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IOWA PUBLIC EMPLOYEES' RETIREMENT SYSTEM

Risk Analysis Report
March, 2019





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March 13, 2019

Investment Board
Iowa Public Employees' Retirement System
7401 Register Drive
Des Moines, IA 50321

Re: Risk Analysis Report

Dear Investment Board Members:

At your request, we have performed a study of the actuarial-related risks faced by the Iowa Public Employees' Retirement System (IPERS or System). This report is designed to support and expand on the actuarial valuation reports that we prepare annually for IPERS. While the exhibits and graphs shown in this report are based on the June 30, 2018, IPERS actuarial valuation, the analysis of the results and the discussion of the implications for IPERS and its stakeholders are expected to remain substantially unchanged for the next few years.

The primary objective of this report is to provide the analysis of risk, as required under Actuarial Standard of Practice Number 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*. There are other risks that IPERS faces, including issues such as cyber security, a catastrophe to the physical location, embezzlement, and many others. These are outside the scope of our analysis, which focuses only on those risks relating to the variance in the measurement of the benefit obligations as well as the contribution rates. There is no specific action by the IPERS Board either required or expected in response to this report, although it is possible that a deeper understanding of the risks faced by the System may prompt some additional discussion or study.

In preparing our report, we utilized the data, methods, assumptions, and benefit provisions described in the June 30, 2018, actuarial valuation of IPERS. That report should be consulted for a complete description of how our work was performed. Some of the results in this report are based upon modifying one or more of the valuation assumptions as noted in the discussion of the analysis being performed.

The consultants who worked on this assignment are pension actuaries with significant public plan experience. In addition, the signing actuaries are independent of the System and the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.



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On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate. The valuation, on which this analysis was based, was prepared in accordance with principles of practice prescribed by the Actuarial Standards Board. Furthermore, the actuarial calculations were performed by qualified actuaries in accordance with accepted actuarial procedures, based on the current provisions of the retirement system and on actuarial assumptions that are internally consistent and reasonable based on the actual experience of the System. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein.

We respectfully submit the following report and look forward to discussing it with you.

A handwritten signature in blue ink that reads 'Patrice Beckham'.

Patrice A. Beckham, FSA, EA, FCA, MAAA
Principal and Consulting Actuary

A handwritten signature in blue ink that reads 'Brent A. Banister'.

Brent A. Banister, PhD, FSA, EA, FCA, MAAA
Chief Actuary



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Actuarial Standard of Practice Number 51 (ASOP 51)

Actuarial Standards of Practice (ASOPs) are issued by the Actuarial Standards Board and are binding for credentialed actuaries practicing in the United States. These standards generally identify what the actuary should consider, document and disclose when performing an actuarial assignment. In September, 2017, ASOP 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*, was issued as final with application to measurement dates on or after November 1, 2018. This ASOP applies to funding valuations, actuarial projections, and actuarial cost studies of proposed plan changes.

A typical retirement system faces many different risks. The greatest risk for a retirement system is the inability to make benefit payments when due. If system assets are depleted, benefits may not be paid which could create legal and litigation risk. The term “risk” is most commonly associated with an outcome with undesirable results. However, in the actuarial world risk is defined as uncertainty. The actuarial valuation process uses many actuarial assumptions to project how future contributions and investment returns will meet the cash flow needs for future benefit payments. Of course, we know that actual experience will not unfold exactly as anticipated by the assumptions and that uncertainty, whether favorable or unfavorable, creates risk. ASOP 51 defines risk as the potential of actual future measurements deviating from expected future measurements due to actual experience that is different than the actuarial assumptions.

Identifying Risks

The first step in a project such as this is to identify the significant risks that affect how IPERS liabilities are measured and contributions determined. Some risks, such as investment return for a funded retirement plan, are obvious, but there are others that are not as clear. There is no definition of “significant” to clearly define which risks should be considered, nor is it possible to tell in advance whether certain risks are significant or not.

The identification of risks is also specific to the retirement plan being studied. Some plan design features, such as lump sums based on market interest rates, could increase the risk a plan faces, while features that adjust benefits based on investment return may reduce the risk to the plan (but not necessarily to the member). Thus, this analysis for IPERS is uniquely prepared for IPERS and the risks it faces. Different plans expect different risks.

Assessing Risks

In this report, we consider a variety of risks faced by IPERS. A common theme for most retirement plans is that risks change as a plan matures. Because this is a fundamental issue, ASOP 51 gives special attention to requiring the disclosure of appropriate measures of how a plan is maturing. In the section of this report that considers maturity measures, we provide a number of illustrations to help demonstrate this trend. It is worth noting that the three membership groups in IPERS (Regular, Sheriffs and Deputies, and Protection Occupation) have some differences that relate to the nature of retirement eligibility and the historical inclusion of certain employment categories. This uniqueness can help explain why certain events may affect the groups differently.

There are some risks that are inherently difficult to quantify, as well as some risks that are addressed by the way in which a system is designed to react. In our section on qualitative measures, we discuss some of these risks. We also discuss how the IPERS contribution rate policy is designed to help address the way in



OVERVIEW

which IPERS faces risks.

Finally, we conclude this report with some numerical assessment of the some significant demographic and economic risks. The point of this analysis is to provide some perspective on the magnitude of the risks faced by IPERS.

Conclusions

Risk is not necessarily a negative concept. As humans, we regularly take risks such as driving in an automobile because we believe that the gain to be received outweighs the possible negative consequences. We do, however, take steps to mitigate the risk by looking both ways at an intersection before proceeding, wearing seatbelts, etc. We do these things, because we have some understanding of the sources of risk. The goal of this report is to help the IPERS Investment Board, Benefit Advisory Committee, and staff understand the major risks facing IPERS' funding, thereby allowing a reasoned approach to determining how to move into the future.

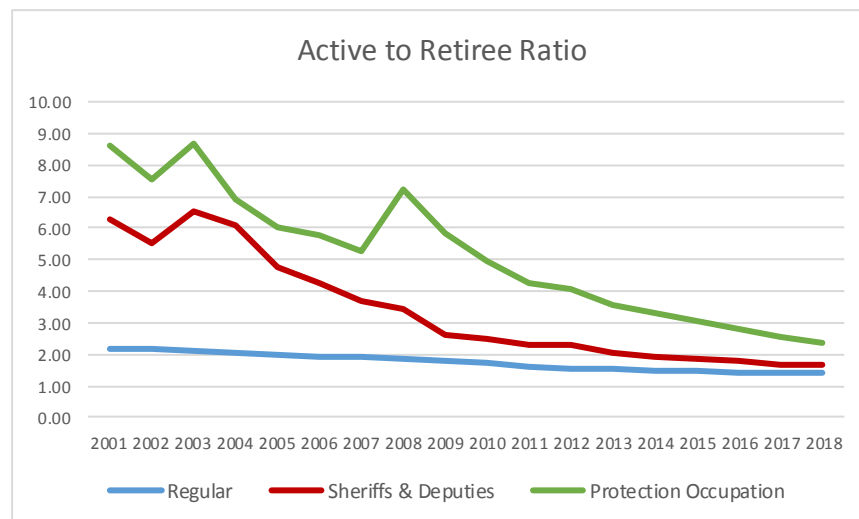
MATURITY OF THE SYSTEM

Most of the public retirement systems in the United States were created shortly after the end of World War II, including IPERS which was created in 1953. The aging of the population, including the retirement of the baby boomers, has created a shift in the demographics of most retirement systems. This change is not unexpected and has, in fact, been anticipated in the funding of the retirement systems. Even though it was anticipated, the demographic shift and maturing of the plans have increased the risk associated with funding the systems. There are different ways to measure and assess the maturity level of a retirement system and we will discuss several in this section of the report.

Historical Active to Retiree Ratio

One way to assess the maturity of the system is to consider the ratio of active members to retirees. In the early years after a retirement system is established, the ratio of active to retired members will be very high as the system is largely composed of active members. As the system matures over time, the ratio starts to decline. A very mature system often has a ratio near or below one. In addition, if the size of the active membership declines over time, it can accelerate the decline in the ratio.

As the following graph illustrates, this ratio of actives to retirees has been declining over time for all three of IPERS' membership groups. The addition of new groups to the Protection Occupation group in 2008 favorably impacted the active to retiree ratio.



Asset Volatility Ratio

As a retirement system matures, the size of the market value of assets increases relative to the covered payroll of active members, on which the System is funded. The size of the plan assets relative to covered payroll, sometimes referred to as the asset volatility ratio, is an important indicator of the contribution risk for the System. The higher this ratio, the more sensitive a plan's contribution rate is to investment return volatility.

The following tables show the historical trend for the asset volatility ratio for each of the IPERS membership groups. As is evident, the differing demographic characteristics of each group translates to different asset volatility ratios and different contribution rate risk.



MATURITY MEASURES

Fiscal Year End	Market Value of Assets (\$ Millions)			Covered Payroll (\$ Millions)			Asset Volatility Ratio		
	Regular Members	Sheriffs & Deputies	Protection Occupation	Regular Members	Sheriffs & Deputies	Protection Occupation	Regular Members	Sheriffs & Deputies	Protection Occupation
6/30/01	\$14,745.3	\$223.7	\$388.5	\$4,357.5	\$62.9	\$131.0	3.38	3.56	2.97
6/30/02	13,780.6	216.6	390.6	4,542.2	65.3	136.1	3.03	3.32	2.87
6/30/03	14,260.8	231.1	424.0	4,657.3	70.2	153.6	3.06	3.29	2.76
6/30/04	15,962.1	258.6	505.6	4,838.4	73.1	160.5	3.30	3.54	3.15
6/30/05	17,360.8	290.5	572.8	4,998.6	72.6	165.6	3.47	4.00	3.46
6/30/06	18,874.0	325.9	647.8	5,265.3	74.5	184.0	3.58	4.37	3.52
6/30/07	21,477.8	380.2	766.4	5,510.4	78.1	193.2	3.90	4.87	3.97
6/30/08	20,607.9	379.9	856.4	5,763.6	81.5	286.3	3.58	4.66	2.99
6/30/09	16,592.7	312.5	698.1	6,059.4	85.9	293.3	2.74	3.64	2.38
6/30/10	18,375.9	353.3	809.7	6,180.7	84.8	305.7	2.97	4.17	2.65
6/30/11	21,365.7	422.9	983.8	6,185.9	90.5	298.5	3.45	4.67	3.30
6/30/12	21,567.5	437.4	1,019.9	6,377.4	93.3	315.5	3.38	4.69	3.23
6/30/13	23,137.3	484.5	1,134.8	6,473.8	93.6	312.7	3.57	5.18	3.63
6/30/14	26,157.8	559.3	1,321.5	6,679.7	97.7	321.9	3.92	5.72	4.11
6/30/15	26,480.4	578.3	1,371.1	6,893.3	100.5	332.6	3.84	5.76	4.12
6/30/16	26,341.4	588.1	1,396.9	7,114.9	105.9	335.8	3.70	5.56	4.16
6/30/17	28,575.3	649.7	1,554.2	7,405.5	109.5	348.2	3.86	5.93	4.46
6/30/18	29,962.9	693.6	1,658.1	7,515.6	115.2	352.4	3.99	6.02	4.71



MATURITY MEASURES

This table illustrates the impact of a return that is 10% lower than the assumed return on the system's contribution rate. For this purpose, no asset smoothing is reflected. To ensure the results are comparable from year to year, the current actuarial assumptions are used for all years rather than the assumptions used in each valuation. Note that the contribution rate impact reflects 20-year amortization of the experience.

Fiscal Year End	Asset Volatility Ratio			Increase in ACR with a Return 10% Lower than Assumed		
	Regular Members	Sheriffs & Deputies	Protection Occupation	Regular Members	Sheriffs & Deputies	Protection Occupation
6/30/01	3.38	3.56	2.97	2.40%	2.53%	2.11%
6/30/02	3.03	3.32	2.87	2.15%	2.36%	2.04%
6/30/03	3.06	3.29	2.76	2.17%	2.34%	1.96%
6/30/04	3.30	3.54	3.15	2.35%	2.52%	2.24%
6/30/05	3.47	4.00	3.46	2.47%	2.84%	2.46%
6/30/06	3.58	4.37	3.52	2.54%	3.11%	2.50%
6/30/07	3.90	4.87	3.97	2.77%	3.46%	2.82%
6/30/08	3.58	4.66	2.99	2.54%	3.31%	2.13%
6/30/09	2.74	3.64	2.38	1.95%	2.59%	1.69%
6/30/10	2.97	4.17	2.65	2.11%	2.96%	1.88%
6/30/11	3.45	4.67	3.30	2.45%	3.32%	2.35%
6/30/12	3.38	4.69	3.23	2.40%	3.33%	2.30%
6/30/13	3.57	5.18	3.63	2.54%	3.68%	2.58%
6/30/14	3.92	5.72	4.11	2.79%	4.07%	2.92%
6/30/15	3.84	5.76	4.12	2.73%	4.09%	2.93%
6/30/16	3.70	5.56	4.16	2.63%	3.95%	2.96%
6/30/17	3.86	5.93	4.46	2.74%	4.21%	3.17%
6/30/18	3.99	6.02	4.71	2.84%	4.28%	3.35%

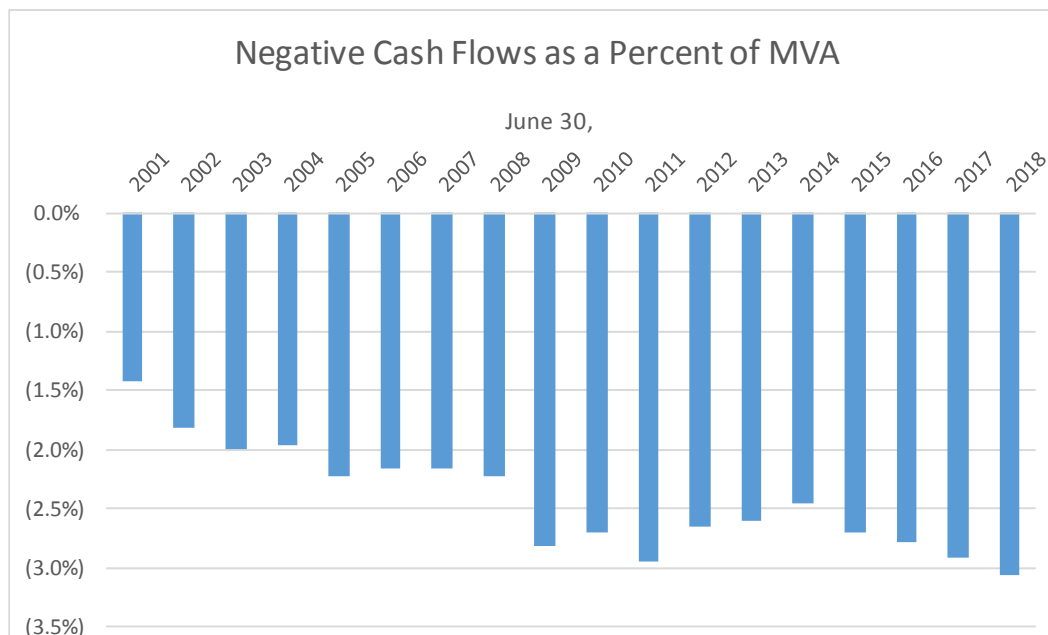
Historical Cash Flows

Plans with negative cash flows will experience increased sensitivity to investment return volatility. Cash flows, for this purpose, are measured as contributions less benefit payments and expenses. If the System has negative cash flows and experiences returns below the assumed rate, there are fewer assets to be reinvested to earn the higher returns that typically follow. While any negative cash flow will produce such a result, it is typically a negative cash flow of more than 5% of market value that causes significant concerns. While this is not a concern for IPERS at this time, it is important to monitor this metric so that any trends can be identified. Note that values shown in the table on the following page are for the total System as all benefits are paid from one trust.



MATURITY MEASURES

Fiscal Year End	Market Value of Assets (MVA)	Contributions	Benefit Payments and Expenses	Net Cash Flow	Net Cash Flow as a Percent of MVA
6/30/01	\$15,357,519,356	\$451,039,187	\$668,450,650	(\$217,411,463)	(1.42%)
6/30/02	14,387,799,637	469,454,575	729,716,496	(260,261,921)	(1.81%)
6/30/03	14,915,941,546	484,985,336	783,338,668	(298,353,332)	(2.00%)
6/30/04	16,726,227,853	506,635,111	836,444,969	(329,809,858)	(1.97%)
6/30/05	18,224,067,613	524,666,845	930,047,385	(405,380,540)	(2.22%)
6/30/06	19,847,676,903	547,488,168	976,187,532	(428,699,364)	(2.16%)
6/30/07	22,624,387,015	574,604,219	1,066,549,966	(491,945,747)	(2.17%)
6/30/08	21,844,112,206	634,189,547	1,120,978,091	(486,788,544)	(2.23%)
6/30/09	17,603,316,618	695,559,397	1,191,706,184	(496,146,787)	(2.82%)
6/30/10	19,538,971,423	755,210,092	1,283,181,315	(527,971,223)	(2.70%)
6/30/11	22,772,344,651	789,353,899	1,460,600,613	(671,246,714)	(2.95%)
6/30/12	23,024,773,746	942,394,013	1,554,642,740	(612,248,727)	(2.66%)
6/30/13	24,756,663,715	1,019,108,941	1,661,824,635	(642,715,694)	(2.60%)
6/30/14	28,038,549,893	1,082,521,228	1,768,869,433	(686,348,205)	(2.45%)
6/30/15	28,429,834,829	1,115,600,029	1,882,337,766	(766,737,737)	(2.70%)
6/30/16	28,326,433,656	1,176,666,912	1,965,566,274	(788,899,362)	(2.79%)
6/30/17	30,779,116,326	1,182,392,100	2,077,514,238	(895,122,138)	(2.91%)
6/30/18	32,314,588,595	1,202,788,183	2,194,788,155	(991,999,972)	(3.07%)





MATURITY MEASURES

Liability Maturity Measurements

As discussed earlier, most public sector retirement systems, including IPERS, have been in operation for over 50 years. As a result, they have aging plan populations indicated by a decreasing ratio of active members to retirees and a growing percentage of retiree liability when compared to the total. The retirement of the remaining baby boomers over the next 10-15 years is expected to further exacerbate the aging of the retirement system population. With more of the total liability residing with retirees, investment volatility has a greater impact on the funding of the system since it is more difficult to restore the system financially after losses occur when there is comparatively less payroll over which to spread costs.

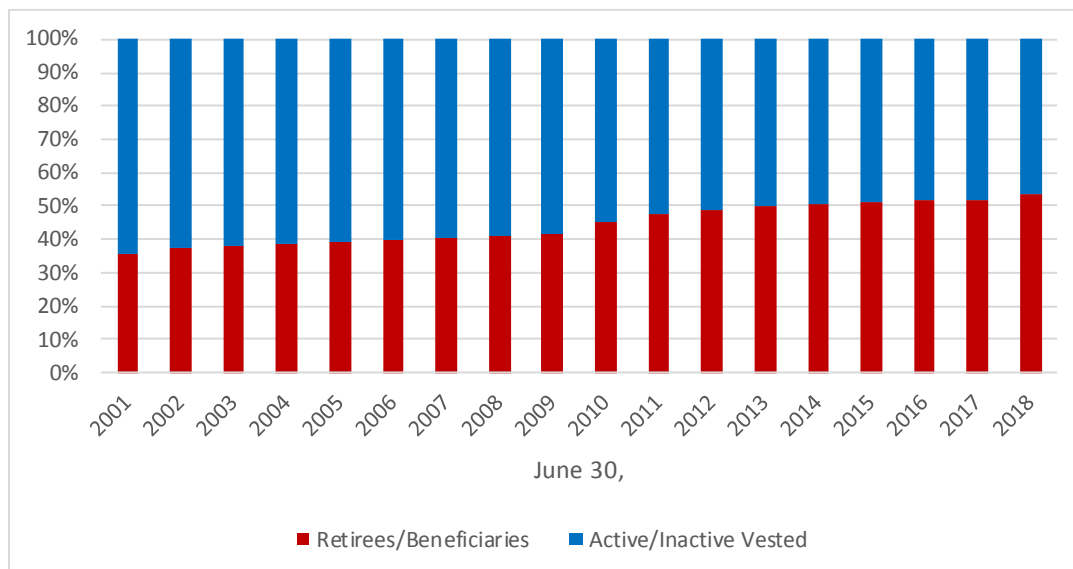
The retirement system is also growing larger with respect to the sponsoring entities, as can be seen by the ratio of actuarial liability to payroll.



MATURITY MEASURES

Regular Members

<u>Fiscal Year End</u>	<u>Retiree Liability</u> (a)	<u>Total Actuarial Liability</u> (b)	<u>Retiree Percentage</u> (a) / (b)	<u>Covered Payroll</u> (c)	<u>Ratio</u> (b) / (c)
6/30/01	\$5,344,310,283	\$15,013,865,677	35.6%	\$4,357,528,179	3.45
6/30/02	6,081,348,774	16,257,802,938	37.4%	4,542,242,862	3.58
6/30/03	6,578,965,060	17,320,970,664	38.0%	4,657,261,722	3.72
6/30/04	7,097,083,773	18,377,187,890	38.6%	4,838,392,770	3.80
6/30/05	7,642,618,806	19,416,559,026	39.4%	4,998,599,461	3.88
6/30/06	8,220,573,243	20,738,291,287	39.6%	5,265,297,137	3.94
6/30/07	8,941,802,561	22,023,863,090	40.6%	5,510,430,731	4.00
6/30/08	9,611,150,768	23,332,771,315	41.2%	5,763,634,079	4.05
6/30/09	10,238,166,793	24,733,483,621	41.4%	6,059,370,512	4.08
6/30/10	11,293,531,095	25,080,605,814	45.0%	6,180,689,916	4.06
6/30/11	12,698,425,109	26,752,154,635	47.5%	6,185,889,267	4.32
6/30/12	13,573,602,957	27,852,385,453	48.7%	6,377,421,205	4.37
6/30/13	14,329,968,181	28,799,324,938	49.8%	6,473,818,092	4.45
6/30/14	15,230,657,798	30,204,846,287	50.4%	6,679,683,181	4.52
6/30/15	16,028,939,271	31,451,851,955	51.0%	6,893,254,991	4.56
6/30/16	16,768,695,428	32,577,657,593	51.5%	7,114,861,564	4.58
6/30/17	18,304,044,337	35,176,950,577	52.0%	7,405,484,923	4.75
6/30/18	19,516,533,248	36,289,160,885	53.8%	7,515,600,156	4.83

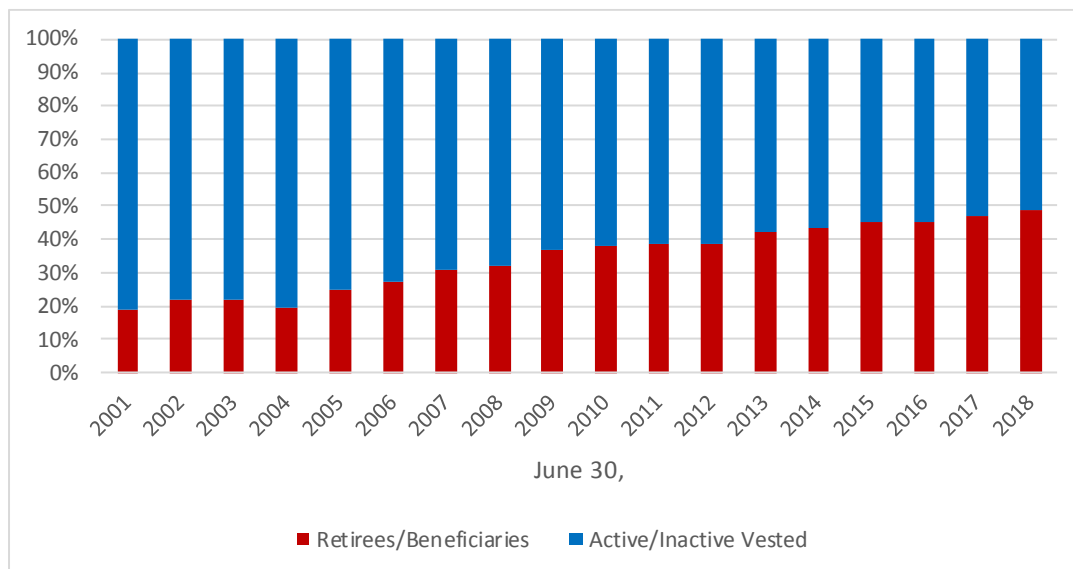




MATURITY MEASURES

Sheriffs & Deputies

<u>Fiscal Year End</u>	<u>Retiree Liability</u> (a)	<u>Total Actuarial Liability</u> (b)	<u>Retiree Percentage</u> (a) / (b)	<u>Covered Payroll</u> (c)	<u>Ratio</u> (b) / (c)
6/30/01	\$39,117,383	\$205,047,675	19.1%	\$62,931,378	3.26
6/30/02	47,676,344	217,603,566	21.9%	65,270,672	3.33
6/30/03	50,582,925	231,459,183	21.9%	70,223,260	3.30
6/30/04	52,891,601	268,791,610	19.7%	73,121,749	3.68
6/30/05	72,956,480	294,184,142	24.8%	72,615,638	4.05
6/30/06	86,780,625	319,723,056	27.1%	74,531,776	4.29
6/30/07	105,514,847	345,220,872	30.6%	78,112,455	4.42
6/30/08	119,881,091	374,066,361	32.0%	81,485,774	4.59
6/30/09	150,926,387	412,167,101	36.6%	85,935,900	4.80
6/30/10	169,436,571	447,627,643	37.9%	84,755,693	5.28
6/30/11	185,018,412	475,559,019	38.9%	90,506,138	5.25
6/30/12	195,188,608	502,716,830	38.8%	93,265,452	5.39
6/30/13	223,706,198	533,033,438	42.0%	93,607,893	5.69
6/30/14	240,964,615	556,135,092	43.3%	97,693,639	5.69
6/30/15	266,693,628	591,002,036	45.1%	100,469,418	5.88
6/30/16	281,179,979	624,791,635	45.0%	105,868,170	5.90
6/30/17	325,186,602	691,205,752	47.0%	109,516,368	6.31
6/30/18	341,195,487	697,339,410	48.9%	115,222,566	6.05

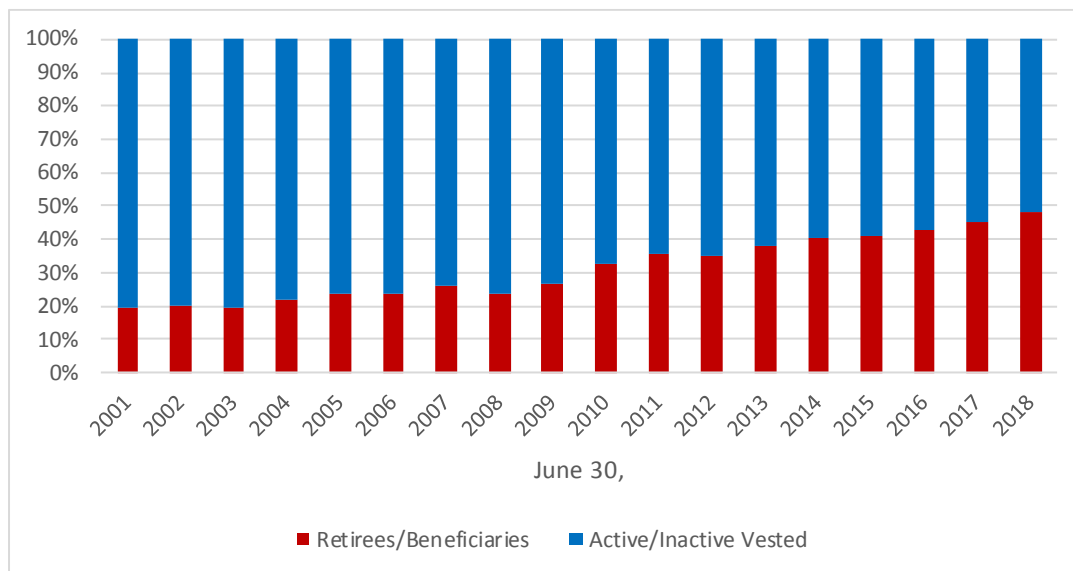




MATURITY MEASURES

Protection Occupation

<u>Fiscal Year End</u>	<u>Retiree Liability</u> (a)	<u>Total Actuarial Liability</u> (b)	<u>Retiree Percentage</u> (a) / (b)	<u>Covered Payroll</u> (c)	<u>Ratio</u> (b) / (c)
6/30/01	\$64,977,950	\$334,465,952	19.4%	\$130,973,134	2.55
6/30/02	78,326,426	393,152,681	19.9%	136,062,890	2.89
6/30/03	84,423,835	434,945,113	19.4%	153,615,256	2.83
6/30/04	105,306,931	482,431,106	21.8%	160,513,387	3.01
6/30/05	125,700,967	529,355,499	23.7%	165,645,787	3.20
6/30/06	141,592,836	593,108,076	23.9%	184,034,408	3.22
6/30/07	169,925,365	657,029,820	25.9%	193,163,013	3.40
6/30/08	191,726,385	815,378,913	23.5%	286,325,514	2.85
6/30/09	234,387,583	872,943,101	26.9%	293,336,712	2.98
6/30/10	306,902,663	940,186,193	32.6%	305,736,396	3.08
6/30/11	368,833,144	1,029,366,460	35.8%	298,477,314	3.45
6/30/12	383,175,993	1,091,095,203	35.1%	315,472,063	3.46
6/30/13	446,902,048	1,165,983,944	38.3%	312,705,149	3.73
6/30/14	503,104,371	1,243,474,709	40.5%	321,900,460	3.86
6/30/15	547,545,074	1,327,464,740	41.2%	332,623,732	3.99
6/30/16	607,529,406	1,417,299,919	42.9%	335,785,986	4.22
6/30/17	705,541,965	1,572,225,700	44.9%	348,159,152	4.52
6/30/18	801,836,796	1,656,333,358	48.4%	352,396,805	4.70





QUALITATIVE ANALYSIS

ASOP 51 provides that the assessment of risk does not necessarily have to be quantitative, but may be qualitative. This report will provide quantitative analysis for each of the three membership groups in a later section, but first we will discuss the overall assessment of risk for IPERS from a qualitative perspective.

(1) Contribution Rate Funding Policy

IPERS covers three different membership groups, each funded with a separate contribution rate. The largest group (95% of the total) is the Regular membership which includes the state of Iowa employees, school employees in the state and employees of local entities. The remaining 5% of the active members are in the Sheriffs and Deputies group and the Protection Occupation group.

In 2006 and 2010, legislation was passed that increased the statutory contribution rate for Regular members. Beginning with the 2011 valuation (which applied to FY 2013), the Investment Board was given the authority to set the Required Contribution Rate for Regular members, subject to a maximum increase of 1.00% per year. The Sheriffs and Deputies group and the Protection Occupation group have historically contributed at the full Actuarial Contribution Rate which was subject to change each year. These groups now contribute based on the same funding policy as is used for the Regular members.

Together the actuarial cost method, the asset valuation method and the amortization of the unfunded actuarial liability (UAL) create the cornerstone of the System's funding policy. During calendar year 2013, a special study of the IPERS' funding policy was performed and each key factor was thoroughly discussed, reviewed, and analyzed. The result of these efforts was a revision of two documents by the Investment Board in September, 2013:

- (1) Actuarial Amortization Policy and
- (2) Contribution Rate Funding Policy.

Changes were made to these policies to meet the competing goals of stabilizing contribution rates and improving IPERS' long term funding as quickly as possible.

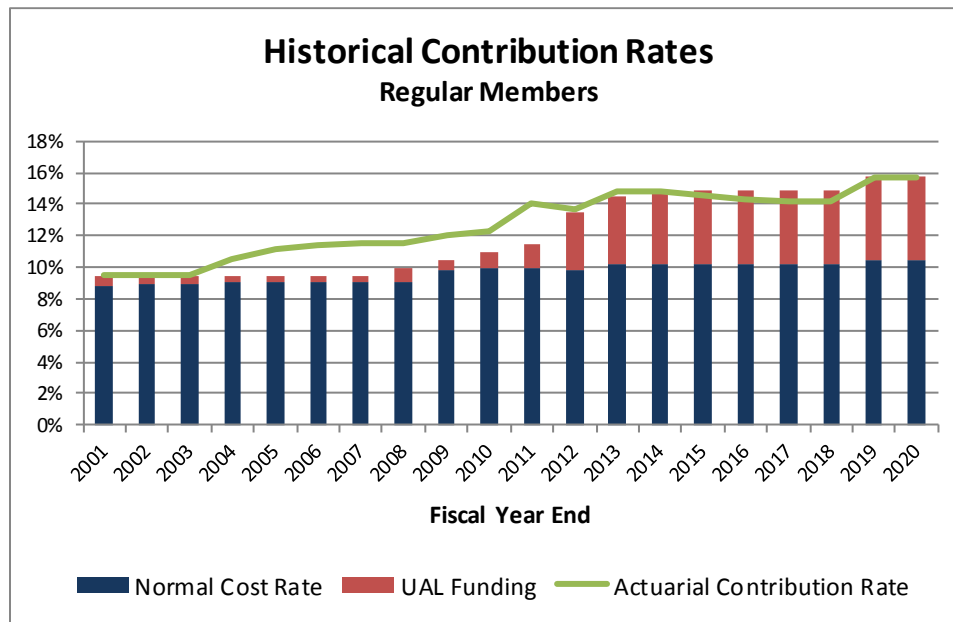
The Investment Board sets the Required Contribution Rate based on the Actuarial Contribution Rate (ACR) in the annual actuarial valuation. The Required Contribution Rate is determined by comparing the ACR determined in the current annual valuation to the Required Contribution Rate of the previous year.

- a. If the ACR is less than the previous Required Contribution Rate by fewer than 50 basis points, then the Required Contribution Rate shall remain unchanged from the previous year.
- b. If the ACR is less than the previous Required Contribution Rate by 50 basis points or more, then the Required Contribution Rate shall be lowered by 50 basis points provided the funded ratio of the membership group is 95% or higher.
- c. If the ACR is greater than the Required Contribution Rate of the previous year, then the Required Contribution Rate shall be:
 - i. Increased to be equal to ACR for Sheriffs and Deputies.
 - ii. Increased to be equal to ACR for Protection Occupation.
 - iii. Increased to be equal to ACR for Regular membership, or one percentage point greater than the prior year's Required Contribution Rate, whichever is smaller.

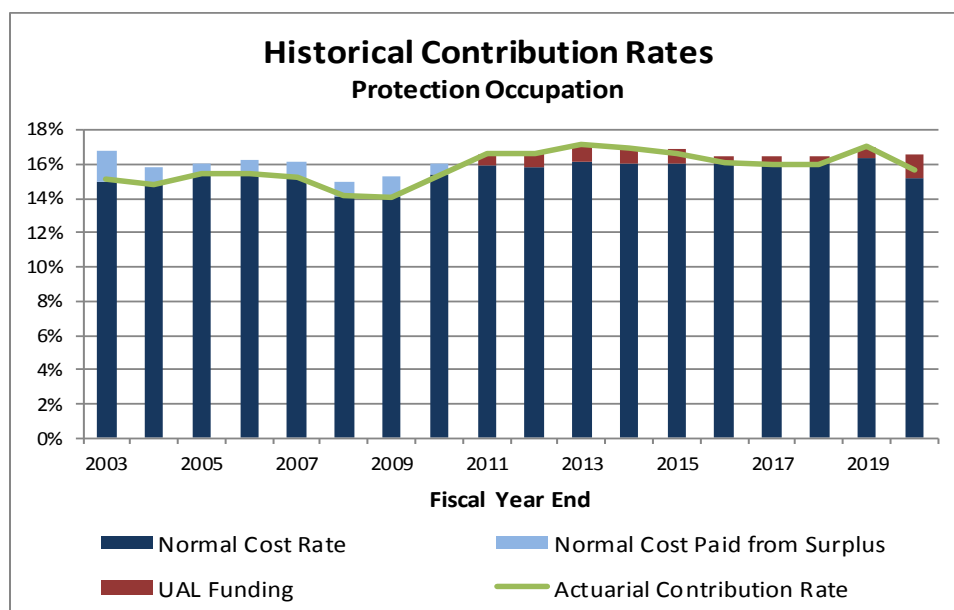
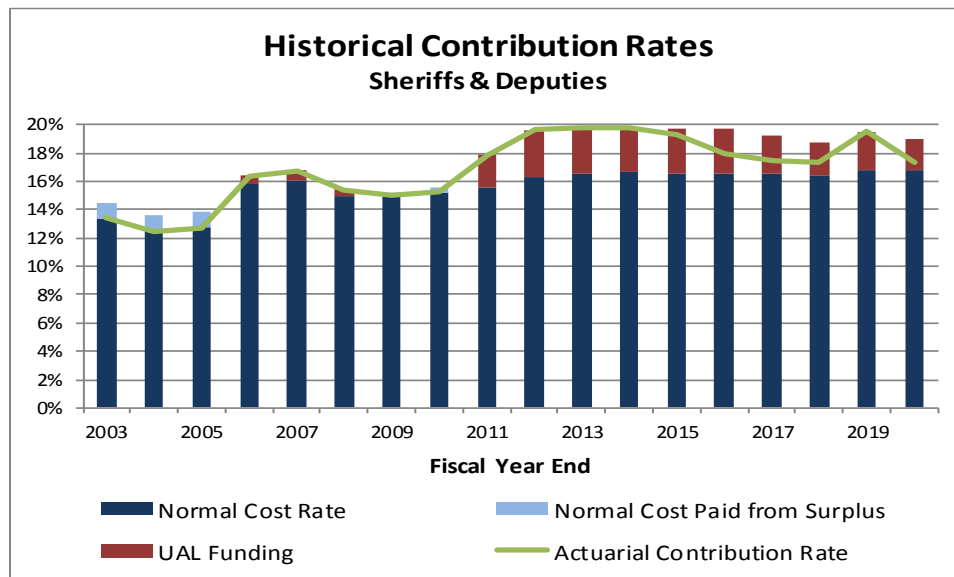
QUALITATIVE ANALYSIS

IPERS' Contribution Rate Funding Policy should be considered as a positive factor in risk assessment because it permits the Required Contribution Rate to increase based on the results of the actuarial valuation, but limits any reduction to the Required Contribution Rate until the group is at least 95% funded.

A historical summary of the actual contribution rate, split between the normal cost and the remaining amount available to fund the UAL, and the Actuarial Contribution Rate is shown in the following graph:



For a number of years, the actual contributions were less than the Actuarial Contribution Rate and only a small portion of the total contribution rate was available to fund the UAL. With the authority granted to the Investment Board to set contribution rates, the portion to fund the UAL has increased and more progress has been made toward eliminating the UAL.



Generally, the strongest positive factor in funding a retirement system is consistently making the full actuarial contribution each year. The legislative change in 2010 that granted the Investment Board the ability to set the Required Contribution Rate and the development of the Contribution Rate Funding Policy has significantly strengthened IPERS' long term funding. The statutory requirement that the increase to the Required Contribution Rate for the Regular membership be limited to 1% per year could be considered a negative factor to the System's funding. However, other aspects of the IPERS Contribution Rate Funding Policy that reduce the Required Contribution Rate slowly and only when the group's funded ratio is at least 95%, provide offsetting positive impacts. In addition, the 1% maximum for the increase and the ability for the Required Contribution Rate to be raised every year provide a reliable mechanism to ensure the Required



QUALITATIVE ANALYSIS

Contribution Rate does not deviate significantly from the Actuarial Contribution Rate for a sustained period. Overall, we believe the IPERS Contribution Rate Funding Policy is a positive factor in addressing the risks associated with funding the System.

(2) Legal Obligation to Make Contributions and Historical Contributions

There is a direct correlation between healthy, well-funded retirement systems and consistent contributions equal to the full actuarial contribution rate each year. As discussed earlier, historically the full Actuarial Contribution Rate has been made for the Sheriffs and Deputies and Protection Occupation Group each year and the funded ratios of these groups reflect this historical pattern. For ten years, the actual contribution rate for the Regular membership group was below the Actuarial Contribution Rate, at times significantly. Since the statute was changed (for FY 2013), the actual contributions for the Regular membership have been equal to or more than the Actuarial Contribution Rate. Given the IPERS Contribution Rate Funding Policy (discussed earlier), the expectation is that the funded ratio for the Regular membership group will increase and eventually reach full funding. IPERS' statutory requirement for members and employers to make the Required Contribution Rate, as set by the Investment Board, is a positive factor. Furthermore, the pattern of historical contributions indicates that actual contributions have consistently followed the statutory requirement, a positive qualitative factor for IPERS.

In addition, IPERS and its stakeholders have a history of addressing significant funding problems by making changes to the benefit provisions and/or the funding mechanism. While this does not reduce any of the risks associated with IPERS' funding, it is important to realize that the risk can be addressed in multiple ways. The Iowa Legislature has proven their willingness to adjust the benefit structure, if necessary.

(3) Amortization Policy

Actuarial assumptions are intended to be long-term estimates so even if experience follows the assumption over the long-term, short-term fluctuations are to be expected. When this occurs, and when changes to the actuarial assumptions, methods, or benefit structure occur, any deviation in the unfunded actuarial liability is financed based on the provisions of the amortization policy.

IPERS Amortization Policy

The UAL is amortized according to the Actuarial Amortization Method adopted by the Investment Board which provides for the use of "layered amortization". The initial layer, which is equal to the unfunded actuarial liability as of June 30, 2014, is amortized over a closed 30-year period. For each valuation subsequent to June 30, 2014, annual net experience gains/losses for each membership group are amortized over a new, closed 20-year period. Plan amendments or changes in actuarial assumptions or methods that create a change in the UAL are amortized over a demographically appropriate period, selected by the Investment Board at the time that the change is incurred (note the changes to assumptions in the 2017 and 2018 valuation were both amortized over closed 20-year periods). The dollar amount of the UAL payment for purposes of computing the UAL component of the actuarial and required contribution rate will be the sum of the amortization payments for each amortization base divided by the total projected payroll. Unless the plan has been 110% funded for the current and prior two years, a negative amortization payment is ignored. If the valuation shows that the group has surplus, the prior amortization bases are eliminated and one base equal to the amount of the surplus is established with an amortization period of a



QUALITATIVE ANALYSIS

30-year open period for all groups. For all purposes, amortization payments are calculated as a level percentage of payroll.

There are both positive and negative aspects to IPERS' Amortization Policy. As of the June 30, 2019 valuation, the remaining amortization period for the initial UAL base (and largest base) is 25 years, but the period for other bases is no greater than 20. In another five years, all amortization bases will be 20 years or less and there will be no negative amortization (interest on the UAL is more than the UAL contribution so the dollar amount of UAL increases). The movement to shorter amortization periods has become a "best practice" in the industry and has been reinforced by the actuarial profession in recent pronouncements. IPERS has taken action to methodically move the System toward shorter, closed amortization periods, as evidenced by the Investment Board adopting a 20-year period to amortize the increases in the UAL due to recent assumption changes. The use of layered amortization is a reasonable approach to funding the UAL and is becoming more common in the industry.

(4) Payroll Growth Assumption and Active Membership

When the actuarial valuation is performed each year, it determines the funded ratio, unfunded actuarial liability and the contribution rates needed to fully fund the System based on IPERS funding policy. The contributions needed (normal cost plus UAL amortization) are expressed as a percent of payroll which is consistent with how contributions are collected. Because the amortization payment on the unfunded actuarial liability is determined using the level percent of payroll methodology, an assumption must be used to develop the payment stream for the amortization of the UAL. The current payroll growth assumption for IPERS is 3.0% per year which implicitly assumes that the number of active members remains stable over time.

The funding of the System could be impacted if there was a material shift in the IPERS active membership. When the payroll of IPERS declines, it requires an increase in the contribution rate to fund the System even if the UAL is unchanged. While the dollar amount of the UAL payment might be the same, the contribution rate has to increase to collect the same amount of amortization payment. Upward pressure on the contribution rates due to payroll growth lower than expected could create issues for participating employees and employers. In addition, given the statutory limit on the increase in the Required Contribution Rate for the Regular membership, sustained declines in payroll over a long time could prevent the Required Contribution Rate from being sufficient to fully fund the system according to the amortization schedule, especially if investment returns were also lower than expected over the same period.



QUANTITATIVE ANALYSIS

There are a number of risks inherent in the funding of a defined benefit plan. These include:

- demographic risks such as mortality, payroll growth, aging population including impact of baby boomers, and retirement ages;
- economic risks, such as investment return and inflation;
- contribution risk, i.e., the potential for contribution rates to be too high for the plan sponsor/employer to pay; and
- external risks such as the regulatory and political environment.

The various risk factors for a given system can have a significant impact – favorable or unfavorable – on the actuarial projection of liabilities and contribution rates. Under ASOP 51, the actuary is required to include plan-specific commentary regarding the risks that are identified. However, such comments can be qualitative rather than quantitative. In this section of the report, we include quantitative analysis to assist with a better understanding of some of the key risks for IPERS.

Demographic Risks

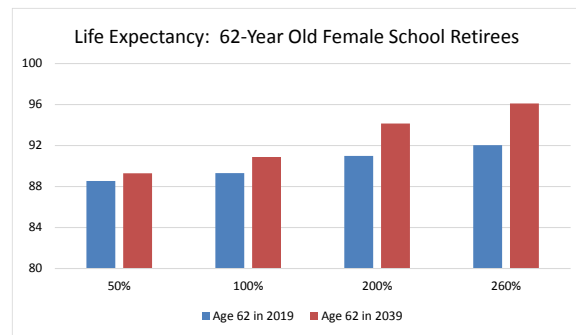
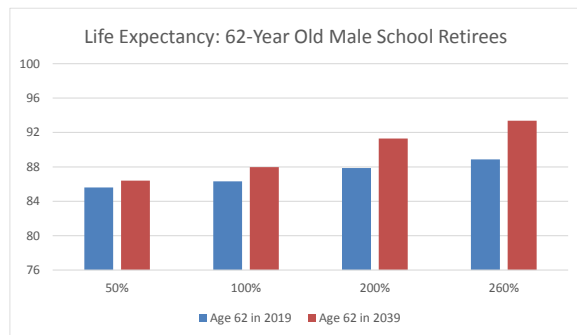
Demographic risks are those arising from the actual behavior of members differing from that expected based on the actuarial assumptions. These changes may arise when a significant portion of members is influenced to take some particular action due to employer or governmental actions, when there are improvements in medicine that affect broad groups of retirees, when societal trends encourage new behavior, or they may simply be random. Examples include early retirement windows, new drugs to treat common diseases, or trends across society to work longer before retiring. Many of these risks are minor in nature since they unfold gradually and generally have a small impact on a retirement system. Some, however, are comparatively more significant and warrant additional discussion.

Mortality Risk

A key demographic risk for all retirement systems, including IPERS, is improvement in mortality (longevity) greater or less than anticipated. While the actuarial assumptions used in the valuation reflect small, continuous improvements in mortality experience each year, and these assumptions are evaluated and refined in every experience study, the risk arises because there is a possibility of some sudden shift, perhaps from a significant medical breakthrough that could quickly impact life expectancy and increase liabilities. Likewise, there is some possibility of a significant public health crisis that could result in a significant number of additional deaths in a short time period, which would also be significant, although more easily absorbed.

Over recent history, mortality rates have improved on average at a rate of about 1 percent per year for the core ages of retirees. The mortality projection scale used for the valuation is somewhat more complex than this, but it suffices for illustration to think of the current mortality improvement assumption as also being about 1% per year. To consider longevity risk, we considered the impact of faster improvements in life expectancies of 2.0 and 2.6 times as much improvement, along with only half as much improvement. As the following charts illustrate, a greater improvement factor greatly increases the life expectancy over time.

QUANTITATIVE ANALYSIS – DEMOGRAPHIC ASSUMPTIONS

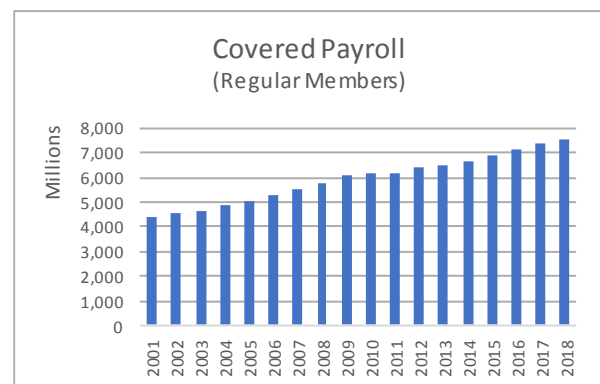
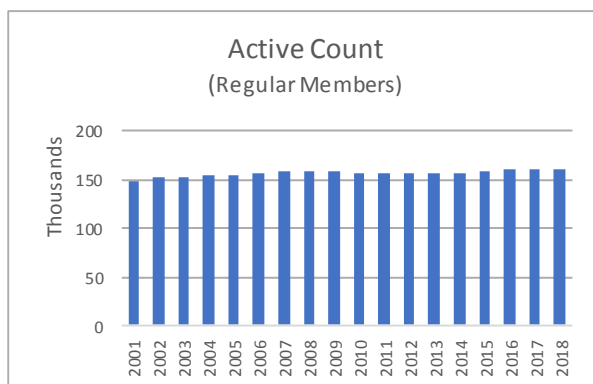


In performing valuations, we do not directly use life expectancy values, but rather apply the mortality rates at each age directly. For 2019, if the mortality improvement scale were cut in half (to a 0.5% per year improvement), the liabilities would decrease by about 1% at age 62, while if the mortality improvement scale were doubled (resulting in a 2% per year improvement), liabilities at age 62 would increase approximately 2%. Over the next 20 years, the impact of either change would roughly double. Note that these changes in mortality improvement are noticeable departures from historical norms, but they are plausible.

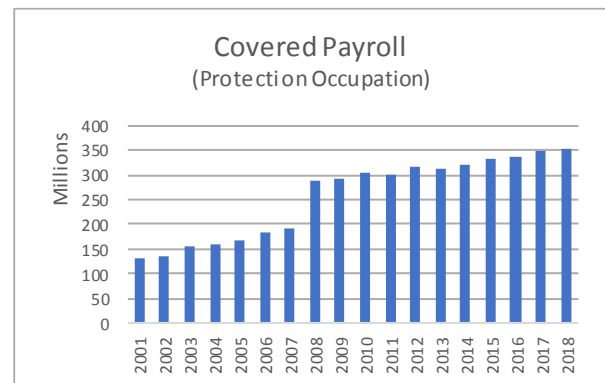
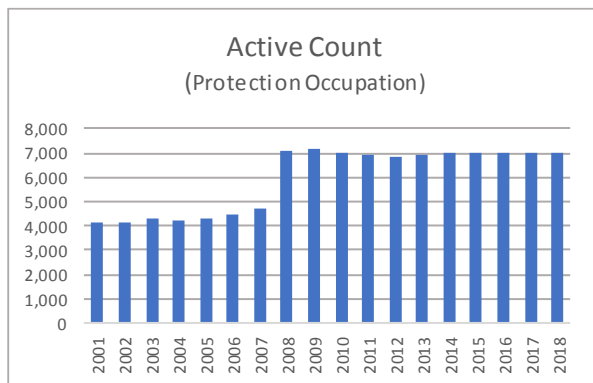
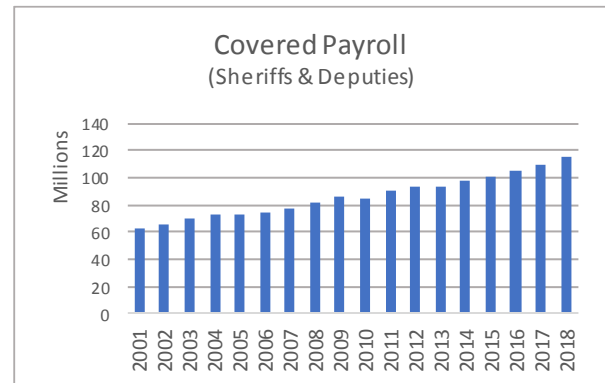
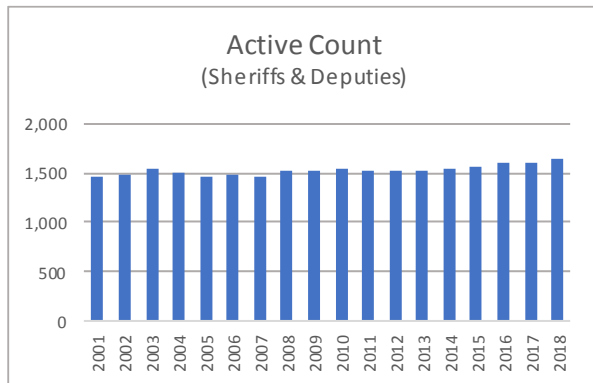
Active Population Growth or Decline Risks

Valuations consider the data on a single date and do not make a direct assumption regarding future members, with the exception of the amortization method's assumption of payroll increases that inherently assumes a constant population size. However, the reality is that if the active membership increases or decreases, it will lead to decreases or increases in the actuarial contribution rate.

The following graphs show the historical count and covered payroll for active members in each membership group:



QUANTITATIVE ANALYSIS – DEMOGRAPHIC ASSUMPTIONS



A decline in IPERS active membership could occur for a number of reasons, but the risk is likely different for the three groups. If the state of Iowa experiences severe and prolonged fiscal challenges, the number of State employees might be reduced. Alternatively, if there is a decline in the student population, it could reduce the need to maintain the current level of teachers. Another possibility that could impact the number of active members is a shift in the way education is delivered, with higher utilization of online teaching. Regardless of the cause for the decline, a substantial decrease in the active membership could pose a risk to the stability of contribution rates.

The risk to the regular membership of IPERS is likely mitigated because IPERS covers such a diverse population across the entire state of Iowa and, as a result, is less vulnerable to significant decreases in the size of the active membership because changes often do not impact all of the various groups. The largest portion of the Regular membership is school employees which again, includes many different school districts across the state, thereby reducing the likelihood of a consistent reduction of active members across all school employers. While state employment has declined over the last ten years, the overall active membership of IPERS has not been impacted as significantly.

A significant decrease in the Sheriffs and Deputies or Protection Occupation groups may be less likely given the type of jobs covered and the ability of the state and counties to severely reduce the size of the covered group. However, because these groups are much smaller, modest changes could be more noticeable as a percentage of membership.



QUANTITATIVE ANALYSIS – DEMOGRAPHIC ASSUMPTIONS

In the event of a significant decrease in population, the payroll used to amortize the UAL is unlikely to grow at the assumed rate. This will, in turn, increase the actuarial contribution rate, although not the contribution amount, needed to pay off the UAL. Referring to the maturity measures shown earlier in the report, it should be evident that lower payroll will increase the Asset Volatility Ratio. Of course, an increase in active membership would decrease the contribution rate and Asset Volatility Ratio.

Other Demographic Risks

Changes to retirement and termination rates are likely to occur through time as the nature of the workforce and societal expectations shift. For instance, over the past decade or so, we have observed a general shift in retirement patterns in which retirements are occurring later. This may be a function of economic considerations, expectations of longer life in retirement, a proportionate decrease in physically-demanding jobs, or changes in family composition. Such changes do affect the funding of the plan, but generally these changes are minor and gradual and are reflected in modified assumptions resulting from regular experience studies.

More significant changes in demographic assumptions are likely to be influenced by something significant such as a legislative change. Obviously, some changes in IPERS provisions or state employment rules could quickly change behavior patterns, but these would probably be anticipated as part of the legislation. Externally, a significant change in Social Security or Medicare provisions could change retirement patterns if the changes were implemented rapidly. These changes are not ones that can be easily quantified because the timing of such events, the impact of the event on behavior, and the magnitude of the behavior change cannot be anticipated.



Investment Return Risk

Investment risk volatility is the greatest risk facing IPERS and most public retirement systems today. As the System continues to mature and move toward full funding, investment returns will have an increasingly greater impact on the funding of the system. When investment returns are below the expected return (investment return assumption), the unfunded actuarial liability increases and additional contributions are needed to make up for the difference between the actual and expected return. Likewise, returns above the expected return, which are easier to absorb, decrease the unfunded actuarial liability and reduce the needed contributions. Because of the inherent volatility of most retirement system investment portfolios, there is, therefore, volatility in the plans' funded status and contribution requirements.

In order to understand the impact of investment volatility, we will proceed with a sequence of projections, based on the model prepared for IPERS as part of the valuation each year. These “deterministic” projections use one or more selected scenarios to help illustrate certain key concepts. Following these projections, we show a summary of the results of a “stochastic” projection in which 1,000 equally plausible random scenarios are run and summarized.

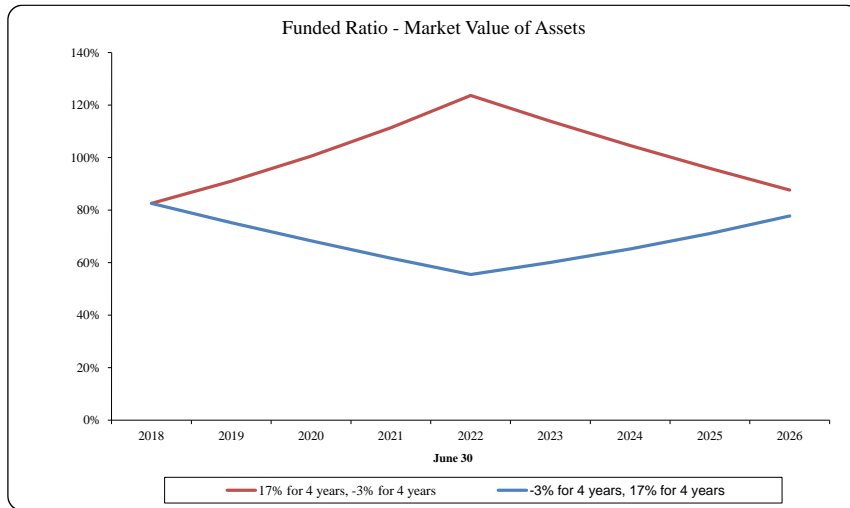
Risk Due to Return Order

The funding outcome is dependent not only on the returns but also the order in which they occur. In other words, a “good” return followed by a “bad” return can lead to a different final result than the same “bad” return followed by the same “good” return. While this may not be intuitive at first, the concept makes sense once it is realized that there are net cash flows out of the system.

To illustrate this concept, consider the funded ratio for the Regular members under two different scenarios. In each case, there are four years of returns that are 17% (10% above the assumed 7% return). There are also four years of -3% returns (10% below the assumed return). In one case, we assume the four good years come before the four bad years, while in the other case, we assume that the four bad years are followed by the four good years. To help illustrate the results, we have also assumed that contribution rates are the same in both cases, and we have focused on the market value of assets to avoid the temporary influence of asset smoothing.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

The following graph shows the results:



At the end of the projection, the high return followed by low return scenario has a funded ratio of 88%, while the low return followed by a high return is 78% funded. The order of the returns leads to a \$4.5 billion dollar difference in market value (\$40.0 billion vs. \$35.5 billion). While the scenarios displayed here are artificial, they do illustrate that the return order matters.

Risk of Low Returns for Sustained Period

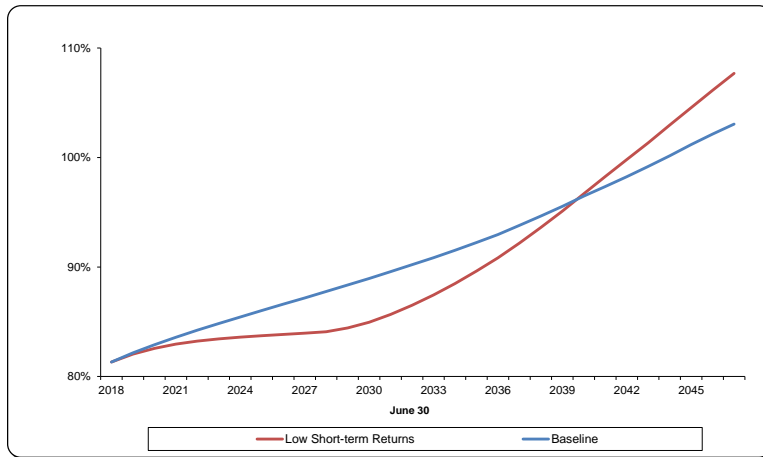
The current view from most investment consultants is that a low return environment may persist for a number of years into the future. Some consultants anticipate that after this extended period, returns will return to historic norms, while others do not extend their assumptions that far into the future. There is no way to know whether this view of low returns for five to ten years is correct or not, but it is important to determine the potential impact of low returns over a sustained period on IPERS' funding.

In particular, we want to examine the scenario suggested by Wilshire, IPERS' investment consultant, that returns will be 6.4% for the next 10 years, and 7.4% thereafter. It should be noted that such an assumption is not inconsistent with the 7.0% long-term rate of return currently used for the IPERS valuation. The difference is really a variant of the prior discussion on order of returns: How does a scenario that has lower returns followed by higher returns compare with a scenario that has the (approximately) average returns for all years?

Unlike the prior discussion where contributions were held constant, we now want to study how both contributions and the funded status are impacted. If returns are consistently below the expected return of 7% in the early years, the actuarial contribution rates will be continually increasing as the unfavorable investment experience is captured in the asset smoothing method. With the statutory cap on the increase in the Required Contribution Rate for the Regular membership, it is possible that the Required Contribution Rate will be less than the full Actuarial Rate for a sustained time period.

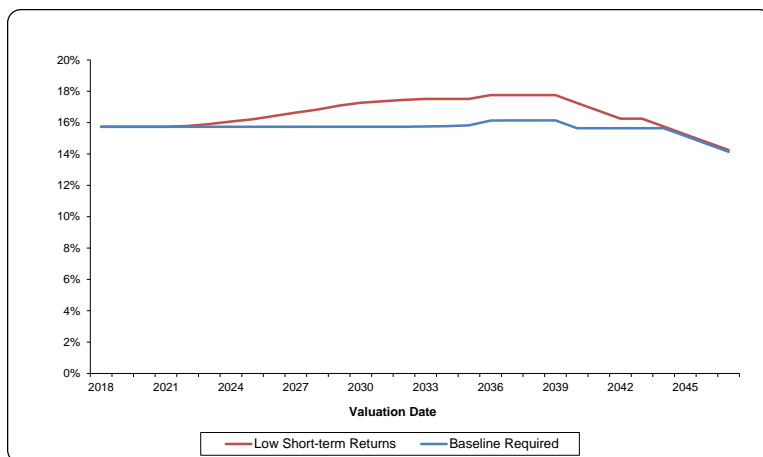
The following graphs shows the impact of low returns on the funded ratio and the Required Contribution Rate for each of the three membership groups in IPERS. In each case, the scenario suggested by Wilshire (6.4% for 10 years, 7.4% thereafter) is compared with the baseline scenario of 7.0% for all years.

Regular Membership – Funded Ratio



In this scenario, the low returns for the next 10 years reduce the funded ratio until 2040. In 2030, the gap is greatest, reaching a 4% difference (85% funded vs. 89% funded, reflecting a UAL difference of \$ 2.0 billion). Ultimately, this difference is eliminated and actually reversed as the higher investment returns, coupled with larger contribution rates, result in a higher funded ratio.

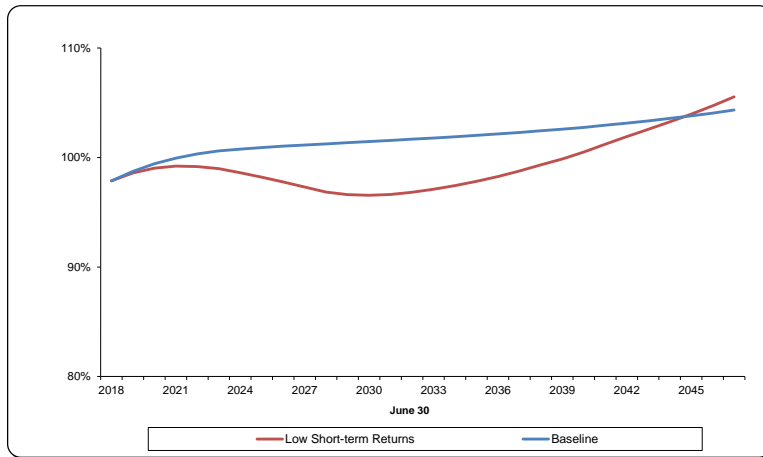
Regular Membership – Required Contribution Rate



This graph provides a partial explanation as to why the funded ratios in the prior graph did not diverge significant for the first 25 years. Under the alternate scenario, the lower returns gradually result in contribution rates increasing above the baseline, reaching a level that is about 1.6% higher than the baseline. (Recall that this total rate is split between employers and members.) As the UAL is eventually paid off, the contribution rates under both scenarios begin to converge toward the normal cost rate.

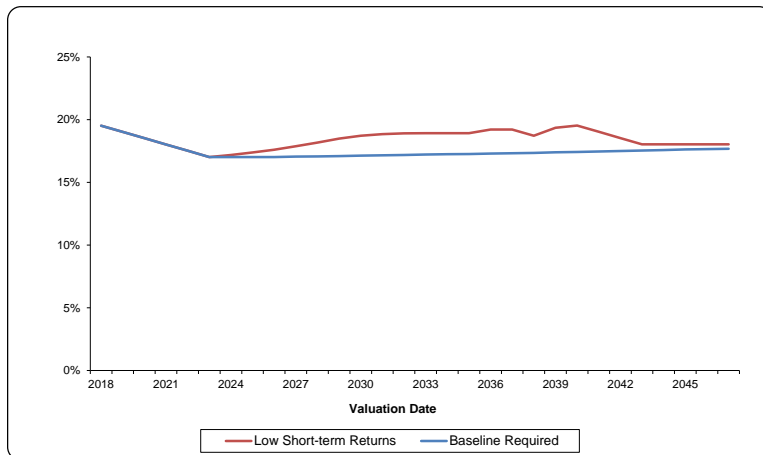
This example illustrates an important concept. The funding policy used by IPERS will result in funding the promised benefits over time. We frequently note that, over the long run, contributions plus investment income equal benefits plus expenses. If the System experiences persistently low returns over the next ten years, the lower income will be replaced by higher contributions to keep the funding equation in balance.

Sheriffs and Deputies Membership – Funded Ratio



Because the Sheriffs and Deputies plan is nearly 100% funded and is not expected to increase significantly, there is less variation in the funded ratio compared with the Regular Membership plan. In 2029, the difference in the funded ratio reaches 4.9%, before the impact of higher returns and larger contributions take effect. Note that in any case, the funded ratio does not fall below 96%.

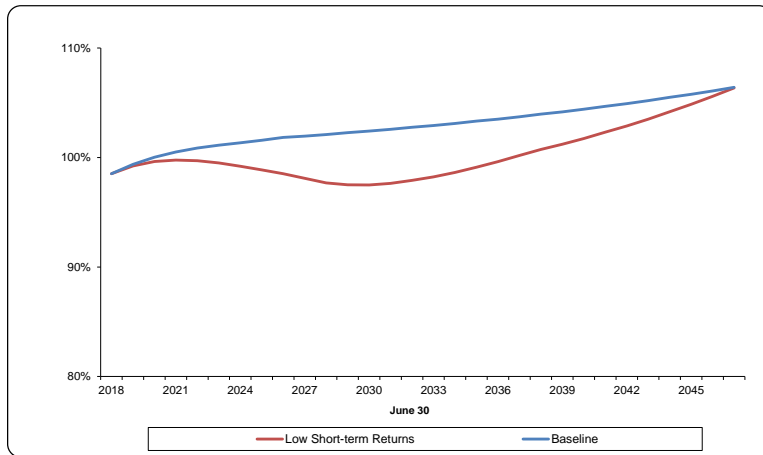
Sheriffs and Deputies – Required Contribution Rate



As would be expected, the lower returns for the first 10 years lead to increasing contribution rates. While the total contribution rates under the alternate scenario are about 2% higher than the baseline (and split evenly between members and employers), the rates do not rise above the current Required Contribution Rate 19.52%.

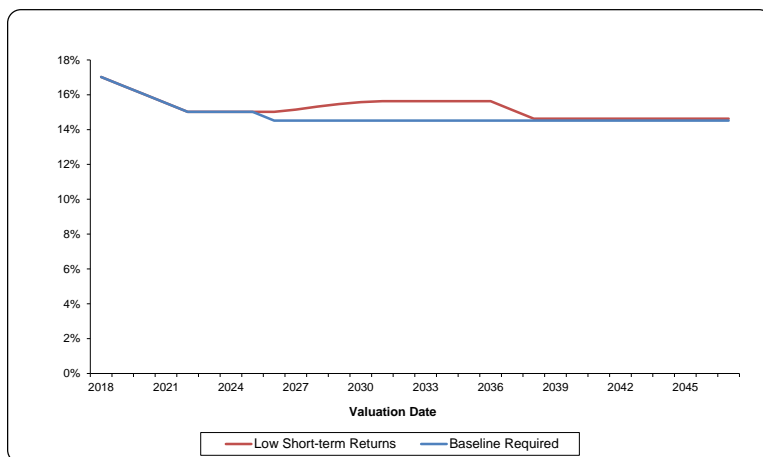
The significant difference between the Sheriffs and Deputies plan and the Regular Membership plan is that contribution rates under the baseline scenarios are already expected to decline and would do so for a few years under the alternate scenario before increasing. This is ultimately related to the strong funded status of the Sheriffs and Deputies plan and the Contribution Rate Funding Policy.

Protection Occupation Membership – Funded Ratio



As might be expected, the Protection Occupation plan has significant similarities to the Sheriffs and Deputies plan. Because this plan is slightly better funded than the Sheriffs and Deputies, contributions are not anticipated to increase as much under the alternate scenario, so the two lines meet later in the projection period.

Protection Occupation Membership – Required Contribution Rate



Because the Protection Occupation plan is nearly 100% funded now, the contribution rate would increase from 15% to around 15.5% rather than decreasing to 14.5% under the alternate scenario beginning around 2025. That difference would then be eliminated over the next 10-15 years. Compared with the current rate of over 17%, contributions are lower under either scenario.

While the scenario suggested by Wilshire will not happen exactly as modeled, if the average returns over the next 10 years are around 6.4% and then the average returns increase to around 7.5%, similar patterns as these will emerge. The graphs here indicate that the effect on contribution rates will not be as significant for the Special Services groups, largely because they are better funded. The increase would be more noticeable for the Regular Membership plan. It should be stressed, however, that this is only one plausible scenario and there is not universal consensus on return expectations.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Risk of Shock in a Single Year

From late 2007 through early 2009, the financial markets crashed both in the U.S. and abroad resulting in the worst annual investment return ever experienced by IPERS. The return on the market value of assets for FY 2009 was -16.27% and this single year dropped the funded status on a market value basis by more than 20%. Like many other systems around the country, IPERS and the State of Iowa responded with changes in the benefit structure and funding policy. Coupled with the financial market recovery, significant progress has been made in improving the situation.

Even with IPERS' current Contribution Rate Funding Policy and the progress made toward improving the funding, there is still risk from another shock of this magnitude in a single year. The impact of such an event would be different depending on when it occurs. As the System matures and assets grow in comparison to payroll (increasing the asset volatility ratio), severe investment declines will have a greater impact on the actuarial contribution rate.

To study the impact of a similar shock, we modeled a repeat of 2009 with its -16.27% return in FY 2019, but 7% returns in every other year. In particular, this analysis assumes that the market bounce-back that followed Fiscal Year 2009 is not repeated. It was further assumed that the current Contribution Rate Funding Policy was followed and the Required Contribution Rate was actually contributed each year.

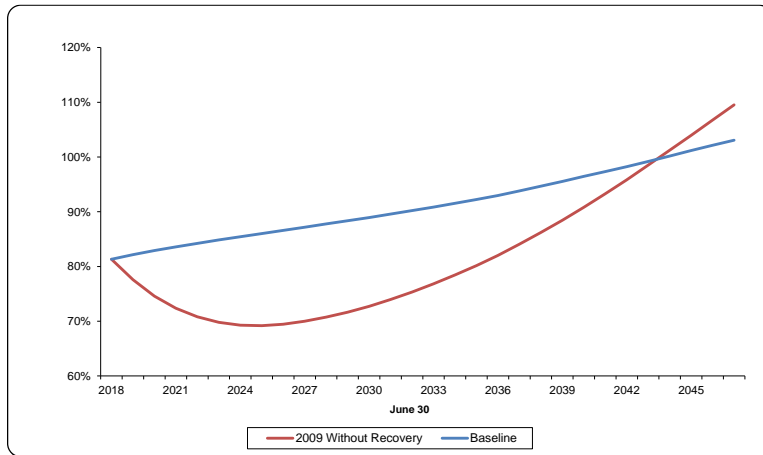
This scenario, as presented, reflects a compound return over the thirty year period of about 6%. Given the specific returns used, it is highly improbable. First, the probability of such a return in a single year (based on Wilshire's capital market assumptions) is around 0.5% to 0.6% - meaning an event that occurs maybe every 150 to 200 years. Second, market crashes have been historically followed by significant rebounds in the following few years that have recovered significant portions of the losses. Third, IPERS and its stakeholders have a history of addressing significant problems by making changes in the benefit provisions and/or funding mechanism. This is not to minimize the risk of a shock. Rather, it is a reminder that the risk can be addressed in multiple ways.

Because there has been a tendency for severe drops in the financial markets to be followed by a market rebound, another graph is shown that includes a third scenario which repeats the shock experienced in 2009, but then reflects the actual returns recognized by IPERS for fiscal years 2010 through 2018. In other words, the returns modeled for 2019 through 2028 are the actual returns observed from 2009 through 2018. For 2029 and beyond, a 7.0% return was assumed to occur.

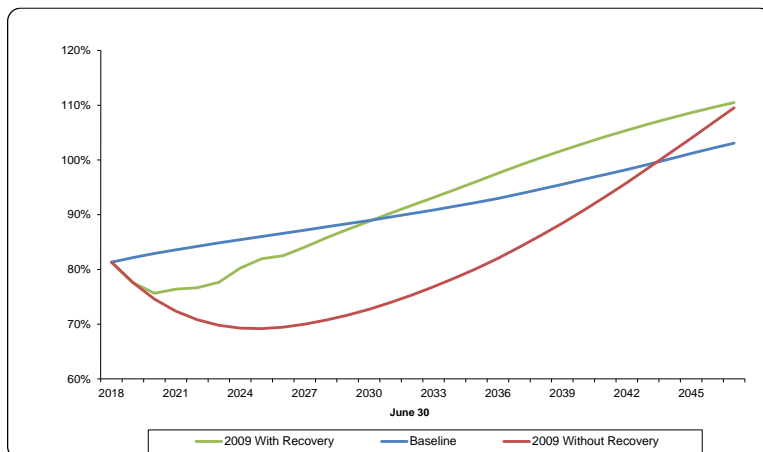
These graphs illustrate that much, but not all, of the damage following a very significant market downturn can be mitigated by the tendency of financial markets to recover.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Regular Membership – Funded Ratio



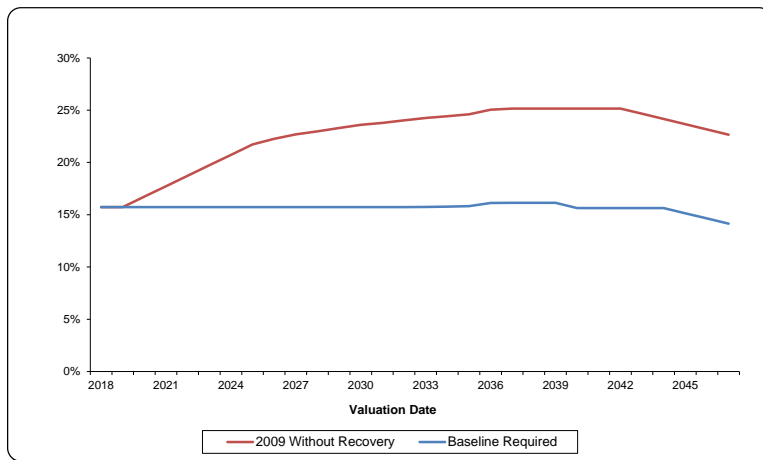
In this scenario, the funded ratio drops significantly in the initial years. Note that this graph is based on the actuarial value of assets, so the smoothing mechanism delays the recognition of the return over several years. The funded ratio starts to increase as additional contributions are made in response to the decreasing funded ratio.



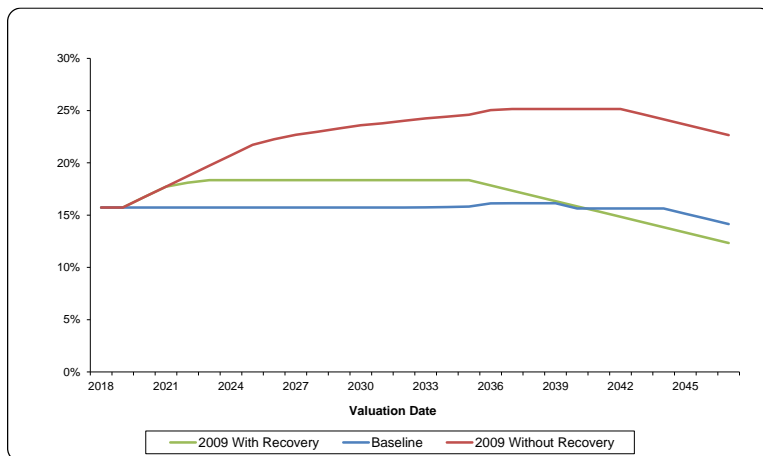
The green line shows how the recovery in the financial markets helps to reverse the declining funded ratio. In the 9 years following the shock, 5 of the returns are double digit returns, so the assets increase significantly, aided by higher contribution rates as well.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Regular Membership – Required Contribution Rate



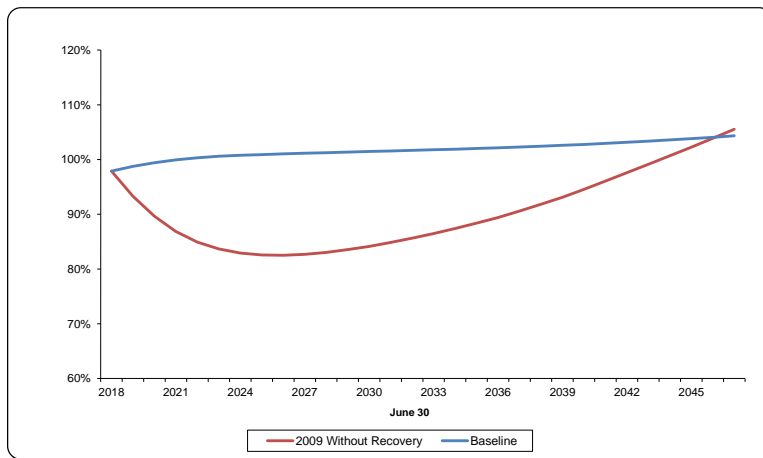
Because there is no market recovery assumed, contribution rates increase to compensate for the lower investment income. For the first six years, the 1% cap increase is applicable in setting the Required Contribution Rate. Over time, the Required Contribution Rate increases between 9% and 10% above the baseline.



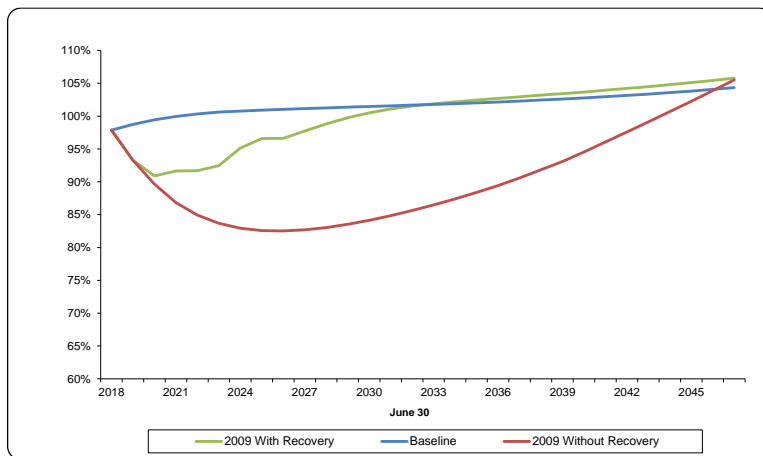
In the scenario reflecting no recovery, the initial shock is significant enough to force contribution rates to increase for the first three years. When the recovery is assumed, the contribution rates do not continue to rise, but they also do not come down until the system is 95% funded, in keeping with the IPERS Contribution Rate Funding Policy.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Sheriffs and Deputies Membership – Funded Ratio



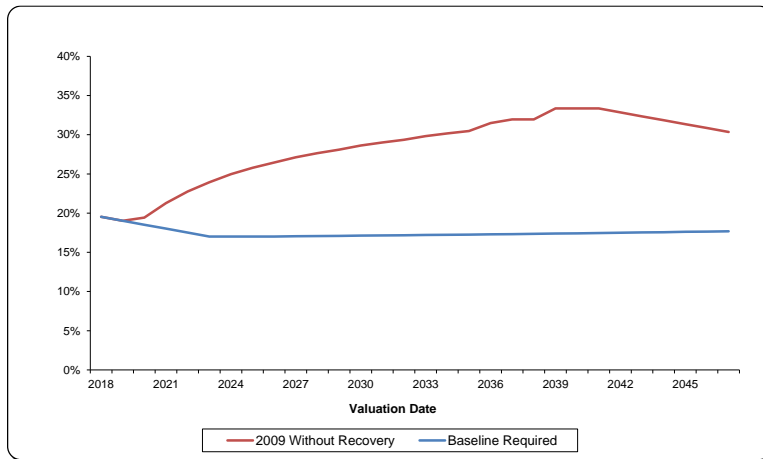
Like the Regular Membership, the funded ratio declines significantly in the early years as the asset losses work their way through the smoothing method. Because this plan is starting from a stronger funded position, the funded ratio (on a smoothed basis) remains above 80% and ultimately returns to being 100% funded with the additional contributions.



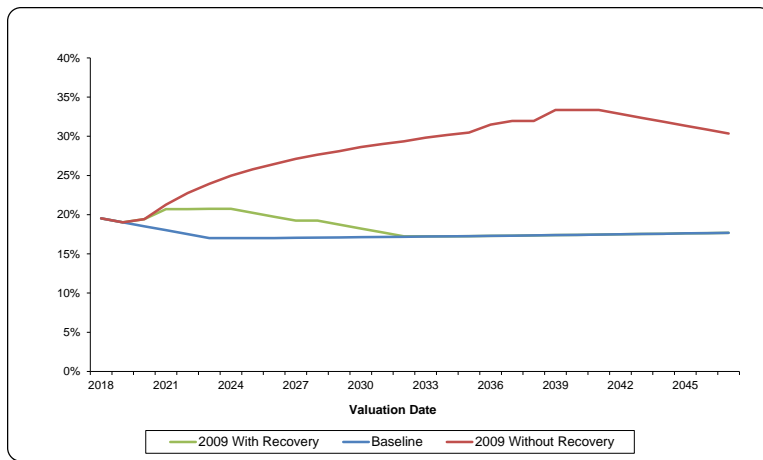
The green line shows how the assumed recovery in the financial markets offsets much of the impact of the negative 16.27% return in FY 2019. This is due to the strong double digit returns in 5 of the 9 years following the shock.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Sheriffs and Deputies – Required Contribution Rate



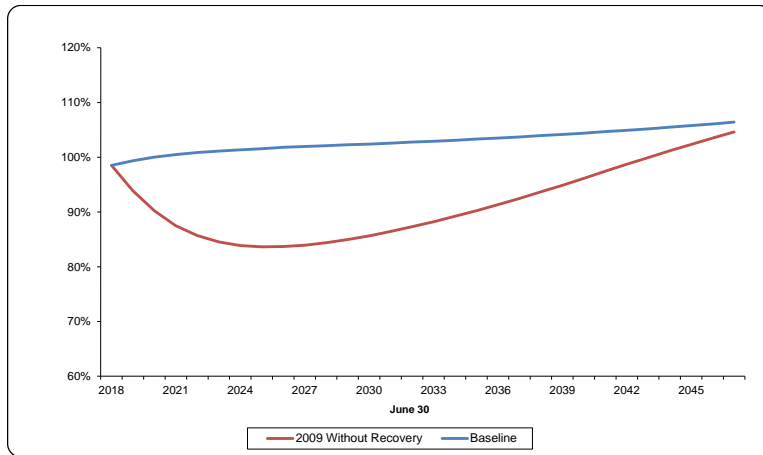
In the section discussing the Asset Volatility Ratio, it was noted that the value for the Sheriffs and Deputies is comparatively higher. The impact of this metric can be observed in this graph. Compared to the Regular Membership, the increase in the contribution rate is proportionately much higher for the same investment returns, reflecting that there is less payroll over which the asset loss can be recouped.



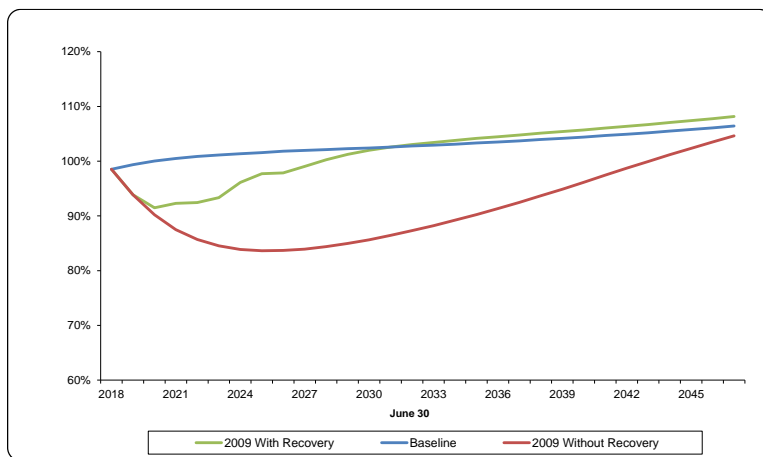
In the scenario reflecting no recovery, the initial shock forces contribution rates to increase significantly. When the recovery is assumed, the contribution rate increases modestly, but do not come down until the system's funding returns to 95%, in keeping with the IPERS Contribution Rate Funding Policy.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Protection Occupation Membership – Funded Ratio



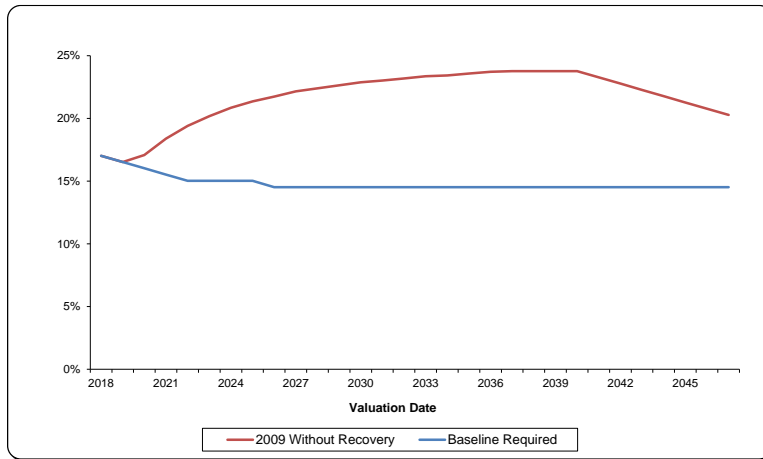
Once again, the Protection Occupation plan has significant similarities to the Sheriffs and Deputies plan. As was the case in the discussion of lower returns for the Sheriffs and Deputies group, the stronger funded ratio of this plan means that contributions are not anticipated to increase as much under the alternate scenario, so the crossover of the two lines occurs after the end of the projection period.



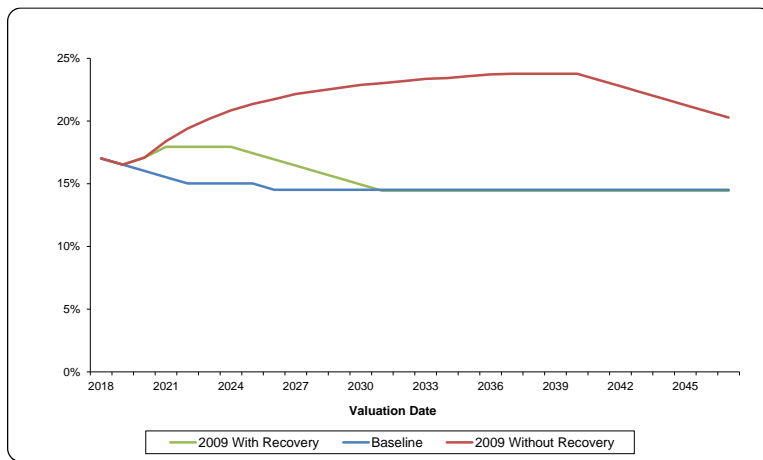
The green line shows how the assumed recovery in the financial markets offsets much of the impact of the negative 16.27% return in FY 2019. This is due to the strong double digit returns in 5 of the 9 years following the shock.

QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Protection Occupation Membership – Required Contribution Rate



The impact of the return on contribution rates for the Protection Occupation plan is between the other two groups. While the Asset Volatility Ratio is higher for Protection Occupation than Regular Membership, it also has a higher funded ratio.

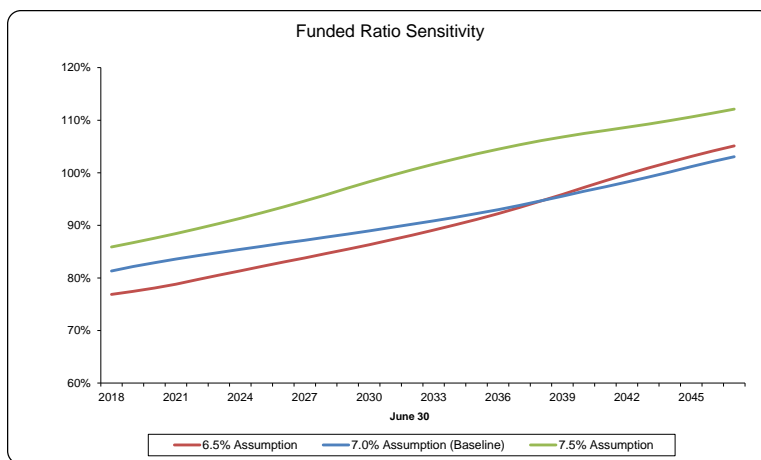


In the scenario reflecting no recovery, the initial shock forces contribution rates to increase significantly. When the recovery is assumed, the contribution rate increases modestly, but do not come down until the system's funding returns to 95%, in keeping with the IPERS Contribution Rate Funding Policy.

Sensitivity Analysis

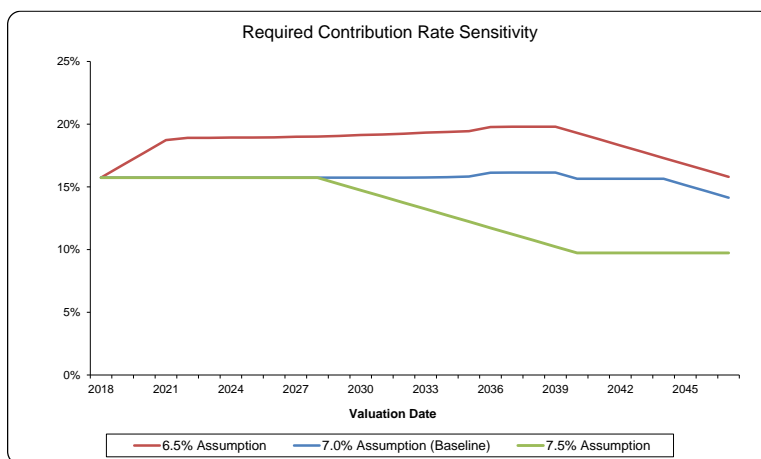
The valuation results are sensitive to the set of economic assumptions used to estimate the System's liabilities. In all scenarios considered thus far, the baseline results are those based on the assumption that all of the current actuarial assumptions (those used in the June 30, 2018 actuarial valuation) will be met in the future. To illustrate the sensitivity of the valuation results to different investment return assumptions, we have modeled the results if the investment return assumption is changed to 6.5% or 7.5%, with no other change in the set of economic assumptions. These illustrations further reflect that the assumed rate of return is actually earned in all years and that the Required Contribution Rate, as set using the current Contribution Rate Funding Policy, is actually contributed.

Regular Membership – Funded Ratio



As would be expected, the 7.5% assumption has the highest funded ratio, largely because the liabilities are the lowest and the assets grow at the highest rate. Conversely, the 6.5% assumption is the lowest until near the end of the period when both the 6.5% and 7.0% cases are around 100% funded.

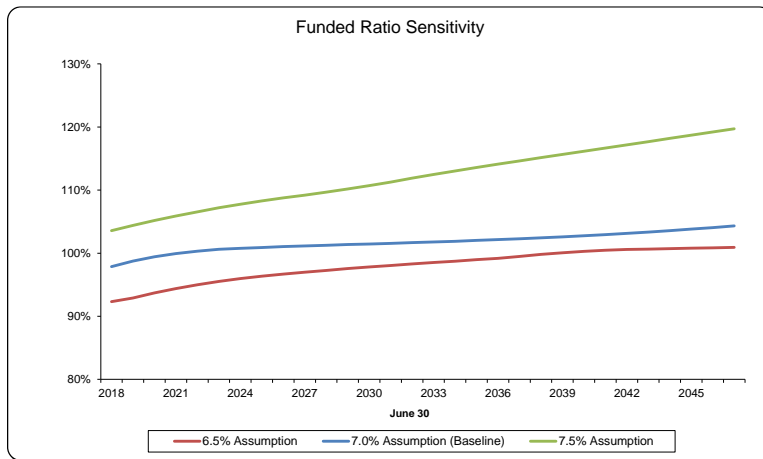
Regular Membership – Required Contribution Rate



The 6.5% assumption scenario requires contributions of about 3.5% more than the baseline scenario for much of this period. Once the amortization base for the assumption change is fully paid in 20 years, the contribution rate begins to gradually decline. Note that due to the Contribution Rate Funding Policy, there is no immediate contribution reduction under the 7.5% assumption scenario. Once the plan is at least 95% funded, the contribution rate declines systematically to the normal cost rate.

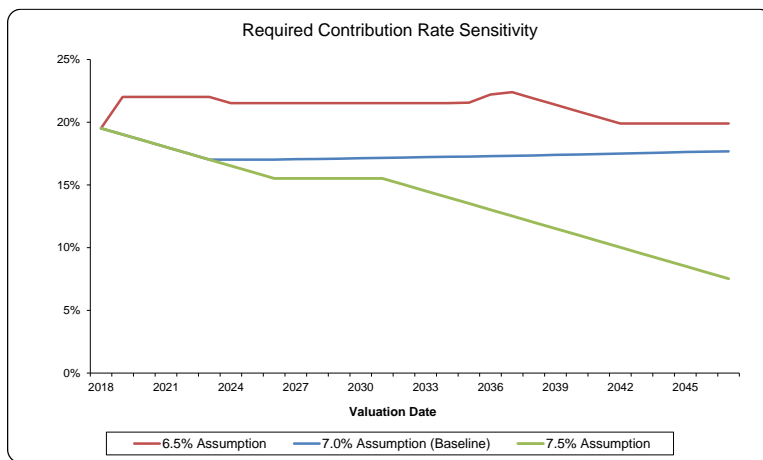
QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Sheriffs and Deputies Membership – Funded Ratio



As expected, both higher assumed and realized rates of return lead to funded ratios that are higher. The funded ratio under the 7.5% assumption scenario climbs significantly because contributions do not adjust immediately due to the Contribution Rate Funding Policy, resulting in higher contributions than are actuarially required in the initial period.

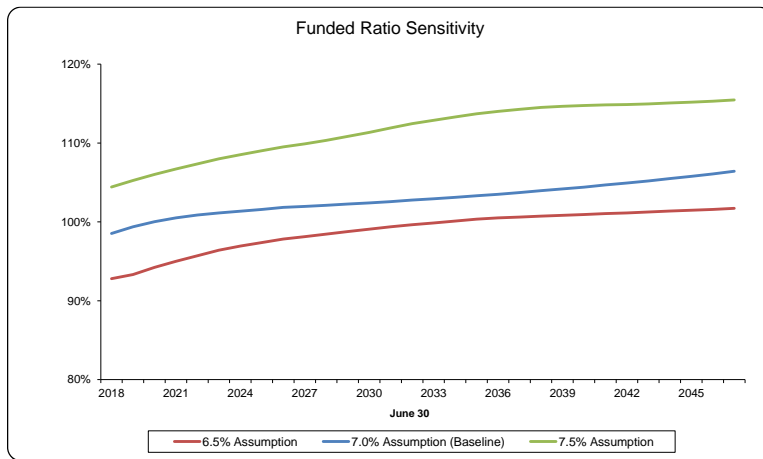
Sheriffs and Deputies – Required Contribution Rate



Under the 6.5% assumption scenario, contribution rates increase and then are relatively stable. Under the 7.0% assumption scenario, there is a decline because the Required Contribution Rates are currently larger than the actuarial contribution rate. With the 7.5% assumption scenario, contribution rates decline in accordance with the Contribution Rate Funding Policy because the funded level is well over 100%.

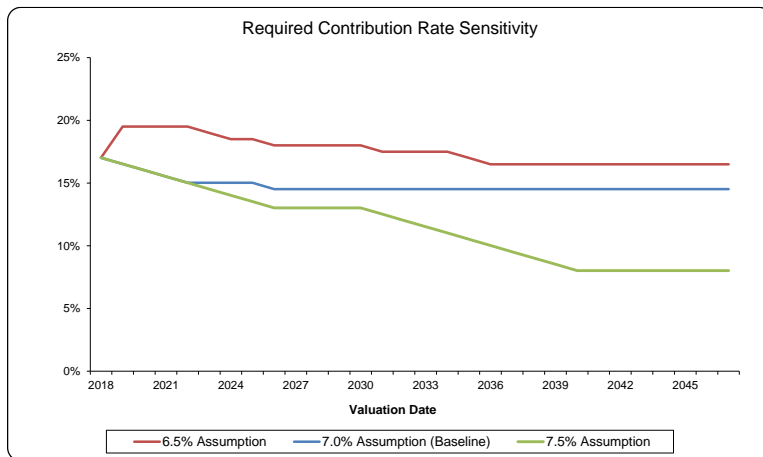
QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Protection Occupation Membership – Funded Ratio



As expected, both higher assumed and realized rates of return lead to funded ratios that are higher. The funded ratio under the 7.5% assumption climbs significantly because under the Contribution Rate Funding Policy contributions do not adjust immediately, resulting in higher contributions than are actuarially required in the initial period.

Protection Occupation Membership – Required Contribution Rate



Under the 6.5% assumption scenario, contribution rates increase and then gradually decline. Under the 7.0% assumption scenario, there is an initial decline because the Required Contribution Rate is currently larger than the actuarial contribution rate. With the 7.5% assumption scenario, contribution rates decline because the funded level is well over 100%.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

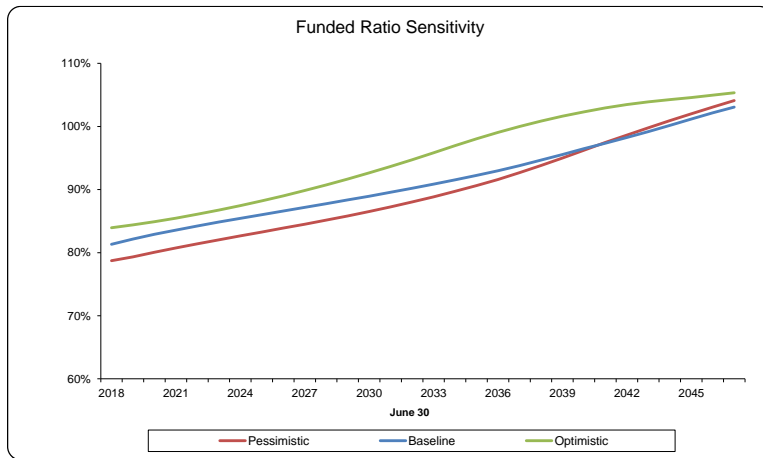
Comparing Different Sets of Economic Assumptions

Rather than just changing the investment return assumption, we can analyze the investment risk by changing the entire set of economic assumptions to represent an optimistic or pessimistic outcome, similar to the forecasting used by Social Security. As with the analysis of the impact of a change to the investment return assumption, we assume that all assumptions are met in the future for each scenario. For this purpose, the following assumption sets were studied:

Assumption	Baseline (Valuation)	Pessimistic	Optimistic
Inflation	2.6%	2.2%	3.0%
Investment Return	7.0%	6.6%	7.4%
Wage Growth	3.25%	2.60%	3.90%
COLA for pre-90 Retirees	2.6%	2.2%	3.0%
Interest on Member Accounts	3.5%	3.1%	3.9%
Active Membership Size	Level	Decrease 1% for 10 years, level thereafter	Increase 1% for 10 years, level thereafter

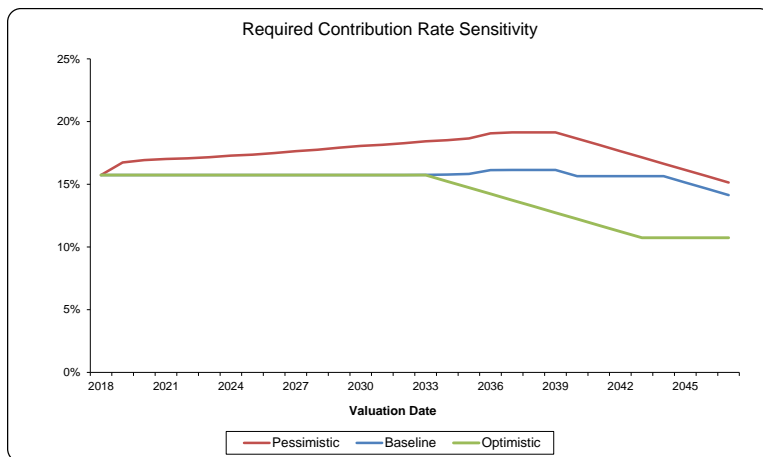
The following graphs show how these scenarios compare:

Regular Membership – Funded Ratio



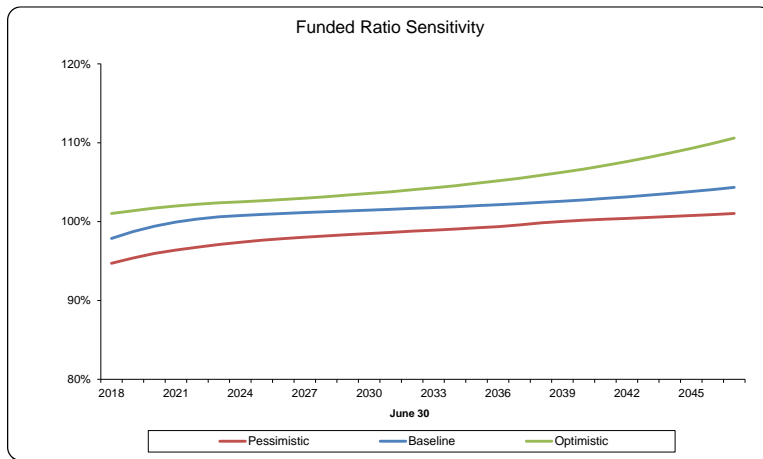
Because the IPERS funding policy is designed to drive funding toward 100%, all of the scenarios tend to move in that direction. As the next graph indicates, this is partly achieved by differences in the contribution rates.

Regular Membership – Required Contribution Rate



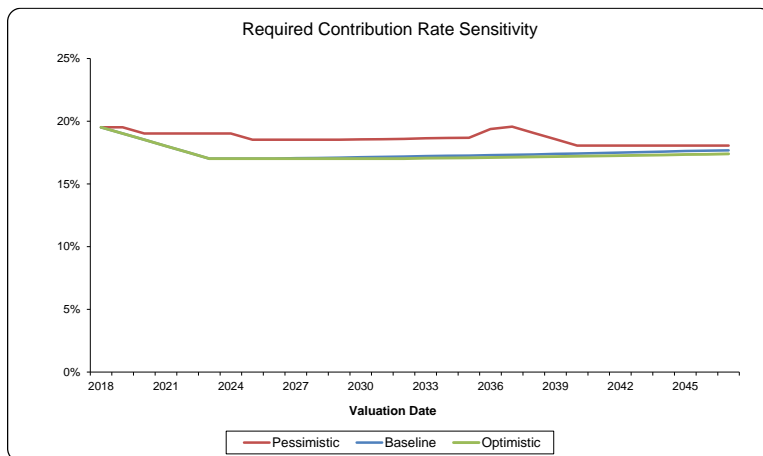
The pessimistic scenario requires total contributions of 2% to 3% more than the baseline for much of this period. Once the assumption change base is paid in 20 years, the contribution rate begins to gradually decline. Note that due to the Contribution Rate Funding Policy, there is no immediate contribution reduction under the optimistic scenario. Once the plan becomes better funded, the rate declines systematically to the normal cost rate.

Sheriffs and Deputies Membership – Funded Ratio



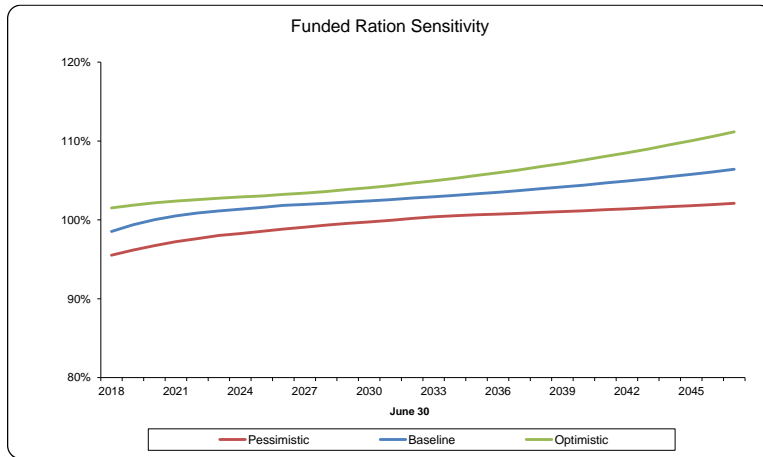
As expected, both higher assumed and realized rates of return lead to funded ratios that are higher. The funded ratio under the optimistic assumption climbs significantly because contribution rates do not adjust immediately, resulting in higher contributions than are actuarially required for the first several years.

Sheriffs and Deputies – Required Contribution Rate



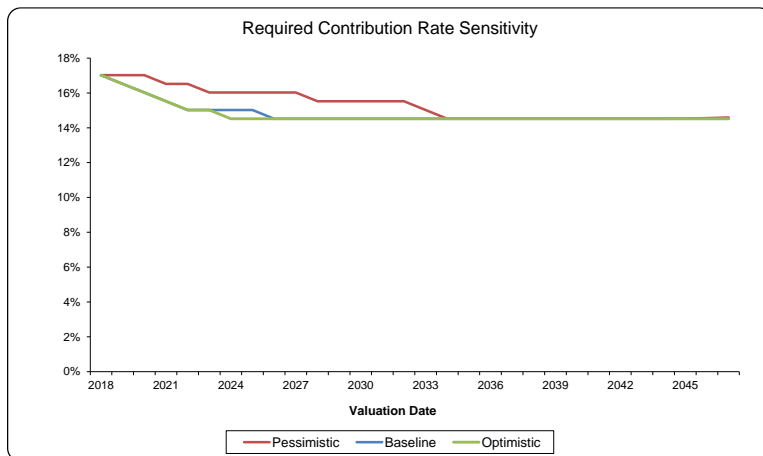
Under the pessimistic scenario, contribution rates are higher, but relatively stable. Under the baseline and optimistic scenarios, there is an initial decline because the Required Contribution Rate is currently larger than the actuarial contribution rate and deferred gains exist. Despite the fact the lines appear to be the same, there are small differences in the two contribution rates after 2027.

Protection Occupation Membership – Funded Ratio



As expected, both higher assumed and realized rates of return lead to funded ratios that are higher. Under the optimistic assumption set, the funded ratio climbs significantly because contribution rates do not adjust immediately under the Contribution Rate Funding Policy, resulting in higher contributions than are actuarially required for the first several years.

Protection Occupation Membership – Required Contribution Rate



Under the pessimistic scenario, contribution rates gradually decline. Under the baseline and optimistic scenarios, there are declines in the initial period because the Required Contribution Rate is currently higher than the actuarial requirements.

Another way to perform sensitivity analysis is to look at how results would unfold if the assumptions remain unchanged, but actual experience varies. Of course, in reality, the assumptions would eventually be updated to reflect actual experience, so this type of analysis is useful only when shorter periods of time are considered. In the following charts, rates of return from 5.0% to 8.0% are considered. The impact is shown using a “heat map” in which the results are color coded from green (most favorable) to red (least favorable) to help visually show trends.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Regular Membership

In this analysis, the current investment return assumption is not changed, but the impact of differing actual returns over the next ten years is studied.

	Funded Ratio at June 30 Valuation									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
5.00%	82%	82%	82%	81%	80%	80%	79%	78%	77%	77%
5.25%	82%	82%	82%	81%	81%	80%	80%	79%	78%	78%
5.50%	82%	82%	82%	82%	81%	81%	81%	80%	80%	79%
5.75%	82%	82%	82%	82%	82%	82%	81%	81%	81%	81%
6.00%	82%	82%	83%	83%	83%	82%	82%	82%	82%	82%
6.25%	82%	82%	83%	83%	83%	83%	83%	83%	83%	83%
6.50%	82%	83%	83%	83%	84%	84%	84%	84%	84%	85%
6.75%	82%	83%	83%	84%	84%	85%	85%	85%	86%	86%
7.00%	82%	83%	84%	84%	85%	85%	86%	87%	87%	88%
7.25%	82%	83%	84%	85%	85%	86%	87%	88%	89%	90%
7.50%	82%	83%	84%	85%	86%	87%	88%	89%	90%	91%
7.75%	82%	83%	84%	85%	87%	88%	89%	90%	92%	93%
8.00%	82%	83%	85%	86%	87%	89%	90%	92%	93%	95%

Note: the funded ratio reflects the smoothed value of assets.

	Required Contribution Rate for Fiscal Year									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5.00%	15.77%	16.01%	16.29%	16.70%	17.18%	17.66%	18.24%	18.84%	19.43%	20.09%
5.25%	15.75%	15.96%	16.20%	16.56%	16.98%	17.40%	17.92%	18.47%	18.98%	19.57%
5.50%	15.74%	15.91%	16.11%	16.42%	16.79%	17.15%	17.60%	18.08%	18.53%	19.05%
5.75%	15.73%	15.86%	16.02%	16.28%	16.59%	16.89%	17.28%	17.69%	18.07%	18.52%
6.00%	15.73%	15.81%	15.93%	16.14%	16.39%	16.63%	16.95%	17.29%	17.60%	17.97%
6.25%	15.73%	15.76%	15.84%	16.00%	16.19%	16.37%	16.62%	16.88%	17.12%	17.42%
6.50%	15.73%	15.73%	15.74%	15.85%	15.99%	16.10%	16.29%	16.47%	16.64%	16.85%
6.75%	15.73%	15.73%	15.73%	15.73%	15.77%	15.82%	15.93%	16.05%	16.13%	16.27%
7.00%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%
7.25%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%
7.50%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%
7.75%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%
8.00%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.73%	15.23%

The results of both of these charts indicate a similar message. The yellow that predominates the left side of the charts indicates that the system is starting from a position that is comparatively in the middle of the outcomes. Higher returns lead to higher funded ratios and lower contributions, indicated by the green color in the lower right, while lower returns lead to lower funded ratios and higher contributions, as indicated in the red in the upper right. The more uniform coloring in the Required Contribution Rate chart also reflects how the IPERS Contribution Rate Funding Policy does not lower contribution rates until the funded ratio is strong.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Sheriffs and Deputies Membership

In this analysis, the current investment return assumption is not changed, but the impact of differing actual returns over the next ten years is studied.

	Funded Ratio at June 30 Valuation									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
5.00%	98%	98%	98%	97%	95%	94%	93%	91%	90%	88%
5.25%	98%	98%	98%	97%	96%	95%	94%	92%	91%	90%
5.50%	98%	98%	98%	97%	97%	96%	95%	93%	92%	91%
5.75%	98%	99%	98%	98%	97%	96%	96%	95%	94%	93%
6.00%	99%	99%	99%	98%	98%	97%	97%	96%	95%	94%
6.25%	99%	99%	99%	99%	99%	98%	98%	97%	97%	96%
6.50%	99%	99%	99%	99%	99%	99%	99%	98%	98%	97%
6.75%	99%	99%	100%	100%	100%	100%	100%	100%	99%	99%
7.00%	99%	99%	100%	100%	101%	101%	101%	101%	101%	101%
7.25%	99%	100%	100%	101%	101%	102%	102%	102%	103%	103%
7.50%	99%	100%	101%	101%	102%	103%	103%	104%	105%	105%
7.75%	99%	100%	101%	102%	103%	104%	104%	105%	106%	107%
8.00%	99%	100%	101%	102%	103%	104%	106%	107%	108%	110%

Note: the funded ratio reflects the smoothed value of assets.

	Required Contribution Rate for Fiscal Year									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5.00%	18.52%	18.02%	18.02%	18.28%	18.97%	19.73%	20.55%	21.50%	22.48%	23.51%
5.25%	18.52%	18.02%	18.02%	18.05%	18.65%	19.31%	20.03%	20.87%	21.73%	22.64%
5.50%	18.52%	18.02%	17.52%	17.85%	18.36%	18.93%	19.55%	20.27%	21.01%	21.79%
5.75%	18.52%	18.02%	17.52%	17.62%	18.04%	18.50%	19.01%	19.62%	20.24%	20.90%
6.00%	18.52%	18.02%	17.52%	17.52%	17.70%	18.06%	18.46%	18.95%	19.44%	19.97%
6.25%	18.52%	18.02%	17.52%	17.52%	17.52%	17.60%	17.89%	18.25%	18.62%	19.01%
6.50%	18.52%	18.02%	17.52%	17.02%	17.04%	17.20%	17.37%	17.60%	17.84%	18.10%
6.75%	18.52%	18.02%	17.52%	17.02%	17.02%	17.02%	17.02%	17.05%	17.07%	17.09%
7.00%	18.52%	18.02%	17.52%	17.02%	17.02%	17.02%	17.02%	17.05%	17.07%	17.09%
7.25%	18.52%	18.02%	17.52%	17.02%	17.02%	17.02%	17.02%	17.05%	17.07%	17.09%
7.50%	18.52%	18.02%	17.52%	17.02%	17.02%	17.02%	17.02%	17.05%	17.07%	17.09%
7.75%	18.52%	18.02%	17.52%	17.02%	17.02%	17.02%	17.02%	17.05%	17.07%	17.09%
8.00%	18.52%	18.02%	17.52%	17.02%	17.02%	17.02%	17.02%	17.05%	17.07%	17.09%

As with the Regular Membership, the funded ratio increases or decreases with rates of return that are higher or lower than the expected return of 7.00%. The Required Contribution Rate chart shows how the contribution rate is expected to decline over the next 10 years, even if actual returns are slightly below expected.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Protection Occupation Membership

In this analysis, the current investment return assumption is not changed, but the impact of differing actual returns over the next ten years is studied.

	Funded Ratio at June 30 Valuation									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
5.00%	99%	99%	98%	97%	96%	95%	93%	92%	91%	89%
5.25%	99%	99%	98%	98%	97%	95%	94%	93%	92%	91%
5.50%	99%	99%	99%	98%	97%	96%	95%	94%	93%	92%
5.75%	99%	99%	99%	98%	98%	97%	96%	95%	95%	94%
6.00%	99%	99%	99%	99%	99%	98%	97%	97%	96%	95%
6.25%	99%	100%	100%	99%	99%	99%	98%	98%	97%	97%
6.50%	99%	100%	100%	100%	100%	100%	99%	99%	99%	98%
6.75%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
7.00%	99%	100%	101%	101%	101%	101%	102%	102%	102%	102%
7.25%	99%	100%	101%	101%	102%	102%	103%	103%	104%	104%
7.50%	99%	100%	101%	102%	103%	103%	104%	105%	105%	106%
7.75%	100%	101%	101%	102%	103%	104%	105%	106%	107%	108%
8.00%	100%	101%	102%	103%	104%	105%	106%	108%	109%	110%

Note: the funded ratio reflects the smoothed value of assets.

	Required Contribution Rate for Fiscal Year									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5.00%	16.02%	15.52%	15.59%	15.84%	16.28%	16.79%	17.29%	17.95%	18.62%	19.32%
5.25%	16.02%	15.52%	15.52%	15.66%	16.04%	16.48%	16.90%	17.47%	18.05%	18.66%
5.50%	16.02%	15.52%	15.52%	15.52%	15.78%	16.15%	16.49%	16.97%	17.47%	17.98%
5.75%	16.02%	15.52%	15.52%	15.52%	15.52%	15.81%	16.06%	16.46%	16.87%	17.28%
6.00%	16.02%	15.52%	15.52%	15.52%	15.52%	15.52%	15.60%	15.91%	16.23%	16.55%
6.25%	16.02%	15.52%	15.52%	15.02%	15.02%	15.15%	15.23%	15.45%	15.67%	15.89%
6.50%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	15.02%	15.02%	15.03%	15.13%
6.75%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	14.52%	14.52%	14.52%	14.52%
7.00%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	14.52%	14.52%	14.52%	14.52%
7.25%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	14.52%	14.52%	14.52%	14.52%
7.50%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	14.52%	14.52%	14.52%	14.52%
7.75%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	14.52%	14.52%	14.52%	14.52%
8.00%	16.02%	15.52%	15.02%	15.02%	15.02%	15.02%	14.52%	14.52%	14.52%	14.52%

These charts are similar to those of the Sheriffs and Deputies group, reinforcing the concept that starting in a strong funded position helps reduce future downside risk concerns.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Variability of Returns – Stochastic Modeling

Deterministic modeling is helpful to compare different scenarios, which can lead to a better understanding of the funding dynamics of the system. Missing in this analysis is an understanding of the likelihood of various scenarios and the plausible range of outcomes from the anticipated volatility associated with the asset allocation. These issues are handled with the more robust approach of stochastic modeling, in which investment performance is varied, based on the expected distribution of portfolio returns. Rather than obtaining a single result, this approach develops the results for many plausible scenarios, so that the distribution of outcomes can be considered.

For this modeling, we generated 1,000 30-year scenarios based on the expected return and standard deviation of the IPERS' portfolio as disclosed in Wilshire's presentation in September, 2018 and assumed that each year's returns are independent. For each simulation, the asset, liabilities, actuarial contribution rate and required contribution rate were modeled for the next 30 years.

Probability of Low Funding Ratios

Because of issues such as asset liquidity and the ability to withstand severe market volatility, low funded ratios are a concern. Consequently, understanding the likelihood of the occurrence of a low funded ratio can be helpful to those responsible for the plan. The following tables show the probability of being below a given level at any point during the specified period.

	Regular Membership				
	Ratio <40%	Ratio <50%	Ratio <60%	Ratio <70%	Ratio <80%
2018 – 2023	0%	0%	2%	9%	40%
2018 – 2028	1%	3%	9%	21%	50%
2018 – 2033	2%	5%	14%	28%	54%

	Sheriffs and Deputies Membership				
	Ratio <40%	Ratio <50%	Ratio <60%	Ratio <70%	Ratio <80%
2018 – 2023	0%	0%	0%	1%	6%
2018 – 2028	0%	0%	2%	7%	18%
2018 – 2033	0%	1%	4%	13%	26%

	Protection Occupations Membership				
	Ratio <40%	Ratio <50%	Ratio <60%	Ratio <70%	Ratio <80%
2018 – 2023	0%	0%	0%	1%	6%
2018 – 2028	0%	0%	1%	7%	17%
2018 – 2033	0%	1%	3%	12%	25%

It is important to note that these are probabilities of the event occurring at any point during the period. There are scenarios in which the first few years may have low investment returns, leading to a low funded ratio (below 70%), but due to strong investment returns in later years and the extra contributions due to the low returns, the funding ratio after 10 or 15 years may be over 100%. Nonetheless, such scenarios would count in this table as an occurrence of a low funded ratio.



QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

In general, there is a less than 15% chance that the funded ratio of the Regular Membership will decline below 60% over the next 15 years, and about a 70% chance that it will not drop below 70%. However, it is about as likely as not that the funded ratio will dip below 80% in the next 15 years. The Special Service groups, in contrast have more than a 50% chance of staying above 90%, and about a 75% chance to stay over 80% funded.

Probability of High Contribution Rates

While the IPERS Contribution Rate Funding Policy is designed to fund the plans systematically, there is some chance that contribution rates will increase to a level that is deemed unaffordable by members and employers. The specific level at which this will occur is unknown, and may depend on additional factors that are not discussed here. The following tables indicate the probability that the total Required Contribution Rate (member and employer) exceeds a given threshold.

	Regular Membership				
	RCR>16%	RCR>17%	RCR>18%	RCR>19%	RCR>20%
2018 – 2023	54%	33%	20%	8%	0%
2018 – 2028	62%	49%	40%	32%	25%
2018 – 2033	66%	54%	47%	42%	38%

For comparison, the current Required Contribution Rate is 15.73%. Given, the volatility associated with the asset allocation, there is nearly a 50% chance that the Required Contribution Rate will exceed 18% over the next 15 years and almost a 40% chance it will exceed 20%.

	Sheriffs and Deputies Membership				
	RCR>20%	RCR>22%	RCR>24%	RCR>26%	RCR>28%
2018 – 2023	24%	13%	6%	2%	2%
2018 – 2028	43%	35%	27%	17%	17%
2018 – 2033	51%	45%	39%	28%	28%

For comparison, the current Required Contribution Rate is 19.52%. While there is a low probability the Required Contribution Rate will exceed 24% in the next five years, over the longer term (15 years) there is almost a 30% chance it will exceed 28%.

	Protection Occupations Membership				
	RCR>18%	RCR>20%	RCR>22%	RCR>24%	RCR>26%
2018 – 2023	17%	7%	3%	1%	1%
2018 – 2028	36%	26%	19%	12%	8%
2018 – 2033	45%	38%	29%	23%	19%

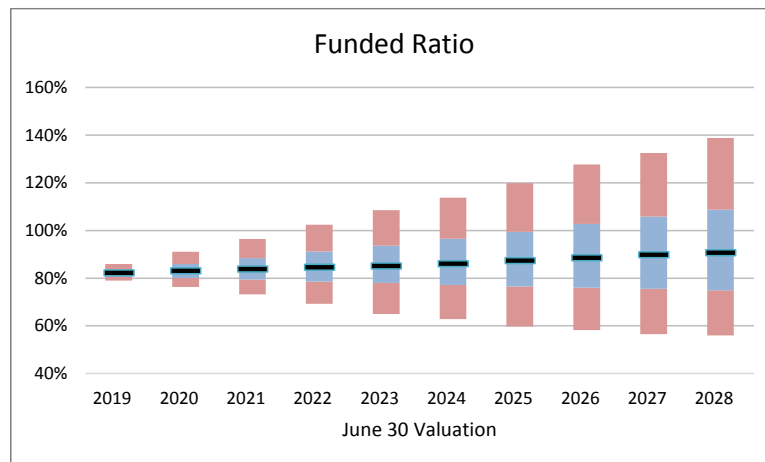
For comparison, the current Required Contribution Rate is 17.02%. Over the next five years, there is only a 3% chance the Required Contribution Rate will exceed 22% and a 1% probability that it exceeds 26%. However, over longer periods the probability increases and there is a 29% chance the Required Contribution Rate exceeds 22% and a 19% chance it exceeds 26% over the next 15 years.

As with the low funded ratio analysis, these probabilities are that the event happens any time during the period, even if a subsequent market recovery reduces the contribution rates below the threshold later in the period.

Distributions of Outcomes

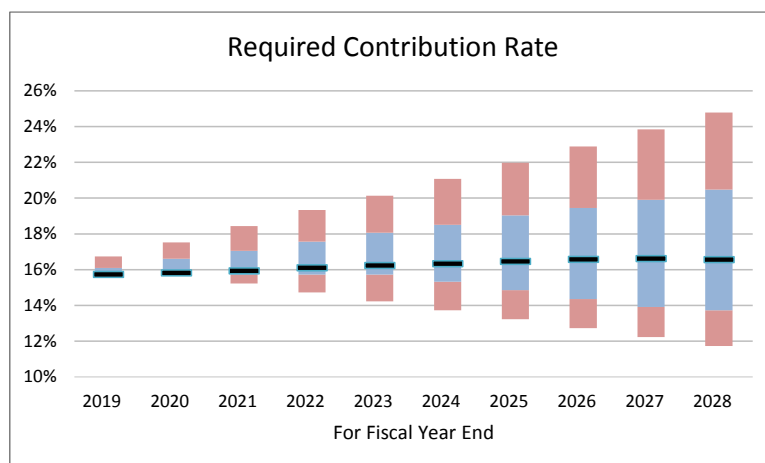
To this point, the discussion of stochastic modeling has focused on the probability of selected outcomes. It can also be useful to examine the distribution of outcomes for insight into the risk associated with investment returns. The following charts show the distribution for the next 10 years of the funded ratio and Required Contribution Rate results for each membership group. In each chart, the blue portion of the bar represents the range between the 25th and 75th percentiles, or the middle 50% of results. A black line in the middle of the blue portion indicates the median (50th percentile) result. The red portion of the bars extend to show the 5th and 95th percentiles.

Regular Membership – Funded Ratio



The median funded ratio tends to follow the pattern of the baseline deterministic scenario. This graph indicates that in 10 years, the middle 50% of possible outcomes are between 75% and 109% funded. There is a 5% chance of being more than 138% funded, and a 5% chance of being less than 56% funded. Of course, should these less likely events occur, changes would mostly likely be made, thus changing the results.

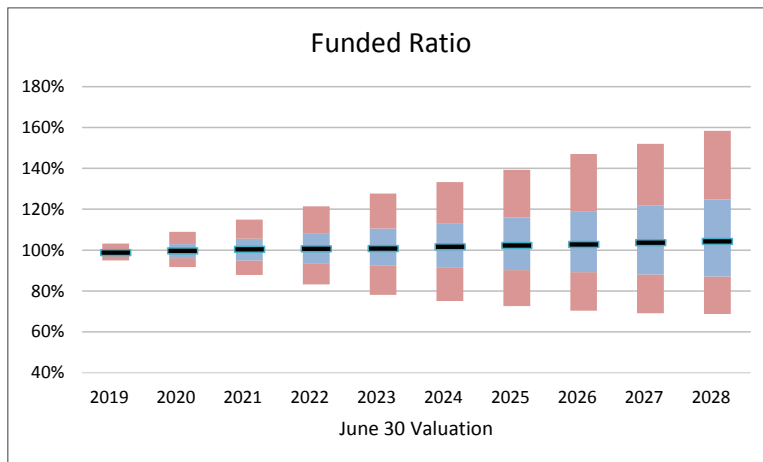
Regular Membership – Required Contribution Rate



As with the funded ratios, the range of outcomes is wide. It is important to remember, however, that if some of these more extreme events unfold, changes can be made, as they have been in the past, to mitigate the impact.

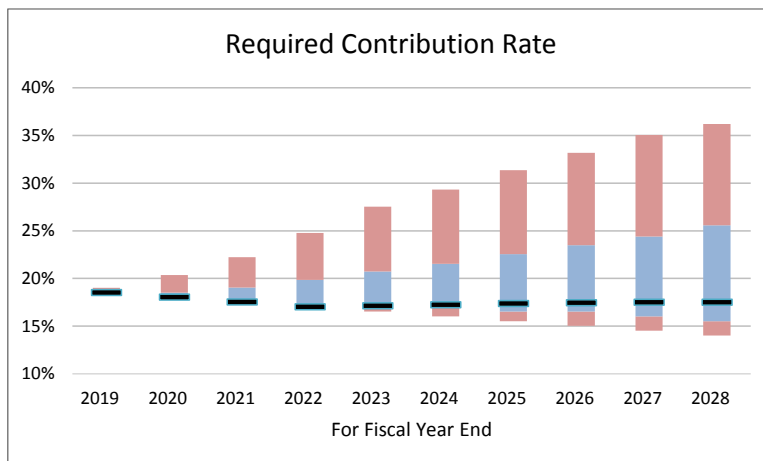
QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Sheriffs and Deputies Membership – Funded Ratio



As with the Regular Membership, there is a wide range of possible outcomes, an indication of the risk associated with investment returns.

Sheriffs and Deputies Membership – Required Contribution Rate

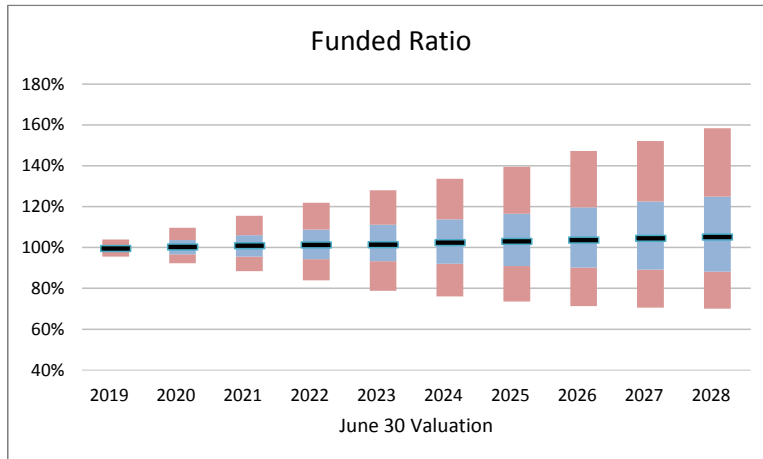


Because of the constraints in the Contribution Rate Funding Policy on when and how quickly contribution rates can be lowered, there is a 50% probability that rates will be between 14.5% and 17.5%. However, adverse events, and no annual cap on contribution increases like the Regular membership, have the potential to significantly increase contribution rates.



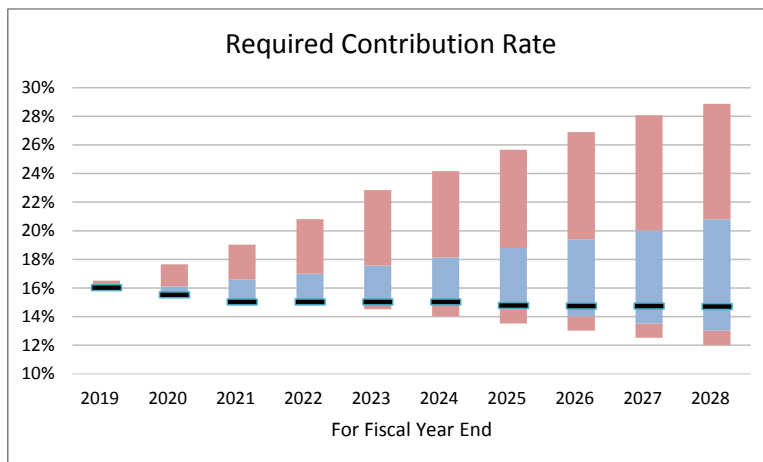
QUANTITATIVE ANALYSIS – ECONOMIC ASSUMPTIONS

Protection Occupation Membership – Funded Ratio



As with many other measures, the Protection Occupation group has similar risk considerations as the Sheriffs and Deputies group.

Protection Occupation Membership – Required Contribution Rate



As with many other measures, the Protection Occupation group has similar risk considerations as the Sheriffs and Deputies group.