



Cavanaugh Macdonald
CONSULTING, LLC

The experience and dedication you deserve

Teachers Retirement Association of Minnesota

Review of Economic Assumptions

Prepared: November 6, 2017





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The experience and dedication you deserve

November 6, 2017

Board of Trustees
Teachers Retirement Association of Minnesota
60 Empire Drive, Suite 400
St. Paul, MN 55103

Dear Members of the Board:

It is a pleasure to submit this report of our review and analysis of the economic assumptions of the Teachers Retirement Association of Minnesota (TRA), reflecting data and observations through the October of 2017.

The purpose of this report is to present the results of our review of the set of economic assumptions used in the actuarial valuation. With the approval of the recommendations in this report from the Board and the Legislative Commission on Pensions and Retirement (LCPR) along with legislation adopting these changes, these assumptions would be used in the July 1, 2018 actuarial valuation.

We hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the principles prescribed by the Actuarial Standards Board (ASB) and the Code of Professional Conduct and Qualification Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries.

We further certify that the assumptions developed in this report satisfy ASB Standards of Practice, in particular, No. 27 (Selection of Economic Assumptions for Measuring Pension Obligations).

In addition, to the best of our knowledge and belief this study was performed in accordance with the requirements of Minnesota Statutes, Section 356.215, and the requirements of the Standards for Actuarial Work established by the State of Minnesota Legislative Commission on Pensions and Retirement (LCPR). We are available to answer any questions on the material contained in the report, or to provide explanations or further details as may be appropriate. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein. Also, we meet the requirements of "approved actuary" under Minnesota Statutes, Section 356.215, Subdivision 1, Paragraph (c).

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Board of Trustees
November 6, 2017
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We would like to acknowledge the help in the preparation of this investigation given by the TRA staff and the Minnesota State Board of Investment.

I, Patrice A. Beckham, F.S.A., am a member of the American Academy of Actuaries and a Fellow of the Society of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

I, Brent A. Banister, F.S.A., am a member of the American Academy of Actuaries and a Fellow of the Society of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Sincerely,

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

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

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

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



SECTION 1 - BOARD SUMMARY – COST IMPACT OF DEMOGRAPHIC ASSUMPTION CHANGES

Introduction

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. Actuarial valuations of TRA are prepared annually to determine the actuarial contribution rate required to fund the System on an actuarial reserve basis, i.e. the current assets plus future contributions, along with investment earnings will be sufficient to provide the benefits promised by the system. The valuation requires the use of certain assumptions with respect to the occurrence of future events, such as rates of death, termination of employment, retirement age, and salary changes to estimate the obligations of the system.

The basic purpose of an experience study is to determine whether the actuarial assumptions currently in use have adequately projected the actual emerging experience. This information, along with the professional judgment of system personnel and advisors, is used to evaluate the appropriateness of continued use of the current actuarial assumptions. When analyzing experience and assumptions, it is important to recognize that actual experience is reported in the short term while assumptions are intended to be long-term estimates of experience.

At the request of the Board of Trustees, Cavanaugh Macdonald Consulting, LLC (CMC), performed a study of the experience of the Teachers Retirement Association of Minnesota (TRA), for the period July 1, 2008 through June 30, 2014. That report was presented in 2015 and accepted by the Board. The economic assumptions, however, also require legislative adoption before implementation, but this had not yet occurred. Earlier in 2017, the Board requested an updated review of the economic assumptions. This report presents the results and recommendations of this new study. It is anticipated that the changes, if approved legislatively, will first be reflected in the July 1, 2018 actuarial valuation of the System.

These assumptions have been developed in accordance with generally recognized and accepted actuarial principles and practices that are consistent with the applicable Actuarial Standards of Practice adopted by the Actuarial Standards Board (ASB). While the recommended assumptions represent our best estimate of future experience, there are other reasonable assumption sets that could be supported by the results of this experience study. Those other sets of reasonable assumptions could produce liabilities and costs that are either higher or lower.

Our Philosophy

Similar to an actuarial valuation, the calculation of actual and expected experience is a fairly mechanical process, and differences between actuaries are generally minor. However, the setting of assumptions differs, as it is more art than science. In this report, we have recommended changes to certain assumptions. To explain our thought process, we offer a brief summary of our philosophy:

- **Don't Overreact:** When we see significant changes in experience, we generally do not adjust our rates to reflect the entire difference. We will typically recommend rates somewhere between the old rates and the new experience. If the experience during the



SECTION 1 - BOARD SUMMARY – COST IMPACT OF DEMOGRAPHIC ASSUMPTION CHANGES

next study period shows the same result, we will probably recognize the trend at that point in time or at least move further in the direction of the observed experience. On the other hand, if experience returns closer to its prior level, we will not have overreacted, possibly causing volatility in the actuarial contribution rates.

- **Anticipate Trends:** If there is an identified trend that is expected to continue, we believe that this should be recognized. An example is the retiree mortality assumption. It is an established trend that people are living longer. Therefore, we believe the best estimate of liabilities in the valuation should reflect the expected increase in life expectancy.
- **Simplify:** In general, we attempt to identify which factors are significant and eliminate or ignore the ones that do not materially improve the accuracy of the liability projections.

Summary of Recommendations – Economic Assumptions

Economic assumptions are some of the most visible and significant assumptions used in the valuation process. The items in the broad economy modeled by these assumptions can be very volatile over short periods of time, as clearly seen in the economic downturn in 2008 followed by a rebound in many financial markets in the years following. Our goal is to try to find the emerging long-term trends in the midst of this volatility so that we can then apply reasonable long-term assumptions.

In our discussion with the Minnesota State Board of Investment, the entity who invests and manages TRA's assets, we understand that they are in the process of reviewing the portfolio asset allocation. If the results of their study result in significant changes in the portfolio composition or changes in economic assumptions, we may suggest that the recommendations in this study be reviewed as well.

Most of the economic assumptions we use are developed through a building-block approach. For example, the expected return on assets is based on the expectation for inflation plus the expected real return on assets. At the core of the economic assumptions is the inflation assumption. As we discuss later in the report, we are recommending a decrease in the inflation assumption to 2.50% from the current 3.00% assumption in place and the 2.75% assumption recommended in the last experience study. While some might argue that inflation will be even lower in the future, we believe this approach is consistent with the general economic outlook as well as our desire to avoid overreacting.

With the change in inflation, other economic assumptions that build upon it will also change. We are recommending that the expected return on assets (investment return assumption) be changed to 7.50%, reflecting the lower inflation assumption as well as a slightly lower anticipated real



SECTION 1 - BOARD SUMMARY – COST IMPACT OF DEMOGRAPHIC ASSUMPTION CHANGES

return. Likewise, we are recommending the payroll growth assumption be decreased to reflect the lower anticipated price inflation.

The following table summarizes the current and proposed economic assumptions:

	Current Assumptions*	Proposed Assumptions
Price Inflation	3.00%	2.50%
Long-term Investment Return	8.50%	7.50%
Wage inflation (above price inflation)	0.75%	0.35% for the next 10 years, 0.75% thereafter
Payroll Growth	3.50%	3.00%
Total Salary Increase	Varies with service	Adjusted by the changes in wage inflation

*Current assumptions are those being used in the July 1, 2017 valuation.

Although we have recommended a change in the set of economic assumptions, we recognize that there may be other sets of economic assumptions which are also reasonable for purposes of funding TRA. We would be happy to discuss this further with the TRA Board.

Summary of Recommendations

The following summarizes our recommendations, split between the entities responsible for approval:

We recommend that the Board adopt changes to the salary increase assumption and the payroll growth assumption as described above.

We recommend that the Legislature adopt a 7.50% investment return assumption, composed of a 2.50% inflation assumption and a 5.00% real rate of return.



SECTION 1 - BOARD SUMMARY – COST IMPACT OF DEMOGRAPHIC ASSUMPTION CHANGES

Financial Impact

The financial impact of the suggested changes was estimated by performing an additional valuation using the July 1, 2016 valuation data. The cost impact, illustrated in the table on the following page, is based on the July 1, 2016 valuation using the recommended set of assumptions outlined in this report.

When this set of assumptions is actually used, likely in the July 1, 2018 valuation, we expect the relative impact to be similar to the results shown here (as a percentage of the actuarial accrued liability and normal cost). However, the actual impact may vary due to underlying changes between valuation dates. Of particular note, the comparability may be affected by the actual investment return experience which in turn affects the anticipated date of the COLA changing from 2% to 2.5%, if that provision is still in place.

We would also note that for the Actuarial Contribution Rates shown, the amortization period has been extended one year to June 30, 2040 following our interpretation of Minnesota Statute 356.215 Subdivision 11. This is the result of blending the current 23-year amortization payment with a 30-year amortization of the liability change. When the new assumptions are actually implemented for the July 1, 2018 valuation, the remaining amortization period will be 21 years, so the increase in the amortization period may not be one year. The relative size of the UAAL at that time compared to the actual impact of the new assumptions on the UAAL will ultimately determine how long, if at all, the amortization period is extended.

Comparison of Valuation Results and Costs		
	7/1/16 Valuation Baseline	Assumption Changes
Actuarial Liability (\$M)	26,716	29,574
Actuarial Assets (\$M)	<u>20,194</u>	<u>20,194</u>
Unfunded Actuarial Accrued Liability (UAAL) (\$M)	6,522	9,380
Normal Cost Rate	8.79%	10.67%
UAAL Amortization Rate	9.70%	13.17%
Expense Rate	<u>0.23%</u>	<u>0.23%</u>
Total Actuarial Rate	18.72%	24.07%
Statutory Contribution Rate	15.94%	15.94%
Sufficiency/(Deficiency)	(2.78%)	(8.13%)
Expected COLA Increase Year	N/A	N/A

Numbers may not add due to rounding.



SECTION 2 – ECONOMIC ASSUMPTIONS

Economic assumptions include the long-term investment return (net of investment expenses), price inflation, and wage inflation (the across-the-board portion of individual salary increases). The merit salary scale is actually a demographic assumption, but it is being discussed with the economic assumptions because the total salary increase assumption applied to individual members includes the wage inflation assumption. Unlike demographic assumptions, economic assumptions do not lend themselves to analysis based heavily upon internal historical patterns, because both salary increases and investment return are influenced more by external forces which are difficult to accurately predict over the long term. The investment return and salary increase assumptions are generally selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for price inflation (called the building block approach).

Sources of data considered in the analysis and selection of the economic assumptions included:

- Historical observations of price and wage inflation statistics and investment returns
- 2017 Social Security Trustees Report
- Future return expectations of the State Board of Investments (SBI), and their consultants
- 2017 Horizon Actuarial Services Survey of Capital Market Assumptions
- U. S. Department of the Treasury bond rates
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators.

Guidance regarding the selection of economic assumptions for measuring pension obligations is provided by Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. Because no one knows what the future holds, the best an actuary can do is to use professional judgment to estimate possible future economic outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment.

ACTUARIAL STANDARD OF PRACTICE NUMBER 27

Actuarial Standards of Practice are issued by the Actuarial Standards Board to provide guidance to actuaries with respect to certain aspects of performing actuarial work. As mentioned earlier, Actuarial Standard of Practice Number 27 (ASOP 27) is the standard that addresses the selection of economic assumptions for measuring pension obligations. Therefore, our analysis of the expected rate of return, as well as other economic assumptions, was performed following the guidance in ASOP 27.

Due to the application of ASOP 27, it may be informative for others to be aware of the basic content of ASOP 27. The standard applies to the selection of economic assumptions to measure obligations under any defined benefit pension plan that is not a social insurance program (e.g., Social Security).

With respect to relevant data, the standard recommends the actuary review appropriate recent and long-term historical economic data, but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying environment. In addition, with respect to any particular valuation, the standard requires that each economic assumption be consistent with all other economic assumptions over the measurement period.



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ASOP 27 recognizes that economic data and analyses are available from a variety of sources, including representatives of the plan sponsor, investment advisors, economists, and other professionals. The actuary is permitted to incorporate the views of experts, but the selection or advice must reflect the actuary’s professional judgment. The standard calls for the actuary to select a “reasonable” assumption. For this purpose, an assumption is considered reasonable if it has the following characteristics:

- a. it is appropriate for the purpose of the measurement;
- b. it reflects the actuary’s professional judgment;
- c. it takes into account historical and current economic data that is relevant as of the measurement date;
- d. it reflects the actuary’s estimate of future experience, the actuary’s observation of the estimates inherent in market data, or a combination thereof; and
- e. it has no significant bias (i.e., it is neither significantly optimistic nor pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included.

The standard goes on to discuss a “range of reasonable assumptions” which in part states “the actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.”

The remaining section of this report will address the relevant types of economic assumptions used in the actuarial valuation to determine the obligations of the System. In our opinion, the economic assumptions proposed in this report have been developed in accordance with ASOP No. 27.

The following table summarizes the current and proposed economic assumptions:

	Prior Assumptions	Recommended Assumptions (2015 Experience Study)	Proposed Assumptions
Price Inflation	3.00%	2.75%	2.50%
Investment Return	8.50%	8.00%	7.50%
Wage Inflation	3.75%	3.50%	2.85%/3.25%
Payroll Growth	3.75%	3.50%	3.00%



SECTION 2 – ECONOMIC ASSUMPTIONS

Price Inflation

Use in the Valuation: Future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return, wage growth, payroll growth and individual salary increases.

The long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that the investor demands a more or less level “real return” – the excess of actual investment return over price inflation. If inflation rates are expected to be high, investment return rates are also expected to be high, while low inflation rates are expected to result in lower expected investment returns, at least in the long run.

The recommended assumption for price inflation in the 2015 experience study is 2.75% per year. The recommended set of economic assumptions has not been adopted by the legislature.

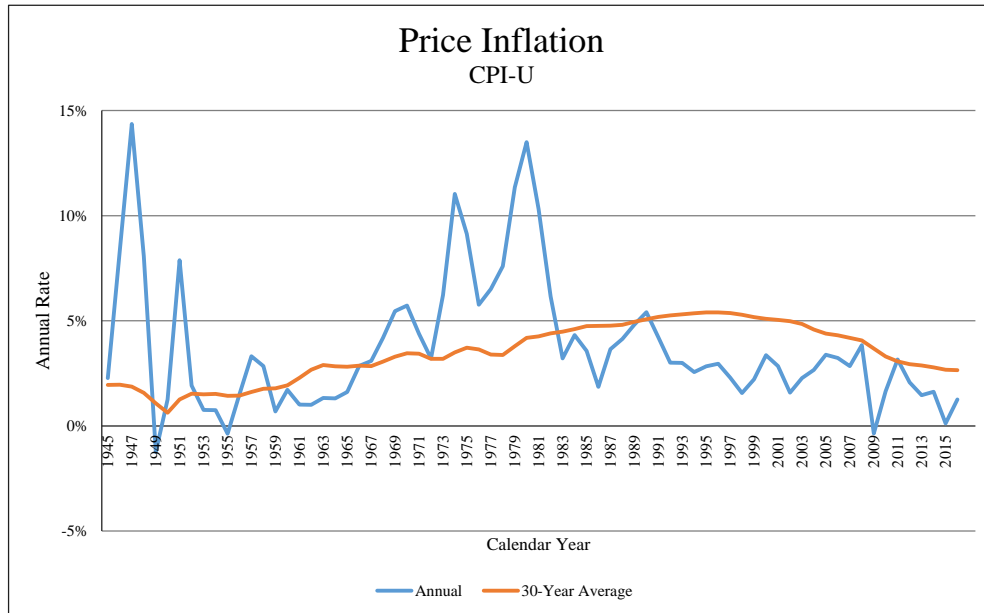
Past Experience: Although economic activities, in general, and inflation in particular, do not lend themselves to prediction solely on the basis of historical analysis, historical patterns and long-term trends are factors to be considered in developing the inflation assumption. The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The following table provides historical annualized rates and annual standard deviations of the CPI-U over periods ending December 31st.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2016	90	2.94%	3.83%
1956 – 2016	60	3.70	2.75
1966 – 2016	50	4.09	2.82
1976 – 2016	40	3.66	2.77
1986 – 2016	30	2.65	1.22
1996 – 2016	20	2.15	1.04
2006 - 2016	10	1.76	1.29

The following graph illustrates the historical annual change in price inflation, measured as of December 31 for each of the last 70 years, as well as the thirty-year rolling average.



SECTION 2 – ECONOMIC ASSUMPTIONS



Over more recent periods (last thirty years), the average annual rate of increase in the CPI-U has been 2.65% or lower. The period of high inflation from 1973 to 1981 has a significant impact on the averages over longer periods which include these rates, even impacting the average rate of 2.94% over the entire 90-year period. However, the volatility of the annual rates in more recent years has been noticeably lower as evidenced by the significantly lower annual standard deviations. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Fed since the early 1980’s to stabilize price inflation.

Implied Forecasts from the Bond Market

Additional information to consider in formulating this assumption is obtained from measuring the spread on Treasury Inflation Protected Securities (TIPS). The spread between the nominal yield on treasury securities (bonds) and the inflation indexed yield on TIPS of the same maturity is referred to as the “breakeven rate of inflation” and represents the bond market’s expectation of inflation over the period to maturity. The table below provides the calculation of the breakeven rate of inflation as of June 30, 2017.

Years to Maturity	Nominal Bond Yield	TIPS Yield	Breakeven Rate of Inflation
10	2.31%	0.58%	1.73%
20	2.61	0.84	1.77
30	2.84	0.99	1.85



SECTION 2 – ECONOMIC ASSUMPTIONS

As this data indicates, the bond market is anticipating low inflation of under 2% for both the short and long term. However, that expectation may be heavily influenced by the current low interest rate environment created by the Fed’s manipulation of the bond market. Whether price inflation returns to the higher rates observed historically and if so, when, remains to be seen.

Forecasts from the Social Security Administration

Although many economists forecast lower inflation than the assumption used by retirement plans, they are generally looking at a shorter time horizon than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the most recent report (July 2017), the projected average annual increase in the CPI over the next 75 years was estimated to be 2.6%, under the intermediate cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 2.00% to 3.20%.

Forecasts from Investment Consulting Firms and Other Professionals

In setting their capital market assumptions, most investment consulting firms use an inflation assumption. Horizon Actuarial Services, LLC publishes a survey of capital market assumptions obtained from various investment consultants. The 2017 Horizon Survey includes the assumptions, including the expected rate of inflation, for twelve advisors who develop longer-term assumptions (20 years or more). The Survey showed a range of expected inflation for the next 20 years, for these twelve consultants, of 2.2% to 2.8%, with a median of 2.5%.

The last asset/liability study for SBI was performed by Callan and Associates in 2015. In that analysis, they used an inflation assumption of 2.25% for a twenty-year period.

Another source to consider in setting this assumption is a quarterly survey of the Society of Professional Forecasters that is conducted by the Philadelphia Federal Reserve of economists. Their most recent forecast (third quarter of 2017) was for inflation over the next ten years (2017 to 2026) to average 2.25%.

Comparison of Inflation Expectations

The following table provides a comparison of the current levels of expected inflation.

Source	Expected Inflation
SBI’s Consultant (Callan)	2.25%
Horizon Survey	2.50%
Bond Market	1.85%
2017 SSA Trustees Report	2.60%
Survey of Professional Forecasters	2.25%



SECTION 2 – ECONOMIC ASSUMPTIONS

While actuarial standards caution against too much consideration of recent events, the lower inflation over the last 10, 20 and even 30 years, coupled with the low future inflation anticipated by the bond markets, investment consultants, and professional economic forecasters suggests that there may have been a fundamental change away from the longer term historical norms. Based on the information presented above, **we recommend the inflation assumption be set at 2.50%.**



SECTION 2 – ECONOMIC ASSUMPTIONS

INVESTMENT RETURN

Use in the Valuation: The investment return assumption reflects the anticipated returns on the current and future assets. It is one of the primary determinants in the allocation of the expected cost of the System’s benefits, providing a discount of the estimated future benefit payments to reflect the time value of money. It is also the most powerful assumption used in the valuation process with small changes producing significant changes to the liabilities and contribution rates. Generally, the investment return assumption is set with consideration of the asset allocation policy, expected long-term real rates of return on the specific asset classes, the underlying price inflation rate, and investment expenses.

The investment return assumption is set in state statute and the current provision reflects an assumed return of 8.00% per year through June 30, 2017 and 8.50% thereafter, net of all investment-related expenses. This approach is called a “select and ultimate rate of return.” Although the TRA Board may adopt a different investment return assumption, it is not effective until legislation is passed by the Legislature and signed by the Governor. Among other changes, the 2015 Experience Study recommended the investment return assumption be reduced to 8.0%, which the TRA Board adopted. However, legislation was not enacted with respect to the change, so the current statutory investment return remains the select rate of 8.0% for July 1, 2012 through June 30, 2017 and an ultimate rate of 8.5% thereafter. As of July 1, 2017, the five-year select period has expired so the effective assumption for the valuation is 8.5%.

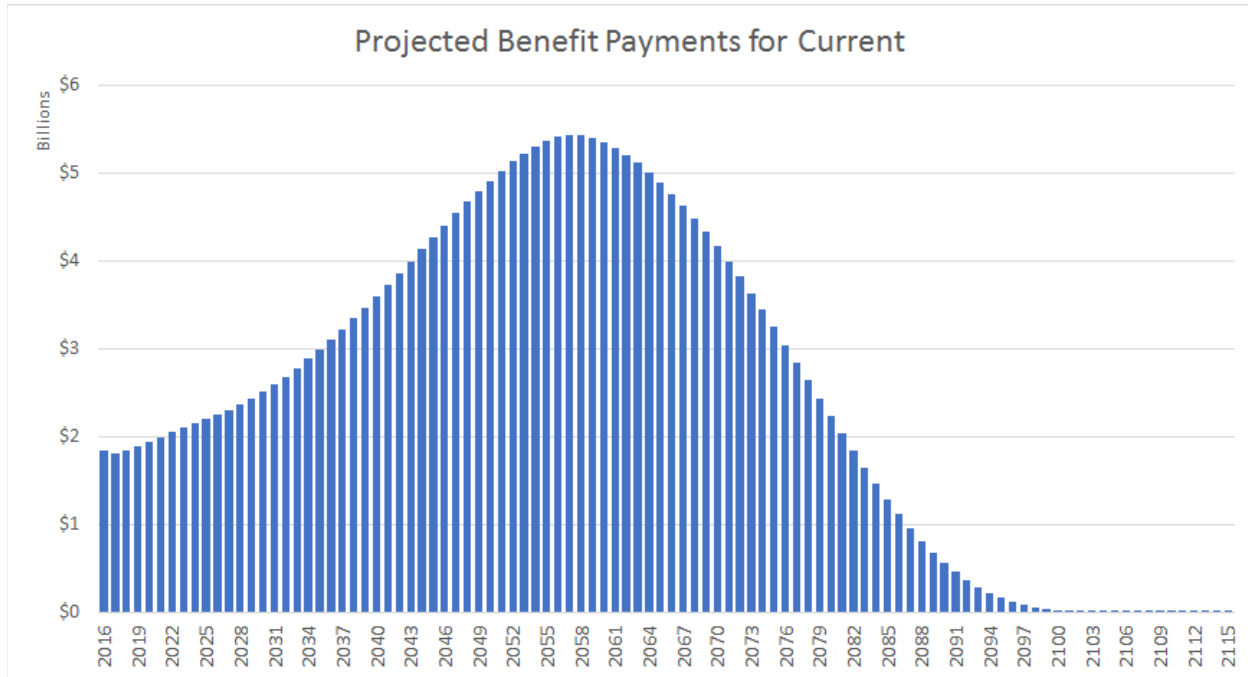
This investment return assumption is the nominal rate of return and is composed of two components. The first component is price inflation (previously discussed). Any excess return over price inflation is referred to as the real rate of return. The real rate of return, based on the current set of assumptions, not the assumption recommended in the last experience study, is 5.50% (the nominal return less 3.00% inflation). Our recommended assumption in the 2015 Experience Study reflected a real return of 5.25% and an inflation assumption of 2.75%.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider very long periods of time as some current employees will still be receiving benefit payments more than 80 years from now. For example, a newly-hired teacher who is 25 years old may work for 35 years, to age 60, and live another 25 years, to age 85. The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 25 years. During the entire 60-year period, the system is investing assets on behalf of the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received after the employee retires. In addition, in an open ongoing plan like TRA, the stream of benefit payments is continually increasing as new hires replace current members who leave covered employment due to death, termination of employment, and retirement. This difference in the time horizon used by actuaries and investment consultants is frequently a source of debate and confusion when setting economic assumptions. The following graph illustrates the long duration of the expected benefit payments for current members on July 1, 2016.



SECTION 2 – ECONOMIC ASSUMPTIONS



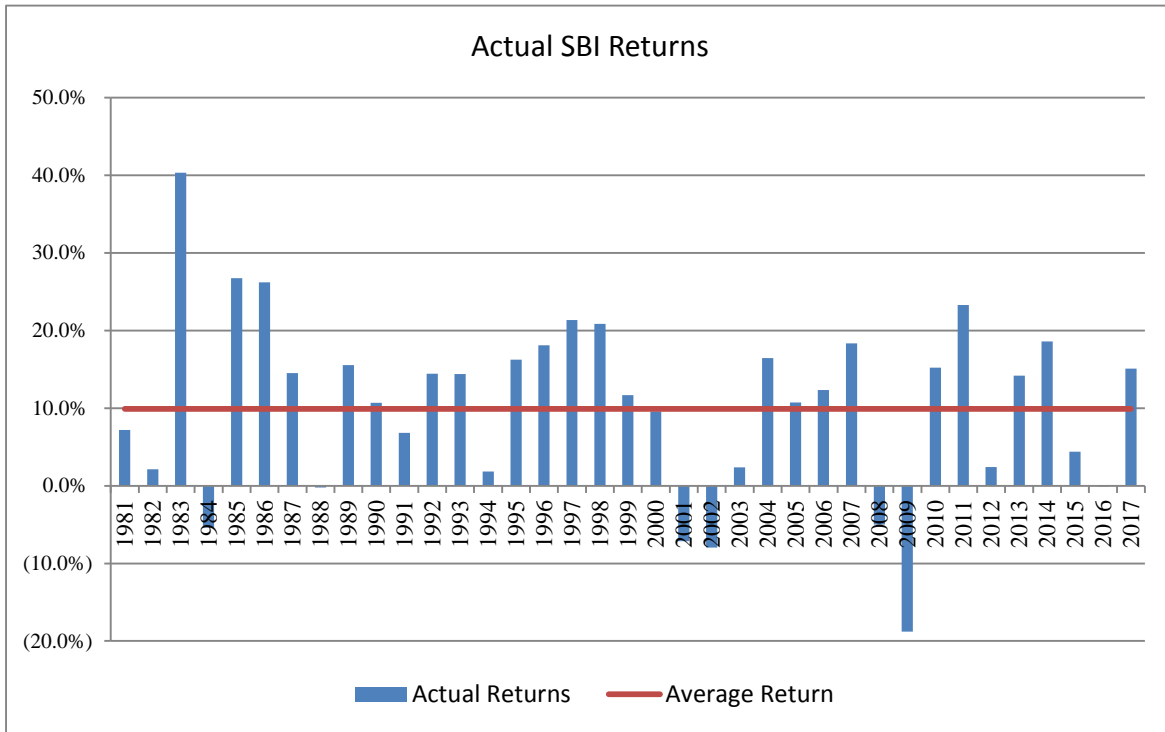
TRA Actual Investment Performance

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, the asset allocation can also impact the investment returns so comparing results over long periods when different asset allocations were in place may not be meaningful.

The following graph shows the actual fiscal year (June 30) net returns for the TRA portfolio for the last 37 years, ending June 30, 2017. The compound return over the entire 37-year period is 9.9%. The returns over various time frames are shown beneath the graph. The graph demonstrates the volatility of the returns – only four of the 37 returns are between 7.9% and 11.9%, while 19 are greater than 11.9% and 14 are less than 7.9%. This volatility makes direct analysis of the historical data challenging, since the same analysis performed in two consecutive years can be significantly affected – up or down - by a single year's return. Consequently, we are cautious in our consideration and use of the historical data.



SECTION 2 – ECONOMIC ASSUMPTIONS



ANNUALIZED RETURNS through 6/30/16			
1-Year Return:	15.1%	10-Year Return:	6.2%
3-Year Return:	6.3%	20-Year Return:	7.2%
5-Year Return:	10.2%	30-Year Return:	8.7%

Forward Looking Analysis

Using SBI Assumptions

TRA's assets are held and invested by the Minnesota State Board of Investment (SBI). This office employs investment professionals who make decisions regarding asset allocation, recognizing the long-term nature of the liabilities of the systems. Since ASOP 27 provides that the actuary may rely on outside experts, we believe it is appropriate to heavily weigh the market outlook and expectations provided by SBI. As part of their duties, SBI performed a comprehensive Asset/Liability Study in 2016 (prepared by Callan and Associates). The portfolio recommended in that study was estimated to have an expected return over the next ten years of 7.30%, assuming a 2.25% inflation assumption, i.e., a real return of 5.05%. The standard deviation of the portfolio was estimated to be 17.44%. SBI has not published updated capital market assumptions since that study was completed, so our analysis is based on the 2016 information.



SECTION 2 – ECONOMIC ASSUMPTIONS

SBI’s current target asset allocation, shown in the following table, was used in our analysis:

Asset Class	Target Allocation
Domestic Equities	39%
International Equities	19%
US Fixed Income	20%
Alternative Investments	20%
Cash	2%

Utilizing the statistical properties of the assumption, we can produce an expected range of real rates of return over a 50-year time horizon. Looking at one year’s results produces a median real return of 5.05% but also has a high standard deviation or measurement of volatility. By expanding the time horizon, the median return does not change much, but the volatility declines significantly. The table below provides a summary of results.

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	6.45%	17.44%	-19.62%	-5.87%	5.05%	17.24%	37.30%
5	5.33	7.68	-6.80	0.02	5.05	10.34	18.41
10	5.19	5.42	-3.48	1.47	5.05	8.76	14.33
20	5.12	3.83	-1.05	2.50	5.05	7.66	11.53
30	5.10	3.12	0.04	2.97	5.05	7.18	10.31
50	5.08	2.42	1.15	3.43	5.05	6.69	9.10

The percentile results are the percentage of random returns over the time span shown that are expected to be less than the amount indicated. Thus for the 10-year time span, 5% of the real rates of return will be below -3.48% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50-year time span, the results indicate a 25% chance that real returns will be below 3.43% and a 25% chance they will be above 6.69%. There is a 50% chance the real returns will be 5.05% or above and a 50% chance the real return will be below 5.05%.

We note that in the Asset/Liability Study, Callan indicated that they were considering a 10-year horizon, shorter than our long-term perspective. There is general consensus that shorter-term returns will be lower than longer-term returns since the current low interest rate environment is holding bond returns low.



SECTION 2 – ECONOMIC ASSUMPTIONS

Using Other Consultants’ Assumptions (Horizon Survey)

Many investment firms or investment consulting firms produce estimates of future asset returns, similar to the expected return analysis developed by SBI. While it might seem desirable to compare these estimates, there is a challenge to such effort. When SBI indicates what it believes its domestic equities will return, it does so in the context of knowing the construction of its domestic equities portfolio. Another investment consultant will likely have in mind a different blend of large versus small stocks or growth versus value equities. There are also comparison challenges in certain asset classes such as international stock (emerging or developed markets), bonds (duration and credit quality), and alternatives (a very broadly interpreted category). For this reason, we believe there is limited value in trying to compare the expected return developed by SBI with the assumptions of another group of investment professionals. Nonetheless, the alternative analysis using other consultants’ assumptions can still provide value as a general confirmation of the analysis performed by SBI and Callan.

Because the goal of this analysis is to corroborate the reasonableness of the SBI results, we consider sets of capital market assumptions resulting from a survey of investment advisors conducted by Horizon Actuarial Services in 2017. The survey looks at the 10-year horizon capital market assumptions for 35 investment advisors (including Callan). The survey also includes results of the 12 advisors who provide assumptions for a twenty-year (or longer) time frame. A summary of these distribution of expected real returns, under both sets of assumptions, are displayed in the following tables:

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5 th	25 th	50 th	75 th	95 th
Ten-Year Horizon Assumptions							
30	4.75	2.44	0.79	3.09	4.72	6.38	8.80
50	4.74	1.89	1.66	3.46	4.72	6.00	7.87
Twenty-Year Horizon Assumptions							
30	5.75	2.44	1.78%	4.09%	5.72%	7.37%	9.80%
50	5.73	1.89	2.66%	4.45%	5.72%	7.00%	8.87%

One item to note is that the expected return, using the 20-year assumptions, is 1% higher than the expected return using the short-term assumption (the next 10 years). While actuarial assumptions are set with the long term in mind, the magnitude of benefit payments in the next 10-15 years is large enough that the short term cannot be ignored. A long-term, real return estimate of 5.00% to 5.25% would not be inconsistent with this data.

Peer System Comparison

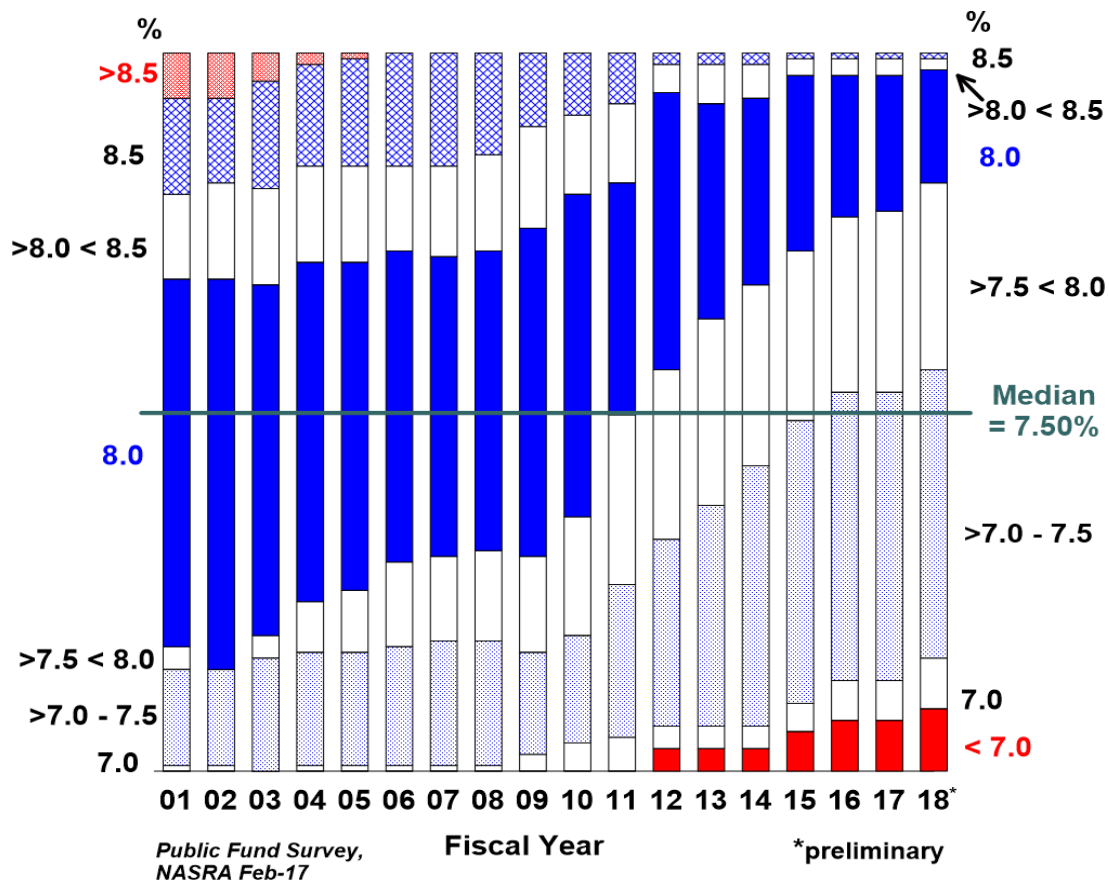
While we do not recommend the selection of an investment return assumption be based on the assumptions used by other systems, it does provide another set of relevant information to consider. It is informative to



SECTION 2 – ECONOMIC ASSUMPTIONS

evaluate where the investment return assumption for TRA is compared to its peer group. The following graph shows the change in the distribution of the investment return assumption from fiscal year 2001 through 2018 for the large public retirement systems included in the National Association of State Retirement Administrators (NASRA) Public Fund Survey. It is worth noting that the median investment return assumption in fiscal year 2012 dropped from 8.00% to 7.75%, and has now reached 7.50%. The assumed rate of return is heavily influenced by the asset allocation of the system. The average asset allocation for the systems in the Public Fund Survey is 2.9% cash, 51.2% equities, 22.5% fixed income, 8.8% real estate, and 14.5% alternative investments which has an impact on the expected return of the systems. Note that TRA is invested in a portfolio that differs significantly in that the equity allocation is 60% and the fixed income allocation is 18%, a somewhat more aggressive portfolio than the average system. As a result, it is reasonable to anticipate that the expected return for TRA could be higher than that of the median system.

The mean real rate of return (nominal return assumption less the inflation assumption) for these plans is 4.50%, which is significantly less than the real return of 5.25% in the last experience study (as noted above SBI's asset allocation also differs from the average system in the Survey). As the graph below indicates, we have witnessed a dramatic change in the investment return assumptions used by public plans over a relatively short timeframe. From 2001 to 2017, 136 of the 170 plans in the Public Fund Survey lowered their assumed rate of return and many systems are taking action to make additional reductions.



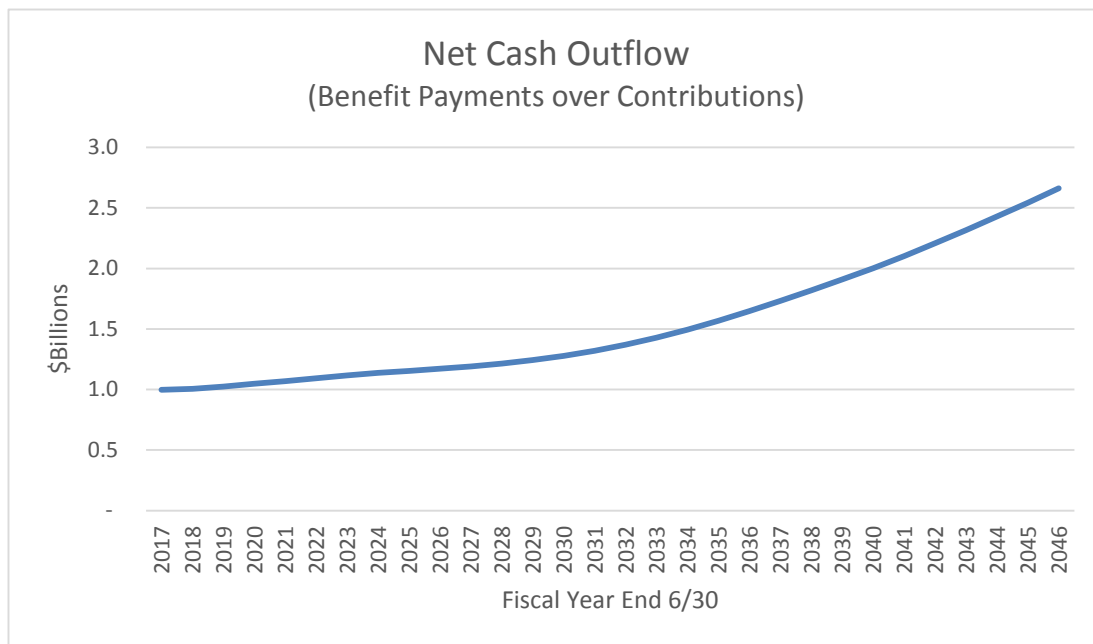


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Plan Dynamics

While TRA is expected to have an indefinite life span, it is a very mature retirement system with a significant portion of its total liability attributable to current retirees and beneficiaries. The July 1, 2016 valuation indicates that 64% of the \$26.7 billion actuarial accrued liability was attributable to members who are currently drawing a benefit from the system. Due to the Plan's maturity, we believe the investment return assumption should not ignore the short-term forecast.

Because of its maturity, TRA has significant negative cash flow due to benefit payments that far exceed the amount of contributions each year. This is to be expected in a mature plan since the whole reason assets were accumulated in prior years was to pay out benefits to retirees. For the year ended June 30, 2017, the negative cash flow was \$1.012 billion. This trend is expected to continue in the future, as shown in the graph below (based on the projection model created in conjunction with the July 1, 2016 valuation).



This situation has an impact when the return expectations are considerably lower in the short term than the longer term, as is currently the case (see earlier discussion). Essentially, there are fewer assets to be reinvested to earn the higher returns that occur in later years. Thus, the impact on the accumulation of trust fund assets is significant. For instance, the assumption summarized by Horizon have a short-term nominal (including inflation) return of 6.96% and a long-term nominal return of 8.16%. The compound return, *in the absence of external cash flows*, for the next 30 years is 7.76%. However, with the expected TRA cash flows, the asset value in 30 years with the Horizon assumptions is the same as if the portfolio earns 7.53% each year over that same period. Thus, the short-term assumptions need to be given more weight because of the plan dynamics.



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Finally, the Plan has been funded with fixed contribution rates and there are indications that the desire is to continue this funding approach. Without the ability for contribution rates to increase in future years to compensate for actual investment experience that is lower than expected by the assumption, we believe that it is prudent to include some conservatism in setting the investment return assumption.

Recommendation:

After reviewing all of the available information, **we recommend the 8.50% investment return assumption be lowered to 7.50%**, composed of an inflation assumption of 2.50% and a real rate of return of 5.00%.



SECTION 2 – ECONOMIC ASSUMPTIONS

WAGE INFLATION

Background: Wage inflation, thought of as the “across the board” rate of salary increases, is composed of the price inflation assumption combined with an assumption for the real rate of wage increases. In constructing the salary increase assumption, the wage inflation assumption is further combined with an assumption for service-based salary increases (called a merit scale). The service-based salary increase assumption is discussed later in this section of the report. The current assumption for the real rate of wage increase is 0.75%.

The excess of wage growth over price inflation represents the increase in the standard of living, also called productivity growth. There has been debate on the issue of whether public sector employees will receive, over the long term, the same rewards for productivity as employees in the private sector, where productivity is more readily measurable. To our knowledge, no definitive research has been completed on this topic. Nevertheless, it is our opinion that public sector employees will eventually be rewarded, even if there is a time lag, with the same or nearly the same productivity increases as those participating in the remainder of the economy.

The payment on the unfunded actuarial accrued liability is determined as a level percent of payroll. Therefore, the valuation requires an assumption regarding future annual increases in covered payroll. The wage inflation assumption is used for this purpose.

Historical Perspective: We have used statistics from the Social Security System on the National Average Wage back to 1951. Because the National Average Wage is based on all wage earners in the country, it can be influenced by the mix of jobs (full-time vs. part-time, manufacturing vs. service, etc.) as well as by changes in some segments of the workforce that are not seen in all segments (e.g. regional changes or growth in computer technology). Further, if compensation is shifted between wages and benefits, the wage index would not accurately reflect increases in total compensation. TRA’s membership is composed exclusively of teachers and administrators, living in Minnesota, whose wages and benefits are somewhat linked as a result of state funding of education. Because the competition for workers can, in the long term, extend across industries and geography, the broad national earnings growth will have some impact on TRA members. In the shorter term, however, the wage growth of TRA and the nation may be less correlated.

There are numerous ways to review this data. For consistency with our observations of CPI, the table below shows the compound annual rates of wage growth for various 10-year periods, and for longer periods ended in 2016 (most recent available data).

Decade	Wages
2006-2016	2.7%
1996-2006	4.1%
1986-1996	3.9%
1976-1986	6.9%
1966-1976	6.4%
1956-1966	3.5%

Period	Years	Wages
2006-2016	10	2.7%
1996-2016	20	3.4%
1986-2016	30	3.6%
1976-2016	40	4.4%
1966-2016	50	4.8%
1956-2016	60	4.6%



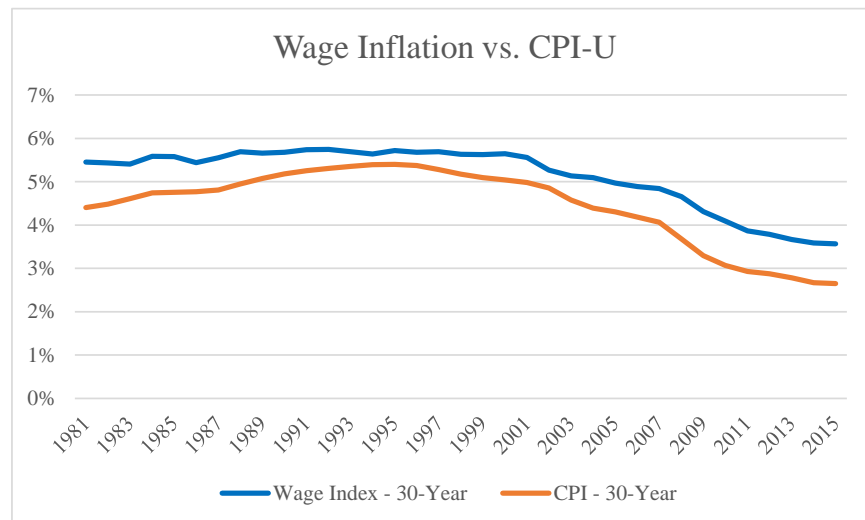
SECTION 2 – ECONOMIC ASSUMPTIONS

The excess of wage growth over price inflation represents the real wage inflation rate. Although real wage inflation has been very low in recent years, likely due to the recovery from the 2008 financial crisis, our focus must remain on the long term. The following table shows the compounded wage growth over various periods, along with the comparable price inflation rate for the same period. The differences represent the real wage inflation rate. The data for each year is documented in Exhibit 3.

Decade	General Wage Growth	CPI Incr.	Real Wage Inflation
2006-2016	2.8%	2.4%	0.4%
1996-2006	3.9%	2.4%	1.5%
1986-1996	4.3%	3.8%	0.5%
1976-1986	7.2%	8.4%	(1.2%)
1966-1976	5.6%	3.8%	1.8%
1956-1966	3.4%	1.4%	2.0%

Period	General Wage Growth	CPI Incr.	Real Wage Inflation
2006-2016	2.8%	2.4%	0.4%
1996-2016	3.4%	2.4%	1.0%
1986-2016	3.7%	2.9%	0.8%
1976-2016	4.5%	4.2%	0.3%
1966-2016	4.8%	4.1%	0.7%
1956-2016	4.5%	3.7%	0.8%

Similar information over rolling thirty year periods is shown in the following graph:



Actual TRA Historical Data

TRA supplied us with data that provides a measurement of average starting teacher salaries for the past 32 years. While the results may be somewhat influenced by the Minneapolis school district not being included in this data until recently, we nonetheless believe it provides a useful assessment of wage inflation for TRA members, particularly because the salaries of all levels of teachers tend to move together. For the period covered, the effective increase in starting salaries was 2.95% per year compared with 2.65% annual price inflation. This suggests that real wage inflation for Minnesota teachers has been approximately 0.30% during the same period that national real wage inflation, measured using the change in the National Average



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Wage Index, was approximately 0.8%. This general trend was also observed when analyzing the average teacher salary over the last 25 years in a study of national wages by state. In addition, an article a couple years ago in the Minneapolis Star Tribune discussed the same salary trend over the last decade, noting that although teacher pay has not kept pace with inflation, much of that is due to the increasing cost of health and pension benefits provided to Minnesota teachers. In other words, employee benefits have become a greater percentage of total compensation (salary plus benefit). Although this is quite insightful when reviewing the data over the recent past, the real question in setting this assumption is whether or not this trend will continue. In our opinion, it seems unlikely to continue for the next 30 to 50 years so we expect the real wage inflation rate to eventually revert back to more normal historical rates.

Social Security Forecast: The wage index we used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their projection analysis. In a report in July of 2017, the annual increase in the National Average Wage Index over the next 30 years under the intermediate cost assumption was 1.2% over price inflation. The range of the assumed real wage inflation in the 2017 Trustees report was 0.58% to 1.82% per year. While we give this some consideration, we also recognize that the Index reflects not only wage growth, but also such things as increased hours worked (which would not be applicable to salaried teachers) and changes in the types of jobs worked in the United States (again, not applicable to teachers).

Recommendation: Based on data available and our professional judgment, we believe that there is also a difference in the short-term and long-term expectations for real wage inflation. In the short term (next 10 years or so) we expect real wage inflation to be comparable to that observed in the recent past, perhaps around 0.30%, as we expect benefits to continue to comprise a larger portion of total compensation increases for public employees. Eventually, however, the wages and salary for educators will have to keep pace with the wage increases in the general economy and we expect to see the wage inflation revert back to longer term, historical levels, around 0.75%. **Our recommendation is to use a select and ultimate approach for this assumption reflecting a real wage inflation of 0.35% for ten years and 0.75% thereafter.**



SECTION 2 – ECONOMIC ASSUMPTIONS

PAYROLL GROWTH ASSUMPTION

The unfunded actuarial accrued liability for TRA is amortized using the level percent of payroll methodology. Under this approach, the dollar amounts of amortization payments increase in each future year with the expected increase in the plan’s covered payroll. Therefore, a specific payroll growth assumption is needed in order to determine the payment schedule for amortizing the unfunded actuarial accrued liability.

Total covered payroll may increase at a rate different from the average pay increase for individual members. When older, long-service members terminate, retire, become disabled or die, they are usually replaced with a new employee with a lower salary. This tends to result in lower growth in total payroll than the average pay increase for individual employees. In addition, the size of the group impacts the total payroll, i.e., an increase or decrease in the number of actives can impact total payroll growth.

The following table shows the average annual payroll growth for TRA, the average annual change in active membership, and the net payroll growth not due to membership growth.

Valuation Date	Count	Covered Payroll	Total Growth	Average Salary	Average Growth
2001	71,097	2,937,964,000		41,323	
2006	79,164*	3,707,901,000	4.8%	46,838	2.5%
2011	76,755	4,106,922,000	2.1%	53,507	2.7%
2016	80,530**	4,828,080,000	3.3%	59,954	2.3%

*Minneapolis merger

**Duluth merger

We propose continuing the assumption that no future growth or decline in the active membership will occur. With no assumed growth in membership, future salary growth due only to general wage increases is being anticipated. If increases should occur not only because of wage increases but also because of additional active members, there will be a larger pool of salaries over which to spread the unfunded actuarial accrued liability, which would result in lower UAAL payments as a percent of payroll.

We recommend the payroll growth assumption, used to amortize the UAAL, be changed to 3.0%, reflecting the lower wage inflation assumption.



SECTION 2 – ECONOMIC ASSUMPTIONS

TOTAL SALARY INCREASE

Estimates of future salaries are based on assumptions for two types of increases:

- Increases in each individual's salary due to promotion or longevity (often called a merit scale), and
- Increases in the general wage level of the membership, which are directly related to price and wage inflation.

Earlier in this report, we recommended a select and ultimate wage inflation assumption of 2.85% for ten years and 3.25% (2.50% inflation and 0.75% real wage growth) thereafter. The merit scale will be added to the wage inflation assumption to develop the total individual salary increase assumption.

Detailed analysis of the merit salary scale is beyond the scope of this study. In addition, because the merit scale was reviewed just two years ago, we do not have any reason to believe that a material change would be observable even if it was studied in-depth. Consequently, we are comfortable with retaining it. Because of the recommended change in the wage inflation assumption, the total salary scale will also be modified since the wage inflation assumption is one of the building blocks of that assumption.



SECTION 2 – ECONOMIC ASSUMPTIONS

Exhibit 1

U.S. Consumer Price Index

December of:	Index	Increase	December of:	Index	Increase
1928	17.1		1973	46.2	8.7%
1929	17.2	0.6 %	1974	51.9	12.3
1930	16.1	-6.4	1975	55.5	6.9
1931	14.6	-9.3	1976	58.2	4.9
1932	13.1	-10.3	1977	62.1	6.7
1933	13.2	0.8	1978	67.7	9.0
1934	13.4	1.5	1979	76.7	13.3
1935	13.8	3.0	1980	86.3	12.5
1936	14.0	1.4	1981	94.0	8.9
1937	14.4	2.9	1982	97.6	3.8
1938	14.0	-2.8	1983	101.3	3.8
1939	14.0	0.0	1984	105.3	3.9
1940	14.1	0.7	1985	109.3	3.8
1941	15.5	9.9	1986	110.5	1.1
1942	16.9	9.0	1987	115.4	4.4
1943	17.4	3.0	1988	120.5	4.4
1944	17.8	2.3	1989	126.1	4.6
1945	18.2	2.2	1990	133.8	6.1
1946	21.5	18.1	1991	137.9	3.1
1947	23.4	8.8	1992	141.9	2.9
1948	24.1	3.0	1993	145.8	2.7
1949	23.6	-2.1	1994	149.7	2.7
1950	25.0	5.9	1995	153.5	2.5
1951	26.5	6.0	1996	158.6	3.3
1952	26.7	0.8	1997	161.3	1.7
1953	26.9	0.7	1998	163.9	1.6
1954	26.7	-0.7	1999	168.3	2.7
1955	26.8	0.4	2000	174.0	3.4
1956	27.6	3.0	2001	176.7	1.6
1957	28.4	2.9	2002	180.9	2.4
1958	28.9	1.8	2003	184.3	1.9
1959	29.4	1.7	2004	190.3	3.3
1960	29.8	1.4	2005	196.8	3.4
1961	30.0	0.7	2006	201.8	2.5
1962	30.4	1.3	2007	210.0	4.1
1963	30.9	1.6	2008	210.2	0.1
1964	31.2	1.0	2009	215.9	2.7
1965	31.8	1.9	2010	219.2	1.5
1966	32.9	3.5	2011	225.7	3.0
1967	33.9	3.0	2012	229.6	1.7
1968	35.5	4.7	2013	233.0	1.5
1969	37.7	6.2	2014	234.8	0.8
1970	39.8	5.6	2015	236.5	0.7
1971	41.1	3.3	2016	241.4	2.1
1972	42.5	3.4			



SECTION 2 – ECONOMIC ASSUMPTIONS

Exhibit 2

National Average Wage Index

	Index	Increase		Index	Increase
1927	\$1,159.14				
1928	1,162.53	0.3%	1972	\$7,133.80	9.8%
1929	1,196.88	3.0	1973	7,580.16	6.3
1930	1,164.95	(2.7)	1974	8,030.76	5.9
1931	1,086.09	(6.8)	1975	8,630.92	7.5
1932	954.02	(12.2)	1976	9,226.48	6.9
1933	892.58	(6.4)	1977	9,779.44	6.0
1934	929.34	4.1	1978	10,556.03	7.9
1935	968.53	4.2	1979	11,479.46	8.7
1936	1,008.20	4.1	1980	12,513.46	9.0
1937	1,071.58	6.3	1981	13,773.10	10.1
1938	1,047.39	(2.3)	1982	14,531.34	5.5
1939	1,076.41	2.8	1983	15,239.24	4.9
1940	1,106.41	2.8	1984	16,135.07	5.9
1941	1,228.81	11.1	1985	16,822.51	4.3
1942	1,455.70	18.5	1986	17,321.82	3.0
1943	1,661.79	14.2	1987	18,426.51	6.4
1944	1,796.28	8.1	1988	19,334.04	4.9
1945	1,865.46	3.9	1989	20,099.55	4.0
1946	2,009.14	7.7	1990	21,027.98	4.6
1947	2,205.08	9.8	1991	21,811.60	3.7
1948	2,370.53	7.5	1992	22,935.42	5.2
1949	2,430.52	2.5	1993	23,132.67	0.9
1950	2,570.33	5.8	1994	23,753.53	2.7
1951	2,799.16	8.9	1995	24,705.66	4.0
1952	2,973.32	6.2	1996	25,913.90	4.9
1953	3,139.44	5.6	1997	27,426.00	5.8
1954	3,155.64	0.5	1998	28,861.44	5.2
1955	3,301.44	4.6	1999	30,469.84	5.6
1956	3,532.36	7.0	2000	32,154.82	5.5
1957	3,641.72	3.1	2001	32,921.92	2.4
1958	3,673.80	0.9	2002	33,252.09	1.0
1959	3,855.80	5.0	2003	34,064.95	2.4
1960	4,007.12	3.9	2004	35,648.55	4.6
1961	4,086.76	2.0	2005	36,952.94	3.7
1962	4,291.40	5.0	2006	38,651.41	4.6
1963	4,396.64	2.5	2007	40,405.48	4.5
1964	4,576.32	4.1	2008	41,334.97	2.3
1965	4,658.72	1.8	2009	40,711.61	-1.5
1966	4,938.36	6.0	2010	41,673.83	2.4
1967	5,213.44	5.6	2011	42,979.61	3.1
1968	5,571.76	6.9	2012	44,321.67	3.1
1969	5,893.76	5.8	2013	44,888.16	1.3
1970	6,186.24	5.0	2014	46,481.52	3.5
1971	6,497.08	5.0	2015	48,098.63	3.5



SECTION 2 – ECONOMIC ASSUMPTIONS

Exhibit 3

Annual Rates of Price and Wage Inflation

<u>Calendar Year Ends</u>	<u>National Wage Index</u>	<u>National Price CPI Index</u>	<u>National Implied Productivity Increase</u>
1985	4.3%	3.8%	0.5%
1986	3.0%	1.1%	1.8%
1987	6.4%	4.4%	2.0%
1988	4.9%	4.4%	0.5%
1989	4.0%	4.6%	-0.7%
1990	4.6%	6.1%	-1.5%
1991	3.7%	3.1%	0.7%
1992	5.2%	2.9%	2.3%
1993	0.9%	2.7%	-1.9%
1994	2.7%	2.7%	0.0%
1995	4.0%	2.5%	1.5%
1996	4.0%	3.3%	1.6%
1997	5.8%	1.7%	4.1%
1998	5.2%	1.6%	3.6%
1999	5.6%	2.7%	2.9%
2000	5.5%	3.4%	2.1%
2001	2.4%	1.5%	0.8%
2002	1.0%	2.4%	-1.4%
2003	2.4%	1.9%	0.6%
2004	4.6%	3.3%	1.4%
2005	3.7%	3.4%	0.3%
2006	4.6%	2.5%	2.1%
2007	4.5%	4.1%	0.4%
2008	2.3%	0.1%	2.2%
2009	-1.5%	2.7%	-4.2%
2010	2.4%	1.5%	0.9%
2011	3.1%	3.0%	0.1%
2012	3.1%	1.7%	1.4%
2013	1.3%	1.5%	-0.2%
2014	3.5%	0.8%	2.7%
2015	3.5%	0.7%	2.8%