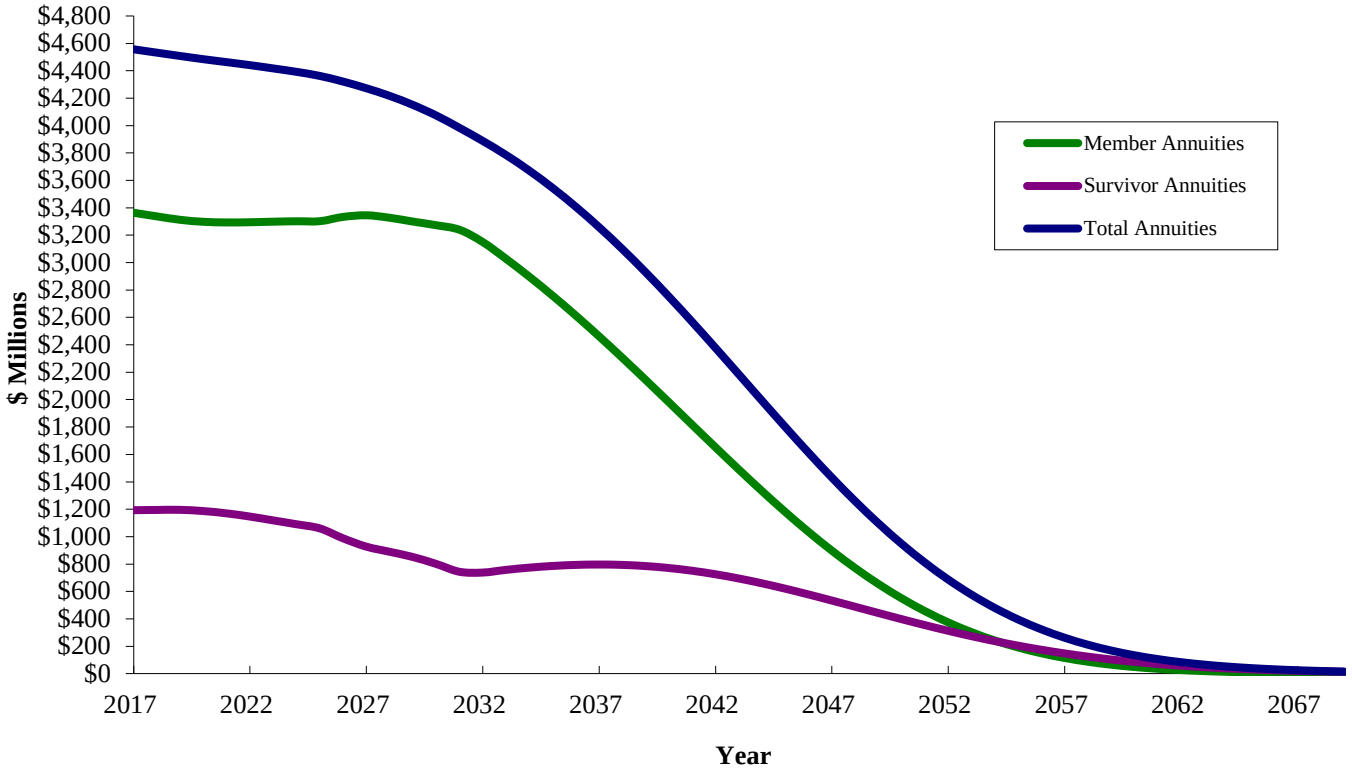
Projected Future Core Annuities



Total Future Payments	$117.3 billion
From Present Assets	52.0
From Investment Return	65.3

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Primary Sources of Variable Adjustment

	% of APV
1. SWIB net of fee investment return	10.6%
2. Adjustment to published effective rate	(0.6)%
3. Published effective earnings rate	10.0%
4. Adjustment to relate earnings to average variable annuity fund balance	(0.3)%
5. Earnings rate based on average balance	9.7%
6. Expected change before adjustments: 1.097/1.05-1	4.5%
7. Adjustment to relate average asset to ending liability	0.1%
8. Carryover from last year due to timing of distribution, accounting adjustments and truncation	(0.3)%
9. Experience study/mortality reserve adjustment	(0.5)%
11. Experience and other effects	0.2%
12. Statutory adjustment: (truncate to whole percent)	0.0%
13. Variable annuity change: (6)+(7)+(8)+(9)+(10)+(11)+(12)	**4.0%**

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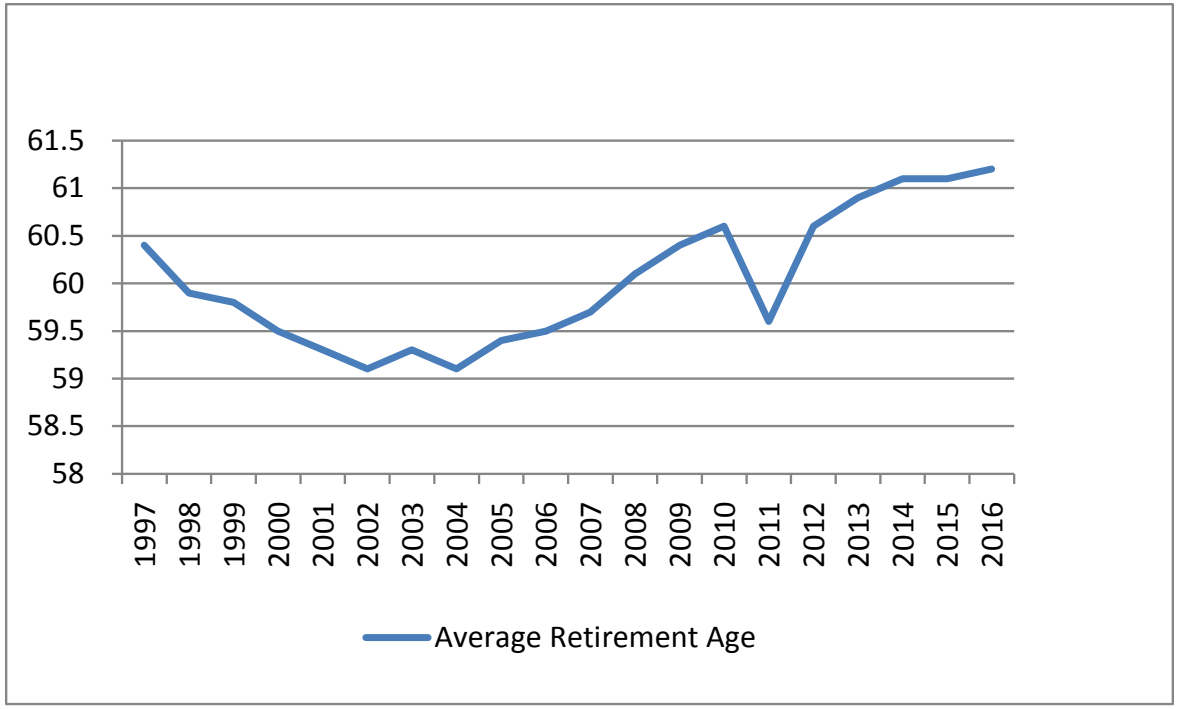
Average Retirement Age



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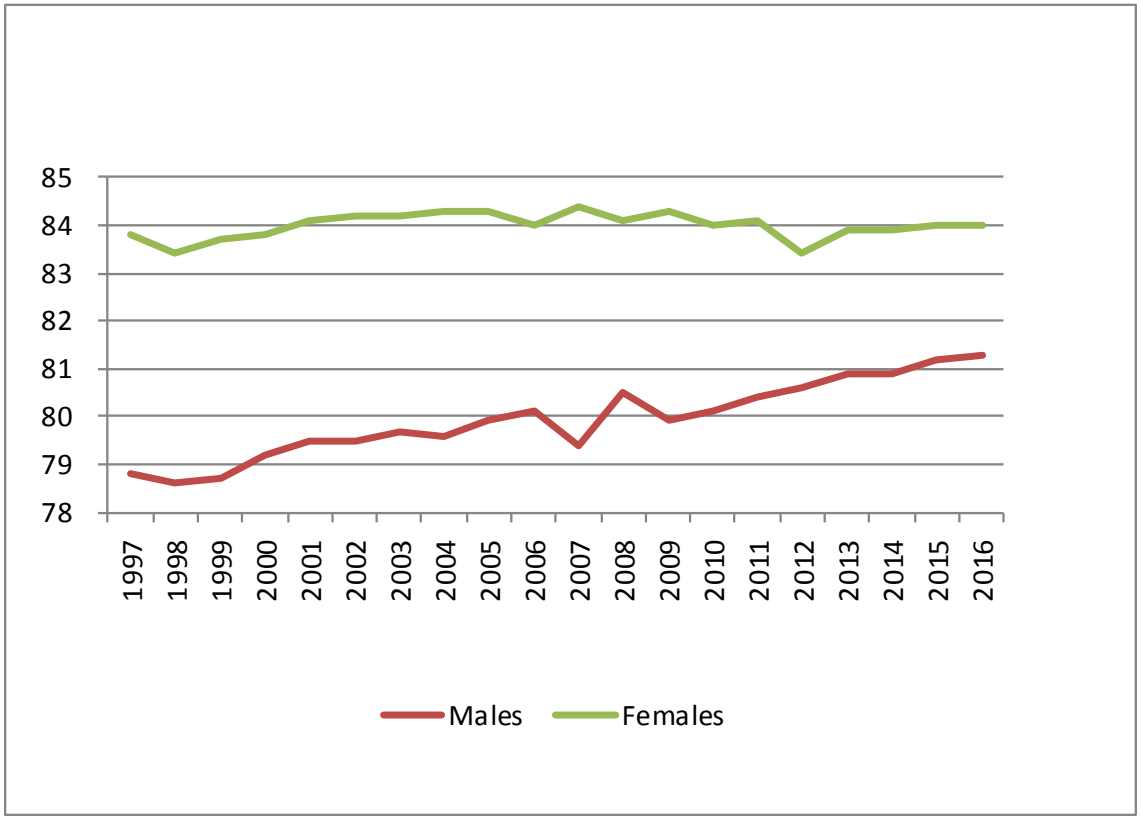
Average Age at Death



Average age at death, while an interesting statistic, is not a proper measure of life expectancy, because it does not include people who have not yet died. The expected age at death for a 65 year old is 85.8 for males and 88.5 for females.

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Comparative Statement - Core

Valuation Date	Number	$ Millions Annual Annuities	$ Millions Fund Balance	$ Millions Actuarial Reserve	Ratio	Change in Annuities Average	Change in Annuities Maximum	CPI*
2007	142,906	3,075.3	35,050.1	32,877.5	1.066	6.6 %		4.1 %
2008	144,033	3,399.3	35,798.1	36,551.5	0.979	(2.1)%	(2.1)%	0.1 %
2009	150,671	3,449.3	36,655.8	37,072.7	0.989	(1.1)%	(1.3)%	2.7 %
2010	155,775	3,532.4	37,798.4	38,148.5	0.991	(0.9)%	(1.2)%	1.5 %
2011	167,453	3,842.0	40,411.5	42,078.3	0.960	(4.0)%	(7.0)%	3.0 %
2012	173,655	3,806.3	40,591.6	41,852.4	0.970	(3.0)%	(9.6)%	1.7 %
2013	180,056	3,800.7	44,273.2	42,300.5	1.047	4.7 %	4.7 %	1.5 %
2014	185,605	4,102.3	47,135.7	45,790.7	1.029	2.9 %	2.9 %	0.8 %
2015	191,795	4,364.9	49,147.0	48,897.5	1.005	0.5 %	0.5 %	0.7 %
2016	197,647	4,523.1	51,972.0	50,941.4	1.020	2.0 %	2.0 %	2.1 %
34-Year Average						**3.9 %**		**2.7 %**
10-Year Average						**0.5 %**		**1.8 %**

**Based on December CPI-U67 index.*

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Comparative Statement - Variable

Valuation Date	Number	$ Millions Annual Annuities	Fund Balance	Actuarial Reserve	Ratio	Change in Annuities	CPI*
2007	33,880	432.6	4,625.0	4,563.7	1.013	0.0 %	4.1 %
2008	34,927	427.0	2,574.5	4,491.0	0.573	(42.0)%	0.1 %
2009	34,836	240.3	3,078.4	2,512.7	1.225	22.0 %	2.7 %
2010	35,866	288.4	3,340.6	3,005.4	1.111	11.0 %	1.5 %
2011	38,949	330.3	3,197.9	3,462.9	0.924	(7.0)%	3.0 %
2012	39,873	304.6	3,463.9	3,169.6	1.093	9.0 %	1.7 %
2013	40,317	324.5	4,187.3	3,347.0	1.251	25.0 %	1.5 %
2014	39,420	386.5	3,995.4	3,917.1	1.020	2.0 %	0.8 %
2015	40,152	387.8	3,704.8	3,910.1	0.947	(5.0)%	0.7 %
2016	40,647	363.6	3,792.0	3,645.1	1.040	4.0 %	2.1 %
34-Year Average						**4.3 %**	**2.7 %**
10-Year Average						**0.0 %**	**1.8 %**

**Based on December CPI-U67 index.*

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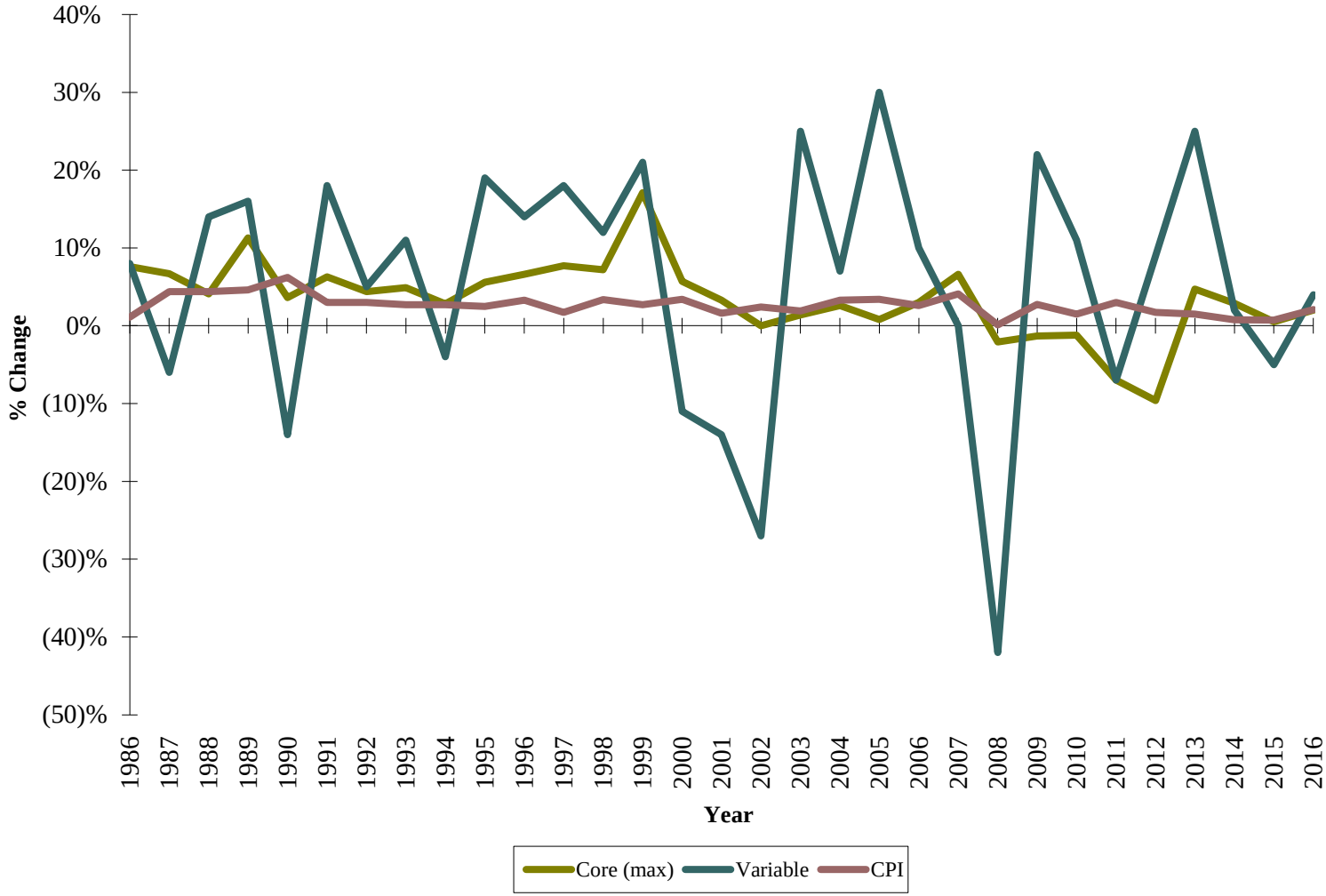
History of % Changes



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Looking Ahead

- As of the December 31, 2016 valuation, there are about $3 billion in unrecognized asset losses in the Core fund
  - recognized over the next four years, about half of which will be applied to the annuitant reserve
- A few more years of positive dividends for all annuitants is needed to decrease the probability of leveraged negative dividends that occurred between 2008 and 2012

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Current Events

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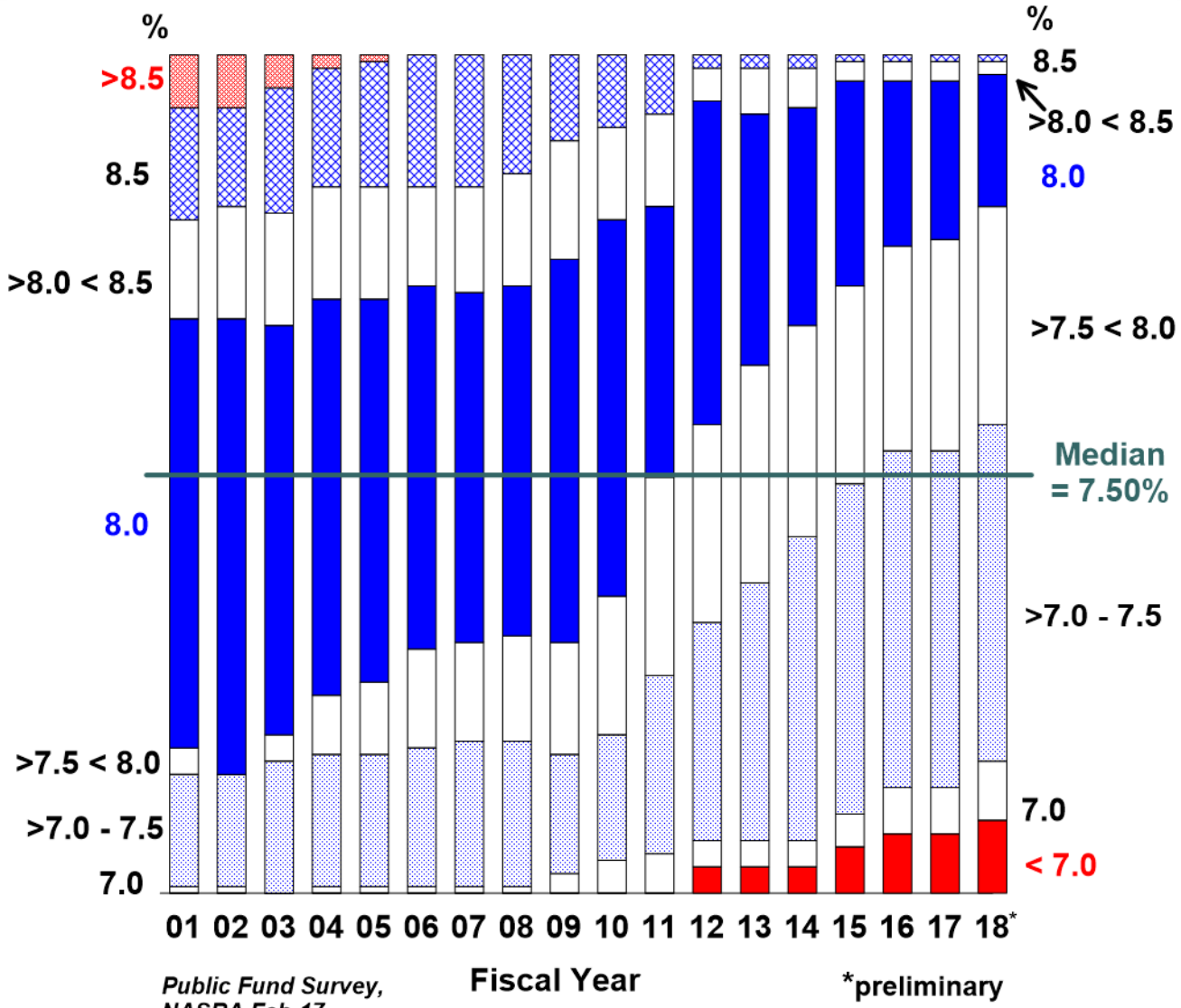
Public Pension Investment Return Assumptions: 2001 -2018



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Understanding Return and Risk

	Steady Return				Volatile Return		
	Beg of Yr	**Return**	**End of Yr**		**Beg of Yr**	**Return**	**End of Yr**
2016	$1,000	7.50%	$1,075		$1,000	20.00%	$1,200
2017	$1,075	7.50%	$1,156		$1,200	-5.00%	$1,140
2018	$1,156	7.50%	$1,242		$1,140	20.00%	$1,368
2019	$1,242	7.50%	$1,335		$1,368	-5.00%	$1,300
2020	$1,335	7.50%	$1,436		$1,300	20.00%	$1,560
2021	$1,436	7.50%	$1,543		$1,560	-5.00%	$1,482
2022	$1,543	7.50%	$1,659		$1,482	20.00%	$1,778
2023	$1,659	7.50%	$1,783		$1,778	-5.00%	$1,689
2024	$1,783	7.50%	$1,917		$1,689	20.00%	$2,027
2025	$1,917	7.50%	**$2,061**		$2,027	-5.00%	**$1,925**
Average Rate of Return							
Arithmetic		**7.50%**				**7.50%**	
Geometric		**7.50%**				**6.77%**	
Variance		**0.00%**				**1.56%**	
Std Dev		**0.00%**				**12.50%**	

A steady return produces a higher ending balance than a volatile return if the arithmetic average is the same. The geometric average reflects that behavior better than the arithmetic average. Basically, Volatility drags down return.

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Evolution of Investment Risk

	Expected Values			
	Constant Return*		Constant Risk	
Year	Return	Risk	Return	Risk
1995	7.50%	6.0%	7.50%	6%
2005	7.50%	8.9%	6.50%	6%
2015	7.50%	17.2%	4.80%	6%

- As measured by the standard deviation of return, earning 7.5% today takes almost triple the risk it did in 1995.
- If we held risk constant at 6%, we would expect 1/3rd less return in 2015 than we would have expected in 1995.
- 17.2% volatility reduces long term return by approximately 148 basis points.
- 6% volatility reduces long term return by 18 basis points.

*Summarized from WSJ Article dated May 31, 2016 quoting Callan Associates

Alternative Liability Measures

One or more of the following calculations is likely to be required by actuarial standards within the next several years

- liability based on the estimated costs of transferring *all* risk to an insurance company;
- liability based on a Treasury yield curve, to approximate the cost of eliminating almost all investment risk
- liability based on discount rates commensurate with the level of risk of the underlying benefit promise
- liability based on a high quality corporate yield curve, for comparability with private sector plans.

Yield to Maturity on Treasuries

	Maturity								
Date	**6 mo**	**1 yr**	**2 yr**	**3 yr**	**5 yr**	**7 yr**	**10 yr**	**20 yr**	**30 yr**
1/3/1995	6.66%	7.23%	7.73%	7.84%	7.88%	7.91%	7.88%	8.07%	7.93%
1/3/2017	0.65%	0.89%	1.22%	1.50%	1.94%	2.26%	2.45%	2.78%	3.04%

Yields on treasuries have dropped remarkably since 1995. Discounting at treasury rates in 1995 would have produced a liability at that time that was similar to discounting at valuation assumed rates. Doing so today could easily produce a liability twice as high.

Mortality Table Changes

	Life Expectancy Years at Age 65 by Year of Attainment of Age 65					
	Healthy Males			Healthy Females		
Year Attain 65	**2016**	**2026**	**2036**	**2016**	**2026**	**2036**
WRS	20.82	21.20	21.57	23.49	23.85	24.22
SOA-Original	21.77	22.61	23.44	23.95	24.78	25.60
SOA-Current	21.34	22.13	22.96	23.43	24.21	25.02

The Society of Actuaries (SOA) published its newest generational mortality table in 2014. GRS tailored that table and the associated projection scale to better fit WRS experience. The SOA has revised its projection scale twice since it first came out moving the SOA figures closer to the WRS figures. The next SOA update is likely to come out Fall of 2017, and a public plan mortality study is expected late in 2018.

Next WRS experience study investigating mortality, investment return, & other assumptions covers the period 2015 -2017 and will be completed in 2018.

Social Security

- Based on intermediate assumptions, the combined OASDI trust fund is expected to be depleted in 2034.
- After that point, 79% of benefits would be payable, declined eventually to 74%.
- Something will happen

Social Security –Look for

- Larger Increases in Wage Base
- Higher OASDI tax rates
- General Revenue Funding
- Age 70 Retirement
- Lower benefits

Suggestions:
Read "Social Security Will it be there for You" at
http://www.grsconsulting.com/knowledge-base/

Play the "Social Security Game" at
http://socialsecuritygame.actuary.org/

- This presentation shall not be construed to provide tax advice, legal advice or investment advice.

- This presentation is intended to be used in conjunction with the actuarial valuation report for retired lives issued on March 12, 2016. This presentation should not be relied on for any purpose other than the purpose described in the valuation report.

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