CONTEMPORARY ECONOMIC POLICY

SWEAT THE SMALL STUFF: STRATEGIC SELECTION OF PENSION POLICIES USED TO DEFER REQUIRED CONTRIBUTIONS

JEFFREY DIEBOLD, VINCENT REITANO and BRUCE MCDONALD

The administrators of state-sponsored defined benefit public pension plans have considerable discretion to determine the accounting and actuarial parameters used to calculate the normal cost contributions and amortization payments that, together, comprise the sponsoring state's annual required contribution amount. Using longitudinal data from the Public Pension Database and a fixed effects approach, we find evidence that suggests plan administrators decisions about cost and amortization methods are influenced by the normal cost and amortization payments, respectively. When these costs increase, administrators tend to use less prudent methods that defer, or keep low, the pension contributions required from the state while, simultaneously, and perversely, improving the appearance of the plan's funded status and the state's funding discipline. (*JEL* H75)

I. INTRODUCTION

Across the United States, state-sponsored defined benefit pension plans lack sufficient assets to meet their future obligations to workers. Munnell, Aubry, and Cafarelli (2014) estimate that plans, on average, have assets equivalent to only 72% of the present value of their future liabilities. One of the most important reasons why many states have low funded ratios is that they fail to make their annual required contribution (ARC; Munnell 2012). The ARC is the amount that the state must contribute to the pension fund in order to amortize the liabilities the pension accrued in the current year (referred to as the "normal cost") as well as any unfunded liabilities accrued, but not fully funded, in previous years (referred to as unfunded liabilities). In 2013, only 14 states paid 100% of their ARC payments, while the average across all states was 80% (Pew Charitable Trusts 2015). Generally speaking, the funding effort by states is insufficient to ensure that their pension systems are able to cover future benefit obligations.

Worse still, estimates of funded ratios likely overstate the current financial condition of pension systems as well as the funding effort of states (Novy-Marx and Rauh 2011). One important reason for this is that plan administrators have considerable discretion to establish and modify both the actuarial and accounting parameters used to measure their plan's pension normal costs and unfunded liabilities that, in turn, determine the funded ratio of a plan and the amount of the state's ARC payment. The ARC payment, for example, can increase or decrease depending on the decisions of the members of the pension board, referred to here as "plan administrators," about how to allow the plan's normal costs to accrue over time and about the length of the amortization period to be used to pay off any unfunded liabilities. Plan administrators can imprudently back-load the plan's normal cost accruals and adopt a never-ending amortization schedule that

Diebold: Assistant Professor, Department of Public Administration, North Carolina State University, Raleigh, NC 27695. Phone 919 515-5125, Fax 919 515-7333, E-mail jcdiebol@ncsu.edu
Reitano: PhD Candidate, Department of Public Administration, North Carolina State University, Raleigh, NC 27695. Phone 732 801-1777, Fax 919 515-7333, E-mail vcreitan@ncsu.edu
McDonald: Assistant Professor, Department of Public Administration, North Carolina State University, Raleigh, NC 27695. Phone 919 515-5178, Fax 919 515-7333, E-mail bcmdona@ncsu.edu

ABBREVIATIONS

AME: Average Marginal Effect
ARC: Annual Required Contribution
AVR: Actuarial Valuation Reports
CAFR: Comprehensive Annual Financial Reports
GASB: Governmental Accounting Standards Board
GDP: Gross Domestic Product
OLS: Ordinary Least Squares
PPD: Public Plans Database

Contemporary Economic Policy (ISSN 1465-7287)
doi:10.1111/coep.12236

reduce the cost of the plan's newly awarded benefits and unfunded liabilities to the state in the short run and, thereby, reduce the amount of the ARC payment required from the state. The widespread use of overly optimistic and overly generous assumptions implies most states are now undercontributing relative to ARC amounts that are already artificially low due to systematic understatements of their plan's liabilities (Novy-Marx and Rauh 2011).

Plan administrators appear willing to engage in this type of opportunistic behavior to the advantage of the state under certain fiscal conditions (Hess 2005). Specifically, the adoption of more generous accounting and actuarial assumptions appears to be most prevalent among plan administrators in more fiscally distressed states (Chaney, Copley, and Stone 2002; Eaton and Nofsinger 2004). While financially and politically expedient, these actions compromise state pension promises as well as the sustainability of the public defined benefit pension system. By accommodating less disciplined funding efforts these actions further increase any funding risk of the promised obligation, which, in turn, increases the likelihood that workers and retirees will have their pension benefits reduced by the state (Thom 2017).

This analysis evaluates the determinants of two unexamined choices made by plan administrators regarding the methods they use to establish schedules for new benefit accrual rates and for paying down the plan's unfunded liabilities. Both of these decisions impact the amount of their state's funding requirement in a given year. This is a timely issue as states have been actively reforming their pension systems within the past decade (Thom 2017), a period notable for significant economic and fiscal stress and the entry of the first wave of Baby Boomers into retirement. This study adds to the growing body of research that suggests that the choices plan administrators make are sensitive to their plan's characteristics and financial circumstances (Chaney, Copley, and Stone 2002; Eaton and Nofsinger 2004; Stalebrink 2014). This study uses longitudinal data from the Public Pension Database and a fixed effects regression model to analyze whether the decisions about the plan's cost methods and the amortization schedules are sensitive to the plan's normal costs and unfunded liabilities, respectively.

This analysis represents a unique contribution to the scholarship on public pension plan management because it is the first to decompose the ARC into normal costs and amortization payments to show that plan administrators' choices about the methods used to calculate each are, in part, governed by the unique cost they generate to the state. That is, those plans with higher normal costs are less likely to adopt the more prudent entry age cost method. Instead, these plans tend to defer the financial burden of normal costs to future budget cycles. We also find that plans with higher amortization payments are more likely to modify their amortization period to allow themselves to "refinance" their unfunded liabilities in each budget cycle and continuously spread the amortization payments over the maximum number of years possible in each budget cycle in perpetuity. Both of these actions reduce the plan's required contributions in the short run while artificially fostering the appearance of a more robust funding effort and a more financially secure pension system. These findings raise broader substantive concerns about the loose regulatory framework that allows plan administrators to strategically choose between these funding methods.

II. BACKGROUND ON PUBLIC PENSIONS

Public sector employees are enrolled in either a defined benefit plan, a defined contribution plan, or, in some cases, both. While defined benefit and defined contribution plans are intended to provide workers with income in retirement, there are important differences in their structures. Defined benefit plans provide retired workers with lifelong annual income payments, the amount of which is determined by a formula that accounts for the worker's salary and years of service. While states are ultimately responsible for ensuring the long-term viability of these benefits, they typically delegate the administration of these plans to a fiduciary board, or board of trustees. These plan administrators are responsible for directing the plan's investments and actuarial and accounting practices (Hess 2005). Defined contribution plans are employee-administered investment accounts to which both the worker and her employer contribute a percentage of her salary. Workers are responsible for determining how these contributions are invested in the mutual funds that their employer makes available to them. The amount the worker has accumulated at retirement depends on contributions levels and investment returns. Retiring workers typically receive this amount as a lump-sum payment and they are responsible for ensuring that they do not outlive these funds.

Despite a significant shift in the pension coverage provided to private sector employees from defined benefit to defined contribution plans over the past four decades, a vast majority of current public sector workers remain covered by a defined benefit plan. According to the U.S. Bureau of the Census (2014a, 2014b), 99.5% of the 14.3 million public employees in the United States are enrolled in a defined benefit plan and a vast majority (88%) of these workers are enrolled in a plan sponsored by their state government. According to an analysis by Novy-Marx and Rauh (2014), the cost of covering these workers varies considerably by state, averaging 6.3% of total tax revenue across all states, but ranging from a low of 2.1% in North Carolina to a high of 12.1% in Nevada. These values were calculated using actual rather than required contributions, so the share of tax revenue contributed to state pension systems across states would increase significantly if states contributed the full ARC amount each year. Indeed, Novy-Marx and Rauh (2014) estimate that in order to fully fund their plans in 30 years, state contributions would need to increase to 22.6% of tax revenue, on average. Their results are consistent with a similar study by Munnell (2012).

States have strong fiscal and political incentives to avoid the significant fiscal strain and the reduction in the resources available for other spending priorities and core government services that fully funding their pensions systems will likely require. In addition to reducing their funding effort, states can, through their plan administrators, manipulate their accounting methods and actuarial assumptions to paper over the true magnitude of their plan's liabilities and to reduce or postpone the contribution amount required from the state. These modifications are advantageous for state officials because they artificially reduce the ARC payments and, thereby, reduce the impact of the pension on the state's budget while, at the same time, improve the appearance state's funding effort. Perhaps the most critical and well-researched of these modifications involves the assumed long-term rate of return on assets invested in the plan. This relatively obscure value determines the discount rate applied to future obligations in order to calculate a plan's current liability and is the subject of intense debate between plan administrators and economists (Munnell 2012). Plan administrators set this rate equal to the expected long-term yield on the assets held in the pension fund (around 8%). But in accordance with finance theory, economists argue that this figure should, instead, reflect the risk that the state will default on the obligation itself. Because promised pension benefits are guaranteed to workers by law, they are "virtually free of [default] risk" (Brown and Wilcox 2009, 538). Their preferred "riskless rate," is, therefore, roughly equivalent to the average yield on a bond issued by the state, which is usually between 3% and 5%. The difference in a few percentage points between the rates currently employed by plan administrators and the riskless rate preferred by most economists has significant implications for a pension's reported liability: the higher the assumed rate, the lower the reported liability. If states were required to discount their obligations using a riskless rate unfunded liabilities estimates would increase by 210%, funded ratios would decline by 33%, and the ARC from states would double, on average (Munnell 2012; Novy-Marx and Rauh 2009).

Plan administrators also have the latitude to modify their actuarial cost and amortization methods to a similar, but less dramatic effect. The actuarial cost and amortization method determine how the state's normal cost and unfunded liability contributions are allocated over time, respectively, in order to fully fund the pension obligation for workers at the time of their retirement. By modifying these factors, plan administrators have the option to front-load or back-load their contribution schedule over the careers of plan beneficiaries. Like the assumed rate of return, plan administrators may opportunistically back-load normal cost and amortization payments when they generate sufficient budgetary pressure.

While plan administrators have significant freedom in the establishment and structure of their pension plans, a number of recommendations on plan management have been issued by the Governmental Accounting Standards Board (GASB). GASB was established in 1984 as a source for guidance to governments in the preparation of their financial statements (Kim, McDonald, and Lee 2016). GASB's guidance comes in the form of standards issued and periodically updated by the organization but these standards are not binding and frequently allow for a subjective interpretation (Kim, McDonald, and Lee 2016). In the context of this study, several standards issued by GASB relate to the cost methods and amortization periods employed. These are: Standard No. 43 and Standard No. 45, both of which were later updated with Standard No. 67 and Standard No. 68.

In statements 43 and 45, issued in 2004, GASB recommended that plan administrators use one of four actuarial cost method to determine an employer's normal cost contribution. The recommended methods include entry age, attained age, projected unit credit, and aggregate. These standards also defined the maximum acceptable amortization period for unfunded liabilities as 30 years but do not state whether these 30-year periods should be open or closed. In 2012, GASB updated these standards with Statements 67 and 68, which specified the entry age method as the only method that plan administrators should use to calculate their plan's normal costs. The new standards also stated that plans should amortize their unfunded liabilities over a defined, closed period.

A. Actuarial Cost Methods

The cost method is an important pension accounting parameter that influences how normal costs accrue over the career of an employee. The two most common cost methods are entry age and unit credit. Entry age refers to the allocation of benefits over the individual's working lifetime from the date of employment, or entry into the pension program, until their assumed age of exit. Under this framework, the salary projections are used to calculate the present value of the employee's prospective pension benefit. This amount is then allocated evenly across the employee's "entry age" to her retirement age (Peng 2008). Thus, the normal costs for employees are fixed over time and are "front-loaded" because, early in the worker's career, these payments exceed the present value of their future benefit. Unit credit refers to the allocation of the present value of benefits based on the benefits that an individual has accrued as of the valuation date. Under this framework, normal costs are adjusted by the employee's probability of survival in service and discount factors that increase each year. Therefore, normal costs are "back-loaded" and increase substantially with time (Peng 2008).

Both entry age and unit credit are accepted actuarial methods and, until recently, the choice between them has not been considered to be very controversial as both ultimately produce the same total cost by the end of employment. From this perspective, plan sponsors using unit credit are simply more willing to exchange lower normal costs today for higher normal costs in the future and prefer these escalating payments to the more stable normal costs of the entry age approach. As long as a state's funding effort increases proportionately with the rise in normal cost accruals over time under the unit credit approach, then the choice between these two methods remains inconsequential. However, Munnell (2012) found that most plans that use a unit credit cost method tend to have higher unfunded liabilities, which suggests that, in general, state contributions do not keep pace with normal costs as they continue to rise over time under this formula. She finds that states with a unit credit cost method are 53 percentage points less likely to make their full required contribution and have a funded ratio that is, on average, 11.5 percentage points lower than those plans using an entry age method. Even these figures may actually overstate the state funding efforts and financial security of these pensions due to the fact that the unit credit method shifts the benefit accruals and, therefore, normal cost payments to cover younger workers' pension benefits to the future.

To see how this works consider the same under-payment of a $1,000 contribution by state i in time period t to fund the normal cost of the same 35-year-old worker with ending pay of $50,000 under each framework. Assume that the normal cost for this employee in the first year of employment, t, is $2,400 under the entry age approach and $1,500 under the unit credit approach. The normal cost payment under the entry age approach is higher because it is "front-loaded," therefore states use this method to prepay a portion of the benefits the workers will earn in future years. In this example, the same $1,000 contribution on the part of the state would result in an unfunded liability amounts in the next year of $1,400 under the entry age approach and $500 under the unit credit approach. Thus, the required amortization payments for these unfunded liabilities included in the ARC will be lower the following year, $t+1$, for equivalent, but still insufficient, contributions in the current period t under a unit credit approach. With a relatively lower ARC payment in $t+1$, states can more easily maintain the appearance of a concerted funding effort without actually changing their funding effort. In addition, the relatively lower estimate of the unfunded liability in $t+1$ under the unit credit method ($500) compared to the entry age method ($1,400) results in a less pronounced reduction in the estimated ratio of the state's assets-to-liabilities used to determine the plan's funded status in $t+1$. Thus, the pension obligations of Plan B can appear more secure than those of Plan A

with equally insufficient funding efforts from the sponsoring state.

Of course, the unit credit approach can only help a state maintain the appearance of a more disciplined funding effort and a more secure pension benefit for a given contribution amount to fund the pension benefits of the worker in this example in the short run. Under the unit credit approach, the worker's benefit accrual rate will rise over time, meaning that the annual normal cost payment required to fund her benefits will also rise and, eventually, exceed the normal cost amount that would otherwise be required under the entry age approach. The fiscal benefits of using the unit credit approach to calculate the normal costs for this worker, therefore, decline as she approaches retirement age. Unless the state contributions to Plan B increase over time to correspond with the rising benefit accrual rates of the worker, then the ARC payments required to fund the underlying obligation will balloon toward the end of the worker's career as the escalating normal cost contributions will be combined with rising amortization payments. Thus, the fiscal benefit to the state from using a unit credit approach is a function of the age distribution of the active members in the pension plan. All else equal, the fiscal benefits will be largest for plans with higher normal costs (i.e., more generous plans) and younger active members.

The possibility that plan administrators strategically avoid the entry age method in favor of the unit credit method for these purposes would not be so troubling if the two approaches resulted in equally secure pension benefits. Assuming equally disciplined funding efforts, pension obligations should be more secure when plan administrators front-load the state's normal cost contributions using the entry age method. While more costly in the short run, the "prepayments" required under this approach can reduce the lifetime budgetary burden of the plan and improve its funded status because they earn investment returns over time. The investment yield on these contributions both reduces the lifetime contributions required from the state to fully fund the plan's obligations and increases the plan's assets relative to its obligations. By contrast, back-loaded normal cost contributions to the second plan (Plan B) using the unit credit approach may result in a lower yield on state contributions due to a relatively short investment horizon that may itself necessitate a more conservative investment strategy. Lower investment returns by the pension fund will increase in the long-term funding effort required from the state to fully fund the plan's obligations.

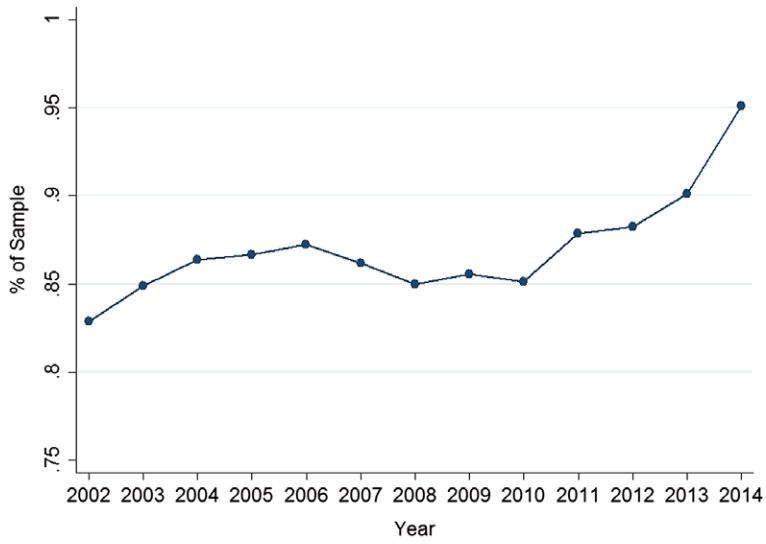
An appreciation of these issues may have compelled GASB to designate the entry age method as the only appropriate method for calculating normal costs in Statements 67 and 68 issued in 2012 (GASB 2012). After GASB established these standards, many pension plans systems transitioned from the unit credit to the entry age cost method. Figure 1 illustrates the gradual, but unsteady, shift from the unit credit to the entry age method among plans from 2002 to 2014. Over this period, the share of plans using the entry age method rose from 83% to 95%. However, there was a small reversal in this trend in the period following the financial crisis in 2007 and throughout the subsequent recession that officially ended in 2009. It appears that plan administrators either changed their plan's cost method from an entry age to a unit credit method or postponed their plan's transition from the unit credit to the entry age method during this period. It is likely that their actions and inactions were motivated, in part, by a desire to reduce pension costs or prevent them from growing further, if only temporarily, during a period of falling tax revenues and heightened fiscal stress.

B. Open and Closed Amortization Periods

In the context of public pensions, amortization is the process of paying down any unfunded liabilities through regular payments over a period of time. Like the amount of the unfunded liability, the length of time over which these payments will be made is an important determinant of the amount of the amortization payment required from the state in each period. For a given unfunded liability amount, the longer the amortization period, the lower the amortization payment. Amortization payments are combined with the normal cost payments to obtain the total ARC amount required from the state each year to fully fund a plan's pension obligations.

Like the cost method, plan administrators have considerable discretion when setting the amortization schedule for their plan's unfunded liabilities. Plan administrators are free select the length of the amortization period for the unfunded liabilities of their plan but almost all voluntarily comply with the provisions in Statement 27 issued by GASB in 1996 that require that these periods not exceed 30 years. However, plan administrators may also choose whether this period of 30 years or less is "open" or "closed," which can have a

FIGURE 1
Percent of Plans Using an Entry Age Cost Method, 2002–2014



Notes: The distribution represents variation in the cost method for plans included in the estimation sample ($n = 101$). The years along the *x*-axis start at 2002 rather than 2001 because we lagged all of the explanatory variables 1 year, which means that 2002 is the first wave in which we observe the dependent variable, entry age, in our sample.

large impact on the amount of the amortization payment required from the state each year.

Open amortization refers to the annual reamortization of a liability using the plan's full amortization period. Because the schedule for payments to cover any unfunded liabilities is reset each year to the maximum number of years, open amortization is analogous to taking out a loan every year for the unpaid balance of the loans taken out in the previous year. Thus, a plan with a 30-year open amortization period will calculate its amortization payment over a 30-year period each year, which results in a date when any unfunded liabilities must be paid off that is always 30 years away. Consider, for example, the amortization schedule of a plan with unfunded liabilities totaling $30 million that will be amortized over an open 30-year period. In the interest of simplification, let's also assume an interest rate of 0% and that the state now makes the full ARC payment each year. In year 1, the amortization payment is $1 million. In year 2, the remaining $29 million liability is spread, once again, over a 30-year period and the required payment amount in this period falls to $966,667. After 30 years, the amortization payment has fallen to $361,662 and the remaining unfunded liability totals $10.5 million. Thus, resetting the amortization schedule each year results in an amortization payment that continues to decline in each subsequent period and an underlying liability that is never fully funded.

Conversely, closed amortization is the adoption of a payment schedule over a fixed number of years that declines by one each year. This is equivalent to taking out a single loan and paying that debt down over time without re-financing. Thus, the number of remaining amortization payments in a closed amortization period depends on the number of years that have previously passed. Consider, again, a plan that has $30 million in unfunded liabilities that will now be amortized over a closed 30-year period. The amortization payment is $1 million in each year over the 30-year period. After 30 years, no amortization payment is made because none of the original unfunded liability remains.

The risks of using an open rather than a closed amortization period to the security of the promised pension benefit concern continuously rolling-over unfunded liabilities. The indefinite deferment of these liabilities results in lower required amortization payment amounts than would otherwise be required under a closed amortization period in a given year. These amounts continue to decline over time without

ever reaching zero because, in each period, a new amortization payment amount is calculated in each new budget cycle by spreading the remaining unfunded liability over the maximum number of years possible. As a result, even in periods of stable or declining state contributions, plan administrators can adopt an open amortization period to improve the appearance of the state's funding discipline while simultaneously reducing the likelihood that the unfunded liabilities will ever be fully funded. This feature may allow states to defer corrective action that may be necessary (e.g., benefit reductions, contribution increases) to ensure that the pension obligations are properly funded upon a worker's retirement. Pension plans cannot interminably defer these unfunded liabilities even if imprudent and illogical accounting strategies will allow them to do so.

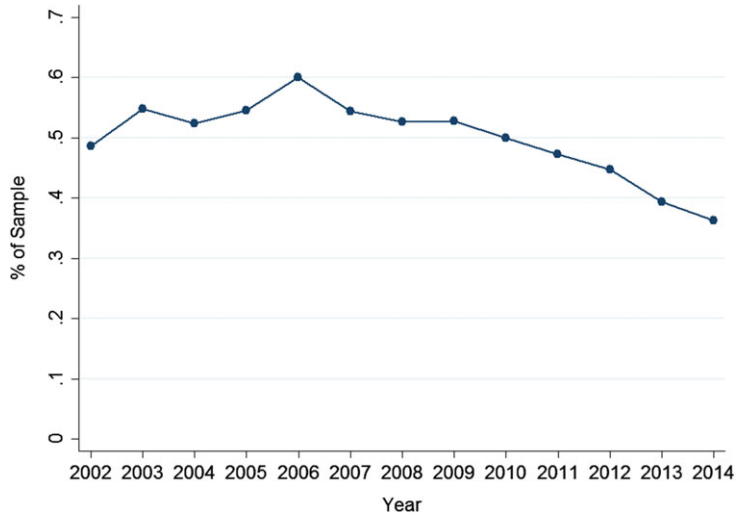
The risks posed by open amortization may have compelled GASB to issue guidelines in Statement 68 that specifically exclude the use of an open amortization period because, in their view, "this approach is inconsistent with the overriding view that the cost of pensions should be recognized over the career-long period during which an employee provides service" (GASB 2012). After the GASB issued this statement in 2012, the share of plans that use open amortization did appear to decline slightly though a substantial minority continues to use it. Figure 2 plots the share of plans that use an open amortization over the observation period in this study. According to the figure, nearly 60% of all plans amortized their unfunded liabilities in 2006; since that time, the share has fallen to roughly 35%.

III. CHOICE OF PENSION PARAMETERS

The "working assumption" of studies analyzing plan administrators' choices regarding the accounting methods and actuarial assumptions is that these decisions are influenced by the interests of political actors to keep pension costs to the state low (Stalebrink 2014). Administrators are expected to be sensitive to political preferences of elected officials because, oftentimes, the positions on a state's pension board are filled by political appointment (Matkin, Chen, and Khalid 2016). This expectation is grounded in the public choice theory that postulates that administrators' decisions are, at least in part, a function of narrow political or self-interest rather than the interest of the public. One important prediction of this model is that public employees will behave opportunistically and favor policies that yield current benefits in exchange for larger longer-term costs that are difficult to identify, even when these policies are economically inefficient. In this context, the opportunistic behavior of plan administrators involves the adoption of accounting and actuarial assumptions favored by state policymakers in exchange for a position on the state's pension board, which are usually among the highest paying public service positions in state government. These actions involve obscure and esoteric decisions about whether to adopt or not adopt a particular cost-method or amortization period which can yield immediate fiscal benefits to policymakers and less obvious future costs to taxpayers and retired workers. Thus, myopic opportunism and information asymmetry combined with political and fiscal expediency may help explain the decision of plan administrators to change their plan's cost method from entry age to unit credit as well as the decision of other administrators to not change their plan's cost method from a unit credit to an entry age. The same is true regarding the plan administrator's decision between an open and a closed amortization schedule.

Previous studies consistently demonstrate that opportunistic pension accounting practices and actuarial assumptions are most prevalent among those plan administrators in fiscally distressed states and of more poorly funded plans. Chaney, Copley, and Stone (2002) found that worse fiscal conditions are associated with the adoption of higher long-term expected rates of return, but only in states with balanced budget amendments. Presumably, the administrators of these plans assume higher rates of return on the assets held by the pension for the purpose of reducing present value of the plan's liabilities and future obligations. Similarly, using data from the same time period, Eaton and Nofsinger (2004) find that plan administrators in states with tight fiscal environments are more likely to increase their expected rate of return and to increase the period over which their liabilities are amortized. Using data on pensions administered by local governments in Michigan and Pennsylvania, Vermeer, Styles, and Patton (2010) also find that greater fiscal constraints are associated with the adoption of "aggressive" methods and assumptions. They find the same tendency among plan administrators of pensions with greater unfunded liabilities. Most recently, Stalebrink (2014) modeled the determinants of the expected rate of return using the most representative data and the most richly specified

FIGURE 2
Percent of Plans Using an Open Amortization Period, 2002–2014



Notes: The distribution represents variation in the amortization method for plans included in the estimation sample ($n = 103$). The years along the x-axis start at 2002 rather than 2001 because we lagged all of the explanatory variables 1 year, which means that 2002 is the first wave in which we observe the dependent variable, open amortization, in our sample.

model to date. He found that plans with less conservative asset allocations, more poorly funded plans, plans with more political appointees on the investment board, and plans that have access to an investment council tend to assume higher rates of return on the assets held by the pension. These results are consistent with earlier work by Hsin and Mitchell (1997) who, in addition, find that these decisions are sensitive to the prevailing economic conditions.

A. Hypotheses

Plan administrators' decisions about the cost and amortization methods have important implications for the estimates of how much the state must contribute in the current period to cover the normal costs and unfunded liabilities of their plan. For this reason, these decisions are likely a function of many of the same determinants of other well-studied accounting and actuarial decisions these individuals must make with similar consequences for a state's pension contributions such as the assumed rate of return on assets held in the pension fund. In addition to these similarities, plan administrators' decisions regarding actuarial cost and amortization methods may be uniquely sensitive to other specific plan characteristics such as the plan's normal cost and the unfunded liabilities, respectively. For example, plans with high normal costs may be less likely to adopt entry age method because this approach can add to those costs and increase the budgetary burden of the pension, particularly if the active members in the plan tend to be younger. Instead, administrators of these plans may prefer to defer the normal cost contributions by allowing them to accrue more slowly in the short run by using a unit credit method. Similarly, plans with high levels of unfunded liabilities may adopt an open amortization period to continuously spread those obligations over the maximum number of years possible in each budget cycle in order to reduce the amount of the amortization payment required from the state. In essence, sponsors may strategically tailor the parameters of their plans to suit the specific source of the fiscal constraints generated by their pension: the cost of new benefits accruals or cost of existing unfunded liabilities. From these expectations, we propose the following hypotheses:

Hypothesis 1a: Plans with high normal costs will be less likely to use an entry age cost method.

Hypothesis 1b: The age of workers covered by the plan will moderate the effect of normal costs on the likelihood that a plan uses an entry age cost method. This relationship will attenuate as the age of covered workers increases.

Hypothesis 2: Plans with high levels of unfunded liabilities will be more likely to use an open amortization period.

IV. EMPIRICAL METHODS

We estimate k fixed effects models of the following form using ordinary least squares (OLS) regression to test the hypotheses outlined above:

$$(1) \quad Y_{it}^{k} = \alpha_i + \beta Normal\,Cost_{it-1} + \gamma Amortization\,Payments_{it-1} + \pi Z_{it-1} + \theta T_t + u_{it},$$

where Y represents outcome k measured for plan i in time period t. The plan's *Normal Cost* measures the present value of the benefits accrued by workers in plan i for which the state is financially responsible in year $t-1$ as a percent of total state expenditures. *Amortization Payments* measures the amount of the annual contribution the state is required to make in year $t-1$ to amortize any unfunded liabilities associated with plan i as a percent of total state expenditures. The term Z denotes a vector of time-varying control variables and T denotes a vector of time dummies for each year $t-1$ and t in the observation period, respectively. All of the explanatory variables are lagged 1 year to avoid the possibility of simultaneity bias. The coefficients in the Equation (1) are estimated using within-plan variation, or changes, in the dependent variable, k, and the explanatory variables over the observation period. The standard errors are robust to account for the heteroscedasticity inherent in linear probability models and clustered at the plan level. When examining these relationships, we make no a priori assumptions about the functional form of the hypothesized relationships, and therefore, test for nonlinearities using quadratic and cubic terms.

This is the first analysis to take advantage of the panel data available on pension plans and to specify a fixed effects regression model to analyze the decisions of plan administrators regarding their accounting and actuarial methods. This approach is preferable to the related cross-section studies because it controls for the bias associated with unobserved time-invariant geographical, historical, or institutional factors that are systematically correlated with the outcome and the explanatory variables of interest. The two-way fixed effects model defined by Equation (1) also controls for the unmeasured factors that account for differences in these methods for all plans in year t. The addition of the time fixed effects is necessary to remove the distinctive time-specific effects that the financial crisis and the Great Recession may have had on these outcomes. One drawback of this approach is that the effects of time-invariant covariates cannot be estimated such as whether the state uses Generally Accepted Accounting Principles for financial reporting which could proxy for accounting professionalism within a state or the existence and stringency of balanced budget requirements, both of which are invariant over the observation period of this analysis.[1]

In this context, there is a distinct advantage to use OLS to estimate Equation (1) for the dichotomous outcomes in this study as opposed to a logistic regression model. Specifically, the estimation sample of fixed effects logistic regression is conditional on variability in the dependent variable over the observation period for a given unit. That is, nonlinear fixed effects models leave only plans that move from a unit credit method to another cost method, or the converse, in the estimation sample. This sample restriction implies that those plans with no variability in the dependent variable provide no information that is useful for estimating these parameters, which, in this context, is not the case. Moreover, this restriction would significantly reduce the generalizability of the results from this study.

As Angrist and Pischke (2009) explain, changes in the expected value of dichotomous dependent variables can be reliably estimated using linear regression. However, this approach is often criticized for generating fitted values that can lie outside of the unit interval, which creates the potential for bias (Horace and Oaxaca 2006). The likelihood that this source of bias affects our estimates is small as a vast majority of the predicted fitted values generated from our models lie between zero and one. Moreover, as Wooldridge (2010, 455) notes: "[i]f the main purpose is to estimate the partial effect of [the covariates] on the response probability, averaged across the distribution of [the covariates], then the fact that some predicted values are outside the unit interval may not be very important. The [linear probability model] need not provide

1. The effects of a time-invariant variable can be estimated by interacting it with a relevant time-varying variable (Allison 2009). While the main effect of the invariant variable is not observed, the coefficient on the interaction term indicates how the effect of this variable changes with respect to the time-varying variable (usually time).

very good estimates of partial effects at extreme values of [all the covariates]." Since we are only interested in the partial effects of normal costs amortization payments at representative, rather than extreme, values of these covariates we use the linear probability models to estimate the coefficients in Equation (1).

A. Data and Sample

The principal dataset used in this study is the Public Plans Database (PPD) which is compiled by the Center for Retirement Research at Boston College, the Center for State and Local Government Excellence, and the National Association of State Retirement Administrators (2016). The PPD is comprised of longitudinal data from 2001 to 2014 on 114 state-sponsored pension plans in the United States. This sample represents 90% of the total public pension membership and public pension assets in the country. The dataset includes comprehensive information on the membership, financial status, and actuarial assumptions of each plan. These measures are constructed using data from the Comprehensive Annual Financial Reports (CAFR) and Actuarial Valuation Reports (AVR) prepared by state officials for each plan they administer. We merged data from several sources with the PPD in order to capture relevant data on the actuarial assumptions of each plan as well as state-level economic, fiscal, and political conditions. The sources of the merged data are included along with the summary statistics in Table 1.

In order to address our research questions, we generated two subsamples from the PPD. The first subsample is comprised of 103 plans that employ either a unit credit or entry age cost method. The remaining 11 plans were not included in the sample because they employ an aggregate cost method ($n = 6$) or a frozen initial liability method ($n = 5$) which represent fundamentally different approaches to calculate the present value of future benefits and normal costs.[2] The 103 plans in the sample represent pension systems from 45 states and cover state employees (58%), teachers (30%), and public safety officials (12%).[3] The second subsample is comprised of 106 plans with nonmissing amortization period data in the PPD. Missing information on the key explanatory and control variables further reduced this sample to 103 plans. The plans in this sample represent pension systems from 47 states that cover state employees (6%), teachers (27%), and public safety officials (13%).[4]

B. Outcome Variables

We constructed two dichotomous outcomes indicating the use of particular cost method and amortization periods. The first measure, *Entry Age*, is coded "1" for plans that use an entry age cost method to calculate the normal costs in year t and "0" for plans that use a unit credit cost method that same year. The second measure, *Open Amortization*, is coded "1" for plan i in each time period, t, that the plan amortizes its unfunded liabilities over an open amortization period. This measure is coded "0" for plan i in each time period t that the plan amortizes its unfunded liabilities over a closed period. Owing to the strong structural similarities between closed and "fixed" amortization periods, this measure is also coded "0" for plan i in each time period t that the plan amortizes its unfunded liabilities over a fixed period.[5] Only 4% of the sample used a fixed amortization period and the results are strongly robust to the inclusion or exclusion of these plans from the estimation sample.

C. Explanatory Variables

Normal Costs and Amortization Payments. In order to test the hypotheses of this study, we measure *employer normal costs* and *amortization payments* as a share of total state expenditures. These variables measure the two components of a state's ARC payment and do not include contributions required from workers covered by the plan. The numerators in these ratios reflect what the state is required to pay in a given year to cover these costs, not what they actually pay. Again, these measures are lagged 1 year to ensure proper

2. For more information about these methods, please see Anderson (2006).

3. All states provide a pension public employees but the pension systems not represented in this sample include those from Nebraska, South Dakota, Tennessee, Washington, and Wisconsin.

4. The pension systems not represented in this sample include those from Nebraska, Vermont, and Wisconsin.

5. Unfunded liabilities must be paid off by a specific date under both a closed and fixed amortization period. The difference between these methods is that the former sets a date in which the plan's total liability must be paid off while the latter sets a date for that is a fixed number of years from the date when an unfunded liability was first created. As a result, when a plan uses a fixed amortization period, the state will be paying down liabilities created in different years, but that are amortized over the same fixed period of time (Munnell, Aubry, and Hurwitz 2013).

TABLE 1
Summary Statistics for Both Estimation Samples, 2001–2014

	Entry Age ($n = 101$)				Open Amortization ($n = 103$)				
	M	*SD*	Min	Max	*M*	*SD*	Min	Max	Data Source
Dependent variables									
Entry age	0.86	0.14	0.00	1.0					Public Plans Database
Open amortization				0.52	0.26	0.00	1.00		Public Plans Database
Explanatory variables									
Employer normal cost	0.90	0.33	0.00	6.62	0.91	0.33	0.00	6.62	Public Plans Database
Amortization payment	1.01	0.51	0.00	6.98	1.00	0.50	0.00	6.98	Public Plans Database
Pension characteristics									
Funded ratio	76.71	9.20	19.10	138.40	77.65	9.03	19.10	138.40	Public Plans Database
Percent of ARC paid	91.51	52.07	0.00	1727.66	91.80	52.04	0.00	1727.66	Public Plans Database
Equity share	54.03	7.73	7.11	99.70	54.36	7.51	7.11	99.70	Public Plans Database
Investment return (3 year)	6.20	6.12	−8.57	17.90	6.19	6.12	−8.57	17.90	Public Plans Database
Ln(plan assets)	16.12	0.18	13.30	19.43	16.25	0.16	13.43	19.46	Public Plans Database
Ln(payroll)	14.84	0.12	12.46	17.62	14.89	0.12	12.46	17.62	Public Plans Database
Ln(active members)	11.07	0.09	8.26	13.66	11.12	0.09	8.26	13.66	Public Plans Database
Plan maturity	1.93	0.37	0.26	8.58	1.93	0.36	0.29	8.58	Public Plans Database
Age of active members	45.03	0.68	36.9	53.7	44.96	0.68	36.9	53.45	Public Plans Database
State-level factors									
State GDP per capita (000 s)	46.12	2.36	29.15	74.29	46.64	2.40	29.15	74.29	Bureau of Economic Analysis (2016)
State unemployment rate	6.45	1.74	2.50	14.40	6.47	1.75	2.50	14.40	Bureau of Labor Statistics (2016)
Percent unionized	11.26	1.07	1.90	25.80	11.64	1.06	1.90	26.10	Bureau of Labor Statistics (2016)
Nominate score	48.42	15.73	0.00	92.45	48.14	15.80	0.00	92.45	Berry et al. (2010)
Tax capacity	14.49	2.33	4.00	41.55	14.50	2.36	4.00	41.55	U.S. Census Bureau, 2016; Tax Policy Center (2016)
Ln(total revenue)	17.04	0.26	14.66	19.59	17.11	0.26	14.66	19.59	U.S. Census Bureau (2013)
Revenue/expenditures	1.03	0.16	0.31	1.61	1.03	0.16	0.31	1.61	U.S. Census Bureau (2014)

Notes: The statistics were generated from the pooled sample of plan-year observations for all plans in the estimation samples from 2001 to 2014. All dollar amounts are expressed in constant 2009 dollars. The standard deviation measures the within-plan variation in the variable over time.

causal ordering. The fixed effects models will use variation in these measures over time to analyze their association with the cost and amortization methods employed by plan administrators. The results of the study are robust to measurement of normal costs and amortization payments as a share of state revenue in a given year rather than expenditures.[6] We contend that expressing these costs as a share of expenditures is the most useful approach as it best captures the choices available to state policymakers in a fiscally constrained environment. Specifically, when pension expenditures increase as a share of a state's total expenditures, either other expenditures will need to be reduced or higher revenues will need to be obtained.[7]

6. Results available upon request.

7. We would like to thank an anonymous reviewer for this insight.

Control Variables. We control for several plan characteristics, all of which are lagged 1 year. Two measures are included to proxy for the states funding effort: *funded ratio* and *percent of ARC paid. Funded ratio* measures the expected present value of the plan's assets divided by the expected present value of the plan's liability and is a proxy for the sponsoring state's long-term funding effort. *Percent of ARC paid* measures the share of the ARC payment the state made in the previous year and, therefore, proxies for the sponsoring state's short-term funding effort. *Equity share* measures the fraction of the plan's assets invested in stocks. This measure serves as a proxy for the plan administrators' appetite for risk. *Investment return* measures the performance of the plans assets over the previous 3 years. *Ln*(*plan assets*) measures the log-transformed amount of assets invested in the pension plan. *Ln*(*payroll*) measures the log-transformed total pensionable

earnings of plan participants. *Ln*(*active members*) measures the log-transformed size of the plan in terms of current contributing members. These variables were logged because linearity is not a reasonable assumption and it is, therefore, more appropriate to measure changes in the outcomes associated with proportional increases in these measures. *Plan maturity* measures the ratio of the number of active members—those workers currently contributing to the pension fund—to the number of beneficiaries—those retired workers currently receiving pension benefits. The final plan-level variable, *Age of Actives*, measures the average age of active members.

We also control for several state-level economic, political, and budgetary factors, lagged 1 year. *State Gross Domestic Product* (*GDP*) *per capita* measures the state's gross domestic product per capita in thousands of dollars in a given year. *State unemployment rate* measures the share of the state's workforce that is unemployed in a given year. *Percent unionized* measures the share of the state's workforce who are members of a union in a given year. *Nominate score* is the *NOMINATE* measure of state government ideology developed by Berry et al. (2010). This measure ranges from "0" to "1" where larger values are associated with more liberal state governments in a given year. More liberal governments may provide more generous pension benefits resulting in higher normal costs that may, in turn, result in more political pressure to manipulate the accounting and actuarial assumptions in these states.[8] We use three variables to capture different dimensions of a state's fiscal climate. The first variable, *tax capacity*, measures the capacity of states to finance their expenditures. Following Chaney, Copley, and Stone (2002), we define this measure as the state tax revenue per capita revenue as a percentage of the median per capita income within the state. The second variable, *ln(total revenue)*, measures the log-transformed total tax revenue collected by the state in a given year and is used to control volatility in each state's tax receipts. The third variable, *revenue/expenditures*, is a ratio of a state's tax revenue to its expenditures (multiplied by 100) in a given year and is included to control for the fiscal health of the state.

Summary Statistics. Table 1 provides the summary statistics of all of the variables included in this analysis. Most importantly, the within-subject standard deviations reported in the table indicate that there is a moderate level of variation in the dependent and key explanatory variables with which to identify the relationships of interest. As documented in Figure 1, the statistics in the table confirm that a large majority of plans used the entry age cost method over the observation period and that there is a moderate level of variation in this outcome within plans over time. The statistics also indicate that roughly half of the sample spread unfunded liabilities over an open amortization period. However, the within-plan standard deviation in this measure indicates that there was a moderate level of variation in this measure as well. This is also clear from Figure 2.

Two interesting results emerge from the descriptive statistics. The first is that annual normal cost and amortization payments account for roughly 2% of a state's total expenditures for each plan it sponsors, on average. Most states (75%) sponsor two or more pension plans, which means that these payments can act as a significant budgetary constraint. The second is the existence of a few large, outlying values for the variable measuring the percent of the ARC payment made by a state. Most outlying values for this measure appear after the sponsoring state has consistently made less than the full ARC payment for several consecutive years. It is possible that, to make up for this fact, the state then makes a very large payment in a single year. The results are robust to inclusion or exclusion of these outlying values.

V. RESULTS

A. *Entry Age Cost Method*

Table 2 displays the regression coefficients from the fixed effects models used to analyze the relationships between normal costs and the use of the entry age cost method. We display the coefficients from a sequence of nested models to demonstrate the robustness of results to the model

8. Many papers simply use partisan identifiers to capture the political environment within a state. However, these measures ignore heterogeneity in the ideological position of state governments that may be more relevant for explaining variation in policy preferences across states. For example, state governments in both North Carolina and Maryland were controlled Democrats for most of the observation period in this study. However, there are likely systematic differences in the pension policies promoted by Democrats across these states because the ideological center of gravity of the former is slightly to the right of that of the latter. This variation is ignored when we measure the political environment using a dichotomous partisan control variable but not when we measure it using the ideology variable created by Berry et al. (2010). Our results, however, are robust to either measure of political environment.

TABLE 2

Plan-level Fixed Effects Linear Probability Regression Models Analyzing the Relationship between Normal Cost Payments and the Use of the Entry Age Cost Method, 2001–2014

	Models					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Employer normal cost	−.036	−.164*	−.187**	−.161**	−.156**	−3.777**
	(.035)	(.088)	(.092)	(.068)	(.069)	(1.168)
Employer normal cost x Employer normal cost		.029*	.032**	.027**	.024*	.522**
		(.015)	(.015)	(.011)	(.012)	(.248)
Employer normal cost x Age of active members						.080**
						(.025)
Employer normal cost x Employer normal cost x Age of active members						−.011**
						(.005)
Age of active members					.032**	−.001
					(.015)	(.016)
Amortization payment			−.002	−.004	−.016	−.023
			(.018)	(.017)	(.018)	(.018)
Funded ratio			−.001	−.001	−.001	−.001
			(.002)	(.002)	(.002)	(.002)
Percent of ARC paid			−.000	−.000	−.000	−.000
			(.000)	(.000)	(.000)	(.000)
Equity share			−.001	−.001	−.002	−.002
			(.002)	(.002)	(.002)	(.002)
Investment return (3 year)			−.002	−.002	−.001	−.001
			(.002)	(.002)	(.002)	(.002)
Ln(plan assets)			.180	.139	.112	.148
			(.134)	(.114)	(.146)	(.144)
Ln(payroll)			.256	.200	.136	.141
			(.243)	(.192)	(.259)	(.241)
Ln(active members)			−.385	−.281	−.135	−.224
			(.253)	(.194)	(.253)	(.241)
Plan maturity			.053*	.039	.036	.037
			(.027)	(.026)	(.034)	(.031)
State GDP per capita				.004	.004	.004
				(.004)	(.004)	(.004)
State unemployment rate				−.000	−.001	−.002
				(.007)	(.006)	(.007)
Percent unionized				.003	.007	.007
				(.009)	(.010)	(.010)
Nominate score				−.000	−.000	−.000
				(.000)	(.000)	(.000)
Tax capacity				.022**	.020**	.019**
				(.009)	(.009)	(.008)
Ln(total revenue)				−.381**	−.402**	−.425**
				(.172)	(.189)	(.174)
Revenue/expenditures				.246	.314	.327
				(.169)	(.209)	(.202)
Year fixed effects (omitted = 2002)						
2003	−.025	−.025	−.051**	−.005	−.000	−.008
	(.016)	(.016)	(.024)	(.029)	(.029)	(.028)
2004	.004	.001	−.041	.022	.036	.024
	(.005)	(.005)	(.032)	(.032)	(.034)	(.030)
2005	−.001	−.005	−.047	.012	.019	.003
	(.004)	(.005)	(.040)	(.035)	(.043)	(.040)
2006	.010	.004	−.043	.063	.072	.049
	(.021)	(.020)	(.040)	(.054)	(.066)	(.062)
2007	−.002	−.010	−.079	.067	.070	.040
	(.024)	(.022)	(.057)	(.065)	(.078)	(.076)
2008	−.007	−.017	−.111	.068	.073	.045
	(.023)	(.021)	(.073)	(.077)	(.097)	(.094)
2009	−.010	−.022	−.155*	.107	.118	.089
	(.024)	(.021)	(.092)	(.098)	(.116)	(.111)
2010	−.009	−.023	−.177*	.113	.139	.106
	(.023)	(.020)	(.103)	(.117)	(.123)	(.115)

TABLE 2
Continued

	Models					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
2011	.020	.003	−.156	.112	.138	.112
	(.016)	(.011)	(.113)	(.120)	(.141)	(.129)
2012	.018	−.004	−.148	.100	.111	.083
	(.016)	(.010)	(.115)	(.111)	(.137)	(.127)
2013	.036	.017	−.115	.174	.177	.137
	(.022)	(.019)	(.121)	(.119)	(.137)	(.130)
2014	.087**	.062**	−.075	.198*	.168	.131
	(.030)	(.026)	(.126)	(.113)	(.136)	(.130)
Constant	.885***	.969***	−1.295	4.548*	3.196	5.493**
	(.033)	(.058)	(1.812)	(2.303)	(2.647)	(2.546)
N[a]	1135	1135	1135	1135	910	910

Notes: Robust standard errors clustered by plan are reported in parenthesis below each coefficient. Each of the fixed effects regression models was estimated using lagged explanatory variables. All of the plan-level variables come from the Public Plans Database (2016) and the state-level variables come from the Bureau of Labor Statistics (2016), Bureau of Economic Analysis (2016), the Census Bureau (2016), and the Tax Policy Center (2016). All dollar amounts are expressed in constant 2009 dollars.

[a]The sample size falls from $n = 103$ to $n = 83$ once we control for the average age of the active members in each plan due to missing values for this measure.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

specification. The results in the table provide compelling empirical support for Hypotheses 1a and 1b. According to the results in column 1, required normal cost contributions, measured as a share of total state expenditures, are not linearly associated with the likelihood that plan administrators use an entry age cost method. However, the quadratic term in the models in Columns 2 through 5 indicate that the two are nonlinearly related. Taken together, the linear and quadratic term indicate that the likelihood that a state employs an entry age credit method declines at a decreasing rate as the plan's normal costs continue to increase. These terms are individually and jointly statistically significant across the models with the full set of control variables.

To more meaningfully assess the direction and curvature of this relationship, we evaluate how the magnitude and statistical significance of average marginal effect (AME) of normal costs on the likelihood of using an entry age cost method varies over the range of relevant normal cost expenses in our sample. The AME coefficients in Table 3 represent the average change in the probability that a plan employs an entry age cost method for a discrete 0.1 percentage point change in the share of state expenditures devoted to normal cost contributions. We estimated the AMEs in this table using Model 5 in Table 2, but the results are robust to other models in the table.[9] The AME estimates indicate that when the median plan's normal costs increase from 0.67% to 0.77% of the state's total expenditures, the likelihood that the plan uses an entry age cost method declines by 1.3 percentage points ($p < .05$). This change is equivalent to moving from the 50th percentile to 58th percentile in normal costs and a 1.5% reduction in the mean likelihood of this outcome. As indicated by the coefficients on the linear and quadratic terms, the magnitude of this change declines as normal costs rise. Among the most expensive plans in the sample—those in the 95th percentile of normal costs—this relationship is no longer significantly different from zero. The decline in the predicted probability that administrators use the entry age method as normal costs increase indicates that normal costs are relevant for understanding cost method decisions of the administrators of all but the most expensive plans. It appears that plan administrators opportunistically avoid using the more conservative, more expensive entry age method when their normal costs are already high. At the same time, however, the deceleration of this decline suggests that normal costs become increasingly less relevant to this decision as the plan they administer becomes more and more expensive.

If plan administrators are opportunistically choosing to use or not use the entry age method

9. Results available upon request.

TABLE 3

Average Marginal Effects of Normal Costs on the Likelihood of Using the Entry Age Cost Method

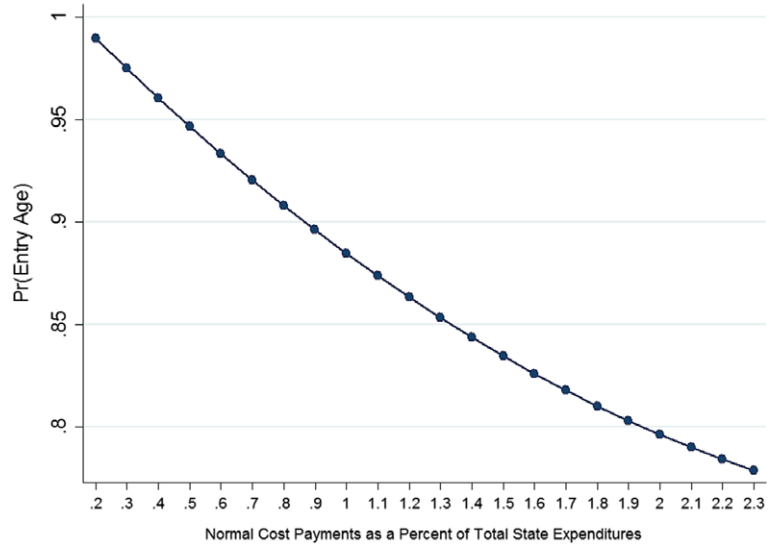
	Normal Cost as a Share of State Expenditures						
	0.12%	**0.20%**	**0.33%**	**0.67%**	**1.22%**	**1.86%**	**2.30%**
	−0.015**	−0.015**	−0.014**	−0.013**	−0.010**	−0.007**	−0.005
	(0.006)	(0.006)	(0.006)	(0.005)	(0.004)	(0.003)	(0.003)
Percentile	5	10	25	50	75	90	95

Notes: Robust standard errors clustered by plan are reported in parenthesis below each coefficient. The AME coefficients in this table measure the effect of a discrete, one-tenth of a percentage point change in the normal cost amount, measured as a share of the state's expenditures. The estimates were generated from Model 5 in Table 2 but are robust to derivation from the other models in the table.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

FIGURE 3

Predicted Probability of Using an Entry Cost Method by Normal Cost Amount as a Percent of Total State Expenditures

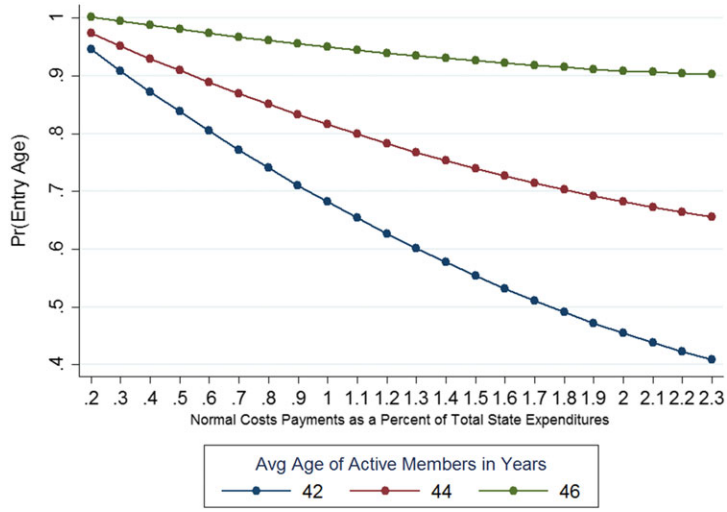


Notes: The figure presents the predicted probability that a plan uses an entry age cost method as a function of the payments required from the state to cover the plan's normal costs, expressed as a percent of the state's total expenditures. These estimates were derived from Model 5 in Table 2.

in order to reduce the normal cost contributions of the state, then we would expect to find that this behavior is moderated by the age composition of the active members of the plan. The younger the active membership of a plan is, the more costly the entry age method will be in the short run. Thus, a rise in the normal costs of a plan should reduce the likelihood that the administrators of that plan use an entry age cost method to the greatest extent when the active members of their plan tend to be younger. To test this possibility, we interacted normal costs contributions with our measure of the average age of active plan members. Column 5 reports the results from these analyses which strongly support the expectation that younger plans with higher normal costs are, as expected, less likely to use the entry age approach. While rising normal costs are associated with lower likelihoods at all ages, the combination of interaction terms indicate that the rate of this decline is most rapid among younger plans. Once again, however, the rate of the observed decline falls as normal costs continue to increase across all plans. These patterns are clear in Figure 3, which plots the predicted probabilities of the use of the entry age method

FIGURE 4

Predicted Probability of Adopting an Entry Cost Method in a Given Year by Normal Cost Amount as a Percent of Total State Expenditures and the Average Age of the Active Workers Covered by the Plan



Notes: The figure presents the predicted probability that a plan uses an entry age cost method as a function of the payments required from the state to cover the plan's normal costs, expressed as a percent of the state's total expenditures, and the average age of active plan members measured in years. These estimates were derived from Model 6 in Table 2.

TABLE 4

Marginal Effects of Normal Costs on the Likelihood of Using an Entry Age Cost Method by the Age of Active Plan Members

	Normal Cost as a Share of State Expenditures						
	0.12%	**0.20%**	**0.33%**	**0.67%**	**1.22%**	**1.86%**	**2.30%**
Age = 42	−0.038***	−0.037***	−0.035***	−0.032***	−0.025***	−0.018***	−0.013**
	(0.012)	(0.012)	(0.011)	(0.010)	(0.007)	(0.006)	(0.005)
Age = 44	−0.023***	−0.022***	−0.021***	−0.019***	−0.015***	−0.010***	−0.007***
	(0.008)	(0.008)	(0.007)	(0.006)	(0.005)	(0.003)	(0.002)
Age = 46	−0.007	−0.007	−0.007	−0.006	−0.004	−0.003	−0.002
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Percentile	5	10	25	50	75	90	95

Notes: Robust standard errors clustered by plan are reported in parenthesis below each coefficient. The AME coefficients in this table measure the effect of a discrete, one-tenth of a percentage point change in the normal cost amount, measured as a share of the state's expenditures. The estimates were generated from Model 6 in Table 2.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

over the ranges of both normal cost measures corresponding to each age category (Figure 4).

In order to ease interpretation of the coefficients on the interacted terms in column 5, we once again calculated the AME marginal effects of normal costs at relevant values of this measure and at representative average ages of the workers covered by plans in the sample. The results are displayed in Table 4. The distribution of marginal effects shows that normal costs are associated with a decrease in the likelihood that plans use the entry age method, but only for plans with younger active members. For example, a 0.1 percentage point increase in normal costs as a share of state expenditures is associated with, approximately, a 3.2 percentage point ($p < .01$) decrease in the likelihood that a plan employs the entry age method when that plan's normal costs account for 0.67% of the state's total expenditures and whose average active member is 42 years old. Moving down the column displaying the AMEs of the median plan, it is clear that magnitude

of this marginal effect falls as the average age of the active membership of plan increases. The same increase in normal costs is associated with a 1.9 ($p < .01$) and 0.6 ($p > .10$) percentage point decrease in the likelihood that a plan employs the entry age method when the average age of that plan's active member is 45 and 48 years old, respectively. All of these results are consistent with the expectation outlined in Hypothesis 1B that the choice of the plan's cost method is a function of both the normal costs of the plan and the age of its active membership. As expected, the effect of normal costs on the likelihood of using the entry age method is most pronounced among more expensive plans with younger active members because, for these plans, the costs of doing so are highest.

B. Open Amortization

The results in Table 5 provide strong support for the expectation that plans with higher amortization payments are more likely to adopt an open amortization period. According to the coefficients in columns 1 through 5, the probability that a plan employs an open amortization period increases as the plan's amortization payments increase. The results in column 5 indicate that this relationship is robust to the inclusion of measures of the short- and long-term historical funding effort from the state, which are highly collinear with the state's amortization expenses. The results in column 6 indicate that this relationship is also robust to the inclusion of the variable measuring the age of the active membership of each plan, which reduces the estimation sample from $n = 103$ to $n = 80$. According to these results in column 6, a 0.10 percentage point increase in the amortization payment as a share of state expenditures is associated with an increase in the likelihood that a plan employs an open amortization period by 0.92 percentage points ($p < .05$). This increase in the amortization payment would move the median plan to the 53rd percentile and increases the likelihood that a plan uses an open amortization period by 1.8%. The results suggest that plan administrators are opportunistically using open amortization to help reduce their amortization payments when their unfunded liabilities increase.

VI. CONCLUSION AND DISCUSSION

This study decomposes the elements of the ARC payment into the normal cost and the amortization payment to examine whether plan administrators opportunistically employ methods that are specifically tailored to the constraints these costs create. Taken together, the results from the analyses of the cost and amortization methods are sensitive to changes in the dimension of the plans each regulates. When normal costs rise, perhaps due to a legislated increase in benefit levels, the plan is less likely to use the entry age method to calculate the amount the state must contribute to fully fund future benefits. We argue that administrators of these plans do not use the more conservative entry age credit cost method in order to reduce or keep to a minimum the normal costs required from the state, to understate the plan's liabilities, and to overstate the state's current funding effort and funding status despite the fact that this cost method is more likely to result in more secure, fully funded pension obligations. As expected, strategic avoidance of the entry age methods is most pronounced among administrators of plans that cover younger workers for whom the short-term budgetary benefits of using the unit credit, as opposed to the entry age method, are the largest. By doing so, plan administrators avoid shifting a larger share of the contributions required to cover future benefits to the current budget cycle.

Likewise, when a plan's unfunded liabilities increase, plan administrators become less likely to use a closed amortization period and more likely to use an open amortization period. Open amortization allows the state to continuously reset the amortization schedule for the plan's unfunded liabilities to the maximum number of periods possible, which reduces the required amortization payment from the state in the short run, improves the appearance of the state's funding effort, and, ultimately, reduces the likelihood that the obligations will ever become fully funded. Once again, we argue that plan administrators use the open amortization schedule to strategically reduce the short-term budgetary constraints generated by the pension system by shifting the payments for any unfunded liabilities on to future workers and future taxpayers.

Both of these findings are consistent with other related studies that also show that states strategically adapt their valuation methods to understate their plan's liability or to reduce the fiscal stress the pension contributions generates for the state (Eaton and Nofsinger 2004; Hess 2005; Stalebrink 2014; Vermeer, Styles, and Patton 2010). Pension expenses compete directly with the other spending priorities of a state. When

TABLE 5

Plan-level Fixed Effects Linear Probability Regression Models Analyzing the Relationship between Amortization Payments and the Use of Open Amortization Periods, 2001–2014

	Models					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Amortization payment	.093**	.118**	.105**	.104**	.110**	.092**
	(.035)	(.059)	(.037)	(.038)	(.040)	(.043)
Amortization payment × Amortization payment		−.006				
		(.009)				
Age of active members						.031
						(.030)
Funded ratio					.002	.006
					(.004)	(.004)
Percent of ARC paid					−.000**	−.000**
					(.000)	(.000)
Employer normal cost			.057	.056	.061	.100*
			(.038)	(.041)	(.042)	(.051)
Equity share			−.003	−.003	−.003	−.004*
			(.002)	(.002)	(.002)	(.002)
Investment return (3 year)			.005	.004	.004	.001
			(.005)	(.005)	(.005)	(.006)
Ln(plan assets)			−.092	−.055	−.117	−.254
			(.151)	(.158)	(.205)	(.242)
Ln(payroll)			−.122	−.158	−.150	−.091
			(.349)	(.433)	(.420)	(.524)
Ln(active members)			−.037	−.073	−.060	−.043
			(.268)	(.308)	(.302)	(.419)
Plan maturity			.169**	.183**	.168*	.127
			(.074)	(.078)	(.086)	(.088)
State GDP per capita				−.001	−.000	.002
				(.012)	(.012)	(.012)
State unemployment rate				.012	.013	.001
				(.019)	(.018)	(.020)
Percent unionized				−.012	−.011	.002
				(.013)	(.013)	(.013)
Nominate score				−.001	−.001	−.001
				(.001)	(.001)	(.001)
Tax capacity				−.003	−.002	−.009
				(.013)	(.012)	(.011)
Ln(total revenue)				.358	.370	.098
				(.270)	(.268)	(.274)
Revenue/expenditures				−.582	−.613	−.182
				(.395)	(.387)	(.355)
Year fixed effects (omitted = 2002)						
2003	.017	.016	.068	−.017	−.007	.084
	(.036)	(.036)	(.041)	(.058)	(.063)	(.066)
2004	.024	.020	.099**	.004	.014	.145
	(.034)	(.035)	(.049)	(.079)	(.090)	(.088)
2005	.008	.004	.089*	.026	.044	.222**
	(.039)	(.041)	(.053)	(.090)	(.112)	(.102)
2006	.090*	.083	.173**	.077	.101	.295**
	(.051)	(.051)	(.073)	(.113)	(.142)	(.139)
2007	.042	.035	.144*	.025	.055	.263*
	(.056)	(.056)	(.080)	(.130)	(.161)	(.155)
2008	.046	.039	.172*	.049	.083	.305
	(.053)	(.053)	(.095)	(.151)	(.180)	(.189)
2009	.040	.033	.204*	−.036	−.003	.268
	(.054)	(.055)	(.106)	(.197)	(.225)	(.235)
2010	.012	.003	.220*	−.126	−.097	.223
	(.055)	(.056)	(.120)	(.244)	(.271)	(.282)
2011	−.037	−.046	.191	−.110	−.080	.253
	(.060)	(.061)	(.122)	(.264)	(.298)	(.312)
2012	−.052	−.063	.164	−.101	−.066	.277
	(.061)	(.062)	(.116)	(.250)	(.287)	(.298)

TABLE 5
Continued

	Models					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
2013	−.146**	−.156**	.052	−.249	−.212	.146
	(.065)	(.066)	(.118)	(.248)	(.284)	(.294)
2014	−.184**	−.195**	.032	−.222	−.182	.136
	(.067)	(.068)	(.127)	(.233)	(.270)	(.282)
Constant	.441***	.436***	3.738	−1.110	−.663	2.723
	(.046)	(.049)	(2.374)	(4.739)	(5.019)	(5.379)
N[a]	1132	1132	1132	1132	1132	878

Notes: Robust standard errors clustered by plan are reported in parenthesis below each coefficient. Each of the fixed effects regression models was estimated using lagged explanatory variables. All of the plan-level variables come from the Public Plans Database (2016) and the state-level variables come from the Bureau of Labor Statistics (2016), Bureau of Economic Analysis (2016), the Census Bureau (2016), and the Tax Policy Center (2016). All dollar amounts are expressed in constant 2009 dollars.

[a]The sample size falls once we control for the average age of the active members in each plan due to missing values for this measure.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

the plan's circumstances generate more fiscal stress, the plan administrators appear to act in the short-term interests of the state to reduce the financial commitment a state's pension obligations require rather than in the long-term financial interests of the employees to have fully funded pension benefits. We have contextualized these findings within the public choice framework, which predicts that such shortsighted behaviors will emerge among public officials—in this case plan administrators, many of whom are political appointees—when they combine clear and immediate benefits with difficult-to-identify costs of low salience.

These findings are of practical importance because they have negative implications for the security of promised pension benefits and the financial security of public sector workers in retirement. The adoption of less rigorous accounting methods and actuarial assumptions allows plan administrators to understate the true cost of the state's pension system, which can perpetuate unsustainable benefit levels and lead to imprudent benefit expansions that may, in turn, necessitate future benefit reductions. More importantly, modification of these parameters can only defer a state's pension costs and paper over its low funding discipline in the short run. Over time, the payments necessary to cover these obligations will balloon. Unless state contributions keep pace, the funding risk of the pension promises will quickly manifest itself through rapid declines in the plan's funded status and funding effort. The empirical evidence suggests that states will likely respond to these changes by reducing the generosity of their pension system or by further reducing their future funding effort (Mitchell and Smith 1994; Thom 2017). In the past decade, almost all states have reformed their pension systems to reduce either, or both, the benefits paid to current retirees and those promised to future retirees. Some of the most common reforms have included a reduction in, or elimination of, cost-of-living adjustments, modifications to the retirement benefit formula, increases in vesting requirements, and increases in the retirement age. As a result, many public workers can expect to receive less pension income in retirement and expect inflation to more rapidly erode what remains.

Such reforms would be particularly unfortunate for the public employees who have willingly accepted both lower wages from the state than they could potentially earn in the private sector and lower wage growth in exchange for the promise of higher income in retirement. By reducing the value of pension benefits, states also reduce the magnitude of the compensating differential for these workers and, thereby, consign them to a lower standard of living both throughout their working lives and in retirement. Perhaps more significantly, if these costs compel states to replace their defined benefit pension system with a defined contribution plan, then the affected public workers states will no longer be able to rely on the income floor provided by a fixed payment in retirement. This particular change represents a massive shift in the financial, investment, and longevity risks of retirement from the state to the employee (Munnell and Sunden 2004). If

plan administrators are prevented from shifting the costs of their pension system to future taxpayers by simply adopting a less credible cost method and amortization period, then it may be possible to avoid these outcomes. Under these constraints, states may be less likely to allow their pension benefits to grow beyond their willingness or capacity to pay for them. Public workers may also have been more reluctant to accept lower wages in exchange for untenable pension benefit expansions or they have been willing to increase their own contribution rates to ensure the solvency and structure of their existing pension benefits.

However, it should be noted that, in general, better cost and amortization methods are becoming more prevalent. Nearly all plans now use an entry age cost method to calculate their normal costs payments. Also, the share of plans that amortize their unfunded liabilities over an open period has declined, although more than a third of all plans continue to use this method despite the unequivocal endorsement of the closed and fixed period approaches by GASB. Going forward, however, there are circumstances under which administrators will have a large fiscal incentive to transition back to the unit credit and open amortization methods. For example, as baby boomers retire and the pool of active members enrolled in state pension systems is comprised of relatively younger workers, the costs of the entry age method to the state will continue to rise. Similarly, a recession or even a period of stagnant or declining asset prices will further increase the fiscal incentive to use an open amortization period. In these instances, our results may be useful for predicting which plans will be more likely to transition to these less prudent practices.

There are several limitations of this study worthy of note. First, fixed effects methods cannot control for the biasing effect of omitted time-varying variables that are systematically correlated with the outcomes and explanatory variables of interest. Second, the adoption of new cost and amortization methods by plan administrators is infrequent. This results in modest within-variation available in the dependent variables with which to efficiently estimate all of the relevant relationships. This results in a decrease in statistical power and an increase in the potential of type II errors. Third, the estimation sample does not represent the entire universe of pension systems. While our estimation samples comprised of plans that cover a vast majority of public workers, they are limited to those pension systems that provide the most detail about their cost and amortization methods in their CAFR and AV statements, which may have affected our results. If, for example, states that do not clearly report their methods are more likely to sponsor plans with less rigorous methods and higher costs, then our results likely understate the magnitude of the associations presented here. Our results are further limited to the understanding of pension systems administered by the state and, therefore, are not relevant to understanding similar relationships for locally administered plans.

In closing, the results presented here suggest that manipulative pension accounting practices extend beyond the state's expected rate of return to include other parameters whose effect on the required contribution amount is more subtle, but nevertheless important. The apparent willingness of plan administrators to adjust the specific parameters to paper over the source of their plan's funding problem suggest the need to reevaluate the loose regulatory environment in which these actors operate. Their actions obscure the true cost of these benefits to taxpayers and compromise security of the public defined benefit system that provides them to workers.

REFERENCES

Allison, P. D. *Fixed Effects Regression Models*. Thousand Oaks, CA: Sage Publications, 2009.

Anderson, A. W. *Pension Mathematics for Actuaries*. New Hartford, CT: Actex Publications, 2006.

Angrist, J. D., and J. Pischke. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press, 2009.

Berry, W. D., E. J. Ringquist, R. C. Fording, R. L. Hanson, and C. E. Klarner. "Measuring Citizen and Government Ideology in the U.S. States: A Reappraisal." *State Politics and Policy Quarterly*, 10(2), 2010, 117–35.

Brown, J. R., and D. W. Wilcox. "Discounting State and Local Pension Liabilities." *American Economic Review*, 99(2), 2009, 538–42.

Center for Retirement Research at Boston College, Center for State and Local Government Excellence, and National Association of State Retirement Administrators. *Public Plans Database*, 2016.

Chaney, B. A., P. A. Copley, and M. S. Stone. "The Effect of Fiscal Stress and Balanced Budget Requirements on the Funding and Measurement of State Pension Obligations." *Journal of Accounting and Public Policy*, 21(4), 2002, 287–313.

Eaton, T. V., and J. R. Nofsinger. "The Effect of Financial Constraints and Political Pressure on the Management of Public Pension Plans." *Journal of Accounting and Public Policy*, 23(3), 2004, 161–89.

Governmental Accounting Standards Board (GASB). *Accounting and Financial Reporting for Pensions: An Amendment of GASB Statement No. 27. Statement No. 68, 2012*. Norwalk, CT: GASB Publications, 2012.

Hess, D. "Protecting and Politicizing Public Pension Fund Assets: Empirical Evidence on the Effects of Governance Structures and Practices." *University of California-Davis Law Review*, 39(1), 2005, 187–224.

Horace, W. C., and R. L. Oaxaca. "Results on the Bias and Inconsistency of Ordinary Least Squares for the Linear Probability Model." *Economic Letters*, 90, 2006, 321–27.

Hsin, P., and O. S. Mitchell. "Managing Public Sector Pensions," in *Public Policy Toward Pensions*, edited by S. Schieber and J. B. Shoven. Cambridge, MA: MIT Press, 1997, 247–66.

Kim, J., B. D. McDonald, and J. Lee. "The Nexus of State and Local Capacity in Vertical Policy Diffusion." *American Review of Public Administration*, 2016; https://doi.org/10.1177/0275074016675966.

Matkin, D., C. Chen, and H. Khalid. "The Governance of Public Pensions: An Institutional Framework." *Administration & Society*, 2016; https://doi.org/10.1177/0095399715621945.

Mitchell, O. S., and R. S. Smith. "Pension Funding in the Public Sector." *Review of Economics and Statistics*, 76(2), 1994, 278–290.

Munnell, A. H. *State and Local Pensions: What Now?* Washington, DC: Brookings Institution Press, 2012.

Munnell, A. H., and A. Sunden. *Coming Up Short: The Challenge of 401(k) Plans*. Washington, DC: Brookings Institution Press, 2004.

Munnell, A. H., J.-P. Aubry, and J. Hurwitz. "Locally-Administered Pension Plans: 2007–2011." Issue in Brief, Center for Retirement Research at Boston College, 2013.

Munnell, A. H., J. Aubry, and M. Cafarelli. "The Funding of State and Local Pensions: 2013–2017." Boston College Center for Retirement Research State and Local Plans No. 39, 2014.

Novy-Marx, R., and J. D. Rauh. "The Liabilities and Risks of State-Sponsored Pension Plans." *Journal of Economic Perspectives*, 23(4), 2009, 191–210.

———. "Public Pension Promises: How Big Are They and What Are They Worth?" *Journal of Finance*, 66(4), 2011, 1207–45.

———. "The Revenue Demands of Public Employee Pension Promises." *American Economic Journal: Economic Policy*, 6(1), 2014, 193–229.

Peng, J. *State and Local Pension Fund Management*. Boca Raton, FL: CRC Press, 2008.

Pew Charitable Trusts. *The State Pension Funding Gap: Challenges Persist*. Philadelphia, PA: The Pew Charitable Trusts, 2015.

Stalebrink, O. J. "Public Pension Funds and Assumed Rates of Return: An Empirical Examination of Public Sector Defined Benefit Pension Plans." *American Review of Public Administration*, 44(1), 2014, 92–111.

Thom, M. "The Drivers of Public Sector Pension Reform across the U.S. States." *American Review of Public Administration*, 47(4), 2017, 431–42.

U.S. Bureau of the Census. "Annual Survey of Public Pensions: State- and Locally-Administered Defined Benefit Data." Washington, DC: U.S. Bureau of the Census, 2015.

Vermeer, T. E., A. K. Styles, and T. K. Patton. "Are Local Governments Adopting Optimistic Actuarial Methods and Assumptions for Defined Benefit Pension Plans?" *Journal of Public Budgeting, Accounting & Financial Management*, 22(4), 2010, 511–42.

Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press, 2010.