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# Teacher Pension Workshop: Connecting Evidence-Based Research to Pension Reform

## Campaigning For Retirement: State Teacher Union Campaign Contributions and Pension Generosity

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# Campaigning For Retirement: State Teacher Union Campaign Contributions and Pension Generosity*

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**Abstract**

Despite rhetoric that public sector unions are partially responsible for the health of state and local pension systems, little concrete evidence exists regarding the role unions play in influencing the generosity of their retirement benefits. Using a panel of state teacher pension plans, we find credible robust evidence linking stronger teachers' unions to more generous benefits. For an average teacher in a strong union state compared to a teacher in a weak union state, our results imply that the differential in the present value of benefits earned each year paid by the plan sponsor is $2,400 per member.

**Keywords**: pensions, pension generosity, public sector unions, campaign contributions, teachers
**JEL Codes**: J3, J45

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# 1 Introduction

The severity of the Great Recession has propelled public sector pension health into the spotlight. Once considered a virtual guarantee, concerns over massive underfunding and the erosion of protections surrounding benefit levels has brought into question the retirement security for millions of state and local employees. Despite rhetoric that public sector unions are at least partially responsible for the crisis, very little concrete evidence exists regarding the role public sector unions play in directly influencing the generosity of their retirement benefits.[1]

In this paper, we propose a new measure of pension generosity and use it to explore the extent to which variation in the strength of teachers' unions affects the generosity of their retirement systems. Unlike many margins over which unions may exert influence, pension benefits are set by statute rather than being negotiated through the collective bargaining process. For this reason, we measure the strength of teachers' unions by their aggregate campaign contributions in statewide elections to candidates, parties, and other organizations.

Teachers' unions are actively engaged in the political process at both the federal and subnational levels. In the 2014 electoral cycle for example, the National Education Association (NEA) contributed more than $29 million dollars at the federal level to candidates, parties and their committees, and other groups and organizations.[2] The dollar amount was large enough that the NEA was ranked the 2nd most generous organization in terms of total contributions (out of more than 17,000 organizations) by The Center for Responsive Politics. At the state level, teachers' unions ranked among the top 20 donors in 33 states in 2014 and were the single largest donor organization in two states.

We pursue an instrumental variables strategy for identification, relying on the geographic diffusion of educational reform policies in neighboring states as instruments for teacher contributions. Using an unbalanced panel of 31 distinct state-administered teacher pension plans over the period from 2001 to 2015, our results show very robust empirical evidence that stronger teachers' unions have a positive and significant causal impact on the generosity of their pensions. For example, other factors constant, we find that the difference in the present value of benefits earned in a single year

[1] There are numerous examples of intense rhetoric connecting public sector unions to the crisis. A few recent examples include Crockett (2018), Lilley (2017), and Tatar (2013).

[2] Source: OpenSecrets.org (https://www.opensecrets.org/orgs/summary.php?id=D000000064&cycle=2014).

that are paid by the plan sponsor varies by $2,400 *per active pension member* for teachers in states with strong unions relative to teachers in states with weak unions (75th versus 25th percentile). We also find evidence that the marginal effect of unions on generosity was strongest in the pre-Great Recession period before weakening some between 2010 and 2013 when nearly all states enacted benefit reductions.

The following sections of the paper provide background information on pensions, propose a metric for measuring pension generosity, outline our data and identification strategy, and offer concluding remarks.

# 2 Background

## 2.1 Previous Literature

Attention on the health of state and local retirement systems is so ubiquitous that nearly every major media or public policy research organization has examined the topic in recent years. Commonly characterized as a crisis, this increased scrutiny on pension financials may partially explain why 48 states have enacted what the National Institute for Retirement Security describes as "significant reforms" in the aftermath of the Great Recession.[3] Despite these reforms, however, a 2018 report issued by The Pew Charitable Trusts claims that many state retirement systems remain on an "unsustainable path" (Pew Charitable Trusts, 2018).

Tension over the viability and certainty of pension benefits has also risen sharply among state and local employees as evidenced by recent high profile teacher strikes in West Virginia, Kentucky, and Oklahoma (to name a few). Media members have reported that teachers in these states have specifically cited concerns over pension funding or reform plans as a contributing factor behind the work stoppages.[4]

A robust body of academic research has also developed over the past decade to explore pension-related issues such as the appropriate valuation of liabilities, fiscal and political factors contributing to the underfunding crisis, and the short- and long-term fiscal consequences to plan sponsors and taxpayers. In terms of valuing liabilities for instance, pension plans typically discount future liabilities by the expected return on the plan's assets, which is generally around 8 percent. If liabilities are discounted at a risk-free rate, as suggested by Novy-Marx and Rauh (2011), or are valued using

[3] https://www.nirsonline.org/wp-content/uploads/2017/07/pensionreform.pdf.
[4] See for instance: https://www.nytimes.com/2018/04/02/us/teacher-strikes-oklahoma-kentucky.html.

a "put option" approach, as Biggs (2011) proposed, then the aggregate shortfall between state and local pension assets and liabilities is 3 to 5 times larger than the actuarial reported gap. According to Pew Charitable Trusts (2018), the actuarial reported funed gap was $1.4 trillion as of 2016.

Pension sponsors also face both direct and indirect consequences from underfunding. For example, numerous state governments and several municipal governments have witnessed their credit ratings downgraded due to pension health. This will likely increase their borrowing costs on investment projects, which could result in fewer projects or more fiscal strain as growing interest costs could crowd-out other expenditures. Increasing sponsor contributions to pension plans could also crowd-out other spending unless it is tax-financed, which, in turn, would reduce the after-tax income for citizens. Expanding employee contributions, which has been a common reform option in many states, increases the concern for intergenerational inequity among public employees. Since current and future taxpayers may ultimately bear the burden of closing pension financial gaps for sponsoring governments, there is some evidence that underfunding has contributed to both out-migration (Aubry and Crawford, 2016) and a reduction in home values (MacKay, 2014) that could decrease tax bases and exacerbate existing fiscal challenges.

In addition, Elder and Wagner (2015) and Splinter (2017) demonstrate that political and fiscal factors have also played an influential role in impacting pension health. Elder and Wagner (2015) find that (actuarial) pension funding levels are lower in states that are more politically competitive and have higher legislative turnover rates. This is consistent with policymakers shifting resources away from pension funding and toward projects that might be expected to provide a more immediate electoral benefit because even severely underfunded pensions have sufficient assets to make their promised benefit payments for at least several years. Similarly, Splinter (2017) shows that state policymakers are significantly less likely to meet their pensions' actuarial required funding during periods of fiscal distress. In fact, Splinter (2017) finds that states cut annual pension contributions at 7 times the rate of other spending in periods of fiscal strain, implying that policymakers are at least partially culpable for the current funding situation.

Despite this recent attention, previous studies exploring the relationship between public sector unions and pensions is somewhat sparse. The work that does exist has tended to focus on the broader issue of assessing the relative generosity (or lack thereof) of public sector compensation compared to private sector compensation. In terms of recent evidence, Reilly (2013) contends that

an average 'blue-collar' public sector worker will be better compensated working for the public sector over his or her lifetime than working in the private sector. This is in contrast to Brewerunge and Rosen (2013) who find no statistically significant difference in total compensation for state and local government workers with similar characteristics using a matched sample of workers over the age of 50 from the Health and Retirement Study.[5] Brewerunge and Rosen (2013) do find, however, that pension wealth accumulation is significantly higher for state and local workers than their private sector counterparts. This is also consistent with Poterba et al. (2007) who also use the Health and Retirement Study to demonstrate that public sector defined benefit plans (DB) tend to be more generous than private sector DB plans. Considering the current evidence, the literature seems to suggest that although state and local government employees tend to be compensated equal to, or even slightly less than, their private sector counterparts, public sector compensation is more heavily tilted toward deferred retirement plans that are more generous than the plans typically found in the private sector. In spite of this research, the public rhetoric about union pensions (and public sector compensation more generally) remains highly polarized as several states, including some traditional union strongholds such as Wisconsin and Ohio, have recently taken actions to limit or weaken the power of public sector unions.

Although the generosity of a retirement system will impact the annual contributions the plan's sponsors need to make to keep the plan actuarially sound, a plan's generosity and its funded ratio are distinct metrics. The only previous work (that we are aware of) to explicitly investigate the strength of public sector unions and pension generosity is a policy brief authored by Munnell et al. (2011). Measuring union strength by the percentage of state and local employees covered by a collective bargaining agreement, Munnell et al. (2011) find no evidence of an empirical relationship between unions and plan generosity. However, as Munnell et al. (2011) note, pension benefits are generally established by means of the legislative process rather than through collective bargaining so their union strength variable may not be adequately capturing the influence of unions.

Our focus in this paper is to explore the extent to which state-to-state variation in the power of teachers' unions influences pension generosity set by state legislatures. We focus on teachers' unions because they are very politically active and a majority of states (29) have distinct pension plans that

[5]Brewerunge and Rosen (2013) do find a nearly 40 percent compensation premium for federal employees after controlling for worker characteristics.

are dedicated solely to teachers. This is the largest set of similar retirement plans across the states for any category of employees. According to the Public Plans Database at Boston University, the number of state-administered pension plans ranges from a low of a single plan covering all employees in 13 different states to a high of 5 distinct plans for different groups of employees in Louisiana, Missouri, and Texas.[6] The most common approach is for a state to have a state-administered plan for teachers and a separate state-administered plan for all other state and local employees.

The effects of teachers' unions on the allocation of school resources and educational outcomes have been extensively studied because teachers have several margins that they may attempt to influence through collective bargaining and the broader political process. These may include, for instance, salaries and benefits, working conditions such as the length of school day or year, paid vacation days, or even tenure and other certification standards.[7] Across these margins, increasing pension benefits (or minimizing reductions) may be an attractive union objective for several reasons. First, changes in pension systems occur gradually so current policymakers may have an incentive to alter benefits for political support knowing that the full ramifications of the decisions will not be felt for many years. Second, as Bulow (2017) notes, public pension systems have operated for many years under a "California rule" structure in which benefits are often viewed as a vested right such than plan sponsors may be prohibited (or severely restricted) from making reductions. Finally, since pension calculations can be complex, Glaeser and Ponzetto (2014) develop a theoretical model showing that public sector compensation may be inefficiently back-loaded when public sector workers understand the value of their benefits better than an ordinary taxpayer.

### 2.2 Measuring Pension Generosity

Every pension plan has a (set of) benefit formula(s), generally based on a multiplier, years of service, and average final salary. When the benefit formula(s) are combined with a set of actuarial assumptions concerning variables such as expected rates of inflation, pay increases, mortality and disability probabilities, employment duration, etc., one can calculate the expected amount of pension benefits current employees accrue in a given period. At a high level, the measure of pension generosity that we propose is the present value of all of the future benefits that an average active plan member earns in each period that are paid for by the plan sponsor. Defining the generosity of

[6] An alternative approach would be to examine the relative power of public sector unions within a state and how this shapes the relative generosity of pensions for, say, teachers relative to police and firefighters.

[7] For an excellent overview of the literature on teachers' unions see Cowen and Strunk (2015).

pension plan $j$ at time $t$ as $g_{t,j}$, our measure may be constructed as:

$$g_{t,j} = \left( \frac{NC^{T}_{t,j}(1 + R_{t,j})^{D}}{(1 + \overline{r})^{D}} - NC^{M}_{t,j} \right) \left( \frac{P_{t,j}}{M_{t,j}} \right) \tag{1}$$

where $NC^{T}_{t,j}$ is the period $t$ total normal cost for pension $j$, $R_{t,j}$ is the pension-specific assumed expected investment return in period $t$, $\overline{r}$ is the risk-free discount rate, $NC^{M}_{t,j}$ is the member's (employee's) share of the normal cost, $D$ is the duration of newly accrued liabilities for plan $j$, $P_{t,j}$ is the total payroll for plan $j$ and time $t$, and $M_{t,j}$ is the number of active members in plan $j$ at time $t$. $g_{t,j}$ is expressed in dollars per active member.

It may be useful to provide some intuition to the terms in equation 1. The duration of newly accrued benefits, $D$, is a weighted average of the timing of future benefits where the weights are determined by the present value of each period's expected benefit payments; it is a measure of the average timing of the present value of future benefits. The term $NC^{T}_{t,j}(1 + R_{t,j})^{D}$ is the sum of the pension plan's newly accrued benefits that were earned in a given period. These payments are discounted using a (constant) risk-free interest rate because pension liabilities should be discounted based on their risk rather than on the plan's expected investment returns (Brown and Wilcox, 2009). When the member's normal cost ($NC^{M}_{t,j}$) is subtracted from this discounted term, the remainder is the (discounted) sum of all newly accrued benefits in a given period that are paid for by the plan sponsor expressed as a percentage of the plan's payroll. The second term in parentheses in equation 1, $\left( \frac{P_{t,j}}{M_{t,j}} \right)$, is simply the plan's payroll per active member used to rescale $g_{t,j}$ into dollars per active member.

A plan's total normal cost ($NC^{T}_{t,j}$), which is expressed as a percentage of plan payroll, is the present value of the future expected sequence of benefits accrued by employees in the current period discounted by the plan's assumed investment return. Another way of thinking about this metric is that it is simply the dollar amount that needs to be saved in a given period so that the expected future benefit payments that employees earned in that period can be cash flowed in the future (assuming, of course, that these dollars compound at the assumed investment return).

Considering that a plan's total normal cost captures the (discounted) value of expected future benefits, it is a natural candidate to be used as a measure of a pension plan's generosity (such as in (Munnell et al., 2011)). One limitation of using the total normal cost in this manner is that pension plans with identical streams of expected future benefits will have different total normal costs if the

plans have different assumed rates of return on their investments. In other words, if two plans have an identical stream of expected future benefits but one plan has a lower assumed investment return, then the plan with the lower discount rate will have a higher total normal cost and will therefore appear to be more generous. In addition, since the total normal cost is the sum of the sponsor and member normal costs, two plans with identical total normal costs may have different contribution rates from their active members. The metric that we propose in equation 1 improves upon these shortcomings.

To better understand the generosity measure, consider a simple example in which a hypothetical pension plan has 5 active members, a total payroll of $1000, and assumes an 8% investment return. Suppose that the expected future benefits of newly accrued liabilities (which are based on the plan's benefit formulas and other actuarial assumptions) in period $t$ are given by $Benefits_{t+1} = 80$, $Benefits_{t+2} = 100$, and $Benefits_{t+3} = 40$. The present value of this sequence is 191.56 using the 8% discount rate, so the plan's total normal cost for the period is 0.1916 (= 191.56/1000).

[Insert Table 1 here]

The duration of newly accrued liabilities for the sequence of future benefit payments is 1.779 (= 340.8/191.6). The term $NC^{T}_{t,j}(1 + R_j)^{D}$ in equation 1 is equal to $0.220 = (0.1916)((1 + .08)^{1.779})$, which is the sum of the future values of the expected benefits payments relative to current payroll. If we assume that the plan sponsor and members bear an equal share of the normal cost, then each group's normal cost would be equal to 0.0958 (= 0.1916/2). Given a risk-free rate of 3%, the first term in parentheses in the generosity measure for period $t$ is $\frac{0.220}{1.03^{1.779}} - 0.0958 = 0.1126$. This figure tells us that the present value of the newly accrued benefits earned by active employees in the current period that are paid by the plan sponsor is equal to 11.26% of current payroll. Since the plan has 5 active members and a payroll of $1,000, the generosity measure in dollars per active member is $22.52 = (0.1126 * ($1000/5))$.

# 3 Data and Identification Strategy

## 3.1 Data

Data for state-administered teacher pension plans was obtained from Boston University's Center for Retirement Research Public Plan Database. This database provides detailed information on

166 state and local defined benefit pension plans, including key characteristics such as the plan's actuarial assumptions, normal cost, expected rate of investment return, covered payroll, and plan membership. The database begins in 2001 so our sample includes all 31 state-administered teacher-only pension plans that operate in 29 states over the period from 2001 to 2015. In addition to a plan for elementary and secondary educators, both California and Illinois sponsor separate defined benefit plans for employees of public universities.

Using each plan's normal cost, employee normal cost, expected investment return, covered payroll, and number of active members from the Public Plans Database, we calculate each plan's generosity for every year that complete data are available using equation 1. Our largest possible sample is an unbalanced panel of 447 observations.[8]

Of the components in equation 1, the duration of newly accrued liabilities ($D$) is not reported in the Public Plans Database, nor is it commonly reported in a plan's comprehensive annual financial report or CAFR. Since Novy-Marx and Rauh (2011) show that duration of newly accrued liabilities is approximately 10 periods longer than the duration of a plan's total accrued liabilities, $D$ can be estimated by adding 10 to the duration of a plan's total accrued liabilities. Hence, given pension plan $j$'s (total) projected liabilities, one can follow the simple example in Table 1 to calculate the duration of total accrued liabilities. The duration of newly accrued liabilities is simply this number plus 10.

While some public pension plans do report their total projected liabilities in their CAFRs, the majority do not. We therefore assume that the total projected liabilities for every teacher plan in our sample is identical to: (a) the projected liabilities for the Wisconsin Retirement System, (b) the Arkansas Public Employees Retirement System, and (c) the Teacher Retirement System of Texas. We use these projected liabilities because they are published and readily available. Doing so ultimately gives us three distinct measures of generosity for plan $j$ at time $t$ (one for each stream of projected liabilities). It is critical to note that although we calculate all three measures

[8]Our sample consists of 15 observations (2001-2015) for each of the following pension plans: Alaska Teachers, Alabama Teachers, Arkansas Teachers, University of California, Georgia Teachers, Illinois Teachers, Illinois Universities Indiana Teachers, Louisiana Teachers, Massachusetts Teachers, Maryland Teachers, Maine State and Teacher, Michigan Public Schools, Missouri Teachers, North Dakota Teachers, Nebraska Schools, New Jersey Teachers, New Mexico Educational, Ohio Teachers, Oklahoma Teachers, Pennsylvania School Employees, Texas Teachers, Vermont Teachers, Washington Teachers Plan 2/3, and West Virginia Teachers. Pension plans with some missing observations that we include are: California Teachers (2001, 2003-2015), New York State Teachers (2001-2012, 2014-2015), Montana Teachers (2002, 2004-2015), Minnesota Teachers (2004-2015), Colorado School (2005-2015), and Connecticut Teachers (2002, 2004, 2006, 2008, 2010, 2012-2014).

of generosity for each plan, our empirical results are not sensitive in any way to the choice of these projected liabilities. This is due to the fact that, as the figure below illustrates, all three streams of future projected liabilities follow a very similar general pattern despite relying on different actuarial assumptions.

[Insert Figure 1 here]

The projected liabilities shown in Figure 1 are plotted as a percentage of each plan's 2015 covered payroll. We do this simply to normalize the liabilities because the dollar value of the liabilities in the Texas plan are 20 times larger then the dollar value of liabilities in the Arkansas plan. As is evident, Wisconsin's plan is projecting higher future liabilities as a share of payroll than either Arkansas or Texas for most of the future. Except for the drop in projected liabilities for Texas and Arkansas in the first future period (what would be 2016), which may be due to recently enacted reforms, the total projected liabilities for all three plans increases gradually for between 32 and 36 years before starting to decline. For our purpose of calculating a pension's duration of total liabilities, and than adding 10 to estimate the duration of newly accrued benefits, these three plans are remarkably close. If we assume that investments compound at 7.5% (the most commonly assumed investment return among our sample of teacher plans), then the Arkansas sequence implies a duration of newly accrued benefits equal to 16.06, the Wisconsin sequence implies 16.23, and the Texas sequence implies 16.49 (all within half a period). We use the Wisconsin projections/duration as our baseline case because it is the median duration. In the appendix, we also report our primary empirical results using the durations from the Arkansas and Texas sequences as well.

With estimates of the duration in-hand, we can turn our attention to the generosity measures in our sample. In terms of dollars per active member, the mean and median generosity are $12,860 and $10,887 respectively.[9] The mean generosity across all plans has increased over the sample, growing from $10,479 in 2001 to $14,472 by 2015 (an average of 2.3% per year). However, generosity has not steadily increased during our sample as the mean generosity across all plans decreased between

[9]We use the mean of the 20-year (annual) Treasury bond rate from 2001 to 2015 as the measure of the risk-free rate, which turns out to be 3.99%. Because interest rates fell sharply in the post-Great Recession era, using a time-varying risk-free rate may obscure one from observing true changes in generosity because the discounted stream of future benefits will increase as the risk-free rate falls. Other factors constant, this will increase the pension's generosity using equation 1. The use of the constant rate ensures that changes in our generosity measure are driven solely by changes in a plan's benefit structure.

2010 and 2011 and again between 2014 and 2015. At the individual plan-level, 19 of the 31 teacher plans were less generous in 2015 than they were during their peak generosity which, for most plans, occurred between 2008 and 2010. In four states, Alaska, Colorado, Illinois (both plans), and New Jersey, the level of generosity was actually lower in 2015 than it was in 2001. Without performing a more rigorous investigation, this certainly seems to be consistent with recent reforms that have reduced benefits.

In terms of the generosity of individual plans, teacher pensions in Missouri, Alaska, Illinois, California, and Ohio were the most generous on average over our sample, while plans in Minnesota, West Virginia, Indiana, New York, and Michigan were the least generous. The gap between the most and least generous pensions is also not trivial. For an average plan member, the present value of newly accrued benefits paid for by the plan sponsor is generally more than $20,000 per period in the most generous plans and this figure falls sharply to around $7,500 per period in the least generous plans. Figure 2 shows the mean generosity per member for each state over our sample. Since California and Illinois have multiple plans, Figure 2 shows their least generous plan per member.

[Insert Figure 2 here]

Since pension benefits are determined by the legislature rather than through collective bargaining, we measure the strength of state teachers' unions using their aggregate campaign contributions to state candidates, parties, and other organizations. The nonpartisan, nonprofit National Institute on Money in Politics has been compiling data from individual state campaign finance reports since 2000. The data are at the individual record level and include such information as the dollar value of the contribution, the recipient candidate or organization, the election cycle, the election jurisdiction, and the address and occupation or business line of the donor. A recent Rand Corporation report, authored by McGovern and Greenburg (2014), provides a detailed overview of these data.

In the most recent election year for most states in our sample (2014), the National Institute on Money in Politics (hereafter NIMP) has compiled more than 4.5 million unique transactions at the state level that exceed $3.8 billion. Roughly $1.4 billion in contributions were made by individuals. The NIMP also classifies donors into more than 100 general industries and more than 400 specific business lines, making it possible to isolate teacher campaign contributions. In 2014 alone, NIMP

identifies 16,194 transactions from teachers' unions that account for more than $90 million in contributions (or 2.4% of the aggregate total). Although roughly 20% of the transactions were made by individuals, contributions from teacher organizations accounted for more than 99% of the aggregate teacher union contributions. The top five contributing teacher organizations nationwide in 2014 were the California Teachers Association ($19.7 mil), the National Education Association ($9.3 mil), Massachusetts Teachers Assocation ($6.3 mil), Illinois Education Association ($5.9 mil), and the American Federation of Teachers ($5.7 mil). Over our entire sample period (2001-2015), teachers' unions have contributed more than $750 billion to statewide candidates, parties, and other organizations.

Teachers' unions were a major campaign contributor in many individual states as well during 2014. Considering all of the individuals and organizations who contributed, teachers' organizations ranked among the top 20 donors in 33 different states. They were also the largest single donors in Alabama and Massachusetts, and among the top 5 contributors in California, Washington, Minnesota, Wisconsin, Nevada, Indiana, and West Virginia.

[Insert Figure 3 here]

Much like the generosity measure, there is considerable variation in teachers' contributions across different states. Figure 3 plots the mean generosity of each teacher plan (in thousands of dollars per active member) against the mean teacher union contributions (per capita) in the state. The data points are labeled using a combination of the state abbreviation and the plan's identification number from the Public Plans Database. For example, MA51 denotes the Massachusetts Teachers' Retirement System plan. The solid lines in the panels are simple regression lines.

Figure 3 is further divided into two panels because our inspection of the teacher contribution data revealed two extremely large values relative to the sample average that both occurred in California (in 2005 and 2012). Panel B shows the scatterplot including these observations while Panel A omits them. For our entire sample, including California in 2005 and 2012, mean per capita campaign contributions by teachers' unions is $0.10. In California, per capita teachers' unions contributions were $1.72 and $1.37 in 2005 and 2012. Many states have years in which (per capita) teacher contributions are significantly higher than the sample mean, such as Massachusetts in 2014 ($0.95), Ohio in 2011 ($0.90), Michigan in 2012 ($0.82), Illinois in 2014 ($0.72), and Alabama in

2006 ($0.71). However, teacher contributions in California in 2005 and 2012 are more than 40% larger than the next highest observed contribution amount. While it is difficult to know precisely why the contribution amounts were so large in California during those years, several high-profile ballot propositions were considered in those years that seem to be likely culprits (Proposition 98 in 2005 and Propositions 30 and 32 in 2012).

If we consider Panel B, per capita teacher contributions in California average $0.40 and this is roughly double the other high-contribution unions in Illinois ($0.21), Alabama ($0.21), and Minnesota ($0.18). If we omit the 2005 and 2012 observations for California, as shown in Panel A, then California's mean contributions falls to $0.22 per capita. Our baseline empirical models include all of the observations. We do present results that omit California's 2005 and 2012 observations in the appendix, which, ironically, actually suggests a slightly *stronger* relationship between contributions and pension generosity.[10]

### 3.2 Empirical Specification

Legislatures do not adjust pension benefits on a regular basis and many of the modifications that do occur, especially on the benefit side, frequently apply only to newly hired employees rather than to all plan members. It may therefore take several years before any detectable change in plan financials is evident within a given state or plan. One approach to potentially identifying a credible causal effect of union contributions on pension generosity, if one exists, is to exploit the cross-sectional (or between) variation in the data. Considering that there are only 31 distinct teacher pension plans, our sample is likely too small to draw credible inferences using the conventional (panel) between estimator. For this reason, we seek to identify any causal effect by estimating a random effects variation of the "within-between" or "Hybrid FE" estimator (Allison, 2009; Bell and Jones, 2015; Schunk, 2013). Specifically, the model we estimate is of the form:

$$g_{t,j,s} = \alpha + \eta X_{t,s} + \gamma W_{t,j} + \delta^b \overline{U_s} + \delta^w (U_{t,s} - \overline{U_s}) + \lambda_t + \mu_{j,s} + \varepsilon_{t,j,s}, \tag{2}$$

where $g_{t,j,s}$ is the generosity of pension plan $j$ at time $t$ that is located in state $s$, $X_{t,s}$ is a vector of time-varying controls that are measured at the state level, $W_{t,j,s}$ is a vector of time-varying controls

[10] You may note that the two pension plans in Illinois have the same mean per capita teacher contributions in Figure 3 while the two pension plans in California do not. This is because we have 15 observations for both plans in Illinois and the University of California plan (CA111) but only 14 observations for the California Teachers plan (CA10) due to missing data in the Public Plans Database.

measured at the pension plan level, $\lambda_t$ is a time fixed effect, $\mu_{j,s}$ is an unobserved component for plan $j$ located in state $s$, and $\varepsilon_{t,j,s}$ is the random disturbance term.

We decompose teacher campaign contributions (that vary at the state level) in equation 2 into two terms that are orthogonal by construction and isolate a between component ($\overline{U_s}$) and a within component ($U_{t,s} - \overline{U_s}$). This decomposition is referred to as group mean centering in the broader mixed model literature. The coefficients, $\delta^b$ and $\delta^w$, yield the between-effect estimate and the within-effect estimate, respectively. Our coefficient of interest, $\delta^b$, is identified using only the cross-sectional variation in our panel so it captures the effect of how changes in teacher campaign contributions influence pension generosity across different plans.

We only decompose teacher union contributions because of concerns for parsimony. Estimated coefficients for the untransformed covariates will be an average of their within- and between-effects, which is standard in random effects models. It is certainly possible to decompose all of the time-varying regressors into their respective within- and between-components. In fact, Bell and Jones (2015) and Schunk (2013) show that such a model is an equivalent formulation of the random effects approach suggested by Mundlak (1978). Conducting an extensive set of simulations, Dieleman and Templin (2014) find that the within-between formulation of the Mundlak (1978) approach is often preferred to both the traditional fixed effects and random effects estimators in small samples when the mean error of the estimated marginal effects is the selection criterion.

The are several advantages to decomposing teacher union contributions in equation 2 to estimate $\delta^b$ rather than relying on the conventional between estimator. First, the larger sample size allows us to control for a broader set of observable factors that may influence pension generosity. Next, we can exploit the panel nature of our data to improve the efficiency of our estimates. Finally, if interested, one could explicitly test for the equality of the between and within effects of a given covariate.

A well-known shortcoming of the random effects specification is that, in addition to assuming the covariates are strictly exogenous, estimation of equation 2 requires that $\mu_{j,s}$ be orthogonal to the covariates. This can be a strict assumption and it naturally raises more concerns about omitted variable bias than in a traditional two-way fixed effects specification that explicitly assumes that the covariates are correlated with the unobserved component.[11]

[11] While the two-way fixed effects specification has the advantage of treating the covariates and unobserved com-

In an effort to mitigate concerns regarding omitted variable bias and the potential for simultaneity between generosity and union contributions, we pursue an instrumental variables strategy to isolate exogenous variation in union contributions. To accomplish this, we rely on the geographic proximity of education reform policies that have passed at the state level as instruments for union contributions. It is well established that policies in one area are often influenced by the policies in another area, and state education policies appear to be no different in this manner. Previous work has found that state policy decisions are dependent on those made in neighboring states on range of issues from pay for performance to charter schools and vouchers (Finger, 2018; Wong and Langevin, 2005). Following this research, we instrument for teacher union contributions in state $j$ based on (non-pension related) educational reforms that have been enacted in common-border *neighoring* states. The basic idea is that if more of state $j$'s neighbors have enacted a policy, then this could affect state $j$'s consideration of the policy and campaign contributions from educators. To lessen the chance that state $j$ is the policy innovator leading neighboring states to consider a specific reform, we only consider a policy as a potential instrument if the legislature in state $j$ has not had a floor vote on that specific policy in the past two years (which is the length of legislative sessions in the lower house in most states). These instruments should satisfy the exclusion restriction because they are plausibly exogenous to pension plan $j$'s generosity as well as to any unobserved factors for plan $j$ that are time invariant.[12]

As Gilardi and Wasserfallen (2017) note, the diffusion literature has identified three primary mechanisms for policies to spread: learning from others, competing with others, and emulating others. While it may be an easier connection to think that state $j$ would be more likely to enact a policy if others do so, the effect may also be in the opposite direction if state $j$ learns that the policy is "bad" policy or has negative electoral consequences (Gilardi and Wasserfallen, 2017). Boehmke and Skinner (2012) also show that while geographic proximity tends to be positively related to

ponent as being correlated, it has a disadvantage in our context because the model eliminates the between variation in the data. Hence, any estimated effect of union contributions on pension generosity would only be identified using the within-pension plan variation. This would be an appropriate empirical strategy if one were interested in how changes in the strength of teachers' unions over time affects changes in pension generosity. Similarly, a fixed effects specification would be well-suited to explore how changes in the strength of, say, teachers' unions relative to other state employees with their own pension plan impacts the relative generosity of their retirement systems.

[12] As an alternative to the diffusion of state education policies, we also explored the use state campaign finance laws as potential instruments. Provisions pertaining to public funding for candidates and restrictions on political action committee (PAC) contributions to state parties were strong instruments in predicting teacher union contributions. However, since they were considerably weaker (in terms of predictive power) than the educational reforms and have a weaker exclusion restriction argument, we opted to rely on the education reforms for our exogenous variation.

policy adoption (across a wide range of issues), states with more professional legislatures and those that are more ideologically different from their neighbors tend to repel neighboring policies. Hence, it may be difficult to make an *a priori* prediction about how a state may react to the policies being considered and enacted in other states.

The Education Commission of the States (hereafter ECS) has tracked enacted and vetoed state-level education legislation since 1996, classifying the legislation into hundreds of areas ranging from accountability to governance. We make use of their database to construct our reform instruments and select topic areas that are more likely to be viewed as controversial. Specifically, we instrument for teachers' contributions using the fraction of state $j$'s common-border neighbors in time $t$ who have enacted statewide legislation pertaining to: (a) gifted or talented program guidelines or funding and (b) instructional or funding-related mandates. Gifted programs are extremely controversial and widely studied, with proponents often pointing toward improved educational outcomes and better engagement and retention among teachers, while opponents often question educational gains, note that the programs often have large gaps between the shares of white and non-white students, and express concerns that scarce resources will be reallocated away from the broader student body (Woods, 2016). Similarly, statewide mandates, which were somewhat less frequent in the ECS database, are often viewed by educators as unwelcome guidelines or rules that restrict (sometimes severely) their discretion over key instructional or financial matters (Jeffries, 2013). Since the between effect for teachers' union contributions is the mean value per state/plan and does not vary over time, we also transform each instrument into its mean value per state/plan. After conditioning on the other covariates in equation 2, which we discuss in more detail below, both instruments are strongly correlated with the between effect of teacher contributions. The results of the first-stage regressions are also reported in Appendix Table 3.

We estimate equation 2 by feasible generalized least squares using the standard (or equicorrelated) random effects structure. To obtain consistent estimates of the residuals that are used to estimate the error variance components in the random effects model, we first estimate equation 2 using linear two-stage least squares. We also report the linear instrumental variables (IV) results for comparison purposes because this specification is actually less restrictive than the random effects model in the sense that it only relies on the orthogonality between the unobserved component and covariates for identification (Wooldridge, 2010). The random effects feasible generalized least

squares instrumental variables (REFGLSIV) estimator has the form:

$$\hat{\beta} = [Z'Q(Q'\hat{\Omega}^{-1}Q)^{-1}Q'Z]^{-1}Z'Q(Q'\hat{\Omega}^{-1}Q)^{-1}Q'g \tag{3}$$

where $g$ is the vector of pension generosity, $Z$ is the full matrix of regressors from equation 2, and $Q$ is the matrix of included and excluded exogenous covariates.[13]

In terms of additional state-level control variables, we include the fraction of public sector employees in state $s$ that are unionized and the mean salary per employee for workers employed in state $s$'s public education sector. We control for attitudes towards unions using an indicator variable that equals unity if state $s$ has a right-to-work law in place at time $t$, and also include the number of major strikes in a state that effect at least 1,000 employees. To control for the strength of other (non-teacher) public sector unions in state $s$, we again rely on data from the National Institute for Money and Politics and include the per capita campaign contributions from police, fire, and all other (non-teacher) public sector unions to candidates, parties, and other organizations. Definitions, descriptive statistics, and detailed source information for all of the variables in our empirical specifications are shown in Table 2.

[Insert Table 2 here]

In terms of state financials, we include the share of state $s$'s revenue that is derived from own-source taxes, the per capita amount of federal aid state $s$ receives, and the level of per capita income in the state. The final two control variables, which vary at the pension plan level, include the actuarial funded ratio of pension plan $j$ located in state $s$ and an indicator variable that equals unity if members of pension plan $j$ are also eligible for Social Security benefits.

# 4 Empirical Results

## 4.1 Baseline Results

The results of our baseline regressions, which use the projected liabilities for the Wisconsin Retirement System, are presented in Table 3.[14] Model 1 shows the results from equation 2 using

[13] The within-effect of teachers' contributions is treated as exogenous in estimating equation 2. By construction, it is orthogonal to the between-effect so modeling it this way will not bias the estimate of $\delta^b$. Moreover, since legislatures reform pension plans relatively infrequently, there is likely to be insufficient variation within plans over time to identify any causal relationship using the within estimator. In addition, Angrist and Pischke (2009) note the added identification challenges that accompany a model with multiple endogenous regressors.

[14] Appendix Table 1 shows the empirical results using the alternative projected liabilities from the Arkansas Public Employees Retirement System and the Teacher Retirement System of Texas. We only present the linear IV estimates

OLS for comparison purposes, while the results in Models 2 and 3 are from the two-stage least squares (denoted IV) and the random effects (denoted REFGLSIV) specifications that treat the between effect for teacher contributions per capita as endogenous. Each specification includes fixed year effects and the standard errors for each model are clustered at the individual pension plan level. Pension generosity is measured in thousands of dollars per active plan member.

[Insert Table 3 here]

As shown in the Table, the educational reforms enacted in neighboring states are incredibly strong instruments for teacher campaign contributions with first-stage F statistics in excess of 200. The Sargan test also fails to reject the null hypothesis that the instruments are uncorrelated with the model errors.

In terms of the control variables, the results show that teacher pensions are significantly less generous in states with a higher percentage of public sector workers that are unionized and when members of the pension plan are also eligible for Social Security benefits. Specifically, a 1 percentage point increase in the share of public sector workers that are unionized is correlated with a teacher pension that is $150 less generous per member. In terms of magnitude, this is relatively small compared to the benefit reduction pension members face when they are also eligible for Social Security benefits. Other factors constant, our results suggest that per member pension benefits are roughly $4,000 lower per period when members are eligible for Social Security. This is an incredibly large effect considering that mean pension generosity is roughly $13,000 per member per period.

Our results also show that state income levels and revenue sources are correlated with pension generosity. For example, an increase in state's a per capita income of $1,000 is correlated with an increase in per member pension generosity of about $260. Moreover, we find that for every additional percentage point of state revenue that is derived from own-source taxes, pension generosity is found to be roughly $120 lower per member.

Turning our attention to teacher campaign contributions, the results show that state-to-state variation in union strength is a significant casual factor in explaining the variation in pension generosity. If per capita teachers' unions contributions rise by $0.01, our results imply that pension

for these projected liabilities to conserve space but will provide the REFGLSIV estimates upon request. Appendix Table 2 shows the empirical results, using the Wisconsin liabilities, when the 2005 and 2012 observations for California are omitted.

generosity will increase by nearly $300 per member per period, other factors constant. In percentage terms relative to the mean, this suggests that a 10% increase in teacher union contributions leads to approximately a 2.3% increase in pension generosity per member. The per member difference in pension generosity is substantial for workers in states with relatively strong versus relatively weak union representation. For instance, the per capita differential in campaign contributions is roughly $0.08 for unions in the 75th percentile versus those at the 25th percentile. Our results imply that, other factors constant, this gap is responsible for approximately a $2,400 difference in the pension benefits earned per member that are paid for by the plan sponsor in a given year.

[Insert Figure 4 here]

More broadly, our estimates imply that the variation in state teacher contributions (relative to the sample mean) is a key factor explaining the observed differences in pension generosity across states. Figure 4 shows these figures for all of the states/plans in our sample. Since California and Illinois have multiple teacher plans, the dollar amount in Figure 4 is from the least generous plan in each state (California State Teachers' Retirement System and Teachers' Retirement System of The State of Illinois, respectively). Suppose we consider a strong teachers' union state such as Alabama and compare it to a weak teachers' union state such as New Mexico. Over our sample, unions in Alabama contributed an average of almost $0.22 per capita to statewide elections while unions in New Mexico contributed an average of just over $0.03 per capita. Thus, relative to the mean contribution for all states (which is $0.10 per capita), per member pension generosity in Alabama is estimated to be $3,455 higher than the sample average because of their union's contributions after conditioning on other observed factors. Since New Mexico's contributions are below the sample average by nearly $0.07, the estimates imply that the per member pension generosity is about $2,000 below the sample average because of their below-average union contributions after conditioning on other factors.

### 4.2 Robustness Checks

Since our coefficient of interest is identified using only the cross-sectional variation, it is capturing an average effect over all of the years in our sample (2001-2015). As a robustness check, we also estimated equation 2 for the pre-Great Recession period (2001-2007), post-Great Recession period (2008-2015), excluding the high pension reform period of 2010-2013, and focusing only on the high

pension reform period. These results are shown in Table 4. Each of the four subsample regressions was estimated using both linear IV and random effects.

The instruments remain strong in each of the subsamples, ranging from a low of 19 in the 2001-2007 period (columns 1 and 2) to a high of 83 when the 2010-2013 period is omitted (columns 5 and 6). Interestingly, if we compare the estimated coefficient of interest in the pre- and post-Great Recession periods, the results suggest that the marginal effect of union contributions on pension generosity may have been somewhat larger before the downturn (columns 1 and 2) than it was after the downturn (columns 3 and 4). Intuitively, this finding would make sense if plan sponsors were in better financial health before the recession and were therefore more receptive to unions' interests.

The results in columns (7) and (8), which only include 2010-2013 period when the number of pension reforms was unusually high, show the smallest marginal effect of unions on generosity. In terms of the absolute magnitude of the estimated coefficients, the marginal effect of unions in the pre-Great Recession period is nearly double the estimated marginal effect during the pension reform period. This finding may be due to the fact that the recession had such a major impact on pension financials and state fiscal health in general that legislatures had few options but to reduce pension benefits. Our results imply that more powerful teachers' unions would have likely been more effective in limiting the benefit reductions that did occur, but that their effectiveness was diminished relative to the pre-Great Recession period.

As an additional robustness check, we also re-estimated equation 2 by linear IV using rolling 2-year and 3-year sample windows starting in 2001. The idea here is to evaluate the estimated effect of teachers' contributions using smaller samples that are still (hopefully) large enough to arguably gain credible inference. The resulting coefficient estimates for $\delta^b$ are plotted in Figure 5 along with the 95% confidence interval for each point estimate.

[Insert Figure 5 here]

For the 2-year rolling samples, the estimated marginal effect of teachers' contributions ranges from 26 to 43 with the exception of the sample that was estimated using 2004 and 2005 data. This coefficient estimate is -2.05. This is very consistent with the estimated marginal effects using the 3-year rolling samples where $\delta^b$ generally ranges from 24 to 45 (ignoring the 2005 sample). The simple averages of the estimated coefficients in the 2-year and 3-year rolling samples are 31.0 and

30.5, respectively, which are (and should be) very close to the full sample coefficient estimate of 29.6 in column(2) of Table 3.

In addition, the 95% confidence interval for the coefficient estimates excludes zero for 10 of the 14 rolling 2-year samples and 11 of the 13 rolling 3-year samples. Combined with the stability of the estimated marginal effects in all of the rolling samples (except, of course, 2005), this gives us a high degree of confidence that the magnitudes and statistical significance we uncovered in Tables 3 and 4 represent a credible effect and are not being driven by a fraction of our observed data.[15]

# 5 Conclusion

Defined benefit pension plans are the norm in the public sector, with roughly 75% of all state and local employees participating in a plan as of 2017. For primary and secondary teachers the participation rate rises to 85%, making them a major component of compensation for a very large number of state and local government workers.[16] In spite of this, very few previous studies have explored the extent to which union strength may affect the generosity of their pension benefits.

In this paper, we propose a new measure of pension generosity that is equal to the present value of benefits an average member earns in a given period that are paid for by the plan sponsor. Using data on 31 state-administered teacher pension plans, this paper is the first to find credible empirical evidence linking stronger public sector unions to more generous retirement benefits. For an average teacher in a relatively strong union state compared to a teacher in a relatively weak union state, our results indicate that the present value of pension benefits earned each year that are financed by the plan sponsor will vary by $2,400 per member.

Although the future outlook for public sector unions is undoubtedly more uncertain than at any time in many years, it seems reasonable to assume that their ability to pressure legislatures for pension benefits (or smaller reductions) may be waning. In addition to more and more states testing the 'reform waters' with regard to collective bargaining rights, the U.S. Supreme Court's recent Janus v. American Federation of State, County, and Municipal Employees is widely expected to weaken unions further as employees who are not members are no longer compelled to pay agency

[15] It turns out that the estimated coefficients for 2005 in the 2-year and 3-year rolling samples in Figure 5 are being pulled down entirely by California's per capita teacher contributions of $1.72 that occurred in 2005. If we omit California's 2005 observation, the estimated coefficients in the 2-year and 3-year rolling samples become 18.2 and 33.2, respectively.

[16] U.S. Department of Labor, Bureau of Labor Statistics, National Compensation Survey: Employee Benefits in the United States, March 2017.

fees. Of course, there are too many factors at play to know how these dynamics will unfold over the next several years and what this may do to the ability of public sector unions to extract additional retirement benefits.

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Table 1: Pension Generosity Example

| Period | Expected Future Benefits | Present Value | Present Value * Period |
|---|---|---|---|
| t+1 | 80 | 74.1 | 74.1 |
| t+2 | 100 | 85.7 | 171.5 |
| t+3 | 40 | 31.8 | 95.3 |
| | Sum | 191.6 | 340.8 |

Figure 1: Projected Pension Plan Liabilities

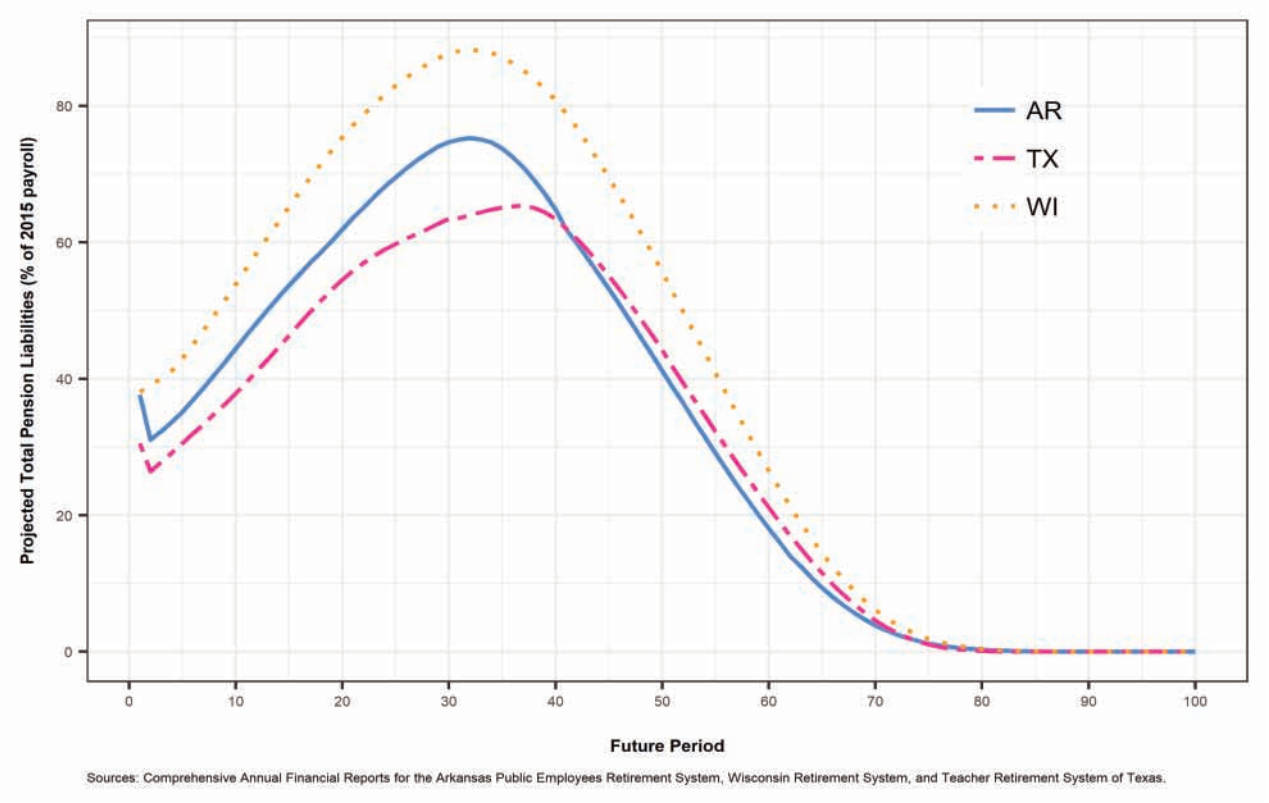


Figure 2: Estimated Mean Per Member Pension Generosity

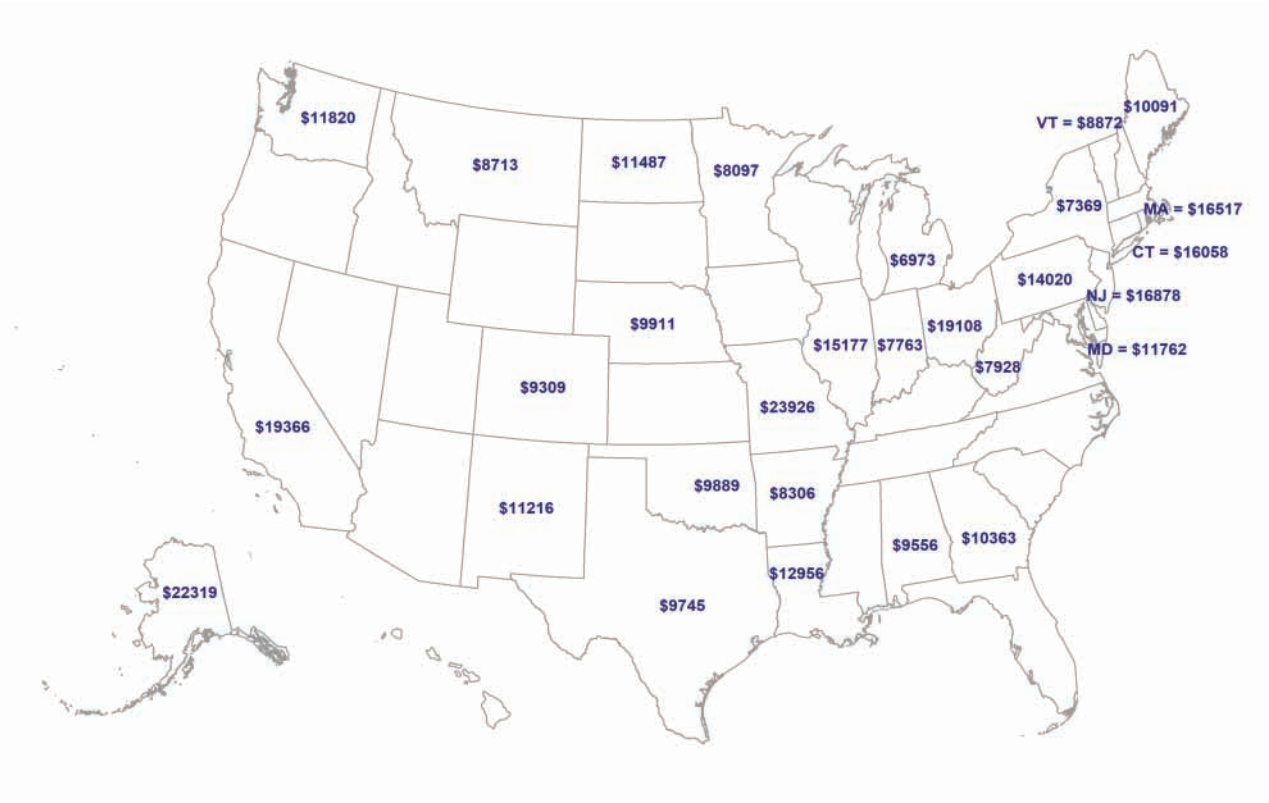


Figure 3: Mean Teacher Contributions Versus Mean Pension Generosity

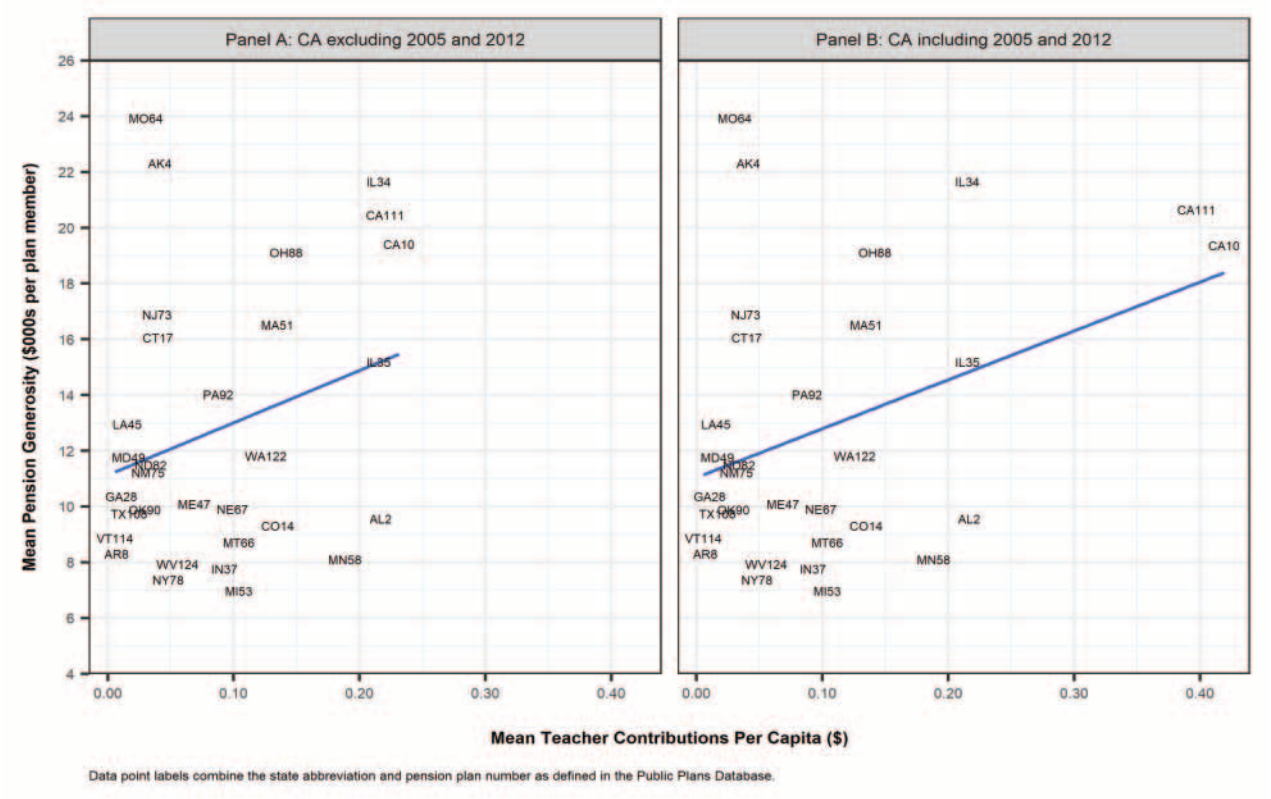


Table 2: Summary Statistics

| Variable | Mean | StdDev | Description |
|---|---|---|---|
| generosity per member | 12.861 | 5.446 | present value of expected future pension benefits earned in the current period per active member (in thousands) |
| teacher contributions per capita | 0.102 | 0.205 | total campaign contributions from teachers unions to statewide candidates or groups scaled by population |
| public union share public employment | 37.751 | 17.310 | fraction of state public sector employees who are unionized |
| average education salary | 43.807 | 9.522 | total state and local education payroll divided by the number of FTE employees |
| right to work law | 0.286 | 0.453 | =1 if the state has a right to work law in place in year t |
| major teacher strikes | 0.063 | 0.300 | number of teacher strikes affecting 1,000 or more employees |
| plan funding level | 0.750 | 0.212 | acturial funded ratio of pension plan |
| nonteacher contributions | 2.252 | 2.734 | total per capita campaign contributions to statewide candidates or groups by all non-teacher public-sector unions |
| covered by social security | 0.624 | 0.485 | =1 if pension plan members are covered by Social Security |
| tax revenue | 42.097 | 9.889 | fraction of a state's total revenue from taxes (share*100) |
| federal aid | 1667.392 | 587.298 | per capita federal aid |
| per capita personal income | 39.444 | 8.265 | per capita state personal income (in thousands) |
| school board reforms | 2.870 | 7.759 | fraction of a state's common-broder neighbors passing reform legislation in year t to school board governance |
| school mandates | 1.080 | 4.833 | fraction of a state's common-broder neighbors considering reform legislation in year t related to mandates, including funding or instructional mandates |

The full sample includes 447 observations from 31 distinct state-governed teacher-only pension plans from 29 states over the period from 2001 to 2015. Pension plan normal cost measures, expected rate of return, plan funding levels, and whether the members are eligible for Social Security are from from Boston University's Public Plan Data. Teacher and nonteacher campaign contributions are from the National Institute on Money in Politics. State total revenue, tax revenue, and federal aid are from the Census. State per capita personal income and population are from the BEA. Major state teacher strikes is from the BLS. The share of public sector employees who are unionized is from www.unionstats.com. The average education salary measure is from the Annual Survey of Public Employment, while the timing of right-to-work adoptions is from the National Conference of State Legislatures. Both instruments were constructed using the state policy tracking database provided by the Education Commission of the States.

Table 3: Baseline Estimates of Pension Generosity

| | generosity per member | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| (Intercept) | 7.251 | 6.083 | 6.186 |
| | (5.689) | (5.856) | (5.697) |
| public union share public employment | -0.109 | -0.151** | -0.147* |
| | (0.072) | (0.071) | (0.077) |
| average education salary | 0.297** | 0.193 | 0.199 |
| | (0.124) | (0.132) | (0.131) |
| right to work law | -1.473 | -1.854 | -1.722 |
| | (2.335) | (2.495) | (2.644) |
| major teacher strikes | 0.562 | 0.285 | 0.391 |
| | (0.810) | (0.869) | (1.003) |
| nonteacher contributions | 0.066 | 0.035 | 0.046 |
| | (0.206) | (0.193) | (0.199) |
| plan funding level | -1.347 | -1.748 | -1.683 |
| | (3.193) | (3.248) | (3.123) |
| covered by social security | -4.869*** | -3.955** | -4.023*** |
| | (1.606) | (1.612) | (1.518) |
| tax revenue | -0.096 | -0.122* | -0.123* |
| | (0.063) | (0.068) | (0.066) |
| federal aid | 0.001 | 0.002 | 0.002 |
| | (0.001) | (0.002) | (0.002) |
| per capita personal income | 0.107 | 0.272* | 0.260* |
| | (0.157) | (0.144) | (0.148) |
| teacher contributions per capita (between) | 13.425* | 29.662*** | 29.289*** |
| | (7.920) | (9.283) | (9.485) |
| teacher contributions per capita (within) | -0.080 | -0.068 | -0.094 |
| | (0.386) | (0.374) | (0.392) |
| Estimation | OLS | IV | RE FGLSIV |
| N | 447 | 447 | 447 |
| $R^2$ | 0.534 | 0.480 | 0.483 |
| Sample | 2001-2015 | 2001-2015 | 2001-2015 |
| First-stage F | | 202.156 | 201.673 |
| Sargan | | 0.981 | 1.130 |

All models include year fixed effects that are not reported. *** denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Standard errors are clustered at the pension plan level.

Figure 4: Estimated Per Member Pension Generosity Differential
Resulting from Above or Below Average Union Contributions

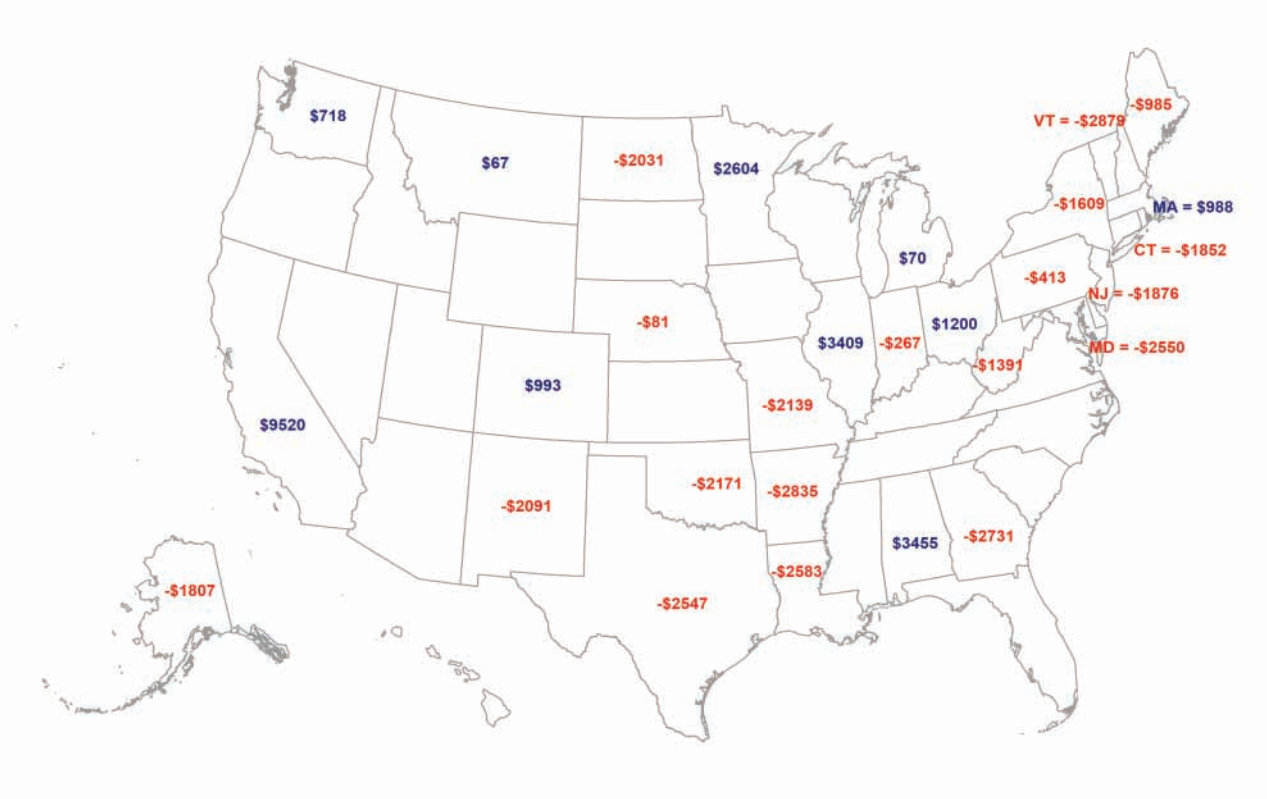
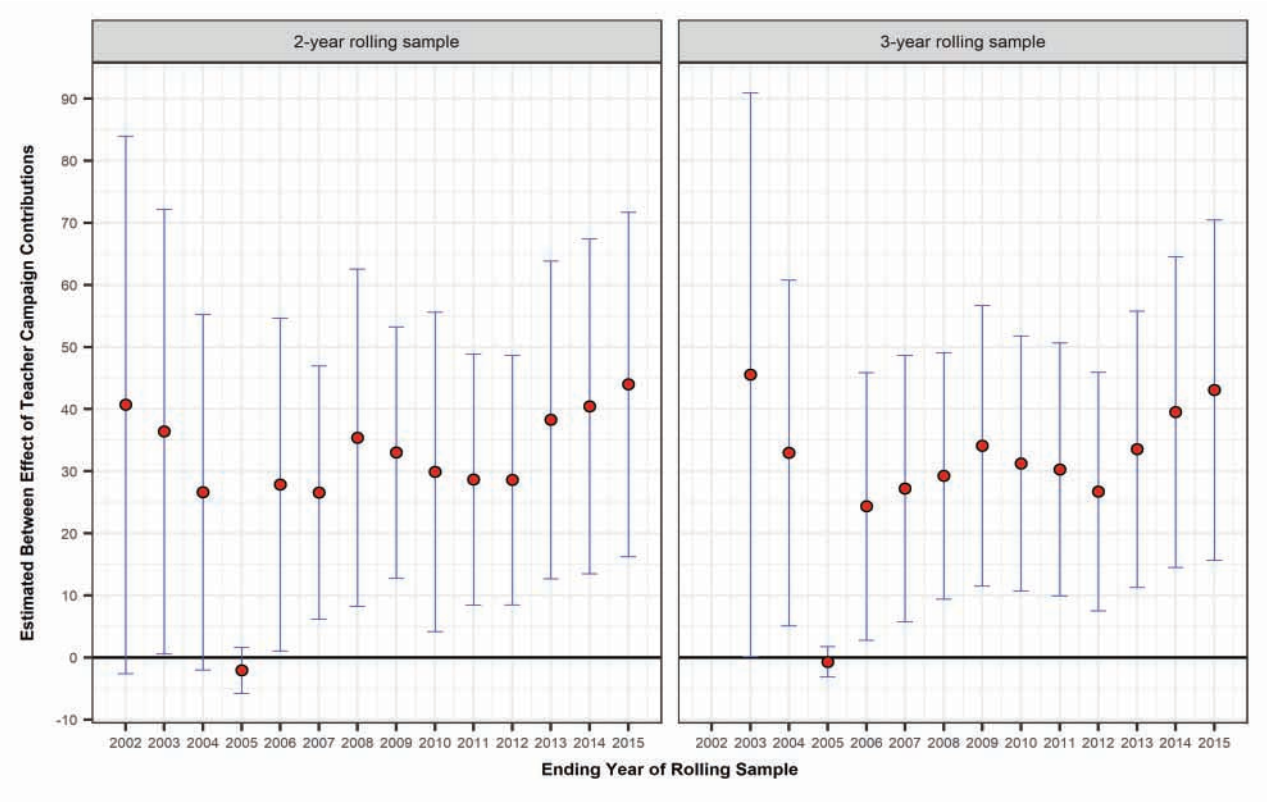


Table 4: Estimates of Pension Generosity: Restricted Samples

| | generosity per member | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| (Intercept) | 19.977* | 20.021* | -6.861 | -6.862 | 7.661 | 7.606 | -8.517 | -8.475 |
| | (11.468) | (11.115) | ( 7.569) | ( 7.385) | ( 6.195) | ( 6.007) | (10.910) | (10.399) |
| public union share public employment | -0.120 | -0.122 | -0.197*** | -0.197*** | -0.144* | -0.144* | -0.201*** | -0.201*** |
| | ( 0.094) | ( 0.090) | ( 0.065) | ( 0.065) | ( 0.078) | ( 0.076) | ( 0.068) | ( 0.065) |
| average education salary | -0.249 | -0.248 | 0.224 | 0.224* | 0.158 | 0.157 | 0.209 | 0.207 |
| | ( 0.355) | ( 0.346) | ( 0.137) | ( 0.135) | ( 0.164) | ( 0.163) | ( 0.187) | ( 0.179) |
| right to work law | -3.326 | -3.368 | -2.042 | -2.042 | -1.878 | -1.892 | -2.636 | -2.664 |
| | ( 2.868) | ( 2.745) | ( 2.729) | ( 2.664) | ( 2.511) | ( 2.501) | ( 2.716) | ( 2.606) |
| major teacher strikes | -1.921 | -1.899 | 0.688 | 0.686 | -0.330 | -0.341 | 1.292** | 1.304** |
| | ( 1.865) | ( 1.809) | ( 0.812) | ( 0.806) | ( 1.561) | ( 1.543) | ( 0.636) | ( 0.608) |
| nonteacher contributions | 0.315 | 0.316 | -0.221 | -0.221 | 0.108 | 0.108 | -0.219 | -0.219 |
| | ( 0.209) | ( 0.202) | ( 0.237) | ( 0.231) | ( 0.193) | ( 0.190) | ( 0.422) | ( 0.403) |
| plan funding level | -4.031 | -3.957* | 3.751 | 3.749 | -2.153 | -2.199 | 3.094 | 3.081 |
| | ( 2.444) | ( 2.303) | ( 4.785) | ( 4.656) | ( 3.143) | ( 2.970) | ( 5.355) | ( 5.087) |
| covered by social security | -3.311 | -3.329 | -3.073 | -3.073 | -4.032** | -4.010** | -3.235* | -3.228* |
| | ( 2.303) | ( 2.233) | ( 1.994) | ( 1.949) | ( 1.711) | ( 1.633) | ( 1.845) | ( 1.752) |
| tax revenue | -0.320* | -0.320* | -0.058 | -0.058 | -0.120* | -0.119* | -0.144 | -0.144 |
| | ( 0.189) | ( 0.183) | ( 0.046) | ( 0.045) | ( 0.071) | ( 0.070) | ( 0.168) | ( 0.160) |
| federal aid | -0.001 | -0.001 | 0.003* | 0.003* | 0.002 | 0.002 | 0.003 | 0.003 |
| | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.003) | ( 0.002) |
| per capita personal income | 0.728* | 0.725* | 0.277* | 0.277* | 0.253 | 0.255 | 0.406** | 0.407** |
| | ( 0.408) | ( 0.396) | ( 0.154) | ( 0.151) | ( 0.189) | ( 0.187) | ( 0.195) | ( 0.185) |
| teacher contributions per capita (between) | 43.887** | 44.037*** | 32.091*** | 32.089*** | 36.446*** | 36.369*** | 26.477*** | 26.556*** |
| | (17.341) | (16.737) | (11.329) | (11.065) | (12.843) | (12.477) | ( 9.125) | ( 8.641) |
| teacher contributions per capita (within) | 0.246 | 0.244 | 0.033 | 0.033 | -0.291 | -0.271 | 0.503 | 0.499 |
| | ( 0.651) | ( 0.632) | ( 0.554) | ( 0.542) | ( 0.575) | ( 0.592) | ( 0.591) | ( 0.563) |
| Estimation | IV | RE FGLSIV | IV | RE FGLSIV | IV | RE FGLSIV | IV | RE FGLSIV |
| N | 203 | 203 | 244 | 244 | 325 | 325 | 122 | 122 |
| First-stage F | 19.437 | 19.331 | 81.235 | 80.871 | 84.087 | 83.807 | 23.924 | 23.696 |
| Sargan | 1.418 | 1.422 | 0.006 | 0.006 | 0.383 | 0.398 | 0.821 | 0.822 |
| $R^2$ | 0.212 | 0.209 | 0.503 | 0.503 | 0.390 | 0.391 | 0.513 | 0.513 |
| Sample | 2001-2007 | 2001-2007 | 2008-2015 | 2008-2015 | 2001-2009:2014-2015 | 2001-2009:2014-2015 | 2010-2013 | 2010-2013 |

All models include year fixed effects that are not reported. *** denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Standard errors are clustered at the pension plan level.

Figure 5: Estimated Effect of Teacher Contributions Using Rolling Samples



# Appendix Table 1: Generosity Estimates Using Alternative Projected Pension Liabilities

| | generosity per member AR | | | | | generosity per member TX | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| (Intercept) | 6.064 | 19.855* | -6.775 | 7.631 | -8.412 | 6.106 | 20.142* | -6.983 | 7.700 | -8.670 |
| | (5.813) | (11.378) | ( 7.512) | ( 6.151) | (10.828) | (5.916) | (11.593) | ( 7.647) | ( 6.257) | (11.024) |
| public union share public employment | -0.150** | -0.119 | -0.195*** | -0.143* | -0.199*** | -0.153** | -0.122 | -0.199*** | -0.146* | -0.203*** |
| | (0.070) | ( 0.094) | ( 0.065) | ( 0.078) | ( 0.068) | (0.071) | ( 0.095) | ( 0.066) | ( 0.079) | ( 0.069) |
| average education salary | 0.191 | -0.247 | 0.221 | 0.156 | 0.206 | 0.197 | -0.251 | 0.227 | 0.161 | 0.212 |
| | (0.130) | ( 0.352) | ( 0.136) | ( 0.163) | ( 0.186) | (0.133) | ( 0.359) | ( 0.139) | ( 0.166) | ( 0.190) |
| right to work law | -1.843 | -3.298 | -2.032 | -1.866 | -2.621 | -1.871 | -3.366 | -2.058 | -1.897 | -2.659 |
| | (2.476) | ( 2.846) | ( 2.709) | ( 2.492) | ( 2.696) | (2.520) | ( 2.899) | ( 2.756) | ( 2.537) | ( 2.745) |
| major teacher strikes | 0.280 | -1.908 | 0.681 | -0.330 | 1.280** | 0.290 | -1.939 | 0.698 | -0.333 | 1.309** |
| | (0.863) | ( 1.851) | ( 0.806) | ( 1.551) | ( 0.631) | (0.877) | ( 1.884) | ( 0.820) | ( 1.576) | ( 0.643) |
| nonteacher contributions | 0.035 | 0.313 | -0.218 | 0.108 | -0.216 | 0.034 | 0.317 | -0.224 | 0.108 | -0.223 |
| | (0.191) | ( 0.208) | ( 0.235) | ( 0.191) | ( 0.419) | (0.195) | ( 0.211) | ( 0.240) | ( 0.195) | ( 0.427) |
| plan funding level | -1.739 | -4.004 | 3.718 | -2.142 | 3.066 | -1.757 | -4.065 | 3.800 | -2.166 | 3.138 |
| | (3.224) | ( 2.426) | ( 4.752) | ( 3.119) | ( 5.316) | (3.282) | ( 2.469) | ( 4.831) | ( 3.177) | ( 5.408) |
| covered by social security | -3.929** | -3.291 | -3.055 | -4.006** | -3.214* | -3.990** | -3.337 | -3.097 | -4.068** | -3.263* |
| | (1.601) | ( 2.285) | ( 1.979) | ( 1.699) | ( 1.831) | (1.628) | ( 2.327) | ( 2.015) | ( 1.728) | ( 1.864) |
| tax revenue | -0.121* | -0.318* | -0.057 | -0.119* | -0.143 | -0.123* | -0.323* | -0.058 | -0.121* | -0.145 |
| | (0.068) | ( 0.187) | ( 0.046) | ( 0.070) | ( 0.167) | (0.069) | ( 0.191) | ( 0.047) | ( 0.072) | ( 0.170) |
| federal aid | 0.002 | -0.001 | 0.003* | 0.002 | 0.003 | 0.002 | -0.001 | 0.003* | 0.002 | 0.003 |
| | (0.002) | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.003) | (0.002) | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.003) |
| per capita personal income | 0.270* | 0.723* | 0.275* | 0.251 | 0.404** | 0.274* | 0.736* | 0.279* | 0.255 | 0.409** |
| | (0.143) | ( 0.405) | ( 0.153) | ( 0.187) | ( 0.193) | (0.145) | ( 0.413) | ( 0.156) | ( 0.191) | ( 0.197) |
| teacher contributions per capita (between) | 29.422*** | 43.513** | 31.834*** | 36.153*** | 26.267*** | 30.003*** | 44.410** | 32.457*** | 36.856*** | 26.783*** |
| | (9.211) | (17.215) | (11.238) | (12.748) | ( 9.049) | (9.381) | (17.513) | (11.455) | (12.973) | ( 9.229) |
| teacher contributions per capita (within) | -0.067 | 0.245 | 0.032 | -0.289 | 0.500 | -0.068 | 0.249 | 0.036 | -0.294 | 0.508 |
| | (0.371) | ( 0.646) | ( 0.549) | ( 0.571) | ( 0.587) | (0.378) | ( 0.657) | ( 0.560) | ( 0.581) | ( 0.597) |
| Estimation | IV | IV | IV | IV | IV | IV | IV | IV | IV | IV |
| N | 447 | 203 | 244 | 325 | 122 | 447 | 203 | 244 | 325 | 122 |
| First-stage F | 202.156 | 19.437 | 81.235 | 84.087 | 23.924 | 202.156 | 19.437 | 81.235 | 84.087 | 23.924 |
| Sargan | 0.985 | 1.407 | 0.006 | 0.383 | 0.826 | 0.974 | 1.428 | 0.007 | 0.386 | 0.816 |
| $R^2$ | 0.480 | 0.212 | 0.503 | 0.390 | 0.513 | 0.480 | 0.212 | 0.503 | 0.391 | 0.514 |
| Sample | 2001-2015 | 2001-2007 | 2008-2015 | 2001-2009:2014-2015 | 2010-2013 | 2001-2015 | 2001-2007 | 2008-2015 | 2001-2009:2014-2015 | 2010-2013 |

All models include year fixed effects that are not reported. *** denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Standard errors are clustered at the pension plan level.

Appendix Table 2: Generosity Estimates Excluding CA Observations in 2005 and 2012

| | generosity per member | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| (Intercept) | 5.668 | 17.877 | -6.496 | 7.088 | -8.513 |
| | (5.861) | (10.938) | ( 7.549) | ( 6.225) | (11.151) |
| public union share public employment | -0.157** | -0.151 | -0.195*** | -0.154* | -0.202*** |
| | (0.070) | ( 0.097) | ( 0.065) | ( 0.080) | ( 0.069) |
| average education salary | 0.201 | -0.172 | 0.226* | 0.164 | 0.214 |
| | (0.133) | ( 0.327) | ( 0.136) | ( 0.170) | ( 0.185) |
| right to work law | -1.871 | -3.594 | -2.000 | -1.916 | -2.582 |
| | (2.508) | ( 2.963) | ( 2.713) | ( 2.548) | ( 2.750) |
| major teacher strikes | 0.182 | -2.805 | 0.727 | -0.578 | 1.255* |
| | (0.858) | ( 2.164) | ( 0.786) | ( 1.669) | ( 0.665) |
| nonteacher contributions | 0.033 | 0.342 | -0.213 | 0.099 | -0.209 |
| | (0.194) | ( 0.217) | ( 0.235) | ( 0.197) | ( 0.433) |
| plan funding level | -1.582 | -3.566 | 3.613 | -1.932 | 3.053 |
| | (3.245) | ( 2.579) | ( 4.687) | ( 3.196) | ( 5.285) |
| covered by social security | -4.028** | -3.750* | -3.184 | -4.030** | -3.414* |
| | (1.626) | ( 2.229) | ( 2.008) | ( 1.739) | ( 1.838) |
| tax revenue | -0.120* | -0.303 | -0.057 | -0.120* | -0.140 |
| | (0.069) | ( 0.185) | ( 0.045) | ( 0.072) | ( 0.175) |
| federal aid | 0.002 | 0.000 | 0.003* | 0.002 | 0.003 |
| | (0.002) | ( 0.002) | ( 0.002) | ( 0.002) | ( 0.003) |
| per capita personal income | 0.275* | 0.705* | 0.270* | 0.263 | 0.400** |
| | (0.148) | ( 0.397) | ( 0.154) | ( 0.197) | ( 0.194) |
| teacher contributions per capita (between) | 31.537*** | 55.357*** | 31.401*** | 40.256*** | 26.725*** |
| | (9.433) | (21.012) | (11.583) | (13.752) | (10.160) |
| teacher contributions per capita (within) | 2.198 | 18.092* | -0.600 | 4.339 | 0.404 |
| | (1.225) | (10.711) | ( 1.160) | ( 2.238) | ( 2.861) |
| Estimation | IV | IV | IV | IV | IV |
| N | 443 | 201 | 242 | 323 | 120 |
| First-stage F | 170.890 | 15.029 | 73.159 | 71.089 | 19.340 |
| Sargan | 0.499 | 0.639 | 0.008 | 0.483 | 0.640 |
| $R^2$ | 0.468 | 0.097 | 0.497 | 0.365 | 0.492 |
| Sample | 2001-2015 | 2001-2007 | 2008-2015 | 2001-2009:2014-2015 | 2010-2013 |

All models include year fixed effects that are not reported. *** denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Standard errors are clustered at the pension plan level.

Appendix Table 3: First-Stage Regression (including subsamples)

| | teacher contributions per capita avg | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| (Intercept) | 0.027 | -0.285 | 0.288*** | -0.045 | 0.329** |
| | (0.090) | (0.217) | (0.090) | (0.107) | (0.162) |
| public union share public employment | 0.003*** | 0.002 | 0.004*** | 0.002** | 0.004*** |
| | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| average education salary | 0.000 | 0.003 | 0.002 | 0.000 | 0.004 |
| | (0.002) | (0.006) | (0.003) | (0.003) | (0.003) |
| right to work law | -0.009 | 0.041 | -0.011 | 0.005 | 0.000 |
| | (0.025) | (0.036) | (0.019) | (0.028) | (0.030) |
| major teacher strikes | -0.006 | 0.042* | -0.019* | 0.021 | -0.017 |
| | (0.012) | (0.024) | (0.011) | (0.021) | (0.011) |
| nonteacher contributions | 0.002 | -0.010** | 0.005 | -0.002 | 0.001 |
| | (0.004) | (0.005) | (0.005) | (0.004) | (0.009) |
| plan funding level | -0.007 | 0.086 | -0.120* | 0.025 | -0.135 |
| | (0.058) | (0.059) | (0.065) | (0.041) | (0.114) |
| covered by social security | -0.046* | -0.028 | -0.058** | -0.031 | -0.032 |
| | (0.026) | (0.043) | (0.025) | (0.028) | (0.044) |
| tax revenue | 0.001 | 0.004 | 0.001 | 0.002* | -0.001 |
| | (0.001) | (0.003) | (0.001) | (0.001) | (0.003) |
| federal aid | 0.000*** | 0.000 | 0.000*** | 0.000*** | 0.000* |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| per capita personal income | -0.002 | -0.004 | -0.005* | 0.000 | -0.006* |
| | (0.003) | (0.006) | (0.003) | (0.004) | (0.003) |
| teacher contributions per capita (within) | -0.003 | 0.007 | -0.007 | 0.001 | -0.001 |
| | (0.005) | (0.006) | (0.006) | (0.005) | (0.008) |
| school gifted programs (between) | 0.013*** | 0.011** | 0.006*** | 0.014*** | 0.003 |
| | (0.004) | (0.005) | (0.002) | (0.004) | (0.004) |
| school mandates (between) | -0.020** | -0.028** | -0.016*** | -0.016 | -0.016*** |
| | (0.009) | (0.012) | (0.005) | (0.018) | (0.004) |
| Estimation | OLS | OLS | OLS | OLS | OLS |
| N | 447 | 203 | 244 | 325 | 122 |
| $R^2$ | 0.710 | 0.476 | 0.724 | 0.601 | 0.639 |
| Sample | 2001-2015 | 2001-2007 | 2008-2015 | 2001-2009:2014-2015 | 2010-2013 |

All models include year fixed effects that are not reported. *** denotes significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level. Standard errors are clustered at the pension plan level.