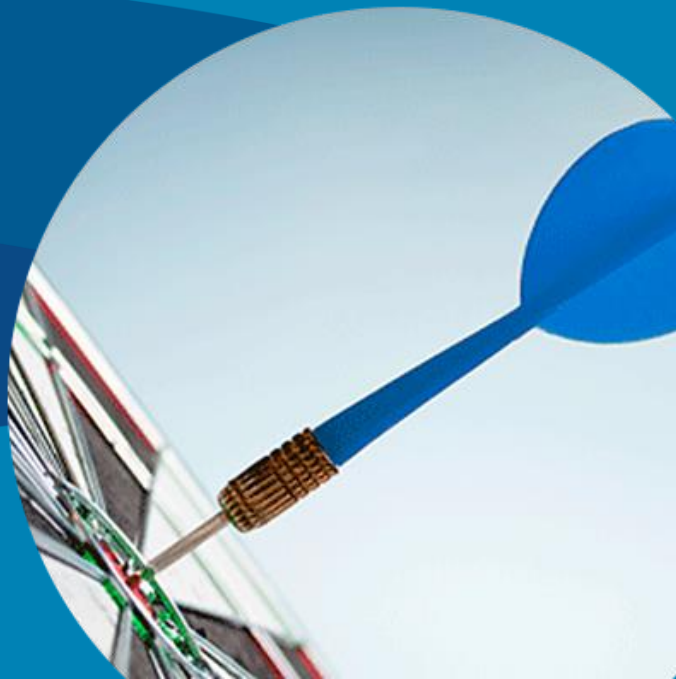
Wisconsin Retirement System

38th Annual Actuarial Valuation of Retired Lives

December 31, 2020



Operation of the System (Simplified Description)

	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

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

Smoothing Mechanisms

Variable

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

Summary of Results – December 31, 2020

$ Millions

	Core	Variable
Number of Annuitants	222,723	41,753
Annual Amount of Annuities Paid	$ 5,423.2	$ 449.7
Fund Balance	63,805.8	4,954.0
Actuarial Reserve	60,691.1	4,383.0
Ratio	**1.051**	**1.130**

Core effective earnings rate = 10.9%, dividend adjustment = 5.1%.
Variable effective earnings rate = 18.0%, and the variable adjustment = 13.0%.

(Report- Cover Letter & Pages 6 and 16)

Summary of Results

Due to smoothing via Market Recognition Account, as of December 31, 2020 there are approximately $11.1 billion in unrecognized **gains** in the Core fund

- Last year was $5.7 billion in unrecognized gains
- Will be recognized over the next four years
- Roughly ½ of gain applies to the annuitant reserve, the other half shared by active members and employers
- May increase probability of future positive annuity adjustments

Operation of Market Recognition Account (MRA) – $ Millions **2019 Valuation**

	2019	2020	2021	2022	2023
Actual Investment Earnings	$ 17,765				
Assumed Investment Earnings	6,744				
Gain/(Loss) to be phased-in	11,021				
Phased-in recognition					
• Current year	$ 2,204	?	?	?	?
• First prior year	(2,048)	$ 2,204	?	?	?
• Second prior year	1,461	(2,048)	$ 2,204	?	?
• Third prior year	119	1,461	(2,048)	$ 2,204	?
• Fourth prior year	(1,344)	119	1,461	(2,048)	$ 2,204
Total recognized gain (loss)	$ 392	$ 1,736	$ 1,617	$ 156	$ 2,204

2020-2023: Expect $5.7 billion in deferred asset *GAINS*
-- Shared by annuitants, actives and employers

Operation of Market Recognition Account (MRA) – $ Millions **2020 Valuation**

	2020	2021	2022	2023	2024
Actual Investment Earnings	$ 15,868				
Assumed Investment Earnings	7,000				
Gain/(Loss) to be phased-in	8,868				
Phased-in recognition					
• Current year	$ 1,774	?	?	?	?
• First prior year	2,204	$ 1,774	?	?	?
• Second prior year	(2,049)	2,204	$ 1,774	?	?
• Third prior year	1,461	(2,049)	2,204	$ 1,774	?
• Fourth prior year	120	1,461	(2,049)	2,204	$ 1,774
Total recognized gain (loss)	$ 3,510	$ 3,390	$ 1,929	$ 3,978	$ 1,774

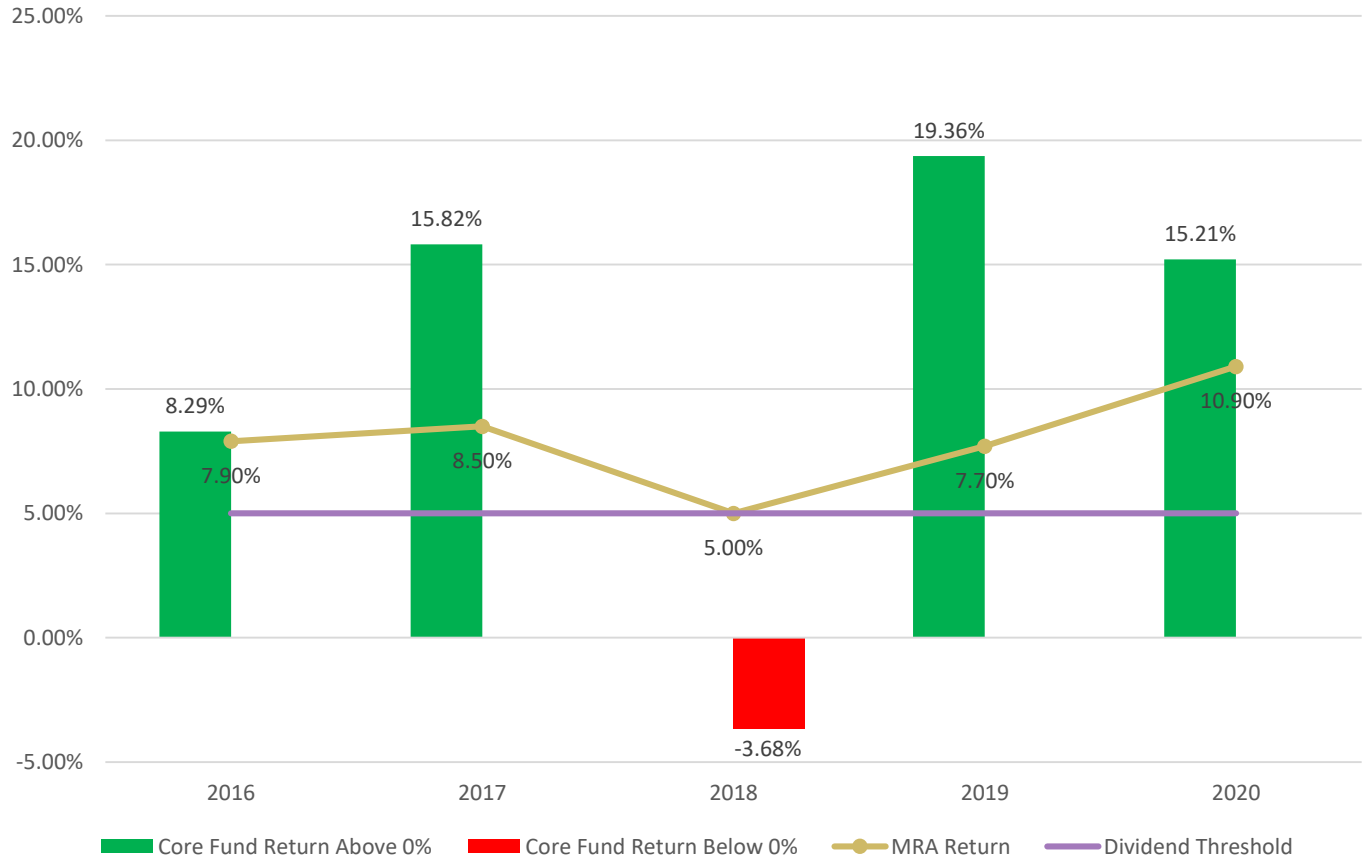
2021-2024: Expect $11.1 billion in deferred asset *GAINS*
-- Shared by annuitants, actives and employers

Asset Rate of Return Calculation

Rate of Return = Investment Earnings / Asset Value

- Rate of Return will vary based on calculation inputs:
  - Asset value could be smoothed or unsmoothed
  - Asset value could be beginning, middle or end of year
  - Timing of Contributions and Benefit Payments will vary
- Result is different Rate of Return calculated by:
  - SWIB (investment manager)
  - ETF (calculations governed by statute)
  - GRS (actuaries)

Core Fund Returns – Market Value vs. Market Recognition Account



Translating Asset Rate of Return to Core Dividend "R-e-S-F-A-P"

Return: 2020 SWIB net of fee return = 15.21%

Smooth vs. 7.0% Investment Return Assumption

- Return > assumption Smoothed over 5 years
  - **Leads to $11 billion unrecognized gains shared by Rets, EEs, ERs**
- Core fund return available for dividend = **10.40%**

Fund annuities at Investment Return 5% Threshold

- Core fund return > threshold provides **dividend before adjustments**: 1.1040/1.05-1 = **5.14%**

Adjustments result in 5.1% dividend Paid

Primary Sources of Core Dividend

	% of APV
1. SWIB net of fee investment return	15.21%
2. MRA adjustment	(4.31)%
3. Published effective earnings rate	10.90%
4. Adjustment to relate earnings to average core annuity fund balance	(0.50)%
5. Earnings rate based on average balance	10.40%
6. Expected dividend before adjustments: 1.104/1.05-1	5.14%
7. Adjustment to relate average asset to ending liability	0.07%
8. Carryover from last year due to timing of dividend accounting adjustments and rounding	0.07%
9. Experience study/mortality reserve adjustment	(0.20)%
10. Experience and other effects	0.05%
11. Statutory adjustment to round to nearest one-tenth percent	(0.03)%
12. **Computed average dividend rate: (6)+(7)+(8)+(9)+(10)+(11)**	**5.1%**
13. Adjustment for members at or near the statutory floor	0.0%
14. **Final computed dividend rate: (12)+(13), if greater than 0.5% (or less than -0.5%) of core annuities, otherwise 0%**	**5.1%**

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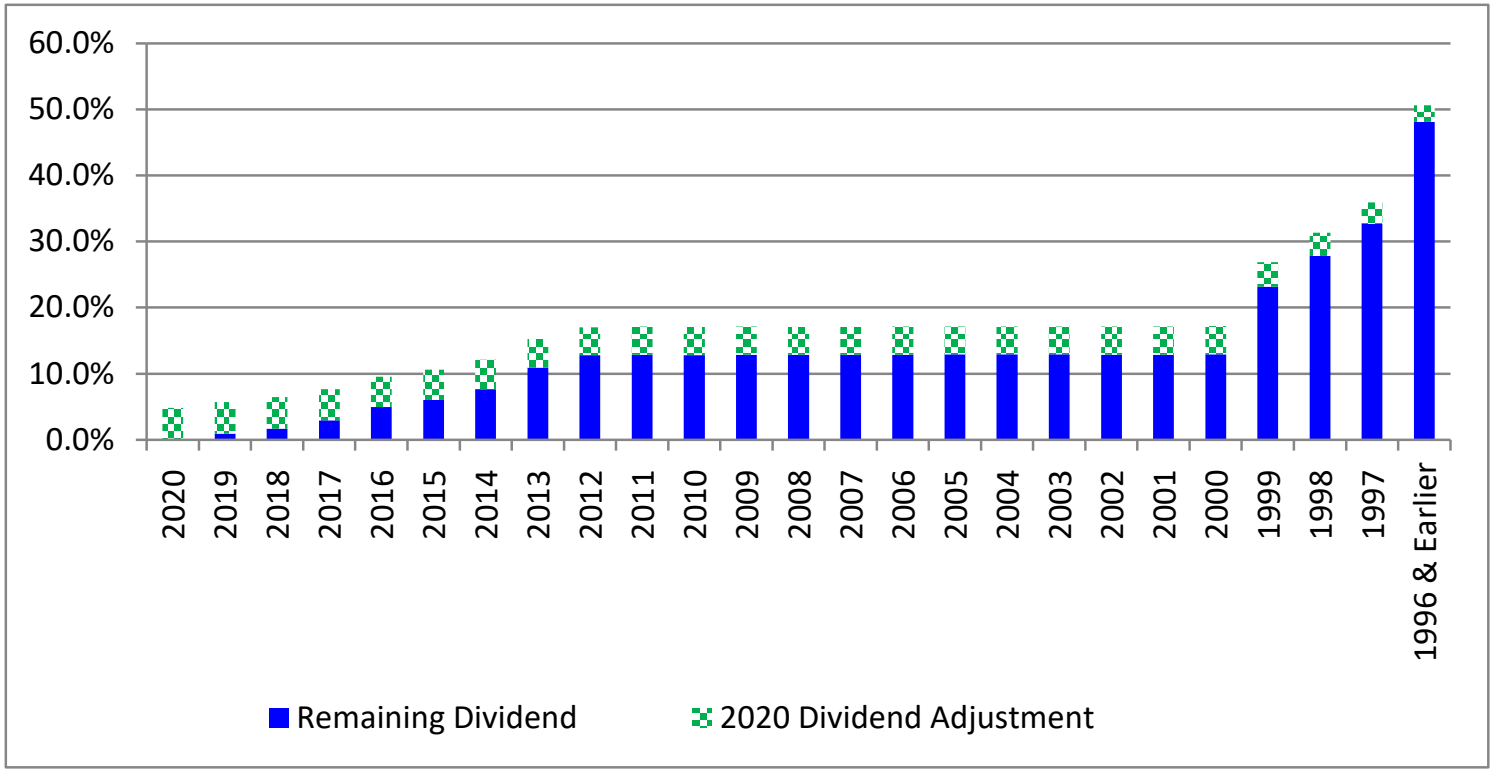
Liability Attributable to Dividends – "Dividend Liability"

Valuation	Liability for Dividend Remaining (billions)	Liability for Dividend Adjustment (billions)	Liability after Dividend Adjustment (billions)
12/31/2011	$6.4	$(1.7)	$4.7
12/31/2012	4.5	(1.3)	3.2
12/31/2013	3.0	2.0	5.0
12/31/2014	4.6	1.3	5.9
12/31/2015	5.5	0.2	5.7
12/31/2016	5.4	1.0	6.4
12/31/2017	6.1	1.3	7.4
12/31/2018	6.9	0.0	6.9
12/31/2019	6.5	1.0	7.5
12/31/2020	7.0	3.1	10.1
12/31/2021 (est)	9.6		

- "Liability for dividend remaining" = value of all previously granted dividends (=$9.2B at 12/31/2008)
- 2021 liability for dividends remaining is >2008, BUT as a percentage of total liabilities, it is smaller
- Substantial asset losses could decrease the liability for dividend remaining to low levels

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



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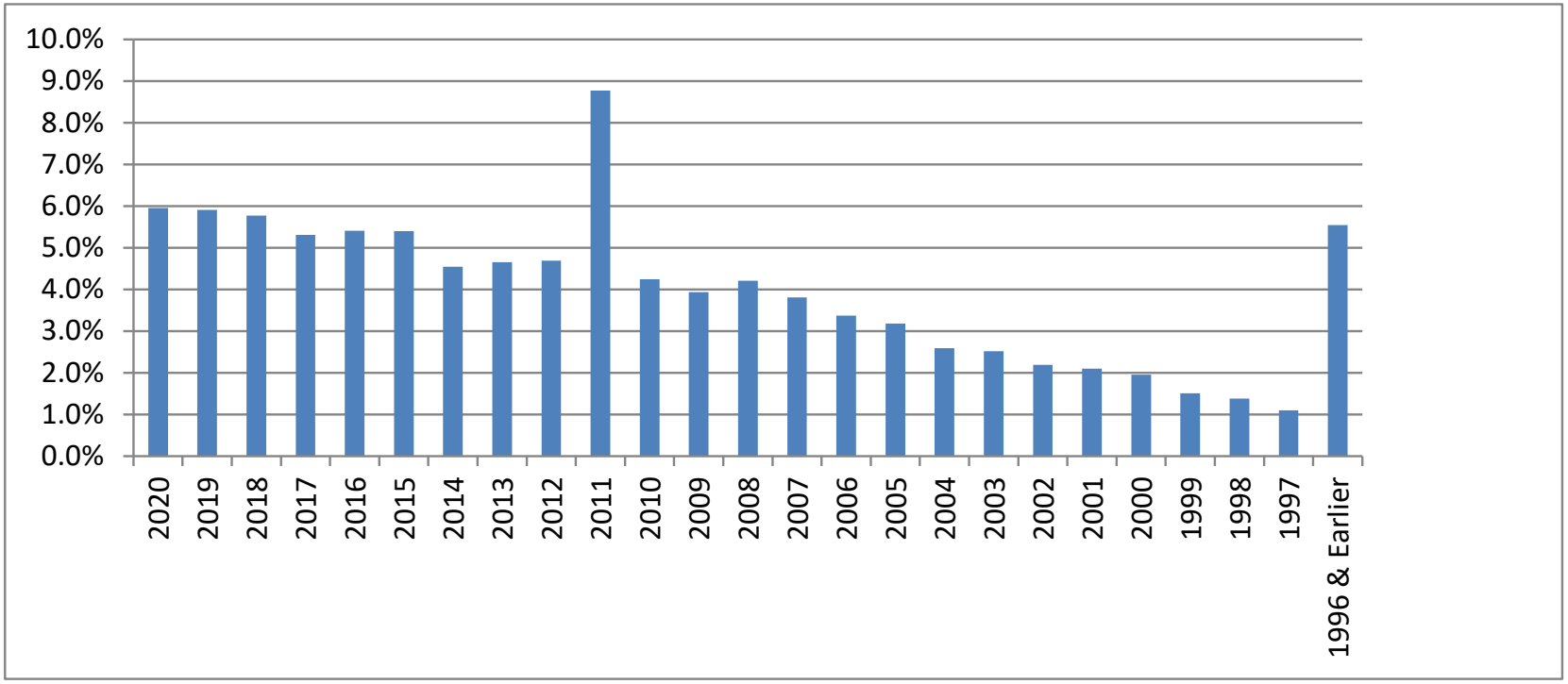
Liabilities (as a Percentage of Total) by Year of Retirement



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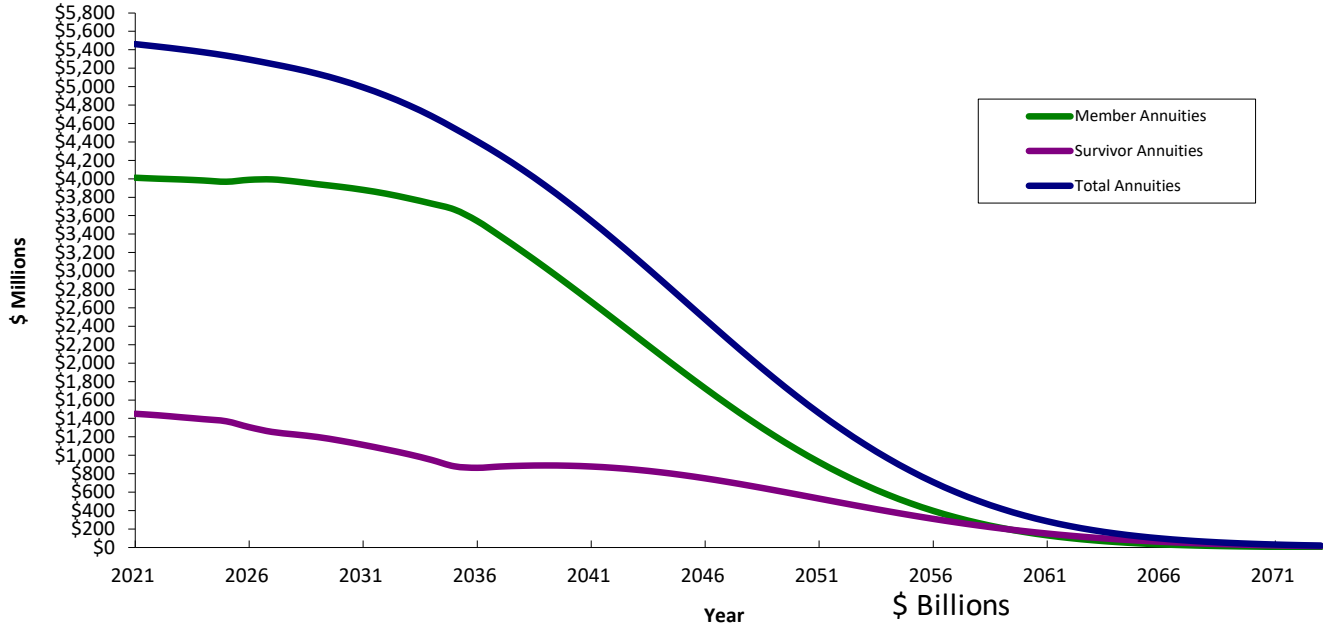
Projected Future Core Annuities



	With Expected Dividends	Without Expected Dividends
Total Future Benefit Payments	$132.9	$102.3
Present Assets	63.8	63.8
Future Investment Return Needed	69.1	38.5

Based upon the assumptions used in the valuation, future dividends are expected to be approximately 1.9% per year. Of course actual dividends will be based upon actual future investment return and the operation of the Market Recognition Account.

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Primary Sources of Variable Adjustment

	% of APV
1. SWIB net of fee investment return	17.5%
2. Adjustment to published effective rate	0.5%
3. Published effective earnings rate	18.0%
4. Adjustment to relate earnings to average variable annuity fund balance	(0.4)%
5. Earnings rate based on average balance	17.6%
6. Expected change before adjustments: (1.176)/1.05-1	12.0%
7. Adjustment to relate average asset to ending liability	0.4%
8. Carryover from last year due to timing of distribution, accounting adjustments and truncation	0.5%
9. Experience study/mortality reserve adjustment	(0.2)%
10. Experience and other effects	0.3%
11. Statutory adjustment: (truncate to whole percent)	0.0%
12. Variable annuity change: (6)+(7)+(8)+(9)+(10)+(11)	**13.0%**

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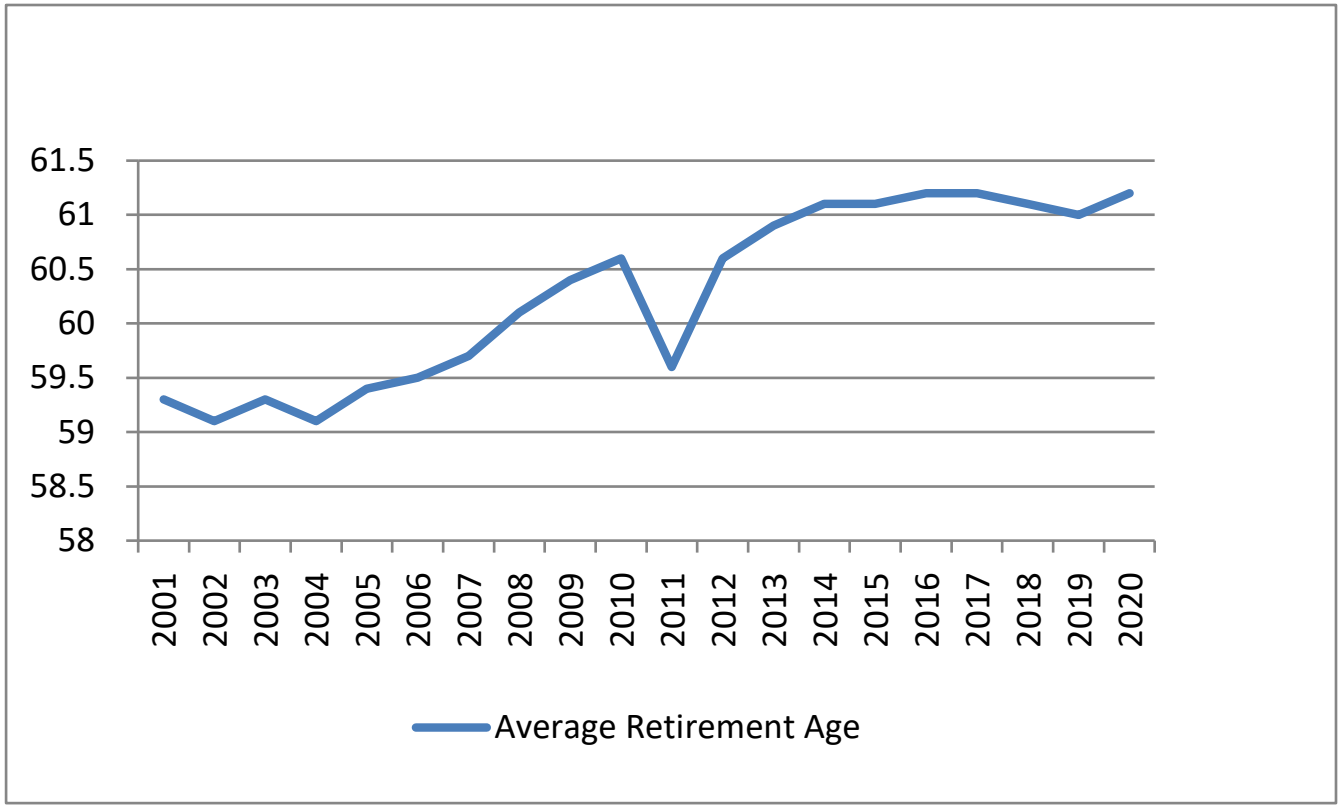
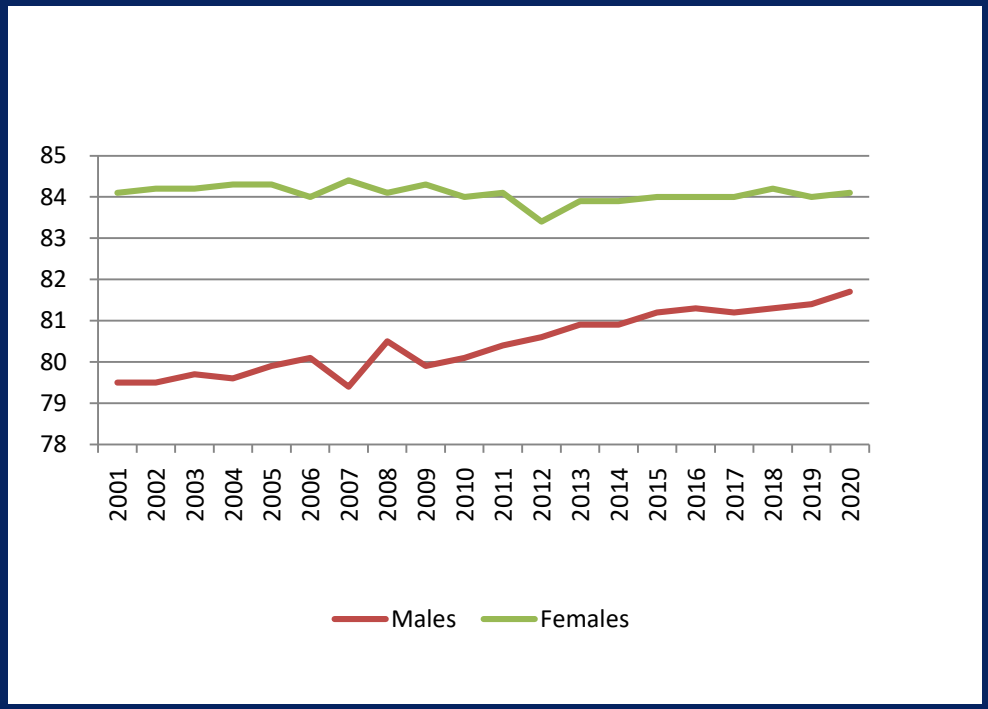
Average Retirement Age



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 86.4 for males and 88.7 for females.



Summary of Mortality Experience

Valuation	Expected Deaths	Actual Deaths	Difference	Death Rate
12/31/2017	4,896	4,850	(46)	0.0250
12/31/2018	4,937	5,032	95	0.0251
12/31/2019	5,147	5,147	0	0.0250
12/31/2020	5,384	5,788	404	0.0273

Of the 404 excess expected deaths in 2020, 374 (or 92%) of these were at ages 85 and older.
The liability for members 85 and older is approximately 4% of total retiree liability.

Summary of Mortality Experience

- Actual number of deaths in 2020 increased by about 12%
- Majority of deaths occurred at older ages where liability is smaller
- Overall impact on Core Dividend relatively small
- Only one year of experience at this point
- Typically need three to five years of data to determine if this will be part of a longer term trend or an isolated short term event

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*
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 %
2017	203,202	4,747.0	54,900.0	53,590.0	1.024	2.4 %	2.4 %	2.1 %
2018	211,126	5,040.9	56,493.8	56,629.3	0.998	0.0 %	0.0 %	1.9 %
2019	216,944	5,183.7	59,138.4	58,157.0	1.017	1.7 %	1.7 %	2.3 %
2020	222,723	5,423.2	63,805.8	60,691.1	1.051	5.1 %	5.1 %	1.4 %
35-Year Average						**3.6 %**		**2.5 %**
20-Year Average						**1.3 %**		**2.0 %**
10-Year Average						**1.2 %**		**1.7 %**
5-Year Average						**2.2 %**		**2.0 %**

**Based on December CPI-U67 index.*

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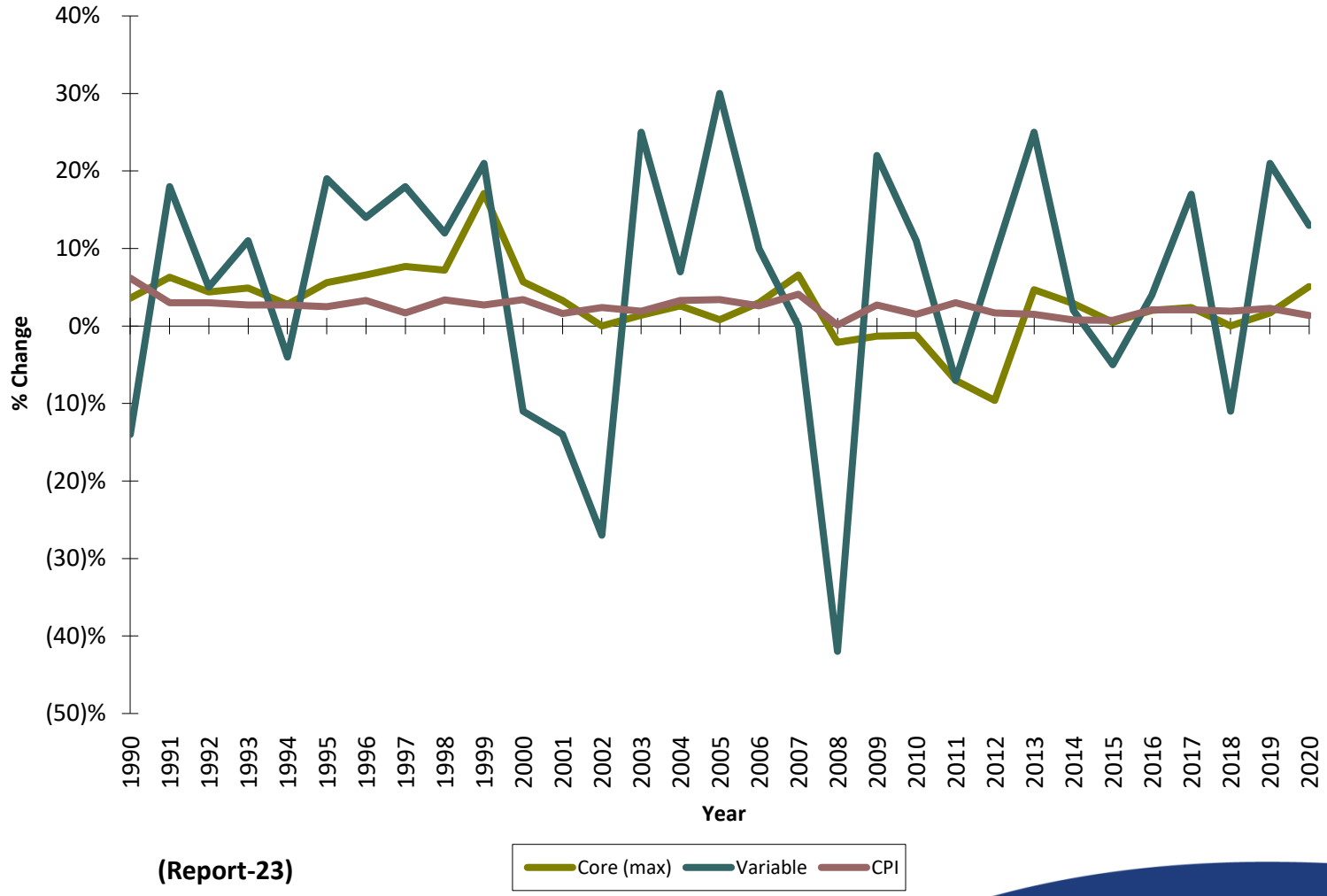
Comparative Statement – Variable

Valuation Date	Number	$ Millions Annual Annuities	Fund Balance	Actuarial Reserve	Ratio	Change in Annuities	CPI*
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 %
2017	40,877	369.9	4,324.9	3,682.1	1.175	17.0 %	2.1 %
2018	41,187	425.8	3,738.6	4,207.6	0.891	(10.0)%	1.9 %
2019	41,777	379.7	4,519.4	3,728.6	1.212	21.0 %	2.3 %
2020	41,753	449.7	4,954.0	4,383.0	1.130	13.0 %	1.4 %
35-Year Average						**4.1 %**	**2.5 %**
20-Year Average						**1.6 %**	**2.0 %**
10-Year Average						**6.3 %**	**1.7 %**
5-Year Average						**8.4 %**	**2.0 %**

**Based on December CPI-U67 index.*

(Report-22)

History of % Dividend Adjustments



(Report-23)

Looking Ahead

- As of the December 31, 2020 valuation, there are about $11.1 billion in unrecognized asset gains in the Core fund
  - About half of this will be applied to annuitant reserve
  - Will be recognized over the next four years
  - May increase probability of future positive annuity adjustments
- We will continue monitoring various plan risks, including dividend liability risk

WRS POTENTIAL DIVIDEND LIABILITY RISK METRIC

Dividend Risk Measure (MRA)

- Dividend Liability (after Dividend adjustment in April) / Total Core Retiree Assets
- Example (2020)
  - Dividend Liability = 10.1 billion
  - Total Retiree Assets (Core) = 63.8 billion
  - Dividend Risk Measure = 10.1/63.8 = 15.8%
- In other words, Retiree Assets (on MRA basis) would need to decrease by 15.8% to deplete the existing Dividend Liability

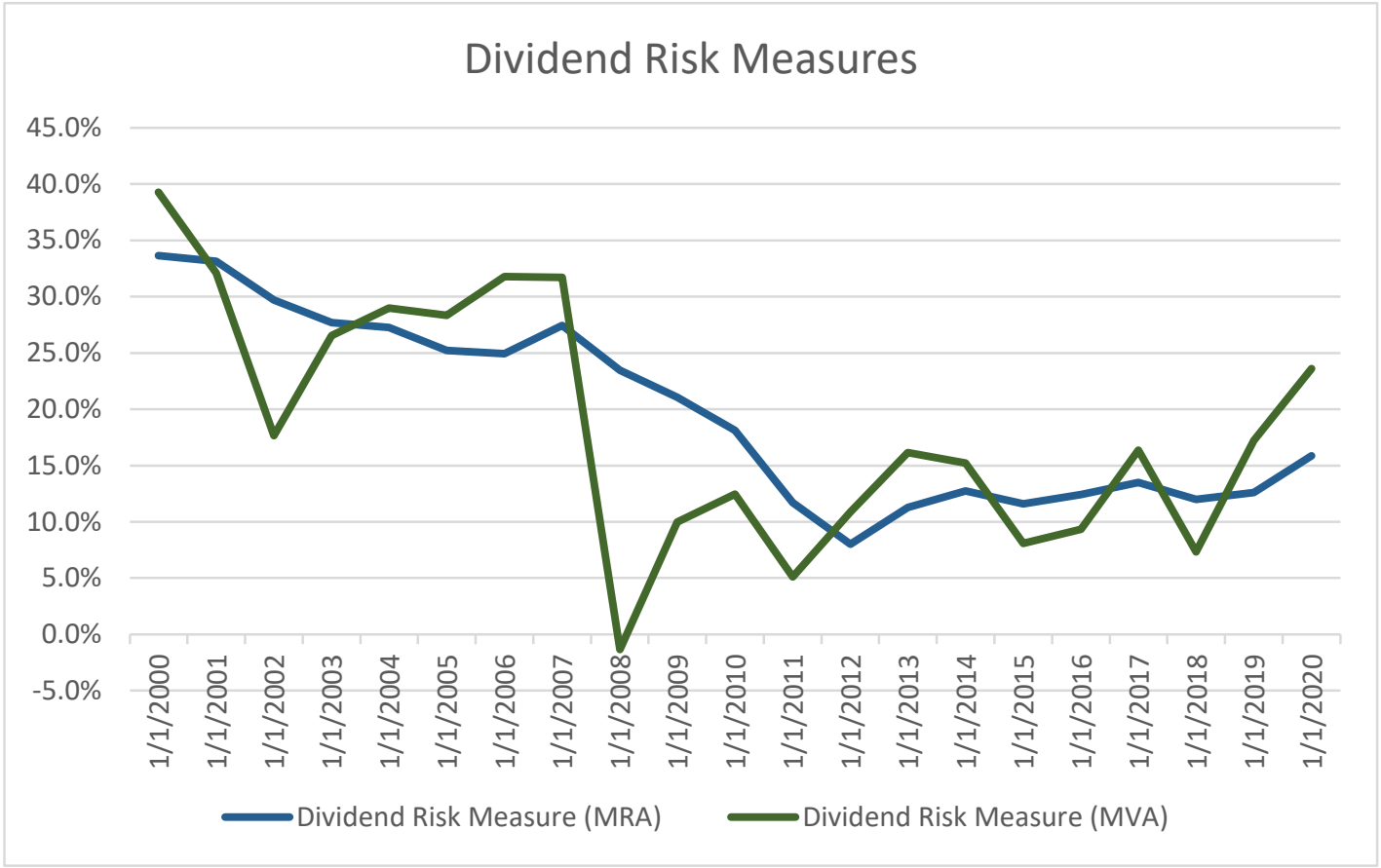
Dividend Risk Measure (Market Value or MVA)

- Dividend Liability (on MVA basis) / Total Core Retiree Assets (on MVA basis)
- Example (2020)
  - Dividend Liability = 10.1 billion
  - Total Retiree Assets (Core) = 63.8 billion
  - Ratio of MVA to MRA = .908
  - Total Retiree Assets (MVA) = 63.8 / .908 = 70.3 billion
  - Dividend Liability (MVA) = 10.1 +70.3 – 63.8 = 16.6 billion
  - Dividend Risk Measure (MVA) = 16.6 / 70.3 = 23.6%
- In other words, Retiree Assets (on MVA basis) would need to decrease by 23.8% to deplete the existing Dividend Liability (on MVA basis)

Why are Both Measures Important?

- Dividend Risk Measure (MRA basis) tells us where we are right now
- Dividend Risk Measure (MVA basis) tells us where we are heading directionally absent any future gains or losses
- Example (2008)
  - Dividend Risk Measure (MRA) = 23.5%
  - Dividend Risk Measure (MVA) = -1.2%
- In other words, in 2008, absent future returns above 5%, the dividend liability would have been depleted within 5 years

Dividend Risk Measures History*



*Higher values are desirable

Disclaimers

- 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 4, 2021. This presentation should not be relied on for any purpose other than the purpose described in the valuation report.
- Readers are cautioned to examine original source materials and to consult with subject matter experts before making decisions related to the subject matter of this presentation.
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