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Jenna M. Skop
University of Kentucky

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MARTIN SCHOOL OF PUBLIC POLICY AND ADMINISTRATION

State Public Retirement Systems

An Examination of Factors Affecting
the Funded Ratio

Jenna M. Skop
Graduate Capstone
Spring 2013

Contents

Executive Summary	2
Introduction	3
Problem Statement	5
Background and Relevant Facts	6
<i>Types of Retirement Plans</i>	6
<i>Investment of Pension Funds</i>	7
Literature Review	8
<i>Governments and Defined Benefit Plans</i>	8
<i>Defined Benefit Plans and the Funded Ratio</i>	9
<i>Public Retirement Systems and Employer Contributions</i>	9
<i>Public Retirement Systems and Social Security</i>	10
<i>Changes Before the Great Recession</i>	11
<i>Changes Since the Great Recession</i>	11
Research Design	12
<i>Data Collection</i>	13
<i>Variables</i>	14
<i>Statistical Models</i>	17
Analysis and Findings	18
<i>Summary Statistics</i>	18
<i>Linear Regression</i>	19
Limitations	23
Conclusions and Recommendations	24
Areas for Future Study	25

Executive Summary

Each of the fifty states oversees at least one public retirement system for employees. This study examines which factors affect the funded ratio of these systems. The intent of this paper is not to solve the problems facing public retirement systems, but to give decision makers and policy leaders a better understanding of what affects the funding levels of these systems. Understanding the various factors that affect the funded ratio will help decision makers determine which changes should be made to public retirement systems.

The funded ratio is one of the main methods used to determine how well funded these systems are and indicates an ability to pay accruing liabilities (Boston College Public Plans Database). It is defined as actuarial assets divided by actuarial liabilities. Existing literature suggests that investment returns and a consistent lack of employer contributions have driven down the funded ratio of states' public retirement systems. This paper examines these factors, but also looks at the effects of Social Security eligibility, cost of living adjustments, type of retirement plan offered, payroll, number of members, and employee contributions.

To determine the effect of these variables on the funded ratio, I created a dataset of state-run public retirement systems from 2001 to 2009. This data was obtained from the Public Plans Database, a product of the Center for Retirement Research at Boston College. A model was created and a linear regression estimated the effects of the various factors. The linear regression model found six significant explanatory variables: plan type, actuarial assets, annual required contributions (ARC), payroll, the employee contribution rate, and employer contributions. All of the explanatory variables were found to be significant at the 99% confidence interval with the exception of employer contributions. Employer contributions were found to be significant at the 90% confidence interval.

Based on the regression results, I recommend states pay toward the existing ARC. Since this impacts the funded ratio, existing statutes prohibiting a certain contribution level or simple failure to make payments, will probably increase the amount that states must pay in the future. Reducing the ARC will lower the system's actuarial liabilities relative to assets and potentially make future ARC payments lower.

Actuarial assets also have a statistically significant impact on the funded ratio in my analysis. Though it is outside the scope of this study to make recommendations regarding specific retirement systems, my analysis indicates that increasing assets relative to liabilities will raise the funded ratio. My results indicate that this could be done through increased employer contributions, a reduction in payroll, and lowering the ARC.

Introduction

In 2012, the Pew Center on the States estimated that public retirement obligations in the United States in 2010 were underfunded by \$757 billion, when accounting for current and future liabilities (Pew Center on the States 2012). In the fall of 2008, the financial markets experienced a near collapse, and public retirement systems suffered from investment losses just like private sector companies and individual portfolios. Coupled with changes by state governments in the early 2000s that increased payments to retirees, and states' failure to consistently make the annual required contributions to retirement systems, a number of systems faced funding challenges (Pew Center on the States 2007).

In many instances, states contribute to multiple retirement systems every year. State public retirement systems consist not only of the traditional state employees' retirement systems (those people working in the legislative, executive, and judicial branches), but also teachers, fire, police, and any other system run by the state. Individual retirement systems exhibit different

characteristics across states. For example, the systems vary in the plan type offered to employees, the number of members participating, and contributions made - both by the employee and the employer.

Despite these differences, one of the main criteria used across all systems to judge whether or not a retirement system is sufficiently funded, and has the ability to meet current and future obligations, is through the calculation of the funded ratio (Munell et. al 2008). The funded ratio is defined as actuarial assets divided by actuarial liabilities. Actuarial assets are a system's asset value based on the assets' current market value and some unrealized gains and losses from previous years. Actuarial liabilities are the present value of future benefits the system must pay to retirees (Boston College Public Plans Database).

When looking at bordering states or even the same system across years, this ratio fluctuates. This inconsistency prompted my research question: which factors affect the funded ratio of states' public retirement systems? I was interested in seeing if the seemingly more obvious factors of plan type, investments, and employer contributions were the only factors affecting the funded ratio, or if other variables, like the total number of members, cost of living adjustments, employee contributions, and Social Security eligibility affected it as well.

This paper includes a problem statement, background of applicable information pertaining to state-level public retirement systems, a review of a set of academic studies and articles, and a research design explaining how the analysis will be conducted. A discussion of my regression results, recommendations, limitations, and ideas for future areas of study complete the contents of this paper.

Problem Statement

Given the challenges facing public retirement systems in recent years, it is important to examine which factors affect the funded ratio. I believe understanding the factors affecting this ratio is helpful to decision makers. Legislators retain the authority to allocate money to these systems and make statutory changes to how they operate. If legislators properly understand what affects the funded ratio, then it might allow them to make more informed decisions in the future regarding possible changes to these systems. This topic is of interest to decision-makers, public-sector employees, and citizens having to potentially bear the cost if sufficient revenue does not exist to pay retirees. Shortfalls in the assets of these systems must be borne through higher taxes paid by citizens or through reduced benefits for retirees (Eaton and Nofsinger 2008). In recent years, court cases have become an issue for state governments wishing to adjust existing retirement benefits. Participants in these systems argue that changing their benefits takes away an established right. According to the Center for Retirement Research, in 2009, the most recent year in my dataset, public retirement systems had over \$3 trillion in liabilities and \$2.6 trillion in assets (Public Plans Database).

As part of this project, I analyze the relationship between the funded ratio and a series of explanatory variables selected through a review of existing literature. Based on previous studies and my own intuition, I hypothesize actuarial assets, employer and employee contributions, the employee contribution rate, total number of members, payroll, Social Security eligibility, and the percent of the annual required contribution paid by the employer will positively affect the funded ratio. I hypothesize that the type of retirement system, actuarial liabilities, cost of living adjustments tied to the Consumer Price Index, and annual required contributions will negatively affect the funded ratio.

Background and Relevant Facts

Types of Retirement Plans

Employees in the United States, both in the public and private sectors, generally participate in one of two types of retirement plans: defined benefit and defined contribution. A defined benefit plan guarantees participants a specified monthly payment during their retirement years. This monthly payment amount is usually based on a number of factors, such as the participant's years of service with the organization, salary during working years, and age. Often the payment is calculated using a formula consisting of these factors (IRS). Because a specified payment amount is guaranteed based on a set of pre-determined calculations, the employer bears the investment risk in this plan. If investment returns are lower than expected, the employer must make up the additional funds to pay retirees.

A defined contribution plan consists of contributions made by both the employee and the employer to an employee's individual account. At the time of distribution, the amount of funds in the account is subject to taxation. The value of the account will fluctuate over time due to market performance and contributions. Unlike in a defined benefit plan, an employee participating in a defined contribution plan does not receive a guaranteed amount of money during retirement – placing the investment risk on the employee. A standard 401(k) plan is an example of this type of plan (IRS).

No two state public pension systems exhibit the same characteristics in terms of the type of plan they offer. The majority of state retirement systems still participate in the traditional defined benefit plan, but some systems have adopted either defined contribution or hybrid plans over the years. Hybrid plans incorporate elements of both defined benefit and defined

contribution plans. Several state governments, including Alaska, now offer this type of plan to public employees.

Investment of Pension Funds

Once contributions are made to a public retirement system, those contributions are invested in various securities to generate income. In calculating the total value of retirement benefits for members of a particular system, actuaries make assumptions about investment performance. In data obtained from Boston College's Public Plans Database, for 104 state-level public retirement systems, the range of projections on investment returns is between four and a half to nine percent. On average, an eight percent return is projected over the long term, a higher expected rate than in the private sector (Coggburn and Kearny 2010). Except for the Kentucky Employees Retirement System in 2008 and the Kentucky Teachers Retirement System in 2007, which projected returns of four and a half percent, all other systems in all other years projected at least a seven percent return. It is important to note that actuaries' investment assumptions are discounted back to the present over the long term. Despite the annual fluctuation in investment returns, which can include multiple years of negative returns, over the long-term actuaries expect a positive investment performance.

While outside the scope of this project, a system's assets are invested in a variety of securities, including stocks, bonds, international securities, real estate, and short-term investments. Despite the positive long-term return projections, many systems recorded negative investment returns over the years examined in this study (Boston College Public Plans Database).

Literature Review

Over the years, a number of studies have reviewed public retirement systems and the issues they face. These studies tend to focus on why public retirement systems are underfunded, particularly in regard to the type of plan offered to employees, investment returns, and the contributions made by employers. Previous studies differ in regard to whether a defined benefit plan is the right option for public employers and how much the type of plan offered impacts the funding levels of retirement systems. Some of the literature also touches on the role that Social Security eligibility might play in regard to systems' funding and employer contributions. Recent articles from the Pew Center on the States, published after the start of the Great Recession, discuss state governments' efforts in the wake of the financial crisis to fund ailing retirement systems. These efforts include changes to cost of living adjustments (COLA) and modifications to plan types; however, in multiple states these changes have been challenged by current and former public employees participating in the retirement systems.

Governments and Defined Benefit Plans

All else equal, scholars assume that employees would prefer a job offering retirement benefits to one that does not. Researchers have found that public employers offering defined benefit pension plans retain more workers and experience less employee turnover (Almeida and Boivie 2009). It appears that defined benefit plans are desirable to workers and an incentive for them to work in public service, as opposed to seeking a perhaps higher paying job in the private sector. Despite the most recent recession, opportunities for obtaining a job in the public sector remain favorable (Franzel 2009). New, and thus a higher number of, employees means greater future liabilities for state retirement systems.

Defined Benefit Plans and the Funded Ratio

Lahey and Anenson (2007) believe the problems facing state public retirement systems directly stem from the existence of defined benefit pension plans. They make this argument because in a defined benefit plan, the state (employer) bears the cost of market fluctuation. If the market performs well, then assets rise and states can contribute less state dollars to retirement systems. In this scenario, the investment income helps to pay actuarial liabilities; however, if the market performs poorly, as it did in the late 2000s, then the employer must pay a greater amount of the accruing liabilities from their own funds. Over time, poor market performance contributes to the amount that governments must pay into public retirement systems. Coupled with budget shortfalls and other state expenditures, payments to retirement systems have sometimes fallen behind.

Lahey and Anenson mention that the primary way to determine whether or not a retirement system is funded is to calculate its funded ratio. Their study mentions how this ratio fluctuates due to investment returns, and how this fluctuation impacts states' retirement liabilities. According to Lahey and Anenson, drops in the funded ratio prove significant, especially for state systems participating in defined benefit pension plans. A drop in this ratio means more accrued liabilities relative to assets.

Public Retirement Systems and Employer Contributions

The funding efforts of public retirement systems are measured through both the funded ratio and the system's consistency in making its annual required contribution (ARC) payments (Munnell et. al 2008). According to this study, those systems making the ARC accrue sufficient savings to pay unfunded and accruing liabilities. Systems that fail to make payments towards the ARC will likely experience an increase in unfunded liabilities as any unpaid liabilities from the

current year will roll into unfunded liabilities. When unfunded liabilities increase relative to assets, the system's funded ratio decreases. Like Munnell et. al, Truesdell (2011) also concluded that state retirement systems with a lower funded ratio have a higher ARC.

While some states fail to make ARC payments for other fiscal reasons, Munnell et. al (2008) found some states are constrained by statute in regard to how much they can contribute to public retirement systems. For example, the authors found that Kansas's 2006 contribution of around 63% of its ARC was slightly smaller than actuaries recommended, due to its statutory constriction. For states not legally constrained in their contributions, Munnell et. al found that larger systems were more likely to fail to make the recommended ARC payments.

Public Retirement Systems and Social Security

The Government Accountability Office (GAO) found that more than twenty-five percent of state and local government workers do not pay into the Social Security System and are ineligible to receive benefits based on their government earnings (Government Accountability Office 2012). Koggburn and Kearny (2009) considered the impact of Social Security eligibility on public retirement systems between 2006 and 2007. They hypothesized that states not offering Social Security to employees would have more funded retirement systems due to the pressure to provide public employees with more generous retirement benefits; however, in their analysis, they did not find Social Security ineligibility to be statistically significant in relation to unfunded liabilities.

A 2012 report by the GAO found that employees and employers in public systems ineligible for Social Security benefits make higher contributions to their states' retirement systems (Government Accountability Office 2012). The report by the GAO, though, did not use statistical analysis to reach this conclusion.

Changes Before the Great Recession

In 2012, the Pew Charitable Trust estimated that as of 2010, states had unfunded pension liabilities of approximately \$757 billion. Changes made to these retirement systems in the early 2000s and market fluctuation throughout the decade impacted public retirement systems. In 2000, approximately half of the states considered themselves fully funded, with the ability to pay future liabilities (Pew Center on the States 2007). At the start of the decade, the market was performing strong and some state legislatures decided to make changes to public retirement systems. These changes included reducing the age at which employees could start receiving benefits and the multipliers used to calculate employees' monthly benefits in defined benefit plans. These changes raised the systems' liabilities by increasing the amount of money employees were eligible to receive in retirement. Despite adding to the liabilities of the systems, a number of states still failed to contribute adequate funding amounts during this time (Lahey and Anenson 2007).

While the market exhibited a strong performance between 1999 and 2000, by the time of the September 11, 2001 terrorist attacks, the market had begun to sour and contribution shortfalls in public retirement systems hurt asset growth (Pew Center on the States 2007). A 2007 report by the Pew Center on the States suggested that pension levels would begin to rise again in 2008. Instead, 2008 rocked the financial markets, the Great Recession began, and contributions to retirement systems actually declined by five percent between 2008 and 2009 (Pew Center on the States 2011).

Changes Since the Great Recession

For many years, public retirees have received increased payments from their former employers to cover cost of living adjustments; however, since the most recent recession, several

state governments' attempts to change public retirees' cost of living adjustments (COLA) have resulted in multiple court cases. Retirees in Colorado, Minnesota, and other states argue that eliminating or reducing COLAs violates their constitutional rights by taking away an existing benefit.

The courts' interpretations of changes to cost of living adjustments in these states have been split. For example, the Colorado District Court ruled that retirees participating in the state's Public Employees Retirement System (PERA) did not have a contractual right to the COLA that existed when they first reached retirement; however, in October 2012, the Colorado Court of Appeals reversed the ruling. The Court of Appeals remanded the case back to the district court and instructed the district court to determine "if the impairment of the right" was considerable and if the COLA reductions served any public purpose (*Justus vs. State* 2012, 2). This case remains ongoing.

In June 2011, Minnesota District Judge Gregg Johnson said cost of living adjustments are not part of a contractual obligation guaranteed by the Minnesota or Federal Constitutions. In his opinion, Johnson said that the power to make changes to COLA resides with the Minnesota State Legislature (Fehr 2011).

Research Design

This quantitative study examines which factors affect the funded ratio of states' public retirement systems. The funded ratio is the state's actuarial assets divided by its actuarial liabilities to current and future retirees. A ratio of one or greater indicates the system's full ability to pay its current and future retirement obligations. In my dataset, the reported funded ratios range from .191 (West Virginia Teachers' Retirement System in 2001) to 1.48 (University of California Retirement System in 2001).

One hundred four state level public retirement systems serve as the units of analyses in this study, with the funded ratio acting as the key dependent variable. A public retirement system, in the context of this project, includes any retirement system made up of state-level public employees and run by the state. Therefore, the funded ratios of public employees, teachers, police, fire, and any other employee-specific system run by a state are included in the analysis. The number of systems is not uniform across states; however, each of the fifty states oversees at least one public retirement system for employees.

This study does not examine the funding ratios of local public pension plans, as they are separate from the state systems. Additionally, retirement systems run by the District of Columbia do not factor into this analysis, as the District is not by definition a state.

Data Collection

I obtained the data for this analysis from the Center for Retirement Research at Boston College's Public Plans Database (PPD)¹. The Center for Retirement Research houses retirement data on state and local public retirement systems from all fifty states and the District of Columbia between 2001 and 2010; however, as of February 2013 the 2010 data had not yet been reported. The PPD breaks down the data by the state, plan name, and fiscal year. Information on systems participating in hybrid and defined contribution plans was obtained from the appendix in “A Role for Defined Contribution Plans in the Public Sector,” a 2011 publication by the Center for Retirement Research. Each state and its pension plan(s) included in this study contain data for each year between 2001 and 2009. Table 4 in the results section of this paper, provides information about summary statistics and missing observations.

¹ More information on the Public Plans Database at the Center for Retirement Research can be found here: <http://pubplans.bc.edu/pls/apex/f?p=1988:3:0>.

Variables

Initially, I thought about the funded ratio as a function of contributions, payment obligations, and characteristics. Contribution variables can be defined as revenue sources. Variables include payments into the system by employers and employees as well as annual investment earnings. All else equal, an increase in contributions increases the amount of money available to pay current and future obligations. Based on my intuition that more dollars into a system increases its funding level, I hypothesize that these variables positively affect the funded ratio.

Governing bodies of state retirement systems invest in a wide range of securities. For the purposes of this project, only the actual income levels from investments factor into the analysis. Income from specific securities and the amount of assets allocated to various types of securities are not examined. Since existing literature discusses a decrease in investment performance since the Great Recession, I believe that investment income will positively impact the funded ratio. Based on my own intuition, I think that systems with higher funded ratios will have greater investment income.

Table 1: Contribution Variables

Variable	Definition	Measurement	Hypothesized Relationship to Ratio
Employee Contributions	Total amount all employees pay	Millions of dollars	Positive
Employee Contribution Rate	Percentage of wages each employee contributes	0-1	Positive
Employer (State) Contributions	Total amount employer annually pays	Millions of dollars	Positive
Investment Income	Amount of income from investments	Millions of dollars	Positive
Actuarial Assets	Actuarial determined amount of assets	Millions of dollars	Positive

Source: Author's compilation and the Public Plans Database

Payment obligation variables influence a system's funding levels and size. Granting cost of living increases or failing to meet the recommended ARC, all else equal, appear to raise a system's liabilities. The ARC is included in this category, because it is the amount actuaries suggest the employer pay into the system to cover current liabilities and existing unfunded liabilities; however, this suggested amount is not always paid, and previous research suggests this affects the funded ratio. Given Truesdell's (2011) finding that states not meeting the suggested ARC payments have lower funded ratios than states paying the suggested amounts, I hypothesize that not making the suggested ARC payments increases the funded ratio. Since previous research concluded that this is a known factor affecting the funded ratio, it would be improper to not include ARC in my model.

COLA also falls into in this category of variables because as states grant cost of living increases to retirees, the pension systems incur greater liabilities. Some retirement systems grant a COLA based on the Consumer Price Index (CPI) and others have different means of deciding these changes. For example, the Tennessee State and Teachers Retirement System allocates an automatic, annual COLA of up to three percent based on the CPI; however, other systems, such the Texas Municipal Retirement System, offer retirees a certain percentage of the change to the CPI, as approved by the state legislature. Still other systems, like the California Teachers Retirement System, have a flat rate (in this case two percent) previously established. I believe a COLA tied to the CPI will have a negative relationship to the funded ratio, since states appear to have less flexibility in setting the actual cost of living increase granted to retirees. For example, if the CPI consistently increases each year, then these systems would be obligated to grant a cost of living increase to retirees to reflect this change.

Table 2: Payout Variables

Variable	Definition	Measurement	Hypothesized Relationship to Funded Ratio
Cost of Living Increase (COLA)*	Annual cost of living increase to retirees	0= COLA not tied to CPI 1= COLA tied to CPI	Negative
Actuarial Liabilities	Actuarial determined amount of liabilities	Millions of dollars	Negative
Annual Required Contribution (ARC)	What employers must pay to cover current and unfunded liabilities	Millions of dollars	Negative
Percent of ARC	Percentage of ARC paid into by the employer	0-1	Positive

Source: Author's compilation and the Public Plans Database

*COLA is a dummy variable

The third category of explanatory variables is system characteristic variables. System characteristics include whether or not employees are eligible for Social Security collection based on their government service, actuarial assets, number of members participating in the system, and the type of plan offered.

I hypothesize that enabling employees to collect Social Security benefits, in addition to state pension benefits, will positively impact the funded ratio. Since employees in these plans can supplement their state pension income with Social Security, it would appear that employees in systems not participating in the Social Security System would need to receive higher pension benefits for consumption smoothing purposes. Using my own intuition, I believe that the number of retirees in a system has a negative relationship to the funded ratio. All else equal, the greater the total members in a system, the greater the amount of money that needs to be paid out in the form of retirement benefits.

In regard to the type of retirement plan offered, previous studies indicate that when a system experiences financial difficulty, it switches from a defined benefit plan to another type of plan. Therefore, I believe that defined benefit systems will have a negative relationship to the

funded ratio. In order to determine the type of plan public retirement systems participate in, I spoke with a researcher at Boston College. After speaking with him and reviewing the data in the PPD, I decided to remove three systems from my analysis. These systems either combined multiple plans or had name variations that made it difficult to determine the type of plan the system participates under.

Table 3: Characteristic Variables

Variable	Description	Measurement	Hypothesized Relationship to Funded Ratio
All Members	Total number of people participating in the system	Millions of members	Positive
Payroll	Amount employer pays to current employees	Millions of dollars	Positive
Social Security*	Participation in Federal Social Security System	0= Not eligible for benefits 1= Eligible for benefits	Positive
Plan Type*	Type of system the state operates under	0= Not Defined Benefit 1= Defined Benefit	Negative

Source: Author's compilation and the Public Plans Database

*Social Security and Plan Type are dummy variables

Statistical Models

After formatting my data, I use Stata statistical software to test my hypotheses. Since I was interested in finding out the effect of each of my explanatory variables on the funded ratio, I used a linear regression model. This model consisted of the key dependent variable, the funded ratio, and a series of explanatory variables.

Since the funded ratio is calculated as actuarial assets over actuarial liabilities, it was inappropriate to include both variables in my regression model. Each of these explanatory variables is a linear function of the other, with a correlation of .98. Therefore, I chose to keep only the actuarial assets in my model.

The linear regression model I used is as follows:

$$\text{Funded Ratio} = \beta_0 + \beta_1 * (\text{Plan Type}) + \beta_2 * (\text{Actuarial Assets}) + \beta_3 * (\text{Payroll}) + \beta_4 * (\text{ARC}) + \beta_5 * (\text{Percent of ARC}) + \beta_6 * (\text{Employee Contributions}) + \beta_7 * (\text{Employer Contributions}) + \beta_8 * (\text{Investment Income}) + \beta_9 * (\text{Social Security}) + \beta_{10} * (\text{COLA}) + \beta_{11} * (\text{All Members}) + \beta_{12} * (\text{Employee Contribution Rate}) + \varepsilon$$

Since my dataset spans ten years, I controlled for time effects in my model. In order to do this, I created a dummy variable for each year between 2001 and 2009. When I ran the linear regression, I included each year's dummy variable except 2001. Since I did not include 2001, it serves as my base year. Additionally my linear regression model reports robust standard errors to control for heteroscedasticity.

Analysis and Findings

This study analyzes the funded ratio of 104 state-level public retirement systems. A linear regression model was utilized to determine the effect of a series of explanatory variables on the funded ratio. The results of the analysis indicate plan type, actuarial assets, payroll, ARC, the employee contribution rate, and employer contributions have a statistically significant effect on the funded ratio.

Summary Statistics

The summary statistics in Table 4 are reported in millions and indicate a variation in the make-up of states' public retirement systems. Some state-run systems are relatively small, with fewer members and assets compared to the larger systems. All retirement systems indicate the presence of actuarial liabilities, but the exact amount of these liabilities varies across systems. Of the retirement systems included in my analysis, 38.7% indicate that cost of living increases are tied to the Consumer Price Index, either through automatic adjustments or legislative approval. Employees participating in nearly 80% of the analyzed state retirement systems are eligible to receive social security benefits in addition to state pension benefits.

Table 4: Summary Statistics

Variable	Observations	Mean	Std. Deviation	Min	Max
Funded Ratio	917	0.847	0.169	0.191	1.477
Actuarial Assets (millions of dollars)	918	21.135	30.488	0.648	244.964
Actuarial Liabilities (millions of dollars)	918	24.3	33.1	0.492	294
All Members (in millions)	928	0.204	0.245	0.001	1.619
ARC (millions of dollars)	936	0.458	0.697	0	7.242
COLA*	935	0.387	0.487	0	1
Employee Contributions (millions of dollars)	926	0.264	0.418	-0.000001	3.882
Employer Contributions (millions of dollars)	933	0.427	0.707	-0.08	7.242
Investment Income (millions of dollars)	850	-0.067	5.058	-56.918	35.683
Payroll (millions of dollars)	917	4.720	6.061	0.033	45.1
Percent of ARC	935	92.465	34.393	0	485.7
Plan Type*	936	0.906	0.292	0	1
Social Security*	936	0.769	0.422	0	1

Source: Author's compilation using STATA and data from the Public Plans Database

*COLA, Plan Type, and Social Security are dummy variables in my model

Linear Regression

As Table 5 indicates below, six of the explanatory variables in my model have a statistically significant impact on the funded ratio. Five variables have significance at the .01 level and one variable has significance at the .1 level. Other explanatory variables that I originally thought would prove statistically significant in my analysis did not. Due to the high correlation between actuarial assets and actuarial liabilities, only actuarial assets were included in my linear regression model.

Table 5: Linear Regression Results

Funded Ratio	Coefficient	Robust Std. Error	t-statistic	p-value
Plan Type	0.0809	0.0265	3.05	***0.002
Actuarial Assets#	0.0062	0.0008	7.41	***<0.0001
Payroll#	-0.0089	0.0033	-2.73	***0.007
ARC#	-0.1259	0.0269	-4.68	***<0.0001
Percent of ARC	0.0003	0.0002	1.44	0.150
Employee Contribution#	-0.0097	0.0291	-0.33	0.739
Employer Contribution#	-0.0339	0.0197	-1.72	*0.085
Investment Income#	0.0016	0.0011	1.44	0.151
Social Security	0.0232	0.0153	1.52	0.130
COLA	0.0122	0.0094	1.31	0.192
All Members#	0.0039	0.0550	0.07	0.943
Employee Contribution Rate	-1.0940	0.2335	-4.68	***<0.0001
FY 2002	-0.0456	0.0283	-1.63	0.104
FY 2003	-0.0798	0.0274	-2.91	***0.004
FY 2004	-0.0953	0.0260	-3.67	***<0.0001
FY 2005	-0.1089	0.0257	-4.23	***<0.0001
FY 2006	-0.1119	0.0262	-4.27	***<0.0001
FY 2007	-0.0951	0.0264	-3.60	***<0.0001
FY 2008	-0.1170	0.0253	-4.62	***<0.0001
FY 2009	-0.1499	0.0258	-5.81	***<0.0001

Source: Author's compilation using output from STATA and data from the Public Plans Database

Significance: ***p<.01; **p<.05; *p<.1; n=744; R-squared=.4222

Indicates that the coefficient is reported in millions

Since I accounted for time effects in my model, the substantive magnitude of the significant variables is an illustration of what the impact would have looked like in my base year of 2001. In my model, the time effects are statistically significant ($p<.01$) and have a negative relationship to the funded ratio. The funded ratio experienced a downward trend between 2002 and 2009. Though still negative, the ratio went up slightly in 2007. Of particular interest is 2009, when the funded ratio decreased nearly fifteen percent relative to the base year of 2001.

Plan type has a positive and statistically significant relationship to the funded ratio. All else equal, participation in a defined benefit retirement plan increases the funded ratio of

retirement systems .08. This runs counter-intuitive to my initial hypothesis that offering a defined benefit plan would negatively impact the funded ratio.

A positive and statistically significant relationship exists between the funded ratio and a system's actuarial assets. This relationship exists at the .01 level. For example, a \$1 million increase in actuarial assets would increase the funded ratio by .006. This result is not surprising given that the funded ratio is actuarial assets divided by actuarial liabilities. States with higher assets relative to liabilities would appear to be more able to pay accruing liabilities.

The annual required contributions (ARC) has a negative and statistically significant relationship with the funded ratio ($p < .01$). Systems with a larger ARC have lower funded ratios. As an illustration, a \$1 million increase in ARC would decrease the funded ratio by .126. This result supports my original hypothesis and existing literature. Given that ARC includes both employer contributions necessary for a current fiscal year, as well as existing unfunded liabilities, it makes sense that having a larger ARC would negatively impact funding levels.

Employer contributions have a negative and statistically significant relationship to the funded ratio ($p < .1$). For every \$1 million increase in employer contributions, the funded ratio decreases by .0339. This finding goes against my initial hypothesis which was that increased contributions would increase the funded ratio. Although my regression model does not tell me why this relationship exists, one possible explanation is that systems increase their contributions as new employees join the system. Bringing more people into the system affects the amount of benefits that need to be paid out in the future, all else equal. This relationship could also exist because if an employer is required to contribute more money per current employee, the employer might be less able to pay down the ARC. If the system cannot reduce ARC, liabilities will continue to exist.

The employee contribution rate has a negative and statistically significant relationship to the funded ratio ($p < .01$). In my base year of 2001, a one percent increase in the rate of wages that employees contribute to public retirement systems decreases the funded ratio by .01. This impact could result from having more employee contributions paid into the system that will eventually need be paid out in the form of benefits.

Last, a system's payroll and the funded ratio have a negative and statistically significant relationship ($p < .01$). As systems' payrolls increase, the funded ratio decreases. For example, a \$1 million increase in payroll decreases the funded ratio by .008; however, a \$10 million increase in payroll would decrease the funded ratio by .08. This result was the opposite of my hypothesis. Based on my own intuition, I reasoned that if payroll was higher, it would indicate the retirement system has a larger contribution base. After reviewing my results, though, it seems that this relationship could exist because more employees on the payroll means more people eventually collecting benefits from the retirement system.

Some of the variables that I expected to be statistically significant, and was personally most interested in, did not affect the funded ratio in the way I thought they would. In the wake of the Great Recession, states began making changes to cost of living adjustments for participants in their retirement systems. Given that nearly forty percent of my data tie these increases to changes in the CPI, I thought this variable would have a significant relationship to the funded ratio. Also, investment income was insignificant, going against my initial hypothesis. Existing literature from the Pew Center on the States and other scholarly articles discuss the downturn in the stock market following the financial crisis. The literature mentions that this income reduction spurred decision-makers to make tweaks to retirement systems to increase

funding. Therefore, it was surprising to me to find its lack of any statistical significance in my model.

Additionally, I originally hypothesized that Social Security eligibility would have an impact on the funded ratio. Existing literature suggests that employees in public retirement systems not participating in the Social Security System receive higher benefits from these systems during retirement. Therefore, I hypothesized that systems that participate in Social Security would have a higher funded ratio. My analysis, though, did not show this relationship to be significant.

Limitations

As previously discussed, public retirement systems differ in their individual characteristics. A limitation of the PPD is that it does not contain all unobserved factors or all of the underlying assumptions used in each system's calculations. Since actuarial assets and liabilities include assumptions about current and future obligations, having the calculations used by each system's actuaries would be helpful in creating an equalizing comparison of these variables across systems.

Additionally, the Public Plans Database reports data from 2001 until 2010, though as of February 2013, the 2010 data had yet to be included in the database. Ten years of analyzed data from 104 public retirement systems increased the internal validity of this study and my results are consistent; however, it is important to mention that the years analyzed in this study contain data from the 2008 financial crisis. During this time, the markets dramatically fluctuated and investment income plummeted. For example, relative to my base year of 2001, the funded ratio in my linear regression model decreased by roughly fifteen percent in 2009. A recession like the one that began in the fall of 2008 does not occur on a regular basis. Due to this occurrence, the

results obtained from this analysis could differ for another time period. Since the financial crisis had such a large impact on the US economy, I suspect this could be the case.

As previously mentioned, this study only focused on state level public retirement systems. Given this fact, it would be inappropriate to generalize the results of this study to local governments' retirement systems, as these systems exhibit different characteristics from the larger state systems.

Conclusions and Recommendations

According to existing literature, the funded ratio is one of the primary determinants of whether or not a public retirement system has sufficient funding levels to pay current and future liabilities (Munnell et. al 2008). Although a number of the variables I thought would hold statistical significance in my model did not, I am still able to offer recommendations based on my results.

First, I recommend decision-makers pay attention to the annual required contributions, since in my analysis ARC had a negative and statistically significant impact on the funded ratio. In other words, states with higher funded ratios have a lower ARC. Some public retirement systems in my dataset have billions of dollars in existing ARC. I understand that states often cannot afford to pay all of their underfunded liabilities in one fiscal year; however, the more a state pays towards the ARC, the more funded their retirement systems will be. If a state has a statutory limit on how much funding can be contributed to the state's retirement systems each year, I recommend that legislators and legislative staff review these laws. Even if a state is adequately funded now, failing to make future payments towards ARC will raise the amount required to cover liabilities and decrease actuarial assets. Laws preventing the suggested

contributions from being made, even if the funds are available, might prove disastrous for a system.

Second, raising a system's assets relative to liabilities is important, as my results show that actuarial assets have a positive effect on the funded ratio. Based on my results, methods such as decreasing payroll or reducing ARC would raise assets relative to liabilities. I recommend decision-makers study what specific changes need to be made to their state's retirement systems to make this happen.

Research has shown that the opportunity for employment in the public sector remains promising and that employees prefer jobs with benefits to those without them. In order to ensure that public retirement systems continue to function as they should in the future, decision-makers should examine the factors that affect the funded ratio of all of the state retirement systems in their states. Using that knowledge, they will have a better understanding about which changes need to be made to the systems and any laws that place constraints on the system.

Areas for Future Study

The analysis of the funded ratio of states' public retirement systems provides a number of opportunities for future research. As previously mentioned two limitations of this study were the absences of unobserved factors and missing underlying assumptions. Using a method that could take all of the different actuarial calculations and standardize them across systems would be very useful to decision makers in the public sector.

Additionally, this study does not examine how the age at retirement or the duration over which retirement benefits received affects a system's funding. This data was not available on the Public Plans Database, but researching this topic could prove useful when considering changes to public retirement systems, their funding levels, and the benefits paid out.

While public retirement systems certainly face many challenges, no existing literature suggests that these systems will be disappearing in the near future. Continuing to conduct research, not only on the funded ratio and factors affecting it, but also retirement systems generally, will give decision makers and those in relevant leadership positions, further recommendations on which to base their decisions. For any possible changes to public employees' retirement, decision makers should have as much data on the subject as they can and a firm understanding of factors affecting the system.

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