Office of the State Actuary

"Securing tomorrow's pensions today."

August 31, 2010

Office of the State Actuary's

2010 Risk Assessment

Moving Beyond Expectations

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Office of the State Actuary

"Securing tomorrow's pensions today."

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About this Report

This report documents the Office of the State Actuary's (OSA) independent assessment of financial risks within Washington's state retirement systems. The seeds for this report were planted in 2009 when OSA conducted a pension "check-up" for the state retirement systems - examining their history, diagnosing their health, and commenting on their prognosis.

In September of 2009 OSA provided its report to the Pension Funding Council (PFC) on the financial condition of Washington's state retirement systems. The State Actuary found that the financial condition of the systems had deteriorated over the past decade. In messages to policy makers, he recommended a shift in focus to identifying, measuring, and managing retirement system risks.

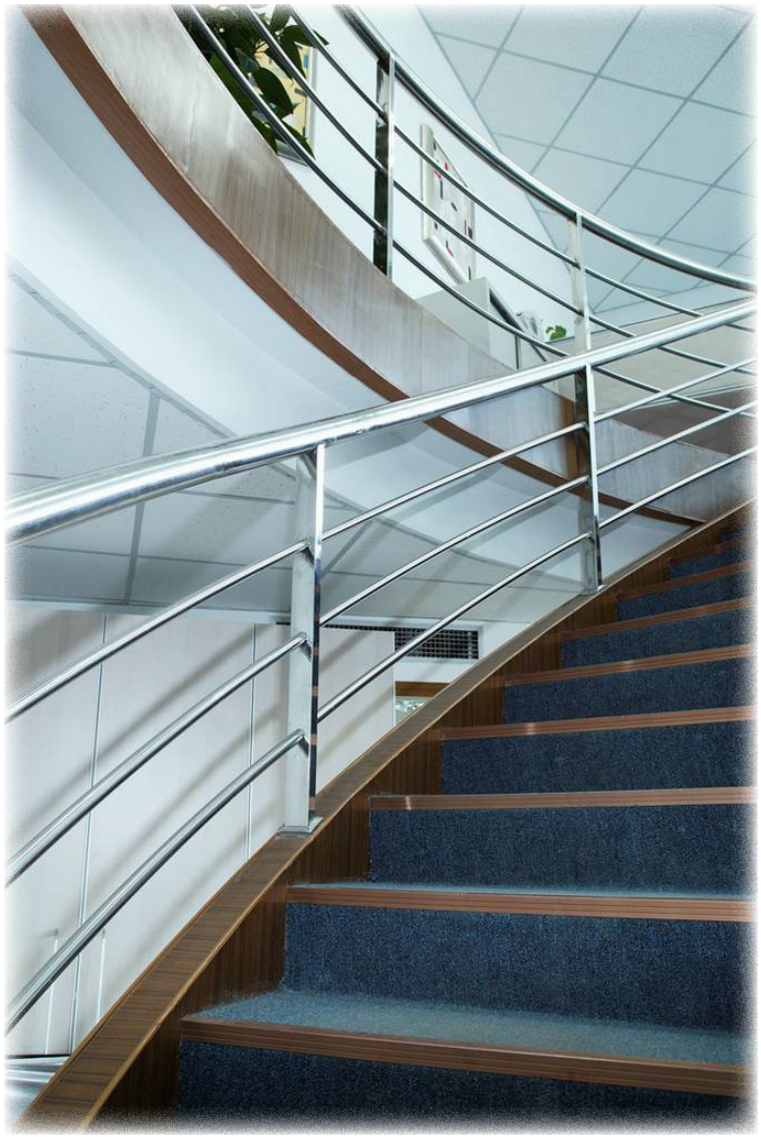
On a parallel track, the Select Committee on Pension Policy's (SCPP) Executive Committee determined in 2009 that managing the future health of the retirement systems was a top strategic priority. The Executive Committee asked that the SCPP receive results from a system-wide risk assessment conducted by the State Actuary. The State Actuary would report at an SCPP interim meeting in 2010.

This report was prepared for the SCPP and supports their strategic efforts to manage the future health of the retirement systems. It focuses on the identification, quantification, and analysis of financial risks. It uses expanded analysis, including a new risk model that can project a full range of possible future outcomes for every state-administered retirement plan. The model can also show how outcomes change as policies and events change. Policy makers can use this expanded analysis to develop strategies and manage retirement system risks in the future. We hope it will lead to improved risk management tools and support the on-going success and soundness of the state retirement systems.

Table of Contents

Appendices *(Continued)*

2010 Risk Assessment



Executive Summary

As governments look for ways to control and contain pension costs, a renewed interest in risk management is emerging as a way to gain increased efficiencies in the pension enterprise. OSA shares this interest.

To lay a strong foundation for managing financial risks in Washington's state-administered pension plans, we believed it was necessary to expand our analysis. The 2010 Risk Assessment is the first step in this undertaking. The results are documented in this report.

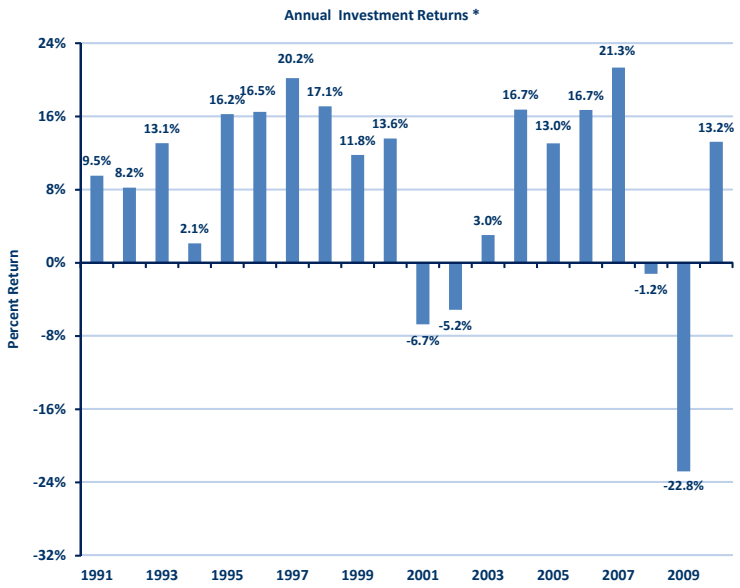
Yes, our report includes analysis, findings, and recommendations. However, a significant outcome from the risk assessment is that we now have tools to quantify the likelihood and magnitude of possible future outcomes for all of Washington's state-administered pension plans.

Does this mean we can predict the future? No. But we can now provide more complete information about financial risks, and we can more objectively evaluate how changes in policies or economic events might effect the future health of the plans.

Twenty-Year Look-Back

As the first step in our assessment, OSA reviewed twenty years of history in the area of investments, funding, and benefits. First, we observed that annual returns during the first decade of the twenty-year period looked very different than annual returns in the second, or most recent decade.

Figure ES.1



*Notes:

Fiscal year, time-weighted returns. Dollar-weighted returns vary by plan.

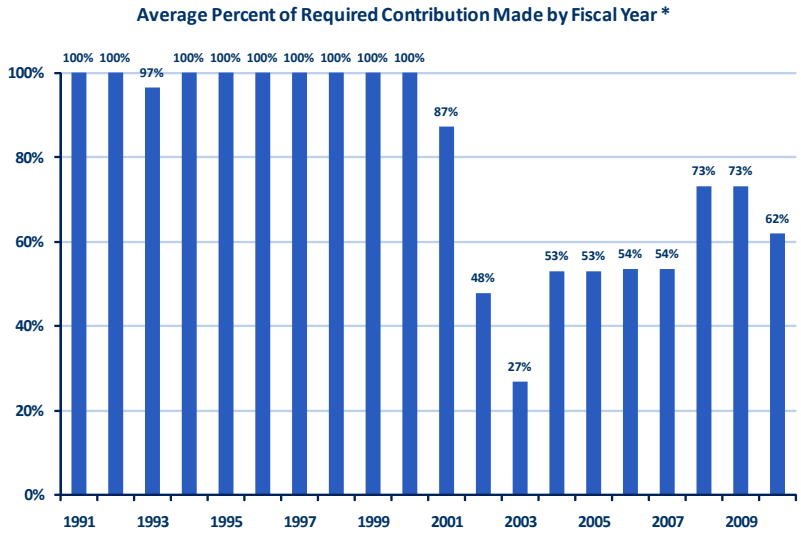
The Commingled Trust Fund (CTF) was created in 1993. Returns for 1993 and later are for the CTF as reported by WSIB. Returns prior to 1993 are total fund returns reported by the Department of Retirement Systems' Comprehensive Annual Financial Report.

We see in **Figure ES.1**, returns in the first decade of the period were quite strong. However in the second decade, annual returns decreased and were much more volatile. Still, the average annual return was 8.23 percent for the twenty-year period. Investment income was right on track, as it exceeded the expected long-term rate of return assumption of 8 percent per year.

There was a similar contrast between the two decades in the area of funding policy. During the first decade of the period, almost all actuarially required contributions were made. However the second or most recent decade was marked by underfunding.

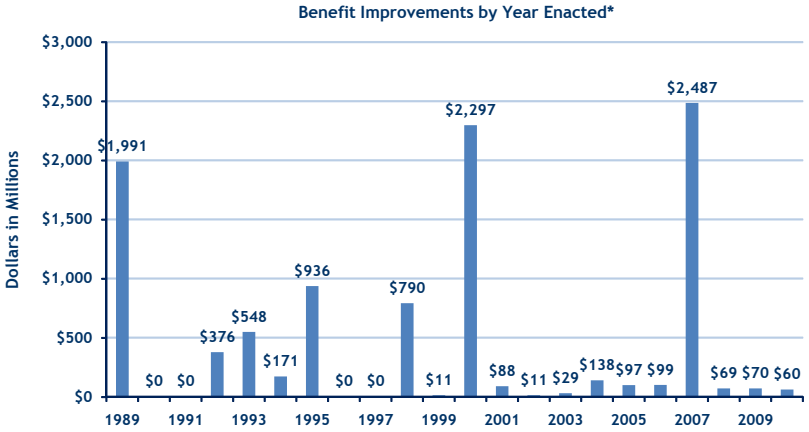
Meanwhile, benefit improvements added significant costs to the plans at the same time that underfunding was decreasing income to the plans. Over the past twenty years, benefits were routinely added, and occasionally, very large benefit improvements were granted.

Figure ES.2



*For PERS, TRS, and SERS combined.

Figure ES.3



Adjusted present value of liability increases in 2010 dollars based on an 8.0% discount rate. Excludes the following:

1) Impacts of Plan 3 gain-sharing prior to 2008 gain-sharing event.

2) Savings from repealing future gain-sharing (cost of future gain-sharing not recognized previously).

3) Benefit improvements where the fiscal note did not report the amount of the liability increase. This includes years showing zero liability increase.

Key to Benefit Spikes

1989 - Plan 1 Age 65 COLA after 40% loss of purchasing power from age 65.

1995 - Plan 1 Uniform COLA.

1998 - Plan 1 Gain-Sharing (excludes cost of future Plan 1 gain-sharing benefits).

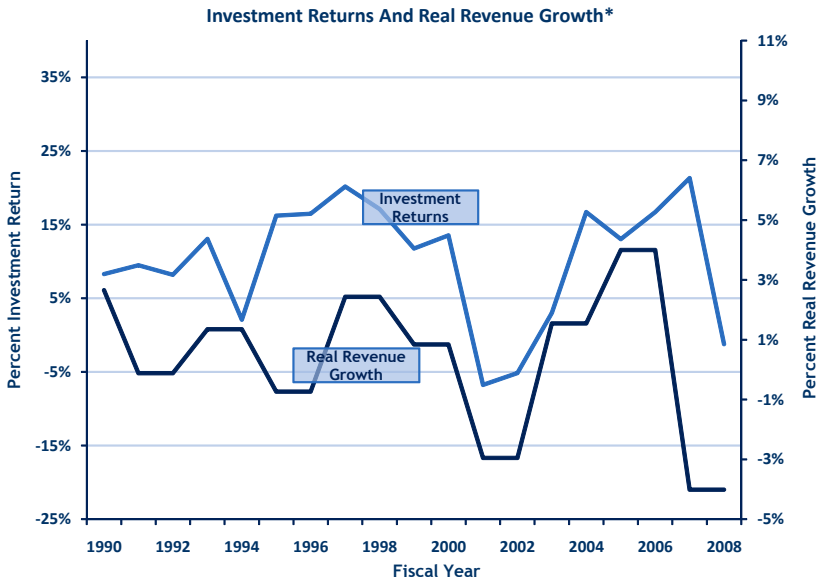
2000 - Plan 2/3 subsidized early retirement reduction factors with 30 years of service.

2007 - Gain-sharing replacement benefits.

And again, the contrast between the first decade and the second decade of the twenty-year period was evident when we observed the growth in state revenue. We saw that state revenue moved with investments. Real revenue growth,* like annual investment returns, was much more volatile in the second (most recent) decade of the twenty-year period.

** Note: Real revenue growth is revenue growth over and above inflation and population growth, also known as "productivity growth."*

Figure ES.4



**Real revenue growth is revenue growth over and above inflation and population growth. Complete data for the 2009-2011 Biennium was not available at the time of publication.*

Over the past twenty years, funding policy seemed to react to increased volatility. This was especially evident during the second decade of the period. We also observed that weak economic environments were correlated to weak investment returns. And lower investment returns created the need for increased contributions when employers and members could least afford them. We also observed that once contribution rates dropped below what was actuarially required, it was harder to increase them - even when investment returns and revenue growth improved.

Finally, in addition to these challenges, a continuing obligation from the past added even more costs to the pension systems. Legacy costs from PERS 1 and TRS 1 required additional employer contributions, and continue to do so today.

Possible Future Outcomes

We used risk modeling to explore what outcomes we could see in the future if these patterns or "past practices" continue. We built a new dynamic model with a stochastic (or probabilistic) component. While traditional actuarial analysis projects the future of pensions based on what is expected to occur, the new model moves beyond expectations. It projects a full range of possible fifty-year outcomes for pensions.

Output from the model allowed us to quantify the likelihood and magnitude of possible future outcomes. We used a variety of measures to quantify financial risks affecting state budgets, pension contribution rates, and the funded status of the plans. Our report focuses on total plan measures, but we also included plan-by-plan summaries in the Appendix.

Figure ES.5 is one example of how we summarized output from the model. This graph shows how continuing past practices could affect the percentage of General Fund-State dollars allocated to pensions in the future.

Figure ES.5

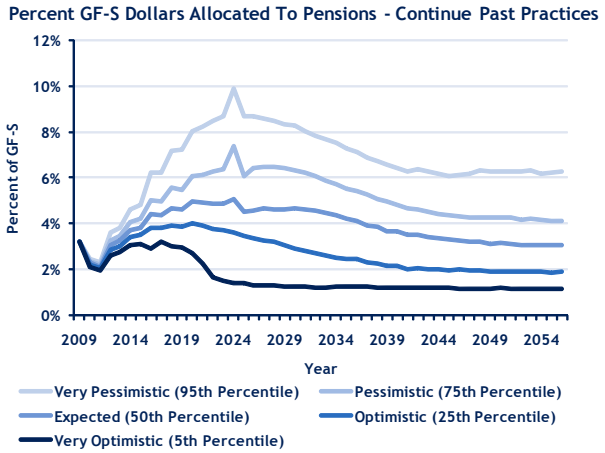
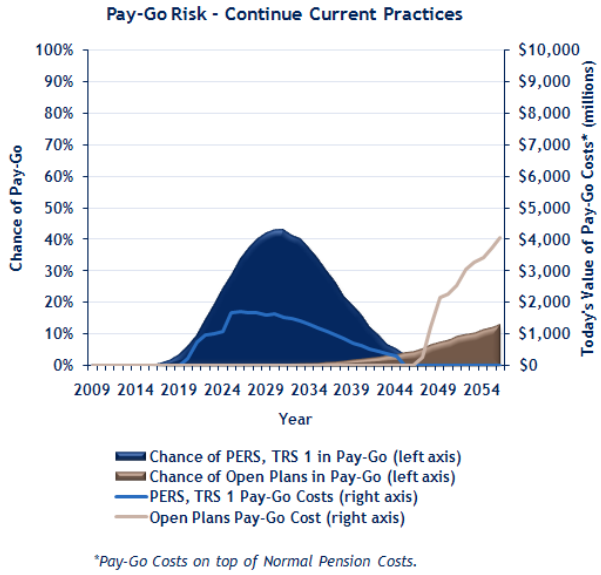


Figure ES.6 is another example of how we summarized output from the model. This graph illustrates the pay-go risk we could see if past practices continue. (Pay-go risk is explained in the full report.) We show this risk for PERS 1 or TRS 1, as well as for any open plan. Pay-go risk shows up in the open plans largely because of the member maximum contribution rates in TRS 2 and WSPRS. Pay-go risk measures for LEOFF 1 are not included in this example, but are included in our full report.

Figure ES.6



The new model also allows us to explore hypothetical changes in policies, practices or economic events. For example, **Figures ES.7** and **ES.8** illustrate how the risk measures in the previous graphs (**Figures ES.5** and **ES.6**) would change if past patterns of reacting to investment and revenue volatility were overcome, and if benefit improvements were curtailed. In this hypothetical change, we assume 100 percent of actuarially required contributions are made and benefit improvements are eliminated in the future.

Figure ES.7

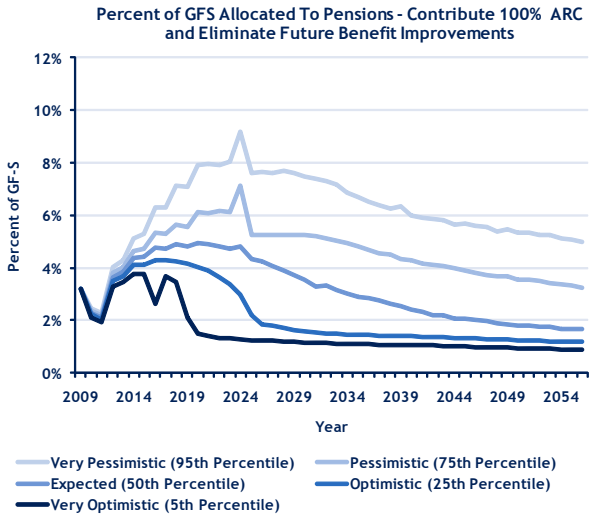
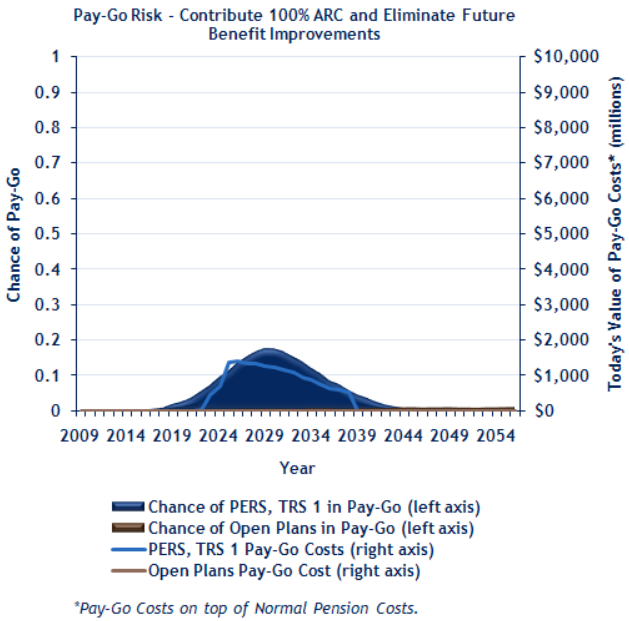


Figure ES.8



Pay-Go Costs on top of Normal Pension Costs.

The risk measures improve considerably under this hypothetical change. Pensions become more affordable, although short-term challenges still remain. Pay-go risk is reduced in the closed plans, and it is almost completely gone in the open plans.

Recommendations from the State Actuary

Findings from risk modeling led the State Actuary to make the following recommendations:

1. Make 100 percent of actuarially required contributions in the future. This includes adhering to the minimum contribution rates required to amortize unfunded past liabilities in PERS 1 and TRS 1.
2. Avoid large benefit improvements in the future until risk and affordability measures significantly improve. Develop new policies for adopting benefit improvements that balance the need to accommodate reasonable adjustments in benefits with the need for sustainable long-term funding.
3. Use risk modeling to further examine pay-go risk. Develop and implement strategies to mitigate or eliminate this risk, especially in TRS 2/3, WSPRS, and LEOFF 1.
4. Prepare for financial risks outside the control of the retirement systems. Use the model to explore how current policies could be amended to better accommodate investment and revenue volatility, budget challenges, and changing economic conditions.

The Next Step is Risk Management

Policy makers may want to develop their own recommendations for managing the future health of pensions. We urge them to study the report and apply their own values and risk tolerances to identify what outcomes they'd like to facilitate, minimize, or avoid.

With the new model, we now have the ability to show how changes in policy or economic events can affect possible future outcomes for pensions. We can quantify these effects using a variety of measures based on what is important to users. We hope these new tools will contribute to better understanding, increased efficiencies in the pension enterprise, and ultimately, to the on-going success and soundness of the state pension systems.

Overview

This report is divided into the following sections:

- **Pension Funding Basics:** This section is designed for those who are less familiar with pensions. A short review of fundamentals establishes a vocabulary and framework for our financial risk analysis.
- **Twenty-Year Look-Back:** This section summarizes what we found when we looked back over the past twenty years. We used the look-back to learn more about where we are today and how we got here. We also used this analysis to inform the development of a new risk model.
- **Possible Future Outcomes:** We built a new model to quantify the likelihood and magnitude of financial outcomes the retirement systems could face in the future. This helps us better understand the dynamics of risk for the pension systems. The model can also show us how future outcomes change if policies change. The goal of this section is to illustrate how the model works and how it can be used by policy makers.
- **OSA's Findings, Conclusions, and Recommendations:** This section summarizes OSA's most high-level findings and conclusions from the risk assessment and includes several recommendations for next steps.

Pension Funding Basics

Pension Plan Income Depends on the Financing Plan

Pensions are funded by contributions and investment returns.

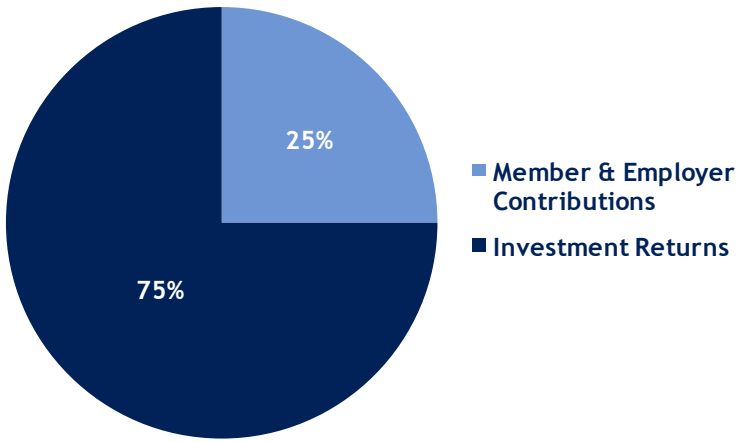
Pensions are a promise today to pay a lifetime benefit in the future. Because of the long time horizon between the promise and the payout, there is an opportunity to take advantage of the time value of money.

Contributions to the pension fund come from two sources: public employers (taxpayers) and retirement system members (employees). Pension contributions are collected as a percentage of each employee paycheck and regularly deposited into a trust fund. The allocation of pension costs between employers and employees depends on the cost-sharing policy for the pension plan.

Through the power of investing, the assets of the trust fund earn additional income. Over time, this expected income covers roughly 75 percent of pension costs.

Figure 1.1

Pension Contributions by Funding Source



Funding policy drives how much income is received from contributions.

In Washington State, the Legislature ultimately decides how much will be contributed to pensions. We call the result "funding policy." Many of the guidelines for pension funding are codified in state law, both in the actuarial funding chapter and in specific plan provisions.

The Legislature has delegated certain responsibilities to the Pension Funding Council (PFC). The PFC adopts contribution rates and makes recommendations on funding policy, subject to revision by the Legislature. The PFC considers advice from the State Actuary, input from the actuarial audit, and recommendations from the Select Committee on Pension Policy (SCPP). Also one pension plan, Law Enforcement Officers' and Fire Fighters' (LEOFF) Plan 2, has a board of trustees with authority to make decisions about funding policy for that plan.

The Legislature makes most pension funding decisions as part of its biennial budgeting process. The amount of revenue available to budget writers can influence how much the Legislature contributes to pensions. Local governments follow

statewide funding policy for pensions, but because of differences in funding sources, they can face different revenue challenges.

Investment policy drives how much income is derived from investments.

The Washington State Investment Board (WSIB) decides how to invest the contributions that are regularly deposited into the pension trust fund. Using the authority delegated to it from the Legislature, WSIB decides how to maximize investment returns at a prudent level of risk. We call the result "investment policy."

The PFC adopts the long-term annual rate of return assumption for investments. This "economic assumption" is found in statute and is subject to revision by the Legislature. The assumption is used to calculate contribution rates for the plans. As such, it becomes the investment "target" for the WSIB.

The current long-term annual rate of return assumption for investments is 8 percent. RCW 41.45.035(1)(c). WSIB's goal is to meet the investment return target set in statute while maintaining a prudent level of risk.

WSIB strategically allocates the pension trust fund assets among different classes of investments, such as stocks, bonds, real estate, and cash in order to meet the investment target. In deciding the trade-off between risk and return, WSIB can take advantage of the long time horizon of the pension financing plan.

The long time horizon for investing means that as a general matter, WSIB does not need to match pension liabilities with the short-term ups and downs in the market. Instead, WSIB can take more investment risk and seek higher expected returns over the long-term. The result is lower contribution rates for members and employers.

Figure 1.2 illustrates how the assumed annual rate of return affects pension contribution rates. A lower assumed annual rate of return requires higher contribution rates from members and employers. Conversely, a lower rate of return calls for higher pension contribution rates. Although the assumed rate of return dictates how we calculate contribution rates in the short-term, the actual investment returns will determine how much of pension costs must be covered by contributions in the long-term.

Figure 1.2

Example of Contribution Rate Calculations Under Different Investment Return Assumptions*

		PERS		TRS		SERS
	Interest Assumption	Plan 1	Plan 2/3	Plan 1	Plan 2/3	Plan 2/3
Member	7 Percent	6.00%	7.70%	6.00%	7.68%	7.04%
	8 Percent	6.00%	4.45%	6.00%	3.96%	3.51%
	9 Percent	6.00%	1.63%	6.00%	0.75%	0.43%
Employer (Normal Cost)**	7 Percent	7.81%	7.81%	8.45%	8.45%	8.04%
	8 Percent	4.56%	4.56%	4.73%	4.73%	4.51%
	9 Percent	1.74%	1.74%	1.52%	1.52%	1.43%
Employer (Plan 1 UAAL)**	7 Percent	5.64%	5.64%	9.34%	9.34%	5.64%
	8 Percent	4.48%	4.48%	6.94%	6.94%	4.48%
	9 Percent	3.41%	3.41%	4.73%	4.73%	3.41%
Total Employer	7 Percent	13.45%	13.45%	17.79%	17.79%	13.68%
	8 Percent	9.04%	9.04%	11.67%	11.67%	8.99%
	9 Percent	5.15%	5.15%	6.25%	6.25%	4.84%

**Rates shown for illustration only. They are not intended for rate-setting purposes and exclude minimum rates and rate ceilings where applicable.*

***Normal cost is the ongoing costs of the open plans. UAAL is the unfunded past cost of the closed plans.*

Pension Plan Payouts Depend on the Benefits Promised

Benefits policy drives how much is paid to plan members.

The Legislature decides the benefits structure and plan design for pensions. We call the result "benefits policy." Plan design influences cost --the more generous the benefits, the more costly the plan. The benefits for each plan are mostly determined when the plan opens, although benefits can also be added throughout the life of the plan. When benefits are added, costs are added.

Benefit improvements can be prospective or retroactive. When new benefits are prospective, or apply to future service credit only, there are opportunities to fund the benefit increases over the working lifetimes of affected employees. This policy promotes fairness across generations, or "intergenerational equity." The current generation pays for benefits for employees whose service occurs in the current generation.

When new benefits are retroactively granted based on past and future service, then intergenerational equity can be compromised. This is because the current generation must pay not only for the benefits of their own generation, but also for the benefits of past generations.

While benefits policy is ultimately decided by the Legislature, policy makers receive recommendations from the SCPP, the LEOFF Plan 2 Retirement Board, and many stakeholder groups representing active members, retired members, and employers.

In Washington, pension benefits are usually treated like contractual rights. This means that employees generally expect employers to pay pension benefits according to the plan or plans that covered them during their public employment.

Both public and private pension plans have rules that prevent employers from arbitrarily reducing employees' pension benefits. In the private sector, the rule is known as the "anti-cutback rule" and derives from federal legislation known as the Employee Retirement Income Security Act (ERISA).

In the public sector similar protections are found in state and local laws, state constitutions, and/or case law. In Washington, these principles have been recognized in the 1956 Washington Supreme Court case entitled *Bakenhus v. City of Seattle*.

Other Economic Variables Affect Pensions

Changes in annual revenue growth can add or reduce financial pressures on pensions.

Some variables affecting pensions are not fully controlled by legislators, investment board trustees, or other policy makers. Still, these factors can affect pensions by adding or reducing financial pressures on the plans.

As part of the 2010 risk assessment, we chose to examine how one of those variables, annual changes in revenue growth, affects pensions. We added this component to our study because available revenues affect funding and benefits policies.

Where Are Washington's Pension Plans Today?

All plans are healthy except Public Employees' Retirement System (PERS) Plan 1 and the Teachers' Retirement System (TRS) Plan 1.

There are several indicators to consider as we evaluate the current health of Washington's pension plans. One is "funded status." Funded status indicates the relationship between assets and liabilities at a single point in time. If the funded status is 100 percent, then there is one dollar in actuarial assets for each dollar of accrued liability (earned benefits). For 2009 the total funded status for all state-administered plans combined is 99 percent.

The funded status varies for each plan. Washington has plans that are open to new employees (Plans 2 and 3) and older plans that are closed to new employees (Plans 1). The funded status of all of Washington's open plans is above 100 percent. This funded status was measured as of June 30, 2009.

Figure 1.3

Calculation of 2009 Funded Status*										
(Dollars in millions)	PERS		TRS		SERS	PSERS	LEOFF		WSPRS	All
	Plan 1	Plans 2/3	Plan 1	Plans 2/3	Plans 2/3	Plan 2	Plan 1	Plan 2	Plans 1/2	Plans
Accrued Liability	$13,945	$15,701	$10,838	$5,213	$2,162	$54	$4,477	$4,325	$758	$57,473
Valuation Assets	$9,776	$18,260	$8,146	$6,160	$2,503	$69	$5,612	$5,564	$900	$56,991
Unfunded Liability	$4,169	($2,560)	$2,692	($947)	($341)	($15)	($1,135)	($1,239)	($143)	$481
Funded Ratio	**70%**	**116%**	**75%**	**118%**	**116%**	**128%**	**125%**	**129%**	**119%**	**99%**

**Source: OSA 2009 Actuarial Valuation.*

The funded status fluctuates over time. The 2009 funded status is 70 percent for PERS 1 and 75 percent for TRS 1. Both of these plans are projected to have a funded status below 60 percent in the future.

Like most public plans, Washington "smooths out" asset gains and losses when calculating contribution rates and reporting funded status. This helps limit fluctuations in these measures that would otherwise arise from the short-term ups and downs of the market, or market volatility.

Washington uses up to an eight-year smoothing period, depending on the size of the gain or loss. For example, one-eighth of 2008-2009 asset losses were initially recognized due to the asset smoothing method. This means that losses will continue to put downward pressure on the funded status of all plans for seven more years as the remainder of 2008-2009 losses are recognized.

Another indicator of plan health is the amount of unfunded past liabilities for benefits already earned. We refer to these liabilities as "legacy costs." They are also known as Unfunded Actuarial Accrued Liabilities or UAAL. In PERS 1 and TRS 1, the legacy costs for both plans combined were approaching $7 billion as of June 30, 2009. These costs are projected to increase as we recognize all the asset losses from 2008-2009.

In Washington's state-administered plans, employees do not pay pension contributions for legacy costs. Legacy costs are spread among employers, including employers for the open plans (Plans 2/3). The plan administrator (the Department of Retirement Systems or DRS) regularly collects these payments from employers as a percentage of employee pay.

Employers are facing steep increases in contribution rates.

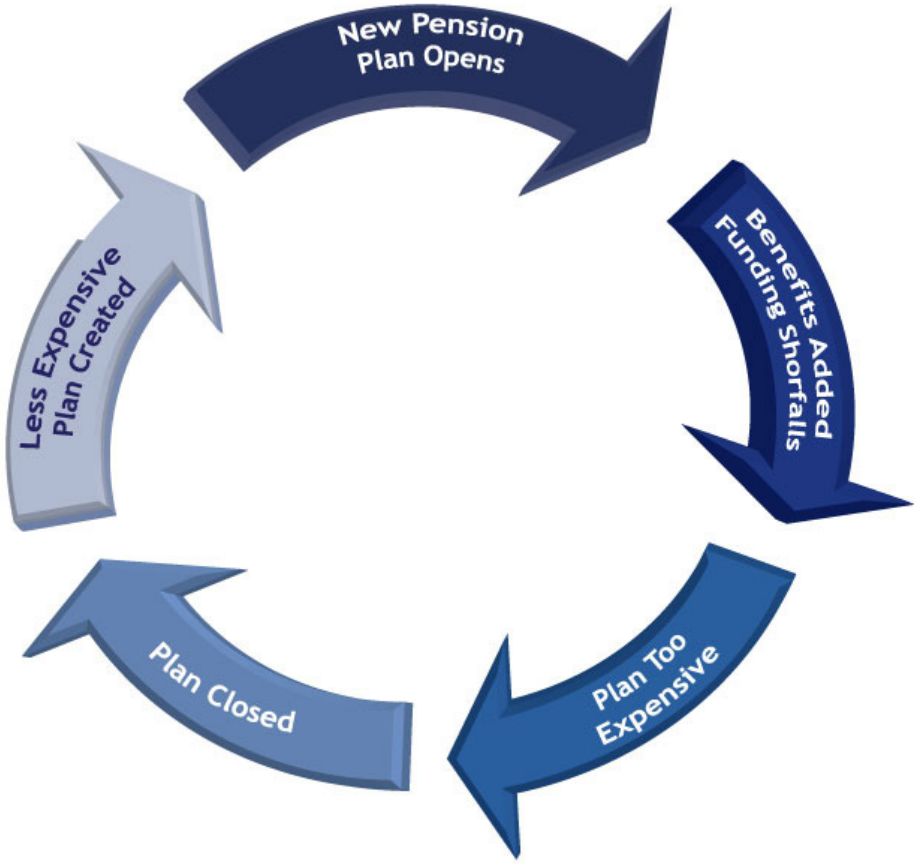
Adequate and affordable contribution rates are also indicators of plan health. As we described earlier in this section, contributions from members and employers provide the regular payments over time that keep the pension fund stable.

As pension plans become more expensive, contribution rates must increase to offset the additional unfunded liabilities. Underfunding, investment losses, legacy costs, benefit improvements, and any combination thereof can trigger the need for contribution rate increases. Also, economic conditions can add pressures that make it more difficult to increase contributions when they are most needed.

As contribution rates increase, they begin to take a larger percentage of budget dollars. History shows that plan sponsors may decide to close a pension plan when contribution rates become unsustainable. This happened when Washington closed the Plans 1 and opened new, less expensive plans in 1977 (the Plans 2).

Figure 1.4

Typical Pension Plan Life Cycle



Today, required contribution rates and GF-S contributions are nearly doubling from the 2009-2011 Biennium to the 2011-2013 Biennium. What is driving these increases? How long will they continue? Are they affordable? Is there a risk that the pension life cycle will be repeated? How do our funding and benefits policies respond to varying economic environments? Do they support the long-term financing plan for pensions? The next two sections of this report will provide information to help answer these questions.

Twenty-Year Look-Back

We studied the period from 1989 to 2009 to shed light on the present and to better understand where the state's pension plans might be going. We started with a twenty-year look-back at pension income and pension costs. We wanted to see how investments, funding policy, and benefit improvements were affecting assets and liabilities, so we gathered twenty years of data on these policies. We also gathered data on available state revenue during the period, as we thought it might be relevant to funding history.

After we saw the data, we looked for relationships. Some of the questions we asked were: How did investment volatility relate to state revenue volatility? How did funding and benefit policies respond to the changing economic environments? What role did Plan 1 legacy costs play? The relationships we saw helped provide insights about the kind of tools we would need to evaluate the pension systems and the risks they face in the future.

Why twenty years? First, this period provides sufficient data for setting actuarial assumptions. Second, this period corresponds to the Legislature's application of "systematic actuarial funding," a policy adopted in 1989 and codified in the actuarial funding chapter. You can see a list of the Legislature's funding goals for pensions in RCW 41.45.010.

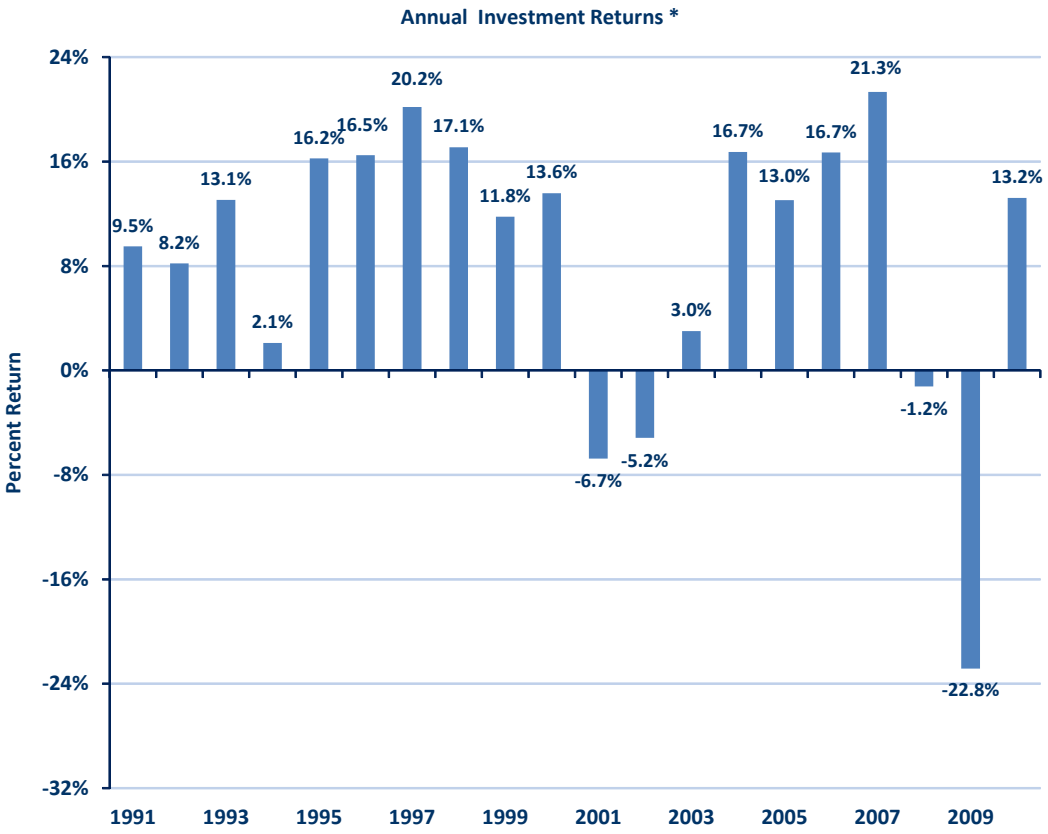
The Track Record Was Mixed

Investment income was on track.

As we mentioned in our discussion of pension basics, the current long-term financing plan for pensions has a target for investments. Returns need to hit or exceed the statutory long-term rate of return assumption of 8 percent per year for the financing plan for pensions to work as intended. Over the past twenty years, investment returns have been right at this benchmark.

Figure 2.1 shows the annual investment rate of return from the Commingled Trust Fund (CTF) by fiscal year. Over the twenty-year period, the average annual return was 8.23 percent. There were no negative returns in the first decade. Annual returns decreased and were more volatile in the second decade of the twenty-year period.

Figure 2.1



Notes:

Fiscal year, time-weighted returns. Dollar-weighted returns vary by plan.

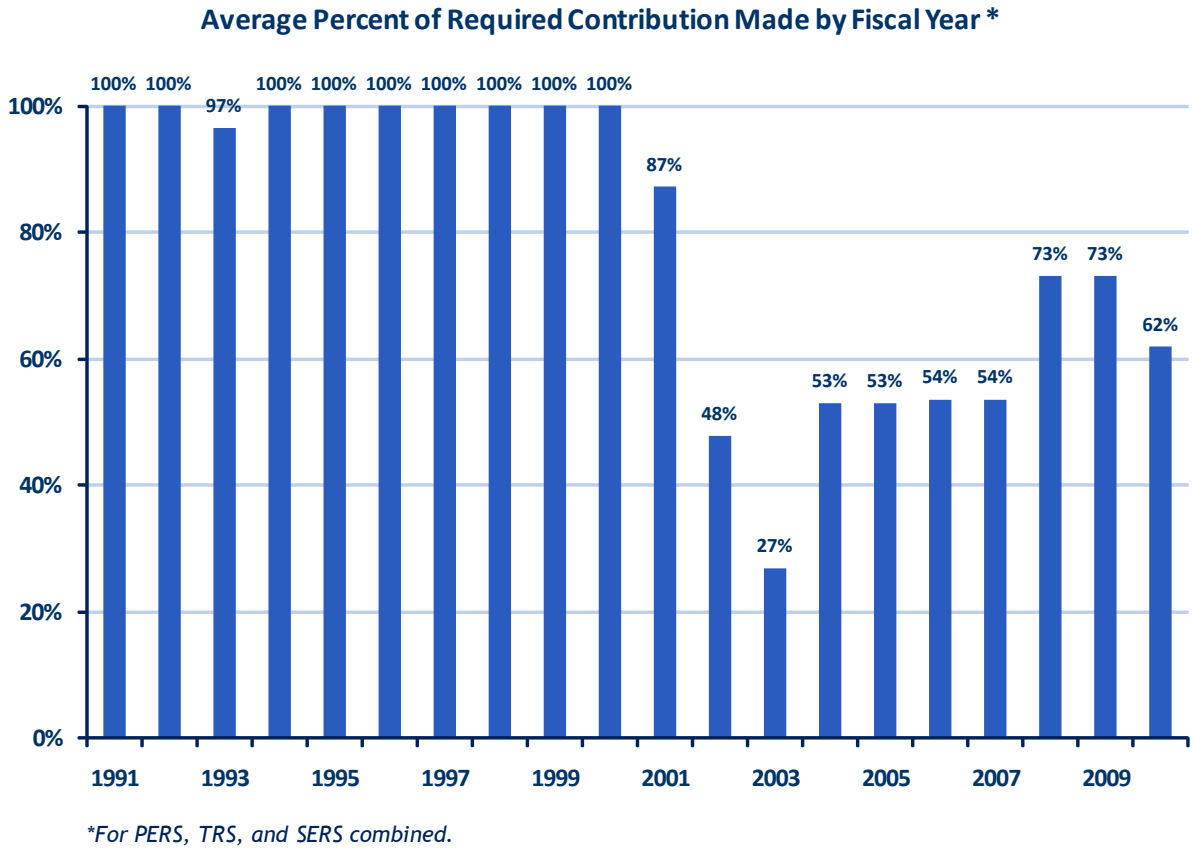
The Commingled Trust Fund (CTF) was created in 1993. Returns for 1993 and later are for the CTF as reported by WSIB. Returns prior to 1993 are total fund returns reported by the Department of Retirement Systems' Comprehensive Annual Financial Report.

Underfunding decreased pension income.

Over the past twenty years, the largest pension plans received about 80 percent of the pension contributions needed.

This graph shows the average annual percent of the required contribution made over the twenty-year period for PERS, TRS, and SERS combined. We used the results of the applicable actuarial valuation for the budgeting period to determine the required contributions. We then compared those results to the actual contributions. For the period, contributions were at or close to 100 percent throughout the first decade, and well below the required amounts during the second decade.

Figure 2.2



For PERS, TRS, and SERS combined.

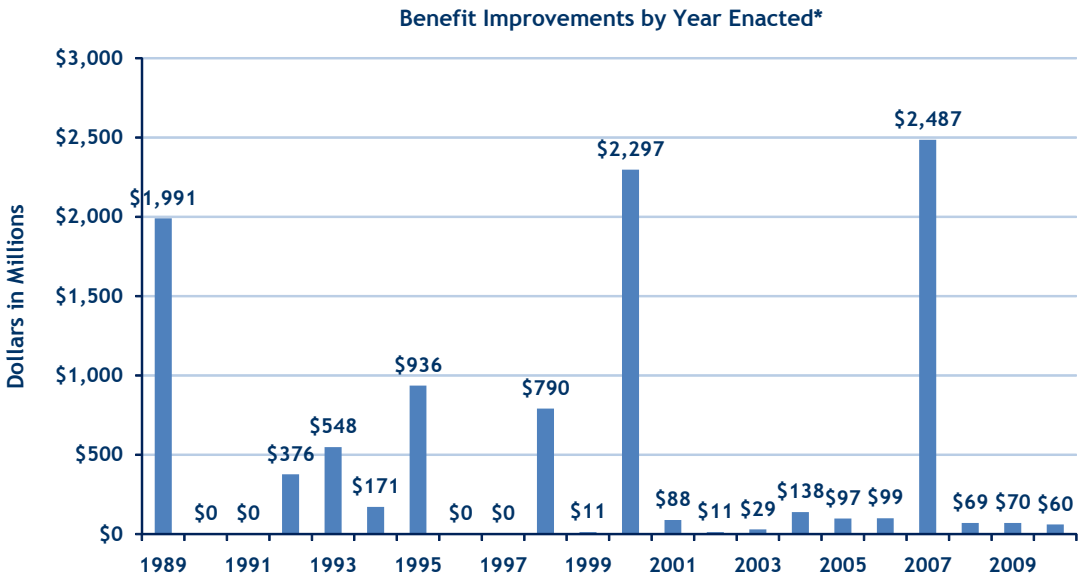
Benefit improvements increased pension costs.

Turning to pension costs, we reviewed benefit improvements over the past twenty years to see how changes to the plan design might be adding to plan liabilities. **Figure 2.3** summarizes what we found.

This history shows a series of smaller benefit improvements that occurred fairly regularly (benefits "creep") throughout the entire twenty-year period. We also observed much larger benefit improvements that occurred less frequently. We refer to these improvements as "spikes." There were not enough data points to statistically correlate the spikes to any other economic variables.

Benefits improvements increased liabilities by 0.45 percent annually in the largest plans. The combination of creep and spikes had a multi-billion dollar impact on long-term pension costs. While we did not observe a huge difference between the first decade and the second decade, there were some differences. During the first decade the spike events were smaller and the creep events were larger. During the second decade, the spike events were larger and the creep events, while more frequent, were smaller.

Figure 2.3



**Adjusted present value of liability increases in 2010 dollars based on an 8.0% discount rate. Excludes the following:*

1) Impacts of Plan 3 gain-sharing prior to 2008 gain-sharing event.

2) Savings from repealing future gain-sharing (cost of future gain-sharing not recognized previously).

3) Benefit improvements where the fiscal note did not report the amount of the liability increase. This includes years showing zero liability increase.

Key to Benefit Spikes

1989 - Plan 1 Age 65 COLA after 40% loss of purchasing power from age 65.

1995 - Plan 1 Uniform COLA.

1998 - Plan 1 Gain-Sharing (excludes cost of future Plan 1 gain-sharing benefits).

2000 - Plan 2/3 subsidized early retirement reduction factors with 30 years of service.

2007 - Gain-sharing replacement benefits.

The absence of small "creep" events during the first decade is partly explained by a change in fiscal note practices at OSA. Past OSA practices did not identify and report an increase in plan liabilities if the increase was insufficient to increase supplemental contribution rates. See RCW 41.45.070.

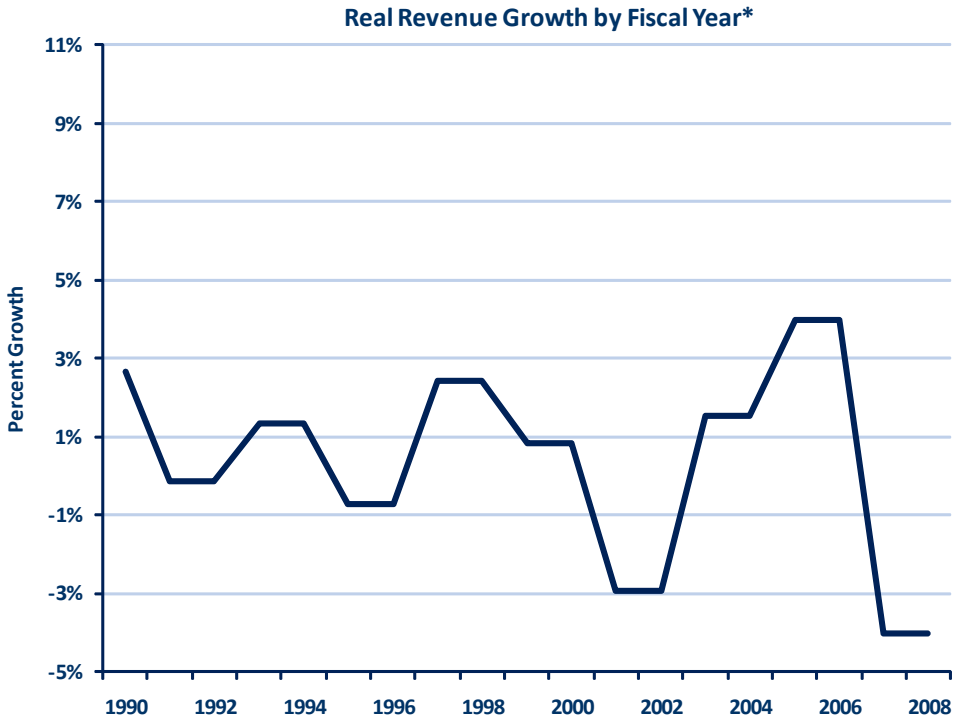
State Revenue and Investments Moved Together

Next we gathered data on state revenue growth because it is relevant to the state's ability to make pension contributions. The following graph shows real revenue growth over the twenty-year period. Real revenue growth is economic growth over and above inflation and population growth (also referred to as productivity growth).

We see from **Figure 2.4** that state general fund revenues were more stable during the first decade of the twenty-year period. During the second decade, state revenues became more volatile, with much larger increases and decreases in real revenue growth.

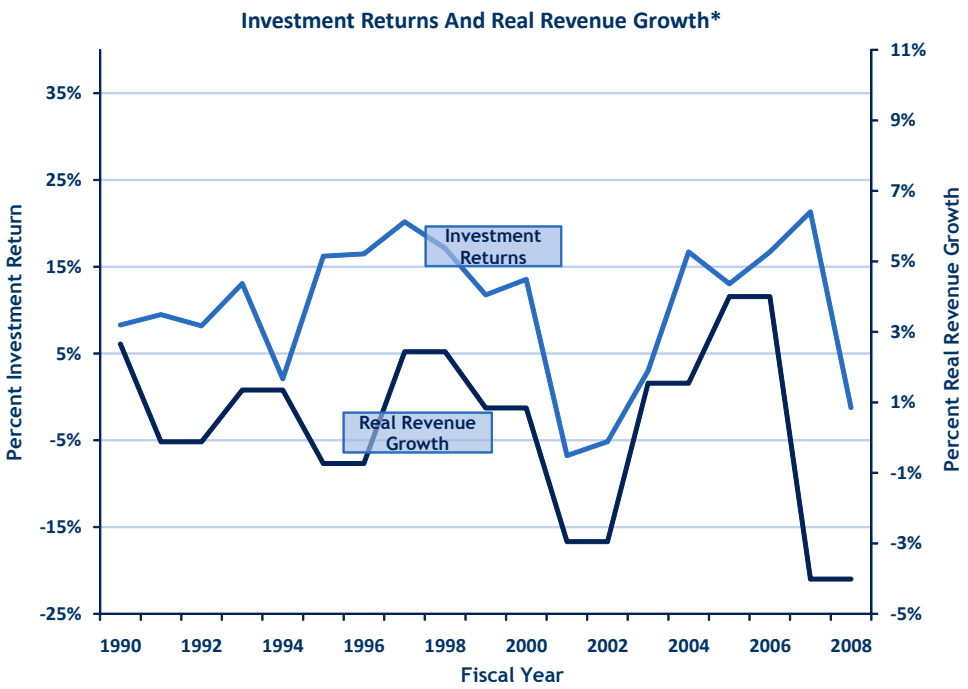
We noticed that this picture was very similar to our earlier picture of annual investment returns, so we looked at them more closely to see if they were correlated. **Figure 2.5** shows how real revenue growth and investment returns moved together over the twenty-year period.

Figure 2.4



Adjusted for inflation and population growth. Complete data for the 2009-2011 Biennium was not available at the time of publication.

Figure 2.5



Real revenue growth is revenue growth over and above inflation and population growth. Complete data for the 2009-2011 Biennium was not available at the time of publication.

Again, the first decade was marked by more stability. The second decade was marked by a significant increase in volatility, both positive and negative, for both investments and revenue.

Long-Term Investment Policy Expects Volatility

As we pointed out in the "Pension Funding Basics" section, WSIB uses a long time horizon for investing. A long time horizon means that WSIB does not need to match pension liabilities with the short-term ups and downs of the market.

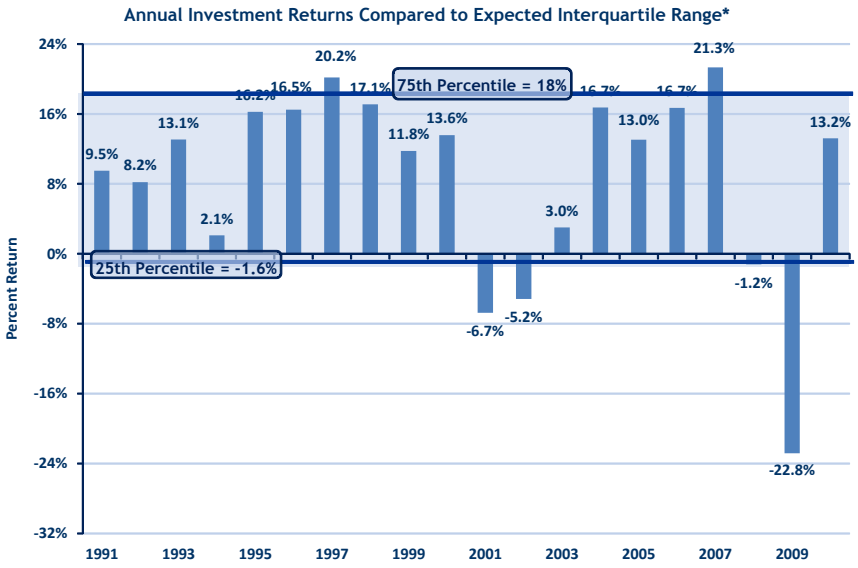
A long time horizon allows WSIB to take more risk. Higher-risk portfolios have more volatility (more ups and downs) in their annual returns, but can achieve higher returns over the long term. This means lower pension contribution rates over the long term. Lower-risk portfolios have lower volatility in their returns, but expected returns are less. This means more of long-term pension costs must be covered by contributions.

See **Figure 1.2** for a comparison of how contribution rates look with a 7 percent, 8 percent, and 9 percent annual rate of return. Washington has chosen the path of an 8 percent expected annual rate of return. This target comes with a certain amount of expected volatility. The policy is based on a long-term view. We measure whether the annual rate of return target has been met over a long period of time, allowing the ups and downs to balance each other out.

Investment Volatility Was Less Than Expected Over the Past Twenty Years

Even though the picture of investment volatility was very different from the first decade to the second, the amount of volatility over the twenty-year period was well within WSIB's long-term expectations.

Figure 2.6



Notes:

Fiscal year, time-weighted returns. Dollar-weighted returns vary by plan.

The Commingled Trust Fund (CTF) was created in 1993. Returns for 1993 and later are for the CTF as reported by WSIB. Returns prior to 1993 are total fund returns reported by the Department of Retirement Systems' Comprehensive Annual Financial Report.

Fifty percent of returns expected to occur between 25th and 75th percentile.

In **Figure 2.6,** the shaded area between the 25th and 75th percentiles indicates where half of investment returns were expected to fall over the twenty-year period. The other half of the investment returns were expected to fall outside of the shaded area.

How did experience compare to expectations? Three-quarters of actual investment returns fell inside the expected "interquartile range" and only one-fourth of the actual investment returns fell outside of the expected range. Even the five events that were outside of the expected range were anticipated by WSIB's modeling, including the one-in-one-hundred-year event that occurred at the end of the period (-22.8 percent annual rate of return).

What's more striking about the two-decade period is the contrast between the first decade and the second. The first decade experienced extended upward volatility. There were no negative returns and significant positive returns, especially in the latter part of the decade.

In contrast, the second decade was marked by much larger increases and decreases in returns. And the second decade included one extremely negative event. The fact that investments were still on target for the period even after such a negative event speaks to how positive much of the period was.

Still, pensions were funded at the rate of 80 percent for the period. What would explain this? Was there something more we could learn about funding dynamics?

We decided to explore the relationship of underfunding to investment volatility. Also, since we saw many changes in funding policy during the period, we wanted to look more closely at the effects.

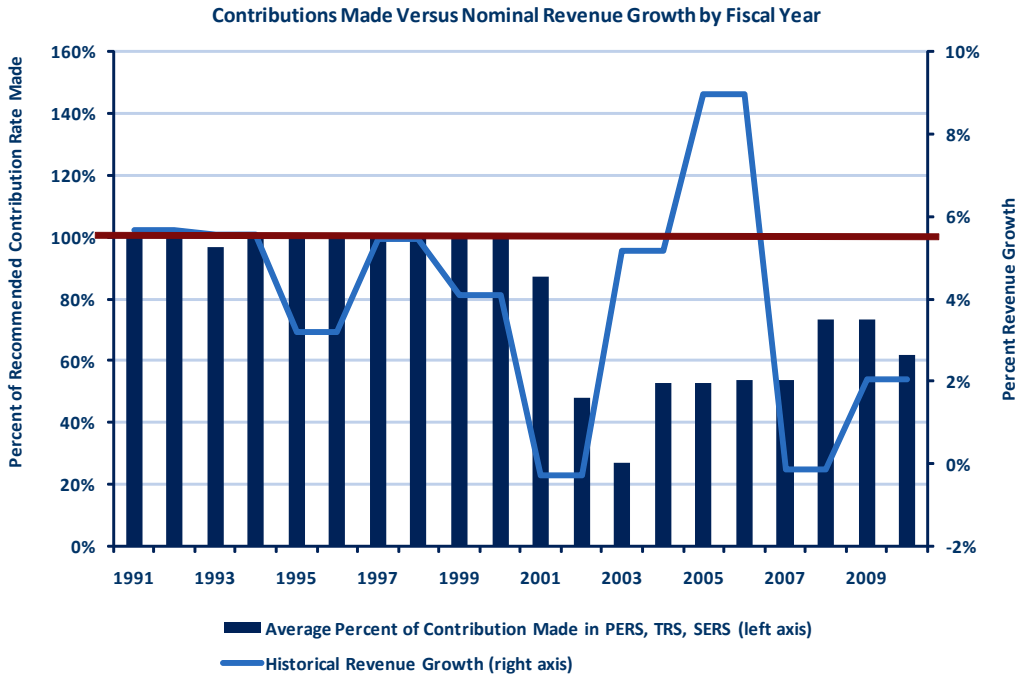
Underfunding Was Correlated to Volatility

During the first decade of the twenty-year period, funding policy was right on track. With one slight exception, all required contributions were made. This was the decade with no negative investment returns and extended upward volatility. State revenues were also strong for most of that decade.

Funding policy seemed to react to the increased volatility (both positive and negative) during the second decade of the twenty-year period. Contributions to the largest plans were missed in both good times and bad. **Figure 2.7** compares nominal revenue growth (which includes the effects of inflation) to contributions made. We used nominal revenue growth as opposed to real revenue growth (which excludes the effects of inflation) because budgets are typically built using nominal dollars.

We observed that weak economic environments were correlated to weak investment returns. Lower investment returns created the need

Figure 2.7



for increased contributions at a time when employers and members could least afford them.

Also, we saw that the likelihood of required contributions being made was less when the previous year's contributions were already lower than what had been required. Contribution rates were at their lowest early in the second decade. Even when revenue growth peaked in the middle of the decade, contributions were still roughly half of what was required.

Once dollars are budgeted away from pensions, it may be difficult to move them back. We saw in the twenty-year look-back that the process of restoring contributions to higher budget levels took longer than it took for investment returns and revenue growth to improve.

Over the past twenty years we saw that when asset returns were low

and there was pressure to increase contribution rates, revenue growth was also low, making it very difficult for policy makers to respond to the pressure. We noted that if fully funding pensions did not or could not occur when there were economic downturns, then there were implications for long-term financial risk. Moreover, if underfunding still occurred when revenues and asset values were trending up, there was even more risk to consider.

Short-Term Funding Policies Also Resulted in Underfunding

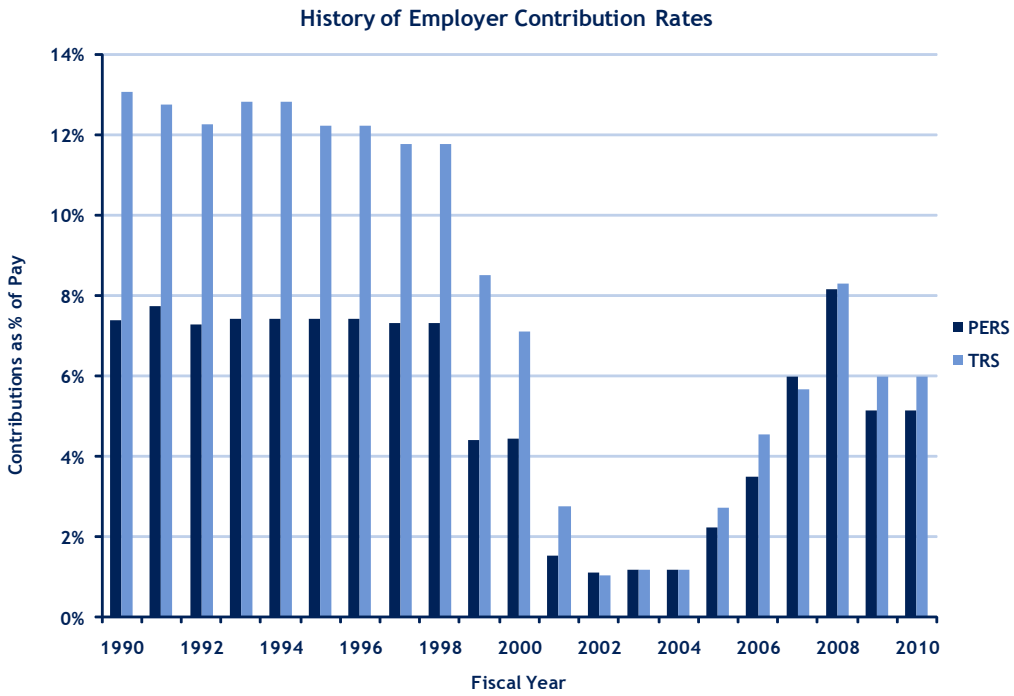
Another part of the funding story involves the timing of certain changes to actuarial methods and assumptions. We observed that asset gains from positive investment returns were captured early, and subsequent asset losses were deferred. These changes resulted in lower contribution rates, which led to underfunding for the twenty-year period.

Here are some of the major changes to funding policy that resulted in accelerating gains and deferring losses.

- **1993:** Change from a six-year contribution rate-setting cycle to a two-year cycle. This occurred during a bull (upward trending) market, allowing gains to be captured over a two-year rather than six-year period, and led to an immediate decrease in contribution rates.
- **2001:** Change from a 7.5 percent to an 8 percent assumed rate of investment return. This change occurred at the end of an extended bull market and increased the amount of future income expected from investment returns, which lowered expected pension costs. Again, the change was accompanied by an immediate decrease in contribution rates.
- **2001:** Change from a three-year to a four-year asset smoothing period. This change occurred right after a bull market and allowed subsequent market losses to be smoothed over a longer period of time. The previous three-year method was also relatively short and contributed to the accelerated recognition of gains.
- **2003:** Change from a four-year to an eight-year asset smoothing period. This change occurred during a bear (downward trending) market and had a similar effect to the 2001 change to a longer smoothing period because of its timing. Losses were deferred, resulting in contribution rate relief. (Later this method change contributed to added rate stability as gains from 2004-2007 were deferred over a longer period.)
- **2000 and 2003:** Adopting contribution rates decreases in certain off-cycle years. This practice allowed for gains to be captured earlier than they would have been, resulting in faster decreases in contribution rates than would have otherwise occurred.

Figure 2.8 applies to PERS and TRS, and shows the effects of capturing past gains early and of deferring losses. The result was a period of very low contribution rates in the early part of the second decade of the twenty-year look back. This period is often referred to as the "happy valley."

Figure 2.8



Again, **Figure 2.8** illustrates the contrast between the first decade and the second decade of the twenty-year period. After rates reached their lowest levels they never returned to historic levels (except briefly for PERS).

What if funding policies had been different over the past twenty years?

Next we used "what if" illustrations in order to better understand pension funding dynamics over the past twenty years and how they might affect the present. We applied these to TRS because it is a large system, has both open and closed plans, and it has not had "spin-offs" into additional plans as in the case of PERS (which has the School Employees' Retirement System, or SERS, and the Public Safety Employees' Retirement System, or PSERS, as spin-off plans).

We wanted to see how TRS would look today if funding policy had been more consistent over the past twenty years. We also wanted to know what the effects would have been if certain funding policy safeguards had been implemented at the beginning of the period and remained in place over two decades. We asked three questions:

1. What if contribution rates had been stable and 1990 contribution rates had been paid into the plans each year?
2. What if today's asset smoothing method and minimum contribution rates had been adopted in 1990 and applied each year?

   Note: The asset smoothing method and minimum contribution rate requirements are described in Chapter 41.45 RCW, the actuarial funding chapter of state law.
3. What if 100 percent of actuarially required contributions had been made over the entire twenty-year period?

Results from these illustrations are summarized in **Figure 2.9**. The table shows the hypothetical impacts on funded status in the closed plan, TRS 1, and in the open plans, TRS 2/3.

Figure 2.9

Effects of Funding Policies on Funded Status Today		
	TRS 1	TRS 2/3
What if …	*(Without / With)*	*(Without / With)*
… 1990 rates paid into plans for 20 years.	75% / 99%	118% / 153%
… today's asset smoothing method and minimum rates.	75% / 89%	118% / 137%
… all required contribution rates.	75% / 80%	118% / 123%

These results show that the funded status of the plans would be better today if long-term funding policies had been in place. Instead, short-term reactions to expected volatility contributed to underfunding, which negatively impacted the health of the plans.

Benefits Policy Reacted to Volatility

We saw that funding policy reacted to investment and revenue volatility over the twenty-year period. What about benefits policy? Did it react to volatility? While most benefit spikes did not have a statistical correlation to other variables, gain-sharing was a significant benefit improvement that was designed to occur in periods of positive investment volatility.

Gain-sharing was implemented in 1998 after a long run of very positive investment returns. It was designed to provide benefit increases to members of the Plans 1 in PERS and TRS, and the Plans 3 in PERS, TRS, and SERS. These increases were contingent upon the occurrence of "extraordinary gains."

Extraordinary gains were deemed to have occurred whenever the compound average of investment returns on pension fund assets exceeded 10 percent for the previous four fiscal years. This trigger resulted in increases to the Uniform Cost of Living Adjustment (U-COLA) in the Plans 1 and lump sum distributions into members' defined contribution accounts in the Plans 3. Plan 2 members did not participate in gain-sharing.

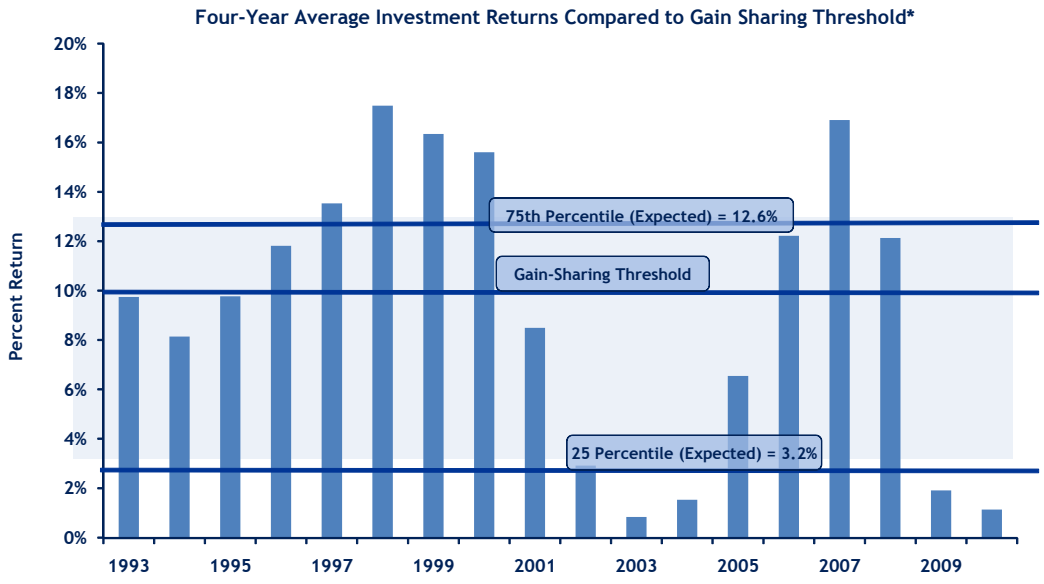
The long-term cost of this benefit was not recognized in advance, and the cost was not prefunded. The idea was to take a portion of asset gains in good times and distribute them to members. However this meant that the amounts distributed would not be available to later offset investment losses that were expected as part of the long-term financing plan for pensions.

You can learn more about gain-sharing here: http://www.leg.wa.gov/SCPP/Documents/2005/Gain-sharing_Subgroup/Final_Gain-Sharing_Report.pdf.

> *Note: Gain-sharing was identified by the Legislature as a non-contractual right. In 2007 the Legislature repealed gain-sharing. Immediately thereafter, certain stakeholders filed a lawsuit in the King County Superior Court. The suit challenges the repeal and asks for reinstatement of the gain-sharing benefit. As of the date of this report, the lawsuit is ongoing and its outcome is unknown.*

We looked more closely at whether the asset returns that triggered gain-sharing were "extraordinary." **Figure 2.10** illustrates that gain-sharing was triggered even when economic events were well within the expected volatility of the long-term investment policy currently in place. Half of the expected four-year rates of investment return fall between 3.2 and 12.6 percent. The 10 percent trigger for gain-sharing lands at the 64th percentile. In other words, there was a 36 percent chance that four-year investment

returns would exceed 10 percent. Figure 2.10



Notes:
Four-year (fiscal), time-weighted returns. Dollar-weighted returns vary by plan.
The CTF was created in 1993. Returns for 1993 and later are for the CTF as reported by WSIB. Returns prior to 1993 are total fund returns reported by the Department of Retirement Systems' Comprehensive Annual Financial Report.

We also considered where TRS would be today if there had been no gain-sharing. We measured the effects on funded status for both the open and closed plans. If there had been no gain-sharing, today's 2009 funded status for TRS 1 would increase from 75 to 78 percent, and the 2009 funded status for TRS 2/3 would increase from 118 to 130 percent. The *long-term* TRS employer contribution rate would be 274 basis points lower.

To summarize, another key take-away from the look-back is that benefits policy created short-term reactions to positive investment volatility. This volatility was an expected part of the long-term financing plan for pensions.

The gain-sharing benefit added significantly to plan costs. Even though gain-sharing was subsequently repealed, its long-term effects remain. Employers are still paying for the cost of past gain-sharing events. Employers and Plan 2 members are also paying for the costs of certain gain-sharing replacement benefits that were enacted when gain-sharing was repealed in 2007.

Plan 1 Legacy Costs Persisted

Over the past two decades, while benefits were increasing plan costs and underfunding and short-term funding policies were reducing income, employers were also paying for PERS 1 and TRS 1 legacy costs -- even though these two plans were closed in 1977. Employers were paying (and still pay) legacy costs in addition to their portion of the ongoing costs for the open plans (Plans 2/3).

All PERS, TRS, SERS, and PSERS employers (Plans 1, 2, and 3) share in the legacy costs; members do not pay for them. Plan 1 legacy costs are a big part of required employer contribution rate increases we see today.

Figure 2.11

Employer Contribution Rates for Unfunded Plan 1 "Legacy" Costs*			
	Current	2011-12	2012-13
PERS	1.14%	3.75%	4.44%
TRS	1.85%	6.50%	6.85%
SERS	1.14%	3.75%	4.44%
PSERS	1.14%	3.75%	4.44%
LEOFF	0.00%	0.00%	0.00%
WSPRS	0.00%	0.00%	0.00%

**Source: OSA 2009 Actuarial Valuation.*

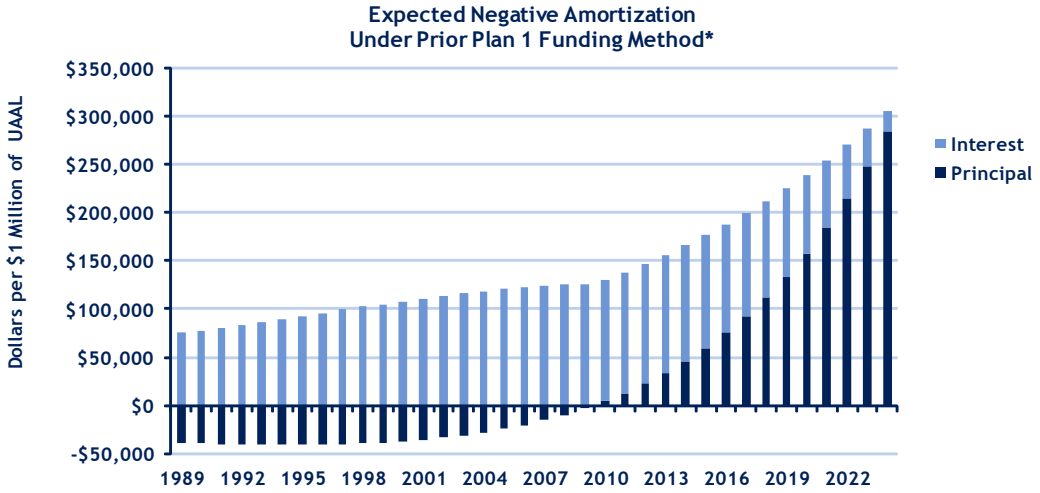
Where did these costs come from? Plan 1 legacy costs are the result of underfunding and retroactive benefit improvements in the Plans 1. However, these Unfunded Actuarial Accrued Liabilities (UAAL) were made worse by the prior Plan 1 funding method.

Negative amortization increased legacy costs.

The funding method that was in place for PERS 1 and TRS 1 included "negative amortization." What does this mean? From 1989 until the Plan 1 funding method was restructured in 2009 (SSB 6161, C 561, L 2009), the annual payments for legacy costs were actually less than the annual interest charge on the debt. The following bar chart illustrates the back-loaded nature of the prior financing plan.

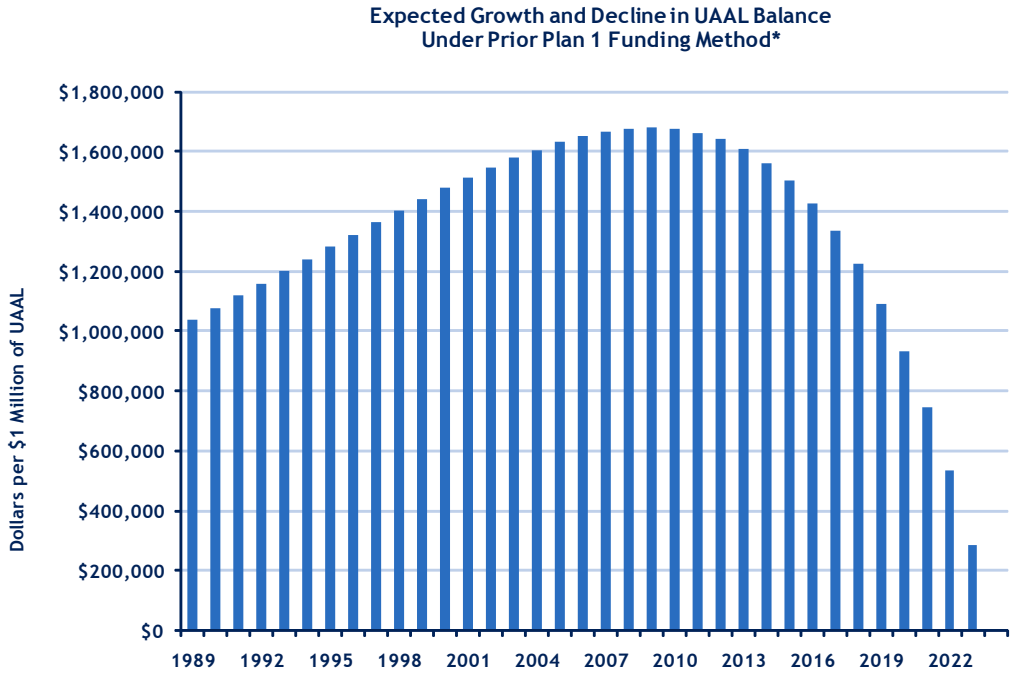
This type of payment plan comes with a cost. It was actually designed to increase unfunded liabilities substantially (to the tune of about $5 billion) before paying off the principal in the final years of the plan. The final pay-off date was scheduled as 2024.

Figure 2.12



**For illustration only. Expected annual payments towards interest and principal per $1 million of UAAL.*

Figure 2.13

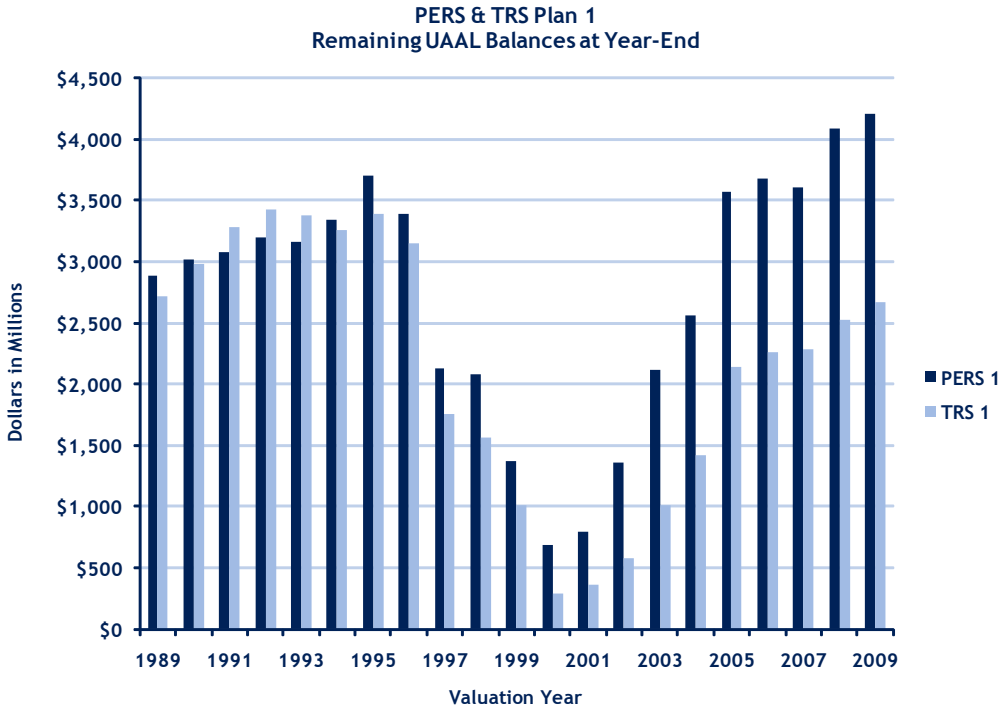


**For illustration only. Expected year-end balance per $1 million of UAAL.*

Having a target payoff date with a back-loaded financing plan greatly increases financial risk. For example, a significant downturn in the market that occurs close to the final pay-off date does not allow time for plan asset values to recover. This means that the chance of running out of money prematurely will increase significantly as the pay-off date for a closed plan approaches.

If a plan runs out of money prematurely then benefits must be paid from annual operating budgets on a pay-as-you-go basis (contributions made as benefits come due). These payments are in addition to normal pension costs. We refer to this as "pay-go" risk. While small pay-go amounts can usually be accommodated at the very end of a plan's life, significant pay-go amounts create challenges for employer budgets.

Figure 2.14



Changing short-term economic conditions can also affect legacy costs. When markets are strong and returns are higher than the long-term expectation, UAAL balances decline. This can lead to a false sense of security. **Figure 2.14** shows how UAAL balances followed a similar path to employer contributions for PERS and TRS generally. The "happy valley" of low UAAL balances in the late 1990s and early 2000s was accompanied by missed payments for legacy costs.

A general "reconciliation" of financial events affecting legacy costs helps explain why legacy costs persist today. Negative amortization, missed contributions and benefit improvements increased legacy costs over the last two decades. There were some offsetting decreases during the past twenty years as well, including investment experience gains.*

** Note: Investment experience gains are returns in excess of the investment target of 8 percent.*

We mentioned earlier that investments were on track and the average annual rate of return was 8.23 percent over the past twenty years. That measure was on a "time-weighted" basis - a common practice for measuring and reporting the returns for an investment portfolio. In this case, it represents a measurement of investment performance for the CTF for all the plans.

For this reconciliation, we measured returns on a "dollar-weighted" basis. This allowed us to account for investment gains and losses on the annual cash flows of each individual plan. Since each plan has different cash flows, the rate of return will vary for each plan.

Dollar-weighted returns for PERS 1 and TRS 1 exceeded 8.23 percent for the twenty-year period due to the fortunate timing of each plan's cash flow. These plans started the twenty-year period with their largest asset base, which coincided with the period of most favorable investment performance. The Plan 1 UAAL would be much higher today if this were not the case.

Figure 2.15 summarizes major sources of change in PERS 1 and TRS 1 legacy costs (UAAL) over the past twenty years.

Figure 2.15

Reconciliation of UAAL Changes*		
(Dollars in millions)	PERS	TRS
Starting Balance (6/30/1990)	$3,000	$3,000
Negative Amortization	3,000	1,900
Investment Experience Gains	(4,400)	(3,700)
Funding Shortfall	500	500
Benefit Improvements	2,000	1,400
Liability / Other	100	(400)
Ending Balance (6/30/2009)	$4,200	$2,700

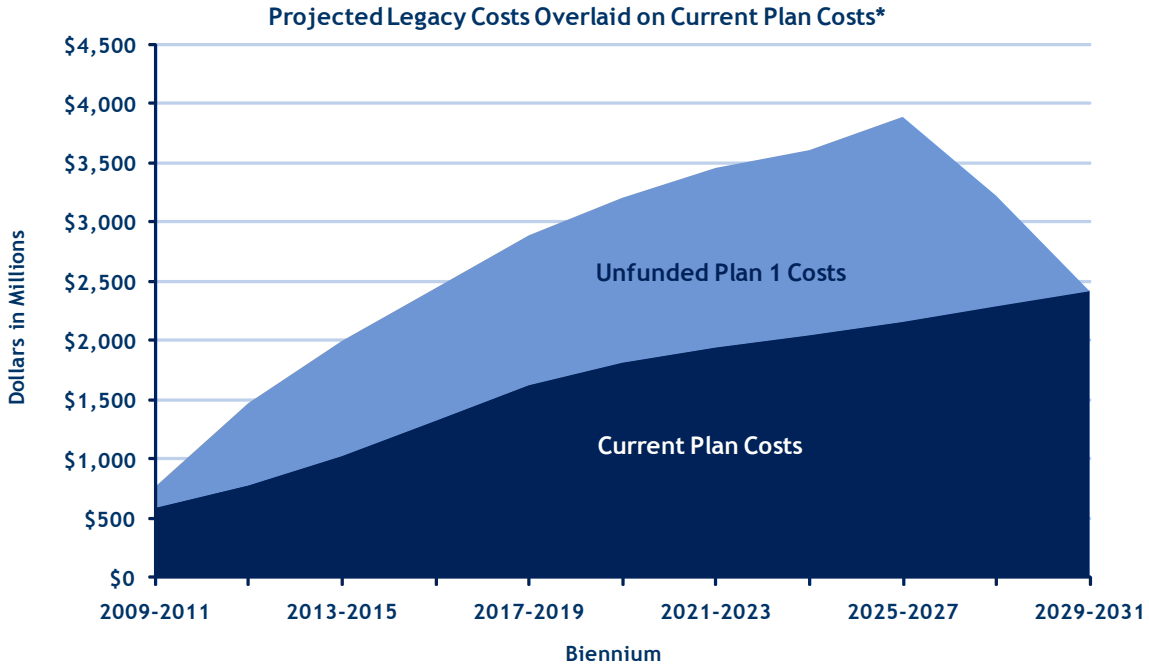
**Results rounded to nearest $100 million.*

Today, the remaining legacy costs are helping to drive large contribution rate increases. Part of the restructuring of the Plan 1 funding method in 2009 was to manage the very large spikes in Plan 1 UAAL contribution rates that would have been necessary to pay off the Plan 1 legacy costs by 2024.

The new PERS 1 and TRS 1 funding method eliminated negative amortization - if all required contributions are made. Still, it will take about two decades for the legacy costs to be retired. And in the meantime, those costs will continue to overlay current plan costs.

To summarize, we observed that risks for closed plans are different than risks for plans with an unlimited time horizon. In particular, large spikes in contribution rates and pay-go risk are more of a concern in Washington's closed plans. Our review of PERS 1 and TRS 1 legacy costs showed how significantly these costs are affecting employer costs today. It also shed light on the importance of a funding policy for closed plans that supports the long-term financing plan for pensions.

Figure 2.16



Based on the OSA 2008 Actuarial Valuation and projected under the expected investment scenario.

Recap of Past Twenty Years

We reviewed the past to gain insight about where we are today. First we looked at pension income. We saw that investments were on track over the twenty-year period. On the other hand, underfunding decreased pension income while benefit improvements increased plan costs.

We looked at state revenue growth to gain more insight into underfunding. We saw significant volatility, especially in the most recent decade of the past twenty years. This volatility was very similar to investment volatility and in fact, the two moved together over the period. Still, the investment volatility was not unexpected but was anticipated by long-term investment policy. And for the twenty-year period, investment volatility was less than expected.

The second (most recent) decade of the period was the most volatile. This was also the decade that was marked by underfunding. When investments were down, revenues were also down, making contributions more difficult to make. Also it was more difficult to make required contributions when the previous year's contributions had been lower than required.

Even when revenue growth peaked in the middle of the second decade, contributions were still roughly half of what was required. And even after the positive track record of the first decade, pension contributions were only enough to fund the largest state-administered plans (on a total plan basis) at an average rate of 80 percent for the twenty-year period.

Meanwhile, benefit improvements during the entire twenty-year period added significant liabilities. One of the most significant improvements, gain-sharing, was a short-term reaction to positive investment volatility.

Finally, overlaying the financing plan for pensions during the past twenty years was a second financing plan for PERS 1 and TRS 1 legacy costs. This overlay was based on negative amortization. Negative amortization provided what appeared to be a manageable extended payment plan, but shifted payment of the principal liabilities to the end of the payment period.

The previous financing plan for legacy costs produced spiking contribution rate requirements following the asset losses from 2008-2009 and exacerbated the pay-go risk for PERS 1 and TRS 1. In 2009 the Plan 1 funding method was revised to eliminate negative amortization and remove spiking contributions. Still, these legacy costs persist and remain a significant liability today.

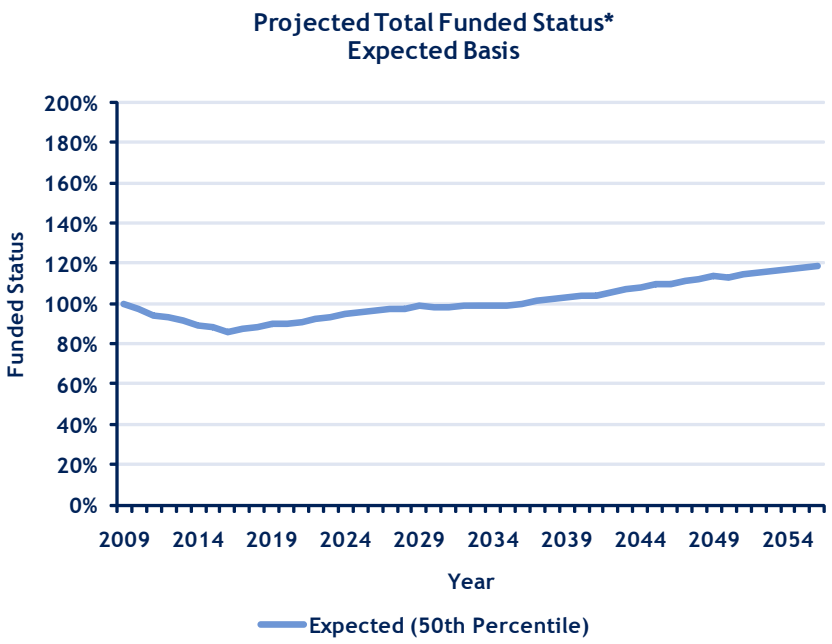
Possible Future Outcomes

This section of the report looks at where the pension plans are headed. This section also introduces OSA's new model. The model can show us not only expected outcomes, but also a full range of possible future outcomes. We used the model to explore outcomes that could occur if policy makers continue to manage the state's pension enterprise according to past patterns or "past practices." We also looked at how outcomes could change if policies or practices change.

Traditional Analysis Can Show Where Plans Are Headed

For many years Washington has used funded status as an indicator of pension plan health. The graph on the following page is an example of how we have traditionally projected the total funded status for the plans. Notice that there is only one line on this graph. This line represents our best estimate of what we expect the funded status to be in the future. In the words of the actuarial profession, our traditional projections have been "deterministic."

Figure 3.1

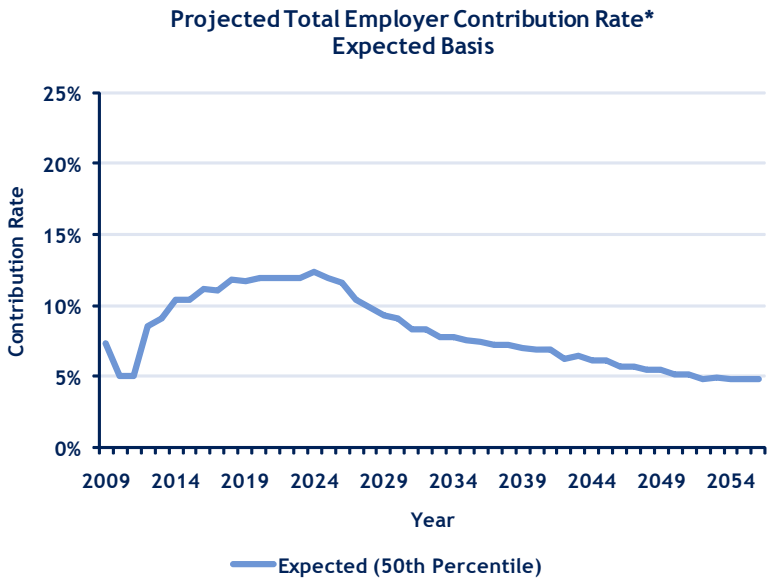


**Total funded status for illustration only. Actual funded statuses vary by plan.*

Figure 3.1 shows that we expect the total funded status for the state-administered retirement systems to decline in the near term with a return to full funding in 2036. This decline is due to the recognition of deferred asset losses from 2008-2009. The deferral occurs because of our asset smoothing method.

We also project future contribution rates to help policy makers plan ahead for future budgets. Projected contribution rates give cues about the future affordability of pensions. **Figure 3.2** is an example of a traditional projection of the expected total employer contribution rate for the plans. Again, there is only one line representing our best estimate of what we expect the total contribution to be in the future.

Figure 3.2



*Total contribution rate for illustration only. Actual contribution rates vary by plan.

Figure 3.2 shows the expected total employer contribution rates peaking at 12.37 percent in 2024 and then gradually declining over the long term.

Neither figure (3.1 or 3.2) informs the user about the likelihood or magnitude of other possible outcomes. Some of these outcomes create risks that might jeopardize the health of pensions, or challenge employer budgets in ways that might be very difficult to accommodate.

New Model Shows Possible Future Outcomes in More Detail

As part of the risk assessment, we wanted to do more than project expected future funded status and contribution rates. While these projections are helpful, they do not fully describe the long-term funding dynamics of pensions. Also, they don't tell the whole story because they don't identify many of the financial risks that pension plans face.

We wanted to look at how the plans behave over time and how they respond to changes in their environment. Of particular concern to us was looking more extensively at pension risks. We wanted to identify, quantify, and communicate the risks, especially those directly impacting pension costs.

We also wanted to learn more about the risks or variability that Washington's pension plans could face over the long-term. Traditional actuarial analysis focuses on what we *expect* to see in the future. However, there are also risks associated with what we *don't expect*. To evaluate the unexpected, we would need to see a full range of possible future outcomes.

OSA expanded its analysis.

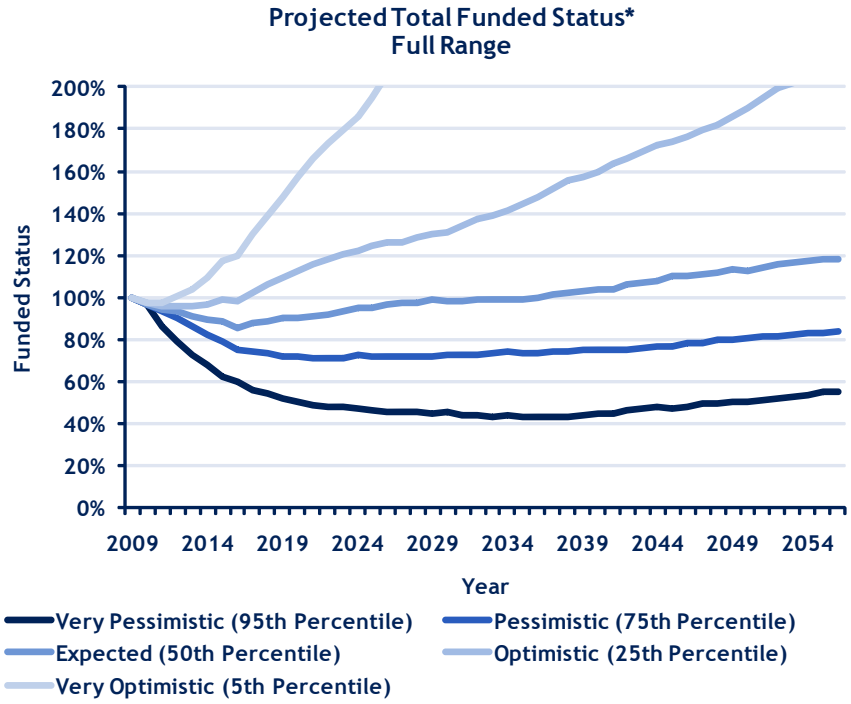
We considered whether our existing tools would fully accommodate this goal, and decided to enhance our analysis by developing a new actuarial model with a stochastic component. The "stochastic" or "probabilistic" component is the part of the model that randomly generates thousands of fifty-year economic paths, allowing us to view a complete range of possible outcomes - including even the most unexpected events.

While we have performed some stochastic analysis related to pensions in the past, the focus has been mostly on investment outcomes and not on funding or benefits policy. Also, we have not included revenue growth as a factor in our stochastic projections until now.

We also used dynamic modeling so we could see the potential reactions to outcomes generated by the stochastic component. Dynamic modeling shows us how a change in one area of interest or concern can affect outcomes in other areas. This approach can provide policy makers with more data about the consequences of various risk management strategies.

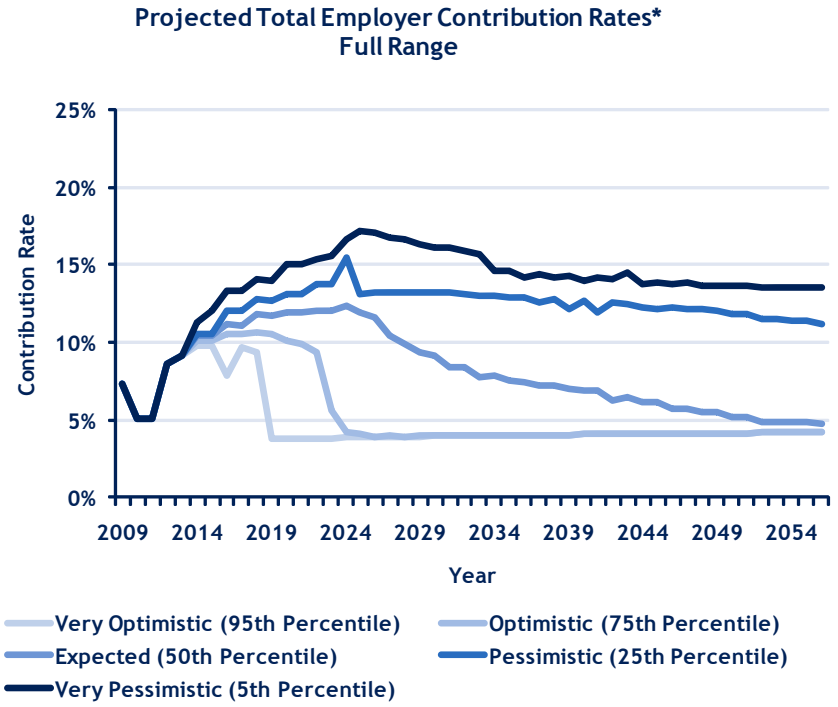
Figures 3.3 and **3.4** illustrate the kind of output that such a model can produce.

Figure 3.3



**Total funded status for illustration only. Actual funded statuses vary by plan.*

Figure 3.4



**Total contribution rate for illustration only. Actual contribution rates vary by plan.*

Key Considerations for Building the New Model

The annual rate of investment returns is a key assumption.

Earlier in this report we mentioned that investment returns generate roughly 75 percent of the income to the pension trust fund, and thus cover about the same percentage of pension costs. This being the case, the assumption we make about investment returns is very important to the model and the results it generates.

We used the 8 percent annual rate of return assumption adopted by the Legislature in RCW 41.45.035 to model pension costs. We also used the WSIB capital market assumptions to model asset returns, and to estimate the annual volatility we can expect to see around the long-term average rate of return. You can read more about these assumptions in the Appendix.

We set two new assumptions about behavior.

Traditional actuarial analysis determines funding requirements at a particular valuation date based on current law. To do that, it makes fundamental and implicit assumptions about pension plans:

1. Required contributions will always be made.
2. Benefits will not be improved.

As demonstrated by our twenty-year look-back, actual plan experience tells a different story. What does this mean for systematic actuarial funding? Plan costs will be higher than what we've projected if this mismatch between assumptions and experience continues.

To model the effects of continuing past practices, we used twenty years of historical data to create new assumptions about funding policy and benefits policy. We set assumptions for each based on this data. The model allows us to turn these assumptions on and off. By looking at different scenarios for the future we see how risk behaves and can compare the effects of different actions or policies.

To model a continuation of past practices, we assumed the Legislature would not always make required contributions.

In order to set assumptions about the rate at which contributions would be made, we considered plan experience since 1989. We chose that date because that's when pension funding reform was enacted to establish a new procedure for adopting contribution rates. We reviewed historical records to compare the actuarially required contribution rates with the actual contribution rates adopted.

We found a history of underfunding during the last two decades. For the largest plans in the state retirement systems, the Legislature set contribution rates at about 80 percent of what was recommended in the applicable actuarial valuations for the period. See **Figure 2.2.** For more information about this assumption please see the Appendix.

To model a continuation of past practices, we assumed that the Legislature would improve benefits.

In order to set an assumption about the rate at which benefit improvements would be made, we again looked to plan experience. We examined historical records since 1989 - again using the date of the Pension Funding Reform Act - to determine what benefit improvements had passed the Legislature and how much they cost.

We found a history of improving benefits, including the ongoing smaller increases we called "creep," and the occasional but significant benefit increases we called "spikes." This history is summarized in **Figure 2.3** (in the previous section of this report), and identifies the most significant benefit improvements during the period.

Generally, we assumed that benefit improvements would increase overall plan liabilities by 0.45 percent per year for the largest plans. We did not have enough data to statistically correlate the large spikes with other events or assumptions. We simply raise the issue that such spikes have existed in the past and might exist again in the future. For more details on the behavioral or response variables related to benefits policy, see the Appendix.

We have the ability to turn these behavioral assumptions on and off when projecting future outcomes. We can also modify these assumptions and look at the change in outcomes. Thus the model can show us what the range of outcomes could be if the responses of the past continue, and what the outcomes could be if the responses are deliberately changed.

The annual change in revenue growth is another important economic variable.

We included revenue growth assumptions in the model in order to observe how the annual change in revenue might be tied to other pension variables or assumptions, including investment returns. We also modeled future levels of revenue to evaluate the affordability of pension in the future.

The building blocks of revenue growth are population growth, inflation, and productivity or "real" growth. (Productivity growth is economic growth over and above inflation and population growth.) You can observe the correlation between real revenue growth and investment returns in **Figure 2.5**. You can also view the details of how we developed our assumptions about revenue growth in the Appendix.

To summarize our key considerations in building the new model, we incorporated assumptions about investment returns and revenue growth, and how the two interacted. We also set new behavioral or response variables in two areas: 1) the rate of underfunding due to missed contributions; and, 2) the rate at which benefit improvements add liabilities to the plans. These new assumptions helped us model how continuing past practices could affect possible future outcomes.

The model also incorporates statutory assumptions from the actuarial funding chapter of state law as well as WSIB's capital market assumptions. Please see the Appendix for a discussion of all the other assumptions we incorporated into the model, including assumptions normally used to perform annual valuations for the pension systems. We highlighted particular stochastic assumptions in this report because of their unique contributions to this risk assessment.

We will continue to monitor the assumptions we made for the model to see if they are consistent with experience over time. In the meantime, it is important for our audience to know that results can change if assumptions change. To better disclose this point, we illustrate what can happen to our results if our assumptions are too optimistic or too pessimistic. We call this "sensitivity analysis," and included it in the Appendix.

What Are the Future Outcomes from Continuing Past Practices?

We used the model to evaluate future outcomes for pensions based on continuing the policies and practices of the past. We included this analysis because it gives us insights into the risks inherent in the system as it is now managed. Also, it serves as a point of comparison for outcomes that can occur if future policies or responses change.

We used affordability and risk measures to summarize our results.

We developed a **pension score card** to summarize and evaluate outcomes from the model. The purpose of the score card is not to grade the pension systems. Instead, the score card is simply a summary of results from the model. The goal is to facilitate users' ability to see and compare scores from other scenarios.

The scores are relative, not absolute - they simply show how risk measures change from one scenario to the next. It is more important how each score compares to scores from other scenarios than whether the score is high or low.

To arrive at a score, we selected measures that reflect affordability for pensions and measures that reflect risk. We included both types of measures because we know policy makers must balance financial risk with affordability. We describe the measures in more detail below.

Future score cards could add another dimension of measures for policy makers to balance, such as measures related to benefit adequacy. For the purpose of this report, however, we decided to focus on just two categories of measures, with three measures for affordability and five measures for risk.

We also assigned a weight to each measure. A different score card could be developed with different measures and/or different weights depending on the values of the user. Also, different weights could be assigned to reflect the values of different users.

The score card in **Figure 3.5** applies to the pension systems as a whole. (We provide plan-specific measures in the Appendix.) The measures in this score card summarize results from the model based on continuing the practices we observed from the twenty-year look-back. An explanation for each category follows.

Figure 3.5

Pension Score Card - Continue Past Practices			
Category *(Dollars in Billions)*		**Value**	**Score**
Affordability			
	Chance Pensions will Consume More than 8% of GF-S[1]	18%	37
	5% Chance GF-S[1] Consumption will Exceed	9.9%	39
	5% Chance Employer Contribution Rate will Exceed	20.1%	44
Risk			
	Chance of PERS 1, TRS 1 in Pay-Go[2]	41%	19
	Chance of Open Plan in Pay-Go[2]	13%	47
	5% Chance Annual Pay-Go Cost[3] in PERS 1, TRS 1 Exceed	$1.7	38
	5% Chance Annual Pay-Go Cost[3] in Open Plans Exceed	$4.0	11
	Chance of Total Funded Status Below 60%	34%	24
Total Weighted Score			**33**

[1] *Currently 2.7% of GF-S.*

[2] *When today's value of annual cost exceeds $50 million.*

[3] *Pay-Go costs on top of normal pension costs.*

What affordability measures did we focus on? First, we know that employer contributions to pensions now consume approximately 2.7 percent of the state's General Fund-State (GF-S) expenditures. For more information on the state's budget, see "*A Citizen's Guide to the Washington State Budget*" at the following link: http://www.leg.wa.gov/Senate/Committees/WM/Documents/Publications/BudgetGuides/2010/CGTB2010Final_3.pdf.

We set our first affordability measure to answer the following question:

- What is the probability that pensions will consume more than 8 percent of the GF-S budget?

We felt that an increase from 2.7 percent to 8 percent of the GF-S was significant enough to be of concern to policy makers.

Finding: If past practices continue, there is an 18 percent chance that the portion of employer contributions allocated to pensions will exceed 8 percent of the GF-S budget.

For our second and third affordability measures, we wanted to identify outcomes that have a one-in-twenty or 5 percent chance of occurring. We applied our own risk tolerance, using 5 percent to reflect a probability that is significant enough that we think policy makers might want to consider it or take it into account. In other words, outcomes with a 5 percent probability of happening are statistically significant, or not highly improbable. We respect that different users may have different values or risk tolerances, and the scoring could be adjusted to reflect those.

Our second affordability measure answers the following question:

- Based on outcomes that have a 5 percent chance of occurring, what percentage of the GF-S budget will employer contributions consume?

Finding: If past practices continue, there is a 5 percent chance that employer contributions to pensions will consume in excess of 9.9 percent of the GF-S budget.

Our third affordability measure focuses on contribution rates. It answers the following question:

- Based on outcomes that have a 5 percent chance of occurring, employer contribution rates will exceed what percentage of employee pay?

Finding: If past practices continue, there is a 5 percent chance that employer contribution rates will exceed 20.1 percent of employee payroll. In contrast, the current total employer contribution rate for the state administered plans is 7.37 percent of employee payroll.

Note: This is a total plans measure and is not plan specific. For a plan by plan summary, please see the Appendix.

Next we turn to risk measures. We identified several measures focused on pay-go risk. These measures help us understand the chance of an open plan running out of money; or in the case of a closed plan, the chance of running out of money prematurely. In a closed plan, running out of money prematurely means the plan's trust fund is exhausted before the ongoing benefit payments are so small that they can reasonably be accommodated within annual operating budgets. According to our risk measure, a plan runs out of money prematurely when the trust fund can no longer pay benefits with a present value that exceeds $50 million.

We assumed that employers would want to avoid paying significant non-discretionary amounts for pensions out of their annual operating budgets, as this would cause a significant jump in annual government expenditures. Thus, we felt that premature pay-go risk was something that all employers would want to avoid, especially since most pension obligations are contractual and not easily repealed or reduced.

To address pay-go risk, we used measures that would answer the following questions:

- What is the chance that PERS 1 or TRS 1 will prematurely run out of money?
- What is the chance that an open plan will run out of money?
- Based on outcomes that have a 5 percent chance of occurring, how much is the PERS 1 or TRS 1 pay-go cost in today's dollars?
- Based on outcomes that have a 5 percent chance of occurring, how much is the open plan pay-go cost in today's dollars?

Findings: We found that if past practices continue, there is a 41 percent chance that PERS 1 or TRS 1 will prematurely become pay-go, and a 13 percent chance that an open plan will prematurely become pay-go.

Findings: There is a 5 percent chance that the annual pay-go cost in PERS 1 or TRS 1 will exceed $1.7 billion. There is a 5 percent chance that the annual pay-go cost in any open plan will exceed $4.0 billion.

Finally, we included a measure related to the plans' "funded status." Funded status measures the actuarial assets on hand for paying the "earned" liabilities of a pension plan at a particular point in time. If the plan has a funded status of 100 percent, then there is a dollar of actuarial assets for every dollar of accrued liability ("earned" benefits) as of that date.

When a plan's funded status drops below 60 percent, we consider the plan to be "at risk." To put this threshold into context, we reviewed federal requirements for qualified private sector pension plans. We noted that a single employer plan with a funded status of below 60 percent is subject to strict regulations, including a requirement that future benefit accruals cease.

Private sector plans calculate their funded status based on market value measures of both assets and liabilities. We use the actuarial value with longer asset smoothing and a long-term interest rate assumption. If we were to calculate the funded status for our public plans the same way that private plans do, our current funded status would be much lower.

We also noted another federal law applicable to these private sector plans. They are prohibited from increasing benefits if the funded ratio would be less than 80 percent after the plan is amended, *unless* the employer immediately contributes the full value of the amendment to the pension fund. The goal is to prevent insolvency and, ultimately, takeover by the Pension Benefit Guarantee Corporation, an

independent agency of the United States government. Our state-administered public pension plans are not subject to these kinds of federal laws or restrictions, nor is there an opportunity to transfer liability to another entity.

With this context in mind, we chose a risk measure for funded status that would answer the following question:

- How likely is it that total funded status for all plans will drop below 60 percent (or become "at risk")?

Finding: If past practices continue, there is a 34 percent chance that the total funded status for all plans will drop below 60 percent.

We scored each measure, applied the weighting, and came up with an overall pension score. The overall pension score card for the scenario we call "Continue Past Practices" is 33. As we mentioned earlier in our description of the score card, the overall pension score is not as important as how the score compares to scores from other scenarios.

The **risk/affordability comparison** is another way to view the results from the pension score card at a glance. We know that risk can be reduced or eliminated if enough money is spent, but that cost may not always be affordable. Policy makers often have to balance financial risk and affordability.

Figure 3.6

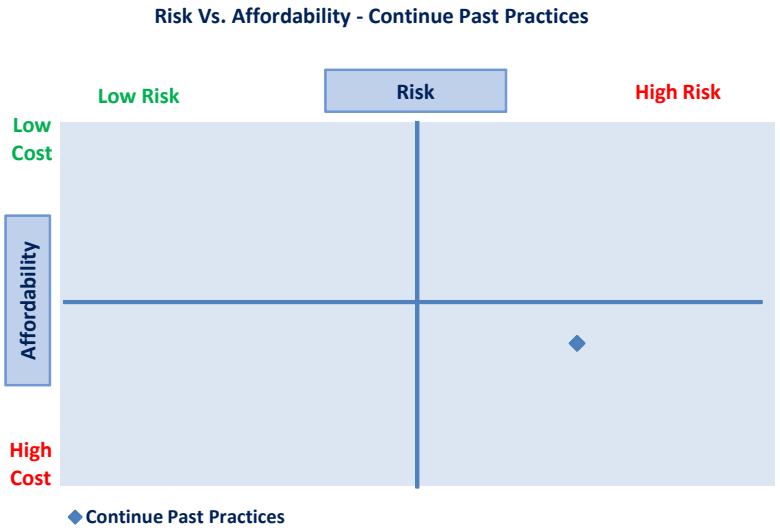
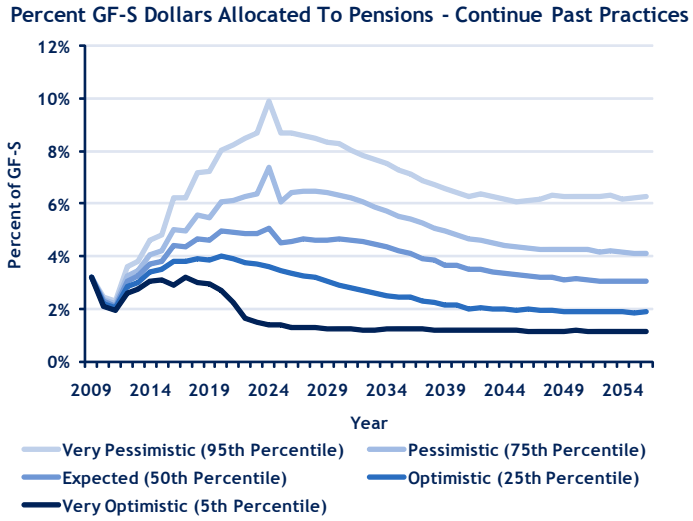


Figure 3.6 shows the balance between risk and affordability based on the measures and scoring we just discussed as elements of the pension score card. A scenario will have the most positive effects (lowest financial risk and most affordability) when the indicator is in the northwest quadrant.

We are displaying the risk/affordability comparison for continuing past practices. The blue diamond is in the southeast quadrant. Why? As we mentioned earlier, the total funded status for the plans is declining. Also, outcomes from the risk model showed significant pay-go risk in the Plans 1 as well as affordability challenges for all plans, especially in the near term.

We also developed a visual summary of fifty years of outcomes for the percent of **GF-S dollars consumed by pensions**. We presented five lines ranging from very optimistic (5th percentile) to very pessimistic (95th percentile). **Figure 3.7** shows that if past practices continue, there will be steep increases in the short-term with amounts starting to level out after about year 2024. Note that future pension costs would return to where they are today only under optimistic and very optimistic outcomes.

Figure 3.7



Finally, we visually summarized the likelihood and magnitude of **future pay-go risk** in any state-administered plan, excluding LEOFF 1. In **Figure 3.8**, the left axis is the probability or percentage chance of a plan prematurely running out of money. We used the shaded area to track the probability of pay-go risk over time. The area shaded in blue represents PERS 1 and TRS 1 (both closed to new entrants) and the area shaded in brown represents the open plans.

The right axis is the present value of annual pay-go costs in the event that a plan runs out of money. We used the blue and brown lines to track this value for the closed and open plans.

If past practices continue, pay-go risk looks like this:

Figure 3.8

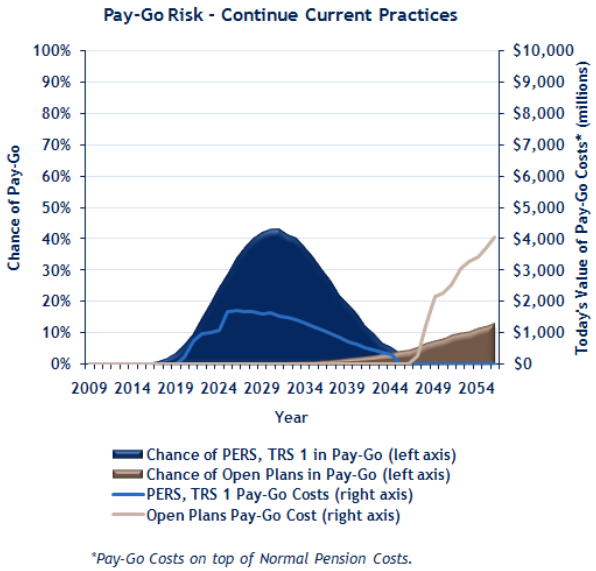


Figure 3.8 shows a 41 percent probability that PERS 1 or TRS 1 will reach pay-go status around 2030. Within the next several decades, the annual Plan 1 pay-go costs could exceed $1.7 billion in today's dollars. These are the same risk measures we used in the pension score card. Also, as we described earlier in this report, this risk reflects the effects of Plan 1 legacy costs.

Pay-go risk does not start to come into the picture for the open plans for several decades. The risk is 13 percent by the end of the fifty-year period. Should that occur, the annual costs could exceed $4.0 billion in today's dollars.

The pay-go dollars identified in **Figure 3.8** are *in addition to* on-going pension costs. Most of the pay-go risk in the open plans is driven by the TRS 2 member maximum contribution rate. RCW 41.45.061(1). When the maximum member rate is triggered, employers must absorb the excess, which drives employer rates even higher. All pay-go risk is borne by employers in this case, not members.

In the Appendix, we have included graphic summaries of output from the model for each plan. We did not include this information in the main body of the report because we wanted to manage the report's length. Please note that the Appendix includes an additional affordability measure for members. This measure was more appropriate for individual plans than for the aggregate summaries we used in the full report.

There Are Significant Financial Risks to Continuing Past Practices

Based on our observations of future outcomes from modeling a continuation of past practices, we found the following:

1. Pension contribution rates are increasing. We can expect to see contribution rates well above historical maximums in most plans.
2. Pensions will consume a greater portion of GF-S revenues in the future.
3. The total funded status for the plans is declining.
4. Past funding and benefit policies have created significant short- and long-term affordability challenges.
5. There is a significant pay-go risk for the PERS 1 and TRS 1 within the next three decades, and a lesser but significant pay-go risk for TRS 2/3 beginning in about three decades.

Figure 3.9 is our complete summary of possible future outcomes based on continuing past practices, and using the risk measures we selected for this report.

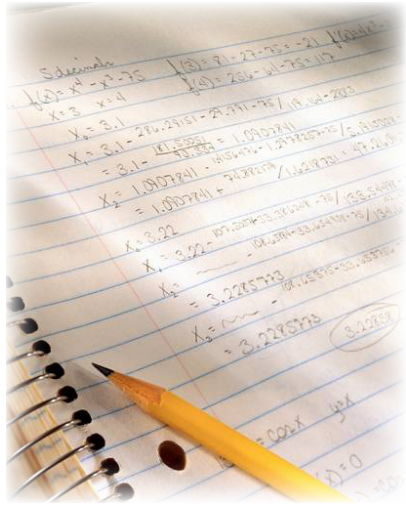


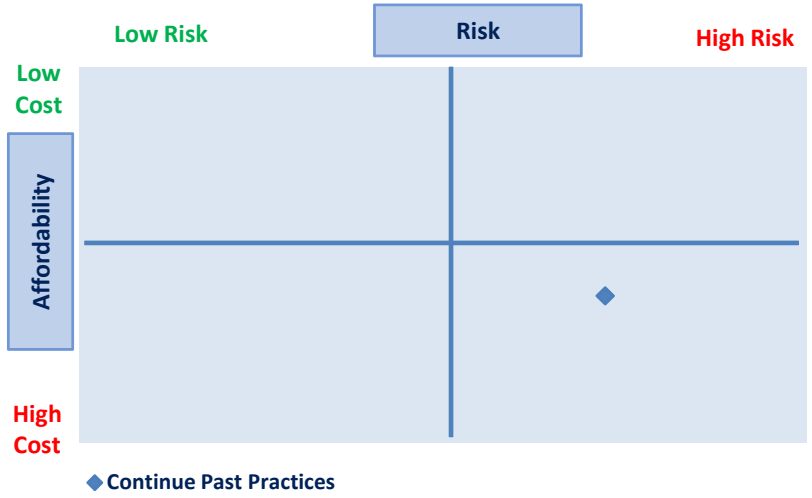
Figure 3.9
Risk Measures: Continue Past Practices

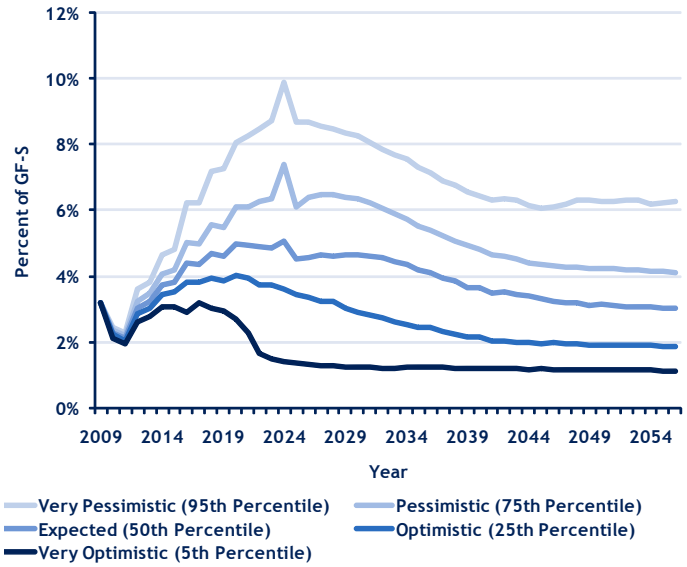
Pension Score Card		
Category *(Dollars in Billions)*	**Value**	**Score**
Affordability		
Chance Pensions will Consume More than 8% of GF-S[1]	18%	37
5% Chance GF-S[1] Consumption will Exceed	9.9%	39
5% Chance Employer Contribution Rate will Exceed	20.1%	44
Risk		
Chance of PERS 1, TRS 1 in Pay-Go[2]	41%	19
Chance of Open Plan in Pay-Go[2]	13%	47
5% Chance Annual Pay-Go Cost[3] in PERS 1, TRS 1 Exceed	$1.7	38
5% Chance Annual Pay-Go Cost[3] in Open Plans Exceed	$4.0	11
Chance of Total Funded Status Below 60%	34%	24
Total Weighted Score		**33**

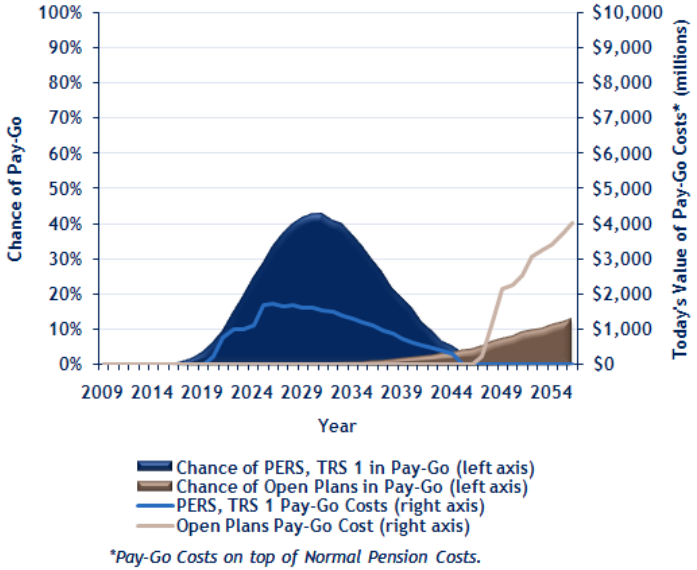
[1] *Currently 2.7% of GF-S.*

[2] *When today's value of annual cost exceeds $50 million.*

[3] *Pay-Go costs on top of normal pension costs.*







Other "Scenarios" Shed Additional Light on Future Outcomes

Next we observed how future outcomes for the pension systems might change under several scenarios. Scenarios are simply hypothetical events or policy changes. We did not choose these scenarios to predict the future or recommend solutions, but rather to help our audience visualize the dynamics of financial risk. We also wanted to illustrate how policy makers might use the risk model.

In order to make the report manageable we summarized only the key results from each scenario. We focused on outcomes related to affordability and risk and placed the results into the four formats we described earlier for the scenario we called "Continue Past Practices." These formats allow readers to quickly compare the outcomes from each scenario. The goal is to see whether the risk and affordability measures improve or get worse, and how much they change as policies change.

The scenarios in this report are just a sample of what we can model. Policy makers can identify other scenarios based on their priorities. We can generate results for specific plans or for all state-administered plans. And as previously stated, we can use different risk measures and apply different weighting and scoring according to the needs and values of various users.

We included results from the following additional scenarios in this report:

- **Contribute 100 Percent of ARC:** What if past practices continue, but 100 percent of Actuarially Required Contributions (ARC) are made in the future?
- **Eliminate Future Benefit Improvements:** What if past practices continue, but there are no benefit improvements in the future?
- **Contribute 100 Percent ARC and Eliminate Future Benefit Improvements:** What if 100 percent of ARC is made *and* no benefit improvements are passed by the Legislature in the future? This combination of assumptions is similar to the assumptions used in a traditional "current law projection." (Current law projections assume that the benefits structure currently in statute will never change and that all actuarially required contributions will be made every year. However current law projections do not show a full range of possible future outcomes.)

Making all required contributions significantly reduces risk, but affordability challenges remain.

Our twenty-year look-back revealed that the largest pension plans were funded at a rate of about 80 percent (or underfunded at a rate of about 20 percent). In contrast, we wanted to see how future outcomes could change if 100 percent of actuarially required contributions are made in the future. This scenario assumes that past practices in the area of benefit improvements continue, and isolates the effects of changing just the past funding policies.

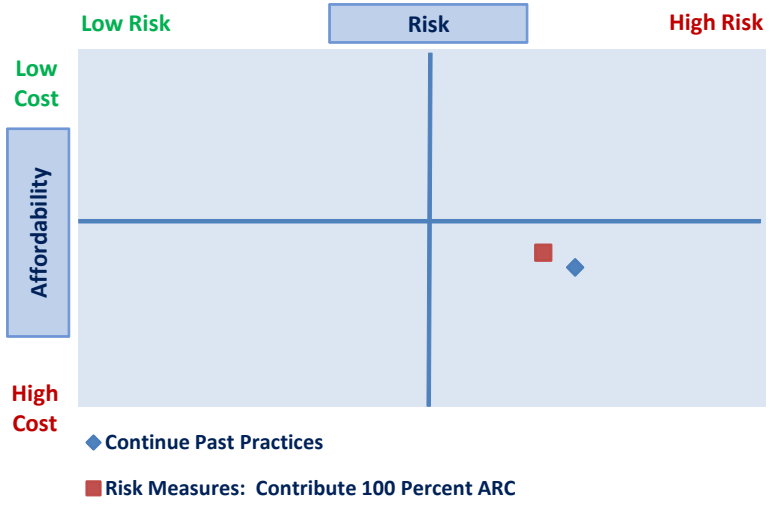
Figure 3.10
Risk Measures: Contribute 100 Percent ARC

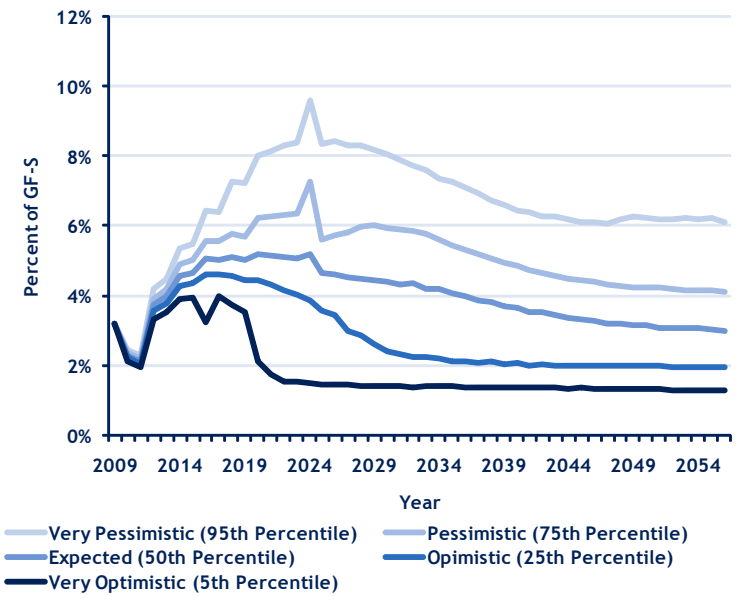
Pension Score Card		
Category *(Dollars in Billions)*	**Value**	**Score**
Affordability		
Chance Pensions will Consume More than 8% of GF-S[1]	16%	43
5% Chance GF-S[1] Consumption will Exceed	9.6%	43
5% Chance Employer Contribution Rate will Exceed	19.8%	45
Risk		
Chance of PERS 1, TRS 1 in Pay-Go[2]	29%	31
Chance of Open Plan in Pay-Go[2]	12%	48
5% Chance Annual Pay-Go Cost[3] in PERS 1, TRS 1 Exceed	$1.7	38
5% Chance Annual Pay-Go Cost[3] in Open Plans Exceed	$3.9	13
Chance of Total Funded Status Below 60%	29%	33
Total Weighted Score		**38**
Past Practice's Weighted Score		**33**

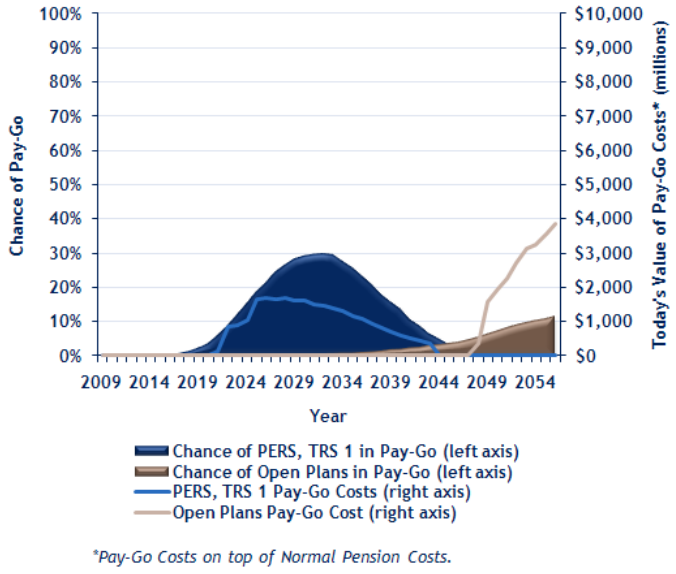
[1] *Currently 2.7% of GF-S.*

[2] *When today's value of annual cost exceeds $50 million.*

[3] *Pay-Go costs on top of normal pension costs.*







*Pay-Go Costs on top of Normal Pension Costs.

The biggest improvement from making 100 percent of the ARC is the reduction in the chance of pay-go risk in the closed plans. If 100 percent of the ARC is made in the future, the chance of PERS 1 and TRS 1 pay-go risk is reduced from 41 percent to 29 percent.

Under this scenario, the total score improves (from 33 to 38). Risk is reduced. The red square shows movement in a northwesterly direction, but it is still in the southeast quadrant. There are small improvements in near-term affordability, but long-term affordability is largely unchanged.

Eliminating future benefit improvements stops pay-go risk in the open plans.

Earlier we described how benefits policy over the last twenty years included small on-going improvements ("creep"), along with random and less frequent large improvements ("spikes"). This particular scenario explores future pension outcomes based on a benefits policy that would not allow any increases going forward.

We show this scenario simply to isolate the effects of past practices in the area of benefit improvements and show how risk and affordability measures for possible future outcomes are affected. For this scenario, we assume that past funding practices continue (that is, that 80 percent of required contributions are made).

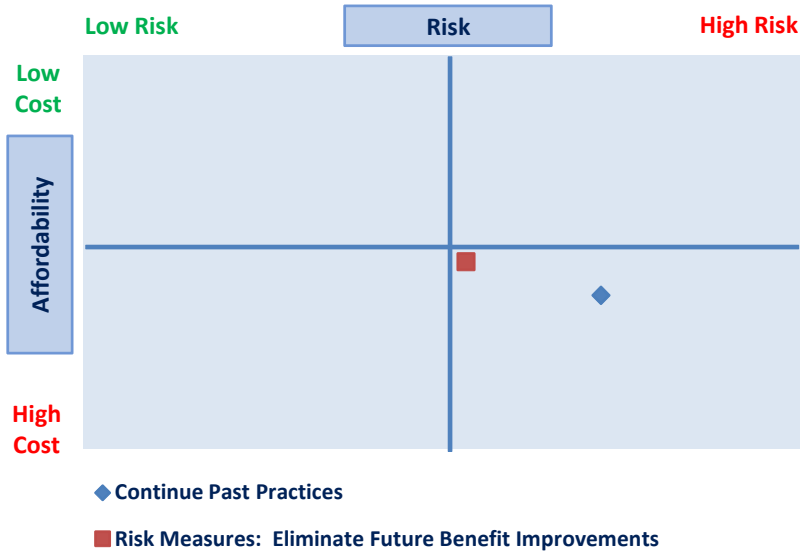
Figure 3.11
Risk Measures: Eliminate Future Benefit Improvements

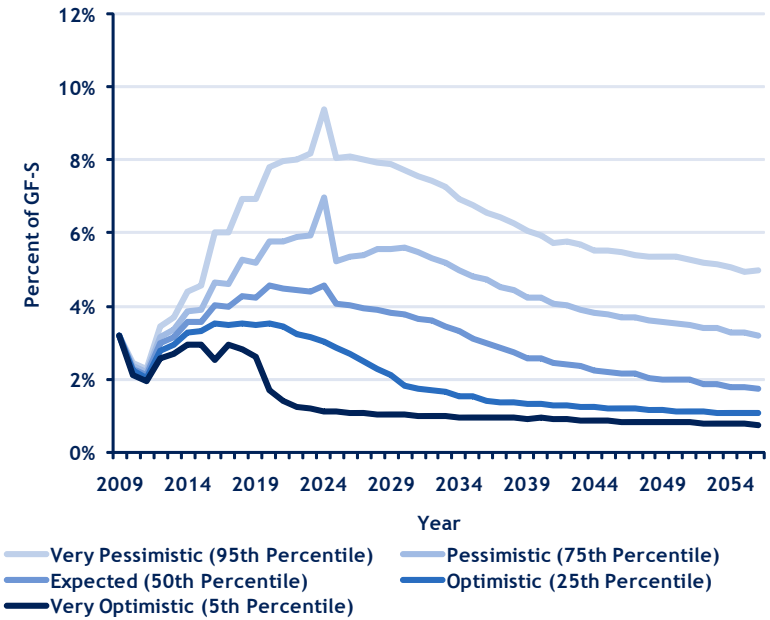
Pension Score Card		
Category *(Dollars in Billions)*	**Value**	**Score**
Affordability		
Chance Pensions will Consume More than 8% of GF-S[1]	14%	49
5% Chance GF-S[1] Consumption will Exceed	9.4%	45
5% Chance Employer Contribution Rate will Exceed	18.7%	49
Risk		
Chance of PERS 1, TRS 1 in Pay-Go[2]	26%	34
Chance of Open Plan in Pay-Go[2]	1%	59
5% Chance Annual Pay-Go Cost[3] in PERS 1, TRS 1 Exceed	$1.4	41
5% Chance Annual Pay-Go Cost[3] in Open Plans Exceed	$0.0	57
Chance of Total Funded Status Below 60%	23%	42
Total Weighted Score		**47**
Past Practice's Weighted Score		**33**

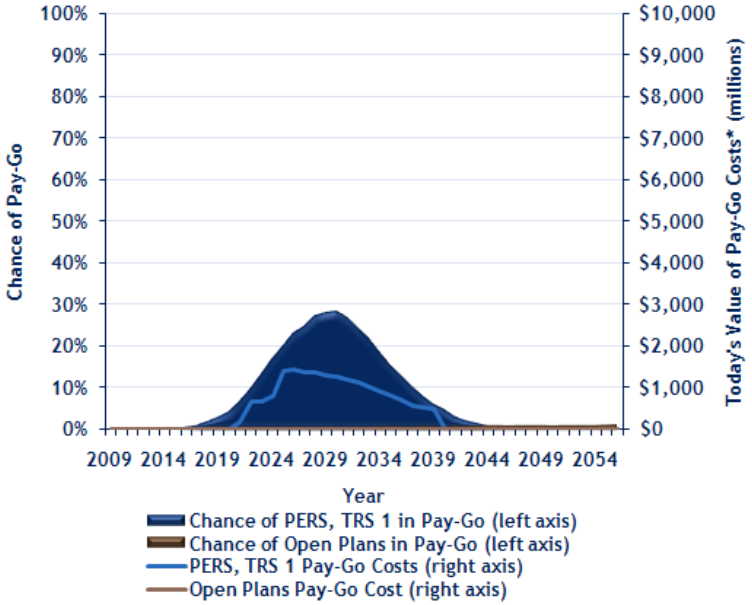
[1] *Currently 2.7% of GF-S.*

[2] *When today's value of annual cost exceeds $50 million.*

[3] *Pay-Go costs on top of normal pension costs.*







**Pay-Go Costs on top of Normal Pension Costs.*

Adopting no benefit improvements in the future would almost eliminate pay-go risk in the open plans, dropping it from 13 percent under past practices to one percent under this scenario. In the closed plans, this scenario reduces pay-go risk for PERS 1 and TRS 1 from 41 percent to 26 percent. Again, the total score improves (from 33 to 47).

This scenario slightly improves affordability, especially in the long run. Most short-term affordability challenges remain, although there is a slight improvement. Still, the red square showing the balance between risk and affordability is not in the northwest quadrant.

Making 100 percent of the ARC and eliminating future benefit improvements improves the risk/affordability balance.

Under this scenario, 100 percent of required contributions would be made and future benefit improvements would be eliminated. This combination is similar to what has traditionally been known as a "current law projection." Such projections typically assume that the same benefits structure currently in statute will continue into the future, and that all actuarially required contributions will be made each year.

Figure 3.12

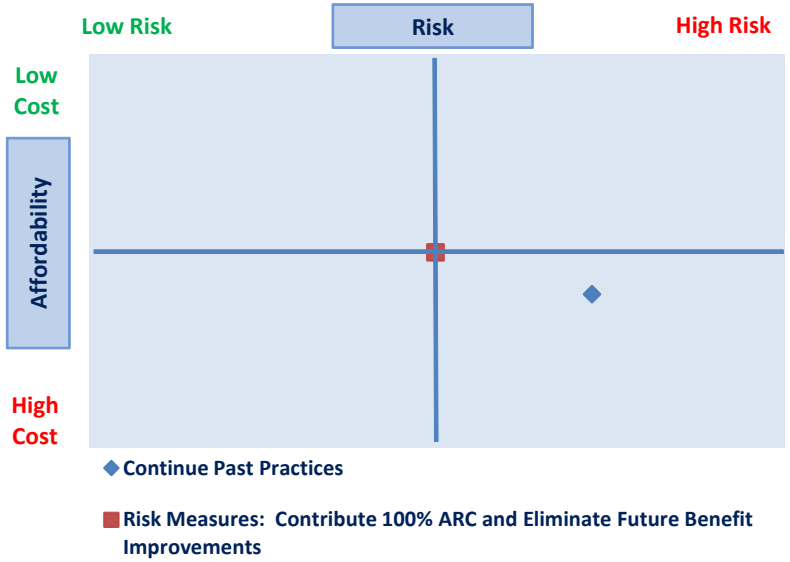
Risk Measures: Contribute 100 Percent ARC and Eliminate Future Benefit Improvements

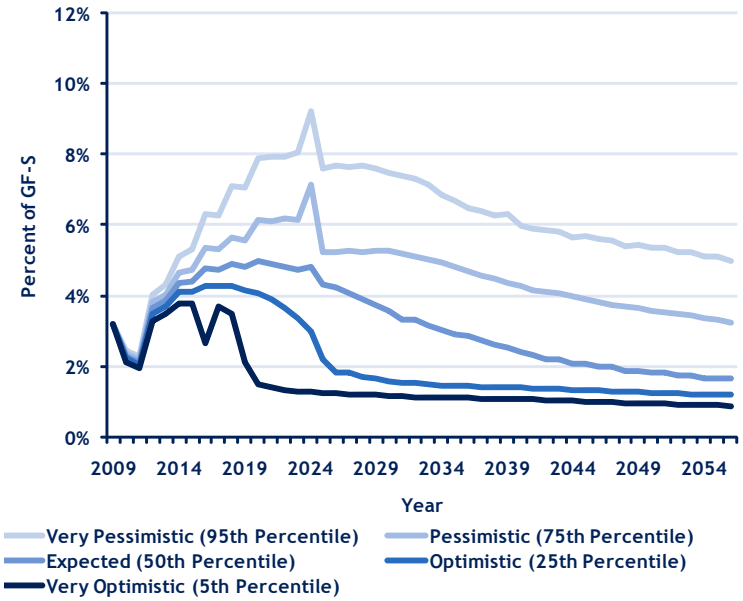
Pension Score Card		
Category *(Dollars in Billions)*	**Value**	**Score**
Affordability		
Chance Pensions will Consume More than 8% of GF-S[1]	14%	51
5% Chance GF-S[1] Consumption will Exceed	9.2%	48
5% Chance Employer Contribution Rate will Exceed	18.3%	51
Risk		
Chance of PERS 1, TRS 1 in Pay-Go[2]	16%	44
Chance of Open Plan in Pay-Go[2]	1%	59
5% Chance Annual Pay-Go Cost[3] in PERS 1, TRS 1 Exceed	$1.4	41
5% Chance Annual Pay-Go Cost[3] in Open Plans Exceed	$0.0	57
Chance of Total Funded Status Below 60%	17%	50
Total Weighted Score		**50**
Past Practice's Weighted Score		**33**

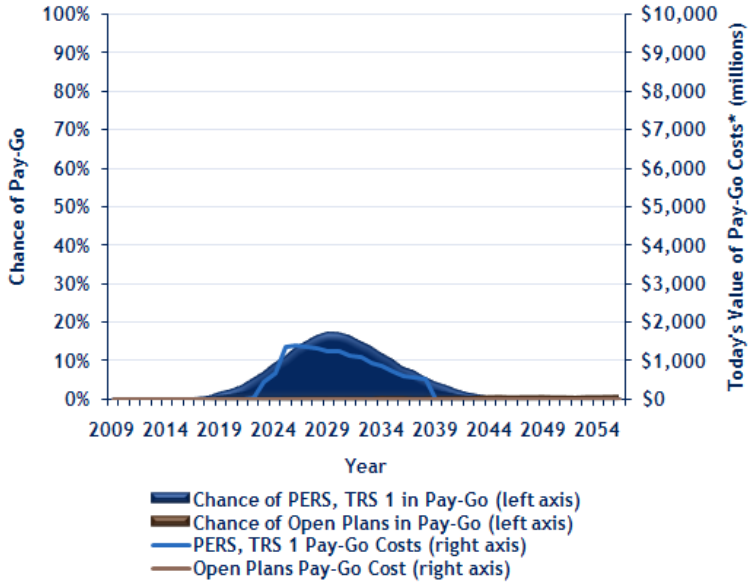
[1] *Currently 2.7% of GF-S.*

[2] *When today's value of annual cost exceeds $50 million.*

[3] *Pay-Go costs on top of normal pension costs.*







*Pay-Go Costs on top of Normal Pension Costs.

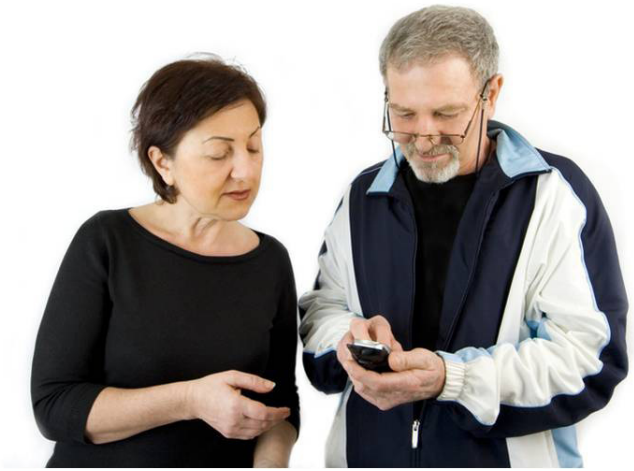
This scenario shows a better balance between risk and affordability. The total score improves (from 33 to 50). The red square moves just inside the northwest quadrant. Pay-go risk in the open plans is almost gone. And pay-go risk for the closed plans has been reduced from 41 percent to 16 percent.

Still there is a 5 percent (or one in 20) chance that pay-go costs for PERS 1 and TRS 1 will exceed $1.4 billion. These costs would be on top of normal pension costs. And there is still a 17 percent chance that the total funded status for the plans will drop below 60 percent, or into the "at risk" category. These risks prevent the red square from moving firmly into the northwest quadrant.

Affordability measures improve, but significant short-term challenges remain. And while long-term affordability looks better, there is still a 14 percent chance that pensions will consume more than 8 percent of the GF-S budget in the future. There is also a 5 percent chance that pensions will exceed 9.2 percent of the GF-S. Finally, there is a 5 percent chance that the total employer contribution rate for pensions will exceed 18.3 percent.

To summarize, results from the model show improvements in risk measures if 100 percent of all actuarially required contributions are made in the future and benefit improvements cease. Yet these courses of action may not be realistic. And significant risks and affordability challenges would still lie ahead.

Many of the challenges we face today are because of past responses and legacy costs. And we know from history that there can be significant external forces that can lead to future funding shortfalls and benefit improvements. So how does Washington move the red square firmly into the northwest quadrant? This is the challenge and opportunity for policy makers today.



The Next Step Is Risk Management

The drivers of financial health for pensions are investment policy, funding policy, and benefits policy. In the most fundamental sense, this is where the opportunities lie to improve risk and affordability measures for the pension enterprise.

Our analysis of the past two decades showed that investments have been on track. However, funding policy reacted to expected investment and revenue volatility in ways that resulted in underfunding. While this underfunding was occurring, benefit improvements added significant costs to the plans. The result is that the plans now face possible future outcomes that are marked by significant financial risk. Policy makers are also grappling with short-term affordability challenges in a very tough economic environment.

We observed that changing past practices improves the long-term outlook for pensions, but significant short-term affordability challenges remain. The new model provided quantitative rigor for our assessment, showing the likelihood and magnitude of future risks and their impacts on affordability.

We chose, scored, and weighted the risk measures we thought were most important. We focused on financial risk, our area of expertise. We reported on the areas of funding and benefits policy that we observed as having the most significant effects on financial risks today.

We also recognize that policy makers may have different values and priorities than ours. And they may be concerned about risks that we have not even identified in this report. Fortunately, the processes and tools we have created lend themselves well to custom analysis.

We encourage policy makers to consider what they most want to accomplish. What is success for the retirement systems? What risks would they like to avoid, reduce, eliminate, or transfer? We can then use the new tools to help evaluate strategies for changing possible future outcomes in ways that are consistent with their goals.

As we explored outcomes from the scenarios we just discussed, other possible risks to the pension systems came to light. The following are just some examples. We include these as possible areas for further discussion or exploration by policy makers.

There are litigation risks related to gain-sharing.

Gain-sharing was first implemented in 1998 to provide benefit increases to members of the Plans 1 in PERS and TRS. Later this benefit was added for the Plans 3 in PERS, TRS, and SERS. (Plan 2 members did not participate in gain-sharing.) These increases were contingent upon the occurrence of "extraordinary gains." Extraordinary gains were deemed to have occurred whenever the compound average of investment returns on pension fund assets exceeded 10 percent for the previous four fiscal years.

This trigger resulted in increases to the U-COLA in the Plans 1 and lump sum distributions into members' defined contribution accounts in the Plans 3.

The long-term cost of this benefit was neither recognized in advance nor pre-funded. Also, the benefit was identified by the Legislature as a non-contractual right. In 2007 the Legislature repealed gain-sharing and replaced it with other benefits. Immediately thereafter, certain stakeholders filed a lawsuit challenging the repeal and asking for reinstatement of the gain-sharing benefit.

The lawsuit is ongoing and its outcome is unknown as of the date of this publication. The plaintiffs seek to reinstate gain-sharing and retain the replacement benefits. This outcome would significantly reduce affordability and increase pay-go risk for the affected plans.

Member maximum contribution rates help drive pay-go risk.

When we examined outcomes from the model we saw that pay-go risk in the open plans was being driven largely by member maximum contribution rates. These plan features exist in TRS 2 and WSPRS.

When contribution rates increase to high enough levels under adverse economic conditions, the member maximums are triggered and the excess must be absorbed by employers. This drives employer rates even higher than they would be normally - and at times when they can least afford the increases. In these plans, all pay-go risk is borne by employers, not members.

There is pay-go risk and the potential for spiking contributions in LEOFF 1.

This risk may seem counter-intuitive since LEOFF 1 (a closed plan) has been well-funded for over a decade, and there were very few benefit improvements in this plan over the past twenty years. However, as we examined possible future outcomes for the percentage of GF-S allocated to pensions, we saw a spike around the year 2024. This spike is being driven by the funding method for LEOFF Plan 1.

The funding goal for LEOFF 1 has been to pay all unfunded past liabilities by 2024, the date by which all active members are expected to have retired. Beginning July 1, 2000, the Legislature suspended employer and member contributions - unless the most recent actuarial valuation indicates that the plan has unfunded liabilities.

The funding policy for LEOFF 1 is very basic. No contributions are made if the plan is fully funded. Actuarially required contributions must be made if the plan is not fully funded at any time prior to 2024.

The current funding policy does not fully address future pay-go risk because no contributions would be collected for the plan after 2024. There would be no active members to make contributions, and the funding policy assumes that employers would no longer make contributions either.

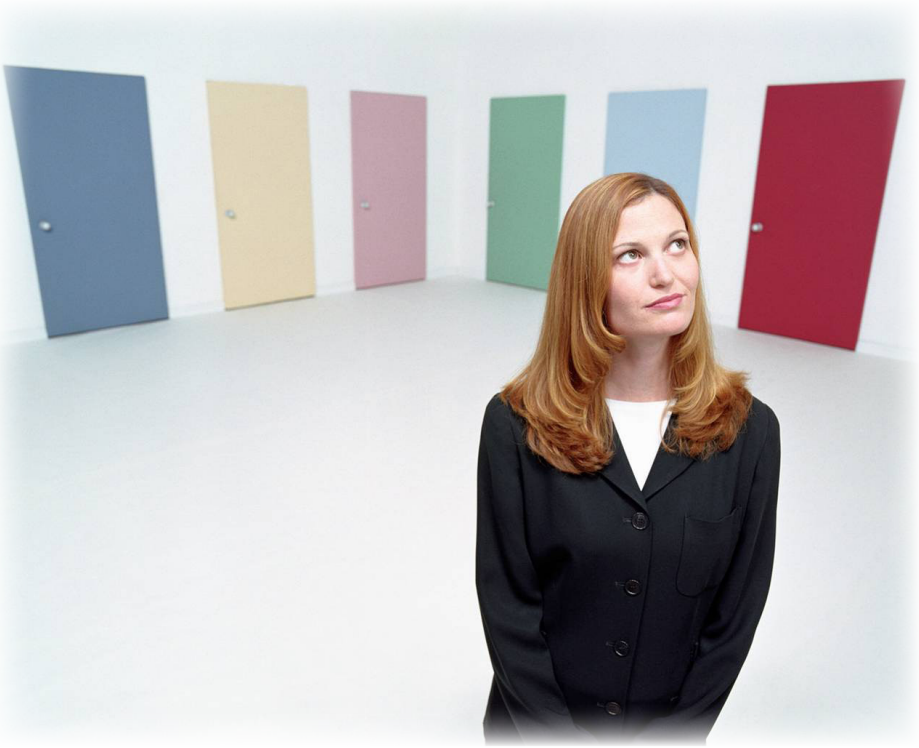
LEOFF 1 has a 41 percent chance of running out of money prematurely. There is a 5 percent chance that annual pay-go contributions could exceed $500 million in today's dollars starting in 2029. For more risk measures affecting LEOFF 1, please see the Appendix.

There are many other opportunities for further analysis.

OSA can analyze the risks we have discussed in this report in more depth if policy makers so choose. We also recognize that risk management is on-going. There will be a need to manage risks in many other areas of funding and benefits policy, even if they do not have as much financial impact on risk measures as those that we have included in this report.

On the benefits side, some examples of additional risks to manage are in areas of benefit adequacy, purchasing power, plan design, and plan complexity. Examples of such risks on the funding side are in the areas of contribution rate adequacy, rate stability, and rate affordability for employers and members. All of these can impact the optimum health of the pension systems.

Another area for proactive risk management is assumption risk. If the assumptions we use for the long-term financing plan are too optimistic, the result can be underfunding. If they are too pessimistic, the result can be overfunding. Some assumptions with the most significant implications for financial risk include the assumed annual investment rate of return, assumptions about retirement behavior, and assumed improvements in longevity.



Finally, we expect that policy makers will have many other ideas about risks they want to avoid and strategies or policy changes they'd like to evaluate. We look forward to sharing our expanded analysis, along with the new model. As we perform our future actuarial work, we will continue to monitor and update the model, quantify future risk, observe the balance between risk and affordability, and evaluate the consequences of risk management strategies.

We hope that these new tools contribute to increased understanding and improved risk management for the state's pension plans. Ultimately we hope to see Washington's pension plans return to optimum health, with a better balance between risk and affordability, and a red square in the northwest quadrant!

Findings, Conclusions, and Recommendations

Findings and Conclusions

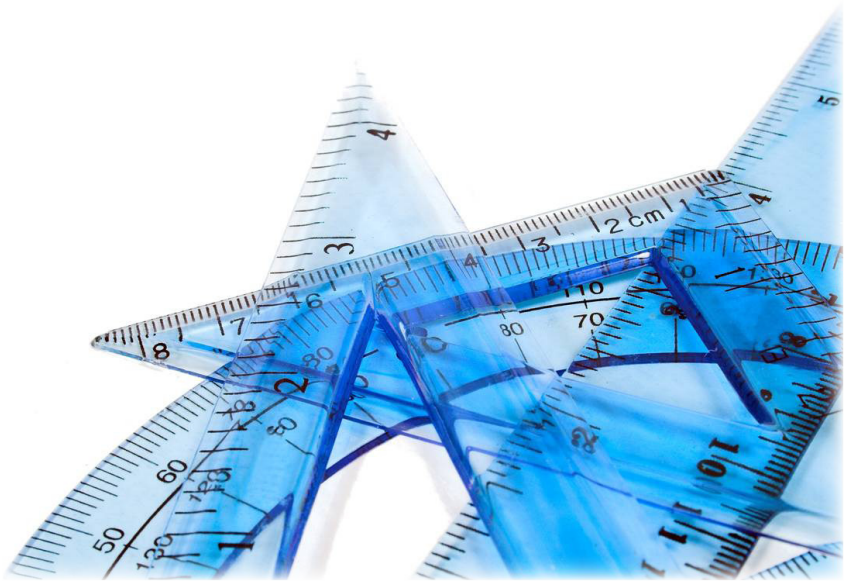
1. Investment policy has met its long-term target of an 8 percent annual rate of return over the past twenty years.
2. Funding policy over the past twenty years resulted in pension contributions that were, on average, 20 percent less than what was actuarially required. Periods of expected investment and revenue volatility were marked by short-term adjustments to funding policy that accelerated the recognition of gains and deferred the recognition of losses.
3. Benefit improvements policy added significant costs to the plans at the same time that underfunding and short-term funding policies were decreasing income to the plans.
4. Past practices have created significant affordability challenges, especially in the short term. If past practices continue, there is an 18 percent chance that the portion of the GF-S budget allocated to pensions will increase from 2.7 percent today to in excess of 8 percent in the future. Even if polices change very quickly to modify those past practices, it will take time for risk and affordability measures to improve.
5. If past practices continue, there is a 41 percent chance that PERS 1 or TRS 1 will prematurely become pay-as-you-go plans. There is a 5 percent chance that annual pay-go cost will exceed $1.7 billion in today's dollars. Pay-go cost is in addition to normal pension costs and

could significantly challenge future employer budgets.

6. There is a 41 percent chance that LEOFF 1 will run out of money prematurely. There is a 5 percent chance that annual pay-go cost in LEOFF 1 will exceed $500 million in today's dollars.
7. There is a 13 percent chance of an open plan running out of money. There is a 5 percent chance that the annual pay-go cost in an open plan will exceed $4 billion in today's dollars.

Recommendations

1. Make 100 percent of actuarially required contributions in the future. This includes adhering to the minimum contribution rates required to amortize unfunded past liabilities in PERS 1 and TRS 1.
2. Avoid large benefit improvements in the future until risk and affordability measures significantly improve. Develop new policies for adopting benefit improvements that balance the need to accommodate reasonable adjustments in benefits with the need for sustainable long-term funding.
3. Use risk modeling to further examine pay-go risk under LEOFF 1's current funding policy as well as in the open plans, especially in TRS 2/3 and WSPRS. Develop and implement strategies to mitigate or eliminate this risk.
4. Prepare for financial risks outside the control of the retirement systems. Use the model to explore how current policies could be amended to accommodate investment and revenue volatility, budget challenges, and changing economic conditions.



Indexes

Index of Acronyms

ARC	Actuarially Required Contributions
CTF	Commingled Trust Fund
DRS	Department of Retirement Systems
ERISA	Employee Retirement Income Security Act
GF-S	General Fund-State
LEOFF 2	Law Enforcement Officers' and Fire Fighters' Retirement System Plan 2
OSA	Office of the State Actuary
PERS	Public Employees' Retirement System
PFC	Pension Funding Council
PSERS	Public Safety Employees' Retirement System
RCW	Revised Code of Washington
SCPP	Select Committee on Pension Policy
SERS	School Employees' Retirement System
TRS	Teachers' Retirement System
UAAL	Unfunded Actuarial Accrued Liability
U-COLA	Uniform Cost of Living Adjustment
WSIB	Washington State Investment Board
WSPRS	Washington State Patrol Retirement System

Index of Figures

Possible Future Outcomes

Appendixes

About the Appendixes

We divided the appendixes into the following sections:

- **Plan-by-Plan Summary of Results:** Provides more detailed results for each individual plan.
- **Certification Letter:** Shows the signing actuaries' certification of results – required by Actuarial Standards of Practice.
- **Model Overview and Methods:** Explains how we arrived at our results.
- **Assumptions and Data:** Describes what we needed to implement our forward-looking model.
- **Model Verification and Validation:** Describes how we checked our model for reasonability.
- **Sensitivity Analysis:** Demonstrates how the results could change if we used different assumptions or methods.

Plan-by-Plan Summary of Results

We provide plan-specific information here since the main body of the report is highly summarized.

Figure A.1.1 shows summary statistics to give an idea about the size and maturity of each plan.

Figure A.1.1

2008 Summary Statistics										
(Dollars in Millions)	PERS 1	PERS 2/3	TRS 1	TRS 2/3	SERS 2/3	PSERS 2	LEOFF 1	LEOFF 2	WSPRS 1/2	Total
Active Count	11,663	150,005	6,061	60,463	51,774	3,981	421	16,626	1,085	302,079
Vested Inactive Count*	56,852	43,537	36,838	11,010	12,473	1	8,135	1,783	949	171,578
Present Value of All Benefits	$14,227	$22,621	$10,937	$7,693	$2,940	$323	$4,383	$6,596	$900	$70,619
Present Value of Earned Benefits	$13,915	$14,065	$10,794	$4,529	$1,906	$30	$4,354	$3,786	$719	$54,098
Actuarial Value of Assets	$9,853	$16,693	$8,262	$5,681	$2,303	$39	$5,592	$5,053	$870	$54,345
Funded Status	71%	119%	77%	125%	121%	127%	128%	133%	121%	100%

**Includes retirees.*

We present the following graphs for each plan under both the continuation of "past practice" (less than 100 percent of ARC and assumed future benefit improvements) and "current law" (100 percent of ARC and no future benefit improvements) projection scenarios:

- **Employer Contribution Rates:** Shows the possible range of employer contribution rates in the future. We show the 5th, 25th, 50th, 75th, and 95th percentiles.
- **Funded Status:** Illustrates the possible range of funded status in the future. We show the 5th, 25th, 50th, 75th, and 95th percentiles.

PERS

- **Pay-As-You-Go:** Demonstrates the probability of running out of assets in the future as well as the 95th percentile of pay-as-you-go costs. These pay-as-you-go costs are in addition to the normal annual contributions paid into the plan.
- **Member Contribution Rates** (if applicable): Exhibits the possible range of Plan 2 member contribution rates in the future (Plan 1 and Plan 2 for WSPRS). We show the 5th, 25th, 50th, 75th, and 95th percentiles.

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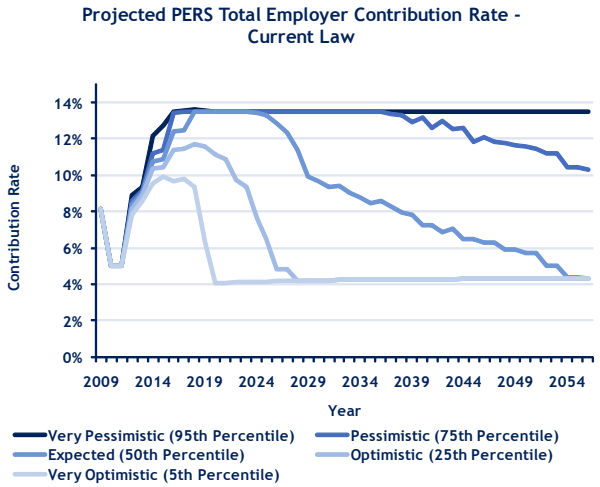

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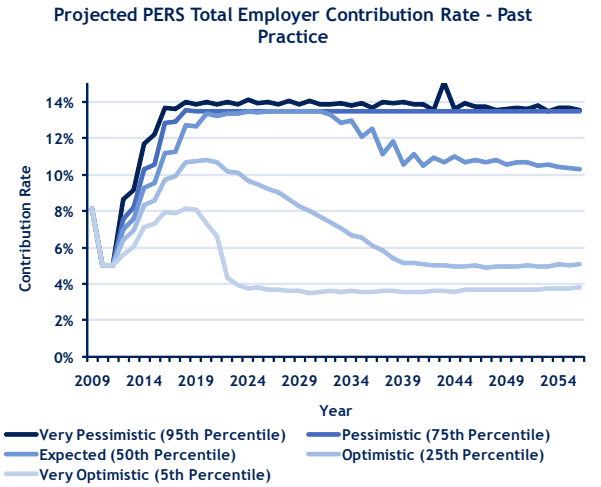

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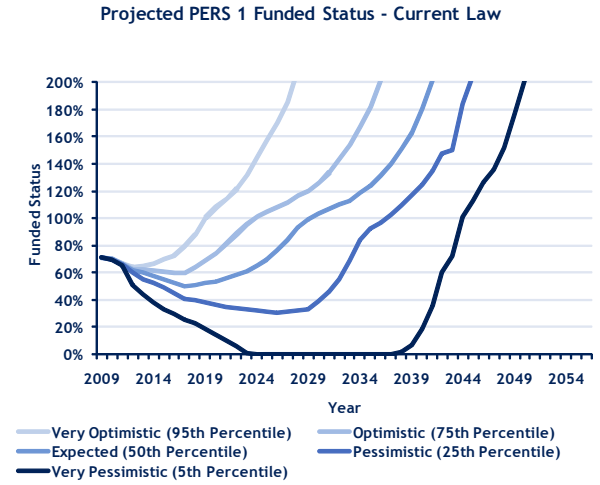

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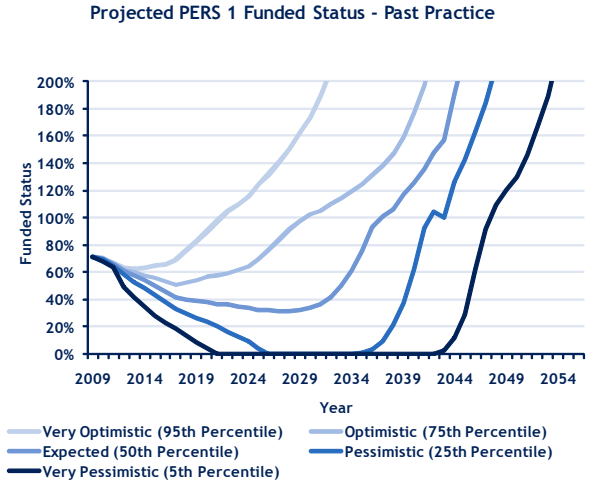

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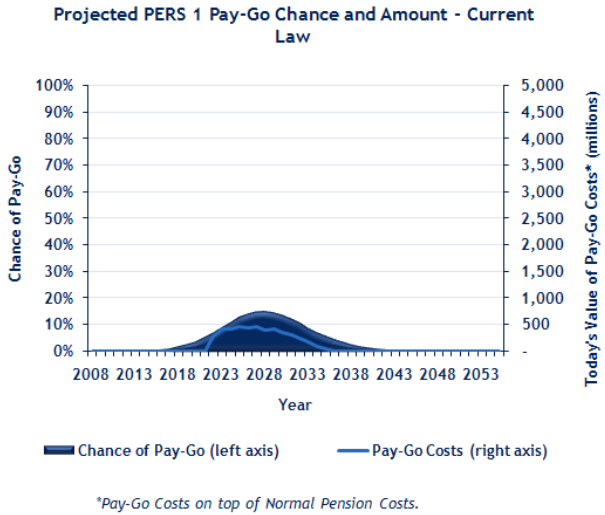
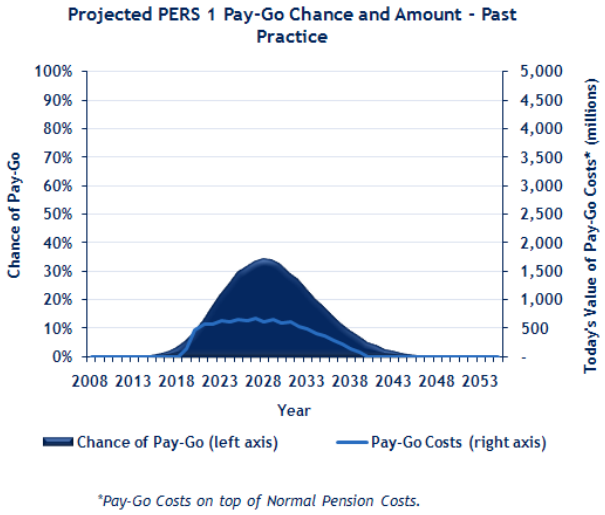


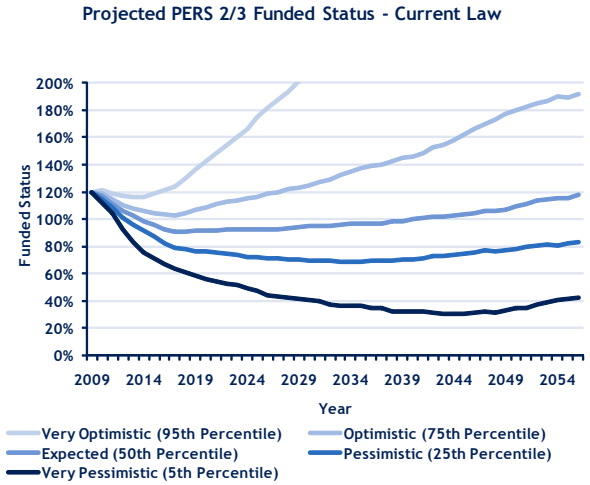
*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.7



*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.8



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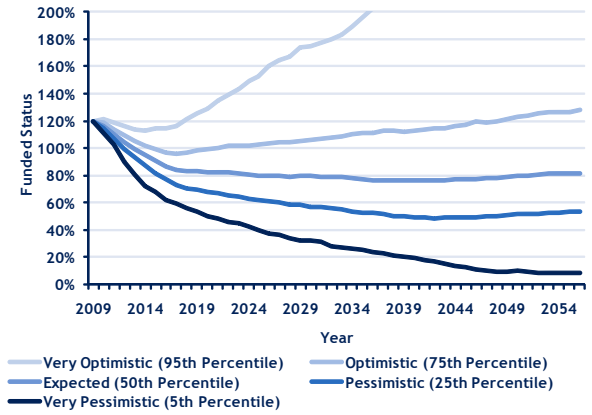

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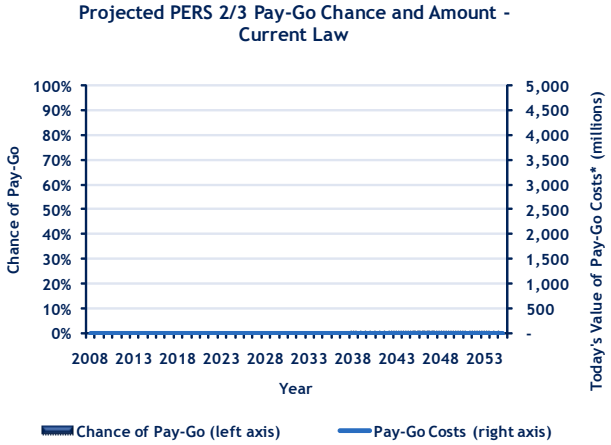

*Pay-Go Costs on top of Normal Pension Costs.

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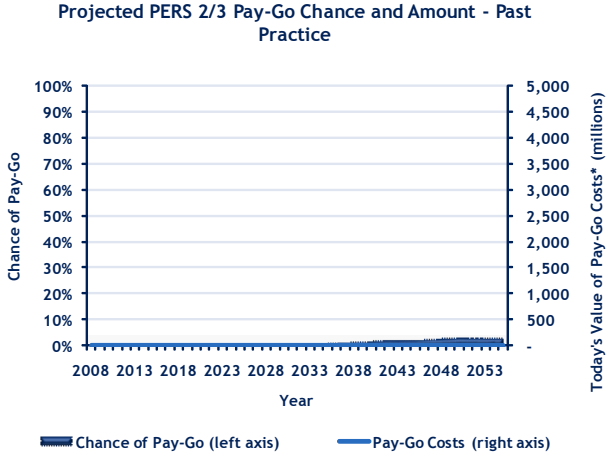
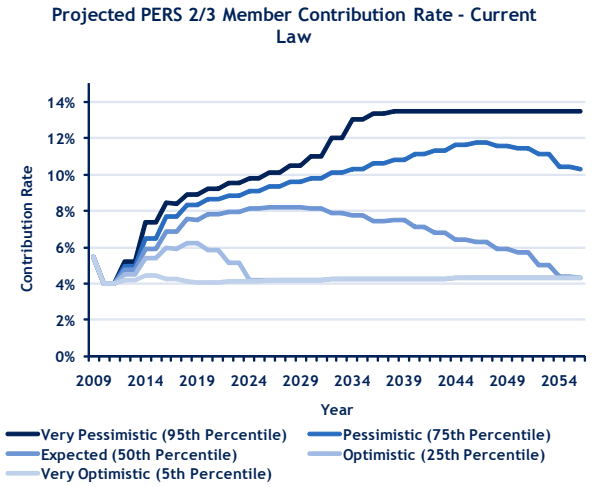


*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.12



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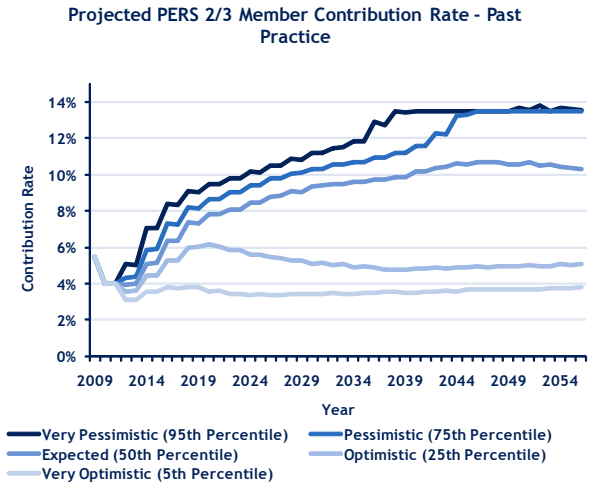
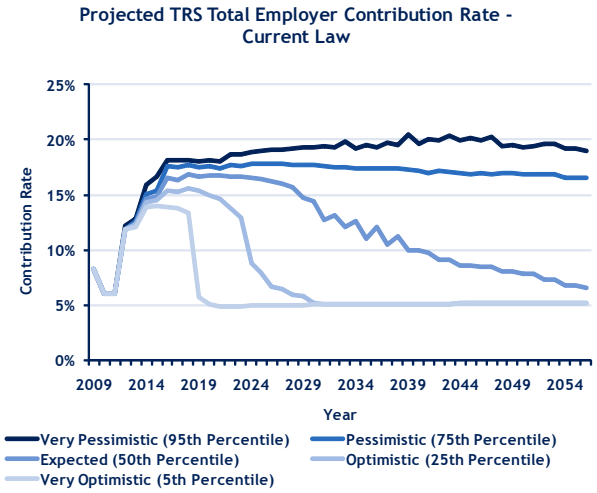


TRS

Figure A.1.14



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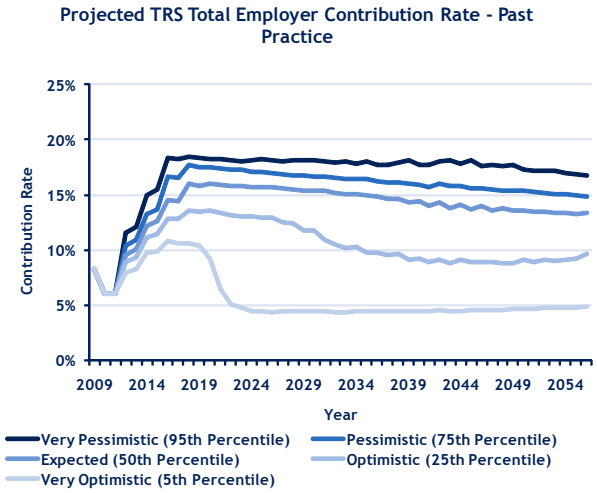

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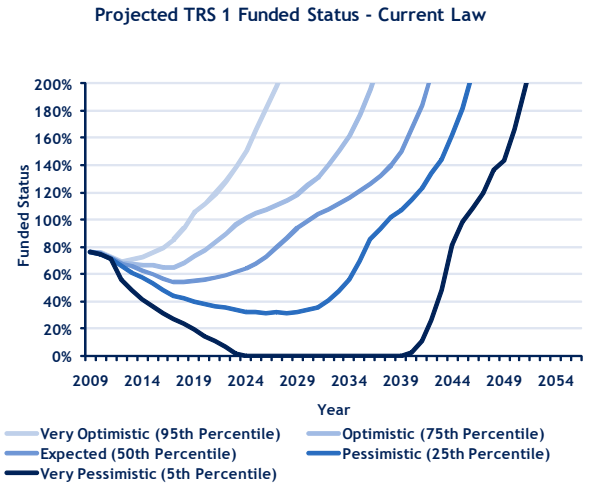

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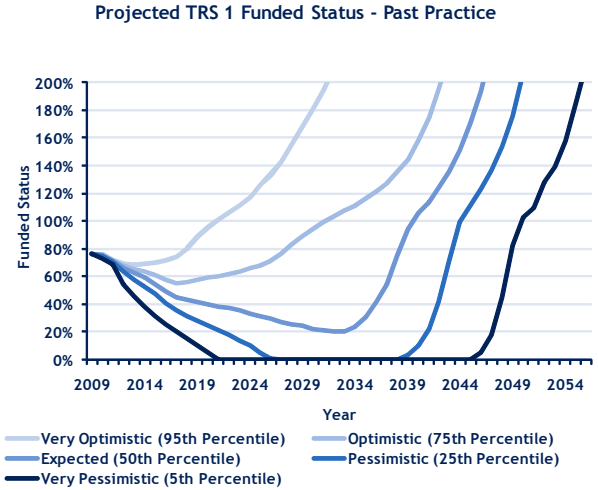

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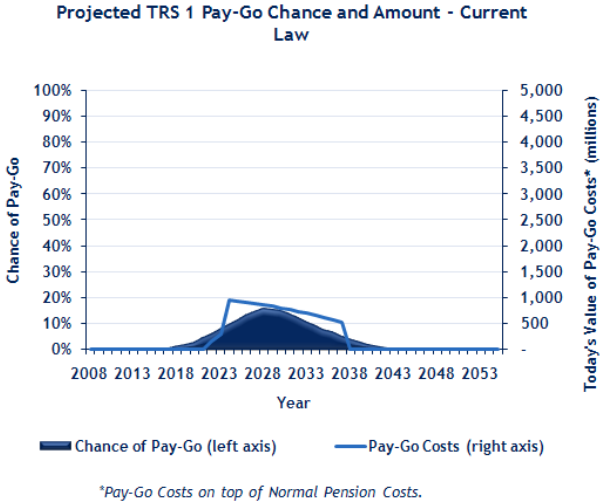
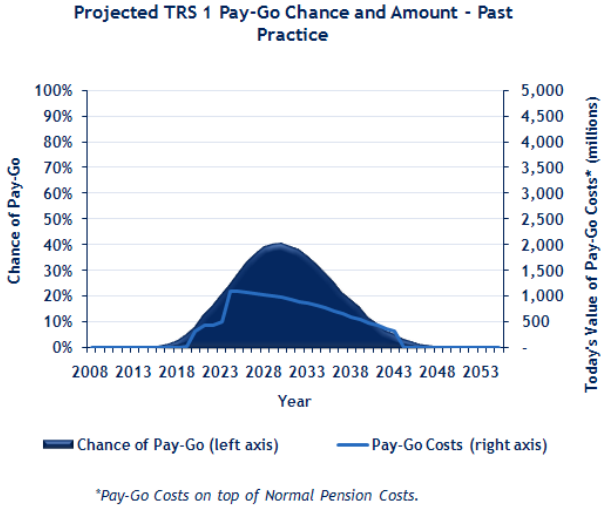


*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.19



*Pay-Go Costs on top of Normal Pension Costs.

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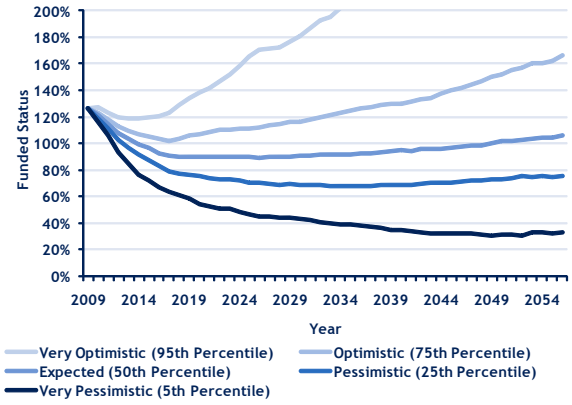

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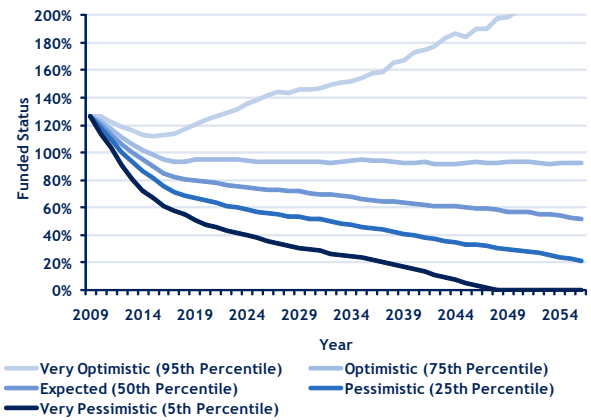

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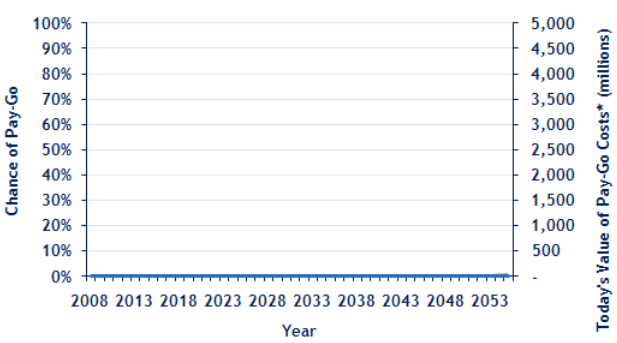
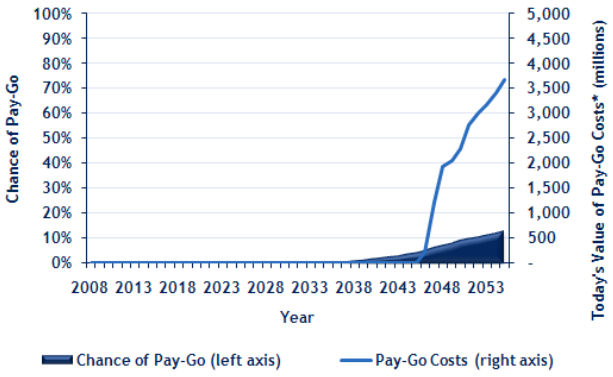


*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.23

Projected TRS 2/3 Pay-Go Chance and Amount - Past Practice



*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.24

Projeced TRS 2/3 Member Contribution Rate - Current Law

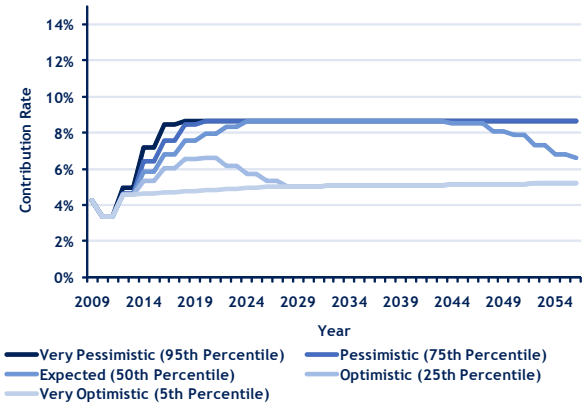
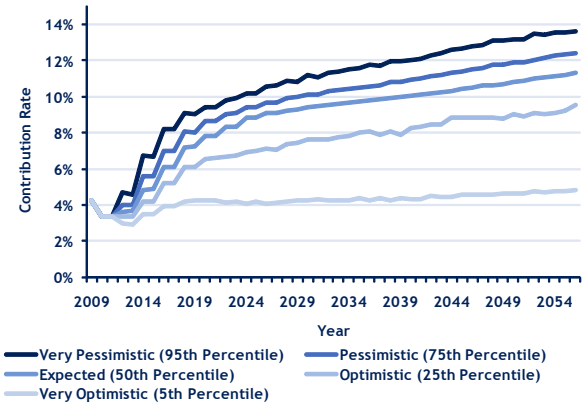


Figure A.1.25

Projected TRS 2/3 Member Contribution Rate - Past Practice



SERS

Figure A.1.26

Projected SERS Total Employer Contribution Rate - Current Law

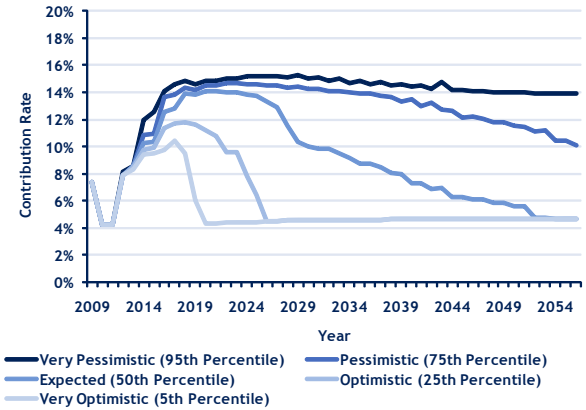


Figure A.1.27

Projected SERS Total Employer Contribution Rate - Past Practice

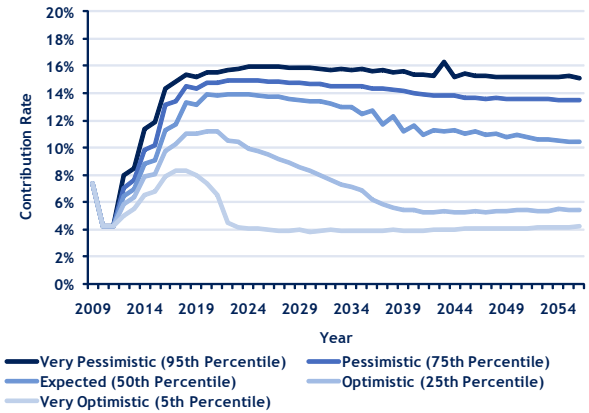
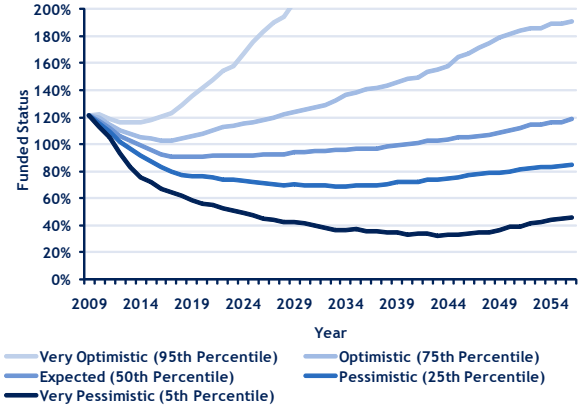


Figure A.1.28

Projected SERS 2/3 Funded Status - Current Law



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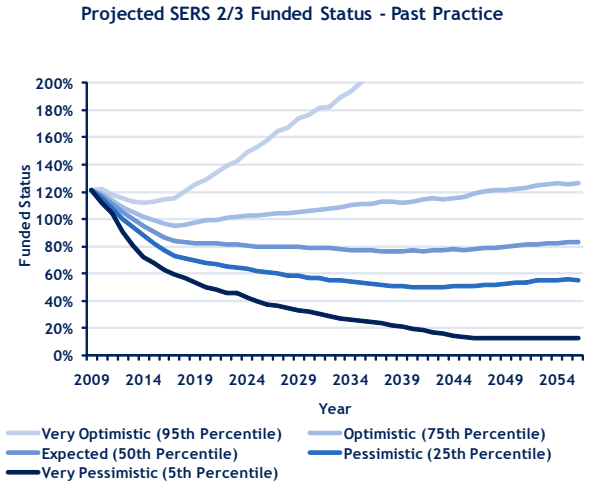

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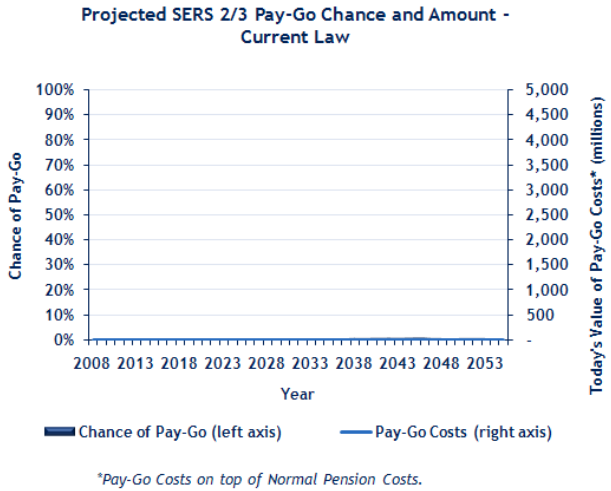
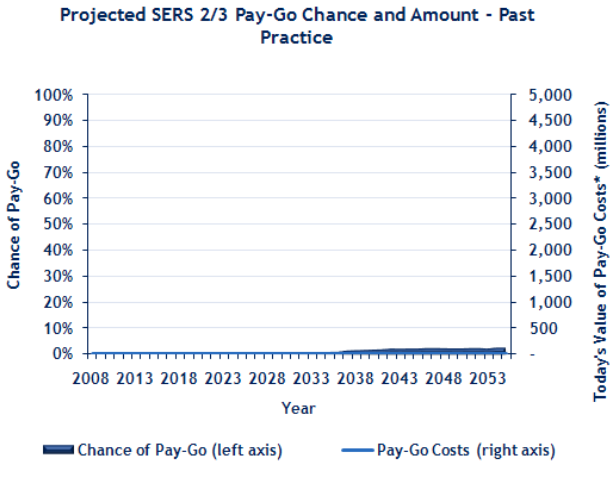


*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.31



*Pay-Go Costs on top of Normal Pension Costs.

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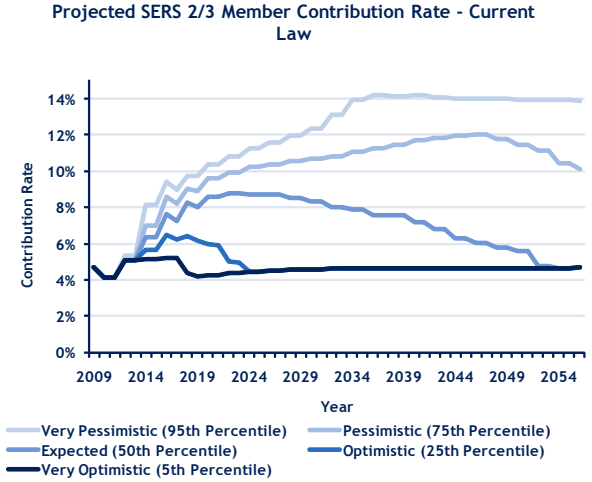

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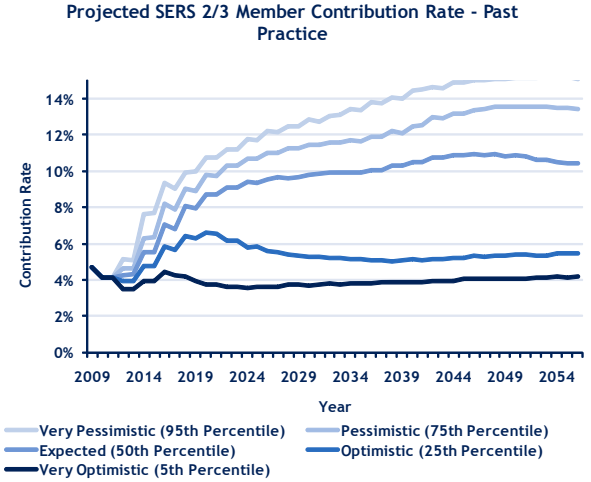


PSERS

Figure A.1.34

Projected PSERS Total Employer Contribution Rate - Current Law

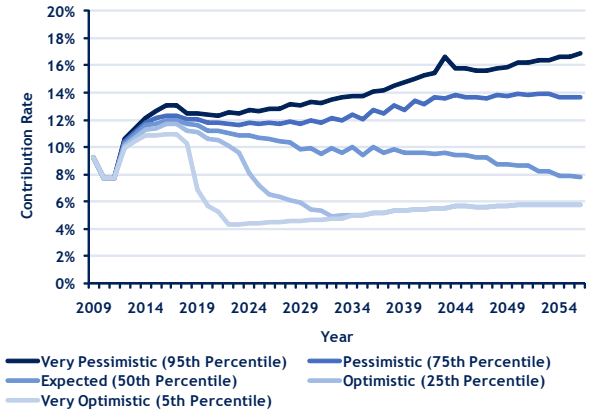


Figure A.1.35

Projected PSERS Total Employer Contribution Rate - Past Practice

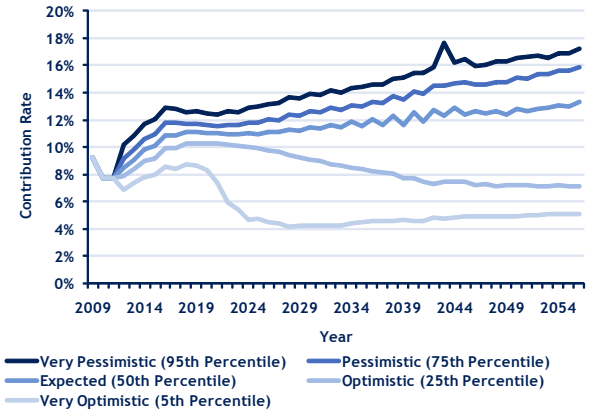


Figure A.1.36

Projected PSERS Funded Status - Current Law

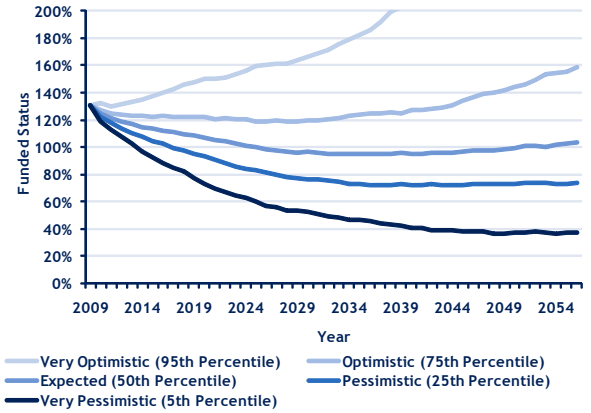


Figure A.1.37

Projected PSERS Funded Status - Past Practice

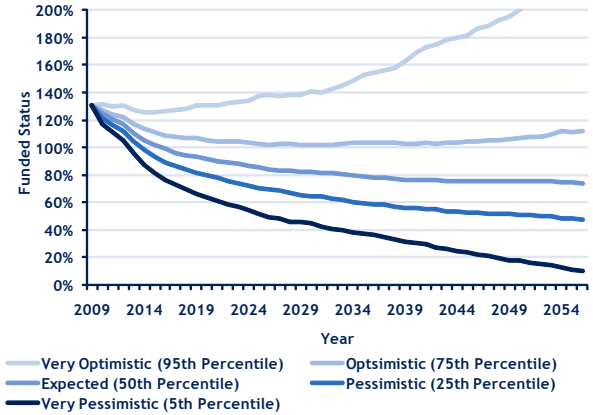
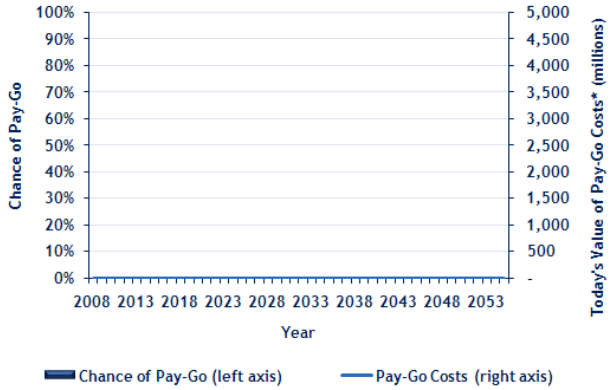


Figure A.1.38

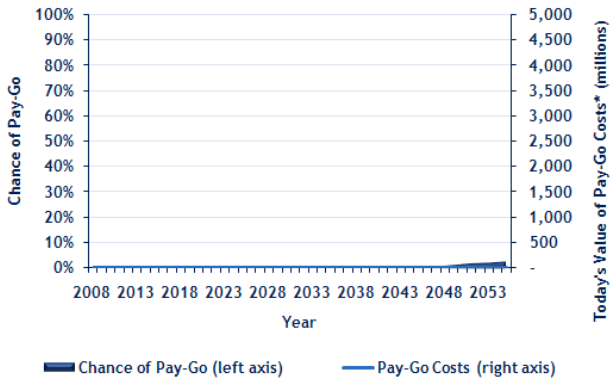
Projected PSERS Pay-Go Chance and Amount - Current Law



*Pay-Go Costs on top of Normal Pension Costs.

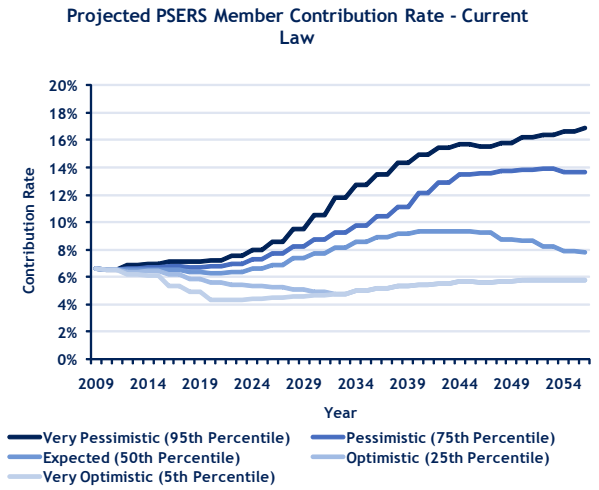
Figure A.1.39

Projected PSERS Pay-Go Chance and Amount - Past Practice



*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.40



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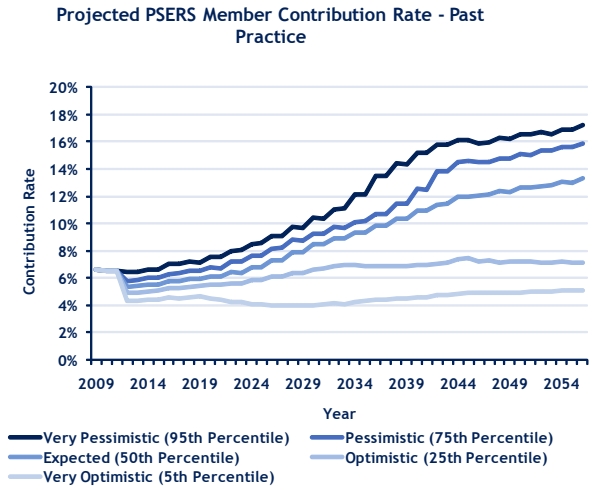
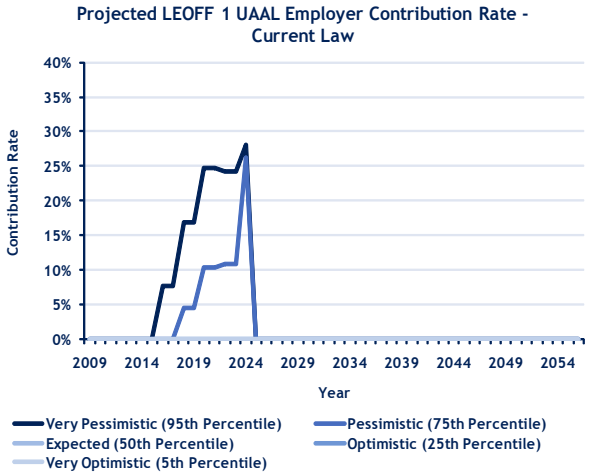


LEOFF

Figure A.1.42



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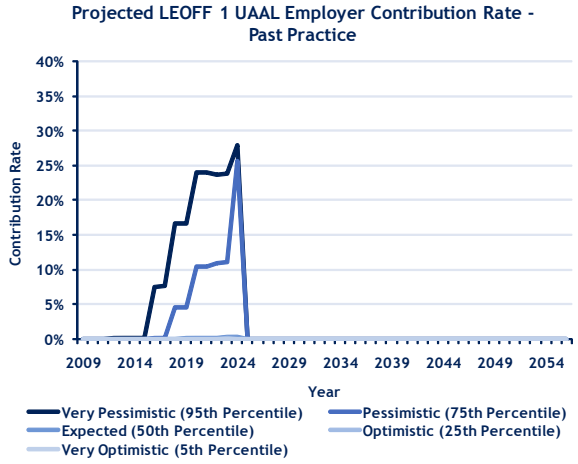

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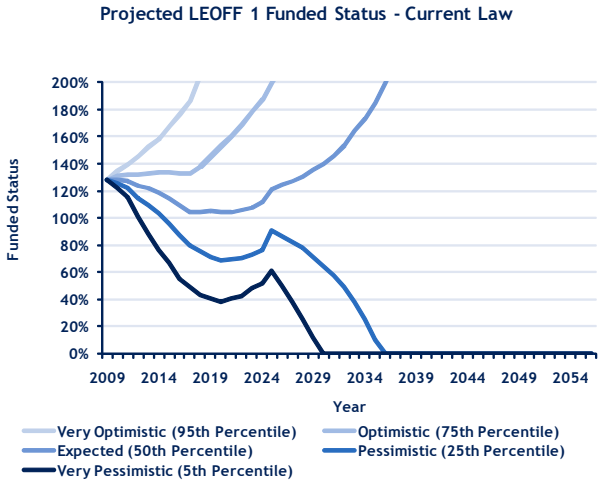

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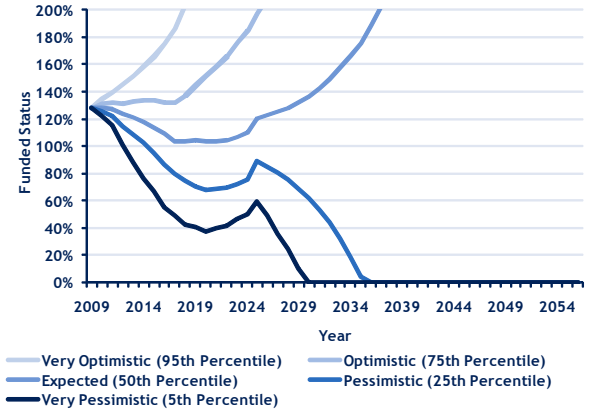

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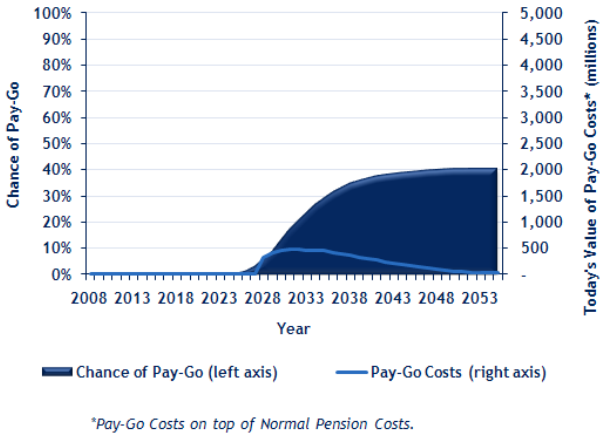
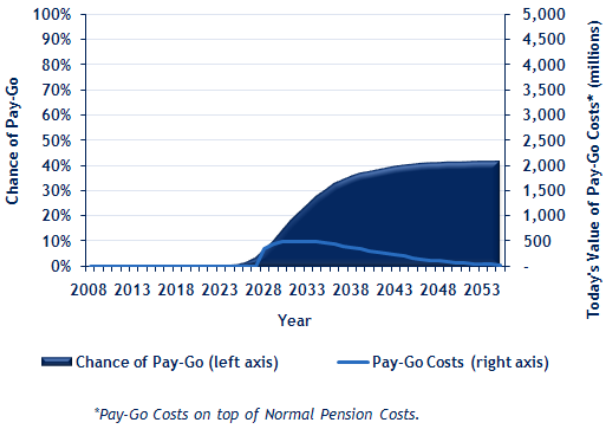


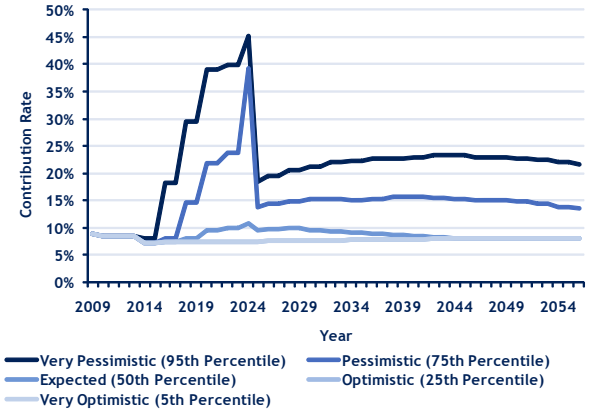
*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.47



*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.48



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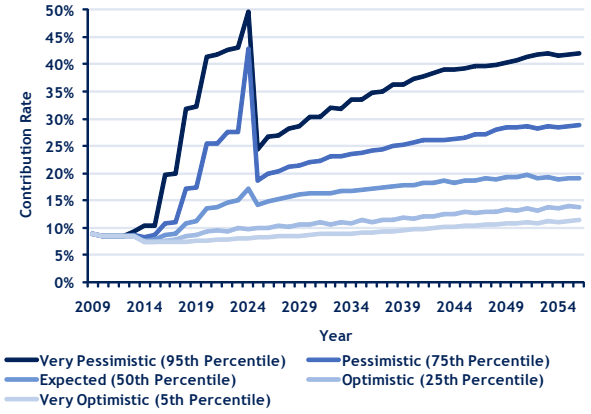

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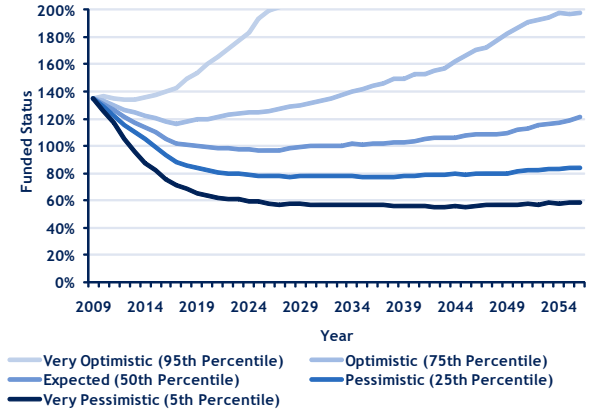

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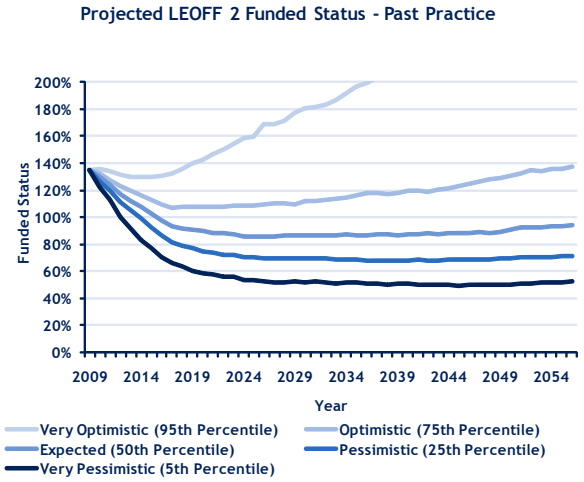

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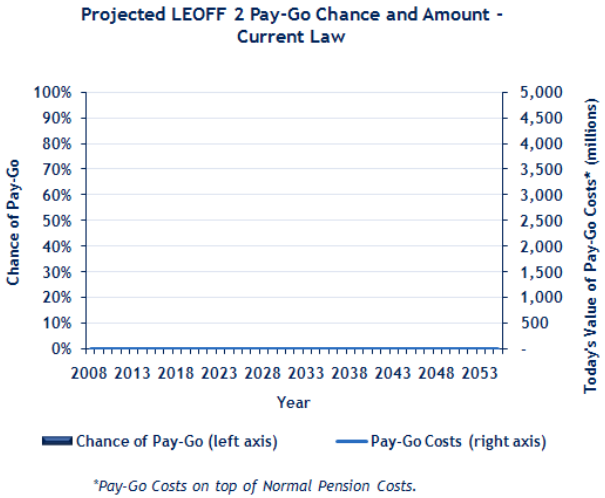
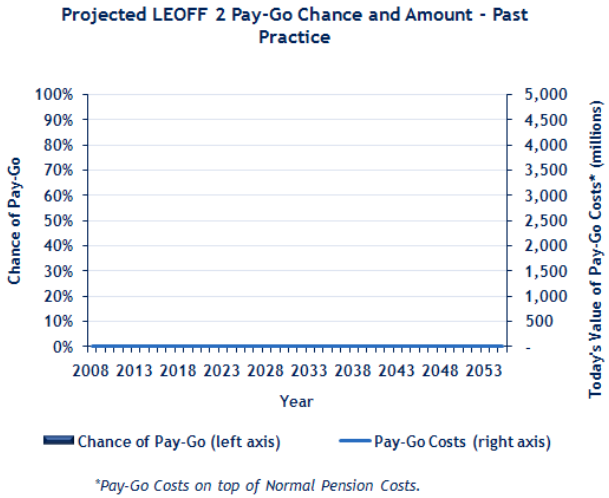


*Pay-Go Costs on top of Normal Pension Costs.

Figure A.1.53



*Pay-Go Costs on top of Normal Pension Costs.

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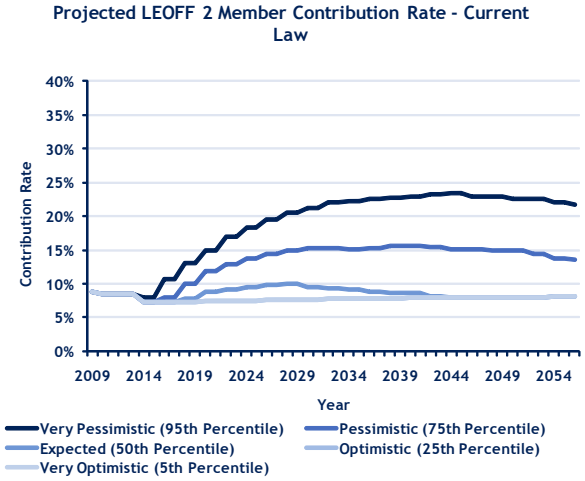

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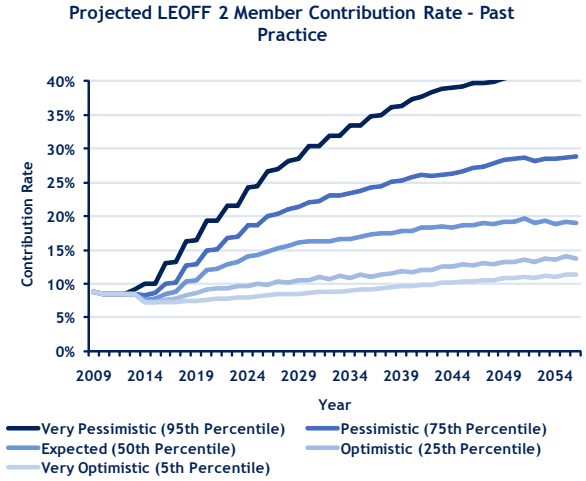


WSPRS

Figure A.1.56

Projected WSPRS 1/2 Total Employer Contribution Rate - Current Law

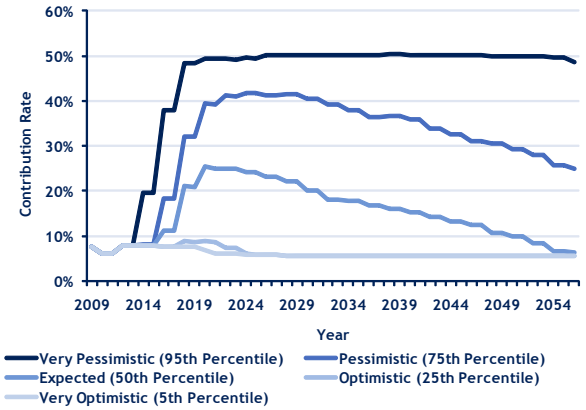


Figure A.1.57

Projected WSPRS 1/2 Total Employer Contribution Rate - Past Practice

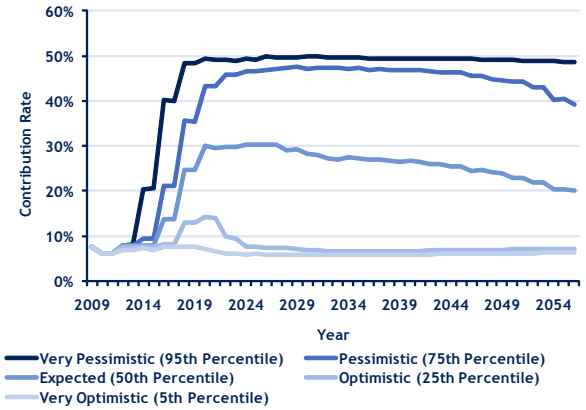


Figure A.1.58

Projected WSPRS 1/2 Funded Status - Current Law

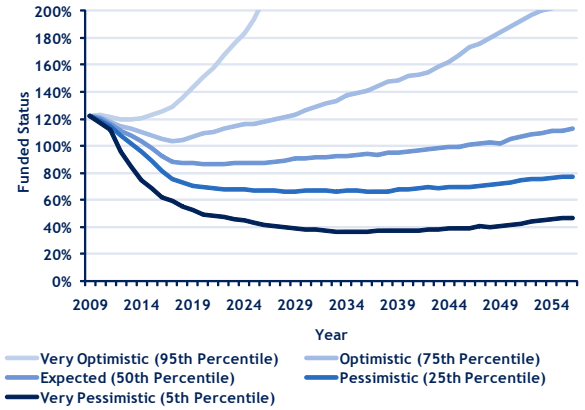


Figure A.1.59

Projected WSPRS 1/2 Funded Status - Past Practice

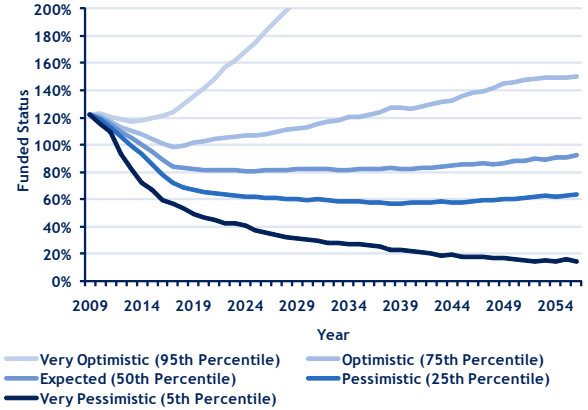


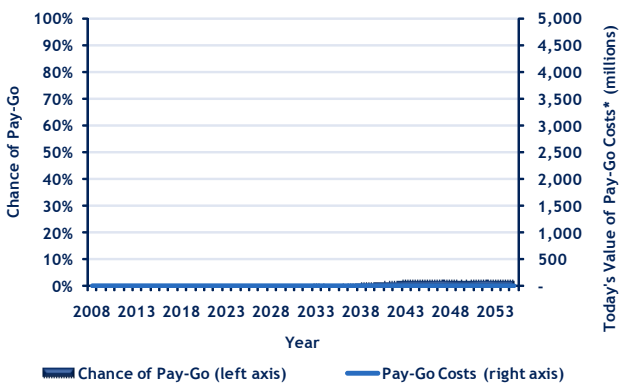
Figure A.1.60

Projected WSPRS 1/2 Pay-Go Chance and Amount - Current Law

**Pay-Go Costs on top of Normal Pension Costs.*

Figure A.1.61.1

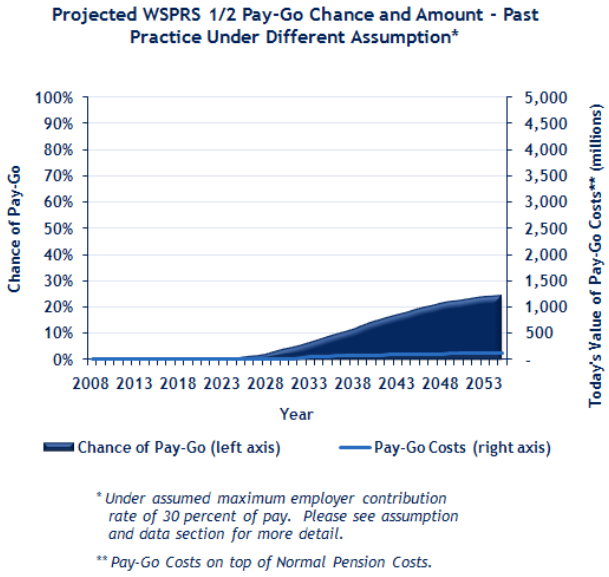
Projected WSPRS 1/2 Pay-Go Chance and Amount - Past Practice



**Pay-Go Costs on top of Normal Pension Costs.*

Note: Please see Figure A.1.61.2 for how these results could change under a lower assumed maximum employer contribution rate. We assume 50 percent of pay in this analysis.

Figure A.1.61.2



Under assumed maximum employer contribution rate of 30 percent of pay. Please see assumption and data section for more detail.

*** Pay-Go Costs on top of Normal Pension Costs.*

Figure A.1.62

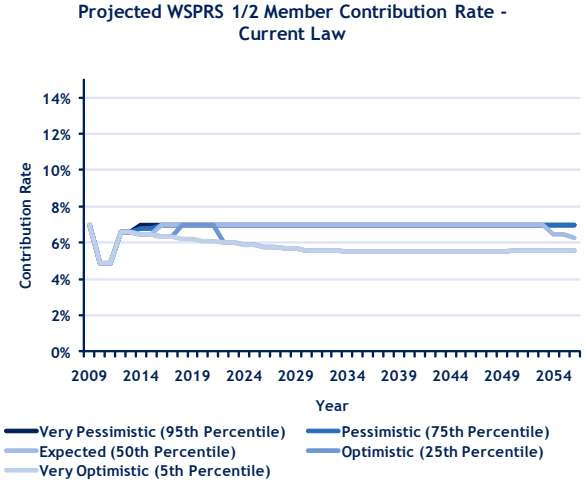
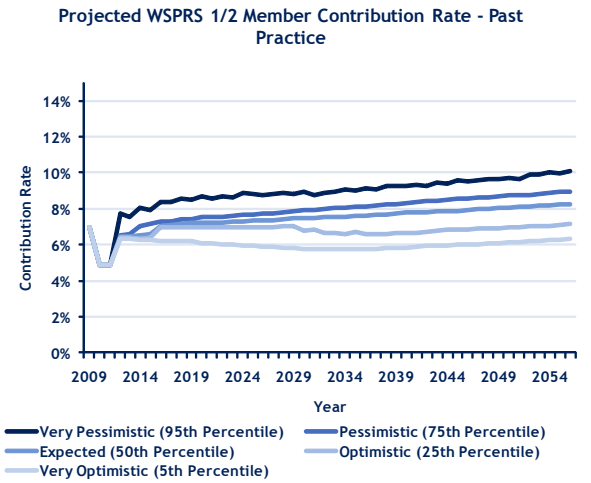


Figure A.1.63



Certification Letter

Office of the State Actuary

"Securing tomorrow's pensions today."

Actuarial Certification

2010 Risk Assessment

August 31, 2010

This report documents the results of an actuarial assessment of the financial risks of the retirement plans defined under Chapters 41.26, 41.32, 41.35, 41.37, 41.40, and 43.43 of the Revised Code of Washington as of the date of this certification. We prepared this analysis to support the strategic planning efforts of the Select Committee on Pension Policy. However, we understand that other readers will use the information in this public report. We advise such readers to review the primary purpose of the report, not use the report for other purposes, and to seek professional guidance in their interpretation of the report.

The primary purpose of this assessment is to identify and quantify the financial risks of the above mentioned retirement plans through use of a customized and dynamic asset-liability model. This assessment does not address all risks to the retirement systems. We intend readers to use the results of this assessment to evaluate which financial risks require additional risk management. Such management will require additional analysis not included in this report.

The results of this analysis will change in the future as actual experience emerges. We plan to monitor this experience and update our model as necessary. We also plan to quantify additional risks not covered in the current model in the future. Please replace this report in the future when the results of a more recent assessment become available.

This risk assessment involved a projection of future actuarial valuation results using both stochastic and deterministic methods on an open-group basis (projection includes future new entrants). Please see the 2008 Actuarial Valuation Report (AVR) for the data, assumptions, and methods used in determining the initial actuarial valuation results for this projection. Please see the Appendix of this report for a description of the data, assumptions, and methods used to project actuarial valuation results beyond the initial results of the 2008 AVR.

We updated the results of the 2008 AVR to reflect recent changes to plan provisions and asset data. Plan provisions reflect changes from the 2008 and 2009 Legislative Sessions. We did not include supplemental contribution rates from the 2010

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Legislative Session. Participant data reflects retirement system census data through June 30, 2008. Asset data reflects investment returns through June 30, 2010.

The Department of Retirement Systems provided unaudited 2008 member and beneficiary data to us. We checked the data for reasonableness as appropriate based on the purpose of this assessment. The Washington State Investment Board (WSIB) provided audited asset information as of June 30, 2009. We relied on all the information provided as complete and accurate. In our opinion, this information is adequate and substantially complete for purposes of this assessment.

We relied on the capital market assumptions (CMAs) from the WSIB to perform our asset projections. We reviewed the CMAs for reasonableness as appropriate based on the purpose of this assessment. In our opinion, the CMAs are reasonable for purposes of this assessment.

The risk assessment summarized in this report involves the interpretation of many factors and the application of professional judgment. We believe that the data, assumptions, and methods used in the underlying assessment are reasonable and appropriate for the primary purpose stated above. The use of another set of data, assumptions, and methods, however, could also be reasonable and could produce materially different results. Another actuary may review the results of this analysis and reach different conclusions.

In our opinion, all methods, assumptions, and calculations are reasonable and are in conformity with generally accepted actuarial principles and applicable standards of practice as of the date of this publication.

The undersigned, with actuarial credentials, meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein and are available to provide extra explanations as needed.

Sincerely,

Matthew M. Smith, FCA, EA, MAAA
State Actuary

Troy A. Dempsey, ASA, MAAA
Actuary

Model Overview and Methods

This risk assessment required OSA to build a customized asset-liability model. Before explaining what the model is, we believe it's important to consider the context around the model's purpose. We will:

- Explain where this model fits into decision making.
- Show a high-level overview of the model's pieces.
- Explain how the model works.
- Explain what goes into the model.
- Explain what the model provides.

Recipe for a Good Decision

Consider an aeronautical engineer building an airplane, or a structural engineer building a skyscraper. Would you like to hear them say, "I put a lot of nails in there and my gut is telling me it will hold up"?

Would you like to hear them say, "based on expected weather conditions, it will hold up"?

Probably not. You want to know that they've built their product with information and decisions that reduce the likelihood of "failure" to an acceptable level.

Information has evolved over time with decision-makers demanding more, and information-providers having more tools available. Actuarial information has followed a similar path.

Intuition: A long time ago, decision-makers made decisions solely on intuition. We've all made mistakes implementing this method. So, we easily see the need for information to inform our decision.

Best-Estimate: The simplest information is to create the future path most likely to occur. Based on whether this path is good or bad, a decision is made. This is the most common information used in decisions. It is regularly used as:

- A family's budget.
- An individual's retirement plan.
- The cost provided in fiscal notes for legislation.

Unfortunately, the actual result usually does not end up matching the estimate. The best-estimate can almost be misleading and can lead to a sense of control that isn't really there. This creates a need for information about the impact if things turn out differently.

Scenarios: Sometimes called "sensitivity analysis", other possible paths are determined. This gives the decision maker extra information for how things could turn out differently from the best-estimate. However, the scenarios can never be exhaustive, and the decision maker lacks information about the likelihood or chances these scenarios will occur.

Simulation: Sometimes called "stochastic projections," "dynamic projections," or "Monte Carlo simulation," many statistically equally likely paths are created. This provides the decision maker with all known information at this point in time. Namely, it provides:

- The best guess at what will occur.
- The range of outcomes that could occur.

- The likelihood of the range of outcomes occurring.

Both types of engineers mentioned at the beginning of this section use simulation to inform their decisions. Actuaries have begun using simulation more and more over the past few decades. Of course, extra information comes at a cost, and the bigger the decision (peoples' lives, large amounts of money at stake), the more necessary complete information becomes.

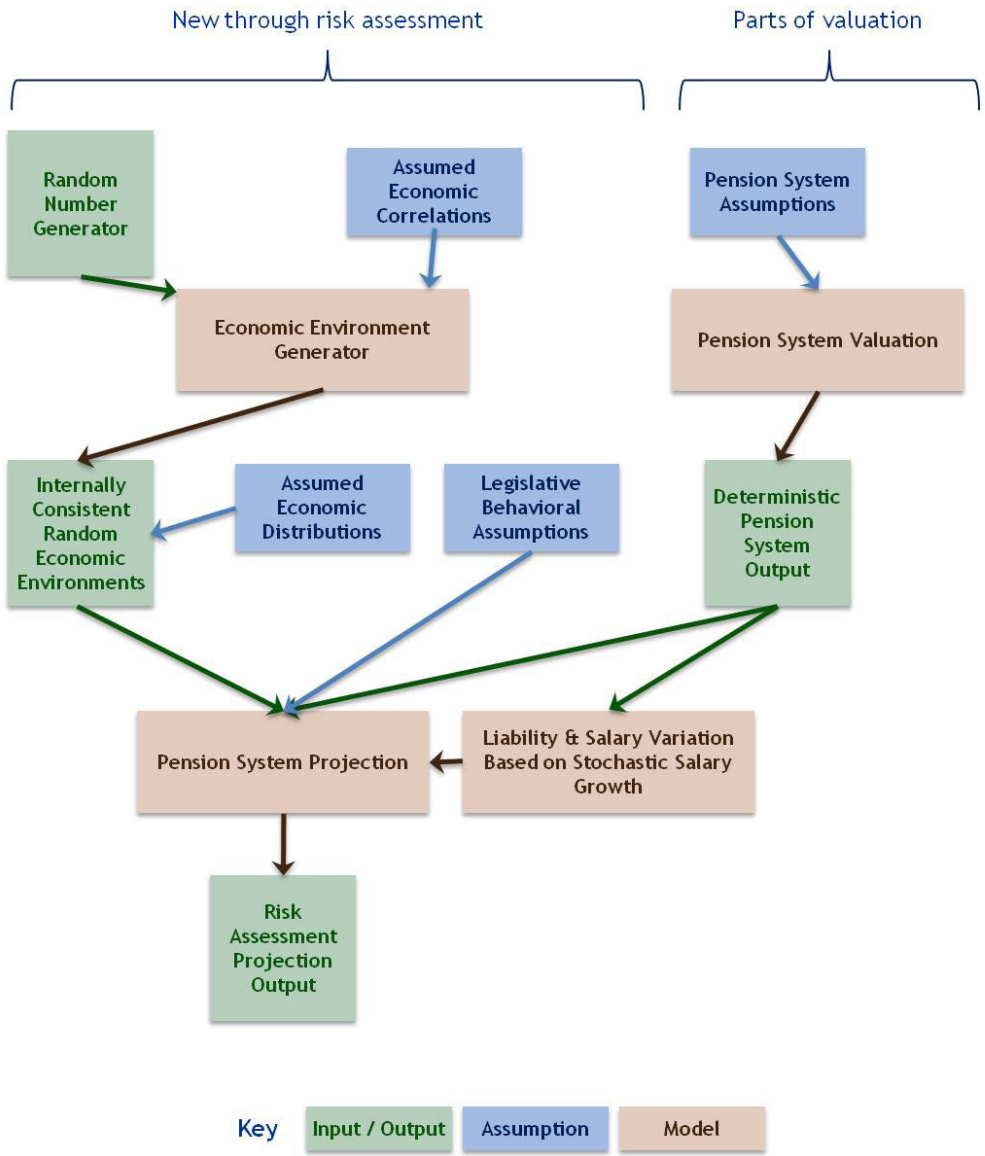
A model is a decision aid, not a decision maker. A model will never forecast the future perfectly. A healthy dose of common sense and intuition, in combination with a good model, is the recipe for the best decision.

Risk Assessment Model Overview

The following flowchart shows the major pieces of the model. We describe each of these major pieces below.

Figure A.2.1

Risk Assessment Model Overview Flowchart



How the Model Works and What is Needed

In this section, we explain the model in three levels of increasing detail – **basics**, **intermediate**, and **advanced**.

Basics

We created a dynamic projection of the pension system using simulation. The purpose of this model is to create a large number (2,000) of equally likely fifty-year economic environments, and see how the pension system responds. Since each of the paths is assumed to be equally likely, comments can be made about the probability of certain events occurring.

To accomplish this goal, the model has two parts.

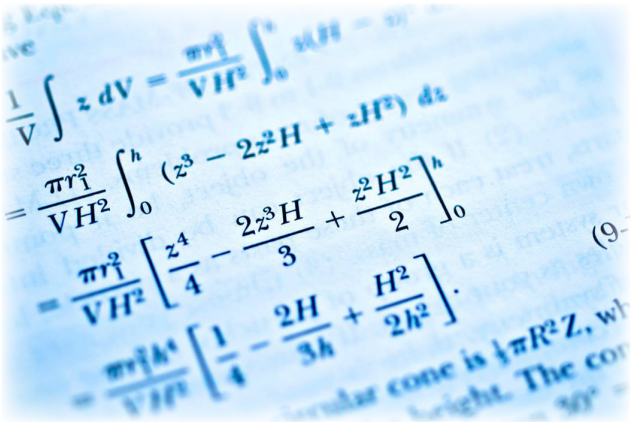
1. The **economic environment generator**, which creates the equally likely economic situations that the pension system will encounter.
2. The **pension system projection**, which models how the systems would react when they encounter each of these economic environments.

Intermediate

The general process we follow to create statistically equally likely simulations is called "Monte Carlo Simulation." We provide an example of how we implement Monte Carlo Simulation below.

We start with our projection spreadsheet and allow certain events to occur randomly. For example, if inflation were to occur randomly in our model, we would measure past inflation and make a reasonable prediction about the likelihood of future inflation levels. A simplified example would be that inflation could take one of three future values: 2.5 percent, 3.5 percent, or 4.5 percent per year. Excel would generate a random number between 0 and 1 for each year of the projection. If the number was between 0 and 0.33, we would assign 2.5 percent inflation for the year. If the number was between 0.33 and 0.67 we would assign 3.5 percent inflation for the year. And, if the number was between 0.67 and 1, we would assign 4.5 percent inflation for the year. We would repeat the process in year two keeping in mind that inflation shows a large positive correlation to the previous year's inflation and a reversion to its long-term mean. After this process is complete for each year in the projection and the results have been recorded, a simulation has been run.

Then, this process is repeated so that a large number of simulations have been run (generally between 1,000 and 10,000). The idea is that each of these path-dependent simulations is equally likely to occur. We then sort these simulations so that we can see how many behave a certain way. For example, if we ran 1,000 simulations and the contribution rate in 2012 was 5 percent or higher in 100 of the simulations, we would say that there is a 10 percent chance that the contribution rate will be at least 5 percent in 2012 (alternatively, there will be a 90 percent chance it will be below 5 percent).



Advanced

Economic Environment Generator

For each fifty-year economic environment, we use Excel's RAND (or random number) function to generate fifty random numbers (between 0 and 1) for each economic variable - excluding inflation and population growth. These fifty random variables represent random economic events each year during the fifty-year projection.

If these economic variables were truly random, we would stop here. However, since most of these economic variables show correlation to another economic variable, we need to modify the random variables to reflect their assumed correlation. We do this using **Cholesky Decomposition**. A general description of the decomposition can be found at Wikipedia here: http://en.wikipedia.org/wiki/Cholesky_decomposition.

As an example, consider investment returns and real revenue growth. Assume the investment return's random number for year one is 0.90, and real revenue growth's random number for year one is 0.20. We found that real revenue growth increases and decreases similarly to investment returns in the same year (positive correlation with no lag). We would alter the 0.20 random number for real revenue growth upward toward 0.90. The magnitude of the change would depend on the magnitude of the correlation (stronger correlation would lead to more change).

A numerical example can help explain:

1. Both random numbers would be converted to Z-Values.
   a. Investment random number = 0.90 ➜ Z-Value = 1.28
   b. Real Revenue Growth random number = 0.20 ➜ Z-Value = -0.84
2. The 2-Variable simplifying equation for Cholesky Decomposition can be used to correlate the real revenue growth to investment returns [Correlated Z-Value = Correlation x Investment Z-Value + Square Root (1- Correlation^2) x Real Revenue Z-Value.
   a. Correlated Revenue Z-Value = 0.30 x 1.28 + Square Root (1 – 0.30^2) x -0.84 = -0.42.
3. The correlated Z-Values are converted back to correlated random numbers.
   a. Investment Z-Value = 1.28 ➜ correlated random number = 0.90.
   b. Real Revenue Z-Value = -0.42 ➜ correlated random number = 0.34.

The Cholesky Decomposition is the complete correlation process for normally distributed random variables in our model. However, for the non-normally distributed random variables, we apply an additional process. We use the Fleishman Power Transformation Method to adjust the method for the skew and kurtosis of the given non-normal random variable. This is done by adjusting the correlation input into the Cholesky Decomposition matrix upward, and modifying the Z-Values after the correlation. A fuller explanation of the method, with formulas, can be found in this article from Vale & Maurelli, 1983: http://www.springerlink.com/content/u334757q3x152512/.

After this adjustment process, the end result is fifty economic variables that are internally consistent (correlated correctly) and in the form of a percentile (number between zero and one). We then use these values to select an equivalent percentile from the assumed probability distribution of each economic variable to produce a single fifty-year economic environment (excluding inflation and population growth).

To model annual inflation and population growth over a single fifty-year projection, we apply an autoregressive time series formula (below) with the random numbers generated above. (We select the parameters of the time series model to approximate the range of observed values, shape of the distribution of observed values, and observed inter-correlations we expect. See the "*Assumptions and Data*" section for further details).

Autoregressive Time Series Formula

[Value = Mean Reversion x Long-Term Average + (1 – Mean Reversion) x Last Period's Value + Normally Distributed Random Number x Standard Deviation]

We repeat this process 2,000 times. The end result is 2,000 fifty-year economic environments ready for use in the pension system projection.

Pension System Projection

The projection model projects the status of the pension system over a fifty-year period, given an economic environment.

The required inputs for the projection model include the following items:

- **Random Economic Environment:** From the economic environment generator.
- **Assumed Legislative Decisions:** Both decision variables affect the state of the pension system. Variables include (1) percent of contributions made and (2) percentage growth in liabilities from future benefit improvements. The formulas are outlined in the "Assumptions and Data" section.
- **Pension System Output:** We use deterministically projected benefit payments, salaries, and liabilities from our annual actuarial valuation of the pension system. We also create and use factors that estimate the change in benefits or salaries based on stochastic nominal salary growth. Details about the assumptions and methods used to generate this output can be found in the June 30, 2008, Actuarial Valuation Report.

In each year of the projection:

1. First we run the annual actuarial valuation. The most pertinent measures are calculated (point in time calculation using an "as of" date). Examples include (but not limited to):
   a. Liabilities.
   b. Assets.
   c. Funded Status.
   d. Recommended Contribution Rate.
2. Next we input an internally consistent economic environment (from the economic environment generator). Examples include:
   a. Nominal investment return for the year.
   b. Inflation for the year.

c. Population growth for the year.

d. Real revenue growth (adjusted for population) for the year.

3. Pension system cash flows respond to economic environment, recommended contribution rate, and legislative behavior.

a. The present value of active liabilities and salaries are adjusted based on the ratio of observed cumulative salary growth divided by expected cumulative salary growth.

b. Annual benefit payments and salaries are adjusted based on factors created to estimate the cash flows when cumulative salary growth is different than expected. The factors are linear and based on differences in cash flows when our valuation software is run at different levels of salary growth for each year.

c. Percent of recommended contributions made is calculated. The actual contribution rate that is made, paid over all salary, is the amount of cash inflow.

d. Benefits are paid and are a cash outflow.

i. If not enough assets are available to cover benefit payments, we assume a mandatory contribution from the state is made to cover the excess of the benefit payments over the assets on hand.

ii. We adjust LEOFF 1 benefit payments based on actual inflation observed in the model. LEOFF 1 is the exception since they have an uncapped post-retirement COLA and almost the entire population is retired.

e. The investment return cash flow is based on the random investment return, the market value of assets, contributions, and benefit payments for the year.

f. The Legislature is assumed to increase benefits consistent with "creep" and, based on a random component, may increase benefits consistent with "spike". See the body of the report for a description of creep and spike. The value of liabilities, benefit payments, and supplemental rate increases are all affected.

This process is repeated fifty times to get one fifty-year projection. We save statistics and measurements for risk analysis. At this point one simulation has been run and saved. We repeat this process 2,000 times, so that we have 2,000 simulations and we save the same output data for each simulation

What the Model Provides

We have saved 2,000 fifty-year strings of each statistic or variable that was of interest from the simulations. Examples include (but not limited to):

- Contribution rates.
- Funded status.
- Pay-as-you-go contributions.
- Percent of General-Fund State revenue used by contributions.

Since each of these fifty-year strings are assumed to be equally likely to occur, we can start to analyze how often particular events occur and why they occur. We can analyze the output in two ways:

- **Forward looking:** You ask the question: "How likely is a particular event to occur?" For example, if the funded status is above 110 percent in 6,000 of the 10,000 simulations we conclude that there is approximately a 60 percent chance of this event occurring.
- **Backward looking:** You ask the question: "Given that the funded status goes above 110 percent, what had to take place for that to happen?" For example, we can look at the simulations that had the event occur and determine what generally happened to achieve that metric.

Assumptions and Data

To create these projections, we need to set assumptions for all unknown future events. Specifically, we need to create assumptions for each variable outlined in the previous section, including the variable's:

- Expected Value.
- Standard Deviation.
- Correlation.

For each assumption we present in the following sections, we use the same categories:

- **Used** – Tells how we use the assumption in the model.
- **Data** – Lists the data available for assumption setting.
- **Expectation** – Shows the expected value of the assumption; what the assumed distribution is centered around.
- **Standard Deviation** – Lists the standard deviation of the assumption (if applicable).
- **Distribution/Formula** – Explains how the volatility of the assumption surrounds the expectation.

We provide a summary of the percentiles for the following assumptions:

- Investment Returns.
- Real Revenue Growth.
- Real Salary Growth.
- Percent of Contributions Made.

We also provide the formulas for modeling the following assumptions:

- Inflation.
- Population Growth.
- Benefit Improvements.

- **Correlation** – Shows the correlation of the assumption to other variables.

We gained insights through representatives at the Office of Financial Management (OFM), Washington State Investment Board (WSIB), the Pension Funding Council (PFC) workgroup, and the Economic and Revenue Forecast Council (ERFC). Feedback from these content-area experts helped us assess the general reasonability of our assumptions.

Investment Returns

Used: To model actual investment returns in the projections.

Data: We used two main sources of data.

The first source of data is the WSIB's Capital Market Assumptions (CMAs).

The second source of data is an 84-year history of investment returns. Returns from 1926 through 1981 are estimated based on the WSIB's current asset allocation. Returns from 1982 through the present are based on actual returns. We did not use this data to set an assumption, but instead used it as a reasonability check. **Figure A.3.1** summarizes the data.

Figure A.3.1

Actual and Estimated Historical Investment Returns		
Investment Return Range	Number of Data Points	Percent of Data in Range
-32% to -29%	1	1.2%
-29% to -26%	0	0.0%
-26% to -23%	2	2.4%
-23% to -20%	0	0.0%
-20% to -17%	0	0.0%
-17% to -14%	2	2.4%
-14% to -11%	2	2.4%
-11% to -8%	1	1.2%
-8% to -5%	5	6.0%
-5% to -2%	3	3.6%
-2% to 1%	5	6.0%
1% to 4%	9	10.7%
4% to 7%	3	3.6%
7% to 10%	7	8.3%
10% to 13%	5	6.0%
13% to 16%	9	10.7%
16% to 19%	9	10.7%
19% to 22%	5	6.0%
22% to 25%	3	3.6%
25% to 28%	4	4.8%
28% to 31%	4	4.8%
31% to 34%	2	2.4%
34% to 37%	1	1.2%
37% to 40%	0	0.0%
40% to 43%	0	0.0%
43% to 46%	0	0.0%
46% to 49%	1	1.2%
49% to 52%	1	1.2%
Total	84	100.0%

Expectation: We relied on the WSIB's CMAs. The median one-year return is 7.81 percent.

Distribution: We relied on the WSIB's CMAs. **Figure A.3.2** shows a sample of the distribution.

Figure A.3.2

Assumed Investment Distribution		
Likelihood	Percentile	Annual Investment Return
1 in 10,000	MIN	-88.1%
1 in 100	1	-23.6%
1 in 20	5	-14.2%
1 in 10	10	-9.5%
1 in 4	25	-1.6%
1 in 2	50	7.8%
1 in 4	75	18.0%
1 in 10	90	28.0%
1 in 20	95	34.6%
1 in 100	99	49.2%
1 in 10,000	MAX	458.5%

Correlation: None. We assumed investment returns are not correlated to any other variable we are modeling.

Inflation

Used: To model the post-retirement Cost of Living Adjustments (COLAs). For LEOFF 1 we stochastically varied benefit payments based on inflation after retirement. For all systems besides LEOFF 1 we stochastically modeled the systems based on inflation as a component of nominal salary growth. Inflation is also used as a building block for nominal revenue growth (population growth + inflation + real revenue growth) and nominal salary growth (inflation + real salary growth).

Data: We used a 94-year history of the regional (Seattle-Tacoma-Bremerton) Consumer Price Index (CPI) from the Bureau of Labor Statistics (BLS). **Figure A.3.3** summarizes the data.

Figure A.3.3

Historical Inflation

Annual Inflation Range	Number of Data Points	Percent of Data in Range
-12% to -10%	1	1.1%
-10% to -8%	2	2.1%
-8% to -6%	1	1.1%
-6% to -4%	1	1.1%
-4% to -2%	1	1.1%
-2% to 0%	7	7.4%
0% to 2%	23	24.5%
2% to 4%	27	28.7%
4% to 6%	12	12.8%
6% to 8%	6	6.4%
8% to 10%	2	2.1%
10% to 12%	4	4.3%
12% to 14%	3	3.2%
14% to 16%	0	0.0%
16% to 18%	2	2.1%
18% to 20%	0	0.0%
20% to 22%	1	1.1%
22% to 24%	0	0.0%
24% to 26%	1	1.1%
26% to 28%	0	0.0%
Total	94	100.0%

Expectation: We expect inflation to average 3.5 percent over the fifty-year projection period. We developed this expectation based on a 60 percent weighting of short-term inflation (30 years) and a 40 percent weighting of long-term inflation (94 years).

Formula: We modeled inflation as an autoregressive time series. The parameters of the time series are:

- Long-Term Average = 3.50%
- Rate of Mean Reversion = 42%
- Random Standard Deviation = 3.00%

Formula: Current Year's Inflation = 0.42 x 3.50% + 0.58 x Last Year's Inflation + 0.03 x Normally Distributed Random Number

Correlation: We assumed inflation would have a 0.54 correlation to inflation one year ago. We developed this assumption based on a 60 percent weighting of short-term correlation (30 years) and a 40 percent weighting of long-term correlation (94 years).

Population Growth

Used: As a building block to determine the annual nominal growth of revenue.

Data: We used a 39-year history and a 21-year projection of population growth from OFM. **Figure A.3.4** shows the summarized data.

Figure A.3.4

Historical Washington Population Growth		
Population Growth Range	Number of Data Points	Percent of Data in Range
-0.4% to -0.2%	0	0.0%
-0.2% to 0%	1	2.6%
0% to 0.2%	0	0.0%
0.2% to 0.4%	0	0.0%
0.4% to 0.6%	1	2.6%
0.6% to 0.8%	2	5.1%
0.8% to 1%	1	2.6%
1% to 1.2%	6	15.4%
1.2% to 1.4%	2	5.1%
1.4% to 1.6%	6	15.4%
1.6% to 1.8%	4	10.3%
1.8% to 2%	6	15.4%
2% to 2.2%	0	0.0%
2.2% to 2.4%	3	7.7%
2.4% to 2.6%	2	5.1%
2.6% to 2.8%	0	0.0%
2.8% to 3%	1	2.6%
3% to 3.2%	1	2.6%
3.2% to 3.4%	1	2.6%
3.4% to 3.6%	0	0.0%
3.6% to 3.8%	1	2.6%
3.8% to 4%	1	2.6%
4% to 4.2%	0	0.0%
Total	39	100.0%

Expectation: We relied on OFM's 21-year projection of population growth. We used the average growth rate of 1.1 percent per year as our expected value.

Formula: We modeled population growth as an autoregressive time series. The parameters of the time series are:

- Long-Term Average = 1.10%
- Rate of Mean Reversion = 35%
- Random Standard Deviation = 0.80%

Formula: Current Year's Population Growth = 0.35 x 1.10% + 0.65 x Last Year's Population Growth + 0.008 x Normally Distributed Random Number

Correlation: We assumed population growth would have a 0.78 correlation to population growth one year ago. We developed this assumption based on historical data.

Real Revenue Growth (After Population Growth)

Used: To model annual changes in the state's available General Fund-State revenue.

Data: We used three sources of data.

The first source of data is a forty-year revenue history from the ERFC.

Figure A.3.5

Real Revenue Growth (After Population Growth)		
Annual Real Revenue Growth Range	Number of Data Points	Percent of Data in Range
-6% to -4%	2	5.0%
-4% to -2%	4	10.0%
-2% to 0%	4	10.0%
0% to 2%	12	30.0%
2% to 4%	8	20.0%
4% to 6%	8	20.0%
6% to 8%	0	0.0%
8% to 10%	2	5.0%
Total	**40**	**100.0%**

The second source of data is a four-year Washington Revenue forecast from the ERFC based on their June 2010 Forecast.

Figure A.3.6

Short-Term ERFC Projected Washington Revenue Growth		
Fiscal Year	Washington Revenue	Revenue Growth
2009	13,089,078	
2010	13,680,001	4.5%
2011	15,602,361	14.1%
2012	16,653,689	6.7%
2013	17,429,209	4.7%

The third source of data is a thirty-year national economic forecast from the ERFC based on their June 2010 forecast.

Figure A.3.7

Long-Term ERFC Projected National Real GDP Growth					
Fiscal Year	Real GDP	Real GDP Growth	Fiscal Year	Real GDP	Real GDP Growth
2009	12,902		2025	20,105	2.7%
2010	13,363	3.6%	2026	20,626	2.6%
2011	13,770	3.0%	2027	21,140	2.5%
2012	14,230	3.3%	2028	21,661	2.5%
2013	14,707	3.3%	2029	22,186	2.4%
2014	15,125	2.8%	2030	22,760	2.6%
2015	15,558	2.9%	2031	23,315	2.4%
2016	15,998	2.8%	2032	23,873	2.4%
2017	16,412	2.6%	2033	24,441	2.4%
2018	16,822	2.5%	2034	25,042	2.5%
2019	17,253	2.6%	2035	25,663	2.5%
2020	17,704	2.6%	2036	26,304	2.5%
2021	18,149	2.5%	2037	26,961	2.5%
2022	18,621	2.6%	2038	27,618	2.4%
2023	19,096	2.6%	2039	28,296	2.5%
2024	19,578	2.5%	2040	29,010	2.5%

Expectation: Over the next four years we expect nominal (total) revenue growth to average 7.5 percent. We relied on the ERFC's four-year Washington State revenue forecast for this assumption. Beyond four years, we expect real revenue growth to equal 1.5 percent per year based on historical data. When inflation and population growth are added to the real component, we arrive at the expected nominal revenue growth of 6.1 percent per year.

Distribution: We created an assumed distribution for real revenue growth that can be seen in **Figure A.3.8**.

Figure A.3.8

Assumed Real Revenue Growth Distribution		
Likelihood	Percentile	Annual Real Revenue Growth (After Inflation and Population Growth)
1 in 200	MIN	-4.3%
1 in 100	1	-4.2%
1 in 20	5	-3.7%
1 in 10	10	-3.3%
1 in 4	25	0.3%
1 in 2	50	1.3%
1 in 4	75	3.9%
1 in 10	90	4.0%
1 in 20	95	4.3%
1 in 100	99	8.3%
1 in 200	MAX	9.3%

Correlation: We assumed real revenue growth is correlated to same-year nominal investment returns. We assumed a 0.30 correlation based on historical data (above).

Percent of Contributions Made

Used: To estimate the percent of the actuarially required contribution (or recommended contribution) that will be made.

Data: We used a twenty-year history for PERS, TRS, LEOFF, and WSPRS. We used a seven-year history for SERS.

Expectation: Based on past experience, we expect approximately 80 percent of contributions to be made for PERS, TRS, and SERS. We expect approximately 98 percent of contributions to be made for LEOFF and WSPRS.

Figure A.3.9

Recommended and Adopted Employer Contribution Rates [1]

	PERS			TRS			SERS			LEOFF			WSPRS		
	Rec. Rate[2]	Adopt. Rate[3]	%Rec.[4]	Rec. Rate[2]	Adopt. Rate[3]	%Rec.[4]	Rec. Rate[2]	Adopt. Rate[3]	%Rec.[4]	Rec. Rate[2]	Adopt. Rate[3]	%Rec.[4]	Rec. Rate[2]	Adopt. Rate[3]	%Rec.[4]
1991	7.10%	7.10%	100%	12.60%	12.60%	100%				16.88%	16.88%	100%	21.47%	21.47%	100%
1992	7.47%	7.47%	100%	12.60%	12.60%	100%				16.44%	16.44%	100%	15.53%	15.53%	100%
1993	7.47%	7.27%	97%	12.60%	12.08%	96%				16.44%	12.99%	79%	15.53%	17.16%	110%
1994	7.19%	7.19%	100%	12.43%	12.43%	100%				13.54%	13.54%	100%	16.02%	16.02%	100%
1995	7.19%	7.19%	100%	12.43%	12.43%	100%				13.54%	13.54%	100%	16.02%	16.02%	100%
1996	7.21%	7.21%	100%	12.05%	12.05%	100%				13.22%	13.22%	100%	14.56%	14.56%	100%
1997	7.21%	7.21%	100%	12.05%	12.05%	100%				13.22%	13.22%	100%	14.56%	14.56%	100%
1998	7.32%	7.32%	100%	11.75%	11.75%	100%				9.20%	9.20%	100%	11.01%	11.01%	100%
1999	7.32%	7.32%	100%	11.75%	11.75%	100%				9.20%	9.20%	100%	11.01%	11.01%	100%
2000	4.36%	4.36%	100%	8.38%	8.38%	100%				2.33%	2.33%	100%	0.00%	0.00%	100%
2001	4.36%	4.10%	94%	8.38%	6.74%	80%				2.33%	2.16%	93%	0.00%	0.00%	100%
2002	3.21%	1.54%	48%	5.38%	2.57%	48%				2.31%	1.80%	78%	0.00%	0.00%	100%
2003	3.21%	1.10%	34%	5.38%	1.05%	20%				2.31%	2.02%	87%	0.00%	0.00%	100%
2004	2.05%	1.18%	58%	2.22%	1.17%	53%	1.74%	0.85%	49%	2.02%	2.02%	100%	0.00%	0.00%	100%
2005	2.05%	1.18%	58%	2.22%	1.17%	53%	1.74%	0.85%	49%	2.02%	2.02%	100%	0.00%	0.00%	100%
2006	5.73%	3.32%	58%	6.73%	3.64%	54%	7.56%	3.69%	49%	2.88%	2.70%	94%	4.51%	4.51%	100%
2007	5.73%	3.32%	58%	6.73%	3.64%	54%	7.56%	3.69%	49%	2.88%	3.11%	108%	4.51%	4.51%	100%
2008	7.72%	6.66%	86%	9.91%	6.43%	65%	9.17%	6.27%	68%	3.24%	3.43%	106%	7.75%	7.70%	99%
2009	7.72%	6.66%	86%	9.91%	6.43%	65%	9.17%	6.27%	68%	3.24%	3.53%	109%	7.75%	7.70%	99%
2010	7.84%	5.13%	65%	10.79%	5.98%	55%	8.12%	5.27%	65%	3.04%	3.38%	111%	8.57%	6.17%	72%

[1] *This table presents data used to develop our assumption on future contributions and is not intended to be a history of actual rates collected. The data is highly summarized and excludes supplemental rates.*

[2] *Initial total employer contribution rates recommended in the actuarial valuation before any assumption or policy changes.*

[3] *Total employer contribution rate adopted.*

[4] *Percent of recommended rate adopted.*

Distribution: We created a normal distribution centered around the historical mean. The parameters below characterize the random variables we used to model each system:

- **PERS, SERS**
  - Mean = 82%
  - Standard Deviation = 10%
  - Correlation = 0.80 to prior year's value.
  - Assumed system maximum employer contribution rate = 13.50%
- **TRS**
  - Mean = 77%
  - Standard Deviation = 10%
  - Correlation = 0.85 to prior year's value.
  - Assumed system maximum employer contribution rate = 18.00%
- **PSERS**
  - Mean = 82%
  - Standard Deviation = 10%
  - Correlation = 0.80 to prior year's value.
  - Assumed system maximum employer contribution rate = 30.00%
- **LEOFF***
  - Mean = 98% for LEOFF 1, 100% for LEOFF 2
  - Standard Deviation = 1% for LEOFF 1, 0% for LEOFF 2
  - Correlation = 0.30 to prior year's value.
  - Assumed system maximum employer contribution rate for LEOFF 1 = 30.00%

** Revised May 5, 2011, to show LEOFF 1 and LEOFF 2.*

- **WSPRS**
  - Mean = 99%
  - Standard Deviation = 1%
  - Correlation = 0.10 to prior year's value.
  - Assumed system maximum employer contribution rate = 50.00%

Correlation: We found the following approximate historical correlations:

- **PERS, TRS**
  - 0.40 correlation to revenue growth 2 years ago.
  - 0.45 correlation to investment returns 2 years ago.
  - 0.80 correlation to last year's contribution pattern.
  - -0.35 correlation to change from last year's contribution to this year's recommended contribution.
- **LEOFF, WSPRS**
  - 0.30 correlation to revenue growth 2 years ago.
  - 0.30 (0.60 in WSPRS) correlation to investment returns 2 years ago.

Benefit Improvements

Used: To estimate the increase in liabilities over time associated with adopting future benefit improvements.

Data: We used a 22-year history for PERS, TRS, LEOFF, and WSPRS. We used a nine-year history for SERS. We excluded many benefit improvements for various reasons (cost not identified in fiscal notes, one-time event we don't believe will repeat in the future, etc.). For this reason, we believe our assumption conservatively estimates future benefit improvements if past practices continue.

We found the data contained a general small "creep", defined as improvements up to 0.20 percent of liabilities, with occasional large "spikes" in excess of 0.20 percent of liabilities. We also found that nearly all "spikes" applied to both past and future service credit.

Figure A.3.10

Percent Liability Increase From Benefit Improvements By Plan										
Year	All Systems	PERS 1	PERS 2/3	TRS 1	TRS 2/3	SERS 2/3	PSERS 2	LEOFF 1	LEOFF 2	WSPRS
1989	2.24%	4.08%	0.00%	3.37%	0.00%			0.00%	0.00%	0.00%
1990	0.00%	0.00%	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%
1991	0.00%	0.00%	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%
1992	0.37%	0.76%	0.00%	0.58%	0.00%			0.00%	0.00%	0.00%
1993	0.52%	0.00%	0.00%	0.00%	0.00%			0.00%	17.99%	0.00%
1994	0.16%	0.26%	0.00%	0.37%	0.00%			0.00%	0.00%	0.00%
1995	0.86%	2.38%	0.00%	1.06%	0.00%			0.00%	0.00%	0.00%
1996	0.00%	0.00%	0.00%	0.00%	0.00%			0.00%	0.00%	0.03%
1997	0.00%	0.00%	0.00%	0.00%	0.00%			0.00%	0.00%	0.00%
1998	0.70%	1.45%	0.00%	1.48%	0.00%			0.00%	0.00%	0.00%
1999	0.06%	0.00%	0.00%	0.00%	0.50%			0.00%	0.00%	1.03%
2000	2.39%	0.00%	6.45%	0.00%	7.67%			0.00%	2.91%	0.00%
2001	0.09%	0.00%	0.00%	0.00%	0.00%			0.00%	0.00%	8.07%
2002	0.01%	0.04%	0.00%	0.00%	0.00%	0.00%		0.03%	0.00%	0.00%
2003	0.03%	0.00%	0.03%	0.00%	0.01%	0.08%		0.00%	0.30%	0.00%
2004	0.17%	0.01%	0.62%	0.01%	0.00%	0.00%		0.00%	0.10%	0.00%
2005	0.12%	0.00%	0.00%	0.02%	0.00%	0.00%		0.21%	1.25%	0.00%
2006	0.13%	0.09%	0.02%	0.03%	0.11%	0.24%		0.51%	0.31%	1.08%
2007	3.25%	3.28%	3.89%	3.31%	6.20%	4.26%		0.00%	0.15%	0.00%
2008	0.09%	0.02%	0.03%	0.08%	0.65%	0.00%	0.00%	0.00%	0.00%	0.00%
2009	0.10%	0.05%	0.08%	0.00%	0.02%	0.04%	0.00%	0.56%	0.16%	0.71%
2010	0.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.90%	0.02%
Average	**0.52%**	**0.56%**	**0.51%**	**0.47%**	**0.69%**	**0.51%**	**0.00%**	**0.06%**	**1.09%**	**0.50%**

Expectation: Based on past experience, we modeled approximately a 0.5 percent increase in the Present Value of Future Benefits (PVFB) per year for PERS, TRS, SERS, PSERS, and WSPRS. We modeled approximately a 1.0 percent increase in PVFB per year for LEOFF 2. We modeled approximately a 0.05 percent increase in PVFB per year for LEOFF 1.

Distribution: We created an assumption that incorporates the "creep" and "spikes" seen in the historical data. Overall the "creep" and "spike" added together equal our expectation.

Figure A.3.11 shows our benefit improvement assumption.

Correlation: The spikes tend to drive the benefit improvement data. Due to the limited number of spikes in the data, we did not observe a strong statistical correlation between benefit improvements and any other variable we are modeling. However, this does not mean a correlation does not exist. For example, two of the spikes relate to gain-sharing benefits (a benefit improvement directly tied to investment returns).

Formula: Even though we did not observe a statistically valid correlation, we implemented a formula based on economic conditions to model future benefit improvements. If past practices continue, we assume the Legislature will adopt more benefit improvements during good economic times and less during bad economic times. To model this we used the formula:

Spike = Spike Probability x Spike Amount x Current Year Revenue Percentile / 0.50

This formula means that during the worst economic times, no spike will occur. During the best economic times the spike will double. During average economic times the spike assumptions in **Figure A.3.11** will hold.

Figure A.3.11

Average Historical Creep & Spike in Liabilities								
	PERS 1	PERS 2/3	TRS 1	TRS 2/3	SERS 2/3	LEOFF 1	LEOFF 2	WSPRS
Annual Creep	0.06%	0.03%	0.06%	0.04%	0.06%	0.03%	0.07%	0.04%
Spike	1.84% Every 3.7 Years	3.45% Every 7.3 Years	1.5% Every 3.7 Years	3.55% Every 5.5 Years	2.05% Every 4.5 Years	0.22% Every 7.3 Years	3.74% Every 3.7 Years	2.53% Every 5.5 Years
Spike Probability	27%	14%	27%	18%	22%	14%	27%	18%

Real Salary Growth

Used: To model annual changes in system salary. Real salary growth affects the present value of liabilities and future salaries (contribution rates), benefit payments, and contributions collected.

Data: We used a 26-year history of salary growth for PERS, TRS, LEOFF, and WSPRS. We used an eight-year history for SERS and a one-year history for PSERS. We excluded PERS data in 2000 since the creation of SERS made it difficult to track the actual year-to-year change.

Figure A.3.12

Real Salary Growth By System							
Year	PERS	SERS	PSERS	TRS	LEOFF	WSPRS	Total
1983	-6.25%			-10.06%	-4.24%	-12.89%	-7.72%
1984	-2.47%			0.00%	-0.87%	5.86%	-1.65%
1985	7.61%			4.80%	4.51%	2.84%	6.35%
1986	0.35%			-0.03%	1.87%	-7.89%	0.28%
1987	2.35%			-0.28%	-0.81%	3.42%	1.16%
1988	1.74%			3.77%	5.47%	1.49%	2.42%
1989	1.42%			2.88%	0.33%	1.74%	1.63%
1990	1.55%			2.03%	3.37%	0.86%	1.60%
1991	2.26%			4.54%	0.00%	4.97%	2.36%
1992	-4.41%			-2.28%	-0.98%	-4.15%	-3.61%
1993	-1.14%			0.02%	-0.18%	-1.73%	-0.71%
1994	-2.58%			-2.83%	0.81%	-1.48%	-2.36%
1995	-0.06%			-1.63%	1.16%	1.83%	-0.29%
1996	-0.53%			0.86%	0.27%	1.56%	-0.14%
1997	-0.56%			-2.44%	1.21%	4.82%	-0.92%
1998	-1.49%			-0.36%	2.08%	1.64%	-0.99%
1999	0.20%			-2.65%	0.81%	1.68%	-0.52%
2000				2.39%	1.40%	-2.14%	1.42%
2001	0.33%	-5.05%		-1.74%	-0.16%	-1.51%	-0.68%
2002	0.89%	1.24%		0.04%	1.38%	-0.67%	0.52%
2003	-0.92%	1.92%		1.03%	-0.46%	-2.20%	0.07%
2004	0.10%	0.01%		-0.36%	2.18%	-2.04%	0.08%
2005	1.10%	0.40%		0.76%	2.61%	3.26%	1.09%
2006	2.43%	0.92%		0.47%	1.91%	4.20%	1.79%
2007	-0.49%	0.16%		2.35%	-0.27%	-0.54%	0.22%
2008	2.35%	1.78%	-0.58%	1.90%	1.71%	0.91%	2.13%

Expectation: We expect annual real salary growth to equal 0.50 percent for all systems besides LEOFF 2. We expect LEOFF 2 to experience 1.00 percent real salary growth per year.

Distribution: We created assumed distributions for real salary growth that can be seen in **Figure A.3.13**. We created one distribution for PERS, SERS, and PSERS. We also created separate distributions for TRS, LEOFF, and WSPRS.

Figure A.3.13

Summarized Assumed Distributions				
Percentile	PERS, SERS, PSERS	TRS	LEOFF	WSPRS
MIN	-5.87%	-9.76%	-4.22%	-12.65%
1	-5.48%	-7.96%	-3.40%	-11.40%
5	-4.25%	-2.48%	-0.93%	-6.72%
10	-2.17%	-2.24%	-0.82%	-2.94%
25	-0.20%	-1.01%	-0.16%	-1.44%
50	0.64%	0.33%	1.01%	1.44%
75	1.89%	2.29%	1.92%	2.83%
90	2.70%	3.63%	3.01%	4.75%
95	2.76%	4.65%	4.24%	5.17%
99	6.28%	5.03%	5.25%	5.88%
MAX	7.99%	5.10%	5.49%	6.10%

Correlation: We assumed real salary growth is correlated to real revenue growth two years ago. We assumed a 0.60 correlation.

Miscellaneous

We assumed generational mortality improvements consistent with 50 percent of Scale AA (a standard mortality projection scale from the Society of Actuaries). The rate of improvement is consistent with the 2008 AVR (performed on a closed-group basis), but the generational length of growth is more appropriate for the open group projection we employed in our model. The generational length of growth perpetually continues throughout the fifty-year projection whereas the 2008 AVR is projected to a static year meant to approximate the closed group population.

We also assumed new entrants would become slightly older over time due to the aging of the baby boomers, decreasing fertility rates and improving life spans. We modeled new entrants entering three years older than the current average new entrant age.

Model Verification and Validation

We intend this model to provide a basis for understanding and implementing a risk management process. This model provides a significant increase in information about the range of outcomes the pension system could experience in the future. The importance of the model lies in this large step forward; it's much more important to know the general range of outcomes that could occur than to worry about whether a specific risk measure is slightly higher or lower than the "actual" value. We built the model with this purpose in mind, and this section explains how we checked our model to make sure we implemented it with enough "precision for the decision" at hand (concept based on a quote from Robert McCrory).

We followed a thorough reasonability procedure to check that we implemented our methods as intended. The list below explains most of the major steps we took to ensure reasonability.

1. We analyzed the randomness of the random numbers that are input into the economic environment generator. We made sure the numbers were indeed uniformly distributed between zero and one, and that they demonstrated no correlation.
2. We analyzed the characteristics of the correlated random numbers for reasonability. We reviewed the range of numbers generated, the shape of the distribution of numbers generated, and the range of inter-correlations that we expected to see.
3. We analyzed the characteristics of the stochastic variables. We reviewed the range of values generated, the shape of the distribution of values generated, and the range of inter-correlations that we expected to see.
4. We analyzed sample simulations to make sure we input the stochastic variables correctly, the calculations reacted correctly to the stochastic variables, and to make sure the results seemed reasonable.
5. We stress tested the model to ensure that it is robust and that the calculations can handle extreme situations that may arise in a given simulation. We stress tested the model by entering extreme values, changing the current status of the pension systems, and creating specific scenarios.
6. We compared model output to past pension projections, such as the 2009 Report on Financial Condition. This demonstrated we are consistently applying our methods and not introducing errors.
7. We performed sensitivity analysis on our assumptions and methods to see how

the model reacts. We reviewed the results to ensure that the model reacts reasonably. Please see additional information on our sensitivity analysis in the next appendix section.

8. The Pension Funding Council solicited an outside actuarial review of the model. As of the date of this publication, the audit has been underway for two months (from the date of initial receipt of information), but is not yet complete. We appreciate the comments we received from the actuarial auditor thus far on assumptions and methods. At this point, we are very confident in the reasonability of the results from our model and the associated findings. We will consider any further comments from the actuarial auditor as we update the model in the future. Please see the next paragraph for an explanation of the on-going nature of this model.

We intend to use this type of analysis, and therefore, this model, on a regular basis in the future. We plan to continually monitor and update the assumptions and methods used as necessary. We will also continue to monitor and ensure the model has assumptions and methods that produce the precision needed for the decisions at hand.

Sensitivity Analysis

Consistent with the Verification and Validation section, we perform sensitivity analysis on our assumptions and methods. We do this for the following primary reasons:

- To check our model for reasonable reactions to different assumptions or methods.
- To determine how much time we should spend refining a given assumption or method. If we change the assumption or method significantly and the results hardly change, it's likely not worth spending too much time refining it.
- To provide readers with a sense of how the results change under different assumptions.

We performed numerous sensitivity runs. Below, we show a few of these and how they affected the results of the model:

1. **Different Investment Return Distribution** – The current model uses the log stable distribution. This run shows how the results would change if the lognormal distribution were used.
2. **Different Investment Return Method** - The current model uses the log stable distribution. This run shows how the results would change if a "regime-switching" model were used. The regimes, which were set up to match the historical Cumulative Distribution Function (CDF), are:
   a. **Boom** – When in this regime, the expected return is 26.0 percent and the standard deviation is 13.2 percent. The maximum return is 50.0 percent and the minimum return is 10.0 percent. There is a 20 percent chance of staying in the Boom regime, a 75 percent chance of moving to a Normal regime, and a 5 percent chance of moving to the Recession regime.
   b. **Normal** – When in this regime, the expected return is 4.7 percent and the standard deviation is 11.3 percent. The maximum return is 26.0 percent and the minimum return is -16.0 percent. There is a 72 percent chance of staying in the Normal regime, a 25 percent chance of moving to the Boom regime, and a 3 percent chance of moving to the Recession regime.
   c. **Recession** - When in this regime, the expected return is -30.3 percent and the standard deviation is 1.0 percent. The maximum return

is 0.0 percent and the minimum return is -35.0 percent. There is a 0 percent chance of staying in the Recession regime, a 50 percent chance of moving to the Normal regime, and a 50 percent chance of moving to a Boom regime.

3. **Lower Investment Distribution for Ten Years** – The current model assumes the same distribution for the fifty-year period. This run shows how the results would change if the first ten years had an investment return distribution that was shifted downward by 100 basis points (1 percent), reverting back to the current distribution after the ten-year period.

4. **Lower Percent of Contributions Made Assumption** – Under the continuation of past practices, the current model assumes a fraction* of recommended contributions will be made – 82, 77, 98, 100, and 99 percent for PERS/SERS/PSERS, TRS, LEOFF 1, LEOFF 2, and WSPRS respectively on average. This run shows how the results would change if 5 percent less were contributed.

5. **Higher Benefit Improvement Assumption** – Under the continuation of past practices, the current model assumes benefit improvements will occur over time – approximately 0.05 percent annual liability increase for LEOFF 1, 1.0 percent for LEOFF 2, and 0.5 percent for the remaining systems. This run shows how the results would change if benefits improved at a 25 percent higher rate than currently assumed.

** Revised May 5, 2011, to show LEOFF 1 and LEOFF 2.*

Figure A.5.1

Sensitivity of Model to Assumptions and Methods

Category (from scorecard in report body)	Current Results	Lognormal Investment Return Distribution	Regime-Switching Investment Return Model	Lower Short-Term Investment Distribution	Lower Contribution Assumption	Higher Benefit Improvement Assumption
:e Pensions will Consume More than 8% of GF-S	18%	16%	17%	23%	19%	19%
ance GF-S Consumption will Exceed	9.9%	9.6%	9.6%	10.1%	9.9%	10.0%
ance Employer Contribution Rate will Exceed	20.1%	19.9%	20.2%	20.6%	20.2%	20.6%
:e of PERS 1, TRS 1 in Pay-Go	41%	42%	38%	48%	46%	46%
:e of Open Plan in Pay-Go	13%	12%	11%	14%	14%	22%
ance Annual Pay-Go Cost in PERS 1, TRS 1 Exceed	$1.7	$1.7	$1.7	$1.7	$1.7	$1.8
ance Annual Pay-Go Cost in Open Plans Exceed	$4.0	$4.1	$4.0	$4.4	$4.1	$6.7
:e of Total Funded Status Below 60%	34%	33%	30%	38%	37%	40%

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