Do State and Local Governments Offer Competitive Compensation?

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Abstract

We examine the relative compensation of state and local government workers compared to their private sector counterparts. Augmenting standard data sources on employee compensation with information on worker benefit provision derived from unpublished Bureau of Labor Statistics data and asset-based methodologies for valuing non-wage benefits, we document a significant erosion in the public sector compensation premium over the past fifteen years. While state and local workers received approximately 8 percent higher total compensation than comparable private sector workers in 2011, our evidence indicates that this differential had declined to negative 7 percent by 2023. This decline stems from multiple factors: public sector wages have fallen steeply relative to private sector wages since the Great Recession, public sector pension and retiree health care benefits have roughly moved sideways in nominal terms, and the historically greater job stability in government employment has eroded. We also document that relative public sector compensation has declined much more for workers with at least a college degree, who now suffer a 16% penalty for working in the state and local sector. These findings have significant implications for public sector recruitment, retention capabilities, and ultimately, for the administrative capacity of state and local governments to effectively implement policies and deliver essential services.

We also document two areas of mismeasurement in official data. First, the use of cash accounting for defined benefit pensions, as opposed to accrual accounting, significantly skews upward the trend in relative public sector compensation in the Employment Cost Index—a principal source of information on compensation trends in the U.S.—over the past 15 years. Second, the accrual-based measures of employee defined-benefit pensions in the NIPAs understate the value of state and local government pensions from 2015 to 2021 when real interest rates were quite low.

I. Introduction

State capacity—the government's ability to effectively implement policies and achieve its objectives—has become a focal point in recent policy discussions, especially in light of challenges that arose in the aftermath of the COVID-19 crisis as well as those surrounding the implementation of the Inflation Reduction Act (IRA). Enacted in 2022, the IRA aimed to allocate substantial funds toward clean energy and climate initiatives. However, its rollout encountered significant delays due to administrative hurdles and regulatory uncertainties, underscoring the critical role of state capacity in translating legislative intent into tangible outcomes. At the subnational level, the water crisis in Flint Michigan is at least partially explained by a lack of adequate technical expertise and oversight capacity at the state level (Flint Water Advisory Task Force 2016); a lack of sufficient capacity at state government departments of transportation helps explain the much higher cost of public infrastructure in the U.S. relative to peer economies (Liscow, Nober, and Slattery 2023); and, more mundane perhaps, but not inconsequential, the Hawaii Department of Taxation struggled to modernize tax administration due to staff lacking the proper skills (Wood 2016). Competitive state and local government worker compensation is thus essential in the context of subnational state capacity in the U.S. as it directly influences the recruitment and retention of skilled personnel necessary for effective governance and policy execution. On the other hand, state and local employees may be overpaid relative to their private sector counterparts (e.g. Biggs 2012). If so, public-sector efficiency gains could be achieved by bringing public sector pay into better alignment with private sector compensation.

Comparisons between state and local government workers and private sector workers are complicated by the very different profile of employees across the sectors; e.g. public sector workers have higher average educational attainment. Moreover, public employees receive a higher share of their compensation in the form of benefits than do their private sector counterparts. Measuring the value of public sector benefits such as defined benefit pensions and retiree health care is methodologically complex and the standard data sources on worker compensation in the U.S., such as the Current Population Survey (CPS) and Employment Compensation Index (ECI), either fail to measure these benefits at all or suffer from notable measurement deficiencies.

In this paper, we measure the total compensation of state and local government (or "public") workers relative to the private sector. In doing so, we make a number of contributions. First, following a surge of work on the topic of relative state and local government pay around 2010, there has been only limited research on this topic in recent years. We bring the research up to date, accounting for the evolution in the public and private labor markets over roughly the last 15 years. Second, we make methodological contributions surrounding the proper measurement of benefit compensation. In particular, we utilize accrual-based measurement to value the defined benefit (DB) pension and retiree health care benefits earned in a given year. In doing so, we document that the Bureau of Economic Analysis's (BEA's) accrual measure of DB pensions understates the value of this benefit at times when real interest rates are low. We therefore develop an alternative accrual-based measure of DB pensions We also quantify the value of retiree health benefits and the value of job stability – i.e. the propensity to be laid off. We then combine these benefit valuation measures with CPS, Employee Costs for Employee Compensation (ECEC), and ECI data, including unpublished tabulations of the ECI provided to

us by the Bureau of Labor Statistics (BLS), to construct a measure of the total public sector wage premia, and also its trend over time. Third, we break down the public sector premia measures by education.

Our preliminary evidence speaks most clearly to the *trend* over time in the public sector relative compensation differential. We find that since the Great Recession, wages of public sector employees have fallen substantially relative to the private sector. Moreover, the value of retiree health care in the public sector and of defined benefit pensions have very roughly moved sideways in nominal terms and relative job stability in the public sector has eroded relative to the private sector. Thus, the total relative compensation of state and local government workers relative to private employees has unambiguously eroded, falling 15 percentage points since 2011.

This conclusion stands in stark contrast to that provided by the Employment Cost Index which suggests that relative compensation has been roughly flat over the past 15 years. We document the difference in the ECI relative to our conclusion stems from two sources. First, the ECI accounts for DB pension benefits on a cash basis. Our switch to accrual accounting for DB pensions, in isolation from any other adjustments, induces a downward trend in total relative public sector compensation. The difference in accounting approaches is material because state and local governments have been sharply ramping up their contributions to pension plans in recent years in order to address the past underfunding of these benefits. In doing so, they push up benefit compensation measured on a cash basis. At the same time, these governments have been paring back on the actual level of pension benefits provided to employees, pushing down on benefits properly measured on an accrual basis. Thus, the two accounting approaches yield very different trends in state and local government benefits. The second factor driving a wedge between our conclusion and the ECI is the ECI's failure to account for retiree health care and job stability. Although the above measurement deficiencies in the ECI have been recognized in past work—e.g. Biggs and Richwine (2014) and Munnell, Aubry, Hurwitz, and Quinby (2011)—we contribute by documenting the extremely large effect of these issues since the Great Recession and also by proposing solutions using publicly available data.

Our evidence on the level of the public sector compensation differential—as opposed to its trend—is less clear cut as it is highly dependent on a number of methodological assumptions. That said, our evidence suggests that public sector workers were paid about 8 percent more than their private sector counterparts as of 2010. Since then, though, this public pay premium has gradually fallen and turned negative; as of 2023, state and local workers appear to be currently paid about [7] percent less than their private sector peers when all job benefits and are accounted for.

We find evidence that the trend decline in relative public sector compensation is essentially all driven by college-educated employees. This decline in college-educated relative public sector pay is confined to those lacking union representation. As of 2023, we estimate that college educated workers were paid roughly 16 percent less than their private sector peers. The decline in relative pay of the highly educated likely has particularly important implications for the capacity of state and local governments.

The paper proceeds are follows. Section II provides background information, including information on public and private sector workers and compensation packages in the two sectors, as well as reviewing past work on public-private pay differentials. Section III discusses the data we utilize, including the important limitations of the primary U.S. data sources on employee compensation. Section IV presents our methodology and results. Section V discusses the implications of our findings. Section VI concludes.

II. Background

II.A Employee Characteristics and Compensation in the State and Local Government and Private Sectors

Employee characteristics differ starkly across the state and local and private sector, as displayed in Table 1. The starkest differences are in educational attainment and occupation: state and local workers are 22 percentage points more likely than private employees to have a four-year college degree or more (rows 9) and 22 percentage points more likely to be in a professional or managerial occupation (row 10). Public workers are also more likely to be married and female than private workers (rows 2 and 3). These differences in characteristics must be accounted for when assessing relative compensation across the sectors.

Table 1
Summary Statistics

row		Private	State and Local Government
	A. Employee Demographics		
1	Age	40.6	44.1
2	Married	0.51	0.60
3	Female	0.47	0.61
4	White	0.60	0.65
5	Black	0.11	0.13
6	Hispanic	0.20	0.15
7	High School	0.26	0.14
8	Some College	0.26	0.22
9	4-year College or More	0.40	0.62
10	Managers and Professionals	0.37	0.59
11	Precision Production, Craft and Repair	0.09	0.03
12	Operators, Fabricators and Laborers	0.13	0.04
	B. Share of Total Employee Compensation		
13	Wages	0.84	0.68
14	Benefits	0.16	0.32
15	Defined Benefit Pension (accrual basis)	0.01	0.12
16	Retiree Health Care (accrual basis)	N.A.	0.03
17	Other Benefits	0.15	0.17

Source. Panel A: 2024 Current Population Survey; Panel B: 2019 National Income and Product Accounts and author's calculations for retiree health care.
Note. Panel A displays means.

Employees in the two sectors also receive their compensation in different forms. Public workers receive around one-third of their total compensation in the form of benefits, whereas private sector workers receive only around one-sixth (row 14). This difference is mostly explained by defined benefit pension plans which account for over 10 percent of public sector compensation, but account for only a very small share of compensation in the private sector (row 15); retiree health care, which is broadly provided in the public sector but is uncommon in the private sector, also plays a role (row 16). Other benefits—e.g. health insurance—account for a similar share of compensation across the sectors (row 17).

II.B Past Research

There was a flurry of research on wage differentials between the private and S&L sector around 2010-2012, driven by the difficult budget conditions confronting these governments in the wake of the financial crisis and Great Recession. These papers generally concur that state and local workers receive lower wages, but higher benefits, than their private sector counterparts. They reach widely divergent conclusions, however, over whether the non-wage compensation is sufficient to result in a positive public sector total compensation premium. The different conclusions generally reflect differences in the methodology used to measure benefits.

Gittleman and Pierce (2012) conducted an unusually comprehensive analysis using the ECI, CPS, and confidential microdata from the BLS's National Compensation Survey (NCS) data. They found that state and local government workers received higher total compensation than similar private sector workers, with the differential driven primarily by more generous benefits. That said, there are difficulties inherent to using the NCS to measure benefits; in particular, pension benefits suffer from a number of methodological concerns (Biggs and Richwine 2012), retiree health care is generally not captured at all, nor is the value of the greater relative job stability in the public sector. The authors acknowledge these shortcomings and conclude that they are unlikely to overturn their conclusion that state and local workers receive a pay premium. Biggs and Richwine (2014) also find positive public-sector compensation premiums across states, ranging from 10% to over 40%. They emphasize the importance of including the value of job security in relative compensation calculations.

In contrast, Munnell et al. (2011), accounting for the value of pensions, retiree health care, and job stability, find that state and local workers earn approximately the same as they would in the private sector. Their work emphasizes education as the critical factor - workers with bachelor's degrees or higher face wage penalties in government work.

Other notable contributions to this body of work include Allegretto and Keefe (2010), Bender and Heywood (2010), Keefe (2012), Lewis and Galloway (2011), Madland and Bunker (2012), Reilly and Reed (2011), Richwine and Biggs (2012), Sherk (2016), Thompson and Schmitt (2010), and Wenger and Wilkinson (2012). Important earlier work on public sector

compensation premiums include Borjas (2002), Edwards (2010), Freeman (1987), Katz and Krueger (1991), Krueger (1988), and Poterba and Rueben (1994), and Smith (1977).[1]

III. Data

This section discusses the data used in the analysis and addresses two key measurement concerns: the distinction between cash and accrual accounting for DB pensions, and the omission of retiree health care benefits from the major sources on compensation in the U.S.

III.A The ECI and CPS

To focus on the *trend* over time in relative pay, we primarily use the BLS's Employment Cost Index (ECI) – the principal national economic indicator for measuring compensation *changes* over time. Interpreting wage changes over time, especially through business cycles, is challenging due to the influence of changing worker composition on wages and benefits. The ECI's defining feature is its use of a methodology to isolate changes in compensation costs unrelated to changes in workforce composition.[2] The ECI provides indexes for various pieces of total benefit compensation – e.g. health insurance. However, there are no published tabulations for DB pensions. Fortunately, though, the BLS generously made available unpublished tabulations which provide detailed information on defined benefit pensions.[3]

Although the ECI is very well suited to examining changes in compensation, it fails to provide information on the *level* of compensation, nor does it allow for controlling for worker characteristics when comparing wages across the public and private sectors. To address these shortcomings, we turn to the CPS.

The CPS microdata contains a rich set of information on worker characteristics which allows us to control for the very different compositions of the private and public workforces. Another advantage of the CPS is its (limited) longitudinal structure which we exploit to examine

[1] We are aware of two contributions on this topic made over roughly the past 10 years. Biggs (2019) examines 1998 and 2017 using BEA data and concludes that public sector relative compensation rose somewhat over this period. Biggs (2022) focuses on Connecticut, but also presents national results using the Census Bureau's American Community Survey and BEA data and find that in states with the lowest public compensation, private and public compensation are well aligned; in contrast, in the states with the highest public renumeration, state and local government compensation is well above that in the private sector.

[2] The ECI achieves this fixed-composition measure in two steps. First, the ECI uses a fixed-weight approach where compensation changes are measured within detailed cells defined by industry, occupation, and sector (private and state and local government) then aggregated up using fixed employment weights. Second, the ECI methodology uses a matched-sample approach under which the change in compensation from time *t-1* to *t* is calculated only using "matched job quotes". Matched job quotes refer to the average compensation costs per hour within an establishment-occupation (i.e. a "job") which are available for both the time *t* and *t-1*. The use of matched job quotes ensures that measured compensation changes do not reflect composition shifts within the detailed industry-occupation cells. E.g. it prevents the entry of a new establishment into the ECI sample at time *t* from influencing measured compensation growth a time *t*.

[3] The DB pension series should be interpreted with care because they do not meet the BLS's standard publication criteria.

differences across the sectors in job stability. The chief drawback of the CPS, however, is its lack of information on non-wage employee benefits.[4]

In principle, we could obtain information on the *level* of benefit provision from the BLS's Employer Costs for Employee Compensation (ECEC). The ECEC is based on the same underlying survey data as the ECI—both are part of the National Compensation Survey (NCS)—and provides information on the dollar value of wages and benefits, but unlike the ECI, does not control for compositional shifts over time. Unfortunately, though, the publicly available NCS data do not allow for the worker characteristic analysis which can be done with CPS. Moreover, the NCS also suffers from methodological issues which render it challenging to use to measure DB pensions, retiree health care, and the value of job stability—a subject we turn to next.

III.B Alternative Data Sources for Benefit Accounting

Job stability, while a valuable job attribute, is not a "benefit" and is therefore not measured in the NCS. Retiree health care is widely provided as a benefit to state and local workers, but is overwhelming not prefunded (Pew 2023). Instead, payments are made annually to cover the insurance costs. As these payments are made on behalf of retirees, not current employees, they are not captured in the NCS. Thus, the NCS mostly misses the value of retiree health care. (Private firms are much less likely to provide this benefit – only around 15% of private sector receive retiree health care prior to Medicare eligibility, whereas nearly 70% of state and local workers do.)

In terms of DB pensions, the NCS measures the value of this benefit on a cash basis – i.e. by the amount contributed to the pension fund annually. This cash accounting does not reflect the benefits being earned by workers which requires measuring on an accrual basis – i.e. by calculating the present discounted value of the future pension benefits earned that year by workers, typically referred to as the normal cost. States and localities have historically failed to fully prefund pension benefits. Moreover, in recent years they have been cutting the level of DB pension benefits while simultaneously increasing pension funding (Lenney, Lutz, Schule, and Sheiner 2021). For these reasons and others, the value of pension benefits under cash accounting can diverge significantly from the value under the more appropriate accrual approach. Thus, the cash accounting for DB pensions in the NCS is a potentially serious measurement concern.

Given the above limitations, we turn to alternative, non-NCS data sources and approaches to measure the value of DB pensions, retiree health care, and job stability. For DB pension, both states, localities, and private firms are required to annually issue actuarial reports which calculate the pension normal cost for that year. However, these state and local reports are themselves

[4] In terms of specifics, the CPS surveys roughly 150,000 individuals each month. Each household is sampled for two four-month periods, with an eight-month gap in between. On the 4th and 8th months in the survey (the outgoing rotations), the CPS collects data on wages. We use the CPS extracts from the Economic Policy Institute (EPI); the EPI Merged Outgoing Rotation Group surveys harmonize data over time on wages and demographic information of workers. We use EPI's wage variable which imputes hourly wages for salaried workers using their reported usual hours worked, and adjusts for workers with variable hours. The EPI wage variable also accounts for top-coding but we exclude overtime, tips, and commissions. Following Gittleman and Pierce (2012), we exclude workers for whom wages or hours data are imputed by the Census (about 43,000 observations in the 2024 ORG Data).

problematic because state and local governments, per accounting rules, use their expected return on assets as the discount rate for the portion of the pension benefit that is funded and their projected borrowing cost for the portion that is unfunded. Standard principles of financial valuation, in contrast, suggest the discount rate should instead reflect the risk profile of the stream of future pension payments, which depends on the probability that the payments will be honored, among other factors. Given the relatively strong legal protections surrounding these payments, it is appropriate to use a discount rate lower than that implied by the expected return on pension plan assets (Novy-Marx and Rauh 2011; Lucas 2012). All else equal, a lower discount rate implies a higher valuation on annual DB pension benefits which will, in turn, increase the measured compensation of public workers relative to the private sector.

To address these issues, we could potentially turn to the Bureau of Economic Analysis's (BEA) National Income and Product Account (NIPA) data—i.e. the GDP accounts. In order to value the annual compensation attributable to defined benefit pension plans, the BEA adjusts the private and state and local actuarial reports to use a common discount rate. For state and local pensions, they apply a lower, more appropriate discount rate—the AAA corporate rate—than the assumed return on plan assets (Lenze 2013).

Unfortunately, there are two related measurement concerns surrounding the BEA's methodology for adjusting the normal cost—the present discounted value of pension benefits earned by the workforce in a year on an accrual basis—to a common discount rate. First, the BEA's aggregate normal costs show insufficient sensitivity to changes in the assumed discount rate relative to widely-used actuarial rules of thumb, as well as relative to the sensitivity implied by a simple, benchmark pension accounting model we have developed (Appendix C). Consistent with this observation, Biggs (2022) notes that the BEA's state-level pension estimates for fiscal year 2018 are low relative to estimates in pension plan actuarial reports for the small number of state plans that publish normal cost sensitivity analysis. Second, the BEA's methodology, when decomposing the assumed nominal discount rate into a real rate and an inflation rate, explicitly fixes the real rate at 2.5 percent (Lenze 2013); variation in the nominal discount rate over time solely reflects variation in assumed inflation. This assumption was consistent with market-based estimates of real rates at the time the BEA introduced accrual accounting for pension liabilities in 2013, but became much less so over time as real rates declined prior to the Covid pandemic (See Appendix Figure A6b). As the discounted present value of normal costs are significantly more sensitive to variation in the real discount rate than variation in assumed inflation, the fixed real rate assumption renders the BEA's estimates of normal costs excessively insensitive to changes in nominal interest rates; in particular, when market real rates are below the BEA's fixed real rate assumption, normal costs will be understated.

In response to these measurement concerns, we calculate our own DB pension normal cost estimates using a multi-step procedure, including the use of microdata on pension plans, a benchmark pension accounting model, the use of annual, market-based interest rate measures, and a benchmarking to the BEA estimates. This methodology is outlined in section IV.B.1 and presented in significantly greater detail in Appendix Section C. Relative to the BEA estimates,

our adjustments make the annual state and local government pension normal costs more variable with changes in real rates and, on average, make them larger. However, they neither significantly affect our estimate of the overall decline in relative state and local compensation nor the level of relative compensation at the end of our sample period. This reflects that the BEA's real rate assumption matches up with market-based real rates relatively well at the start (2010) and end (2023) of our sample (but do not match up well for much of the period in between). Finally, using the methodology described in section IV.B.1, we use our DB pension estimates to adjust the CPS and ECI-based estimates of relative public sector compensation such that they reflect pension benefits.

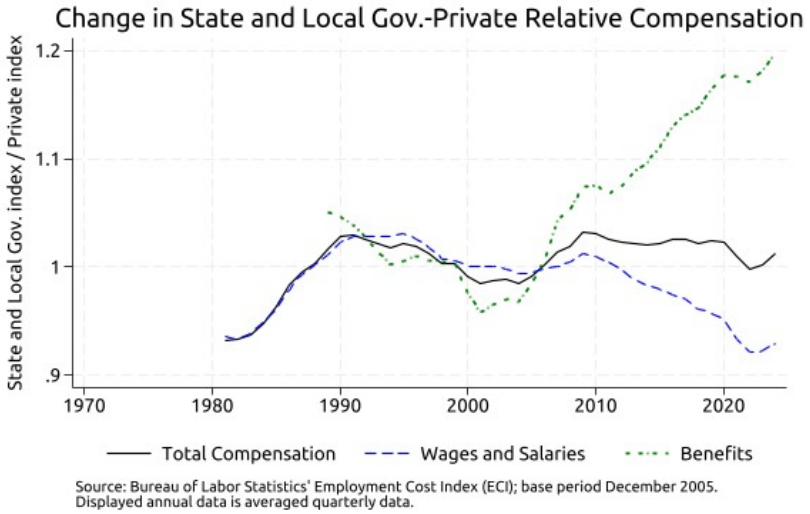
For retiree health care, plans have been required to provide sufficient detail to calculate normal costs only since 2017. We use data on a large number of plans from PEW (2023) to calculate the annual normal cost accrual value in 2018, and calculate changes over time using data from a smaller subset of plans. The methodology is presented in detailed in section IV.B.2. Finally, we estimate the value of job stability using CPS data and the methodology discussed in section IV.B.3.

Finally, an alternative approach to the one employed in this paper would be to simply use the NIPA data, adjusted to reflect retiree health care (which the BEA captures as cash flows to current retirees, rather than as accruals) and job stability, to calculate relative public sector compensation. However, our approach, which is anchored in the use of ECI and CPS data, has the significant advantage of permitting us to address compositional shifts in the public and private workforces over time. Moreover, our approach allows us to investigate how relative composition has changed over time for different subsets of workers, for example by education. It also allows us to attempt to address the shortcomings we have identified in the BEA methodology for defined benefit pensions.

IV. Results

We start the examination of state and local government compensation differentials with the private sector by examining *trends* in relative compensation over time using the ECI. The black line in Figure 1 displays the ratio of the state and local government total compensation index in the ECI to its the private sector counterpart; it is indexed to equal 1 in 2005. The series can be interpreted as capturing the percent change in the public pay premia relative to 2005. During the 1980s the public pay premia rose substantially; thereafter the premia declined gradually through 2005. From 2005 through 2010, the premia reversed as state and local workers gained on their private sector counterparts. These results are consistent with past research such as Poterba and Rueben (1994) and Gittleman and Pierce (2011).

Figure 1



After 2010, relative compensation as measured by the ECI held roughly constant through 2024. That said, the flat relative compensation over this period masks a stark shift in S&L relative compensation toward benefits and away from wages and salaries. In Figure 1, relative wages and benefits are shown by the dash blue line and dash-dot green line, respectively; they moved broadly in tandem until around 2010. Since then, relative wages have tumbled, while relative benefits have soared. Next, we examine relative wages and benefits in more detail.

IV.A Wages

Relative public sector wages, holding industry, occupation, and "job" fixed, have declined by 8 percentage points through 2024 relative to their 2009 peak according to the ECI. While only a portion of total compensation, wages are likely particularly relevant to attracting new workers as they are the most salient component of compensation. Moreover, younger workers may place limited value on retirement benefits such as pensions and health care (e.g. Clark and Morrill 2016). More generally, workers of all ages may not fully value benefits such as pensions because of their complexity (e.g. Gustman and Steinmeier 2005, Fitzpatrick 2015, Ni and Podgursky 2016, Quinby 2020). Thus, the relative decline in state and local government wages may have important implications for these governments' ability to attract and retain workers regardless of the trend in relative non-wage compensation.

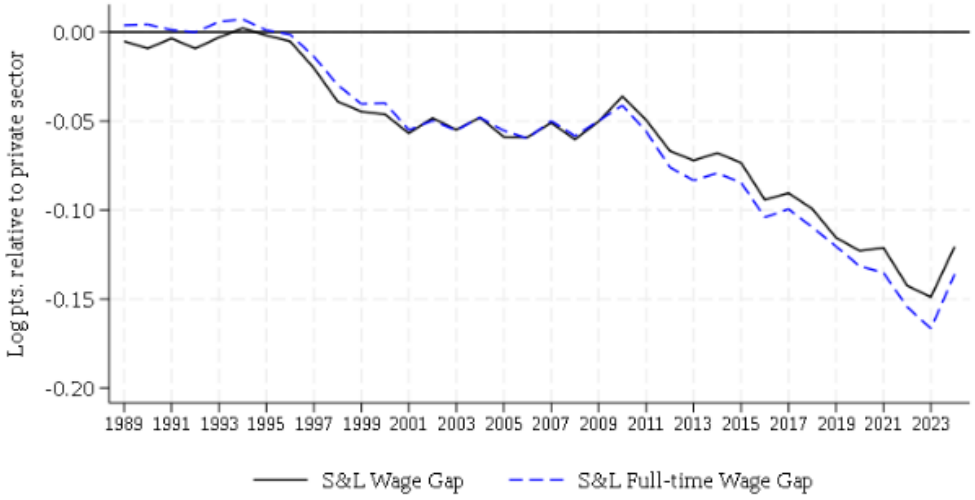
In order to confirm the results on the trend in relative public wages from the ECI, and to shed light on the level of relative wages, we turn to the CPS data. Unconditional average wages in the state and local government sector (not shown) are higher than those in the private sector by about 15% from the 1990s through about 2015, after which S&L pay fell to only about 5% higher than in the private sector. However, workers in the two sectors differ along a number of important determinants of pay such as educational attainment. The unconditional CPS data provides comparisons of these dissimilar workers.

To compare pay of similar workers, we estimate Mincer-style regressions of hourly wages of workers using the CPS from 1989-2024. In particular, following the approach in the past literature—e.g. Katz and Krueger (1991), Poterba and Rueben (1994), and Gittleman and Pierce (2011)—for each year in the sample we regress the log of the wage on an indicator for whether the worker is a state and local government worker and include the following controls: a quartic in age, four education categories, marital status, Census division interacted with metro status, race interacted with gender, and major occupation.[5] We weight the regression with the CPS survey weights to make the results representative of an average worker.

Figure 2 displays the coefficients on the state and local government indicator. The results indicate that the relative pay of state and local workers leveled off at about 5% lower than comparable private sector workers from the late 1990s through about 2010. After the Great Recession, and coinciding with large deterioration in the budget positions of these governments, state and local government relative worker pay fell substantially. Thus, the evidence from the ECI and CPS paint a broadly similar picture of a steady decline in relative S&L wages since the Great Recession. In terms of the level of the public wage differential, by 2024 wages of public sector workers were a substantial 12% lower than their comparable private sector counterparts.

Figure 2

S&L government wages relative to private sector



Gap in wages for S&L workers relative to private. Regressions are weighted and control for quartic in age, four education groups, metro status interacted with Census division, race interacted with gender, marital status, and major occupation. Full-time is defined as usually working 35 or more hours per week.

[5] See Gittleman and Pierce (2011) for a detailed discussion of the role of control variables in assessing public-private compensation differentials. We omit union representation from our set of control variables as, in recent years, union representation has become very substantially more common in the state and local government sector than the private sector. Thus, union representation can be viewed primarily as an attribute of the state and local sector which should not be controlled for when comparing compensation across the sectors. Including unionization status as a control somewhat lowers the state and local relative wages displayed in Figure 2.

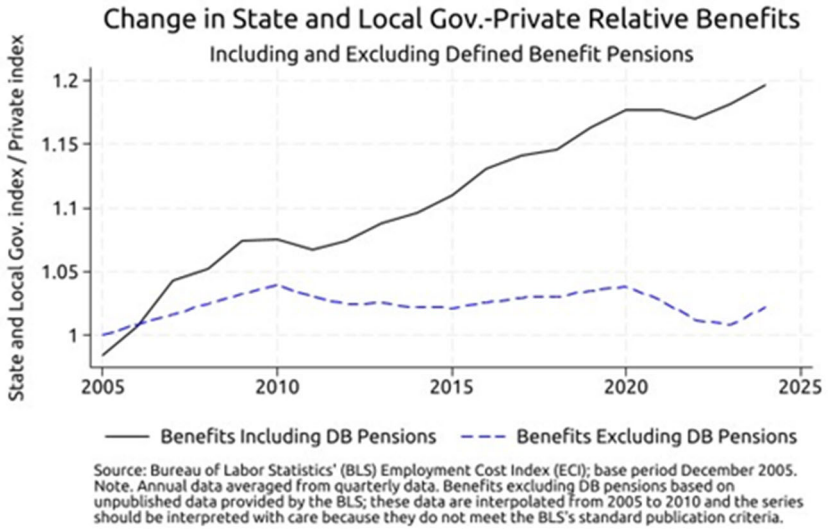
IV.B Benefits

We now turn to examining relative differences in non-wage compensation. We focus on defined benefit pensions, retiree health care, and job stability as they are areas for which there are substantial measurement challenges not addressed by the ECI. That said, in our final accounting of the overall public sector compensation differential, we also account for other benefits such health insurance.

IV.B.1 Defined Benefit Pensions

Unpublished data provided by the BLS, and displayed in Figure 3, reveals that the surge in relative public sector benefits displayed in Figure 1 is solely attributable to defined benefit (DB) pension plans. As shown by the blue dashed line, relative benefits are flat once DB pensions are removed from the private and public indexes used to construct relative benefits.[6] The rise in relative pension benefits is surprising because states and localities have been reducing DB pension generosity for current workers—e.g. paring back cost-of-living-adjustment s—and introducing new, less generous benefit tiers for new workers— (Lenney, Lutz, Schule, and Sheiner 2021). However, as discussed above, the ECI measures DB pension benefits on a cash basis which does not necessarily reflect the annual benefits being earned by workers.

Figure 3



As an alternative, accrual-based measure of DB pensions is provided by the BEA in the NIPA. However, as we mentioned above (and discuss in detail below) this measure is problematic because it is excessively insensitive to real interest rate changes. We therefore construct an

[6] Private DB pensions have become a small share of private sector compensation. As a result, private sector DB benefits do not play an important role in the relative S&L benefits trend displayed in Figure 3.

alternative, accrual-based measure of DB pension benefits. Our starting point is the Public Plans Data (PPD); these data provide a panel over our sample period of individual pension plans capturing around 95 percent of state and local government pension liabilities.[7] We then build a simple, benchmark actuarial pension model with which we can adjust key parameters, such as discount rates, and observe the effect on the normal cost. We use these implied relationships from the model to adjust the PPD annual normal costs onto a common basis reflecting market-based measures of inflation and real interest rates; in particular, we use the AAA nominal corporate rate and market-based inflation expectation estimates.[8] Finally, in order to ensure we are capturing all pension obligations, we benchmark our estimates to the BEA's accrual-based DB pension measure using a calibration factor calculated by adjusting the PPD pensions onto the same basis—i.e. same inflation and real rate assumptions—as the BEA data. These adjustments boost state and local pension benefits over roughly 2015-2021, when real rates were very low by historical standards, but do not significantly affect our estimate of the overall decline in relative state and local compensation nor the level of relative compensation at the end of our sample period.

Figure 3a displays pension benefits per full-time equivalent worker on a cash basis (from the NIPA) and on accrual basis (our measure). Benefits on an accrual basis were roughly twice as large as benefits on a cash basis at the start of the sample in 2005. By 2023, though, cash benefits had eclipsed the accrual-based benefits.

Figure 3b displays the indexed version of the cash and accrual S&L pension benefits. There is a very stark difference in the growth rates between cash and accrual accounting. As measured by cash accounting (the black solid line), there has been rapid growth in pension benefits. This is consistent with evidence in Lenney, Lutz, Schule, and Sheiner (2021) that states and localities have significantly increased their contributions to pension funds in recent years. However, such funding can be lower than pension benefit accruals if governments are underfunding pensions or greater than current year accruals if they are paying down legacy liabilities – i.e. addressing past years' underfunding.[9]

[7] Public Plans Data. 2001-2023. Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association.

[8] Both the BEA in constructing the NIPA and the Federal Reserve Board in constructing the Financial Accounts of the U.S. use the AAA corporate rate to discount pension liabilities. The BEA, however, only adjusts the nominal interest rate assumption periodically (less than annually) and holds the real rate fixed over time. In contrast, we allow the nominal interest rate, the real interest rate, and expected inflation to all vary annually. Finally, we measure expected inflation using the Cleveland Federal Reserve's 10-year expected inflation estimate and we measure real interest rates as the difference between Moody's Seasoned Aaa Corporate Bond Yield and the expected inflation measure.

[9] The gap between the accrual and cash benefits in Figure 3a captures the shortfall of funding in that year relative to benefits earned that year (i.e. the normal cost). The gap does not capture the portion of the stock of past unfunded liabilities which standard actuarial methods dictate be amortized in that year.

Figure 3a

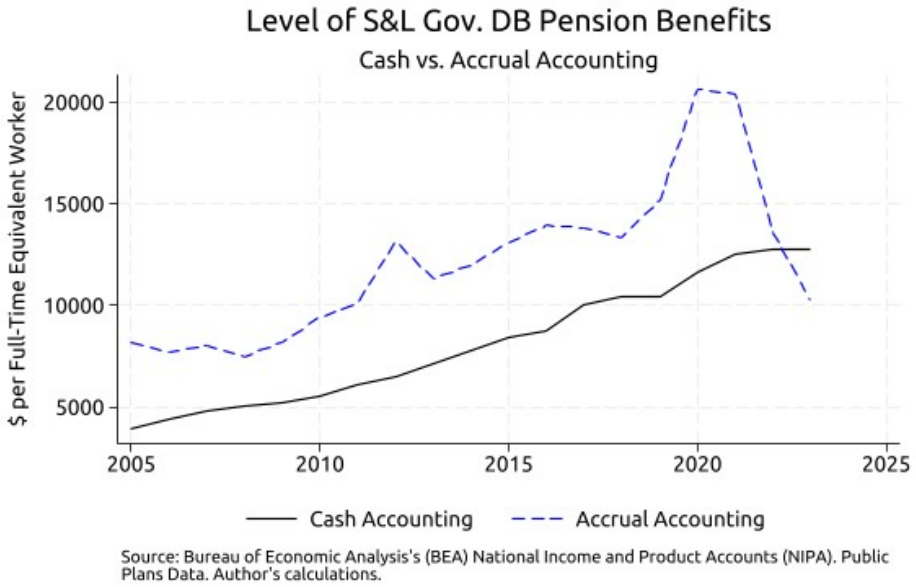
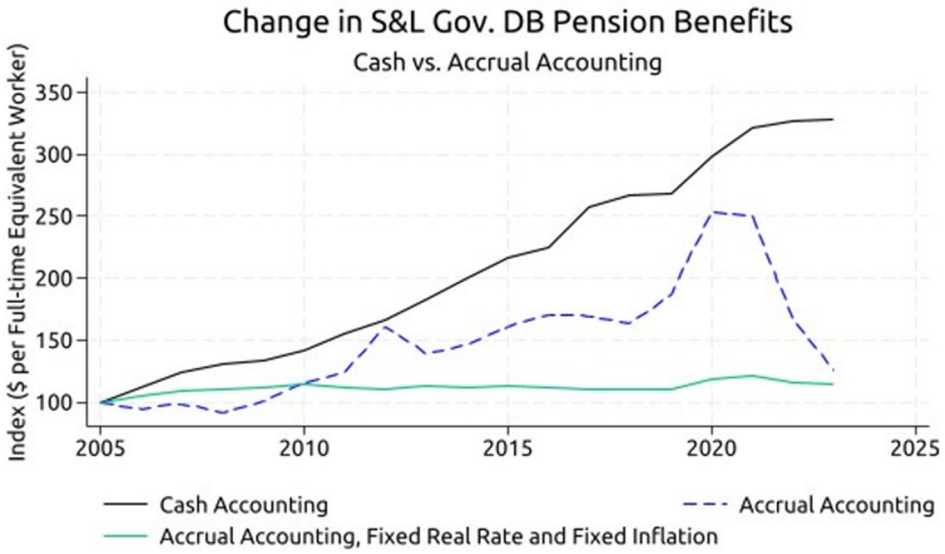


Figure 3b



The accrual DB pension measure has also risen, although at a slower pace than the cash measure. The rise in the accrual measure from 2009 to 2021 importantly reflects the gradual fall in real and nominal interest rates over this period. The plunge in normal costs per worker post-2021 reflects the surge in interest rates over that period. These changes in the accrual measure are properly viewed as well-measured benefit changes because they reflect changes in the market price of buying a comparable annuity from a private source. That said, it is unclear if workers

perceive such sharp annual swings in benefits driven by financial market prices. Future work will present sensitivity analysis for variation in assumed discount rates.

The green line in Figure 3b shows the evolution of the accrual value of pension benefits under a counterfactual of constant inflation and interest rates (set equal to their values in 2023). Without changes in interest rates, the nominal value of benefits per FTE would have been flat over the past two decades—meaning that benefits as a share of wages would have been declining. This accords well with the literature showing that governments have been making pension plans less generous over time, particularly for new hires. (Lenny et al, 2021).

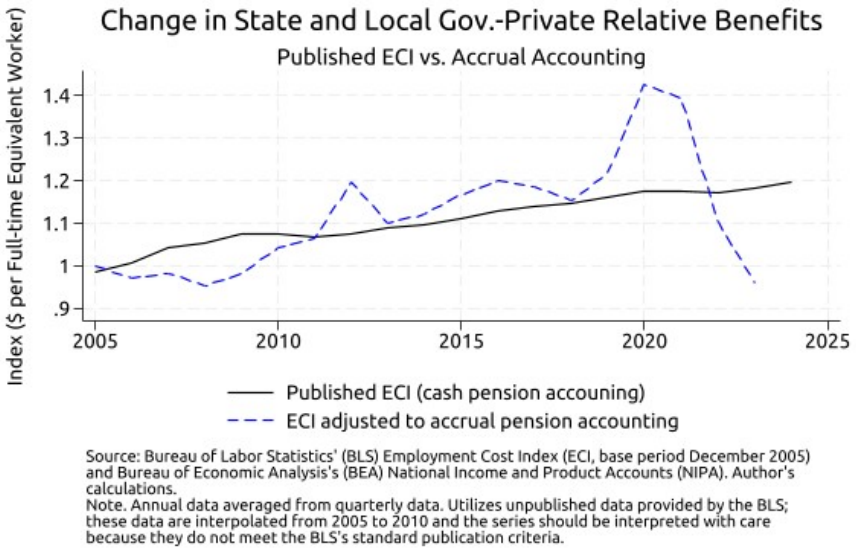
Figure 4 displays the ECI relative total benefit index (displayed on Figure 1) adjusted to be on an accrual basis for DB pensions—the dashed blue line—using our DB pension measure. The adjusted and unadjusted state and local government relative benefit indexes display similar growth through 2018. The similar growth rates in the two series may appear puzzling given the much more rapid growth in the cash DB pension index relative to the accrual-based index in Figure 3b. However, the more rapid growth in the cash measure is tempered by its relatively smaller size relative to the accrual measure in 2005 shown in Figure 3a; 2005 is the base index year which define the aggregation weights used to construct the total benefit index under accrual DB accounting index on Figure 4. Stated differently, in aggregating up the indexes in Figure 3b with the index for all other benefits to produce the series on Figure 4, the accrual-based measure receives significantly more weight than the cash-based measure.

In 2019 the accrual accounting total relative benefit measures in Figure 4 diverges sharply from the cash-based measure, first surging above the cash measure and then tumbling well below it by 2023. By 2023, the difference in total relative benefit growth between the published ECI total benefit index and the accrual DB pension-based index is a substantial 22 percentage points. Thus, compared to the published ECI, correctly accounting for DB pension benefits leads to very different conclusions about relative benefit growth in the public sector.

A potential issue with the aggregation used to produce the accrual-based benefit index in Figure 4 is that the ECI isolates wage changes independent of compositional changes in industry, occupation, and employer. Our DB pension index does not hold such factors fixed and therefore reflects compositional shifts. However, available evidence suggests the distortion for failing to account for compositional shifts is not excessively severe. Appendix Figure A1 reveals the growth in state and local DB pension benefits measured on cash basis is very roughly similar when using the ECI and the ECEC (which does not adjust for composition), suggesting that bias from compositional shifts may be small. See Appendix Section B for additional discussion and evidence pertaining to this issue and for a technical presentation of the aggregation technique used to combine the ECI and NIPA data into the series displayed on Figure 4.[10]

[10] We measure private DB pensions using the accrual-based measure in the NIPA. While this measure may suffer from some of the deficiencies of the state and local government NIPA measure, by the start of the sample period in 2005, private DB pensions measured on either a cash or accrual basis had become a small share of private sector benefits. E.g. on an accrual basis as measured in the NIPA they comprised only around 8% of private sector

Figure 4



IV.B.2 Retiree Health Care

Access to subsidized health care during retirement is far more common in the state and local sector than in the private sector. In 2024, about 65% of S&L workers had access to retiree health insurance; just 14% of private workers did (Bureau of Labor Statistics, 2024).

The provision and generosity of retiree health care benefits varies much more across state and local governments than that of pensions. Some states finance a large share of the cost of health insurance for their retirees, while other states simply allow their retirees to purchase health insurance through their employer plan, providing an implicit subsidy given that retirees are older and have higher expected medical claims. We estimate that the accrual value of retiree health insurance for state employees is less than 1 percent of wages in 20 states but ranges from 8 to 20 percent of wages in states like California, Connecticut, New York, and New Jersey.

As with pensions, the Employment Cost Index (ECI) uses employer contributions to retiree health trust funds as the measure of the compensation value of employer-provided retiree health benefits. However, since these benefits are predominantly unfunded, the ECI effectively excludes them, failing to capture any changes in their value.[11] Given that the most state and local

benefits. Hence, they don't play a major role in the evolution of the accrual-based relative benefit series shown in Figure 4. Appendix Figure A5 displays the evolution of accrual-based and cash-based private sector DB pension benefits as measured in the NIPA.

[11] Less than 10 percent of OPEB benefits have been prefunded by the states (Pew Charitable Trust 2023).

governments offer these benefits to employees, while few private-sector employers do, this omission skews public sector compensation measurements.[12]

To address this disparity, we estimate both the current value of these benefits and their evolution over time, enhancing the assessment of public versus private sector compensation differences. Recent changes in accounting standards, specifically Government Accounting Standards Board (GASB) Statements No. 74 and 75, have mandated that governments report the estimated future cost of retiree health benefits and other non-pension post-employment benefits (OPEB). These data are not always published however and are sometimes simply embedded in other financial reports.

Our method for valuing these costs is as follows. We have two sources of data on the accrual value of retiree health costs for a comprehensive set of plans at one point in time. PEW (2023) provides data on 173 state and local retiree health insurance plans for fiscal year 2018, while Biggs (2022) provides more recent data on state OPEB plans.[13] We adjust both sources of data so that the accrual value is measured using our preferred discount rate (discussed below), rather than the plans' discount rates. Using the data in Biggs, we estimate that normal costs are about 4% of wages, but the more comprehensive data from Pew suggest that aggregate normal costs represent only about 2% of wages. While we believe the Pew data are likely fairly comprehensive, we calibrate our data such that the normal cost in fiscal 2018 is 3 percent of wages – the mid-point between Biggs (2022) and PEW (2023). We also assume that private sector workers have no access to retiree health benefits, even though NCS surveys data suggest that a small share of private sector employees—around 15 percent in 2023—do have access to this benefit. In contract, nearly 70 percent of state and local employees have access prior to Medicare eligibility when the share falls close to 65 percent. Our analysis of the changes in the value of these benefits over time is tentative, given the data limitations. In particular, from 2010 to 2015, we rely on data for a small subset of OPEB plans that published it. We gather more comprehensive data from 2015 on.

We also gather information on reforms that state and local governments have made to their retiree health plans. These have almost all been geared toward lowering the cost of retiree health insurance, either by requiring contributions from employees, tightening eligibility rules, or simply reducing the value of the subsidy. In addition, health care costs—particularly the costs of Medicare and Medicare Advantage plans, have been coming in significantly lower than expected over the past 10 to 15 years (CBO, 2023), also reducing the estimated accrual value of retiree health benefits.

In terms of the discount rate, GASB standards require states to use a discount rate that reflects a blend of the expected return on investments and the municipal bond borrowing rate, with the proportion of funded liabilities determining the share of the blended discount rate equal to the

[12] The BEA includes firms' costs of providing health insurance to retirees in its measure of the costs of health insurance provided to current workers, and so does not attempt to measure OPEB accrual values. Thus, the NIPA fails to provide a measure of retiree OPEB benefits.

[13] Most plans calculate normal costs for a particular year using the discount rate from the previous year, and then make an adjustment to the total OPEB liability based on changes in the discount rate. We update the data from Biggs (2022) to include the lagged discount rate for each plan he covers. Most of the data in Biggs (2022) are for fiscal year 2022, but some are older given state reporting lags.

municipal bond rate. As most plans are unfunded, the applied discount rate is typically the relatively low municipal bond rate—significantly lower than the discount rate used for pension liabilities.

As already discussed in regards to pensions, however, the discount rate for future benefit liabilities should correspond to the risk profile of those benefits. Unlike pensions, retiree health insurance is not guaranteed and generally lacks strong legal protections; in most cases state and local governments can modify or terminate these benefits at their discretion. For instance, the Texas Employee Retirement System cautions: "The Texas Legislature determines the level of funding for such benefits and has no continuing obligation to provide those benefits beyond each fiscal year." Numerous states and localities have reduced the generosity of, or even eliminated, the benefit in the past (Clark, 2009; Franzel and Brown, 2013). Thus, for our analysis, we discount retiree health benefits using a rate that is 1 percentage points higher than the AAA corporate rate used by BEA to discount future pension benefits, with the higher rate reflecting the much higher uncertainty about whether these benefits will be available in the future.[14]

While we judge default risk as the dominant factor in setting the discount rate for retiree health care, the appropriate rate is a very complex issue with numerous factors to consider – see section 2.4 of Lutz and Sheiner (2014) for a discussion. Accordingly, in a future draft we will explore the sensitivity of our analysis to variation in the discount rate. Appendix section D provides greater details on the data sources and methodology we use to quantify OPEB benefits.

As shown in Figure 5a, our preliminary findings indicate that, in 2023, the average nominal value of retiree health benefits per worker was approximately $1,325 per worker in the state and local sector, similar to the nearly $1,375 in 2010. Part of the sharp decline since 2020 is the result of rising interest rates, but even holding interest rates constant, the value of the retiree health benefit has been declining since 2017, as benefits have been cut back and as the expected costs of health insurance have decreased.

Figure 5b shows benefits as a share of wages and also includes a counterfactual in which interest rates are held constant. Benefits have declined as a share of wages on average, although the low interest rates in 2020 boosted them temporarily. Holding interest rates fixed, retiree health insurance accruals have been falling as a share of wages since 2015. (We have no data after 2022, so simply assumed that benefits as a share of wages would have been constant if not for change in interest rates.)

[14] Moreover, unlike the BEA which adjusts its nominal interest rate assumption only periodically, we allow the rate to vary annually.

Figure 5a

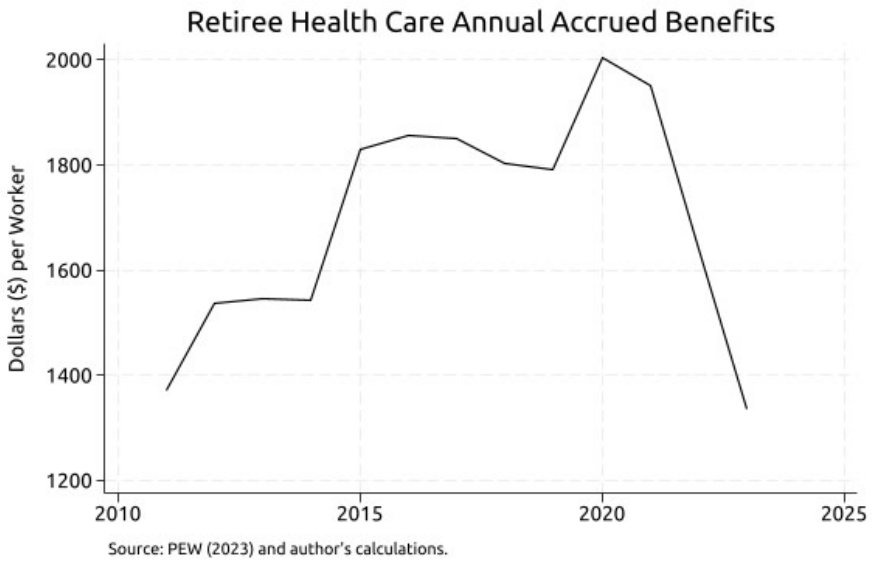
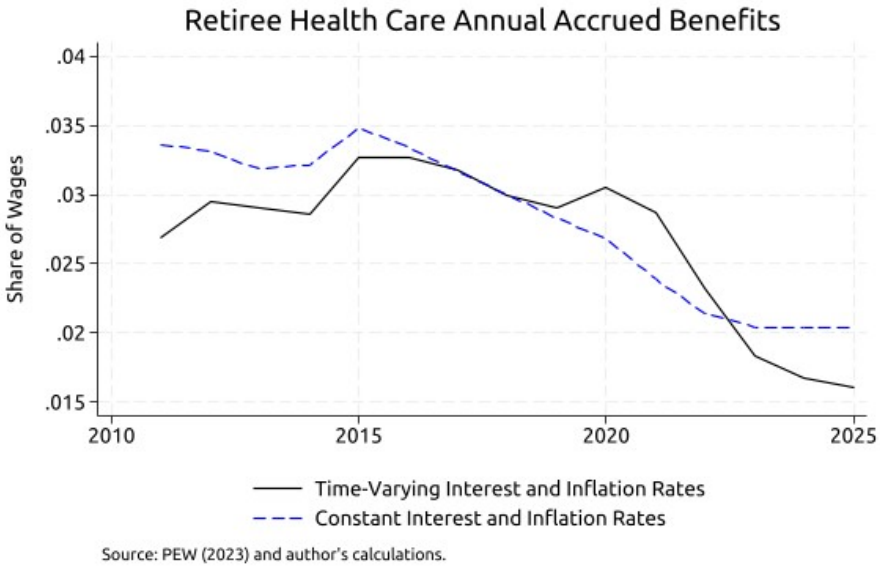


Figure 5b



IV.B.3 Job Stability

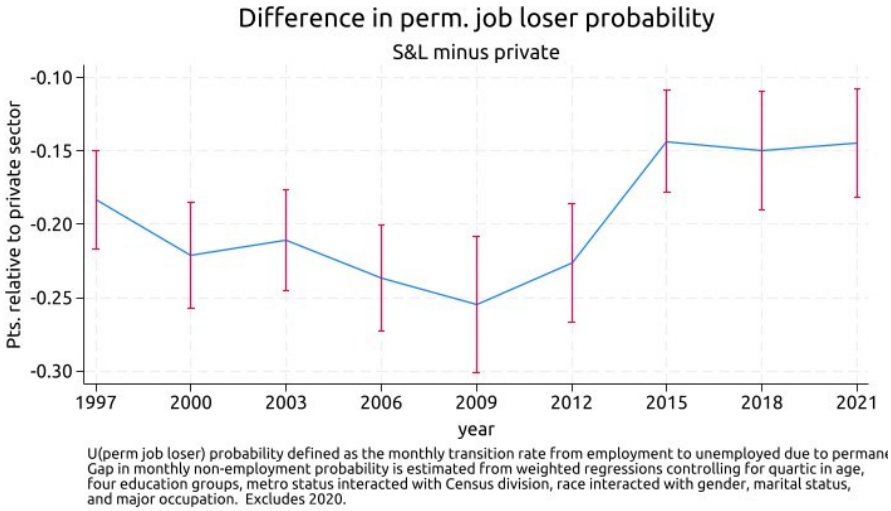
In addition to wages and benefits, jobs are valuable to workers if they are more stable and secure. Government jobs are typically viewed as less prone to layoff or job loss risk. Our relative compensation estimates above, though, do not capture the value of job stability as this job

attribute is not explicitly captured in any of the data sources we use on job benefits. Moreover, little research has shed light on how relative job stability between the public and private sectors has changed over time.

To estimate the change in relative job stability over time, we estimate linear probability models akin to the wage regressions shown above in section IV.A using longitudinally-linked CPS data. In particular, we estimate monthly job loss probabilities among private and state and local government workers. We define job losers as those experiencing a transition from employment to unemployment due to a permanent job loss. The results are qualitatively similar if we examine any type of employment-to-unemployment transition or if we include transitions of those who leave the labor force but report wanting a job. Because job loss probabilities are notably different for school-age and retirement-age workers, we restrict this analysis to those aged 25-54, and control for a similar set of characteristics as in the wage analysis (again omitting union coverage). We pool three years of data together due to the smaller sample sizes when matching data longitudinally.

As shown in Figure 6, we find that the job loss probability of S&L workers relative to similar private-sector workers improved from the late 1990s through the Great Recession, with the difference falling to 0.25 percentage point per month in 2009—or 3% per year. However, since 2012, the job loss rate has risen for S&L workers relative to private-sector workers to a gap of about 1.8 percentage point per year—with S&L workers facing a job loss probability of about 1.4% in the past few years, while comparable private sector workers faced a job loss probability of 3.1%. Thus, the loss in relative job stability of state and local government workers compounded the decline in relative wages and benefits that occurred over roughly the same time period.

Figure 6



How do workers value changes in job loss rates, compared to changes in other aspects of compensation such as wages? To answer this question, we rely on estimates of the cost of job loss. A long literature has shown that job losses cause persistent declines in the earnings potential of workers.

Davis and von Wachter (2011) focus on a particularly costly type of job loss: workers with at least 3 years of tenure who lose their job in a mass layoff event. This type of job loss likely destroys favorable matches and may also occur during downturns in local labor markets, They show that this type of job loss reduces the present discounted value of lifetime earnings by about 12% on average, or about 1.7 times current wages, with the costs larger in recessions and smaller in expansions. But they also show that most job destruction does not meet these criteria, because many short-tenure workers lose their jobs (according to the Displaced Worker Survey, workers with less than 3 years of tenure account for about 60% of job displacement) and because not all jobs are destroyed during mass layoffs. They find that the type of job displacement they focus on accounts for 20% to 25% of total job destruction.

Our measure of job loss is broader than that used by David and von Wachter. It includes all permanent job losers regardless of tenure (the monthly CPS does not include data on job tenure) and doesn't condition on mass layoff events. For these reasons, it is likely that the job losses we capture will be less costly than those analyzed by Davis and von Wachter. On the other hand, the probability of mass layoffs may be particularly low in the public sector (unfortunately, there are no data on this), suggesting that the sector provides even more insurance against the more costly types of layoffs.

While we have no way to pin this down directly, we assume that the job displacements we capture are 75% as costly as the job displacements studied by Davis and von Wachter. However, Davis and von Wachter use a real interest rate of 5%, which is much higher than the rates we use to value pensions and retiree health (averaging 2.5% and 3.5% over our samples, respectively.) While job loss is not as low risk as the pension promise is, workers are risk averse — so they likely value the implicit insurance against job loss at more than its expected actuarial cost. This suggests that using a lower discount rate, consistent with valuing guaranteed streams, is appropriate or at least conservative. Our adjustment for a lower interest rates raises our estimate of the cost of job loss to 1.6 times the current wage on average.

Let the probability of job loss be δ and the cost of job loss be L percent of the current wage, w. For workers to be indifferent between a job in the S&L and private sectors:

$$(w_p - \delta_p \mathrm{L} w_p) = (w_{SL} - \delta_{Sl} \mathrm{L} w_{SL})$$

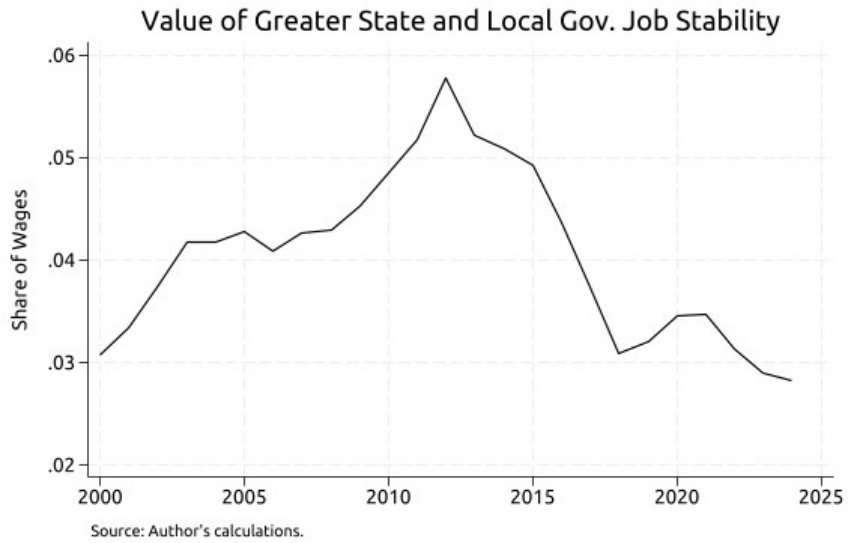
This leads to a private sector wage premium of:

$$\frac{w_p}{w_{SL}} = \frac{(1 - \delta_{Sl}\mathrm{L})}{(1 - \delta_p \mathrm{L})}$$

Using this equation, adjusting L for differences in the discount rate over time, and using the estimates of δ from the exercise displayed in Figure 6, provides us with the estimates of the value of greater job stability shown in Figure 6b. We estimate that the value of better job stability

peaked in 2012 at 5.8% of wages but has declined since to a value of just 2.8% of wages in 2024.[15] Thus, while S&L workers still enjoy a premium due to job stability which partially offsets the lower wages, that wage premium has fallen by about 3 percentage points from 2005 to 2024.

Figure 6b



IV.C Comparing Total Compensation

In this subsection we combine the benefit value measures presented above for DB pensions and OPEB benefits with the CPS, ECI, and ECEC to obtain total relative compensation comparisons.

II.C.1 Trends in Relative Total Compensation

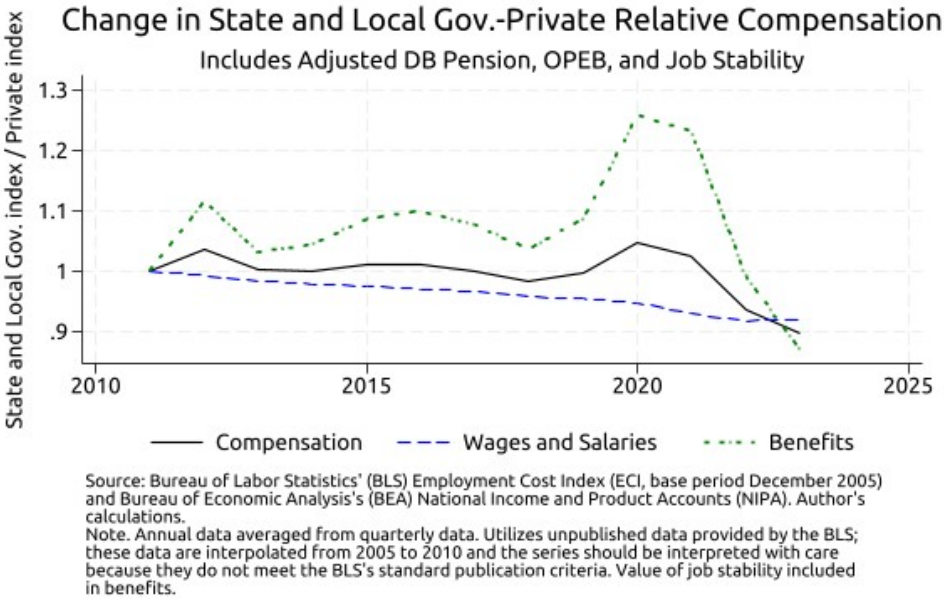
Figure 7 shows our estimate of the ECI-based trend in public sector total compensation relative to the private sector. To generate the estimate, we aggregate the ECI data on wages and benefits excluding DB pensions with our accrual-based valuation index measures for DB pensions, retiree health care benefits, and job stability.[16] Incorporating accrual accounting for DB pensions and the inclusion of OPEB benefits alters the trajectory of relative S&L compensation since 2010. Instead of flat relative compensation over the entire post-2010 period as displayed using the published ECI data in Figure 1, relative compensation is falling gradually from 2011 to 2019, as a decline in wages is not fully offset by a rise in relative benefits driven by the decline in interest rates which pushed up the value of the relatively generous DB pension and retiree health benefits in the public sector. Over 2020 and 2021, total relative compensation popped up as interest rates moved unusually low, further bolstering the value of public pension and OPEB benefits.

[15] Biggs (2011) used data on the premiums charged to federal and private workers for supplemental insurance premiums and found that the value of job security was worth 2.4 percent of wages.

[16] The ECI does not capture retiree health benefits and there is therefore no need to remove it before the aggregation step as is done with DB pensions.

Thereafter, as interest rates began moving up sharply in 2022, total relative compensation fell, ending 10 percent beneath its value in 2011.

Figure 7



Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI, base period December 2005) and Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Author's calculations.
Note. Annual data averaged from quarterly data. Utilizes unpublished data provided by the BLS; these data are interpolated from 2005 to 2010 and the series should be interpreted with care because they do not meet the BLS's standard publication criteria. Value of job stability included in benefits.

IV.C.1 Level of Relative Total Compensation

We now turn to estimating the absolute *level* of the public relative total compensation premia—which is not possible with the ECI-based approach. Our analysis is based on the following equation

$$\frac{\boldsymbol{TC_{SL}}}{\boldsymbol{TC_{Private}}} = \frac{\boldsymbol{W_{SL}}}{\boldsymbol{w_{Private}}} * \frac{(\mathbf{1} + \boldsymbol{benshare_{SL}})}{(\mathbf{1} + \boldsymbol{benshare_{private}})}$$

We measure wage premiums, $\frac{\boldsymbol{W_{SL}}}{\boldsymbol{w_{Private}}}$, using our CPS-based estimates which correct for differences in the composition of employees across the sectors (Figure 2). We then calculate relative public (private) benefits as a share of wages, $\boldsymbol{benshare_{SL}}$. For state and local DB pensions, we use our alternative estimates of pension normal costs as a share of wages and salaries in the NIPA.[17] For private DB pensions, we use the NIPA accrual-based measures of pensions and NIPA wages. For public OPEB we use our estimates of OPEB normal costs as a share of NIPA wages and salaries; for private we assume there are no OPEB benefits (which biases us toward over stating the share of public compensation relative to private). For all other benefits, both public and private, we use hourly benefits as a share of hourly wages and salaries

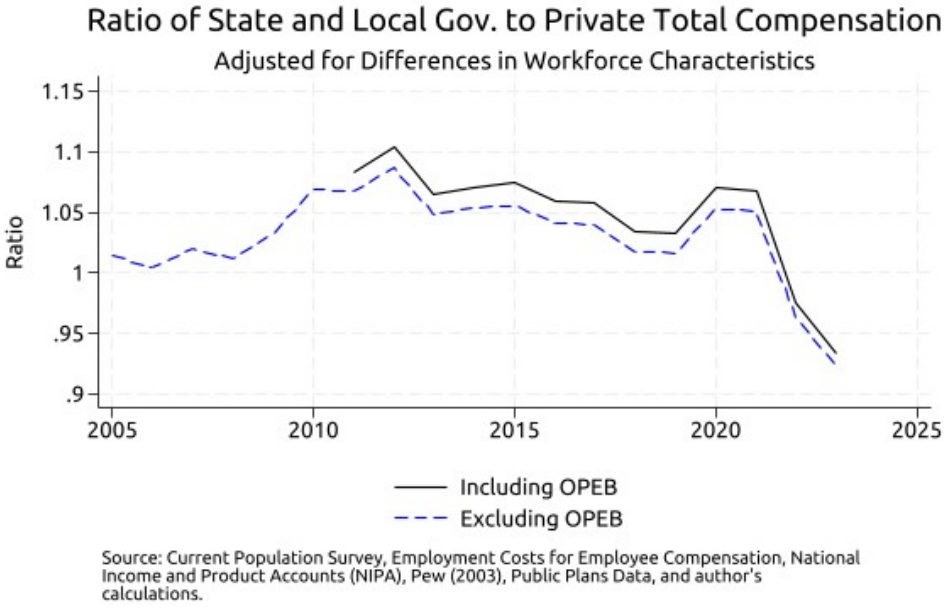
[17] Our state and local government DB pension estimates are benchmarked to the comparable pension estimates in the NIPA. Thus, using NIPA wages to calculate the pension benefit share is appropriate.

as measured in the ECEC. Finally, for job stability we use the wage premium estimates displayed in Figure 6b.

Figure 8a presents the relative total public compensation differential expressed as a percent deviation of public compensation from private compensation – i.e. a value of 1 indicates parity in compensation across the sectors. At the onset of the Great Recession, this preliminary evidence suggests that state and local workers were overcompensated by almost 10 percent relative to their private sector peers. This differential, however, moves lower over the ensuing years and then plunges with the rise in interest rates—and corresponding lower present value of relatively generous public pension and OPEB benefits—such that as of 2023 the public premium is a negative 5 percent; i.e. state and local workers were being paid five percent less than their private sector counterparts.

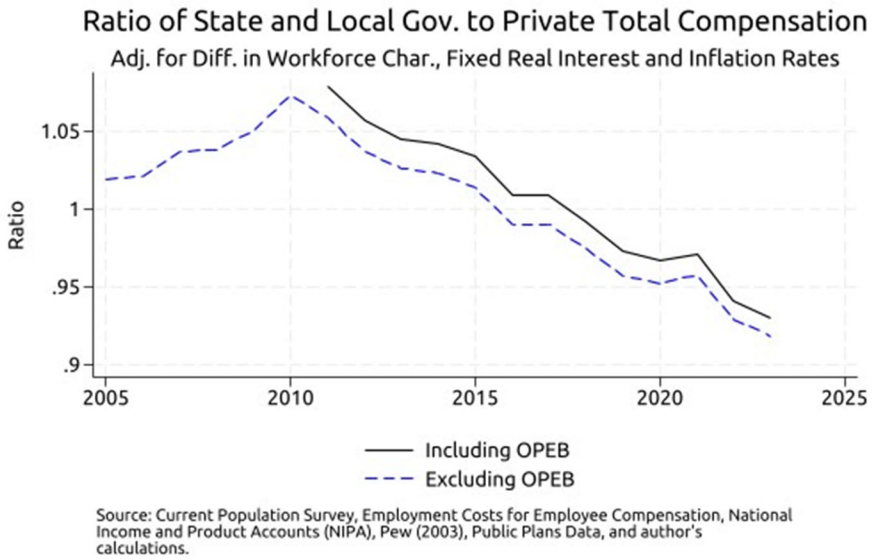
Figure 8b shows our calculations holding interest rates and inflation fixed at the 2023 value. Here we see a different story—a steady decline in the relative compensation in the state and local sector relative to the private sector. While the calculations underlying Figure 8a are clearly correct from a financial accounting perspective, the declining compensation shown in Figure 8b may be more of what workers perceive.

Figure 8a



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2003), Public Plans Data, and author's calculations.

Figure 8b



IV.D Relative Compensation by Age and Education

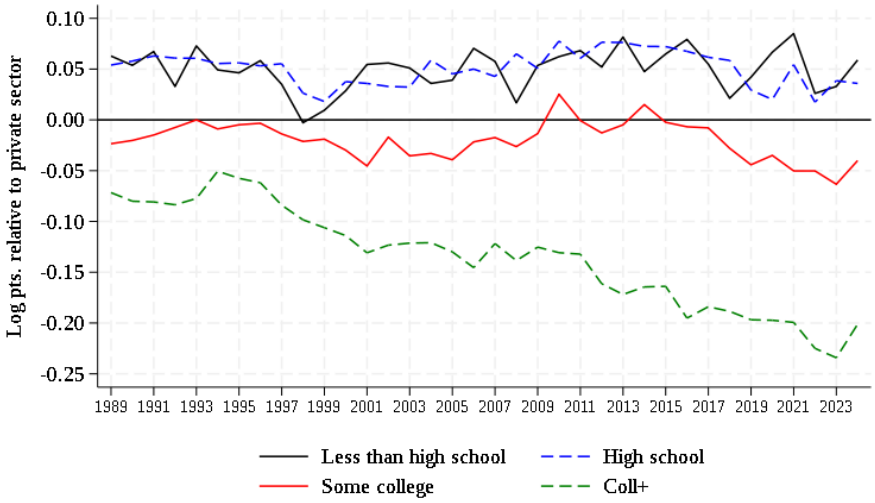
We now return to an examination of the public-private wage differentials by group to understand the sources of declining wages and the potential policy implications. We do so by returning to the Current Population Survey data and re-estimating the wage gaps by a variety of subgroups. The most striking finding, shown in Figure 9, is that the relative decline in wages for public-sector workers was entirely concentrated within the most educated group. For those with at least a college degree, the relative pay of S&L workers was about 10 percentage points less than in the private sector in the early 1990s; that gap expanded gradually over time, accelerating after the Great Recession and was about -20 percentage points in 2024.

Because the most highly educated workers represent nearly two-thirds of state and local workers, the decline in the relative pay amongst that group explains a large portion of the overall decline in relative pay shown in Figure 2. However, there is both a within-group decline in relative pay for the most highly educated as in Figure 9, as well as a between-group dynamic at play. The latter arose from the fact that over this time period, the educational attainment of workers in both sectors increased. Given that college educated workers have the largest negative pay differential across educational groups, this compositional shift would increase the negative pay premium in the S&L sector as a whole, even if the college-educated public-private pay differential had not widened. When we hold fixed the educational shares of workers in the S&L sector constant at their 2005 values, we find that roughly half of the overall decline in the S&L pay premium was

due to the decline in pay of the most highly educated (the green line in Figure 9) and about half due to the rising educational attainment of workers.[18]

Figure 9

S&L government wages relative to private sector by education



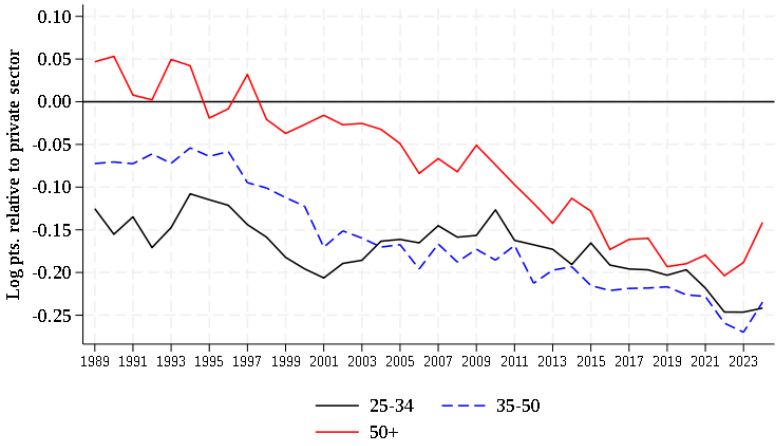
Gap in wages for S&L workers relative to private. Regressions are run separately for each education group and are weighted and control for a quadratic in age, metro status interacted with nine Census divisions, race interacted with gender, marital status, and major occupation.

Informed by Figure 9, we turn to investigating patterns of wage dynamics within the most highly educated groups over time. An important question is whether the decline in relative wages is concentrated among younger groups of college-educated workers, which would in turn suggest that the S&L sector would potentially have trouble attracting the most talented young workers to pursue a public sector career. However, the data shown in Figure 10 do not suggest that wages for early career college-aged workers aged 25-34 (the black line) have fallen markedly in the sector compared to similar workers in the private sector. Rather, the bulk of the decline has been concentrated among old workers. Middle-career workers aged 35-50 have seen relative wages fall by about 10 percentage points since 2000; despite the tick up in the relative pay of older workers in 2024, their relative pay has also steadily declined over time. These dynamics suggest that it is the return to experience and tenure within the sector that is not keeping up with that in the private sector. While the potential for future wage gains of a young worker choosing a sector at the beginning of a career may be less salient than the starting wage, it is likely that relatively stunted pay growth within the sector raises the difficulty of attracting workers.[19]

[18] In principle, the decomposition of the change over time in the *relative* pay of two sectors could be calculated in a number of ways which may give somewhat different results. For the purposes of this section, we take the coefficients in Figure 9 as fixed and hold the shares of workers by education in the S&L sector fixed in 2005, allowing the share of workers by education to adjust in the private sector. Future work will explore a full decomposition of the change in the relative pay by groups.

[19] Because the CPS does not track worker experience over time, without panel data on workers over time, we cannot show wages by tenure or experience within the sector.

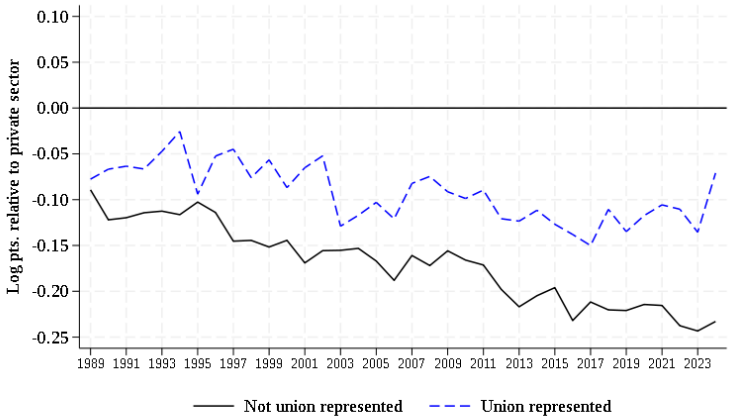
Figure 10
S&L government wages relative to private sector by age
College +



Gap in wages for S&L workers relative to private among those with at least a college degree. Regressions are run separately for each age group and are weighted and control for a linear term in age, metro status interacted with nine Census divisions, race interacted with gender, marital status, and major occupation.

Finally, it appears that wages among the more highly educated have fallen especially for those who are not covered by unions. Since 2000, Figure 11 shows little relative decline in pay of those represented by a union (the blue dashed) line, whereas relative pay of those who are not represented by a union saw pay decline by roughly 10 percentage points from roughly 2000 to 2024.

Figure 11
S&L government wages relative to private sector by union status
College +

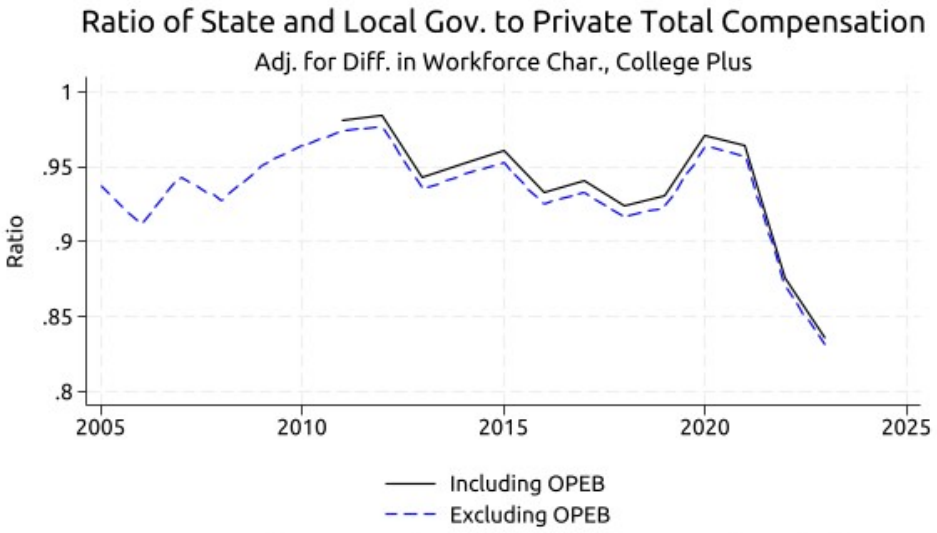


Gap in wages for S&L workers relative to private among those with at least a college degree. Regressions are run separately for each age group and are weighted and control for a quadratic in age, metro status interacted with nine Census divisions, race interacted with gender, marital status, and major occupation.

Figures 12a and 12b present the relative total public compensation differential level expressed as a percent deviation of public compensation from private compensation for workers with a college degree (12a) and with only a high-school education (12b). We assume that the ratio of pension benefits and job stability to wages does not vary by education, but that the ratio of the

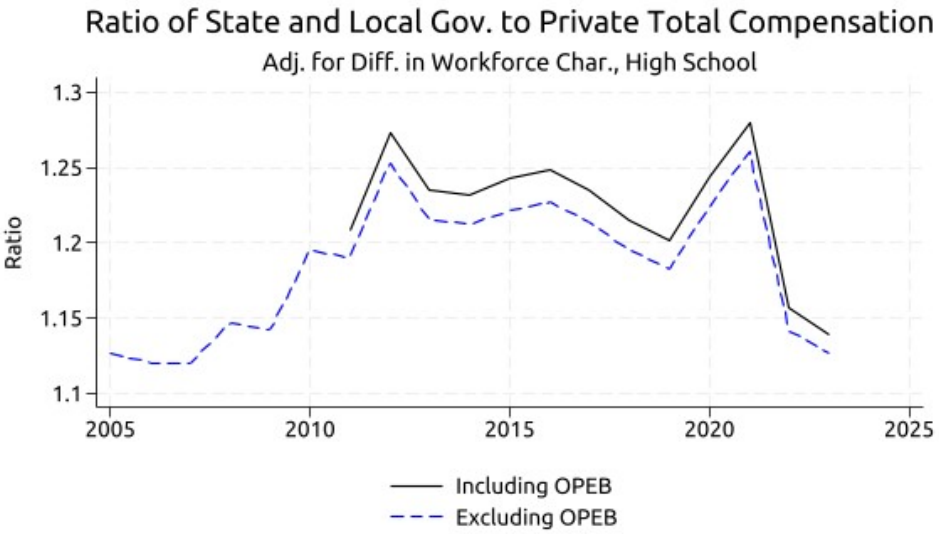
value of retiree health insurance does—since the benefit is a fixed benefit that is more valuable as a share of wages for lower-wage workers. The figure suggests that relative pay of college educated public workers has declined by about 14 percentage points; in 2023, college plus workers experienced a pay deficit in excess of 16 percent relative to their private sector counterparts. For high-school educated workers, the decline has been much less steep—about 7 percentage points, and these workers still enjoy a 14% bonus for working in the S&L sector.

Figure 12a



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2003), Public Plans Data, and author's calculations.

Figure 12b



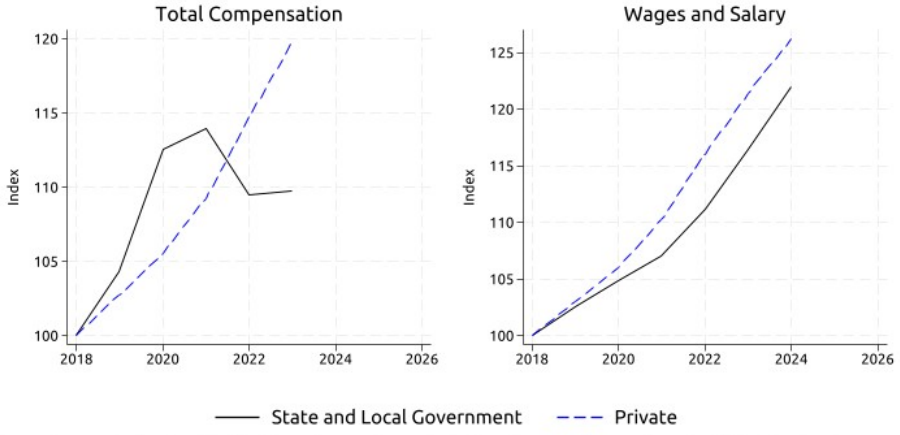
Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2003), Public Plans Data, and author's calculations.

V. Implications

Our firmest conclusion—that state and local government compensation has eroded over the past 15 years—has important implications for the ability of these governments to attract and retain employees. Although a detailed exploration of these implications is beyond the scope of this paper, we offer two suggestive pieces of evidence that the decline in relative compensation may be affecting public sector hiring.

First, as the economy emerged from the Covid pandemic, private sector compensation accelerated, whereas state and local government compensation initially did not. This dynamic can be seen in Figure 13 which presents both our DB pension-adjusted total compensation measure and wages, both indexed to equal 100 prior to the pandemic in 2018. By 2023, private sector compensation had surged 10 percentage points above state and local compensation; private wages had shot up 4 percent above state and local wages. Over the same period, state and local payrolls recovered only very slowly from their decline at the onset of the pandemic, despite the budgets of these governments being historically strong (Cashin, Lutz, Peterman, Ratner, and Rodman 2023). In contrast, private sector payrolls recovered more quickly.[20] Thus, it appears that the failure of the public sector to increase compensation in line with the market allowed private firms to outcompete them for workers.

Figure 13
Compensation and Wages Following the Covid Pandemic



Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI) and Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Author's calculations.
Note. Annual data averaged from quarterly data and re-indexed to equal 100 in 2018. The left panel utilizes unpublished data provided by the BLS; these data should be interpreted with care because they do not meet the BLS's standard publication criteria.

Second, several aspects of the labor market landscape for K-12 teachers suggests negative impacts of declining relative pay in the public sector. There has been a surge in teacher strikes in recent years with grievances over compensation a key cause (Lyon, Kraft, Steinberg 2024). There has also been a decline in observable teacher credentials—e.g. the share of novice teachers

[20] Private employment exceeded its February 2020 level in April of 2022, whereas state and local government employment did not reach this threshold until October of 2023.

has increased (Garcia and Weiss 2019). Perhaps most notably, occupational prestige, interest among students, the number of individuals preparing for entry, and on-the-job satisfaction for K-12 teachers all began a sustained decline in 2010 and have now fallen to at or near their lowest level in 50 years (Kraft and Lyon 2024). The decline in relative public sector wages and compensation we document coincides neatly with this decline in the teaching profession and is therefore a potential cause.

While both the Covid era and K-12 teaching episodes are consistent with declining relative public sector pay infringing on the ability of state and local governments to hire and retain high quality workers, they are far from definitive. Future research should aim to estimate the causal connection between relative public sector pay and public sector labor market outcomes.

VI. Conclusion

Our analysis demonstrates that the compensation premium for state and local government workers relative to comparable private sector employees has eroded over the past fifteen years. The relative decline is concentrated among workers with at least a college degree. Although our estimate of the relative level of compensation across the sectors is subject to elevated methodological uncertainty compared to our estimate of the relative trend, we find that college educated worker's total public sector compensation is more than 15 percent beneath that in the private sector. Our findings are relevant to the future ability of state and local governments to recruit and retain qualified personnel and, correspondingly, to achieve the administrative capacity to effectively implement policies and deliver essential services.

References

Allegretto, S. A., & Keefe, J. (2010). The Truth about Public Employees in California: They are Neither Overpaid nor Overcompensated. Center on Wage and Employment Dynamics, University of California, Berkeley.

Bender, K. A., & Heywood, J. S. (2010). Out of Balance? Comparing Public and Private Sector Compensation over 20 Years. Center for State and Local Government Excellence and National Institute on Retirement Security.

Biggs, A. G. (2012). Overpaid Public Workers: The Evidence Mounts. Wall Street Journal, Opinion. April 10.

Biggs, A. G. (2019). The Growth of Salaries and Benefits in the Federal Government, State and Local Governments and Public Education, 1998-2017. American Enterprise Institute Working Paper 2019-09. April.

Biggs, A. G. (2022). State Employee Compensation in the Fifty States, With a Special Focus on Connecticut. February.

Biggs, A. G., & Richwine, J. (2014). The Effect of Pension Accounting Rules on Public–Private Pay Comparisons. ABA Journal of Labor & Employment Law, Vol. 27, No. 2, Winter.

Borjas, G. J. (2002). The Wage Structure and the Sorting of Workers into the Public Sector. NBER Working Paper No. 9313.

Brown, J. R., & Wilcox, D. W. (2009). Discounting State and Local Pension Liabilities. American Economic Review, 99(2), 538-542. https://doi.org/10.1257/aer.99.2.538

Bureau of Labor Statistics. (2022). "The Linked Employment Cost Index." Monthly Labor Review, December. Retrieved from https://www.bls.gov/opub/mlr/2022/article/the-linked-employment-cost-index.htm

Bureau of Labor Statistics. (2024). Employee Benefits, National Compensation Survey.

Cashin, D., Lutz, B., Peterman, W., Ratner, D., & Rodman, S. (2023). The Restrained Recovery of State and Local Government Payrolls from the Pandemic Recession. *FEDS Notes*. Board of Governors of the Federal Reserve System.

Center for Retirement Research at Boston College (2022). Legacy Pension Debt Report: Illinois State Employees Retirement System.

Clark, Robert L. (2009). "Will Public Sector Retiree Health Benefit Plans Survive? Economic and Policy Implications of Unfunded Liabilities." American Economic Review, 99(2), 533-537.

Clark, R. L., & Morrill, M. S. (2016). Evaluating Workplace Education for New Hires. TIAA-CREF Institute Research Dialogue, Issue No. 129. https://www.tiaainstitute.org/publication/evaluating-workplace-education-new-hires

Congressional Budget Office (CBO). (2019). The 2019 Long-Term Budget Outlook.

Congressional Budget Office (CBO). (2023). CBO's Projections of Federal Health Care Spending. https://www.cbo.gov/publication/58997

Fitzpatrick, M. D. (2015). How Much Are Public School Teachers Willing to Pay for Their Retirement Benefits? American Economic Journal: Economic Policy, 7(4), 165-188. https://doi.org/10.1257/pol.20140087

Flint Water Advisory Task Force. (2016). Final Report. Office of the Governor, State of Michigan.

Franzel, Joshua, & Brown, Alex. (2012). "Understanding Finances and Changes in Retiree Healthcare." Government Finance Review, 59-63.

Freeman, R. B. (1987). How Do Public Sector Wages and Employment Respond to Economic Conditions? NBER Working Paper No. 1653.

García, E., & Weiss, E. (2019). The Teacher Shortage Is Real, Large and Growing, and Worse Than We Thought. *Economic Policy Institute*.

Gittleman, M., & Pierce, B. (2012). Compensation for State and Local Government Workers. Journal of Economic Perspectives, 26(1), 217-242.

Governmental Accounting Standards Board (GASB). (2015). Summary of Statement No. 75: Accounting and Financial Reporting for Postemployment Benefits Other Than Pensions.

Gustman, A. L., & Steinmeier, T. L. (2005). Imperfect Knowledge of Social Security and Pensions. Industrial Relations, 44(2), 373-397. https://doi.org/10.1111/j.0019-8676.2005.00389.x

Katz, L. F., & Krueger, A. B. (1991). Changes in the Structure of Wages in the Public and Private Sectors. Research in Labor Economics, 12, 137-172.

Krueger, Alan B. (1988). "Are Public Sector Workers Paid More Than Their Alternative Wage? Evidence from Longitudinal Data and Job Queues." In Richard B. Freeman and Casey Ichniowski (Eds.), When Public Sector Workers Unionize (pp. 217-242). University of Chicago Press.

Keefe, J. H. (2012). Are Public Employees Overpaid? Labor Studies Journal, 37(1), 104-126.
Lewis, G. B., & Galloway, C. S. (2011). A National Analysis of Public/Private Wage Differentials at the State and Local Levels by Race and Gender. Andrew Young School of Policy Studies Research Paper Series.

Kraft, M. A., & Lyon, M. A. (2024). The Rise and Fall of the Teaching Profession: Prestige, Interest, Preparation, and Satisfaction Over the Last Half Century. *NBER Working Paper Series* #32386.

Liscow, Z., Nober, W., & Slattery, C. (2023). Procurement and Infrastructure Costs (Working Paper No. 31705). National Bureau of Economic Research.

Lenze, David G. (2013). "State and Local Government Defined Benefit Pension Plans: Estimates of Liabilities and Employer Normal Costs by State, 2000-2011." Bureau of Economic Analysis, Washington, D.C., December 2013.

Lucas, Deborah J. (2012). "Valuation of Government Policies and Projects." Annual Review of Financial Economics, 4(1), 39-58.

Lutz, B., & Sheiner, L. (2014). The Fiscal Stress Arising from State and Local Retiree Health Obligations. Journal of Health Economics, 30(1), 193-208. https://doi.org/10.1016/j.jhealeco.2010.11.003

Lyon, M. A., Kraft, M. A., & Steinberg, M. P. (2024). The Causes and Consequences of U.S. Teacher Strikes. *NBER Working Paper Series* #32862.

Munnell, A. H., Aubry, J.-P. (2016). An Overview of the Pension/OPEB Landscape. Center for Retirement Research at Boston College.

Munnell, A. H., Aubry, J.-P., Hurwitz, J., & Quinby, L. (2011). Comparing Compensation: State-Local Versus Private Sector Workers. Center for Retirement Research at Boston College.

McCaulay, M. (2013). Duration and Convexity for Pension Liabilities. Society of Actuaries, Pension Section News, Issue 81.

Ni, S., & Podgursky, M. (2016). How Teachers Respond to Pension System Incentives: New Estimates and Policy Applications. Journal of Labor Economics, 34(4), 1075-1104. https://doi.org/10.1086/686263

Nicholson, J., & Powers, R. (2015). The Pay Premium for Manufacturing Workers as Measured by Federal Statistics. U.S. Department of Commerce, Economics and Statistics Administration, Issue Brief # 05-15.

Novy-Marx, R., & Rauh, J. D. (2009). Public Pension Promises: How Big Are They and What Are They Worth? The Journal of Finance, 66(4), 1211–1249.

Pew Charitable Trusts. (2023). Do States Have Enough Saved for Retiree Health Care Benefits? State Retiree Health Insurance Liabilities. Washington, DC: Pew Charitable Trusts. Retrieved from https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2023/05/do-states-have-enough-saved-for-retiree-health-care-benefits

Poterba, J. M., & Rueben, K. S. (1994). The Distribution of Public Sector Wage Premia: New Evidence Using Quantile Regression Methods. NBER Working Paper No. 4734. National Bureau of Economic Research. https://doi.org/10.3386/w4734

Reinsdorf, Marshall, David Lenze, and Dylan Rassier (2014). Bringing Actuarial Measures of Defined Benefit Pensions into the U.S. National Accounts. Paper Prepared for the IARIW 33rd General Conference Rotterdam, the Netherlands, August 24-30. http://old.iariw.org/papers/2014/ReinsdorfPaper.pdf

Smith, Sharon P. (1977). Equal Pay in the Public Sector: Fact or Fantasy. Princeton, NJ: Industrial Relations Section, Princeton University.

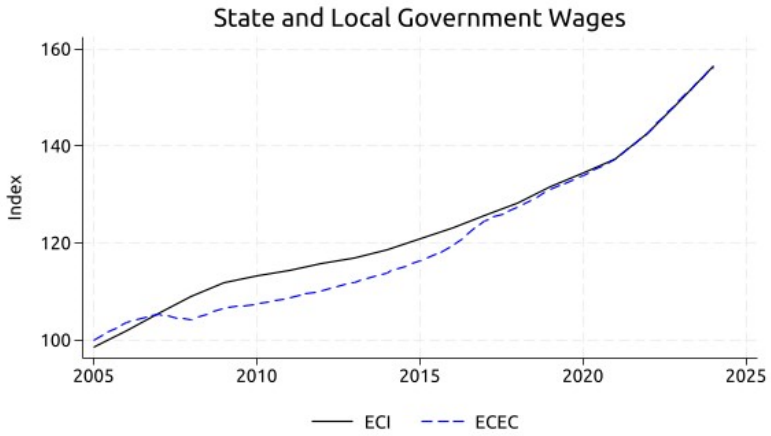
Quinby, L. D. (2020). Do Deferred Benefit Cuts for Current Employees Increase Separation? Journal of Pension Economics and Finance, 19(2), 165-189. https://doi.org/10.1017/S1474747218000458

Wood, C. (2017). Hawaii tax director abruptly resigns amid struggling $60 million system modernization. Statescoop.

Appendix

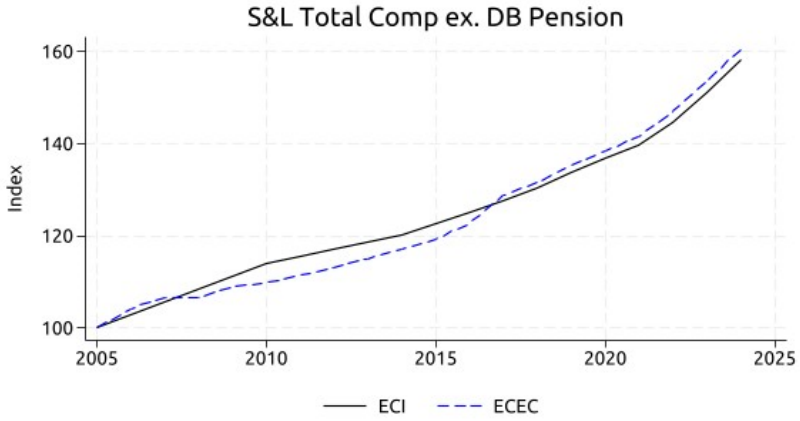
A. Figures and Tables

Figure A1



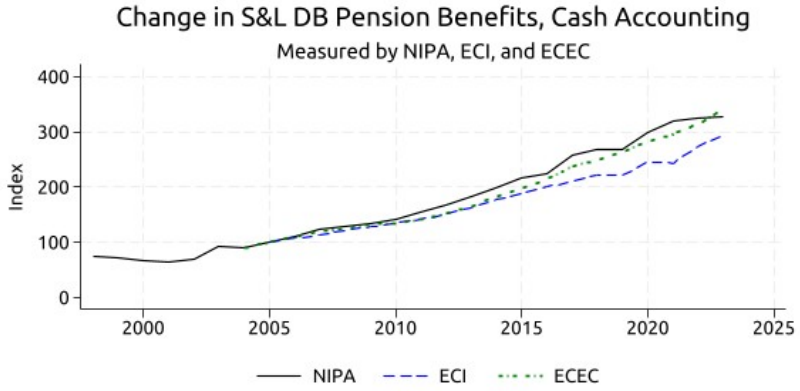
Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI) and Employee Costs for Employee Compensation (ECEC).
Note. Annual data averaged from quarterly data.

Figure A2



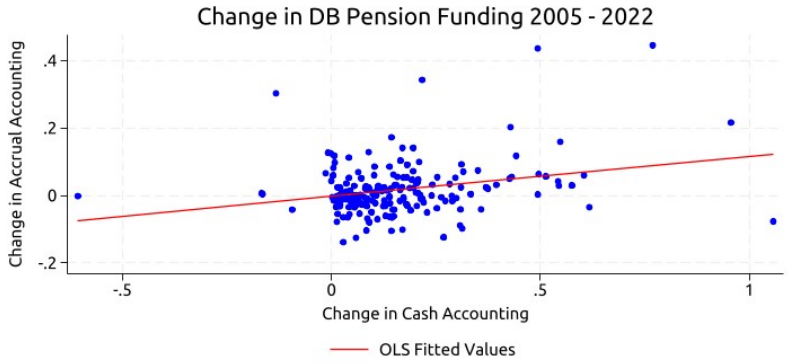
Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI) and Employee Costs for Employee Compensation (ECEC).
Note. Annual data averaged from quarterly data. Utilizes unpublished data provided by the BLS; these data are interpolated from 2005 to 2010 and the series should be interpreted with care because they do not meet the BLS's standard publication criteria.

Figure A3



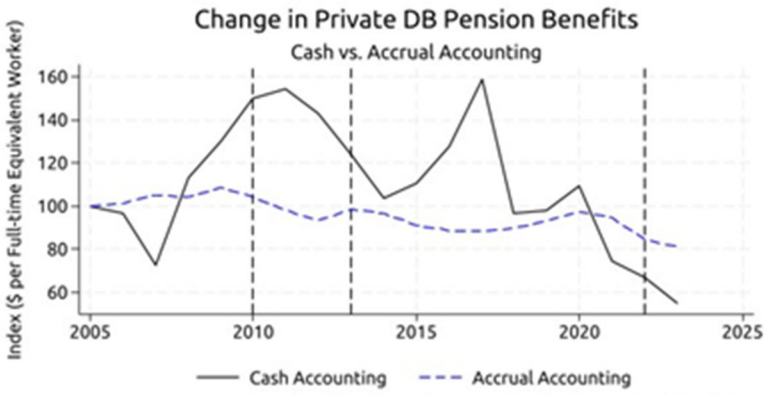
Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI, base period December 2005) and Employer Costs for Employee Compensation (ECEC). Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Author's calculations.
Note. Annual data averaged from quarterly data. ECI series is unpublished data provided by the BLS; these data are interpolated from 2005 to 2010 and the series should be interpreted with care because they do not meet the BLS's standard publication criteria. BEA series is indexed version of defined benefit pension benefits measured in dollars per full-time equivalent worker.

Figure A4



Source: Public Plans Data. 2001-2023. Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Author's calculations.
Note. The change in cash accounting is the change from 2005 to 2022 in the total contribution to the pension fund as a share of payroll. The change in accrual accounting is the change from 2005 to 2022 in the normal cost expressed as a share of payroll.

Figure A5



Source: Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Author's calculations.
Note. Annual data averaged from quarterly data. Dashed vertical lines denote changes in the discount rate used by the BEA to discount future pension benefits; the discount rate from 2005 to 2009 is 5.5 percent, from 2010 to 2012 it is 5 percent, from 2013 to 2021 it is 4 percent, and from 2022 to present it is 5 percent.

Appendix Table 1: OPEB Reforms

	State share of Aggregate Normal Cost	Reform 1	Reform 1 Affects	Reform 2	Reform 2 Affects:
Texas	16%	Reduced Contribution for Workers with less than 20 years of service (State pays 50% for 10-14, 75% for 15-19)	Employees with <5 years of service as of 9/1/2014	Increased Required years of Service from 5 to 10	Employees hired after 9/1/2009
California	15%	State lowered share of premium from 100/90 (retiree/dependent) to 80/80	Employees Hired after 1/1/ 2017 or 1/1/2016, depending on bargaining unit	Began requiring certain actives to contribute; these contributiosn have increased and become more common over time. Also Increased min retirements age from 50 to 52	Employees hired after 1/1/2013
New Jersey	12%	Increased retiree share of premium, with increase largest for those with the largest pensions.	Employees/retirees with less than 20 years of service as of 6/2011		
Illinois	9%	Required retirees to pay 1% of pension benefit if on Medicare, 2% if pre-Medicare as health insurance premium; increased to 2%/4% in 2015.	2014-2015. Then ruled unconstitutional.		
New York	9%	NONE			
North Carolina	6%	Eliminated Retiree Health Insurance - reduced from 50% premium (10-20 years of service) and 100% premium (20+) paid by state	Employees hired after 1/1/2021		
South Carolina	3%	Reduced share of premium paid by employer and increased years of service required to get subsidy	Hired after 5/1/2008		
Massachusetts	3%	Lowered state contribution from 80% to 75% of premium	Employees hired after 7/1/2003		
Georgia	3%	Reduced subsidy for those with less than 30 years of service, with contribution rangins from 15% of premium (10 years 0f service) up to 75% (30 years of service).	Employees with <5 years of service as of 1/1/2012		
Connecticut	3%	Increased # years of contributions from 10 to 15.	Employees hired after 7/1/2017	State required employees to contribute 3% of pay toward retiree health for a period of 10 years	First employees with <5 years of service as of 2009, then expanded to all employees in 2011.
Ohio	2%	Reduced employer contribution to fixed $ amount (based on years of service and Medicare/non-Medicare) rather than share of premium.	2022 all retirees		
Florida	2%	Florida maintained $5 nominal contribution per month per year of service from 2001 to 2023; raised it to $7.50 7/1/2023			
Total	83%				

Note: Share of Aggregate Normal Costs from Pew (2023) on total S&L OPEB by state (adjusted to our discount rate) but reforms documented are for the state plans alone.

B. Aggregation of ECI-based series using alternative data sources

Using the terminology of Bureau of Labor Statistics (2022), the percent change in the ECI total benefits index for period t can be calculated as

$$\frac{O_t + DB_t}{\tilde{O}_{t-1} + \widetilde{DB}_{t-1}}$$

where DB_t is the cost weight for defined benefit pensions at time t—i.e. the total dollar value of DB pension benefits earned at time *t*—and O_t is the cost weight for all benefits other than DB pensions; $\tilde{O}_{t-1}$ and $\widetilde{DB}_{t-1}$ are the prior period cost weights measured at the current time—the cost weights for period *t-1* calculated from job quotes which match those used to calculate $O_t + DB_t$. (Use of matched job quotes ensures that changes in the index do not reflect composition shifts within detailed industry-occupation cells.)

The ECI benefit index B_t is then:

$$B_t = B_{t-1} * \frac{O_t + DB_t}{\tilde{O}_{t-1} + \widetilde{DB}_{t-1}}$$

In order to operationalize combining subcomponents of the ECI index (e.g. O_t) with data from alternative sources (e.g. DB_t from our alternative series as done in Figure 4) we assume that $DB_{t-1} = \widetilde{DB}_{t-1}$. Furthermore, we must assume that the change in alternative measure of DB_t over time does not reflect shifts in the composition of industry and occupation. Intuitively, these two assumptions amount to assuming that the change in DB_t over time does not reflect composition shifts across industry-occupation cells or composition shifts within these cells (e.g. shifts to a different set of employers in the sample).

Making these assumptions, recursively, the level of the index at time t equals

$$B_t = \frac{O_t + DB_t}{O_b + DB_b}$$

where *b* denotes the base period for measurement, *b*<*t*. Then we can aggregate up to form the

$$B_t = \frac{O_t+DB_t}{O_b+DB_b} = \frac{\frac{O_t}{O_b} * O_b + \frac{DB_t}{DB_b} * DB_b}{O_b+DB_b}$$

We obtain $\frac{O_t}{O_b}$ from the unpublished ECI data as the level of the other benefits index at time *t*. $\frac{DB_t}{DB_b}$ is obtained from the as the ratio of the dollar value of accrued pension benefits at time *t* relative to time *b*. The aggregation weight, O_b, is obtained as a dollar value from the NIPA and DB_b is obtained as a dollar value from our alternative measure.

The assumption that the change in DB_t over time does not reflect composition shifts across industry-occupation cells or composition shifts within these cells is very unlikely to strictly hold. That said, the available evidence suggests the assumption is likely approximately, or roughly, to hold.

Figures A1 and A2 reveal that the growth in state and local government wages and total compensation excluding defined benefit pensions, respectively, evolve very similarly across the ECI and ECEC. The ECEC and ECI are both based on the same sample of establishments captured in the National Compensation Survey (NCS). However, the ECEC is not adjusted for compositional shifts across or within industry-occupation cells. Thus, the tight correspondence across the ECEC and ECI of both wages and total compensation excluding pensions suggests that compositional shifts within the state and local government sector are not important for measuring compensation growth over this period.

Appendix Figure A3 displays the growth in state and local government defined benefit pension compensation measured on a cash basis in the ECI, ECEC, and NIPA.[21] Although there is some deviation between the NIPA and ECEC, which both fail to control for compositional shifts, and the ECI, all three measures broadly track together. As of 2023, the latest year the NIPA measure is available, the ECI index is 10 percent lower than the comparable NIPA index, implying a relatively small difference in growth rates given the nearly 20-year time horizon and very rapid annual growth in all three series. Thus, as measured on a cash basis, Figure 3A fails to suggest that using the NIPA to adjust the ECI will induce significant bias due to the inability to control for compositional shifts in the NIPA. Moreover, the gap between the ECI and NIPA suggests that the NIPA—to which we benchmark our public DB pension measure—*overstates* pension benefits on a cash basis by failing to control for compositional shifts. Figure A4, using data on state and local government pension plans, suggests there is a mild association between the change from 2005 to 2022 in defined benefit pension benefits measured on a cash basis and measured on an accrual basis. (The simple correlation in the two rates of change is 0.27.) As a result, the NIPA accrual-based pension measure may possibly overstate the growth in state and local government defined benefit pension benefits measured on an accrual basis.

Overall, the evidence presented here, while very far from conclusive, suggests that the ECI-based compensation measures we have adjusted to reflect accrual accounting for defined benefit pensions are unlikely to suffer very severe bias due to the inability to control for shifts across and within industry-occupation cells. And to the extent that bias exists, it likely causes us to overstate state and local government compensation deriving from defined benefit pensions which pushes *against* our conclusion that state and local compensation relative to the private sector has been eroding over the past 20 years.[22]

C. Adjusting the BEA's Normal Cost Estimates for Defined Benefit Pensions

BEA uses the entry age normal actuarial approach to measure the accrual value of pension (and OPEB) benefits. This method assumes that benefit accruals are a constant share of wages equal to the present value of current and future benefits divided by the present value of current and future wages. This is the share of wages that, if invested in a fund that earned the assumed discount rate over an employee's tenure, would be sufficient to fully fund the benefit. Entry age normal is also the method pension plans use to calculate normal costs, per requirements established by the Government Accounting and Standards Board (GASB).

The BEA's entry age normal, defined-benefit pension accounting methodology is complex and we have identified two interconnected measurement issues regarding how the BEA adjusts normal costs to a standardized discount rate. The first concern relates to inadequate responsiveness of the BEA's aggregated normal costs when discount rate assumptions change.

[21] The relevant NIPA measures are not included on Figures A1 and A2 because the NIPA wage measure is broader than the NCS measure—see Nicholson and Powers (2015)—and thus not comparable to the NCS measure.
[22] We utilize the NIPA, accrual-based measure of private defined pension benefits to calculate relative pension benefits across the public and private sectors. DB pensions are only a small share of total compensation for private sector employees. As a result, any bias induced by using NIPA data to adjust ECI measures onto an accrual basis for private defined benefit pensions is likely to be negligible.

The second concern is the use of a fixed assumption for the real discount rate in the face of notable moves in market-based estimates of the real rate over our sample period.

Starting with the concern over the sensitivity of the aggregate BEA normal costs to changes in the nominal discount rate. Standard and widely used actuarial rules of thumb suggest that the effective duration of public pension normal costs is equal to 20 to 25 – e.g. for every 1 percentage point decrease in the nominal discount rate, the value of public pension normal costs will increase by 20 to 25 percent.[23] [24] However, a back-of-the-envelope style calculation suggests that when the BEA changes its discount rate assumption the implied duration is only 14.[25] Moreover, a streamlined pension actuarial model that we have developed—described below—produces higher durations, broadly in-line with the actuarial rules of thumb. Consistent with these finding, Biggs (2022) observes that BEA state-specific pension calculations underestimate normal costs compared with values in actuarial reports for the limited number of state plans that provide discount rate sensitivity analyses for normal costs in fiscal year 2018. This observation suggests that the BEA's adjustment of the discount rate downward in this year is not inflating the value of the normal cost to the degree indicated by the plans' sensitivity analysis.

Turning to the issue of real discount rates, the BEA periodically adjusts it nominal discount rate assumption (Figure A6a) but assumes a fixed, time-invariant 2.5 percent real discount rate (Figure A6b).[26] While this fixed assumption aligned well with market real rates when the BEA adopted accrual pension accounting in 2013, it became increasingly unmoored from markets as real rates fell in the years before the Covid pandemic (Figure A6b). Finally, the BEA defines expected inflation as the difference between the nominal and real discount rates (Figure A6c). The decomposition of the nominal rate assumption into a real and inflation component is material for valuing pension normal costs because such costs are more sensitive to changes in the real rate than to changes in the expected inflation rate.

A reduction in the real discount rate will raise the normal cost rate (i.e. the present value of current and future benefits divided by the present value of current and future wages) because the present value of benefits will increase more than the present value of wages, given that retirement benefit cash flows extend further into the future than do wage cash flows.[27] A reduction in the inflation rate matters much less for the normal cost rate. For example, for a

[23] E.g. Munnell and Aubry (2016), Center for Retirement Research (2022), and Winkelvoss (1977).
[24] The duration of a bond (or liability) is the present value–weighted average number of years until payments are made. Effective duration approximates the slope of a bond's value as a function of changes in interest rate. See McCaulay (2013).
[25] Since 2000, the BEA has changed its discount rate assumption four times. These four instances provide an opportunity to very roughly assess the responsiveness of the BEA's pension normal costs to changes in the discount rate. In particular, using the BEA's implied normal cost rate (the normal cost divided by wages and salaries), a detrended percent change is calculated for the year t of a discount rate change as the percent change from year t to year t-1 in the normal cost rate minus the percent change from year t-1 to year t-2. This detrended percent change, in combination with the percentage point change in the discount rate assumption, yields an implied effective duration. The average of the four estimated effective durations is 13.5.
[26] Our understanding of the BEA's methodology for defined benefit pension plans is consistent with Lenze (2013), other published BEA documents, as well as with personal communication with both current and former BEA staff members who have work(ed) with the methodology.
[27] The size of the effect depends on the duration of the normal cost, which it itself equal to the difference between the duration of benefits and the duration of wages.

pension plan with a cost-of-living-adjustment (COLA) that is fully indexed to inflation and wages indexed to inflation, a decrease in the expected inflation rate will have no effect on the normal cost rate; stated differently, the present discounted value of both wages and benefits are unchanged because the rise in wages (benefits) is perfectly offset by the rise in the discount factor.[28] Not all plans' COLAs are fully indexed to inflation and so a reduction in the inflation rate will raise the normal cost on average, but the effect will be relatively small. E.g. even with a fixed COLA or no COLA, lower inflation will lower benefits by lowering wages (and benefits are calculated as a fraction of final wages), offsetting much of the effect of the lower discount rate.

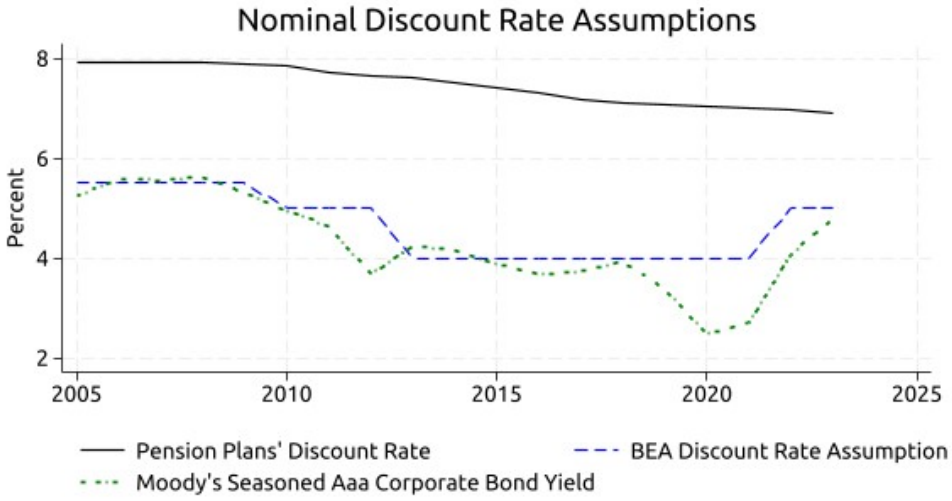
The BEA aims to produce pension valuations that reflect market interest rates, hence the time-varying nominal interest rate which roughly tracks the market rate (Figure A6a). In periods when the market-based real interest rate deviates from the assumed 2.5 percent, however, the valuation of pension liabilities will be out of sync with market implied values.

In order to address this concern, we develop a simple, streamlined pension accounting model. The model assesses the duration of benefits for a typical pension plan for someone entering at 39 years of age and retiring at age 61. Mortality after 65 is modeled using mortality rates from the Social Security actuaries. Wages rise 1 percentage point faster per year than inflation and COLAs are fixed at 2 percent. BEA's model is a bit more complex—they model pensions over the distribution of entry ages and also assume differing wage increases by age. Nonetheless, our model produces a sensitivity of the normal cost to the real interest rate equivalent to a duration of 23 years, consistent with the literature.

We find an effective duration of about 10 years for changes in inflation—a bit below the 12 years reported by Reinsdorf, Lenze, and Rassier (2014). As shown in Lenney, Lutz, Schule, and Sheiner (2021), most plan COLAs are not fully indexed to inflation, but some of them are. We are comfortable using a slightly lower duration of the normal cost to inflation than that found by BEA because it can be seen as accounting for the fact that, for some plans, changes in inflation will have no effect on the normal cost.

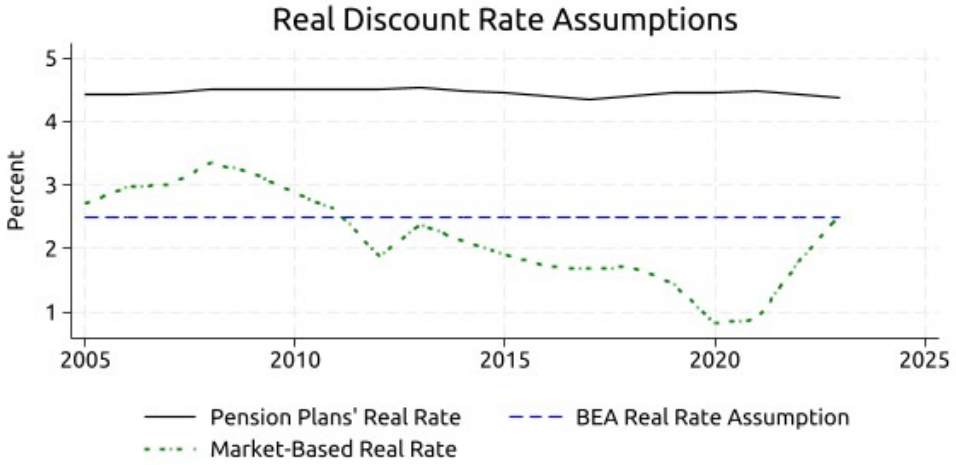
[28] E.g. assuming for simplicity that wage growth arises only due to inflation, the present discounted value of wages equals $\sum_{t=1}^{n} \frac{w_1*(1+i)^t}{(1+r)^t(1+i)^t} = \sum_{t=1}^{n} \frac{w_1}{(1+r)^t}$ where time $t=1$ is the year of entry into employment, n is the year of retirement, r is the nominal interest rate, and i is the expected inflation rate.

Figure A6a



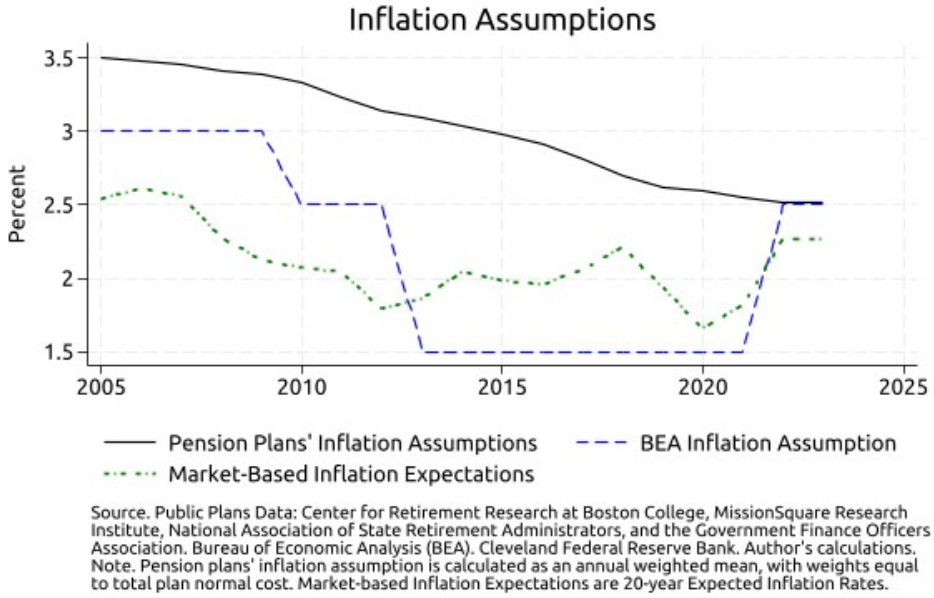
Source. Public Plans Data: Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Bureau of Economic Analysis (BEA). Moodys Investor Service. Author's calculations.
Note. Pension plans' discount rate assumption is calculated as an annual weighted mean, with weights equal to total plan normal cost.

Figure A6b



Source. Public Plans Data: Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Bureau of Economic Analysis (BEA). Moodys Investor Service. Cleveland Federal Reserve Bank. Author's calculations.
Note. Pension plans' real rate assumption equals the weighted average of each plan's nominal discount rate minus their assumed inflation, with weights equal to total plan normal cost. The market-based real rate equals Moody's Seasoned Aaa Coporate Bond Yield minus 20-year expected inflation rates.

Figure A6c



Source. Public Plans Data: Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Bureau of Economic Analysis (BEA). Cleveland Federal Reserve Bank. Author's calculations.
Note. Pension plans' inflation assumption is calculated as an annual weighted mean, with weights equal to total plan normal cost. Market-based Inflation Expectations are 20-year Expected Inflation Rates.

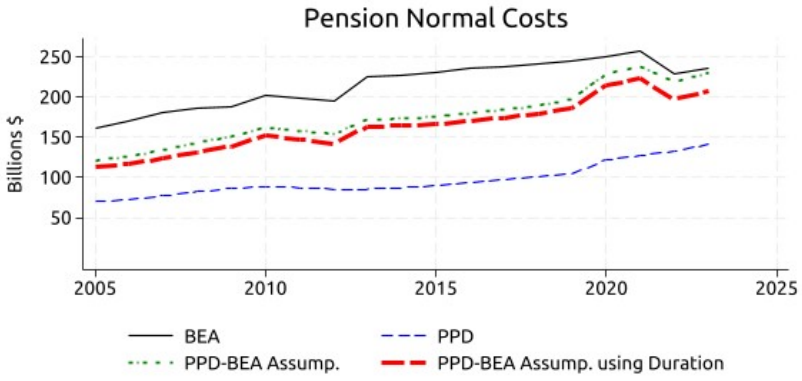
In order to generate an estimate of aggregate pension liabilites we start with the Center for Retirement Research at Boston College's Public Plans Data (PPD) which provides an annual panel dataset of state and local government pension plans; it includes information on plan normal costs and the actuarial assumptions used to calculate them, including the nominal interest rate and expected inflation. As can be seen in Figures A6a, A6b, and A6c, these plan-specific assumptions, on average, tend to differ from market-based estimates. In order to adjust the plan data to be aligned with market-based assumptions, we first estimate the normal cost in our pension accounting model under different real interest rate and inflation assumptions. Next, we summarize the sensitivity of normal costs as semi-elasticities by fitting a cubic spline in real interest rates (inflation) to explain variation in the log of the model-produced normal costs; the cubic spline flexibly allows for non-linearlity. Finally, we use the difference between the real interest rate (inflation) assumptions of the plan and the market-based measures, along with the cubic spline semi-elasticity relationships, to adjust each pension plan's normal cost to reflect market-based assumptions. Both the BEA in constructing the NIPA and the Federal Reserve Board in constructing the Financial Accounts of the U.S. use the AAA corporate rate to discount pension liabilities. They, however, only adjust the nominal interest rate assumption periodically (less than annually) and hold the real rate fixed over time. In contrast, we allow the nominal interest rate, the real interest rate, and expected inflation to all vary annually.

The blue line in Figure A7a displays the annual aggregate normal costs in the PPD while the black line displays the published BEA normal costs. As would be expected given that the plans' assume much higher real interest rates than does the BEA (Figure A6b), the plans'a aggregate normal cost is much lower than is the BEA's. In order to assess the accuracy of the method we have developed for adjusting the plan's normal costs to different interest rate and inflation assumptions, we use our method to adjust the plans' normal costs to be consistent with BEA's

assumptions (the green dot-dash line in Figure A7a). These adjusted estimates match almost exactly the BEA's estimates in the last years' of our sample. They diverge, though, in earlier years. The reasons for this divergence in the pre-2020 sample is unclear and, given the complexity of the BEA's pension methodology, would likely be difficult to pin down.[29] [30] In order to ensure we do not understate the magnitude of state and local government pension liabilities, we benchmark our annual normal cost estimates to the BEA's normal costs estimates by calculating a calibration factor equal to the ratio of the published BEA normal cost to our normal cost produced with BEA assumptions (i.e. the ratio of the black to green lines in Figure A7a.)

Our final normal costs estimates are produced in two steps. First we use the cubic spline semi-elasticity relationship to adjust the pension plans in the PPD to reflect market-based values for real interest rates and expected inflation and aggregate them to annual, national values. Second, we benchmark the estimate to the BEA's normal costs by multiplying the estimate from the first step by the BEA calibration factor. These final estimates are displayed as the dashed blue line in Figure A7b. These estimated normal costs are fairly close to the BEA published normal costs (black line) from 2005 through 2015. Thereafter, as market real interest rates fell significantly below the BEA's assumption, our market-based normal cost estimate moves substantially above the BEA's normal costs. With the sharp rise in real rates in starting in 2022, our normal costs move back into alignment with the BEA's.

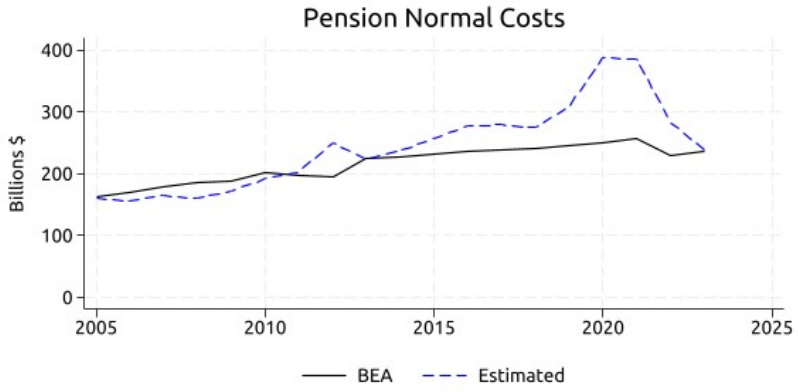
Figure A7a



Source: Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Public Plans Data. 2001-2023: Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Author's calculations.
Note. PPD-BEA assumption line displays the PPD normal cost adjusted to the BEA's assumptions for inflation and real rates using our pension model approach. The PPD-BEA assumption using duration line displays the PPD normal cost adjusted to the BEA's nominal interest rate assumption using a standard effective duration calculation.

[29] In principle the PPD captures 95 percent of total state and local pension liabilities.
[30] We also adjust the PPD normal costs using a standard effective duration adjustment, assuming a duration of 25, and the deviation between the plans' nominal interest rate and the BEA's assumption (the red dashed line in Figure A7a). These estimates are similar to, but somewhat lower than, our preferred normal cost estimates produced using our more complex, model-based procedure.

Figure A7b



Source: Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Public Plans Data. 2001-2023: Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Author's calculations.
Note. BEA line represents the published normal cost in the NIPA. The Estimated line is our calculation of the aggregate normal cost based on PPD data, market-based assumptions for inflation and real interest rates, and an annual calibration factor.

D. Retiree Health (OPEB) Estimates

For 2022, we have gathered data on normal costs, employee contributions, payroll, discount rates and inflation rate for the largest 26 state retiree health care plans (OPEB), and use the data from Biggs (2022) for the remaining, smaller states. Our hand-collected data represent 96% of employer normal costs (normal costs less the employees' contributions) for state plans.[31] The average employer normal costs for these plans, after adjusting to our preferred discount rate, is 4%. However, Pew (2023) collects data on a much larger set of plans, including many local plans. After adjusting their data for differences in the discount rate, their aggregate OPEB normal cost represents just 2% of BEA State and Local wages.[32] This much smaller estimates suggests that the large state plans are the most generous. In addition, not all workers participate in these plans, either because they are ineglibile (possibly part-time and seasonal workers) or choose not to contribute when a contribution is required. We average these two estimates and calibrate the level of employer normal costs in 2018 to be 3% of wages.

From 2018 through 2022, we have collected data for 13 large plans in the 8 states that represent 69% of aggregate OPEB costs. We adjust the normal costs in those plans for differences between our preferred real discount rate and that used by the plans, convert them from a fiscal year to a calendar year basis, and then aggregate them. We use the growth rate of that aggregate to estimate the normal cost from 2018 forward. Some of these plans have data going back to 2011

[31] One difference between our data is that we have collected the discount rate from the preceding period, as this is typically the one that is used to calculate normal costs under GASB. Biggs does not collet inflation rates, and we only want to adjust for differences in the real rate of interest, so for the plans on which we rely on Biggs, we substitute our own rate. These plans represent only a small fraction of the aggregate so these differences will have no material effect on our estimate.

[32] BEA adds the employer share of FICA taxes to total wages, but that concept of wages differs from the one used in the CPS. We adjust for this by dividing BEA wages by 1.0765.

and some start later. We use the growth rates of plans for which we have data to back-cast the employer normal from 2018 backwards.[33]

Finally, in order to adjust the discount rate for OPEB normal costs, we created a prototypical retiree health insurance plan to estimate duration. The model differs in three respects from the model used to assess pension duration. First, as is the case in the data we have collected, we assume that the cost of retiree health insurance falls by 70 percent once retirees turn 65 and become Medicare eligible. Second, we assume that health insurance costs rise more than consumer prices over time. The first factor shortens OPEB duration relative to pensions while the second lengthens it. In our estimates, these factors are roughly offsetting, leaving the duration of the OPEB normal cost about the same as the pension normal cost duration. Finally, we assume that health insurance costs fully reflect changes in consumer price inflation, and so only real discount rates affect OPEB normal costs. This assumption is a sensible one and is also a feature of the model used by many retiree health insurance plans to estimate long-run medical cost inflation (e.g. the Society of Actuaries' Getzen Model of Long Run Medical Cost Trends.)

[33] Our data cover the following plans, with the calendar year start date of our data in parentheses: the New York City Teachers (2011) and New York State Employees plan (2018), the Massachusetts State Employees plan (2011), the Illinois State employees plan (2011) and Illinois Teachers plan (2012), the New Jersey state plan (2011), the California State plan (2011), the Pennsylvania state employees plan (2015), the Texas Teachers (2016) and Texas State Employees Plan (2017), the Ohio School Employees (2017), the Ohio Teachers (2017), and the Ohio state employees plan (2018). Many of the state plans also cover some local employees.