Falling Behind? State and Local Government Compensation Since the Great Recession?

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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 Augmenting standard data sources on employee compensation with information on worker benefit provision derived from unpublished Bureau of Labor Statistics data and asset-based methodologies for valuing non-wage benefits, we document a significant erosion in the public sector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 10 percent higher total compensation than private sector workers with similar observable characteristics in 2011, our evidence indicates that this differential had declined to negative 5 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 declined as a share of compensation, 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—falling from a very slight wage premium in 2011 to a nearly 15 percent penalty by 2024. Finally, we show that the decline in relative public compensation has been pervasive, having occurred not only nationally, but also in each of the 50 states. 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 public sector defined-benefit pensions in the NIPAs understate the value of state and local government annual pension accruals 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 emerged as a focal point in recent policy discussions, particularly in the wake of challenges exposed by the COVID-19 pandemic and the rollout of the Inflation Reduction Act (IRA). Enacted in 2022, the IRA committed substantial resources to clean energy and climate initiatives, yet its implementation encountered significant delays stemming from administrative hurdles and regulatory uncertainties—a vivid illustration that legislative ambition can outpace institutional capability. The problem is not confined to the federal level. The water crisis in Flint, Michigan, is at least partly attributable to inadequate technical expertise and oversight capacity within state government (Flint Water Advisory Task Force 2016). A lack of sufficient capacity in state departments of transportation helps explain why public infrastructure costs in the United States far exceed those in peer economies (Liscow, Nober, and Slattery 2023). And while perhaps less dramatic, the Hawaii Department of Taxation's struggle to modernize tax administration due to skill gaps among its staff illustrates how capacity shortfalls can impede even routine government functions (Wood 2016).

These examples point to a common thread: the quality of the public workforce matters. Competitive compensation for state and local government workers is therefore central to subnational state capacity, as it directly shapes the recruitment and retention of the skilled personnel on whom effective governance and policy execution depend. At the same time, this assessment of public-sector pay is not uncontested. Some researchers argue that state and local employees are already overcompensated relative to comparable private-sector workers (e.g., Biggs 2012), suggesting that realigning public pay with market rates could yield meaningful efficiency gains.

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 very 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, unionization status, and by state.

Our 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 with the same observable characteristics and in the same occupation. Moreover, the value of retiree health care in the public sector and of defined benefit pensions have very roughly moved sideways in nominal terms—failing to keep pace with wage growth—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 between 10 to 14 percent 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 10 percent more than their private sector counterparts with similar observable characteristics as of 2011. 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 5 percent less than their private sector peers when all job benefits are accounted for.

We further document 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 nearly 15 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. We also document that the decline in relative state and local government compensation is very pervasive as it has occurred in all 50 states.

Finally, we acknowledge an important limitation to our results: they cannot establish whether or not public employees are earning rents—i.e. if they are "overpaid" or "underpaid"—relative to their private sector peers. This limitation arises from two factors. First, the unobservable quality of the public sector labor force likely reflects relative pay – e.g. as relative pay falls, the unobservable quality of the public workforce may decline. Second, we do not account for, nor can we easily measure, non-compensation aspects of jobs that workers may value (beyond job stability). Both explicit non-compensation amenities, such as flexible scheduling and teleworking policies, and more intangible amenities, such as dignity at work, have been shown to be valued by workers (see Mas 2025 for a comprehensive treatment; see also Collis and Van Effenterre 2025; Dube, Naidu, and Reich 2022; Mas and Pallais 2017; Wiswall and Zafar 2018; and Maestas et al. 2023). For example, Tsao (2025) who compares teachers' pay to their own next-best alternatives—effectively holding both observable and unobservable worker characteristics constant—and finds that teachers in Kentucky were paid more than they would have been paid in their next-best jobs, which tended to be relatively low-paying positions, but that this higher pay was almost fully offset by poorer working conditions, implying little or no rents, particularly for inexperienced teachers.

The declining relative pay of public sector workers that we document may thus be associated with several (non-mutually exclusive) labor market changes. The composition of the public sector workforce could be shifting to lower unobservable quality. Rents available to public sector employees could be decreasing. Or the value of non-wage amenities in the public sector could be increasing to offset the reduction in compensation. As discussed below, these outcomes may differ by employee age as older public sector workers tend to face higher costs to transitioning to the private sector due to the structure of pension and retiree health benefits. Although we mostly leave sorting out the implications of the decline in relative public-sector pay to future research, we do conclude the paper with a brief discussion of two suggestive pieces of evidence that the decline in relative pay has inhibited the ability of the sector to attract and retain high-quality employees: the difficulty governments had restaffing relative to the private sector following the Covid-19 pandemic and the eroding labor market landscape for K-12 teachers.

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	0.85	0.70
14	Benefits	0.15	0.30
15	Defined Benefit Pension (accrual basis)	0.01	0.13
16	Retiree Health Care (accrual basis)	.	0.01
17	Other Benefits	0.15	0.16

Source. Panel A: 2024 Current Population Survey; Panel B: 2023 National Income and Product Accounts and author's calculations for defined benefit pensions and 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 small role (row 16). Other benefits—e.g. health insurance and paid time off—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 state and local government (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.[1] [2]

[1] 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), Freeman (1987), Katz and Krueger (1991), Krueger (1988), and Poterba and Rueben (1994), and Smith (1977).

[2] 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.

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 data 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.[3] 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.[4]

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 differences across the sectors in job stability. The chief drawback of the CPS, however, is its lack of information on non-wage employee benefits.[5]

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[3] 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*.

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

[5] 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).

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 problematic because state and local governments, per accounting rules, use their expected return on assets as the discount rate unless assets are projected to be depleted, in which case a lower municipal bond rate applies to the portion of benefits payable after asset exhaustion. 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 and the use of annual, market-based interest rate measures. 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

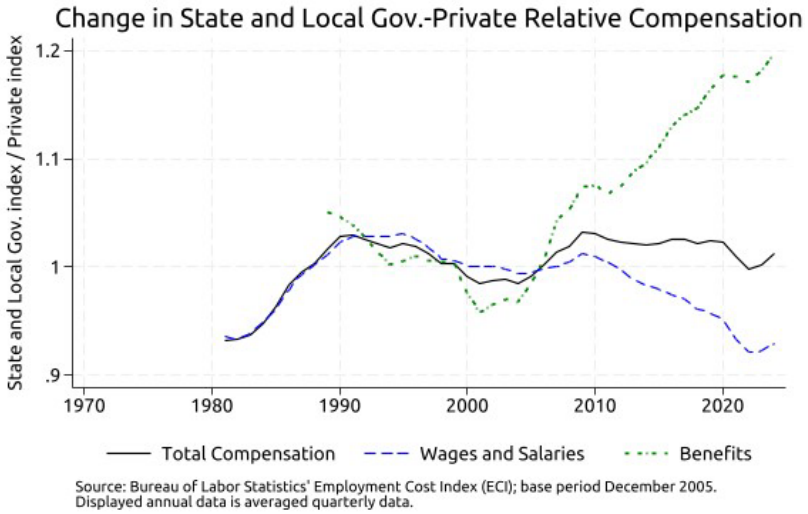
annual normal cost accrual value in 2018, and calculate changes over time using data from a smaller subset of plans. The methodology is presented in detailed in section IV.B.2. Finally, we estimate the value of job stability using CPS data and the methodology discussed in section IV.B.3.

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.

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.[6] 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

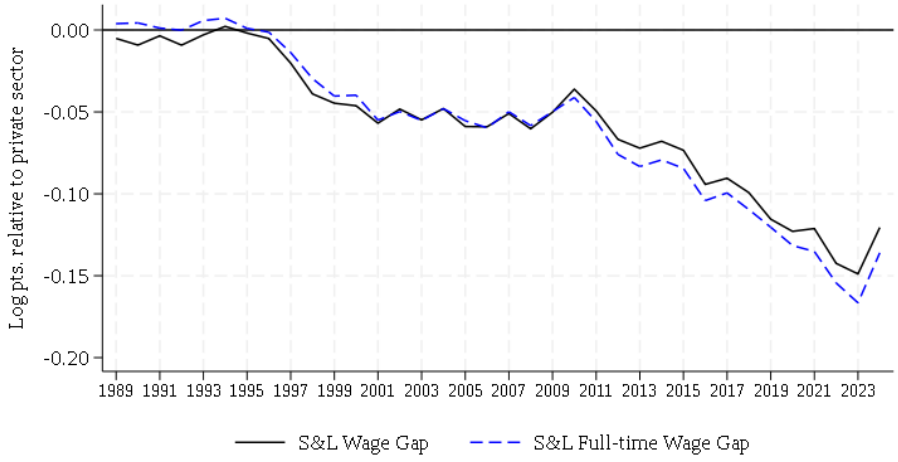
[6] See Gittleman and Pierce (2011) for a detailed discussion of the role of control variables in assessing public-private compensation differentials. We omit union representation from our set of control variables as, in recent years, union representation has become very substantially more common in 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.

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.

We view the above estimates as conservative—i.e. tending toward finding a higher relative public wage premium—as we have omitted control variables often used in the past literature which depress the measured premia. See Appendix Figure A0 which documents that controlling for firm size or union status, which we omit from the results displayed in Figure 2—significantly reduce the public wage premium.

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.

IV.B Benefits

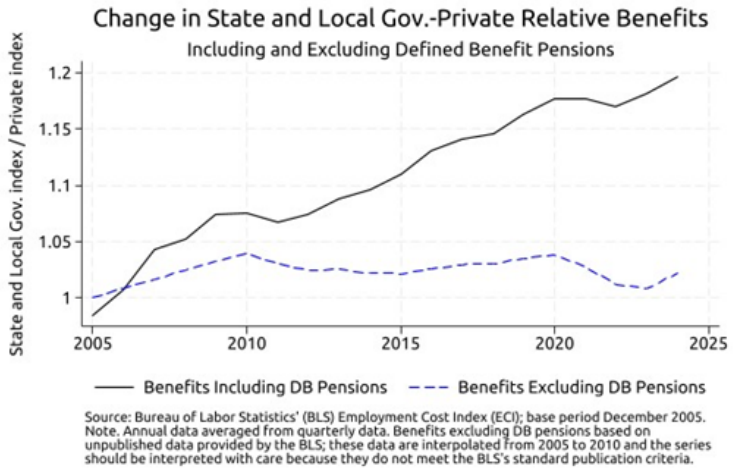
We now turn to examining relative differences in non-wage compensation. We focus on defined benefit pensions, retiree health care, and job stability as they are areas for which there are substantial measurement challenges not addressed by the ECI. That said, in our final accounting of the overall public 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.[7] The rise in relative pension benefits is surprising because states and localities have been reducing DB pension generosity for both current workers, e.g. by paring back cost-of-living-adjustments, and for new workers, e.g. by introducing new, less generous benefit tiers and requiring increased employee contributions (Abashidze, Clark, and Craig 2021; Aubry and Crawford 2016; 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



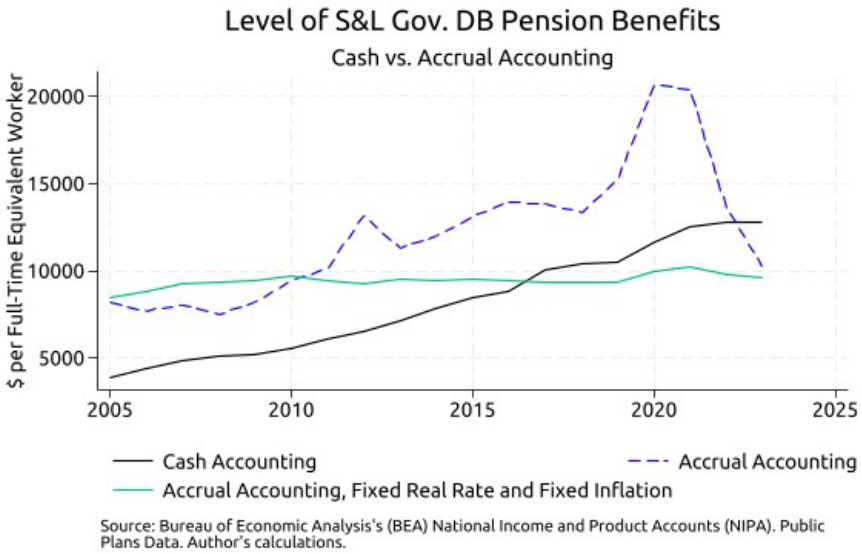
An alternative, accrual-based measure of DB pensions is provided by the BEA in the NIPA. However, as mentioned above, this measure is problematic because it is excessively insensitive to real interest rate changes. Furthermore, as we discuss in Appendix C, the BEA measure shows sharper declines in normal costs over time than seems consistent with the changes that have been made to plans . We therefore construct an 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.[8] 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 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.[9] Finally, in order

[7] 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.
[8] Public Plans Data. 2001-2023. Center for Retirement Research at Boston College, Mission Square Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association.
[9] 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

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. See Appendix C for a detailed discussion of both the measurement issues we have identified with the BEA's measure of state and local government pension accruals and our procedure for producing our alternative measure of pension accruals.

Figure 3a displays pension benefits per full-time equivalent worker on a cash basis (from the NIPA, black line) and on accrual basis (our measure, dashed blue line). 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 3a



Source: Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Public Plans Data. Author's calculations.

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.

Figure 3b

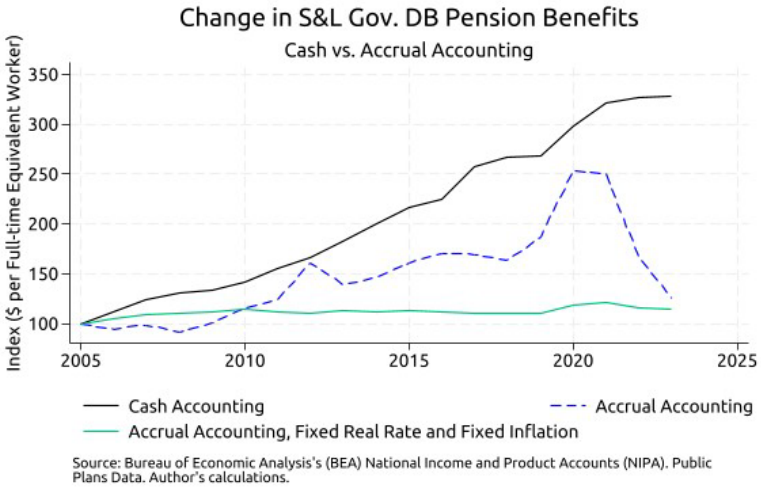


Figure 3b displays the indexed version of the cash and accrual S&L pension benefits. There is a very stark difference in the growth rates between cash and accrual accounting. As measured by cash accounting (the black solid line), there has been rapid growth in pension benefits. This is consistent with 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.[10]

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.

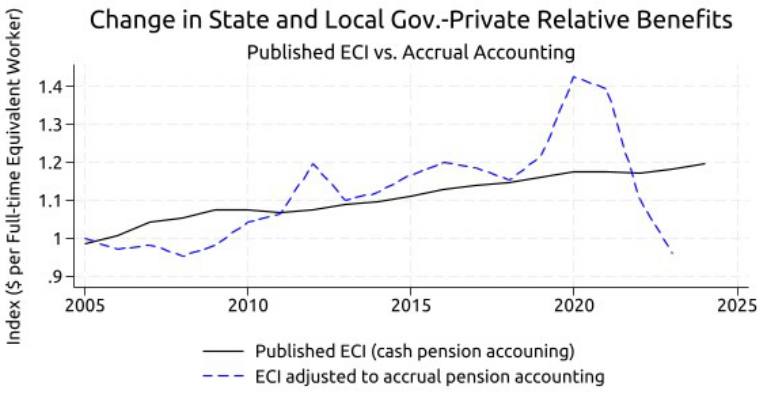
The green lines in Figures 3a and 3b show the evolution of the accrual value of pension benefits under a counterfactual of constant inflation and interest rates (set equal to their values in 2023). Without changes in interest rates, the nominal value of benefits per FTE would have been flat over the past two decades—meaning that benefits as a share of wages would have been declining. This accords well governmentsmaking pension plans less generous over time.

[10] 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 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 measure 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.

Figure 4



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.

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.[11]

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). Appendix section D provides details on the data sources and methodology we use to quantify OPEB benefits

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.[12] Given that the most state and local governments offer these benefits to employees, while few private-sector employers do, this omission skews public sector compensation measurements.[13]

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.

[11] 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 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.

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

[13] 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.

Our method for valuing these costs is as follows. PEW (2023) provides data on 173 state and local retiree health insurance plans for fiscal year 2018. We adjust the PEW data so that the accrual value is measured using our preferred discount rate (discussed below), rather than the plans' discount rates. The Pew data suggest that aggregate normal costs represented only about 2% of wages in FY2019. We overestimate the compensation differential due to OPEB because we 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 contrast, those data show that 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 public sector retiree health benefits over time is inherently constrained by data limitations. In particular, from 2011 to 2015, we rely on data for the small subset of public OPEB plans that published it. We gather more comprehensive data from 2016 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 unfunded liabilities determining the share of the blended discount rate equal to the 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 regard 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]

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

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.
As shown in Figure 5a, our findings indicate that, in 2023, the average nominal value of retiree health benefits was approximately $920 per worker in the state and local sector, similar to the $810 in 2010.

Figure 5b shows these benefits as a share of wages and also includes a counterfactual in which interest rates are held constant at their 2023 value. Benefits have declined as a share of wages on average (black line), although the low interest rates in 2020 boosted them temporarily. Holding interest rates fixed (dashed blue line), retiree health insurance accruals have been falling as a share of wages since 2015. (We lack data on retiree health care benefits after 2022, so simply assume that benefits as a share of wages would have been constant if not for change in interest rates.)

Figure 5a

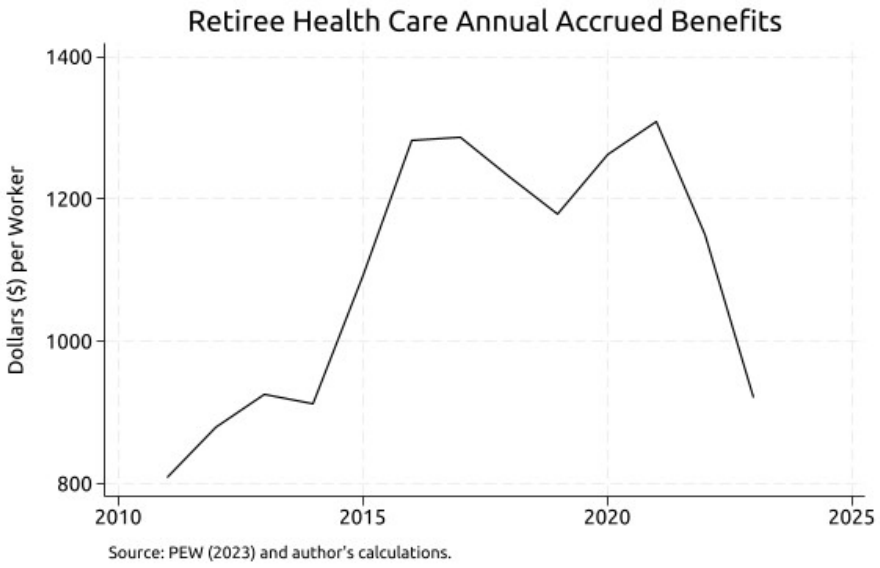
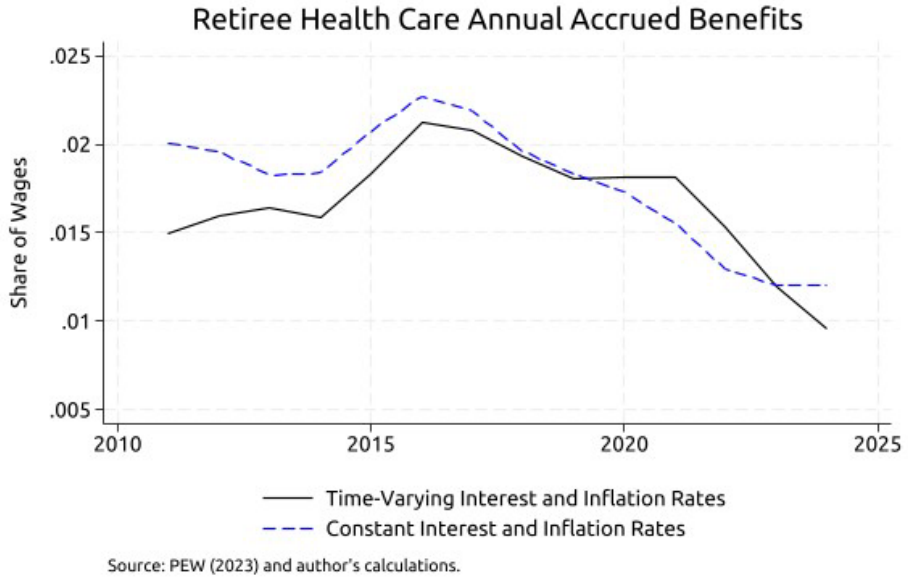


Figure 5b



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.

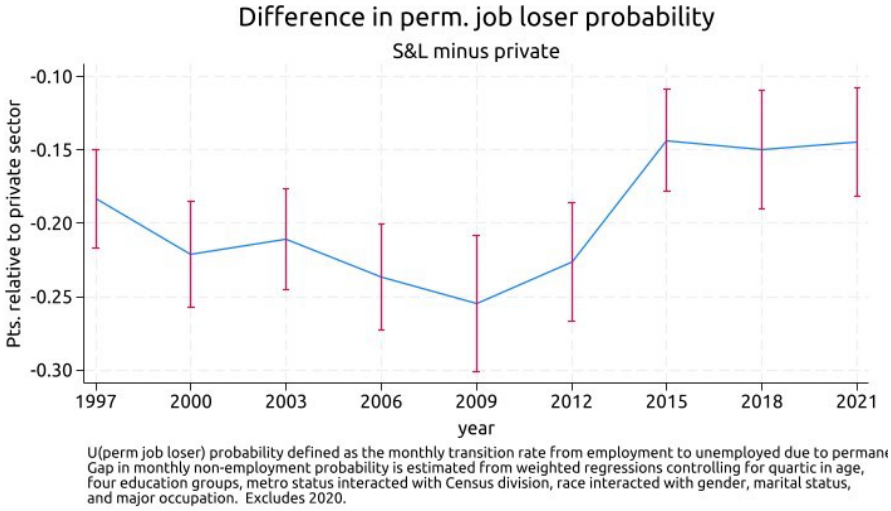
As shown in Figure 6, we find that the job loss probability of S&L workers relative to similar private-sector workers improved from the late 1990s through the Great Recession, with the difference falling to 0.25 percentage point per month in 2009—or 3 percentage point per year. However, since 2012, the job loss rate has risen for S&L workers relative to private-sector workers to a gap of about 0.15 percentage point per month—or 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.

To determine how valuable a given degree of job stability is for a worker, we outline a very simple model of job loss. We ground the model in the long-running empirical literature which has shown that job losses cause persistent declines in the earnings potential of workers. In particular, we rely on the influential analysis of Davis and von Wachter (2011) who show that job loss causes a roughly 12% decline in the present value of wages for a worker.

Let the present discounted value of a job be represented by the value V_t, and equals the flow of wages from the job discounted by both the real interest rate as well as the probability of losing the job. We assume that the probability of job loss is δ and, consistent with David and von Watcher (2011), the cost of the job loss is α percent of the value of the job, $U_{t+1} \equiv (1-\alpha)V_{t+1}$.

Figure 6



The equation for the value of a job can be written

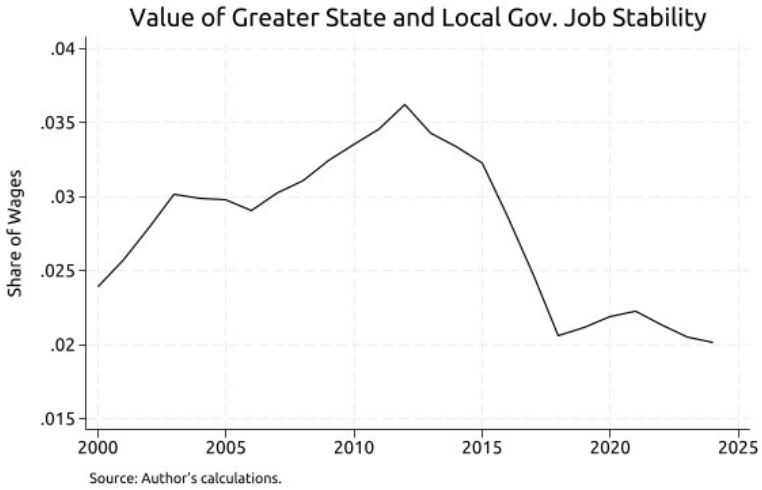
$$V_t = w_t + \beta[\delta U_{t+1} + (1-\delta)V_{t+1}],$$

where $\beta = \frac{1+g}{1+r}$ where g is the annual growth in real wages and r is the real discount rate. Plugging in for U_{t+1} and iterating forward for T periods (assumed to be 20 years), where the worker faces the job loss risk each year, the value of a job is given by the simple expression

$$V_t = w_t \frac{\left(1-\beta^T(1-\delta\alpha)^T\right)}{1-\beta(1-\delta\alpha)}.$$

The value of the job is therefore declining in the probability of job loss, reflecting a premium for job stability, holding the wage fixed. Therefore, for workers to be indifferent between jobs in the public and private sectors with different job loss rates (δ) the wage must adjust to compensate. Using this equation, the estimate of $\alpha = 12\%$ from Davis and von Wachter (2011), the estimates of δ from the exercise displayed in Figure 6, our annual market-based real discount rate *r* assumption, and an assumption of 0.02 for real wage growth *g*, 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 about 3.5% of wages but has declined since to a value of just 2% of wages in 2024. 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 ¾ percentage point from 2005 to 2024.[15] [16]

Figure 6b



[15] While we view our simple job stability framework as a useful and transparent method to value job stability, we acknowledge there are any number of possible objections. We briefly note two. First, the framework implicitly assumes workers are risk neutral. If we incorporate risk aversion, the certainty equivalent wage premium rises quickly with the degree of risk aversion. That said, the Davis and Von Wachter (2011) empirical estimates are expressed as the PDV of wage loss, not utility; its unclear if *U* and *V* were measured in in our framework in utility units, rather than dollars, that the Davis and Von Wachter (2011) empirical estimates would remain appropriate. Second, 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 document 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. Our measure of job loss is broader than that used by Davis and von Wachter (2011) as 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 (2011).

[16] 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.

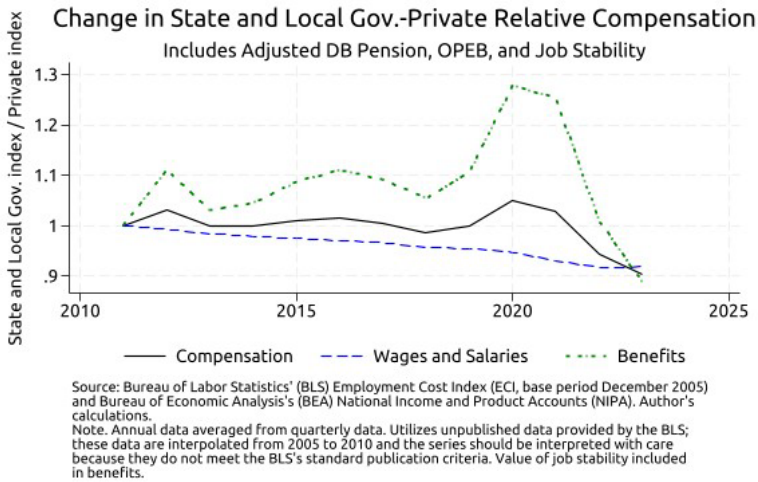
IV.C Comparing Total Compensation

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

IV.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.[17] Incorporating accrual accounting for DB pensions and the inclusion of OPEB benefits and job stability 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 roughly flat from 2011 to 2019, as a decline in wages is 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. 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.

[17] 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.

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

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

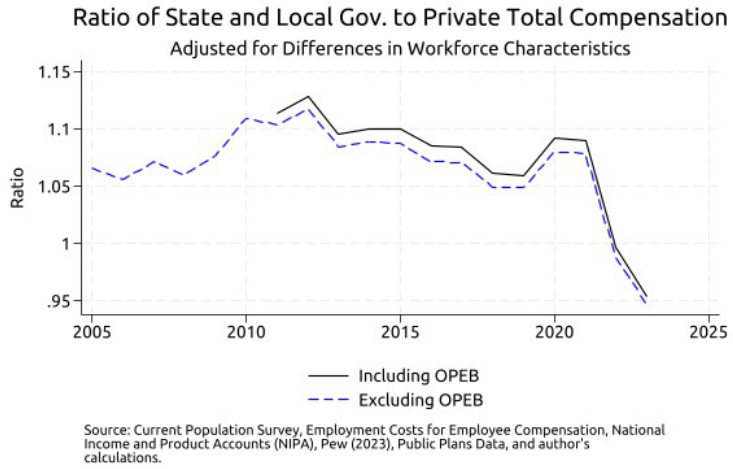
We measure (or approximate) wage premiums, $\frac{W_{SL}}{w_{Private}}$, using our CPS-based estimates which correct for differences in the composition of employees across the sectors (Figure 2). We then calculate relative public (private) benefits as a share of wages, $benshare_{SL}$ ($benshare_{Private}$). 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.[18] 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 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 evidence suggests that state and local workers were overcompensated by around 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 correspondingly 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 consistent with what workers perceive.

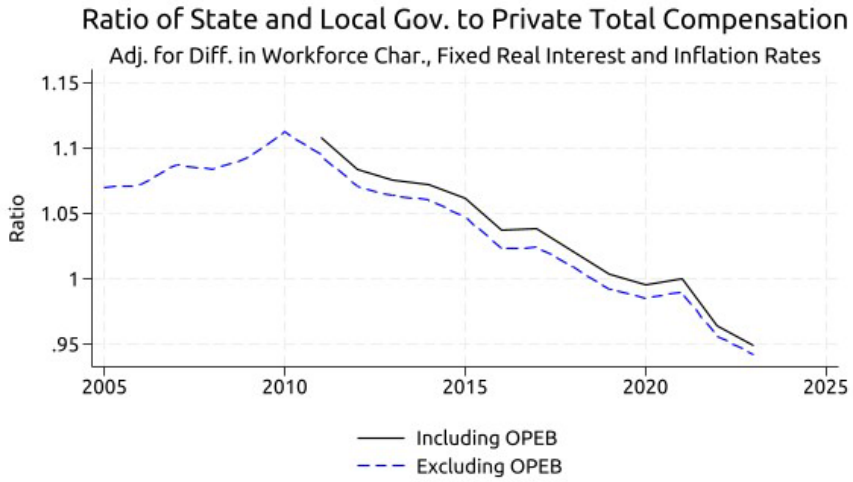
[18] Our state and local government DB pension estimates are benchmarked to the comparable pension estimates in the NIPA. Thus, using NIPA wages to calculate the pension benefit share is appropriate.

Figure 8a



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2023), Public Plans Data, and author's calculations.

Figure 8b



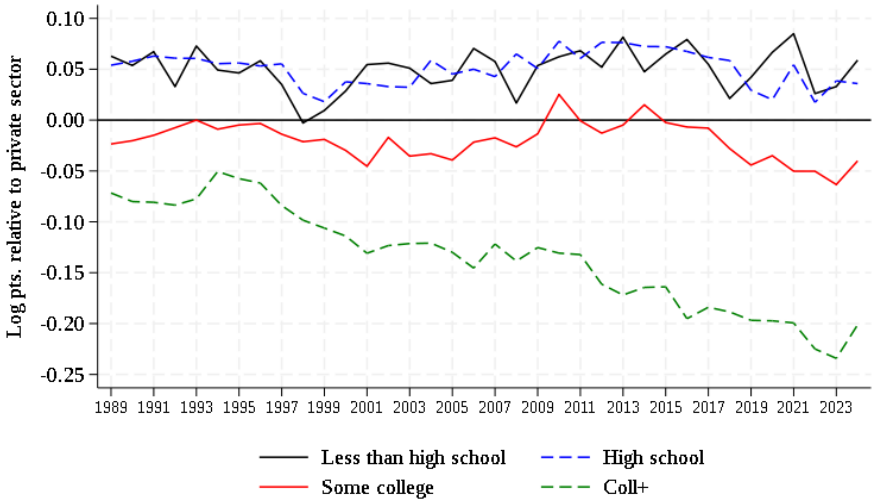
Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2023), Public Plans Data, and author's calculations.

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 mid 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.[19]

Figure 9
S&L government wages relative to private sector by education



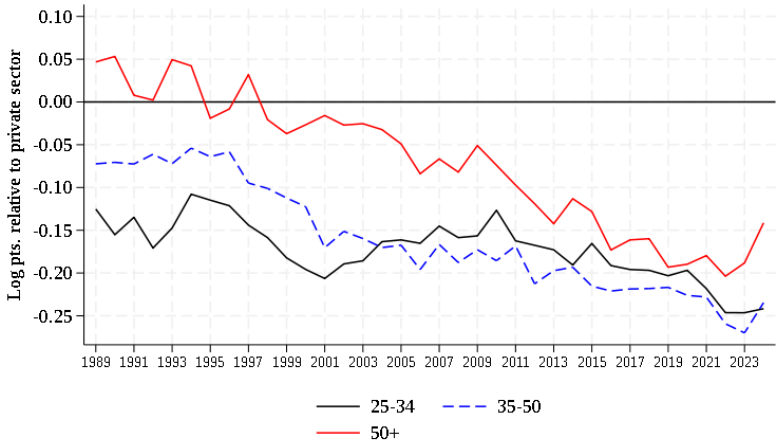
Gap in wages for S&L workers relative to private. Regressions are run separately for each education group and are weighted and control for a quadratic in age, metro status interacted with nine Census divisions, race interacted with gender, marital status, and major occupation.

Informed by Figure 9, we turn to investigating patterns of wage dynamics within the most highly educated group 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

[19] 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.

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.[20]

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

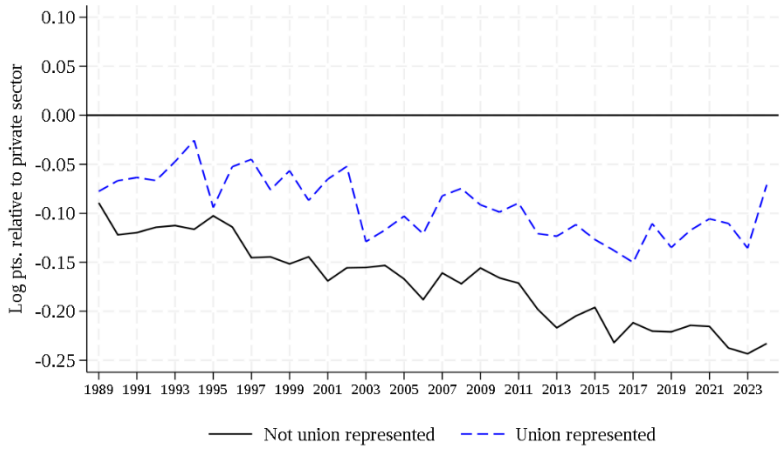


Gap in wages for S&L workers relative to private among those with at least a college degree. Regressions are run separately for each age group and are weighted and control for a linear term in age, metro status interacted with nine Census divisions, race interacted with gender, marital status, and major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

Finally, it appears that relative wages among the more highly educated have fallen especially for those who are not covered by unions. Figure 11 shows little relative decline in pay of those represented by a union (the blue dashed) line since 2000, whereas the relative pay of those who are not represented by a union saw pay decline by roughly 10 percentage points from roughly 2000 to 2024. This result is broadly consistent with Baker, Halberstam, Kroft, Mas, and Messacar (2024) who show that unionization boosts the wages of highly educated public sector workers.

[20] 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 11
S&L government wages relative to private sector by union status
College +

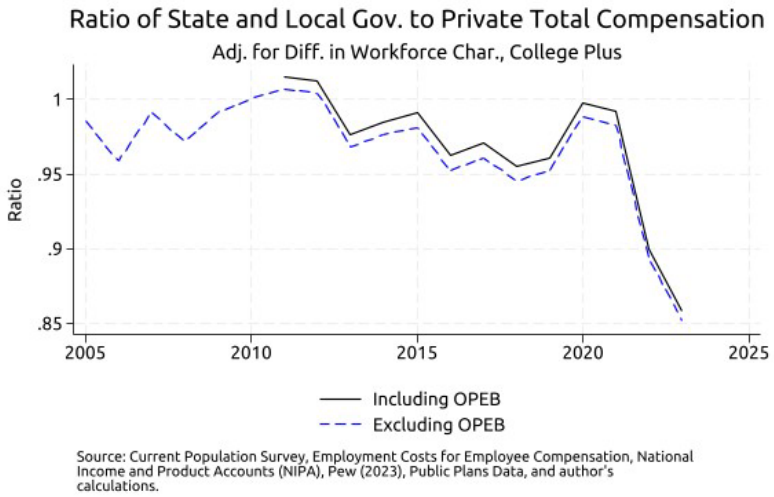


Gap in wages for S&L workers relative to private among those with at least a college degree. Regressions are run separately for each age group and are weighted and control for a quadratic in age, metro status interacted with nine Census divisions, race interacted with gender, marital status, major occupation,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

Figure 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.[21] The results suggests that relative pay of college educated public workers has declined by about 14 percentage points since 2011; in 2023, college plus workers experienced a pay deficit of nearly 14 percent relative to their private sector counterparts. For high-school educated workers, the decline has been much less steep—about 8 percentage points, and these workers still enjoy a bonus of 17 percent for working in the S&L sector.

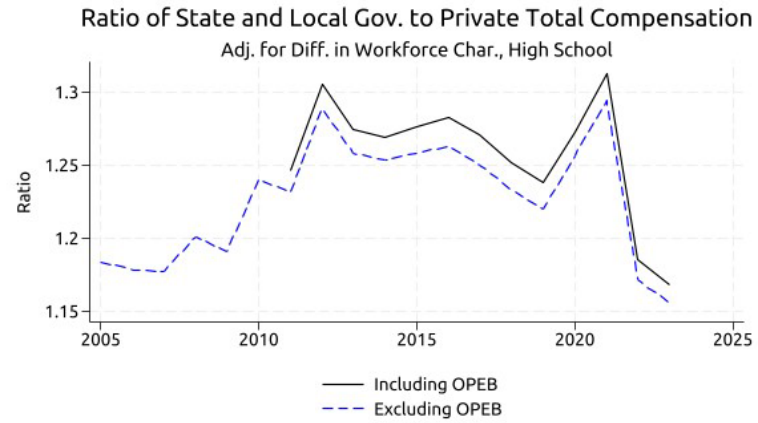
[21] We scale the retiree health care portion of $benshare_{SL}$ in equation (1)—i.e. the aggregate normal cost for retiree health care—by the ratio of the average wage for all workers to the average wage for the given education group . This adjustment ensures workers in all education groups are credited with the same dollar value of benefits. Relative to not making the adjustment, the value of retiree health care is reduced for workers with a college degree and boosted for workers with only a high school degree.

Figure 12a



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2023), 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 (2023), Public Plans Data, and author's calculations.

IV.E Relative Compensation by State

We conclude our analysis with an examination of the public-private compensation differentials across states. To do so, we use our CPS-based methodology as the CPS provides state-level identifiers. Our methodology for calculating the differentials is generally the same as for the national estimates, but with the data aggregated to the state-year level instead of year.[22] That said, there are a few important deviations. In order to smooth through year-to-year variability in the public-private wage differential estimates, which can be substantial for smaller states, we use a three year backward moving average of these estimates. We lack any state-specific information on benefits other than pensions and retire health care by state and therefore assign each state the national per-worker values calculated above for other benefits. Fortunately,

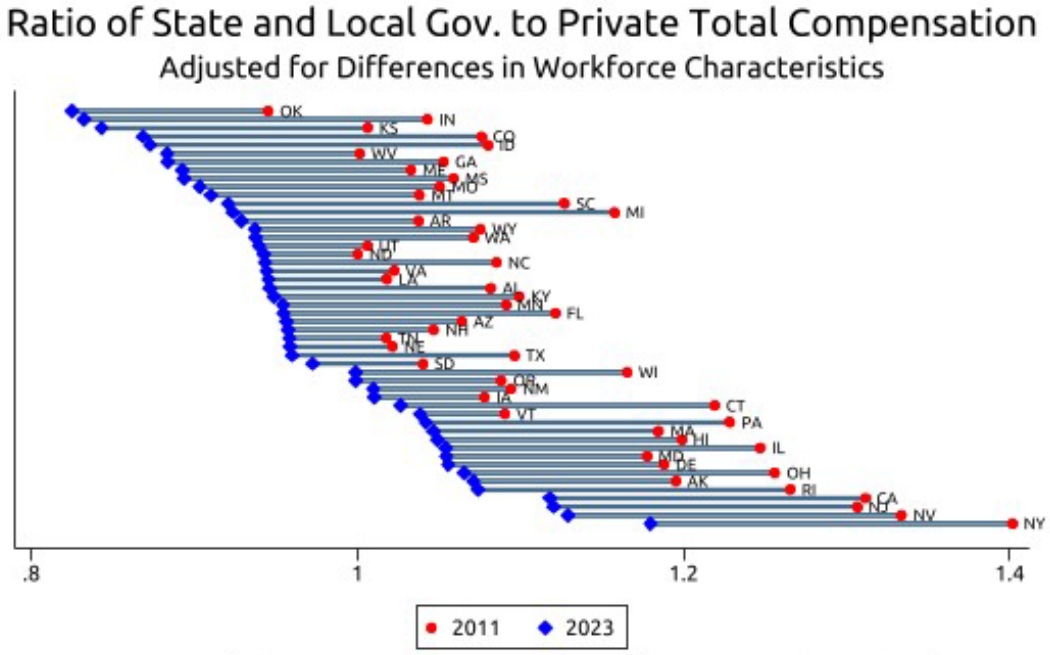
[22] The NIPA provide measures of state and local government pension normal costs disaggregated by state. For retiree health benefits we rely on Pew (2023) and state government actuarial reports.

outside of health insurance coverage, these other benefits tend to vary less across employers than do pension and retiree health care benefits (Biggs 2014). The lack of state-specific information on health insurance coverage, though, is a limitation of our state-level estimates. Similarly, lacking information on private sector pensions by state, we assign our national-level estimates to each state. As private pension benefits have become a small share of overall private sector compensation, state-specific information on this benefit would not significantly alter our conclusions. Finally, we assign our national relative job stability values to all states.

Figure 13 summarizes the state-level results and yields two primary conclusions. First, there is substantial heterogeneity across the states in relative public sector compensation. In 2023, displayed by the blue dots, it ranged from a high of nearly a 40 percent premium in New York to a nearly 20 percent penalty in Oklahoma, Indiana, and Kansas. A majority of states, 34, have compensation penalties. Second, all states have experienced a decline in relative compensation and the decline is substantial in most cases. Thus, our firmest national-level conclusion—that relative public sector pay has eroded significantly in recent years—also holds for the more disaggregated state analysis.

Figure 14 unpacks the state results a bit further. Panel a documents that high income states, measured in terms of personal income per-capita, tend to have the highest relative public sector compensation. That said, there are a few notable exceptions – e.g. Colorado is among the highest income states but has one of the lowest levels of relative public compensation. Panel b reveals a strong relationship between initial, 2011 relative pay and the subsequent decline through 2023: states with the largest 2011 relative public-sector pay experienced the largest subsequent declines.

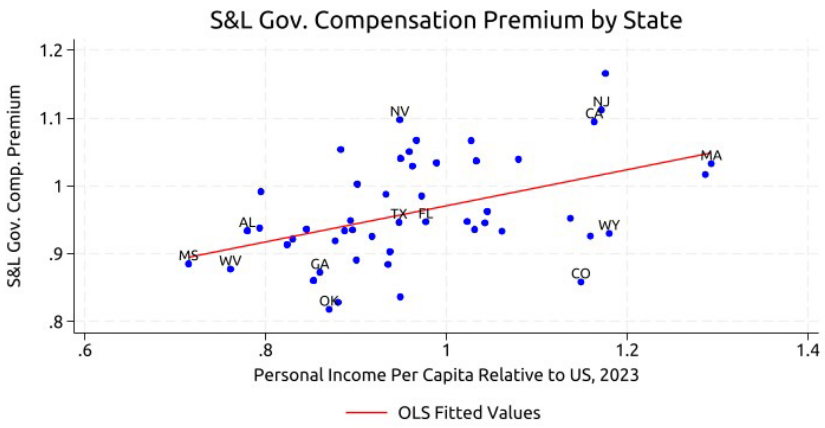
Figure 13



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2023), Public Plans Data, and author's calculations.

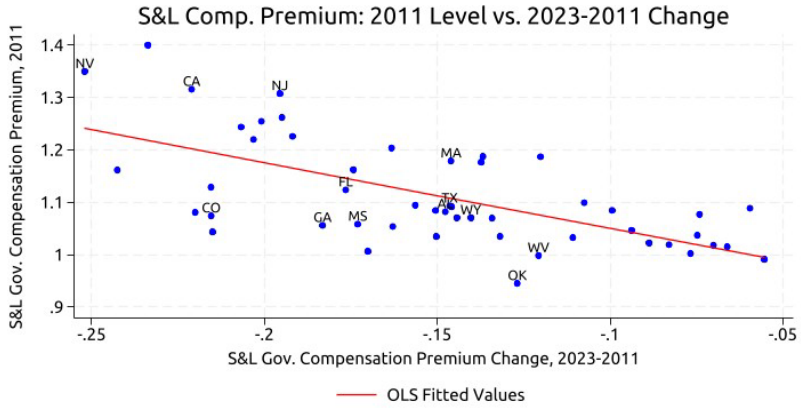
Figure 14

Panel a



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2023), Public Plans Data, and author's calculations.

Panel b



Source: Current Population Survey, Employment Costs for Employee Compensation, National Income and Product Accounts (NIPA), Pew (2023), Public Plans Data, and author's calculations.

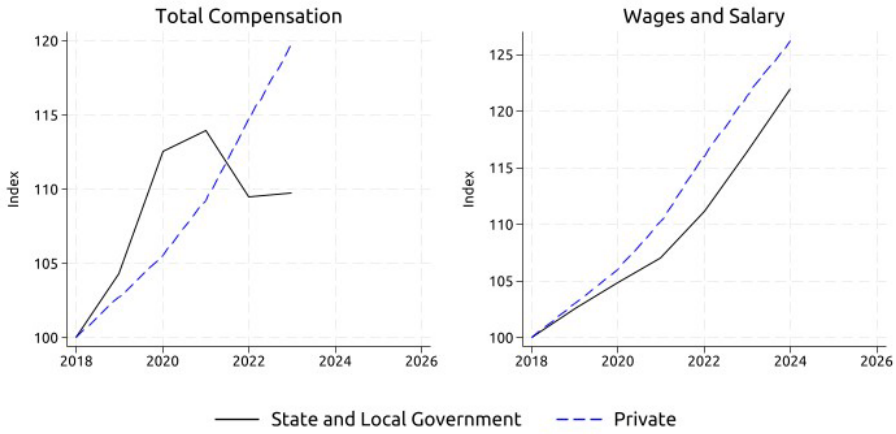
V. Implications

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 negatively affecting public sector hiring, as opposed to, for example, decreasing the rents available to public sector employees.

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 15 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.[23] 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 15
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 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. [24]

[23] 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.
[24] Bates and Johnston (2025) suggest that pension compensation does not appear to influence teacher retention in the late stages of teaching careers. More work in this vein, considering a broader set of outcomes and aspects of public sector compensation, is needed.

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 around 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.

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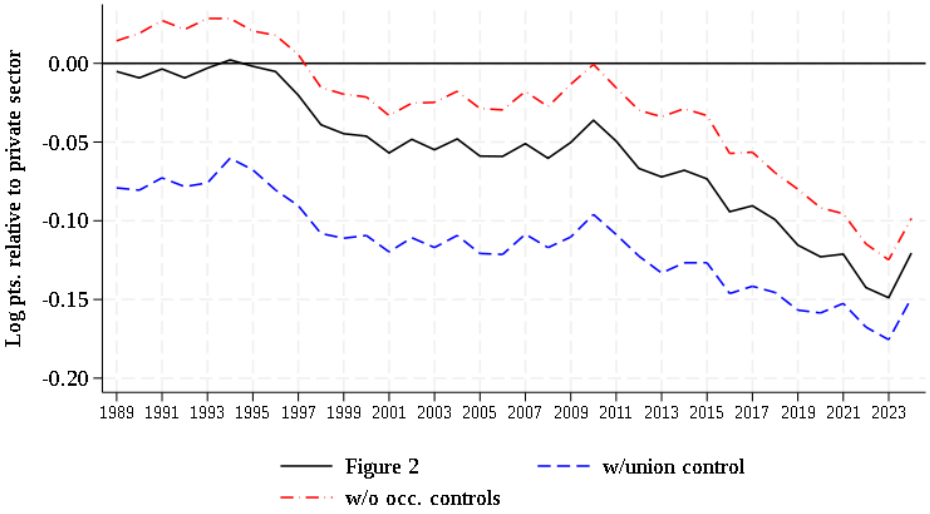
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Appendix

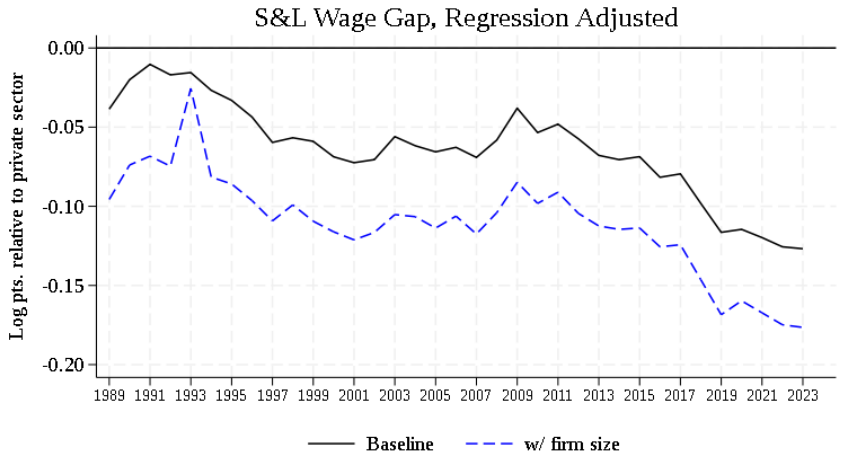
A. Figures and Tables

Figure A0
Panel a



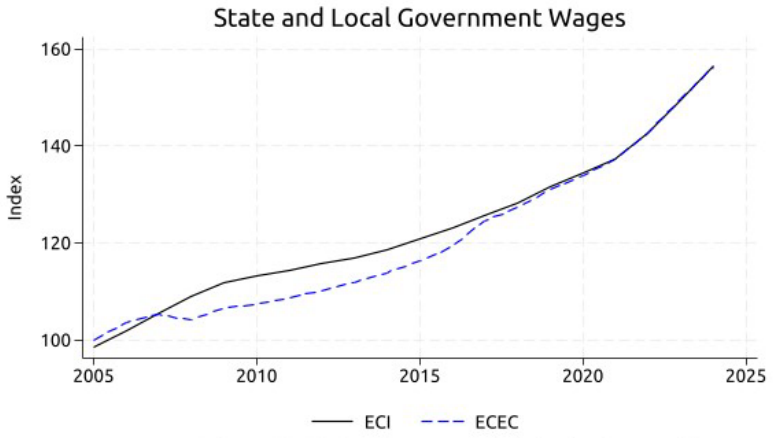
Gap in wages for S&L workers relative to private. Regressions are weighted and control for quartic in age, four education groups, metro status interacted with Census division, race interacted with gender, marital status, and major occupation. Dashed line regression includes baseline controls in Figure 2 plus a control for union status.

Panel b



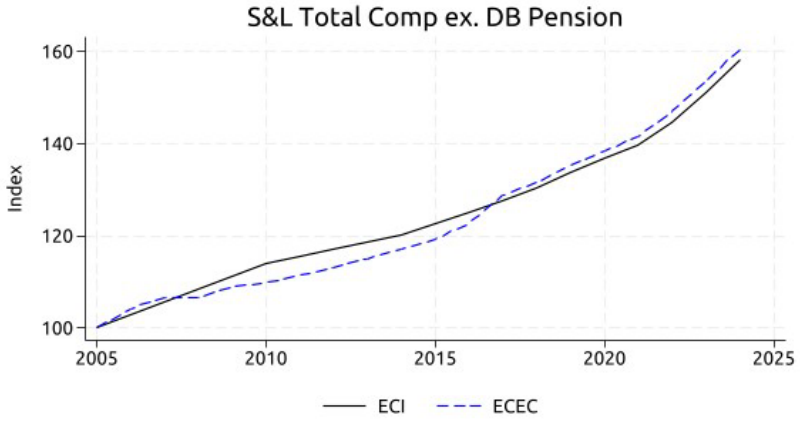
Gap in wages for S&L workers relative to private. Regressions are weighted and control for quartic in age, four education groups, metro status interacted with Census division, race interacted with gender, marital status, and major occupation. Full-time is defined as usually working 35 or more hours per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

Figure A1



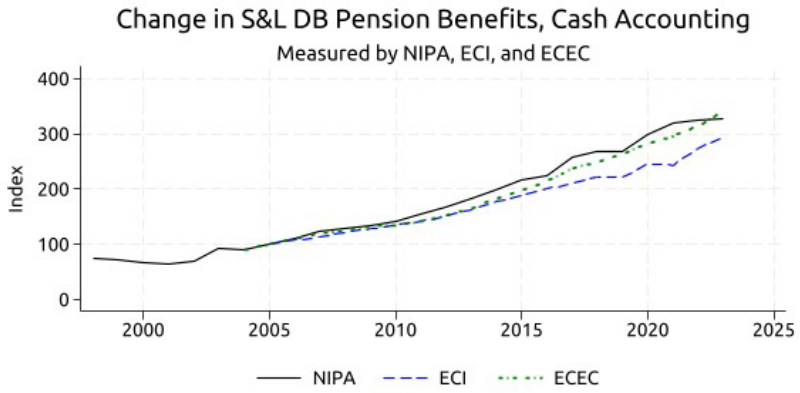
Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI) and Employee Costs for Employee Compensation (ECEC).
Note. Annual data averaged from quarterly data.

Figure A2



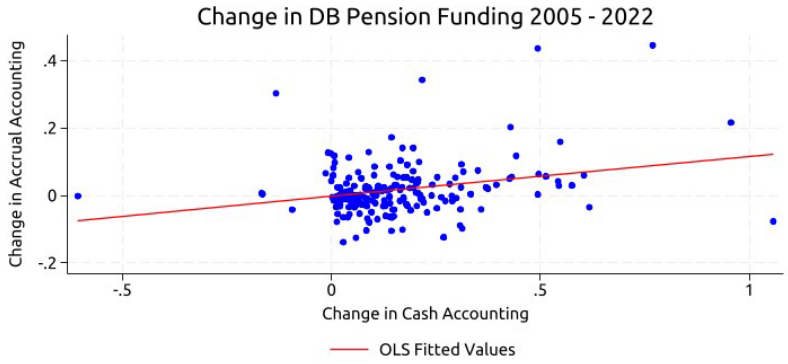
Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI) and Employee Costs for Employee Compensation (ECEC).
Note. Annual data averaged from quarterly data. Utilizes unpublished data provided by the BLS; these data are interpolated from 2005 to 2010 and the series should be interpreted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

Figure A3



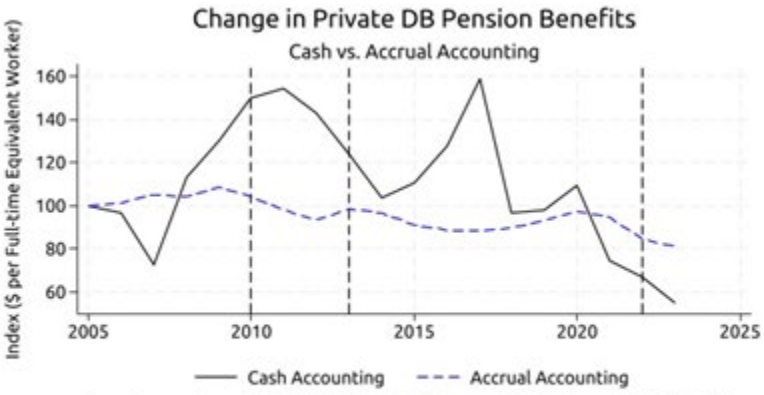
Source: Bureau of Labor Statistics' (BLS) Employment Cost Index (ECI, base period December 2005) and Employer Costs for Employee Compensation (ECEC). Bureau of Economic Analysis's (BEA) National Income and Product Accounts (NIPA). Author's calculations.
Note. Annual data averaged from quarterly data. 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 pension normal cost measure (see Appendix Section C below).

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.[25] 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.[26]

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.

[25] 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.
[26] 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.[27] [28] However, a back-of-the-envelope style calculation suggests that when the BEA changes its discount rate assumption the implied duration is only 14.[29] 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 in fiscal year 2018 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).[30] 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.[31] A

[27] E.g. Munnell and Aubry (2016), Center for Retirement Research (2022), and Winkelvoss (1977).
[28] 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).
[29] 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.
[30] 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.
[31] 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.

reduction in the inflation rate matters much less for the normal cost rate. For example, for a 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.[32] 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.

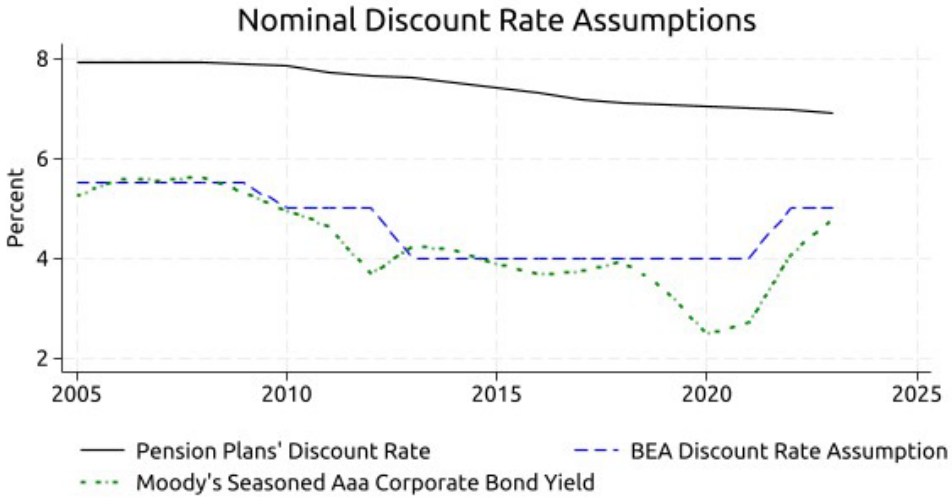
The BEA aims to produce pension valuations that reflect market interest rates, hence the time-varying nominal interest rate which roughly tracks the market rate (Figure A6a). In periods when the market-based real interest rate deviates from the assumed 2.5 percent, however, the valuation of pension liabilities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

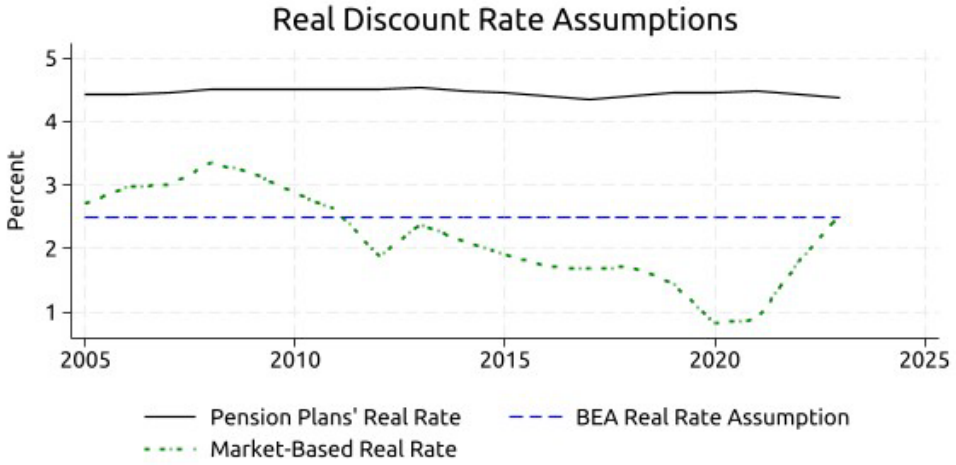
[32] E.g. assuming for simplicity that wage growth arises only due to inflation, the present discounted value of wages equals $\sum_{t=1}^{n} \frac{w_1*(1+i)^t}{(1+r)^t(1+i)^t} = \sum_{t=1}^{n} \frac{w_1}{(1+r)^t}$ where time $t=1$ is the year of entry into employment, n is the year of retirement, r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

Figure A6a



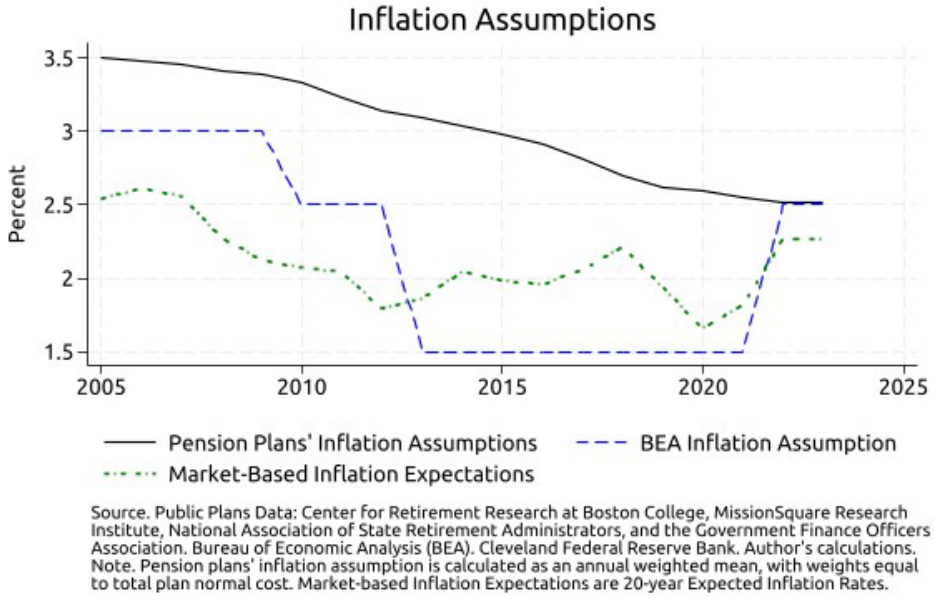
Source. Public Plans Data: Center for Retirement Research at Boston College, MissionSquare Research Institute, National Association of State Retirement Administrators, and the Government Finance Officers Association. Bureau of Economic Analysis (BEA). Moodys Investor Service. Author's calculations.
Note. 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.

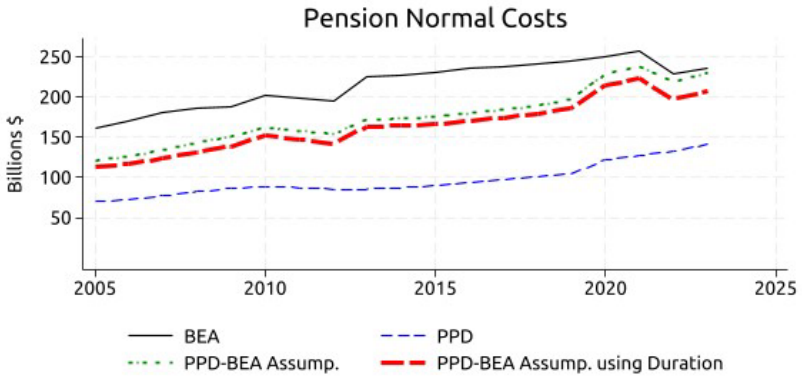
In order to generate an estimate of aggregate pension liabilites we start with the Center for Retirement Research at Boston College's Public Plans Data (PPD) which provides an annual panel dataset of state and local government pension plans; it includes information on plan normal costs and the actuarial 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.[33] [34] In order to ensure we do not understate the magnitude of state and local government pension normal costs, 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.

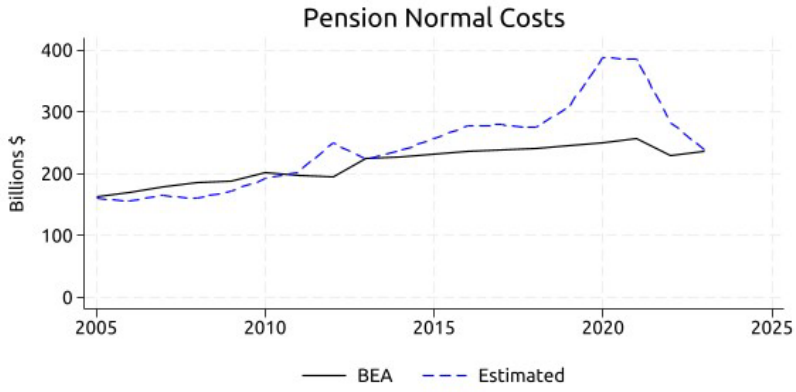
Figure A7a



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.

[33] In principle the PPD captures 95 percent of total state and local pension liabilities.
[34] 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 a bit lower than, our preferred normal cost estimates produced using our more complex, model-based procedure (the green dashed line).

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

National-level Estimates: Pew (2023) collects FY2019 data on a very large set of OPEB plans, including many local government plans. After adjusting their data for differences in the discount rate, their aggregate employer share of the OPEB normal cost represents 1.9% of BEA State and Local wages.[35] We use this estimate to calibrate our OPEB estimates.

To estimate employer normal costs for OPEB in other years, we have collected data for 26 large plans—mostly state government plans, but some local plans as well—from 20 states. [36] We adjust the normal costs in those plans for differences between our preferred real discount rate and that used by the plans, and subtract any required employee contributions (which only a minority of plans require) to calculate the employer normal cost. We then convert the normal costs from a fiscal year to a calendar year basis and aggregate them.

We use the changes in the employer normal costs for plans for which we have data to estimate national OPEB normal costs from calendar year 2011 to 2022, weighting each plan's growth rates by their share of the service costs. For the most recent years, we assume that the plan provisions don't change, but that the normal costs do because of changes in discount rates.

[35] 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.

[36] Our data cover the following plans, with the fiscal year start date of our data in parentheses: the New York City Teachers (2010) and New York State Employees plan (2017), the Massachusetts State Employees plan (2010), the Illinois State employees plan (2010) and Illinois Teachers plan (2011), the New Jersey state plan (2010), the California State (CALPERS) plan (2010), the Pennsylvania state employees plan (2014), the Texas Teachers (2014) and Texas State Employees Plan (2016), the Ohio School Employees (2016), the Ohio Teachers (2016), and the Ohio state employees plan (2016), and state plans from Delaware (2016), Hawaii (2016), Vermont (2016), Virginia (2016), North Carolina (2016), South Carolina (2016), and West Virginia (2016). Many of the state plans also cover some local employees.

We have data for all our plans for FY 2016 on. On an adjusted basis, these states covered by our plans represent 89% of aggregate OPEB cost. We have many fewer plans for earlier years. For example, for 2011-2013, we have data for only 6 large plans.

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 actuarial 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.)

Estimates by State:

The PEW data include estimates of the employer share of the normal cost by state, which we use for FY 2019. To create time series, we use a combination of methods: for states and years in which we have data on at least one plan, we use changes in the normal costs for those plans to estimate changes for the state as a whole. For years and states for which we have no plan data, we use the national estimates of changes in normal costs. In collecting plan data, we collected data from both the states that represented a large share of aggregate employer normal costs, but also (where possible) from states that had high employer normal costs as a fraction of wages, so for most of the states where OPEB is a relatively large fraction of wages, we have data on at least one plan.