Salaries, Pensions, and The Retention of Public-Sector Employees: Evidence from Wisconsin Teachers*

Barbara Biasi†

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Abstract

In the public sector, generous pensions are frequently used as a means to retain employees but often come at the cost of lower salaries. This paper assesses the efficacy of this strategy by estimating and comparing workers' extensive-margin labor supply responses to salaries and future pension benefits. To distinguish between responses to these two forms of compensation, I study the retirement behavior of teachers in Wisconsin around the passage of Act 10, a budget-saving reform that cut salaries and pension benefits with staggered timing across teachers and school districts. Estimates of retirement elasticities to these forms of compensation, derived from a life-cycle model of consumption and retirement that allows the substitution response to the two forms of compensation to differ, reveal that teachers respond much less to changes in pensions than to changes in salaries. This muted response can only partly be explained by low salience and information surrounding pension benefits. Back-of-the-envelope calculations suggest that 800 additional teachers (11% of all retirement-eligible teachers) would have been retained in Wisconsin had the state opted for cutting pensions rather than salaries.

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†Yale School of Management, Evans Hall, 165 Whitney Avenue, New Haven (CT), and NBER. E-mail: `barbara.biasi@yale.edu`.

1 Introduction

A large portion of public-sector U.S. employees still receives generous defined-benefits (DB) pensions upon retirement. In 2022, 86% of all state and local employees had access to a DB pension (Bureau of Labor Statistics, 2023b), including 99% of all public-school K-12 teachers (Bureau of Labor Statistics, 2023a). Public pension plans are often very generous, with replacement rates of up to 90%.[1] By design, these plans shift a significant portion of each employee's lifetime compensation to after retirement. Due to their generosity and to insufficient contribution rates, 41 states had unfunded pension liabilities in 2021 (Trusts, 2023).

A traditional justifications for the existence of such generous plans is that they provide local governments with a personnel tool to attract and retain good employees, particularly as public-sector salaries remain low (Ehrenberg, 1980; Schiller and Weiss, 1980; Montgomery and Shaw, 1997; Chalmers et al., 2014). Whether pensions are effective at achieving this goal, though, crucially depends on how much employees value them. In fact, the existing evidence shows that many employees do not fully understand how their pensions are calculated (Gustman and Steinmeier, 2004; Liebman and Luttmer, 2015; Blundell et al., 2016), which suggests that they may not be taking them into consideration–or not as much as they rationally should–when making their labor market choices.

If workers are less sensitive to pensions than to salaries, employers may be better off raising salaries (rather than pensions) to attract and retain workers. Conversely, they may want to cut pensions when money is tight. To test this hypothesis empirically, the ideal policy experiment would exogenously reduce active employees' salaries and future pension benefits at different points in time and measure their extensive-margin labor supply responses. The scarcity of concurrent (but distinct) changes in salaries and pensions, however, has so far prevented this type of analysis.

In this paper, I test this hypothesis by studying workers' responses to a public-sector reform that cut both salaries and future pension benefits for active workers close to the retirement age, with a staggered timing. In 2011, in an attempt to reduce the state's deficit, the state of Wisconsin dramatically reduced both salaries and future pension benefits of active retirement-eligible teachers

[1] Replacement rates are defined as the ratio between the average salary of active members and the average pension benefit, as reported by the Pension Plans data of The Center for Retirement Research at Boston College (2022). The Austin Firefighters Retirement plan had the highest replacement rate in 2023 (94%), followed by City of Atlanta Firefighters' Pension Plan (89%) and by school employees' plans within the Colorado Public Employee Retirement Association (83%).

by changing the rules of collective bargaining. Due to differences in the expiration dates of districts' pre-existing collective bargaining agreements (CBAs), though, these changes took place at different points in time across districts. Retirement rates (my measure of labor supply) rose sharply after the passage of the reform. Embedding the staggered changes in compensation into a life-cycle model of consumption and retirement, I estimate a negative retirement elasticity to salaries and a positive elasticity to pensions. The magnitudes of these elasticities indicate that teachers react significantly more to salaries than to pensions,in terms of both substitution and income effects. The muted response to pensions is consistent with a lack of salience of pension benefits, which leads workers to treat these future payments differently from salaries when making decisions on retirement.

My analysis leverages a comprehensive reform of public-sector employment, which occurred in the U.S. state of Wisconsin in 2011. Facing a projected $3.6 billion deficit in the state budget, the state legislature passed Act 10, a bill aimed at reducing expenditure on public employees which disproportionately affected K-12 teachers. This piece of legislation dramatically changed how teachers are paid and the extent to which they must contribute to the pension fund. Importantly, the various provisions of the reform became applicable at different points in time across school districts.

First, the reform lowered gross salaries and future pension benefits of older teachers through changes in the rules governing collective bargaining. Act 10 prevented teachers' unions from negotiating with the school districts over seniority-based salary schedules. Districts thus became free to set teachers' pay and to adjust it at the level of the individual teacher. Previous works have shown that this flexibility led to an increase in the salaries of younger and higher-quality teachers (Biasi, 2021) and of men relative to women (Biasi and Sarsons, 2022). Here, I demonstrate that it also led to a decline in salaries for teachers eligible to retire (i.e., aged 55 or older and with at least five years of seniority). Since pension benefits are calculated as a function of the three most recent salary figures, this decline translated into a 5% decline in the future pension benefits of retirement-eligible teachers.

Second, Act 10 required teachers to contribute more to their healthcare plans and to future pensions. Prior to the reform, districts would be responsible for paying the entire contribution to the pension plan (11.6% of each teacher's pay), while teachers would pay zero. In addition, districts would pay the entirety or near-entirety of healthcare premiums. Act 10 mandated that pension contributions be split equally between districts and teachers, thus imposing a 5.8% "tax" on employees' salaries. Notably, the increase in the pension contribution rate left pension benefits unchanged, because the latter are a function of gross (not net) salaries and the total contribution to the pension fund remained the same. In addition, the reform required employees to contribute at least 12% of their healthcare premiums, which further reduced workers' net pay.

Changes in net salaries and future pension benefits, though, did not happen concurrently in all districts. While the pension contribution rate increased (causing net salaries to fall) starting from 2012 everywhere in the state, all the other provisions of the reform only took effect after each district's CBA that was in place prior to Act 10 expired. For historical (and thus idiosyncratic) reasons, expiration dates differed across districts. A majority of them (77%) had agreements expiring in 2011; 14% in 2012, and 8% in 2013 (Baron, 2018; Biasi and Sarsons, 2022).

To understand how workers react to cuts in salaries and pension benefits, I focus on the extensive-margin response of retirement-eligible teachers, which I refer to as retirement. This group of teachers experienced the most dramatic cuts in gross salaries (and thus future pension benefits); in addition, they should be most responsive to changes in benefits (Rohwedder and Kleinjans, 2006). In theory, declines in salaries and future pension benefits should affect retirement in different ways. A decline in net salary should produce two opposite effects: A positive substitution effect (workers are more likely to retire when working becomes less attractive), and a negative income effect (workers are less likely to consume leisure, and thus less likely to retire, when they become poorer). A decline in future pension benefits should instead produce both negative income and substitution effects.

Examining exit rates in the employment records of the Wisconsin Department of Public Instruction reveals that the passage of Act 10 in 2011 was followed by a large and sudden increase in retirement, some of which persisted over the next five years. Comparing the timing of this change across districts with different CBA expiration dates in an event study framework, I quantify that retirement rose sharply by nearly 75% in all districts regardless of CBA expiration, a response I ascribe to the 5.8% cut in net salaries due to increased pension contributions. This increase suggests a strong substitution effect of salaries. After each CBA expiration, retirement increased by an additional 47-63%. Since both salaries and pension benefits declined after this point, this positive effect confirms a strong substitution effect of salaries. Given that a pension decline should have a negative effect on retirement, this increase also suggests teachers may not be responding to changes in pensions as much as they do to changes in salaries. These findings remain robust if I exclude the year 2011 (in which most of the increase in retirement occurred) or the cohort of districts with CBAs expiring in 2011, for whom all the provisions of Act 10 occurred at the same time.

Despite their robustness, though, these findings are not enough to definitively conclude that the responses to salaries and pensions are not the same. In the event studies, the responses to pensions may appear smaller due to a smaller size of the pension decline, or because people discount the future at a high rate. To ensure a proper comparison between the retirement responses to salaries and pensions, I use a simple life-cycle model of consumption and retirement as the theoretical grounding for the estimation of elasticities to salaries and pensions. In the model, each individual makes a consumption and retirement decision for each period of her life to maximize a time-separable utility function, subject to a budget constraint and an additional constraint that determines how pension benefits grow from year to year. Crucially, I set up the model to allow for the possibility that salaries and pensions are valued differently by each worker, thus allowing for differences in salience (Bordalo et al., 2022) or mental accounting behavior when considering different forms of compensation (Thaler, 1999).

The model can be used to derive income and substitution elasticities of salaries and pensions, which are useful for evaluating the presence of mental accounting. I show that, if workers value an equal percent change in salaries and pensions the same along the substitution margin, the magnitude of the substitution elasticities of salaries and pensions should also be the same. These two elasticities, though, cannot be estimated without further assumptions about preferences and the evolution of salaries over time (Blundell and MaCurdy, 1999; Gelber et al., 2016). Instead of imposing such restrictions, I use the variation in salaries and pension benefits introduced by the reform to estimate "full" retirement elasticities to salaries and pensions (i.e., comprising both substitution and income responses) and use these to derive bounds on income and substitution effects. I show how these full elasticities can be used to construct a statistical test for the equality of substitution responses to salaries and pensions, which I implement using estimates of these elasticities obtained using the Wisconsin data. The results from this test confirm what suggested by the event studies: both the income and substitution effects of salaries are significantly larger in magnitude than the effects of pensions, indicating that teachers respond much less to changes in the latter form of compensation.

Providing a definite answer as to why people react less to changes in pensions than to changes in salaries is outside the scope of this paper. Yet, the data suggest that lack of salience and information may play a role. Responses to changes in pension benefits are larger among older workers. They are also larger for workers with a larger share of colleagues who were eligible to retire or closer to the "normal" retirement age of 62, particularly if they are of the same gender, and who may thus be more likely to be exposed to information about how pensions are calculated.

Taken together, the findings of this paper indicate that generous pensions may be a less effective tool to attract and retain workers compared with higher salaries. They also indicate that, in circumstances when states (or employers more generally) have to cut labor expenses, lowering pensions may lead to the loss of fewer employees than lowering salaries. Back-of-the-envelope calculations using my estimates indicate that, had Wisconsin not increased employees' required pension contributions (reducing net salaries) and decreased pension benefits instead (to hold total savings on retirement-eligible teachers constant), 11% of all retirement-eligible employees who retired after Act 10 would have been retained—an outcome that may have been beneficial for some schools, particularly in light of the dramatic teacher shortages that some districts face.

This paper is related to several strands of literature. The first, summarized by Blundell et al. (2016), has studied the determinants of workers' labor supply and retirement decisions. This body of works encompasses comprehensive structural models of retirement, incorporating factors such as the design of pensions, health, wealth, and spousal decisions;[2] empirical analyses based on the option value model of Stock and Wise (1990) (Coile and Gruber, 2007; Samwick, 1998); and reduced-form studies of the impact of different characteristics of pension plans, such as notches and benefit discontinuities (Krueger and Pischke, 1992; Mastrobuoni, 2009; Liebman et al., 2009; Chalmers et al., 2014). My analysis contributes to the existing literature by providing quasi-experimental estimates of the retirement effects of separate (but sequential) changes in both salaries and pensions, which allow me to understand how workers trade off these two forms of compensation. As part of my analysis, I also produce new estimates of extensive-margin labor supply elasticities for workers close to retirement, contributing to a set of studies that have investigated the magnitude of income and substitution effects (Costa, 1995; Gelber et al., 2016; Manoli and Weber, 2016; Fetter and Lockwood, 2018; French et al., 2022).

[2]Structural models of retirement include Gustman and Steinmeier (1986); Rust and Phelan (1997); Gustman and Steinmeier (2000); French (2005); Van der Klaauw and Wolpin (2008); French and Jones (2011); O'Dea et al. (2018).

This paper is also related to a literature that has documented retirement patterns inconsistent with individual rationality and studied potential explanations for these behaviors. For example, Mastrobuoni (2011) and Chan and Stevens (2004) have demonstrated that people don't respond to incentives embedded in the design of Social Security benefits as much as they should. Other studies have shown that this behavior can be explained by a lack of information and ability to understand how benefits are calculated (Gustman and Steinmeier 1999; Bhargava and Manoli 2015; Liebman and Luttmer 2015; Brown et al. 2017; Brown et al. 2017).[3] This paper contributes to this literature by providing additional evidence of a lack of fully rational behavior in individual retirement decisions, by showing that workers respond much more to changes in salaries than to similarly sized changes in pension benefits, possibly due to a lack of salience on benefit calculation. In addition, the Wisconsin Act 10 setting allows me to directly compare responses to salaries and pensions, which are crucial to account for when designing the optimal compensation package for public-sector employees.

By studying the retirement responses of public school teachers, this paper also relates to a set of studies on teacher pensions and retirement. Most of these works have focused on the implication of pension benefit and plan design on employee retention and workforce quality (Furgeson et al., 2006; Costrell and Podgursky, 2009; Costrell and McGee, 2010; Koedel et al., 2013; Ni and Podgursky, 2016; Ni et al., 2022). Brown (2013) has highlighted how responses to changes in benefits are quite small. A smaller set of works more closely related to this paper have sought to understand how much teachers value their pensions. Fitzpatrick (2015) examines responses to a unique opportunity given to Illinois teachers to purchase additional pension benefits and estimates a willingness to pay for an additional dollar of pensions at only $0.20. Fuchsman et al. (2023) use a hypothetical-choice survey to elicit teachers' willingness to pay for a higher pension replacement rate, finding that they would be willing to pay $0.6 for an additional dollar of pensions. While these studies provide first-cut evidence that teachers may prefer higher salaries to generous pensions, as Fitzpatrick (2015) also recognizes, these results do not necessarily generalize to a context where pensions are reduced, rather than increased, which is what occurred in Wisconsin from 2011. This type of behavior is possibly the most relevant to study in a scenario—such as the current one in the U.S.—in which pension liabilities of current employees are largely unfunded and there may be a need to reduce

[3] Other works have studied how the elderly make mistakes even when making other types of financial decisions, e.g., about healthcare plans (Abaluck and Gruber, 2011).

them.

Lastly, this paper contributes to a small set of studies of the impact of Act 10, including on teachers' mobility across districts (Biasi, 2021), the allocation of teachers across districts serving different types of students (Biasi et al., 2021), student outcomes (Baron, 2018), and the gender wage gap (Biasi and Sarsons, 2022). Roth (2019) studies teacher turnover after Act 10 and finds it to be larger in the short run and more modest in the long run. I contribute to these studies by using post-Act 10 Wisconsin as a laboratory to investigate retirement responses to the related, but distinct, changes in salaries and pension benefits brought about by this reform.

2 Salaries and Pensions for Wisconsin's Public School Teachers

This section provides a brief overview of how salaries and pensions were determined in Wisconsin prior to Act 10 and describes the changes introduced by the reform.

2.1 Salaries and Fringe Benefits

As is common across many US states, until 2011 the salaries of Wisconsin public schools teachers were determined using step-and-lane schedules, as outlined in the CBA negotiated between each district and the teachers' union. Therefore, each teacher's pay was uniquely a function of her years of seniority (which determine her placement along the "steps" of a schedule) and academic credentials (which determine placement along the "lanes," Podgursky, 2006). Negotiations between a district and an individual teacher were not possible (Biasi and Sarsons, 2022). Districts also provided teachers with benefits such as healthcare, life, and disability insurance, with premiums almost entirely paid by the district; these benefits were also covered by CBAs.

2.2 Retirement Benefits

Wisconsin offers retirement pensions to all full-time state and local public employees, including public school teachers. These pensions are paid out of a state fund called Wisconsin Retirement System (WRS). Coverage under WRS is mandatory for all eligible employees, and public-school teachers become vested to a pension after five years of service. Vested employees can collect a pension starting from age 55, upon terminating all service in employment positions covered by the

WRS. Prior to Act 10, districts' CBAs typically mandated that retired teachers remain covered by district-sponsored health insurance until age 65, when they would become eligible for Medicare (Roth, 2019).

Pensions paid out of the WRS consist in an annuity, paid out in monthly installments, whose size is determined using the following defined-benefits formula:

$$B = \min\{\bar{W} \times s \times \pi(a, s) \times r, 0.75 \times \bar{W}\}. \tag{1}$$

where B is the annual pension benefit, $\bar{W}$ are final average earnings (i.e., the average across the 3 highest annual salary figures for each teacher), s are years of service, $\pi(a, s)$ is an actuarial reduction factor that ranges between 0.584 and 1 and depends on age a and seniority s (Appendix Figure A1), and r is a "formula multiplier", equal to 1.6% during the sample period of this study.[4]

The WRS is funded through three sources: employer contributions, employee contributions, and investment earnings. In the case of teachers, though, until 2011 virtually all contributions were made by the employer (i.e., the school districts), while employees were contributing zero.

2.3 The Impact of Act 10 on Teachers' Salaries and Pensions

In an attempt to improve the state's finances and close a a projected budget deficit of $3.6 billion, in 2011 the state legislature passed the Wisconsin Budget Repair Bill, which came to be known as Act 10. The bill sought to achieve budget cuts through a sweeping reform of public-sector employment. Two sets of provisions predominantly affected public school teachers: (i) changes in the rules for collective bargaining, with consequences for the determination of teacher salaries and pension benefits, and (ii) a reduction in fringe benefits, achieved primarily by cutting benefits and requiring employees to contribute more towards pensions and healthcare.

[4] The stated objective of the WRS pension plan is to provide teachers who retire at a "normal" age (i.e. above 57) and with a full career of public employment (between 25 to 30 years of service) a total retirement income between 50% and 75% of the pre-retirement earnings. For teachers with a shorter career, the actuarial reduction factor reaches one when the teacher either (a) reaches 30 years of experience, or (b) reaches 65 years of age, whichever comes earlier. In addition to defined-benefits pensions, the WRS allows all employees to additionally save for retirement through the Wisconsin Deferred Compensation Program (WDC), a 457 deferred-compensation plan with features similar to 401(k) or 403(b) plans. Participation to the WDC is optional and the size of the program was not directly impacted by Act 10. I hence abstract from it in my analysis.

Changes in collective bargaining rules and implications for teachers' salaries and pensions Act 10 imposed severe limits on the powers and scope of action of teachers' unions. First, the law allows unions to negotiate only on base pay (i.e., the starting step of a salary schedule) and prohibits the inclusion of salary schedules in districts' CBAs. Districts are thus not compelled to use these schedules and can adjust pay at the individual level if they wish to do so (for example, they could pay a teacher with 15 years of seniority and one with 5 years of seniority the same salary). Districts used their newly gained flexibility in different ways: Some continued to set pay almost entirely based on seniority and academic credentials, some began to link it to principal or peer evaluations, and others gave some teachers raises to attract them to the district or to retain them (Kimball et al., 2016; Biasi, 2021). Since the old salary schedule rewarded more experienced teachers and penalized younger ones, the introduction of pay flexibility led to a "flattening" of the salary-experience profile and to a relative loss in salaries for older teachers on average (Appendix Figure A2). This loss has direct implications for the size of future pension benefits, which are calculated as a function of the three highest salary figures.

Act 10 also made it more difficult for unions to operate. It requires them to recertify every year with the consensus of a majority of all members, it limits the validity of newly stipulated CBAs to one year, and it prohibits the automatic collection of union dues from employees' paychecks. As a result, union membership among Wisconsin public school teachers dropped by nearly 50% in the 5 years following Act 10.[5]

Increases in employee pension contributions In an attempt to generate cost savings for the state and the school districts, Act 10 required employees to share the burden of pension contributions with their employers. While prior to the reform the entire pension contribution (equal to 11.6% of each worker's pay in the case of teachers) was paid by the employer, after the passage of Act 10, employees were required to pay half of it from their paychecks. This requirement thus imposed a new "tax" on salaries equal to 5.8%, which was further increased to 6.65% in 2014 and 7% in 2015 (Appendix Figure A3). Act 10 also required employees to pay at least 12.5% of their health insurance premium and encouraged districts to cut their fringe costs, by selecting cheaper insurance plans and by reducing healthcare benefits for retirees.

[5]See D. Belkin and K. Maher, *Wisconsin Unions See Ranks Drop Ahead of Recall Vote*, The Wall Street Journal. Retrieved from https://www.wsj.com/articles/SB10001424052702304821304577436462413999718.

Differences in timing The provisions of Act 10 went into immediate effect after its passage. All CBAs stipulated between school districts and teachers' unions prior to 2011, though, remained valid until their expiration. As CBAs regulate teacher's salaries and fringe benefits (such as healthcare), any changes in gross salaries (and, subsequently, in pension benefits) and healthcare premium contributions may only have occurred after the expiration of each district's pre-existing CBA. The increase in employee contribution rates (impacting net salaries) instead took place immediately, starting from 2011-12 in all districts.

Due to differences in electoral cycles, the expiration dates of pre-existing CBAs (and of their extensions) varied across districts. Figure 1 displays the number of all teachers and retirement-eligible teachers working in districts with a given CBA expiration year. The majority of them (77% of retirement-eligible teachers, in 87% of all districts) had agreements that expired in 2011; 14% had agreements expiring in 2012 and 8% in 2013 (with 9% and 3% of all districts, respectively). Furthermore, a total of 133 districts (53%) unilaterally extended the expiration of their agreements by one or two years, up to 2012, 2013, 2014, or 2016 (Biasi and Sarsons, 2022). In my empirical analysis I refer to the dates of expiration of the original CBAs as the point in time when salary schedules were discontinued. For robustness, I also replicate my analysis focusing on districts with no extension (Appendix Figures A4, A8, and A9).

Cross-district differences in expiration and extension dates and the sharp timing of the other provisions of Act 10 introduce plausibly random variation in the salaries and future pension benefits of retirement-eligible teachers, with a staggered timing. While the increase in employee pension contribution led to a decline in net salaries in 2011 in all districts, changes in gross salaries, healthcare premiums, and future pension benefits could only have happened after the expiration of each district's CBA. This variation is useful to understand how employees respond to cuts in salaries and pensions. Before examining these responses, I show empirically the timing and magnitude of changes in these two forms of compensation across districts.

3 Data

To conduct my empirical analysis, I primarily rely on the employment records on the universe of Wisconsin public school teachers in each year between 2007 and 2017. I complement these data with hand-collected information on the expiration dates of the CBAs in place in each district when Act 10 was approved in 2011. Data are reported by academic year, referenced using the calendar year of the spring semester (e.g. 2007 for 2006-07).

3.1 Wisconsin Public School Employee Records

Information on the universe of all teachers in public schools each year is from the *PI-1202 Fall Staff Report - All Staff Files* maintained by the Wisconsin Department of Public Instruction (WDPI). These files list all individuals employed by the WDPI in each year. For each observation the files report the name and identifier of the hiring agency (typically a school district) and working agency (usually a school), the position (e.g., teacher), the full-time equivalency (FTE) units, total gross salary, fringe benefits (which include employer contributions to pensions, health care, and life insurance), demographic information (such as gender, race, and birth year), highest education degree, and years of teaching experience. For teachers, the data also list the assignment area (for example Math) and the grades taught. A unique teacher identifier allows me to link individual records across the years and determine who exits public schools in each year. I remove records pertaining to the school districts of Milwaukee and Kenosha due to mistakes in salary reporting. I restrict attention to teachers; for most of my analyses, I focus on those eligible to retire with a pension (older than 55 years of age and with 5 or more years of experience). For teachers working less than full time, I express salaries in FTE units by dividing them by the FTE worked by the teacher.

3.2 Collective Bargaining Agreements

Using district identifiers, I link teachers' employment records to information on the date of expiration of districts' 2011 CBAs, collected from multiple sources and also used in Biasi (2021) and Biasi and Sarsons (2022). The sources of CBA information include union contracts, districts' employee handbooks, school board meetings minutes, and local news sources. For example, school board minutes typically mention whether the contract was set to expire in 2011 because the board would have to decide how to adjust teachers' contracts after that date. They usually also mention whether an extension was granted, and for how long. Similarly, early versions of district employee handbooks are useful to establish when the post-CBA pay regime was introduced (which typically coincides with the date of the earliest handbook at the latest). When available, I prioritize data from union contracts, school board minutes, and handbooks. In cases where these documents are unavailable, I complement records with information from online local news sources. These outlets covered news surrounding union negotiations, offering enough information to infer when the CBA was slated to expire and, in some cases, mentioning an extension to this deadline.

The sources used to compile the database of CBA expiration dates are listed in detail in Appendix Table B1. Information on the expiration dates is available for 247 out of 428 school districts, employing 83 percent of all teachers. I thus exclude districts with missing expiration dates from the analysis. For 225 of these 247 districts (employing 80 percent of teachers) the records indicate the presence or absence of an extension. We exclude districts with missing expiration dates from our analysis and we assume that districts with an expiration date but no information on extensions had no extension.[6]

3.3 Summary Statistics

Table 1 shows summary statistics of relevant variables for my analysis, for the full sample of retirement-eligible teachers (column 1) and by expiration date of the pre-Act 10 CBA in their district (columns 2-4). The full sample includes 85,197 teacher-year observations and 23,448 unique retirement-eligible teachers; this sample represents 24% of all teachers in Wisconsin in 2007-2017. The composition of the teaching body is similar across districts with different CBA expiration dates in terms of age, experience, and education. This corroborates the assumption that the expiration timing is idiosyncratic to district characteristics. Both salaries and future pension benefits were on an upward trajectory each year in all districts, growing by 2% and 10% yearly on average in 2009-2011. The trajectory of these variables, though, changed after Act 10. I describe these changes next.

4 Impacts of Act 10 on Salaries and Pension Benefits

I begin my analysis by showing empirically how net salaries and pension benefits changed across districts and over time after the passage of Act 10. These variables are not directly reported in the administrative data, so I calculate them using observable information and the provisions of the law. Specifically, I define and calculate net salaries as the difference between gross salaries and employee

[6]Our results are robust to including districts with missing expiration dates and assigning them a 2011 expiration, as well as to excluding districts that have an expiration date but no extension date (see Appendix Figure AIII).

contributions to pensions and healthcare. For simplicity, I abstract from income and other payroll taxes, which did not change during my sample period. The net salary of employee i in year t can be written as $w_{it} = \tilde{w}_{it}(1 - \tau_t - h_{j(it)t})$, where $\tilde{w}_{it}$ is the gross salary, τ_t is the pension contribution rate (mandated by the law and illustrated in Appendix Figure A3), and h_{jt} is the healthcare contribution rate in the teacher's district j. I calculate pension benefits using the formula in equation (1).

Employee healthcare contributions While τ_t is known and common across all districts in each year, employee healthcare contribution rates h_{jt} can differ across teachers and districts and are not reported in the data. Prior to Act 10, these contributions were very low (Costrell and Dean, 2013). Act 10 raised them by requiring employees to pay at least 12% of their healthcare premia. Yet, rates ultimately depend on each employee's salary, which I observe, and by the plan offered by each district and the type coverage (individual or family) selected by the employee, which I do not observe.

To obtain a conservative estimate of the change in employee healthcare contributions after Act 10, I use information on total fringe benefits as reported in the administrative data. Fringe benefits primarily cover employer contributions to pensions and healthcare.[7] Subtracting employer pension contributions (which were equal to 11.6% of salaries prior to Act 10 and 5.8% or more afterwards) from the total, I can thus calculate how much employer healthcare contribution rates went up after Act 10 by measuring how much fringe benefits (net of pension contributions and expressed as a fraction of 2011 salaries) declined in the aftermath of Act 10. I do so by estimating the following equation:

$$\bar{h}_{it} = \tau_{2011,c}\mathbb{1}(t > 2011) + \tau_{CBA,c}\mathbb{1}(t > c_{j(it)}) + \gamma X_{it} + \theta_{j(it)} + \varepsilon_{it} \tag{2}$$

where $\bar{h}_{it} = 1 - h_{it}$ is the the ratio between fringe benefits of worker i in t and the worker's salary in 2011; c_j is the year of expiration of district j's CBA; X_{it} are worker characteristics such as age, experience, and education fixed effects; and θ_j are district fixed effects. Since compensation is expressed in nominal terms, I de-trend the dependent variable using a linear trend estimated prior to 2011. In this equation, $\tau_{2011,c}$ measures the change in contribution rates after the passage of Act

[7] Using information on healthcare premium costs for each district, available at the district and plan level starting from 2019, I am able to confirm that employer contributions to pensions and healthcare represent approximately 98% of all fringe benefits. Healthcare premium costs are available at `https://doa.wi.gov/Pages/2018-19-SchoolDistrict-HealthCareBenefits-Report.aspx`.

10, but before a CBA expiration, in districts with expiration date c; $\tau_{CBA,c}$ measures the additional change in compensation after the CBA expiration (I assume $\tau_{2011,2011} = 0$).

Estimates of these two parameters, shown in column 3 of Table 2 and summarized as the right bar of Figure 2 (which displays averages across cohorts) indicate that fringe benefits as a share of salaries did not change prior to a CBA expiration. However, they declined by up to 3 percentage points after a CBA expiration. Panel (c) of Appendix Figure A6 confirms this result by showing the evolution of this variable across time for each cohort.[8] Assuming no changes in the size of the premium, this implies that the rate of employee healthcare contributions increased by 3 percentage points following a CBA expiration. I use this uniform rate across all districts and employees in my analysis, and I consider district-specific or employee-specific rates in robustness checks.

It is important to note that this estimate of the change in employee healthcare contribution is likely an upper bound of the true change: Total premiums became cheaper after Act 10 (Costrell and Dean, 2013), so it is possible that the observed reductions in fringe benefits are driven by lower total healthcare spending plans rather than by a cut in employees' net salaries. If this is the case, my estimates of the retirement responses to net salaries, which I present and discuss in Sections 5 and 6, would understate the true responses.

Net salaries Given the timing of implementation of the reform's provisions, net salaries should have declined in all districts beginning in 2012 due to the increase in employee pension contributions. They should have then declined even more after the expiration of each district's CBA, due to changes in gross salaries and increases in employee healthcare contributions. I confirm this empirically by re-estimating equation (2) with net salaries as the dependent variable. Following the passage of Act 10 but before a CBA expiration, net salaries declined by 9.8%, roughly equivalent to the combined increase in employee contributions to healthcare and pensions. They then declined by an additional 12% after the expiration of each district's CBA (column 1 of Table 2 and Figure 2, left bar).[9]

[8] Appendix Figure A6 shows point estimates for the parameters of a version of equation (2) where, instead of $\tau_{2011,c}$ and $\tau_{CBA,c}$, I estimate year fixed effects for each cohort.

[9] Panel (a) of Appendix Figure A6 shows the dynamics of changes in net salaries between 2007 and 2017 for each expiration cohort. Appendix Figure A4 replicates Figure 2, but allows compensation to also vary following the expiration of a CBA extension when present. While compensation continued to decline after the expiration of an extension, the result that only net salaries declined after Act 10 but before a CBA expiration holds.

Pension benefits Pension benefits depend on gross salaries. As a result, they declined only after the expiration of districts' CBAs. I show this in column 2 of Table 2 and the central bar of Figure 2, which shows estimates of equation (2) using future pension benefits as the dependent variable. Pension benefits did not decline immediately after Act 10, but only after the expiration of each district's CBA expiration (by around 5% on average across expiration cohorts).[10]

The findings described so far indicate that the changes in salaries and pension benefits of retirement-eligible teachers triggered by Act 10 were not aligned across districts and over time. Differences in timing are useful to isolate the retirement responses to variations in these two types of compensation, which I study next.

5 Teacher Retirement in The Aftermath of Act 10

Act 10 was followed by a doubling in the share of retirement-eligible teachers who exited the market (from 15% in 2010 to 31% in 2011). It is plausible to assume that these exits constitute retirement, since the exit rate of teachers aged 53-54 (who were not yet eligible to retire) rose by only 28% (from 2.2% to 2.8%, Appendix Figure A7). In this section, I characterize the precise timing of changes in retirement across districts after Act 10 and link it to the changes in net salaries and pension benefits introduced by the reform.

5.1 Effects of Act 10 on Retirement: Theoretical Predictions

The theoretical implications of the changes introduced by Act 10 on workers' propensity to retire are ambiguous ex ante. A decline in pensions should have a negative effect on retirement. First, by making retirement relatively less attractive than working, it should have a negative substitution effect. Second, by reducing workers' lifetime income and, subsequently, the demand of leisure, it should generate a negative income effect.

A decline in salaries, instead, has an ambiguous effect on retirement. First, it should have a positive substitution effect because it makes working relatively *less* attractive (and, by converse, retirement more attractive). Second, it should have a negative income effect similar to that of a

[10]Panel (b) of Appendix Figure A6 shows the dynamics of changes in pension benefits between 2007 and 2017 for each expiration cohort.

decline in pension. With DB pensions, a decline in *gross* salaries—which enter the formula used to determine the pension benefits—should have an additional positive effect on retirement, because it reduces workers' incentives to postpone retirement to increase their future pension benefits.

Lastly, in the Wisconsin context, the increased uncertainty over retiree healthcare benefits may have induced workers to retire immediately before a CBA expiration to secure these benefits (Roth, 2019).

5.2 Retirement Responses to Changes in Salaries and Pensions

Since changes in salaries and pensions occurred at different times across districts, comparing retirement rates across cohorts of CBA expiration and over time can offer a first insight into how workers react to these two forms of compensation. To this end, Figure 3 plots average retirement rates by year (relative to 2010) and cohort of CBA expiration, conditional on age, experience, education, and district fixed effects.

Retirement rates were on a similar, flat trend across the three cohorts until 2010 and then increased in 2011 in all cohorts. By that time, the 2011 cohort had experienced both a decline in net salaries due to increased pension contributions and a further decline in net salaries and future pension benefits due to the expiration of CBAs. The 17 percentage point increase in retirement for this cohort in 2011 can thus be ascribed to the impact of all these changes combined. Instead, in the same year the 2012 and 2013 cohorts (which I refer to as "off-cycle cohorts") had only experienced a decline in net (but not gross) salaries. Retirement rose more in 2011 for the 2012 cohort compared to the 2013 one. This difference is likely due to the uncertainty on retiree healthcare after the CBA expiration, which could have induced some employees to leave right before the expiration to secure post-retirement benefits.

In off-cycle cohorts, retirement rates continued to rise after the CBAs expired. For example, relative to 2010, the 2013 retirement rate was 18 percentage points higher for the 2012 cohort and 9 percentage points higher for the 2013 cohort. Restricting attention to districts with no extensions reveals even cleaner patterns, with a spike in retirement in all districts in 2011 and a further increase following a CBA expiration in off-cycle cohorts (Appendix Figure A8).

5.2.1 Decomposing retirement responses

To more precisely quantify the retirement responses to the declines in net salaries and pension benefits following Act 10, I pool data on all three expiration cohorts and estimate the following model via OLS:

$$e_{it} = \sum_{s \neq 2010} \eta_s \mathbb{1}(t = s) + \sum_{s \neq -2} \beta_s \mathbb{1}(t - c_{j(it)} = s) + \gamma X_{it} + \varepsilon_{it} \tag{3}$$

where e_{it} equals one if teacher i retires at the end of year t, c_j is the year of expiration of district j's CBA, X_{it} contains age-by-experience-by-education and district fixed effects, and ε_{it} is an error term. In this equation, the parameters η_s measure changes in teachers' retirement rates that occurred in year s relative to 2010, *conditional on CBA expiration dates*. The parameters β_s measure changes in retirement by time elapsed since a CBA expiration, relative to two years prior to an expiration and conditional on academic years. Absent any anticipatory retirement effects prior to 2010, η_s for $s \geq 2011$ captures the retirement response to a decline in net salaries; β_{-1} captures the response to increased uncertainty over retiree benefits; and β_s for $s \geq 0$ captures the response to a concurrent additional decline in net salaries and pension benefits, driven by income and substitution effects of these two forms of compensation and by a change in the option value of delaying retirement.

Estimates of η_s, shown as the solid line in panel (a) of Figure 4, confirm that retirement rose by 14 percentage points (or 93% of the pre-2011 mean) across districts in 2011, regardless of CBA expiration timing. It was still 10 percentage points higher in 2016. Estimates remain robust when I restrict attention to districts with no CBA extension (Appendix Figure A9).

Estimates of β_s, shown in panel (b) of Figure 4, further indicate that the retirement rate began to slightly increase one year prior to a CBA expiration, by 3 pp (19%). Retirement rates were 6 pp higher the year of the expiration, as well as 13 pp and 11 pp higher one and two years later, respectively. As before, this finding is robust to restricting attention to districts with no CBA extension (Appendix Figure A9).

Table 3 summarizes the changes in retirement that followed Act 10 by showing linear combinations of the parameters η_s and β_s in equation (3). Across all cohorts, retirement rose by 12.8 pp in 2011 (or 80% relative to a pre-2011 average of 0.16), by 3.3 pp (21%) the year prior to a CBA expiration, and by 7.2 pp (45%) in the two years following the expiration of districts' CBAs (column

1).

5.3 Some Caveats and Robustness

The interpretation of the retirement changes described so far as responses to changes in net salaries and pension benefits has some caveats. I discuss them here, along with additional test to probe the robustness of the results to this interpretation.

Alignment between the passage of Act 10 and the expiration of districts' CBAs A potential issue with the event study estimates is that, for the 2011 cohort, the post-Act 10 era and the post-CBA expiration era coincide; separately identifying responses to the various provisions of Act 10 is thus impossible. Since this cohort is also the largest in terms of numbers of districts and teachers, a concern may be that estimates of η_{2011} in equation (3) may also include responses to a CBA expiration. To assess this possibility, I re-estimate equation (3) only on "off cycle" cohorts. All estimates remain robust; in particular, retirement rose by 12% pp in 2011 also in these cohorts (Figure 4, dashed lines, and Table 3, column 3).

Other drivers of the surge in retirement in 2011 One of the provisions of Act 10, the increase in employee pension contributions, was implemented in 2011 in all districts. This implies that all districts became "treated" with this provision starting from 2011 and there is no proper control group. It is thus not directly possible to rule out the possibility that the spike in retirement benefits was due to reasons other than Act 10. I argue that this is unlikely: Act 10 was extremely salient to the Wisconsin public, as evidenced by the number of Google searches (Appendix Figure A10).

Even if Act 10 was indeed the reason why so many teachers retired in 2011, it remains possible that there were other aspects of the reform (in addition to the drop in net salaries) that induced people to leave. Act 10 was a controversial reform, perceived by many to be an attack to the whole teaching profession (Stein and Marley, 2013). Some teachers may have thus chosen to retire earlier to leave a system they did not like anymore. To probe the robustness of my results to this possibility, I perform two tests. First, I re-estimate equation (3) excluding data for the year 2011. Estimates of the retirement responses to the CBA expiration remain robust; in addition, retirement rates increase over the period 2012-14 even conditioning on CBA expiration (Table 3, column 2). Second, I compare retirement rates by year for public-school teachers with those of teachers in independent charter schools, who still belong to the public sector but are not part of the WRS and, as such, are not required to pay a pension contribution. This comparison reveals that exit rates increased in 2011 also for charter school teachers, but by considerably less (5% on average, Appendix Figure A11).

Selection of teachers into non-retirement An additional consequence of the timing of Act 10's provisions is that there is no group of districts that did not experience a drop in net salaries before experiencing the further drop in salaries and pension benefits. Therefore, the retirement responses to a CBA expiration are estimated off of the sample of teachers who had previously chosen not to retire. This sample could be selected on the basis of unobservable characteristics, also correlated with the propensity to retire. To overcome this issue, I re-estimate the model in equation (3) using, in each year, only teachers who *just* became eligible to retire (either because they just turned 55, or because they are older than 55 but just became vested). This sample should not suffer from a selection problem, as these teachers could not have retired previously. Estimates using this sample reveal even larger positive responses of retirement to the expiration of CBAs (Table A1, columns 1-3).

Uncertainty over retiree healthcare benefits vs uncertainty over other aspects of CBA expiration So far, I have interpreted the increase in retirement that preceded a CBA expiration (which I refer to as "anticipatory" response) as a way to avoid losing employee healthcare benefits. In principle, it could be possible that teachers were uncertain about the salary and pension changes that would have followed an expiration, and they were retiring for these reasons. This possibility would complicate the interpretation of changes in retirement as a labor supply response to salaries and pension benefits. To confirm that the anticipatory response was exclusively due to uncertainty about retiree healthcare coverage, I re-estimate equation (3) on the subsample of workers already eligible for Medicare (who would be ineligible for this coverage even before Act 10). The anticipatory effect is absent for workers with access to Medicare, confirming that concerns about the loss of retiree healthcare drove the anticipatory effect (Table A1, columns 4-6).

5.4 Interpreting retirement responses

The increase in retirement following the decline in net salaries in 2011, particularly in off-cycle cohorts, suggests a strong substitution effect of salary changes and a more muted income effect (changes in net salaries do not affect workers' incentives to delay retirement to increase their pension benefits). The additional increase in retirement after the expiration of districts' CBAs further suggests that any negative income and substitution responses to a decline in pensions are not enough to overcome the substitution, income, and delaying incentives responses to the decline in salaries, resulting in a net positive effect on retirement.

There are three possible explanations for these findings. The first is that the magnitude of pension declines is smaller than the magnitude of salary declines and, subsequently, retirement responses are also smaller. The second is that the reduction in the incentives to delay retirement following a decline in salaries is large enough to compensate for the negative retirement impact of pension declines. The third is that workers are more responsive to changes in salaries than to changes in pensions, particularly along the substitution margin. Assessing which of these explanations is at play is important for policy, but difficult to do exclusively with a reduced-form analysis. To better isolate the impact of each of these explanations, I turn to a model.

6 Comparing Retirement Elasticities to Salaries and Pensions

To better illustrate the retirement responses to changes in salaries and DB pension benefits, I use a simple life-cycle framework similar to that of Blundell and MaCurdy (1999). I adapt this framework in two ways. First, I embed the DB formula as a constraint faced by each worker, to capture the incentives to delay retirement to increase future pension benefits (as in Gelber et al., 2016). Second, I allow for the possibility that workers may react differently to different forms of compensation along the substitution margin, for example due to differences in salience (Bordalo et al., 2022) or mental accounting (Thaler, 1999). I use the model to derive a formal test for the equality of the substitution responses to salaries and pensions, and I implement this test using using data from Wisconsin in the years surrounding Act 10.

6.1 Model Details

Each worker seeks to maximize a time-separable utility by choosing consumption c_t and leisure l_t. The choice of leisure is equivalent to a decision over retirement: $l_t = 0$ if the person works, earning a net salary $w_t = \tilde{w}_{it}(1 - \tau_t)$ (where $\tilde{w}_{it}$ is gross salary and τ_t is the rate of employee contributions to pensions and healthcare), and $l_t = 1$ if the person is retired, earning a pension b_t determined by a formula akin to (1). Workers discount the future at rate β and earn a return r on their savings. Everybody lives until period T.[11]

This framework implies that each worker must solve the following optimization problem:

$$\max_{\{c_t, l_t\}_{t\in[0,T]}} \sum_{s=0}^{T} \beta^s u(c_s, l_s) \tag{4}$$

$$\text{s. t. } a_{t+1} = (1+r)a_t + w_t(1-l_t) + g(b_t, w_t)l_t - c_t \tag{5}$$

$$\text{and } b_{t+1} = b_t + (1-l_t)\mu(\tilde{w}_t) \tag{6}$$

where equation (5) is the period-t budget constraint and equation (6) describes how pension benefits grow over time. The function $\mu(\tilde{w}_t)$ is deterministic and corresponds to the increase in future pension benefits from delaying retirement from t to $t+1$. The function $g(b_t, w_t)$ captures differences in salience between salaries and pensions, which I allow to depend on the values of these two variables (as in Bordalo et al., 2022).

Assuming that the marginal utility of wealth and pension wealth is the same, solving the model yields the following demand for retirement:

$$Pr(l_t = 1) = L(p_t + \mu(\tilde{w}_t), \lambda_t), \tag{7}$$

where $p_t = w_t - g(b_t, w_t)$ is the "price" of retirement, captures the substitution trade-off work and retirement in t, and λ_t is the marginal utility of wealth.

6.2 Elasticities of Salaries and Pensions

Using the demand function in (7), it is possible to derive retirement elasticities with respect to salaries and pensions. Omitting the time subscripts, the elasticity of retirement to salaries can be written as

$$\tilde{\epsilon}^w = \sigma^w + o^w + \iota^w, \tag{8}$$

[11]For simplicity, I do not incorporate survival risk into the model. When estimating the model's elasticities I control for age and gender, which are the main determinants of mortality.

where, denoting x_y as the partial derivative of x with respect to y, $\sigma^w = l_p(1 - g_w)\frac{w}{l}$ is the substitution (or Frisch) elasticity, which captures the change in retirement driven by a change in the retirement price p; $o^w = \mu_{\tilde{w}}$ captures the change in retirement driven by a change in the delaying incentives embedded in the pension formula; and $\iota^w = l_\lambda \lambda_w \frac{w}{l}$ is the income elasticity, which captures the change in retirement driven by changes in the marginal utility of wealth.

The elasticity of retirement to pensions can be expressed in an analogous way:

$$\epsilon^b = \sigma^b + \iota^b, \tag{9}$$

where $\sigma^b = l_p(-g_b)\frac{b}{l}$ is the substitution elasticity of pensions and $\iota^b = l_\lambda \lambda_b \frac{b}{l}$ is the corresponding income elasticity. It is useful to recognize that if retirement is a regular good, its demand should decrease with p: As a result, $\sigma^w \leq 0$ and $\sigma^b \geq 0$. If retirement is a normal good, its demand should increase with income/wealth: $\iota^w \geq 0$ and $\iota^b \geq 0$. The delaying incentive of salaries o^w should be weakly negative; as the increase in pension benefits from delaying retirement increases, the likelihood of retiring should decrease.

6.3 When Are Substitution and Income Elasticities of Salaries and Pensions The Same?

The model's elasticities can be used to establish whether workers react to the same percentage change in salaries and pensions in the same way along the substitution margin. Due to the opposite sign of the substitution elasticities to salaries and pensions, the two substitution effects are the same if and only if $|\sigma^w| = \sigma^b$. If the two elasticities are non-zero, this condition can be expressed as

$$H \equiv \frac{\sigma^b}{|\sigma^w|} = \frac{g_b}{g_w - 1}\frac{b}{w} = 1 \tag{10}$$

Intuitively, the relationship between the substitution effects of salaries and pensions depends on the individual valuation and the baseline magnitudes of these two forms of compensation.

One way to test the condition in (10) is to construct H empirically by separately estimating the income and substitution elasticities of salaries and pensions. However, this requires making assumptions about the functional form of λ. Instead of making these assumptions, I use $\tilde{\epsilon}^w$ and ϵ^b to derive bounds to the substitution elasticities of the two forms of compensation and show how they can be used to construct an empirical test for the equality of substitution responses. Defining

$\epsilon^w = \tilde{\epsilon}^w - o^w$, if $\epsilon^w < 0$, then the opposite signs of the substitution and income elasticities of salaries imply that $|\epsilon^w| \leq |\sigma^w|$. In words, the magnitude of the full elasticity of retirement to salaries (net of the delaying effect) is a lower bound for the magnitude of the substitution elasticity. By a similar argument, the concordant signs of the substitution and income elasticities of pensions imply that $\epsilon^b \geq \sigma^b$, i.e., the full elasticity to pensions is an upper bound for the substitution elasticity. From this it follows that if the substitution elasticities of salaries and pensions have the same magnitude, the following condition must hold:

$$|\epsilon^w| \leq \epsilon^b. \tag{11}$$

6.4 Testing for The Equality of Substitution and Income Elasticities of Salaries and Pensions

Testing condition (11) empirically requires estimating ϵ^w and ϵ^b. To do so, I model the probability of retirement as follows (I re-introduce the subscripts i to denote individuals and t to denote years):

$$l_t = \nu^w \ln(1 - \tau_{it}) + \tilde{\nu}^w \tilde{w}_{it} + \nu^b \ln b_{it} + \alpha X_{it} + \omega_{it} \tag{12}$$

In this model, $\nu^w = l_{it}\varepsilon^w$ denotes the semi-elasticity of net salaries, which corresponds to the sum of the income and substitution elasticities of this form of compensation (since net salaries do not affect the incentives to delay retirement through the pension formula). The parameter $\tilde{\nu}^w = l_{it}\tilde{\varepsilon}^w$ denotes instead the semi-elasticity of *gross* salaries, which also incorporates the incentive to delay retirement. Lastly, the parameter $\nu^b = l_{it}\varepsilon^b$ is the semi-elasticity to pension benefits, which is also the sum of the corresponding income and substitution elasticities.

Instrumental variables approach Consistently estimating ν^w and ν^b in equation (12) requires ω_{it} to be orthogonal to w_{it} and b_{it}. In words, there cannot exist unobservable factors that are correlated with both compensation and retirement. This assumption could be violated in reality, especially in the post-Act 10 world with the end of salary schedules. To get around this issue, I use the timing of the provisions of the reform and their heterogeneous impact across teachers—due to differences in district served, age, experience, and education—as instruments for salaries and pensions in a two-stage least squares (2SLS) framework. The first-stage equations have the following form:

$$\ln y_{it} = \mathbb{1}(t \geq 2011) s_{it} e_{it} \gamma_1 + \mathbb{1}(t \geq C_{j(it)}) * s_{it} e_{it} \gamma_2 + \mathbb{1}(t \geq C_{j(it)}) s_{it} a_{it} \gamma_3 + \omega_{it}^y \tag{13}$$

where y_{it} is either $(1 - \tau_{it})$, $\tilde{w}_{it}$, or b_{it}, and s_{it}, e_{it}, and a_{it} are vectors of seniority, education, and year fixed effects. This first-stage equation implies that the effects of salaries and pension benefits are identified using only the variation in contribution rates and in CBA expiration across teachers with different seniority, education, and age working in districts with different CBA expiration dates.

6.5 Estimation Results

2SLS estimates of equation (12) indicate that individuals respond more to changes in salaries than to changes in pensions along the substitution margin. Table 4 (column 1) shows estimates and standard errors of the parameters ν^w, $\tilde{\nu}^w$, and ν^b together with the corresponding elasticities. In these estimates, the vector X_{it} contains district and education fixed effects and quadratic polynomials of age and seniority. A negative estimate for ν^w equal to -0.71, with an implied total elasticity ϵ^w equal to -3.679, indicates that a 10% decline in salaries leads to a 3.7% increase in retirement. The negative sign of this estimate confirms that the substitution effect of salaries is stronger than the income effect. As expected, the estimate of ν^b is positive at 0.171, with a corresponding elasticity of 0.888. This implies that a 10% decline in pensions leads to a 8.9% decline in retirement. Importantly, the estimate of ν^b is significantly smaller in magnitude than ν^w, allowing me to reject the null hypothesis that $\nu^b \geq \nu^w$ with a p-value very close to zero.

Estimates of the elasticities are largely robust to the inclusion of seniority and age fixed effects (Table 4 , column 2) and year fixed effects (column 3) as part of the vector X_{it} in equation (12). First-stage estimates, shown in Appendix Table A2, confirm the findings presented in Section 4: gross salaries and pensions decline after a CBA expiration, whereas net salaries also declined after the passage of Act 10 in 2011. F-statistics ranging between 20 and well above 100 indicate that the instruments are strong. For comparison, Appendix Table A3 shows OLS estimates of the specifications shown in Table 4. The corresponding elasticities are smaller, highlighting the importance of accounting for the endogeneity of salaries and pensions to retirement. Yet, even these estimates imply that $|\nu^w| > \nu^b$.

Effects by gender Previous works have shown gender differences in labor supply elasticities in general (Eissa and Liebman, 1996; Meyer and Rosenbaum, 2001) and substitution elasticities more specifically (Caldwell and Oehlsen, 2022). Women have also been found to respond more to changes in retirement benefits than men (Liebman et al., 2009; Furgeson et al., 2006). In Table 5 I test for the presence of gender differences in the retirement responses to salaries and pensions. In columns 1 and 2 I show estimates of equation (12) separately on male and female teachers; in column 3 I again pool data from both genders and expand equation (12) to include interaction of the three main explanatory variables with an indicator for females. Women appear to have a larger elasticity to salaries, equal to -3.044 compared with -2.926 for men (columns 1 and 2); this difference is statistically significant at the 10% level. The elasticity to pensions is instead indistinguishable across genders and equal to 0.71. Importantly, for both genders I can reject the null hypothesis that the substitution effects of salaries and pensions are the same, with p-values very close to zero.

6.6 Robustness Checks

As highlighted in Section 5, using the staggered retirement behavior of teachers across districts to identify responses to salaries and pensions relies on some assumptions and involves some identification challenges. I review them here and propose tests for the robustness of my estimates to these issues.

Restricting attention to off-cycle districts For the cohort of districts with CBAs expiring in 2011, the post-Act 10 era and the post-CBA expiration eras coincide. This may make the identification of retirement elasticities to salaries and pension benefits more challenging. To better understand the extent to which this identification challenge affects the estimates, in column 3 of Table 4 I re-estimate equation (12) using only data from off-cycle districts. Estimates are largely robust to this choice.

Other drivers of the surge in retirement in 2011 The increase in employee pension contributions, the main driver of the decline in net salaries, was implemented at the same time in all districts. If there were other factors that increased retirement in 2011 (for example a high degree of resentment towards the government), their impact would be captured by ν^w and mistakenly interpreted as the effect of lower salaries. To probe the robustness of the results to this possibility, in column 4 of Table 4 I re-estimate equation (12) excluding data from the year 2011. While the estimate of ν^w is lower with this restriction, it is still larger in magnitude than ν^b. This implies that I can still reject the null hypothesis in equation (11).

Selection of teachers into non-retirement The timing of implementation of the provisions of Act 10 implies that districts could only have experienced a drop in pension benefits after experiencing a drop in net salaries. This further implies that the retirement elasticity to pensions is estimated off of the sample of teachers who had previously chosen not to retire, which could be selected on the basis of unobservables. As before, I assess the importance of this selection by restricting attention to the subsample of teachers, who, in each year, had just become eligible to retire. Estimating of equation (12) on this subsample , shown in Appendix Table A4 confirm the conclusion that the substitution response to salaries is larger in magnitude that the response to pensions even in this subsample, and allow me to reject the null hypothesis that in equation (11) (Appendix Table A4, columns 1-4).

Alternative calculations of the rate of contributions to healthcare In the results presented so far, I have been assuming a rate of contribution to healthcare 3 pp lower after each CBA expiration compared to before. In Appendix Table A5 I consider an alternative specification of this contribution rate. Namely, I calculate the average district-level change in fringe benefits (net of employer pension contributions and expressed as a share of 2011 salaries) and assign it to all teachers in their respective districts. On average, this district-specific change is equal to -3.2 pp, which implies an increase in employee healthcare contributions of 3.2 pp. Estimates of salary and pension elasticities of retirement remain robust to this change.

6.7 Summary and Implications for Employee Retention

Taken together, estimates of the retirement elasticities to salaries and pensions indicate that even workers eligible to retire are more responsive to cuts in salaries than to cut in pensions along the substitution margin. This finding is robust to a variety of econometric specifications and holds on different subsamples of the data.

In addition to being informative about the retirement behavior of public-school teachers, this result has implications for the impact of budget-saving measures, such as Act 10, on the retention of experienced employees. Using the elasticities shown in column 1 of Table 4, I calculate that an alternative budget-saving policy designed to generate the same savings as Act 10 on the subsample of retirement-eligible teachers who were active in 2012 would have had to cut pensions by about 0.2% for each teacher. Absent general-equilibrium effects on hiring and retention of non-retirement-eligible teachers, this alternative policy would have retained 840 additional teachers in 2013 and 825 in 2014 (about 11% of all retirement-eligible teachers active in 2012 in my sample). While the effect of this policy on students is not obvious ex ante (previous works have found some evidence of potentially positive effects of teacher retirement on students; see Fitzpatrick and Lovenheim 2014; Roth 2019), and while this analysis abstracts from budget savings achieved on younger teachers and any general-equilibrium effects in terms of new teacher hiring, this result is still important to keep in mind for policy-makers when considering generous pensions as an employee retention tool.

7 The Role of Salience and Information Over Pensions

The results presented so far indicate that workers' substitution response to a change in future pension benefits is significantly more modest than the same percent change in salaries. A possible explanation for this type of behavior is a lack of information on or salience of pensions. Several works have shown that workers don't fully understand how Social Security benefits work (Liebman and Luttmer, 2015) and do not respond to changes in them in a way that is consistent with rational behavior (e.g., Mastrobuoni, 2009).

To understand whether salience and/or information can explain the small response to pensions, I exploit the fact that different groups of workers may have been differentially exposed to information on these benefits, which could impact both the amount and accuracy of information they hold and the salience of this form of compensation. These differences are related to workers' age and the share of their colleagues who retired immediately prior to Act 10. I describe these differences next.

7.1 Differences by Workers' Age

Pension benefits may be more salient to older workers because they are closer to a standard retirement age. For example, Rohwedder and Kleinjans (2006) have shown that older workers respond more strongly to changes in Social Security benefits.

I test this hypothesis in Table 6, which shows estimates of the parameters in equation (12) separately for workers aged 55-57, 58-61, 62-64, and 65 and above. These estimates confirm that older workers respond more strongly to changes in salaries and pensions. For example, a 10% decline in net salaries causes a 7.9 pp increase in retirement for workers aged 55-57 (column 1) and a larger 13.5 pp increase for those aged 65 and above (column 4), with coefficient magnitudes that grow monotonically across age groups. Similarly, a 10% decline in pensions reduces retirement by 1.6 pp and 3.5 pp, respectively. Since older workers retire at higher rates on average, these semi-elasticities correspond to lower elasticities of salaries and pensions for older workers. Importantly, though, even for older workers I can reject the null hypothesis that the substitution elasticities of salaries and pensions have the same magnitude. I can thus conclude that differences in age, which may be correlated with differences in information and salience on pension benefits, are not enough to explain the modest responses to changes in pension benefits.

7.2 Differences by Share of Retirement-Eligible Colleagues

To further quantify the role of salience and information on workers' responses to changes in pensions, I leverage differences across workers in the retirement behavior of their colleagues prior to Act 10. In particular, I classify workers depending on whether the share of teachers in the school they were in in 2010-11 who retired during those year is above or below 10%, which corresponds to the 75th percentile across districts. The idea behind this test is that workers who retired prior to Act 10 were on average better informed on or aware of how pension benefits are calculated, and they may thus have increased information and salience among their peers.

Estimates of these equations, shown in Table 7, indicate that having a higher share of colleagues who retired in 2010-11 is associated with larger elasticities of both salaries and pensions. For example, a 10% decline in net salaries leads to a 5.4 pp increase in retirement for workers with a share of retired colleagues below the median and a much larger 20 pp increase for workers with a share above the median (columns 1 and 2, respectively). The corresponding semi-elasticities of pensions are equal to 1.5 pp and 3.0 pp. Differences are even larger if I split the sample according to the share of teachers who retired in 2010-11 who are of the same gender as the teacher (columns 3 and 4): the semi-elasticities to salaries are 4.9 pp and 25.1 pp and the semi-elasticities to pensions are 1.4 pp and 3.8 pp, respectively, for workers with shares below and above the median. Importantly, in all these specifications I can reject the null hypothesis that the substitution responses to changes in salaries and in pensions are the same. Taken together, these findings indicate that while a larger share of workers who have made the decision to retire in the past is associated with larger elasticities of salaries and pensions, it cannot explain the difference between the responses to the two forms of compensation that I observe in the data.

8 Discussion and Conclusion

This paper has studied how public-sector employees react to changes in salaries and future pension benefits by examining the experience of Wisconsin teachers after Act 10, a reform that cut these two forms of compensation with a staggered timing across districts. The retirement behavior of teachers after the reform, together with estimates of model-based extensive-margin labor supply elasticities to salaries and pensions, indicate that teachers are significantly more responsive to cuts in salaries than they are to cuts in pension benefits along the substitution margin. I find no strong evidence that differences in salience–albeit measured imperfectly–can explain this finding: Teachers for whom the retirement decision should be more salient respond more strongly to both types of compensation.

These findings have important implications for the design of compensation packages for public-sector employees, who continue to receive generous pensions and more modest salaries compared to similarly skilled workers in other sectors. Pensions appear to have more modest power to retain employees compared to salaries. In addition, cuts in pensions generate much smaller labor supply responses than cuts in salaries. Governments in need of addressing budget deficits—such as Wisconsin in 2011—who do not want to lose employees may be better off reducing future pension benefits rather than forcing employees to pay more towards them. A question that remains open is why employees do not respond much to changes in future pension benefits. This question, which also has important policy implications, represents a fruitful avenue for future research.

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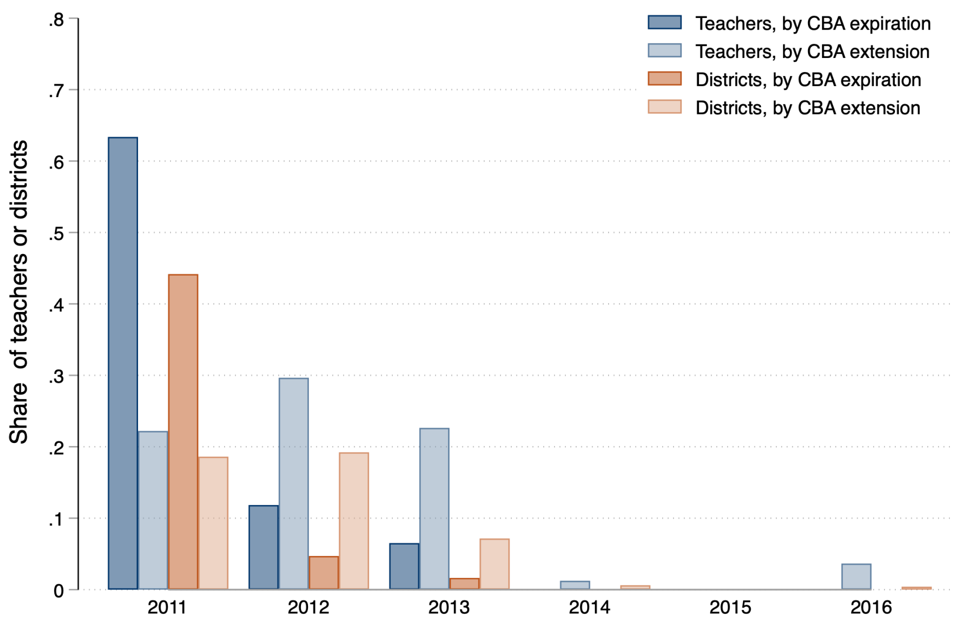
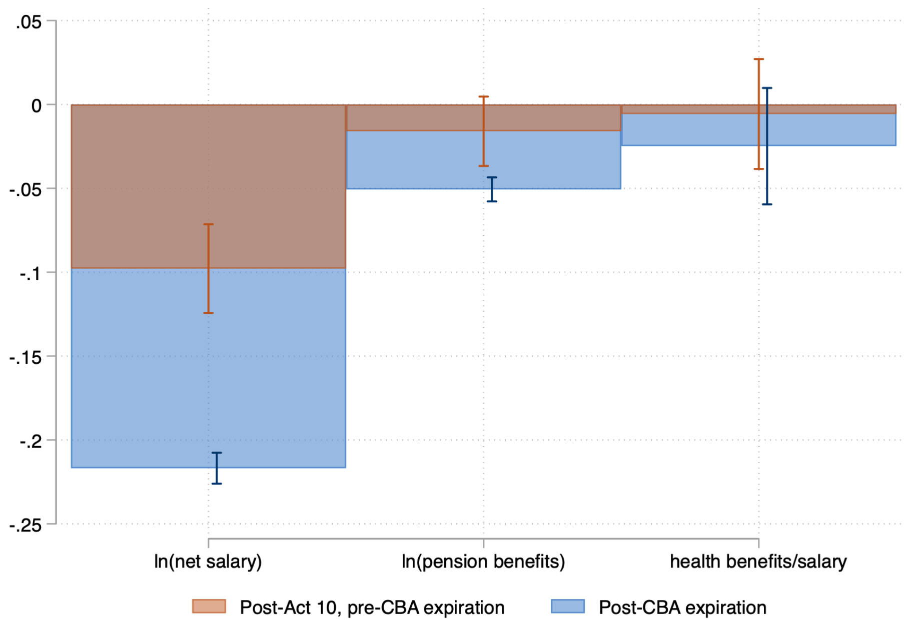
Figure 1: Distribution of Teachers and Districts by CBA Expiration Dates



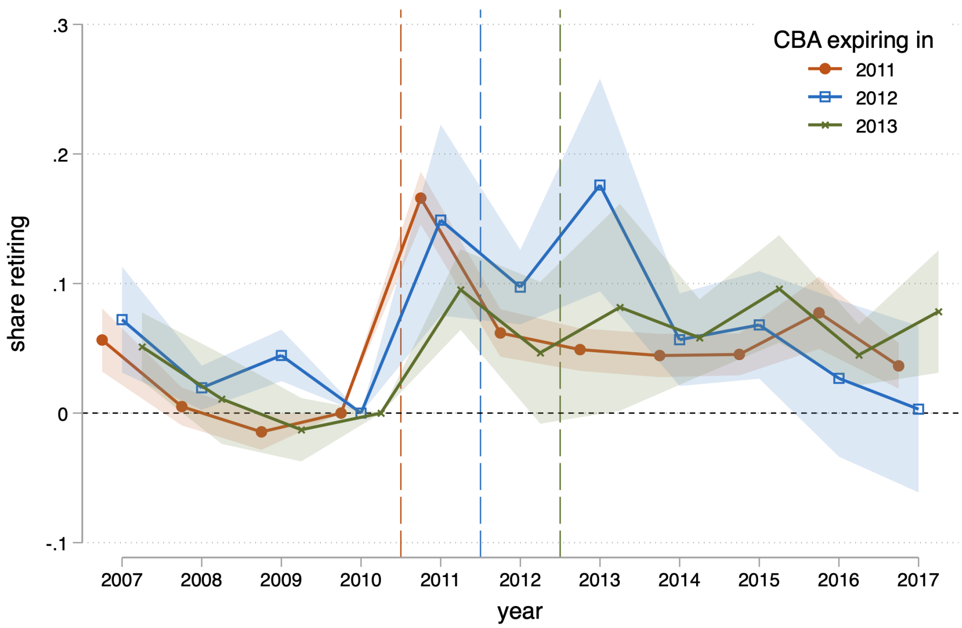
Notes: Share of teachers and districts by date of expiration of the district's CBA or of its extension.

Figure 2: Changes in Net Salaries, and Pension Benefits, and Healthcare Contribution Following Act 10



Notes: Average of parameter estimates $\tau_{2011,c}$ (in orange) and $\tau_{CBA,c}$ (in blue) in equation (2) across cohorts c, obtained using the natural logarithm of net salaries (left bar), the natural logarithm of pension benefits (central bar), and the rate of employee contributions to healthcare (right bar). All these variables are defined in the text and detrended using years prior to 2011. Confidence intervals are calculated using standard errors clustered at the district level.

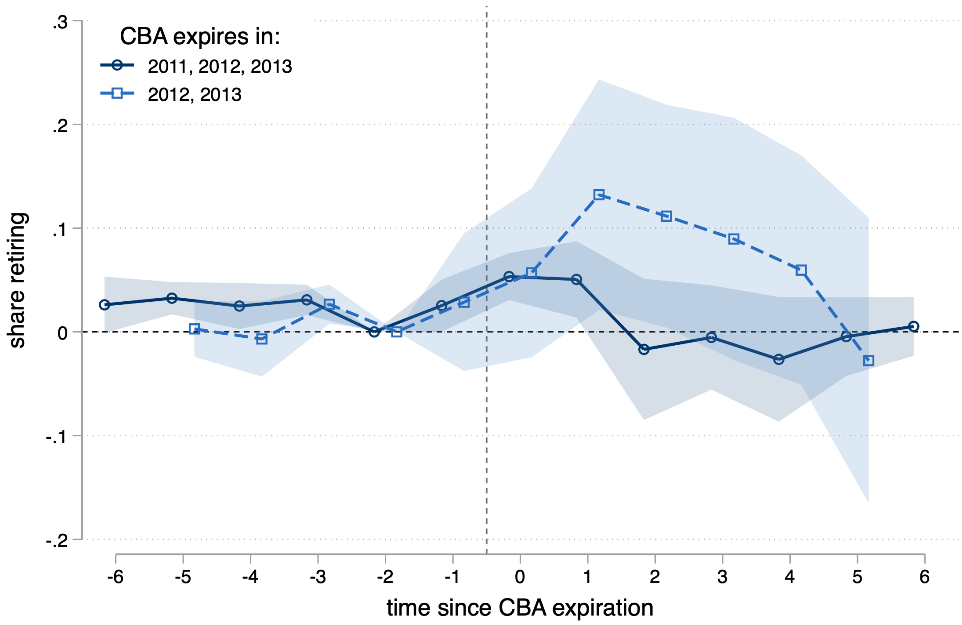
Figure 3: Exit Rates of Retirement-Eligible Teachers, by CBA Expiration Cohort



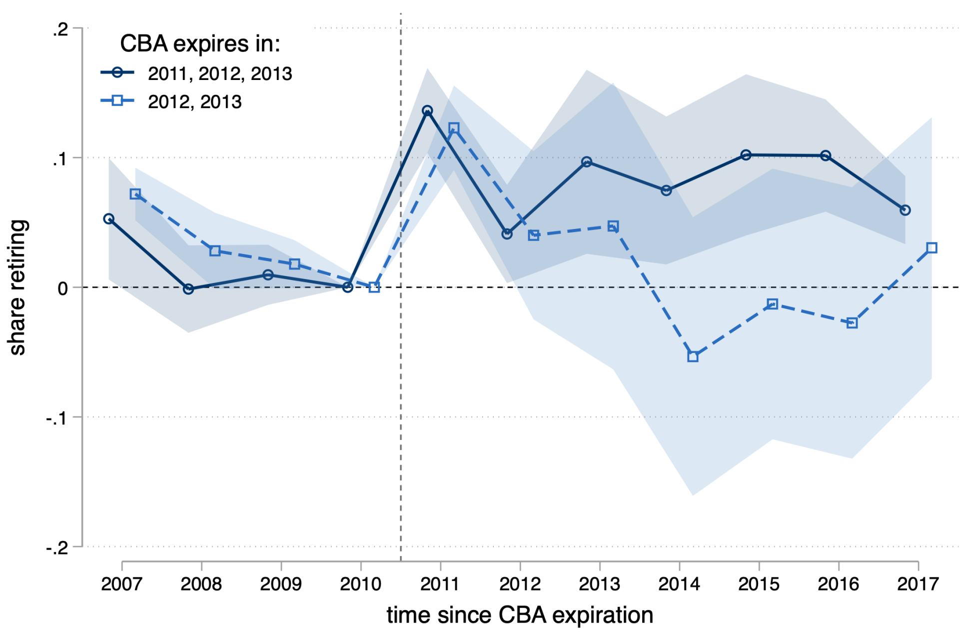
Notes: Estimates and confidence intervals of year effects in cohort-specific regressions of an indicator for exit and district, age, experience, and education fixed effects. The fixed effect for the year 2010 is omitted. Standard errors are clustered at the district level.

Figure 4: Decomposing Changes in Retirement After Act 10

(a) By time since CBA expiration



(b) By time since Act 10



Notes: Estimates and confidence intervals of the parameters β_s (panel (a)) and η_s (panel (b)) in equation (3). The solid line is estimated on the full sample of districts; the dashed line is estimated on the subsample of off-cohort districts. Standard errors are clustered at the district level.

Table 1: Wisconsin Teacher Employment Data: Summary Statistics, Teachers Eligible to Retire

		CBA Expires in:		
	All Districts	2011	2012	2013
net salary ($)	51,929	51,364	55,465	51,327
	(13,311)	(13,178)	(13,474)	(13,378)
benefit ($)	34,682	34,505	36,252	33,694
	(11,992)	(11,729)	(13,243)	(12,027)
annual % change in net salary, 2009-11	0.04	0.04	0.03	0.04
	(0.12)	(0.13)	(0.09)	(0.12)
annual % change in benefits, 2009-11	0.02	0.02	0.01	0.02
	(0.26)	(0.26)	(0.27)	(0.27)
age	42.82	42.61	43.76	43.24
	(10.57)	(10.54)	(10.63)	(10.69)
years of experience	12.22	12.44	11.00	12.20
	(8.29)	(8.33)	(8.15)	(7.96)
% with master's or PhD	0.55	0.56	0.43	0.59
	(0.50)	(0.50)	(0.50)	(0.49)
% female	0.75	0.74	0.74	0.77
	(0.44)	(0.44)	(0.44)	(0.42)
% Retiring in 2009 or 2010	0.06	0.06	0.07	0.06
	(0.25)	(0.24)	(0.25)	(0.23)
N teachers	96,492	75,895	15,213	8,200
N districts	247	216	23	8
N teacher-district observations	527,624	412,575	73,077	41,972

Notes: Means and standard deviations (in parentheses) of variables used in the analysis.

Table 2: Changes in Compensation Following Act 10: OLS, Dependent Variables are Healthcare Contribution Rate, ln(Net Salary), ln(Pension Benefits)

	ln(net salary)	ln(pension benefits)	healthcare contr. rate
	(1)	(2)	(3)
Post 2011 * CBA expires 2012	-0.084***	-0.005	0.019
	(0.007)	(0.004)	(0.014)
Post 2011 * CBA expires 2013	-0.095***	-0.019	-0.004
	(0.022)	(0.017)	(0.032)
Post CBA expiration (2011)	-0.183***	-0.047***	-0.028***
	(0.005)	(0.005)	(0.005)
Post CBA expiration (2012)	-0.079***	-0.054***	-0.082***
	(0.005)	(0.013)	(0.018)
Post CBA expiration (2013)	-0.087***	-0.029***	-0.017
	(0.005)	(0.005)	(0.051)
Fixed effects	Yes	Yes	Yes
N	84318	84318	77037
Nr clusters	247	247	247
Adj. R2	0.34	0.86	0.11

Notes: The dependent variable is the natural logarithm of net salaries, defined as gross salaries minus employee contributions to pensions and health care (column 1); the natural logarithm of future pension benefits, calculated using the pension formula; and the rate of employee contributions to health care, defined as the difference, for each teacher, between fringe benefits and employer pension contributions, divided by the teacher's salary in 2011 (column 3). All columns show OLS estimates. *Post 2011* equals 1 for years following 2011; *CBA expires in X* equals 1 for all districts whose CBAs expired in year X; and *Post CBA expiration (X)* equals 1 for all districts with CBA expiring in year X and years following X. All specifications control for district, experience, education, and age fixed effects. Standard errors in parentheses are clustered at the district level. $^{*} \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table 3: Decomposing Changes in Retirement After Act 10

	All cohorts		Off-cycle cohorts	No extensions
Time:	(1)	(2)	(3)	(4)
2011	0.1278***		0.1186***	0.1780***
	(0.018)		(0.023)	(0.039)
2012-2014	0.0454	0.0533	-0.0017	0.0750***
	(0.028)	(0.035)	(0.034)	(0.019)
2015-2017	0.0368	0.0402	-0.0294	0.0270
	(0.023)	(0.025)	(0.023)	(0.016)
yr before CBA	0.0331*	0.0346***	0.0330	0.0807**
	(0.018)	(0.011)	(0.037)	(0.030)
1-2 yrs post CBA	0.0715***	0.0563***	0.1054***	0.0653**
	(0.016)	(0.019)	(0.034)	(0.032)
3-7 yrs post CBA	0.0374	0.0325	0.0657***	0.0929***
	(0.038)	(0.034)	(0.019)	(0.030)
Controls	X	X	X	X
Years	All	Excl. 2011	All	Excl. 2011
R^2	0.075	0.061	0.078	0.086
N	83,970	74,927	19,706	28,098
# clusters	247	247	31	114

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. *2011*, *2012-2014*, and *2015-2017* are indicators for the corresponding year ranges. *yr before CBA* equals 1 the year preceding a CBA expiration; *1-2 yrs post CBA* and *3-7 yrs post CBA* equals 1 1-2 and 3-7 years following a CBA expiration, respectively. All specifications control for district, experience, age, and education fixed effects. Standard errors in parentheses are clustered at the district level. $^{*} \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table 4: Retirement Elasticities to Salaries and Pensions: Two-Stage Least Squares Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
ν^w $(1-\tau)$	-0.710***	-0.757***	-1.534**	-0.988***	-0.466***	-0.831***
	(0.047)	(0.073)	(0.752)	(0.235)	(0.083)	(0.260)
ϵ^w	**-3.679**	**-3.923**	**-7.946**	**-5.457**	**-2.605**	**-4.862**
$\tilde{\nu}^w$ (salaries)	-0.372***	-0.342***	-0.308***	-0.610***	-0.271***	-0.465**
	(0.047)	(0.084)	(0.072)	(0.197)	(0.073)	(0.204)
$\tilde{\epsilon}^w$	**-1.930**	**-1.771**	**-1.597**	**-3.373**	**-1.513**	**-2.717**
ν^b (pensions)	0.171***	0.158***	0.126***	0.174***	0.132***	0.159***
	(0.026)	(0.018)	(0.023)	(0.026)	(0.020)	(0.026)
ϵ^b	**0.888**	**0.820**	**0.655**	**0.963**	**0.740**	**0.930**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000	0.032	0.001	0.000	0.005
District FE	X	X	X	X	X	X
Experience, age controls	X					
Experience, age FE		X	X	X	X	X
Year FE			X			
Cohorts	All	All	All	Off-cycle	All	Off-cycle
Years	All	All	All	All	Excl. 2011	Excl. 2011
Mean dep. var.	0.193	0.193	0.193	0.181	0.179	0.171
N	84,319	84,301	84,301	20,018	75,263	17,790
Nr. clusters	247	247	247	31	247	31

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. All columns show 2SLS estimates, using equation (13) as the first-stage model. All specifications control for district and education fixed effects; column 1 also controls for quadratic polynomials in age and experience, columns 2-6 also control for experience and age fixed effects, and column 3 also controls for experience, age, and year fixed effects. Columns 1-3 are estimated on the full sample of districts and years; columns 4 and 6 are estimated on the subsample of districts in off-cycle cohorts, and columns 5 and 6 are estimated on all years excluding 2011. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table 5: Retirement Elasticities to Salaries and Pensions: Estimates by Gender

	Women	Men	All	Women	Men	All
	(1)	(2)	(3)	(4)	(5)	(6)
ν^w $(1-\tau)$	-0.744***	-0.644***	-0.565***	-0.724***	-0.519***	-0.471***
	(0.051)	(0.073)	(0.070)	(0.067)	(0.100)	(0.096)
ϵ^w (men)	**-3.917**	**-3.172**	**-2.926**	**-3.999**	**-2.867**	**-2.603**
ν^w * Woman			-0.118*			-0.123
			(0.067)			(0.111)
ϵ^w (women)			**-3.044**			**-2.726**
$\tilde{\nu}^w$ (salaries)	-0.386***	-0.345***	-0.320***	-0.365***	-0.271***	-0.335**
	(0.048)	(0.069)	(0.062)	(0.091)	(0.068)	(0.149)
$\tilde{\epsilon}^w$	**-2.029**	**-1.699**	**-1.660**	**-2.016**	**-1.497**	**-1.849**
$\tilde{\nu}^w$ * Woman			-0.009			-0.005
			(0.006)			(0.010)
$\tilde{\epsilon}^w$ (women)			**-1.669**			**-1.854**
ν^b (pensions)	0.167***	0.179***	0.136***	0.146***	0.109***	0.147**
	(0.024)	(0.037)	(0.035)	(0.016)	(0.019)	(0.054)
ϵ^b	**0.880**	**0.880**	**0.706**	**0.806**	**0.600**	**0.812**
ν^w * Woman			0.010			0.006
			(0.006)			(0.012)
ν^w (women)			**0.715**			**0.818**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000		0.000	0.000	
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$, men			0.000			0.003
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$, women			0.000			0.000
District FE	X	X	X	X	X	X
Experience, age controls	X	X	X	X	X	X
Cohorts	All	All	All	Off-cycle	Off-cycle	Off-cycle
Mean dep. var.	0.190	0.203	0.193	0.181	0.181	0.181
N	64,297	20,022	85,115	15,159	4,874	20,407
Nr. clusters	247	246	247	31	31	31

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. *Woman* equals one for women. All columns show 2SLS estimates, using equation (13) as the first-stage model (in columns 3 and 6 I further interact all excluded instruments with *Woman*). All specifications control for district and education fixed effects and for quadratic polynomials in age and experience. Columns 1 and 4 are estimated on the subsample of male teachers; columns 2 and 5 are estimated on the subsample of female teachers. Columns 4-6 are further estimated on the subsample of districts in off-cycle cohorts. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table 6: Retirement Elasticities to Salaries and Pensions: Estimates by Age

Age	55-57	58-61	62-64	65+
	(1)	(2)	(3)	(4)
ν^w $(1-\tau)$	-0.785***	-0.992***	-1.033***	-1.349***
	(0.153)	(0.136)	(0.126)	(0.211))
ϵ^w	**-5.453**	**-5.087**	**-3.756**	**-3.920**
$\tilde{\nu}^w$ (salaries)	-0.586**	-0.719***	-0.156	-0.357***
	(0.153)	(0.136)	(0.126)	(0.211)
$\tilde{\epsilon}^w$	**-4.073**	**-3.686**	**-0.569**	**-1.038**
ν^b (pensions)	0.163***	0.165**	0.183***	0.347**
	(0.020)	(0.060)	(0.063)	(0.142))
ϵ^b	**1.133**	**0.848**	**0.667**	**1.008**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000	0.000	0.000
District FE	X	X	X	X
Experience, age FE	X	X	X	X
Mean dep. var.	0.144	0.195	0.275	0.344
N	38,359	25,911	17,367	2,547
Nr. clusters	247	247	247	199

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. All columns show 2SLS estimates, using equation (13) as the first-stage model. All specifications control for district, education, age, and experience fixed effects. Column 1 is estimated on the subsample of teachers aged 55-57, column 2 on the subsample aged 58-61, column 3 on the subsample aged 62-64, and column 4 on the subsample aged 65 and above. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table 7: Retirement Elasticities to Salaries and Pensions: Estimates by Share of Colleagues Who Retired Before 2011

	% colleagues who retired		% same-gender colleagues who retired	
	Low	High	Low	High
	(1)	(2)	(3)	(4)
ν^w $(1-\tau)$	-0.538***	-2.000***	-0.493***	-2.514***
	(0.094)	(0.179)	(0.100)	(0.183))
ϵ^w	**-2.844**	**-9.569**	**-2.635**	**-11.531**
$\tilde{\nu}^w$ (salaries)	-0.326***	-0.935***	-0.328***	-1.210***
	(0.094)	(0.179)	(0.100)	(0.183)
$\tilde{\epsilon}^w$	**-1.726**	**-4.473**	**-1.755**	**-5.552**
ν^b (pensions)	0.151***	0.300***	0.140***	0.378***
	(0.020)	(0.064)	(0.021)	(0.073))
ϵ^b	**0.798**	**1.436**	**0.747**	**1.733**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000	0.000	0.000
District FE	X	X	X	X
Experience, age controls	X	X	X	X
Mean dep. var.	0.189	0.209	0.187	0.218
N	65,827	17,330	67,494	15,520
Nr. clusters	239	156	245	181

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. All columns show 2SLS estimates, using equation (13) as the first-stage model. All specifications control for district and education fixed effects and for quadratic polynomials in age and experience. Columns 1 and 2 are estimated on the subsamples of teachers with a share of colleagues who retired prior to 2011 above and below the median, respectively; columns 3 and 4 are estimated on the subsamples of teachers with a share of same-gender colleagues who retired prior to 2011 above and below the median, respectively. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

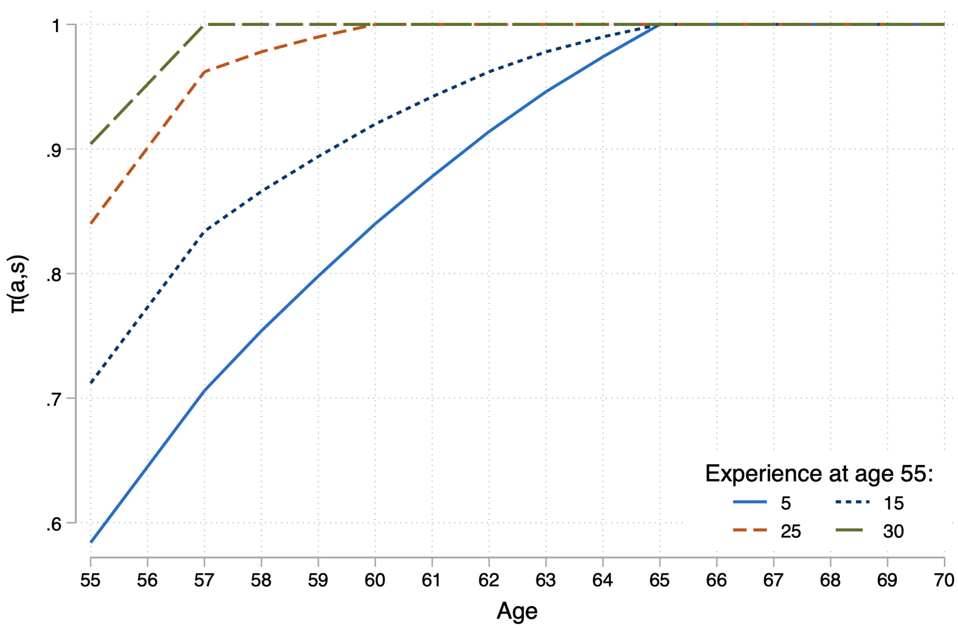
Salaries, Pensions, and The Retention of Public-Sector Employees: Evidence from Wisconsin Teachers

Online Appendix

Barbara Biasi

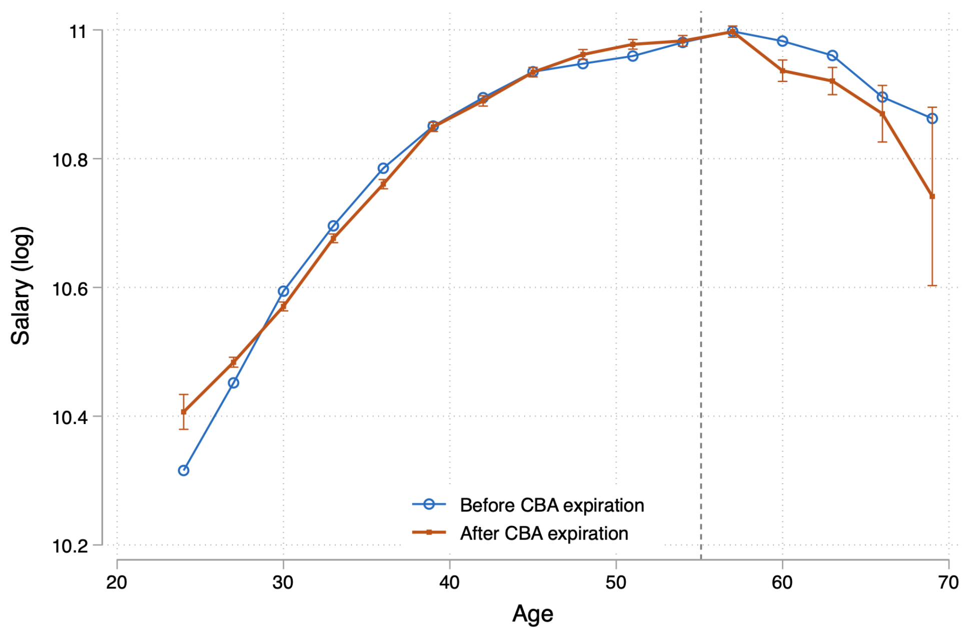
A Additional Tables and Figures

Figure A1: Actuarial Reduction Factor in Wisconsin Pension Formula



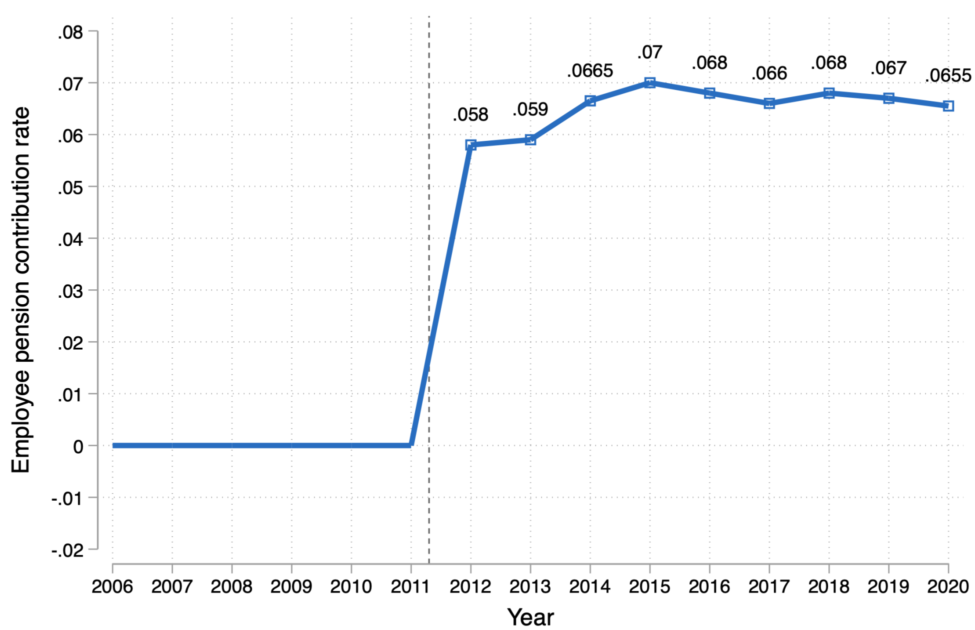
Notes: Actuarial reduction factor in the Wisconsin pension formula, shown by age and separately for teachers who have 5, 15, 25, and 30 years of experience by age 55.

Figure A2: Salary by Age, Before vs After CBA Expirations



Notes: Average salaries of teachers by 3-year age groups, the year of each district's CBA expiration and two years later. Confidence intervals are constructed using heteroskedasticity-robust standard errors.

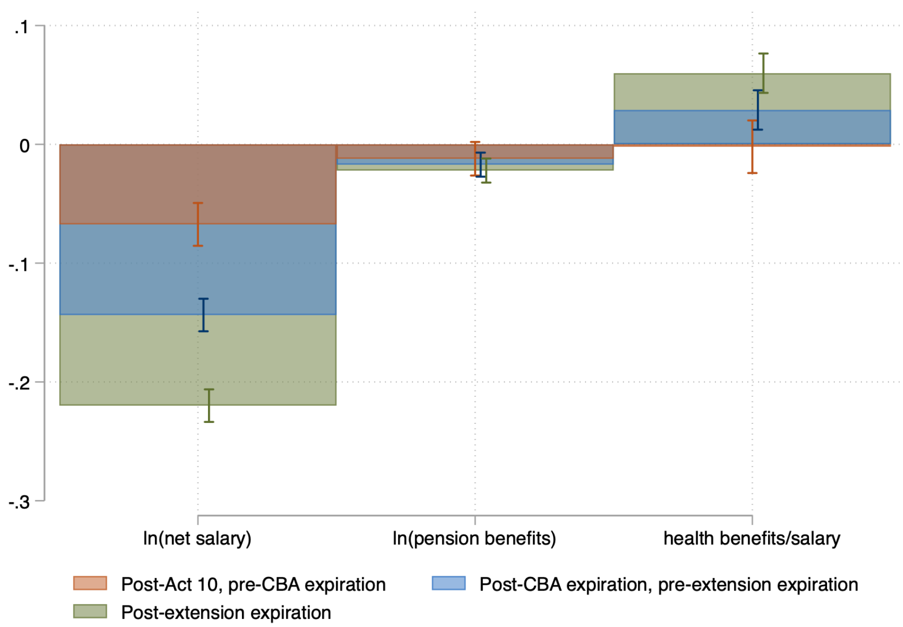
Figure A3: Employee Pension Contribution Rate



Notes: Rate of employee contributions to the pension fund, expressed as a share of total salary.

Figure A4: Changes in Net Salaries, and Pension Benefits, and Healthcare Contribution Following Act 10

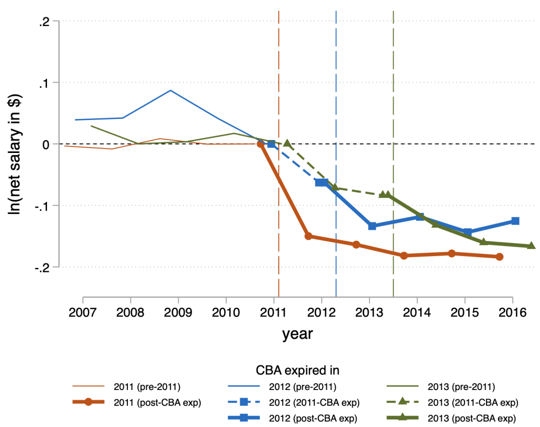
Figure A5: Net salaries



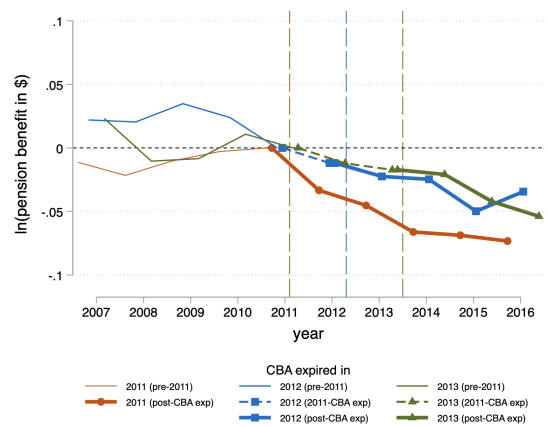
Notes: Average of parameter estimates $\tau_{2011,c}$ (in orange) and $\tau_{CBA,c}$ (in blue), and $\tau_{CBAext,c}$ (in green) in a version of equation (2) that also includes $\mathbb{1}(t > x_j)$, where x_j is the year of expiration of district j's CBA extension (if one was issued). Averages are taken across cohorts c. Estimates are obtained using the natural logarithm of net salaries (left bar), the natural logarithm of pension benefits (central bar), and the rate of employee contributions to healthcare (right bar); these variables are defined in the text and detrended using years prior to 2011. Confidence intervals are calculated using standard errors clustered at the district level.

Figure A6: Changes in Compensation Following Act 10 – Dynamics

(a) Net salaries



(b) Pension benefits



(c) Employer healthcare contributions (as a fraction of 2011 salaries)

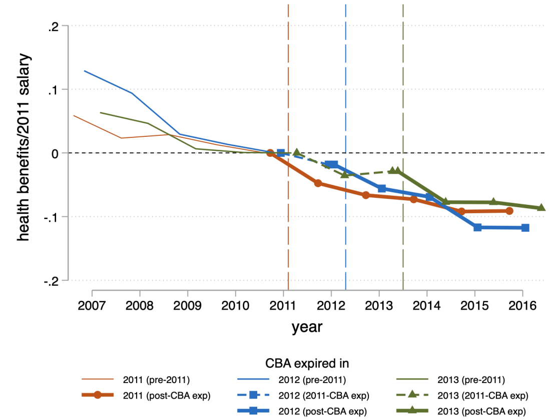
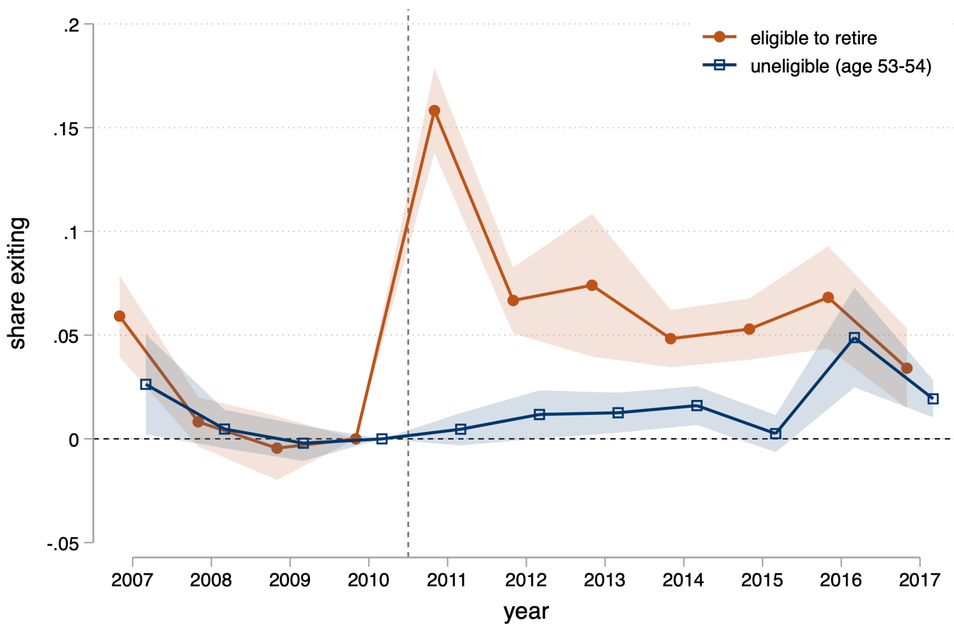
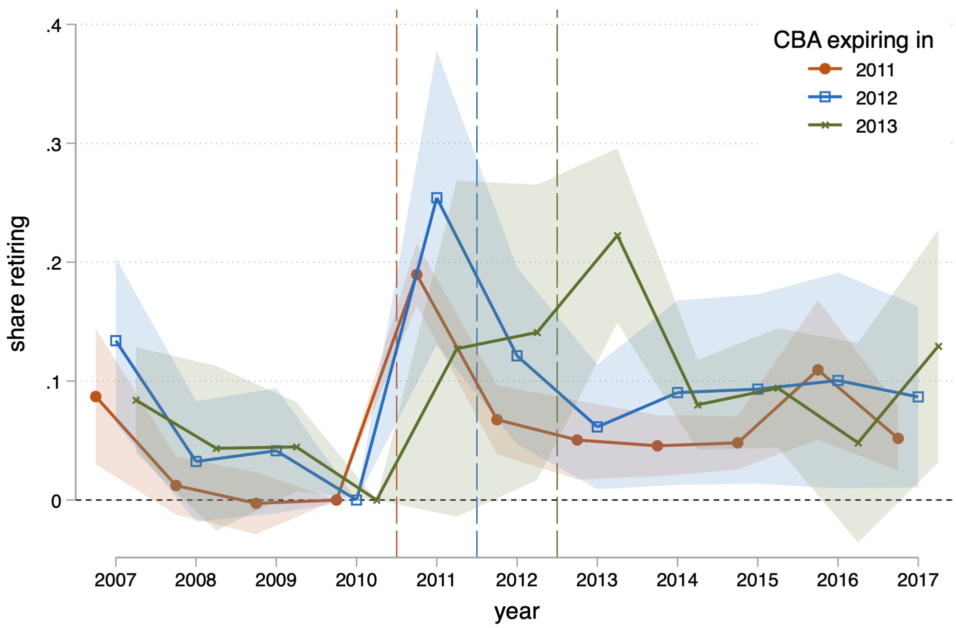


Figure A7: Exit Rates of Wisconsin Public School Teachers



Notes: Estimates and confidence intervals of year effects in cohort-specific regressions of an indicator for exit and district, age, experience, and education fixed effects. Estimates marked with full circles are estimated on retirement-eligible teachers; estimates marked with hollow squares are estimated on the subsample of teachers aged 53-54 in each year, still ineligible to retire.The fixed effect for the year 2010 is omitted. Standard errors are clustered at the district level.

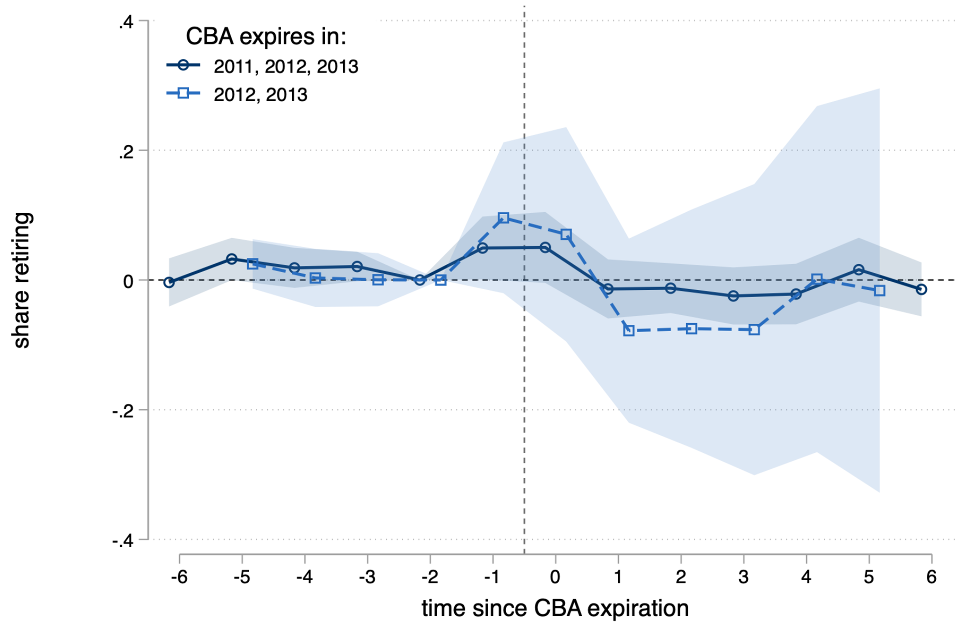
Figure A8: Exit Rates of Retirement-Eligible Teachers, by CBA Expiration Cohort. Excluding Districts with A CBA Extension



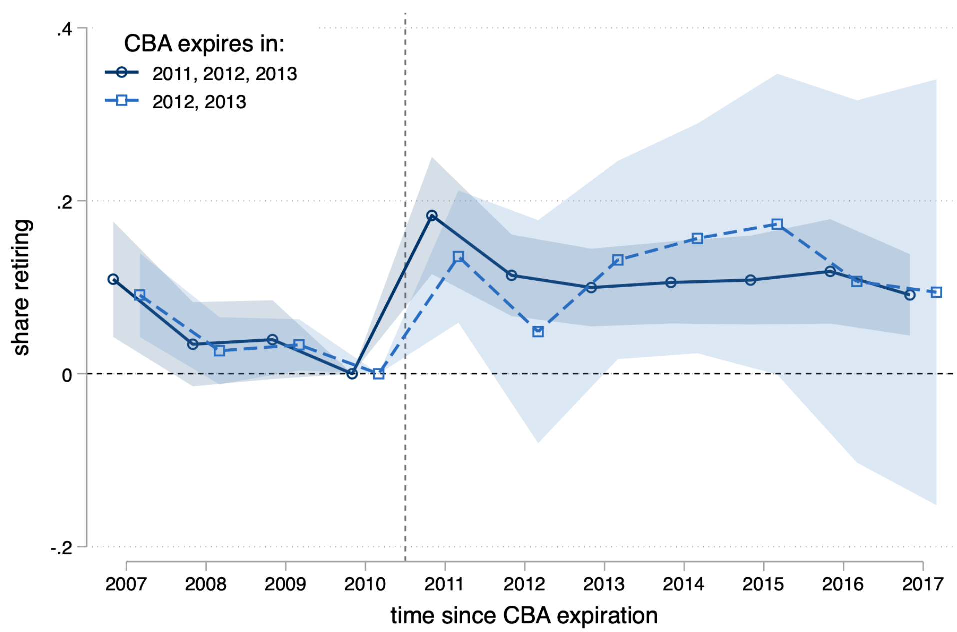
Notes: Estimates and confidence intervals of year effects in cohort-specific regressions of an indicator for exit and district, age, experience, and education fixed effects. The fixed effect for the year 2010 is omitted. Districts with a CBA extension are excluded. Standard errors are clustered at the district level.

Figure A9: Decomposing Changes in Retirement After Act 10. Excluding Districts with A CBA Extension

(a) By time since CBA expiration

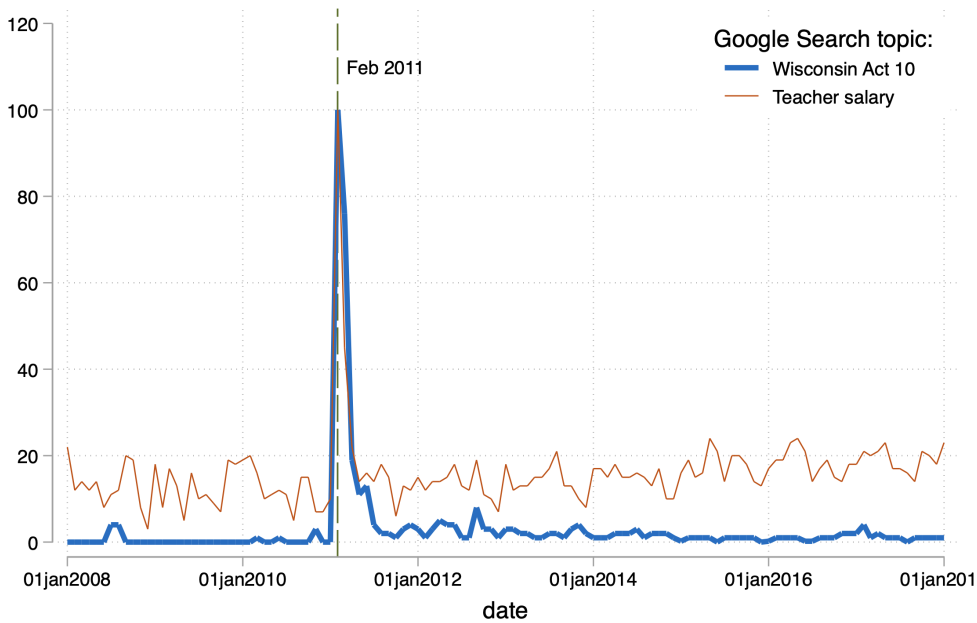


(b) By time since Act 10



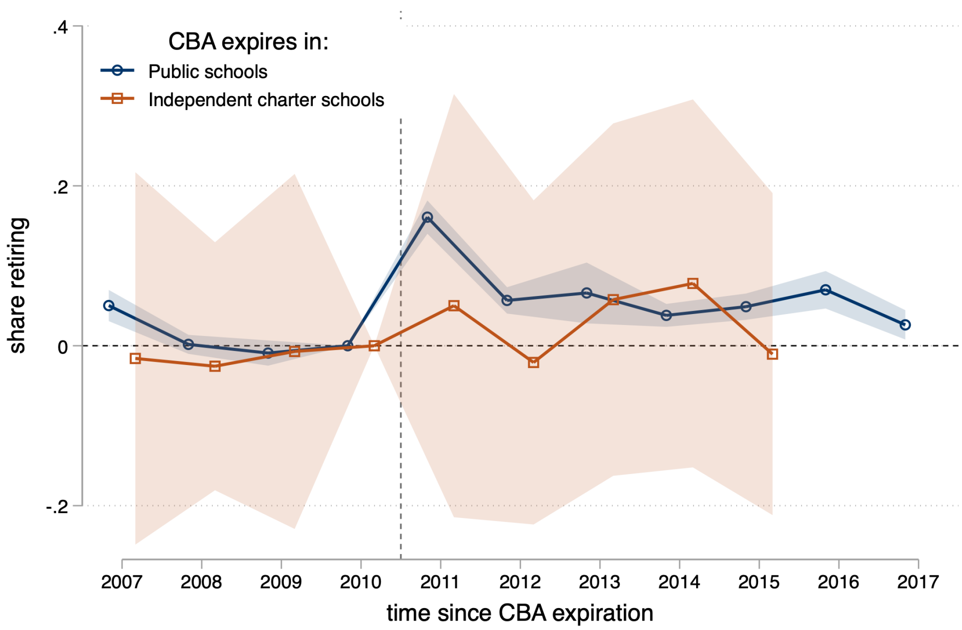
Notes: Estimates and confidence intervals of the parameters β_s (panel (a)) and η_s (panel (b)) in equation (3). The solid line is estimated on the sample of districts without a CBA extension; the dashed line is estimated on the subsample of off-cohort districts without a CBA extension. Standard errors are clustered at the district level.

Figure A10: Google Searches of Act 10-Related Terms



Notes: The figure shows trends in Google searches of various Act 10-related terms, such as *Wisconsin Act 10* and *Teacher salary*, between January 2008 and January 2018.

Figure A11: Exit Rates of Retirement-Eligible Teachers: Public Schools vs Independent Charter Schools



Notes: Estimates and confidence intervals of year effects in cohort-specific regressions of an indicator for exit and district, age, experience, and education fixed effects. Estimates marked with hollow circles are obtained on the full sample of retirement-eligible public-school teachers; estimates marked with hollow squares are obtained on the sample of teachers in district charter schools.The fixed effect for the year 2010 is omitted. Standard errors are clustered at the district level.

Table A1: Decomposing Changes in Retirement After Act 10 - Robustness Check

	Just eligible to retire			Medicare eligible		
		Off-cycle	Excl. 2011		Off-cycle	Excl. 2011
Time:	(1)	(2)	(3)	(4)	(4)	(6)
2011	0.1035***	0.0364		0.1432***	0.2113**	
	(0.016)	(0.025)		(0.035)	(0.080)	
2012-2014	0.0183	-0.0452	0.0297	0.1677***	0.2159***	0.1545*
	(0.017)	(0.034)	(0.025)	(0.046)	(0.060)	(0.081)
2015-2017	0.0149	-0.0250	0.0166	0.0871*	-0.0194	0.0912
	(0.013)	(0.025)	(0.015)	(0.051)	(0.042)	(0.061)
yr before CBA	0.0546***	0.1186***	0.0364***	-0.0707	-0.1819*	-0.0257
	(0.018)	(0.036)	(0.011)	(0.047)	(0.091)	(0.036)
1-2 yrs post CBA	0.0775***	0.1255***	0.0420*	-0.1003**	-0.1919***	-0.0657
	(0.019)	(0.041)	(0.024)	(0.036)	(0.054)	(0.061)
3-7 yrs post CBA	0.0716**	0.0705***	0.0512**	-0.0953	-0.0339	-0.0644
	(0.028)	(0.018)	(0.020)	(0.062)	(0.026)	(0.079)
Controls	X	X	X	X	X	X
R^2	0.049	0.023	0.036	-0.018	0.018	-0.034
N	24,836	5,741	22,387	6,270	1,512	5,480
# clusters	247	31	247	239	30	239

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. *2011*, *2012-2014*, and *2015-2017* are indicators for the corresponding year ranges. *yr before CBA* equals 1 the year preceding a CBA expiration; *1-2 yrs post CBA* and *3-7 yrs post CBA* equal 1 1-2 and 307 years following a CBA expiration, respectively. Columns 1-3 are estimated on the subsample of teachers who had just become eligible to retire in each year; columns 4-6 are estimated on teachers aged 65 and above, and thus eligible for Medicare benefits. Columns 2 and 5 further restrict the subsample to districts in off-cycle cohorts, and columns 3 and 6 are estimated on all years except for 2011. All specifications control for district, experience, age, and education fixed effects. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table A2: Retirement Elasticities to Salaries and Pensions: First-Stage Estimates

	$\ln(1-\tau_t)$	ln (salary)	ln (benefit)
	(1)	(2)	(3)
after 2011	-0.059***	0.048	0.063
	(0.000)	(0.037)	(0.041)
after CBA expiration	-0.043***	-0.395*	-0.473**
	(0.001)	(0.207)	(0.213)
F-stat	1.8e+05	22.499	54.223
District FE	X	X	X
Experience, age FE	X	X	X
N	84,301	84,301	84,301
Nr. clusters	247	247	247

Notes: Estimates and confidence intervals of the first-stage model shown in equation (13). Standard errors in parentheses are clustered at the district level.

Table A3: Retirement Elasticities to Salaries and Pensions: OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
ν^w $(1-\tau)$	-0.529***	-0.687***	-1.415*	-0.716***	-0.429***	-0.647***
	(0.044)	(0.049)	(0.727)	(0.116)	(0.065)	(0.132)
ϵ^w	**-2.742**	**-3.562**	**-7.333**	**-3.958**	**-2.399**	**-3.784**
$\tilde{\nu}^w$ (salaries)	-0.150***	-0.143***	-0.137***	-0.114***	-0.152***	-0.117***
	(0.019)	(0.025)	(0.025)	(0.036)	(0.025)	(0.033)
$\tilde{\epsilon}^w$	**-0.777**	**-0.739**	**-0.710**	**-0.630**	**-0.849**	**-0.683**
ν^b (pensions)	0.086***	0.095***	0.091***	0.053*	0.088***	0.050*
	(0.015)	(0.024)	(0.024)	(0.026)	(0.023)	(0.024)
ϵ^b	**0.447**	**0.493**	**0.472**	**0.294**	**0.491**	**0.293**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000	0.038	0.000	0.000	0.000
District FE	X	X	X	X	X	X
Experience, age controls	X					
Experience, age FE		X	X	X	X	X
Year FE			X			
Cohorts	All	All	All	Off-cycle	All	Off-cycle
Years	All	All	All	All	Excl. 2011	Excl. 2011
Mean dep. var.	0.193	0.193	0.193	0.181	0.179	0.171
N	85,115	85,098	85,098	20,391	76,060	18,163
Nr. clusters	247	247	247	31	247	31

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. All columns show OLS estimates. All specifications control for district and education fixed effects; column 1 also controls for quadratic polynomials in age and experience, columns 2-6 also control for experience and age fixed effects, and column 3 also controls for experience, age, and year fixed effects. Columns 1-3 are estimated on the full sample of districts and years; columns 4 and 6 are estimated on the subsample of districts in off-cycle cohorts, and columns 5 and 6 are estimated on all years excluding 2011. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table A4: Retirement Elasticities to Salaries and Pensions. Robustness Checks: Only Workers Who Just Became Eligible to Retire

	(1)	(2)	(3)	(4)
ν^w $(1-\tau)$	-0.577***	-0.545***	-0.471***	-0.383***
	(0.072)	(0.089)	(0.066)	(0.087)
ϵ^w	**-4.977**	**-5.448**	**-4.364**	**-4.028**
$\tilde{\nu}^w$ (salaries)	0.023	-0.053	-0.036	-0.010
	(0.082)	(0.072)	(0.061)	(0.045)
$\tilde{\epsilon}^w$	**0.197**	**-0.533**	**-0.338**	**-0.101**
ν^b (pensions)	0.099***	0.054***	0.089***	0.022**
	(0.028)	(0.013)	(0.024)	(0.010)
ϵ^b	**0.853**	**0.537**	**0.826**	**0.234**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000	0.000	0.000
District FE	X	X	X	X
Experience, age FE	X	X	X	X
Cohorts	All	Off-cycle	All	Off-cycle
Years	All	All	Excl. 2011	Excl. 2011
Mean dep. var.	0.116	0.100	0.108	0.095
N	12,512	3,046	11,241	2,759
Nr. clusters	247	31	247	31

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. All columns show 2SLS estimates, using equation (13) as the first-stage model. All specifications control for district, education, age, and experience fixed effects. All columns are estimated on the subsample of workers who had just become eligible to retire in each year. Columns 1 and 3 are estimated on the full sample of districts and years; columns 2 and 4 are estimated on the subsample of districts in off-cycle cohorts, and columns 3 and 4 are estimated on all years excluding 2011. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

Table A5: Retirement Elasticities to Salaries and Pensions: Robustness Checks: Alternative Calculation of Employee Healthcare Contributions

	(1)	(2)	(3)	(4)
ν^w $(1-\tau)$	-0.577***	-0.545***	-0.471***	-0.383***
	(0.072)	(0.089)	(0.066)	(0.087)
ϵ^w	**-4.977**	**-5.448**	**-4.364**	**-4.028**
$\tilde{\nu}^w$ (salaries)	-0.406***	-0.478**	-0.252***	-0.432*
	(0.091)	(0.224)	(0.076)	(0.229)
$\tilde{\epsilon}^w$	**-2.104**	**-2.641**	**-1.407**	**-2.527**
ν^b (pensions)	0.173***	0.170***	0.134***	0.159***
	(0.017)	(0.023)	(0.019)	(0.024)
ϵ^b	**0.899**	**0.941**	**0.749**	**0.928**
P-value $H_0 : \lvert\epsilon^w\rvert \leq \epsilon^b$	0.000	0.000	0.000	0.001
District FE	X	X	X	X
Experience, age FE	X	X	X	X
Cohorts	All	Off-cycle	All	Off-cycle
Years	All	All	Excl. 2011	Excl. 2011
Mean dep. var.	0.193	0.181	0.179	0.171
N	84,301	20,018	75,263	17,790
Nr. clusters	247	31	247	31

Notes: The dependent variable is an indicator for a teacher exiting the sample at the end of the year. ν^w, $\tilde{\nu}^w$, and ν^b are the semi-elasticities to net salaries, gross salaries, and pension benefits, respectively; the relative elasticities are denoted by ϵ^w, $\tilde{\epsilon}^w$, and ϵ^b and are reported in bold. Net salaries are calculated using a district-specific employee rate of contribution to healthcare, calculated as the average across all workers in the district. All columns show 2SLS estimates, using equation (13) as the first-stage model. All specifications control for district, education, age, and experience fixed effects. Columns 1 and 3 are estimated on the full sample of districts and years; columns 2 and 4 are estimated on the subsample of districts in off-cycle cohorts, and columns 3 and 4 are estimated on all years excluding 2011. Standard errors in parentheses are clustered at the district level. $^* \leq 0.1$, $^{**} \leq 0.05$, $^{***} \leq 0.01$.

B Sources for CBA Expiration/Extension Dates

Table EI: CBA data sources

Code	Name	CBA Expiration	Extension?	Extension until	Sources	Links			
63	Albany Sch Dist	2011	Yes	2016	MoA district-union	source (1)			
70	Algoma Sch Dist	2011	No	--	handbook	source (1)			
84	Alma Sch Dist	2011	no info	no info	online source (WILL)	source (1)			
105	Almond-Bancroft Sch Dist	2011	Yes	2013	online source (MacIver Inst)	source (1)			
112	Altoona Sch Dist	2011	Yes	2013	board minutes	source (1)	source (2)	source (3)	
119	Amery Sch Dist	2011	Yes	2012	district website; handbook	source (1)	source (2)		
147	Appleton Area Sch Dist	2011	Yes	2012	district website; handbook	source (1)	source (2)	source (3)	source (4)
2450	Arrowhead UHS Sch Dist	2011	Yes	2012	online source (WILL); district website	source (1)	source (2)		
170	Ashland Sch Dist	2011	No	--	online source (governor website)	source (1)	source (2)		
182	Ashwaubenon Sch Dist	2011	Yes	2012	district website	source (1)	source (2)	source (3)	source (4)
203	Auburndale Sch Dist	2011	no info	no info	online source	source (1)			
217	Augusta Sch Dist	2012	No	--	handbook	source (1)			
231	Baldwin-Woodville Area Sch Dis	2011	Yes	2012	online news source (MJS)	source (1)			
245	Bangor Sch Dist	2011	No	--	online source	source (1)			
280	Baraboo Sch Dist	2011	Yes	2012	online source (MacIver Inst)	source (1)	source (2)	source (3)	source (4)
308	Barron Area Sch Dist	2011	Yes	2013	online source (MacIver Inst)	source (1)			
315	Bayfield Sch Dist	2011	Yes	2012	handbook	source (1)			
336	Beaver Dam Unified Sch Dist	2011	Yes	2013	handbook	source (1)	source (2)		
350	Belleville Sch Dist	2011	no info	no info	union contract	source (1)			
413	Beloit Sch Dist	2011	Yes	2013	union contract	source (1)	source (2)		
422	Beloit Turner Sch Dist	2011	Yes	2012	online news source (Beloit Daily News)	source (1)			
427	Benton Sch Dist	2011	No	--	district website	source (1)			
434	Berlin Area Sch Dist	2011	Yes	2012	online news source (PolitiFact)	source (1)			
476	Black River Falls Sch Dist	2011	No	--	handbook	source (1)			
485	Blair-Taylor Sch Dist	2011	Yes	2012	handbook	source (1)			
497	Bloomer Sch Dist	2011	No	--	handbook	source (1)			
602	Bonduel Sch Dist	2011	Yes	2013	online source (MacIver Inst)	source (1)	source (2)		
700	Brodhead Sch Dist	2011	Yes	2012	online source (MacIver Inst)	source (1)	source (2)		
721	Brown Deer Sch Dist	2011	No	--	handbook	source (1)			
777	Burlington Area Sch Dist	2011	Yes	2013	online news source (Journal Times)	source (1)			
870	Cadott Community Sch Dist	2011	No	--	handbook	source (1)			
910	Campbellsport Sch Dist	2011	No	--	handbook	source (1)			
1015	Cedarburg Sch Dist	2011	No	--	handbook	source (1)			
1080	Chetek-Weyerhaeuser Area Sch D	2011	No	--	board minutes	source (1)	source (2)		
1085	Chilton Sch Dist	2011	Yes	2012	district website	source (1)			
1092	Chippewa Falls Area Unified Sc	2011	Yes	2012	online news source (Chippewa Herald)	source (1)	source (2)		
1141	Clintonville Sch Dist	2012	No	--	online news source (Waupaca now)	source (1)	source (2)		
1155	Cochrane-Fountain City Sch Dis	2011	no info	no info	online source (EAG)	source (1)			
1162	Colby Sch Dist	2011	Yes	2012	handbook	source (1)			
1183	Columbus Sch Dist	2011	Yes	2012	online news source (MJS)	source (1)	source (2)		
1232	Crivitz Sch Dist	2013	No	--	handbook	source (1)	source (2)		
1253	Cudahy Sch Dist	2011	No	--	online news source (Cudahy Now); handbook	source (1)	source (2)		

4970	D C Everest Area Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)		
1295	Darlington Community Sch Dist	2011	No	--	handbook	source (1)			
1316	De Forest Area Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)		
1414	De Pere Sch Dist	2011	Yes	2013	handbook	source (1)	source (2)	source (3)	
1421	De Soto Area Sch Dist	2011	Yes	2012	board minutes	source (1)			
1309	Deerfield Community Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)		
1380	Delavan-Darien Sch Dist	2011	No	--	district website	source (1)	source (2)		
1407	Denmark Sch Dist	2011	No	--	board minutes	source (1)			
2744	Dodgeland Sch Dist	2011	No	--	board minutes	source (1)	source (2)		
1428	Dodgeville Sch Dist	2011	Yes	2012	district website; handbook	source (1)	source (2)		
1499	Durand Sch Dist	2011	Yes	2012	online source (MacIver Inst)	source (1)	source (2)	source (3)	
1540	East Troy Community Sch Dist	2011	No	--	district website	source (1)			
1554	Eau Claire Area Sch Dist	2011	Yes	2012	handbook; online source (MacIver Inst)	source (1)	source (2)	source (3)	source (4)
1568	Edgerton Sch Dist	2011	Yes	2013	online source (MacIver Inst)	source (1)	source (2)	source (3)	
1638	Elkhorn Area Sch Dist	2011	Yes	2013	handbook	source (1)	source (2)		
1659	Ellsworth Community Sch Dist	2011	Yes	2012	online source (MacIver Inst)	source (1)	source (2)		
714	Elmbrook Sch Dist	2011	No	--	online news source (Patch)	source (1)	source (2)	source (3)	source (4)
1666	Elmwood Sch Dist	2011	No	--	online source (WILL)	source (1)			
1694	Evansville Community Sch Dist	2011	Yes	2013	online news source (GazettExtra)	source (1)	source (2)		
1729	Fall Creek Sch Dist	2012	No	--	handbook	source (1)			
5757	Flambeau Sch Dist	2011	no info	no info	online source (WILL)	source (1)			
1862	Fond du Lac Sch Dist	2011	No	--	online news source (MJS)	source (1)	source (2)		
1883	Fort Atkinson Sch Dist	2012	No	--	union contract	source (1)	source (2)		
1900	Franklin Public Sch Dist	2011	No	--	district document	source (1)			
2009	Galesville-Ettrick-Trempealeau	2011	No	--	online source (WEA)	source (1)			
2058	Germantown Sch Dist	2011	No	--	union contract	source (1)	source (2)	source (3)	source (4)
2114	Gibraltar Area Sch Dist	2012	Yes	2013	handbook	source (1)			
2184	Glendale-River Hills Sch Dist	2012	No	--	board meeting minutes	source (1)			
2212	Goodman-Armstrong Creek Sch	2011	No	--	handbook	source (1)			
2217	Grafton Sch Dist	2011	No	--	handbook	source (1)			
2233	Grantsburg Sch Dist	2011	No	--	handbook	source (1)			
2289	Green Bay Area Public Sch Dist	2011	Yes	2013	online source (MacIver Inst); board minutes	source (1)	source (2)		
2310	Green Lake Sch Dist	2011	Yes	2013	online source (MacIver Inst)	source (1)	source (2)		
2296	Greendale Sch Dist	2011	No	--	online news source (Patch)	source (1)			
2303	Greenfield Sch Dist	2011	No	--	handbook	source (1)			
2420	Hamilton Sch Dist	2011	No	--	district website	source (1)	source (2)		
2443	Hartford J1 Sch Dist	2011	No	--	online source (WILL)	source (1)	source (2)		
2460	Hartland-Lakeside J3 Sch Dist	2011	No	--	online source (EAG)	source (1)	source (2)		
2478	Hayward Community Sch Dist	2011	No	--	handbook	source (1)			
2527	Highland Sch Dist	2011	Yes	2012	online news source (The Dodgeville Chronicle)	source (1)			
2562	Holmen Sch Dist	2011	Yes	2012	online news source (The Lacrosse Tribune)	source (1)	source (2)	source (3)	source (4)
2576	Horicon Sch Dist	2011	No	--	online source (EAG)	source (1)			
2583	Hortonville Area Sch Dist	2011	Yes	2013	handbook	source (1)	source (2)		
2604	Howard-Suamico Sch Dist	2011	No	--	online source (EAG)	source (1)	source (2)		

2605	Howards Grove Sch Dist	2011	Yes	2012	handbook	source (1)				
2611	Hudson Sch Dist	2011	No	--	online source (EAG)	source (1)	source (2)	source (3)		
2632	Independence Sch Dist	2012	No	--	handbook	source (1)				
2639	Iola-Scandinavia Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
2646	Iowa-Grant Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
2695	Janesville Sch Dist	2013	No	--	online news source (Channel3000)	source (1)	source (2)	source (3)		
2730	Johnson Creek Sch Dist	2011	Yes	2012	school board minutes	source (1)				
2758	Kaukauna Area Sch Dist	2011	No	--	handbook	source (1)	source (2)			
1376	Kettle Moraine Sch Dist	2011	No	--	handbook	source (1)	source (2)	source (3)		
2800	Kewaskum Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)	source (3)		
2814	Kewaunee Sch Dist	2011	Yes	2013	school board minutes	source (1)				
2828	Kiel Area Sch Dist	2011	No	--	handbook	source (1)				
2835	Kimberly Area Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)	source (3)		
2842	Kohler Sch Dist	2011	no info	no info	online source (EAG)	source (1)				
2849	La Crosse Sch Dist	2011	Yes	2012	online news source (The Lacrosse Tribune)	source (1)	source (2)	source (3)	source (4)	
3862	Lake Country Sch Dist	2011	no info	no info	online source (EAG)	source (1)				
3647	Lakeland UHS Sch Dist	2011	No	--	online source (WEA)	source (1)				
3129	Little Chute Area Sch Dist	2011	Yes	2012	school board minutes	source (1)	source (2)	source (3)		
3150	Lodi Sch Dist	2012	No	--	handbook	source (1)	source (2)	source (3)		
3220	Luxemburg-Casco Sch Dist	2011	Yes	2012	handbook	source (1)				
3269	Madison Metropolitan Sch Dist	2013	Yes	2016	union contract; district website	source (1)	source (2)	source (3)	source (4)	source (5)
3276	Manawa Sch Dist	2011	no info	no info	online news source (Waupaca County News)	source (1)				
3290	Manitowoc Sch Dist	2011	No	--	handbook	source (1)				
3297	Maple Sch Dist	2011	Yes	2012	school board minutes	source (1)	source (2)			
3304	Marathon City Sch Dist	2011	No	--	handbook	source (1)				
3311	Marinette Sch Dist	2011	Yes	2012	handbook	source (1)				
3332	Marshall Sch Dist	2011	Yes	2012	district press release	source (1)				
3339	Marshfield Unified Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
3360	Mauston Sch Dist	2011	No	--	online news source (Wiscnews); handbook	source (1)				
3381	McFarland Sch Dist	2011	Yes	2013	online news source (WI State Journal); handbook	source (1)	source (2)			
3409	Medford Area Public Sch Dist	2012	no info	no info	handbook	source (1)	source (2)			
3428	Melrose-Mindoro Sch Dist	2011	No	--	online news source (The Lacrosse Tribune)	source (1)				
3430	Menasha Joint Sch Dist	2011	Yes	2012	school board minutes	source (1)	source (2)			
3437	Menomonee Falls Sch Dist	2011	Yes	2013	online source (EAG)	source (1)	source (2)			
3444	Menomonie Area Sch Dist	2011	Yes	2013	handbook	source (1)	source (2)			
3479	Mequon-Thiensville Sch Dist	2011	No	--	online source (EAG); district website	source (1)	source (2)			
3500	Merrill Area Sch Dist	2011	Yes	2012	online news sources	source (1)	source (2)	source (3)		
3549	Middleton-Cross Plains Area Sc	2013	Yes	2014	online news source (Channel 3000)	source (1)	source (2)	source (3)		
3612	Milton Sch Dist	2011	No	--	online news source (GazettExtra)	source (1)	source (2)			
3619	Milwaukee Sch Dist	2012	Yes	2013	online sources (EAG, MJS)	source (1)	source (2)	source (3)		
3633	Mineral Point Unified Sch Dist	2011	No	--	handbook	source (1)				
3640	Minocqua J1 Sch Dist	2011	No	--	online source (WEA)	source (1)				
3661	Mishicot Sch Dist	2011	No	--	online source (WEA)	source (1)				

3668	Mondovi Sch Dist	2011	no info	no info	online source (WILL)	source (1)				
3675	Monona Grove Sch Dist	2011	No	--	handbook	source (1)	source (2)			
3682	Monroe Sch Dist	2011	No	--	handbook	source (1)	source (2)			
3689	Montello Sch Dist	2011	No	--	online news source (Portage Daily Register)	source (1)				
3794	Mount Horeb Area Sch Dist	2011	No	--	handbook	source (1)				
3822	Mukwonago Sch Dist	2011	No	--	handbook	source (1)				
3857	Muskego-Norway Sch Dist	2011	No	--	school board minutes	source (1)	source (2)			
3871	Necedah Area Sch Dist	2011	No	--	online news source (Juneau County Star Times)	source (1)				
3892	Neenah Joint Sch Dist	2011	No	--	union contract	source (1)	source (2)	source (3)		
3899	Neillsville Sch Dist	2011	No	--	handbook	source (1)				
3906	Nekoosa Sch Dist	2011	Yes	2012	online source (MacIver)	source (1)				
3925	New Berlin Sch Dist	2011	Yes	2012	handbook	source (1)				
3941	New Holstein Sch Dist	2011	No	--	handbook	source (1)				
3948	New Lisbon Sch Dist	2011	No	--	online news source (Juneau County Star Times)	source (1)				
3955	New London Sch Dist	2011	Yes	2012	online news source (Mercury News)	source (1)				
3962	New Richmond Sch Dist	2011	No	--	handbook	source (1)	source (2)			
3983	North Fond du Lac Sch Dist	2011	Yes	2012	news source (The Reporter Fond du Lac)	source (1)	source (2)			
1526	Northland Pines Sch Dist	2011	No	--	union-district arbitration documents	source (1)	source (2)			
4018	Oak Creek-Franklin Joint Sch D	2011	Yes	2012	online news source (Patch)	source (1)				
4025	Oakfield Sch Dist	2013	No	--	school board minutes	source (1)				
4060	Oconomowoc Area Sch Dist	2011	No	--	handbook	source (1)	source (2)			
4074	Oconto Falls Public Sch Dist	2011	Yes	2014	handbook; online news source (Oconto Times Herald)	source (1)	source (2)			
4067	Oconto Unified Sch Dist	2011	no info	no info	handbook	source (1)	source (2)			
4088	Omro Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
4095	Onalaska Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)	source (3)		
4144	Oregon Sch Dist	2011	Yes	2012	online news source (WSJ)	source (1)	source (2)			
4165	Osceola Sch Dist	2011	No	--	online news source (PressPubs)	source (1)				
4179	Oshkosh Area Sch Dist	2011	Yes	2012	online source (EAG)	source (1)	source (2)	source (3)	source (4)	source (5)
4186	Osseo-Fairchild Sch Dist	2012	No	--	board minutes	source (1)				
4207	Owen-Withee Sch Dist	2011	No	--	board minutes	source (1)				
4221	Palmyra-Eagle Area Sch Dist	2011	No	--	handbook	source (1)				
4228	Pardeeville Area Sch Dist	2011	Yes	2013	online news source (Portage Daily Register)	source (1)	source (2)			
4151	Parkview Sch Dist	2011	No	--	board minutes	source (1)	source (2)			
4305	Peshtigo Sch Dist	2011	no info	no info	online news source (Peshtigo Times)	source (1)				
4312	Pewaukee Sch Dist	2011	No	--	handbook	source (1)				
4368	Pittsville Sch Dist	2011	No	--	online source (WEA)	source (1)				
4389	Platteville Sch Dist	2011	Yes	2012	handbook	source (1)				
4473	Plymouth Joint Sch Dist	2011	Yes	2013	online source (MacIver)	source (1)	source (2)			
4508	Port Edwards Sch Dist	2012	No	--	handbook	source (1)				
4515	Port Washington-Saukville Sch	2011	Yes	2012	online news source (Patch)	source (1)				
4501	Portage Community Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
4529	Potosi Sch Dist	2012	no info	no info	handbook	source (1)				
4543	Prairie du Chien Area Sch Dist	2011	No	--	handbook	source (1)				

4557	Prairie Farm Public Sch Dist	2011	No	--	online source (MacIver)	source (1)				
4578	Prescott Sch Dist	2011	No	--	online source (EAG)	source (1)	source (2)			
4613	Pulaski Community Sch Dist	2011	No	--	online source (EAG)	source (1)	source (2)	source (3)		
4620	Racine Unified Sch Dist	2011	Yes	2013	union contract; online news source (Journal Times)	source (1)	source (2)	source (3)	source (4)	source (5)
4641	Random Lake Sch Dist	2011	Yes	2012	board minutes	source (1)				
4753	Reedsburg Sch Dist	2011	No	--	online news source (Reedsburg Time Press)	source (1)	source (2)			
4781	Rhinelander Sch Dist	2011	No	--	handbook	source (1)				
4865	Rio Community Sch Dist	2011	no info	no info	online source (The Wisconsin Taxpayer)	source (1)				
4872	Ripon Area Sch Dist	2011	Yes	2012	online source (EAG); handbook	source (1)	source (2)			
4893	River Falls Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)			
4904	River Ridge Sch Dist	2011	Yes	2012	board minutes	source (1)				
5523	River Valley Sch Dist	2011	Yes	2013	budget hearing documents	source (1)				
4956	Rosendale-Brandon Sch Dist	2011	no info	no info	online source (The Wisconsin Taxpayer)	source (1)				
4963	Rosholt Sch Dist	2013	no info	no info	board minutes	source (1)				
4998	Rubicon J6 Sch Dist	2011	no info	no info	online source (The Wisconsin Taxpayer)	source (1)				
5019	Saint Croix Falls Sch Dist	2011	No	--	handbook	source (1)				
5026	Saint Francis Sch Dist	2011	No	--	board minutes	source (1)				
5100	Sauk Prairie Sch Dist	2011	Yes	2012	online news source (The Sauk Prairie Eagle)	source (1)	source (2)			
5138	Seymour Community Sch Dist	2011	Yes	2012	online news source	source (1)				
5264	Shawano Sch Dist	2011	Yes	2012	online news source (Shawano Leader)	source (1)	source (2)			
5271	Sheboygan Area Sch Dist	2011	Yes	2012	district documents	source (1)	source (2)	source (3)	source (4)	
5278	Sheboygan Falls Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
5306	Shell Lake Sch Dist	2011	No	--	board minutes	source (1)				
5348	Shiocton Sch Dist	2012	No	--	board minutes	source (1)				
5355	Shorewood Sch Dist	2011	No	--	handbook	source (1)				
5376	Siren Sch Dist	2011	Yes	2012	online news source (PressPubs)	source (1)				
5390	Slinger Sch Dist	2013	No	--	online news source (Journal Sentinel)	source (1)	source (2)	source (3)		
5432	Somerset Sch Dist	2011	Yes	2012	online news source (RiverTowns)	source (1)	source (2)			
5439	South Milwaukee Sch Dist	2013	No	--	online news source (South Milwaukee)	source (1)	source (2)			
4522	South Shore Sch Dist	2012	No	--	handbook	source (1)				
5457	Southern Door County Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)			
5460	Sparta Area Sch Dist	2011	no info	no info	online source (EAG)	source (1)				
5474	Spooner Area Sch Dist	2011	No	--	handbook	source (1)				
5593	Stanley-Boyd Area Sch Dist	2011	Yes	2012	district documents	source (1)				
5607	Stevens Point Area Public Sch	2011	Yes	2012	union contract	source (1)	source (2)			
5621	Stoughton Area Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)			
5628	Stratford Sch Dist	2011	no info	no info	online source (EAG)	source (1)				
5642	Sturgeon Bay Sch Dist	2011	Yes	2013	online source (MacIver, EAG)	source (1)	source (2)			
5656	Sun Prairie Area Sch Dist	2011	Yes	2012	handbook	source (1)				
5663	Superior Sch Dist	2011	Yes	2012	online news source (Superior Telegraph)	source (1)	source (2)	source (3)	source (4)	
3510	Swallow Sch Dist	2011	No	--	online source (WILL)	source (1)				
5726	Thorp Sch Dist	2012	No	--	handbook	source (1)				

5747	Tomah Area Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)	source (3)	source (4)	
5754	Tomahawk Sch Dist	2011	No	--	online news source (Tomahawk Leader; EAG)	source (1)	source (2)			
126	Tomorrow River Sch Dist	2011	Yes	2012	online source (MacIver)	source (1)	source (2)			
4375	Tri-County Area Sch Dist	2011	No	--	online source (MacIver)	source (1)				
5824	Two Rivers Public Sch Dist	2011	No	--	online source (MacIver)	source (1)	source (2)	source (3)		
5901	Verona Area Sch Dist	2011	No	--	handbook	source (1)	source (2)			
5985	Viroqua Area Sch Dist	2011	Yes	2012	online news source (Vernon County Broadcaster)	source (1)	source (2)	source (3)		
6027	Washburn Sch Dist	2012	No	--	handbook	source (1)				
6113	Waterford Graded J1 Sch Dist	2011	Yes	2012	online news source (The Journal Times)	source (1)				
6118	Waterloo Sch Dist	2011	No	--	handbook	source (1)				
6125	Watertown Unified Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)	source (3)		
6174	Waukesha Sch Dist	2011	Yes	2012	handbook	source (1)	source (2)	source (3)		
6181	Waunakee Community Sch Dist	2011	Yes	2012	board minutes, handbook	source (1)	source (2)			
6195	Waupaca Sch Dist	2011	No	--	online news source (Waupaca County Post)	source (1)				
6216	Waupun Sch Dist	2011	Yes	2013	online souce (MacIver)	source (1)	source (2)			
6223	Wausau Sch Dist	2011	Yes	2013	online news source (Wsaw)	source (1)				
6230	Wausaukee Sch Dist	2011	no info	no info	union contract	source (1)				
6244	Wauwatosa Sch Dist	2011	Yes	2012	online news sources (Patch, MJS)	source (1)	source (2)			
6293	Webster Sch Dist	2012	no info	no info	online source (WTA)	source (1)				
6300	West Allis-West Milwaukee Sch	2011	Yes	2012	online news source (MJS)	source (1)	source (2)			
6307	West Bend Sch Dist	2011	No	--	online news source (Heartland)	source (1)				
6370	West Salem Sch Dist	2011	Yes	2012	board minutes	source (1)	source (2)			
6321	Westby Area Sch Dist	2011	Yes	2012	online news source (Westby Times)	source (1)				
6354	Weston Sch Dist	2011	No	--	online source (EAG)	source (1)				
6384	Weyauwega-Fremont Sch Dist	2011	no info	no info	online source (Waupaca County News)	source (1)				
6412	Wheatland J1 Sch Dist	2011	No	--	handbook	source (1)				
6440	White Lake Sch Dist	2011	No	--	district documents	source (1)				
6419	Whitefish Bay Sch Dist	2011	No	--	online news source (Patch)	source (1)	source (2)	source (3)		
6461	Whitewater Unified Sch Dist	2011	Yes	2013	online source (EAG)	source (1)				
6470	Whitnall Sch Dist	2011	No	--	online source (EAG, Patch)	source (1)	source (2)			
6678	Wisconsin Dells Sch Dist	2011	Yes	2014	online source (MacIver)	source (1)	source (2)			
469	Wisconsin Heights Sch Dist	2011	Yes	2013	union contract; online news source (WSJ)	source (1)	source (2)			
6685	Wisconsin Rapids Sch Dist	2011	Yes	2013	online source (MacIver)	source (1)	source (2)	source (3)	source (4)	source (5)