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Working Paper

The impact of unions on wages in the public sector: Evidence from higher education

Working Paper Series, No. 67

Provided in Cooperation with:
Canadian Labour Economics Forum (CLEF), University of Waterloo

Suggested Citation: Baker, Michael; Halberstam, Yosh; Kroft, Kory; Mas, Alexandre; Messacar, Derek (2024) : The impact of unions on wages in the public sector: Evidence from higher education, Working Paper Series, No. 67, University of Waterloo, Canadian Labour Economics Forum (CLEF), Waterloo (Ontario)

This Version is available at:
https://hdl.handle.net/10419/289600

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WORKING PAPER SERIES

The Impact of Unions on Wages in the Public Sector: Evidence from Higher Education

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CLEF WP #67

The Impact of Unions on Wages in the Public Sector: Evidence from Higher Education[1]

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April 2024

Abstract

We study the effects of the unionization of faculty at Canadian universities from 1970-2022 using an event-study design. Using administrative data which covers the full universe of faculty salaries, we find strong evidence that unionization leads to both average salary gains and compression of the distribution of salaries. Our estimates indicate that salaries increase on average by 2 to over 5 percent over the first 6 years post unionization. These effects are driven largely by gains in the bottom half of the wage distribution with little evidence of any impact at the top end. Our evidence indicates that the wage effects are primarily concentrated in the first half of our sample period. We do not find any evidence of an impact on employment.

[1] Monica Essig Aberg, Ethan Bergmann, Steven Ryan, Annabel Thornton and Stephen Tino provided excellent research assistance. Baker gratefully acknowledges the research support of a Canada Research Chair at the University of Toronto. We thank Matthew Notowidigdo and seminar participants at Laval for helpful comments.

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1. Introduction

Understanding the effects of unions on the distribution of income has long been a central goal of economists. In a seminal contribution, Freeman (1980) challenged the prevailing view at the time, showing empirically that unions reduce income inequality. The publication of "*What Do Unions Do?"* (WDUD, Freeman and Medoff 1984)) triggered a substantial body of research on the effects of unions on workers' and firms' outcomes.

Historically most union jobs were held in the private sector, but in recent periods the public sector has become the dominant source of union jobs. Card, Lemieux, and Riddell (2020) report that union coverage rates are 5 times higher in the public sector than the private sector in Canada and the United States accounting for half of all unionized workers.[2] The recent initiative by the Biden administration to create a new taskforce on worker organizing and empowerment reflects this trend. In response to this initiative, the number of federal government employees in a union has increased by around 20 percent.[3]

There is good reason to expect that the economic effects of unions on wages in the public sector are different than the effects of unions in the private sector. For example, while unions can do little to increase the demand for a firm's product in the private sector, in the public sector they may be able to extract greater resources and greater budgets for education, policing and other types of services. Hence, firms may be more opposed to unions in the private sector than organizations in the public sector.

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[2] Card, Lemieux and Riddell (2020) report unionization rates of 39% in the U.S. public sector vs 7% in the private sector and 76% vs 17% in Canada. This implies one-half of unionized workers in the U.S. and close to 60% in Canada are employed in the public sector even though that sector accounts for only 15% (U.S.) to 20% (Canada) of total employment.

[3] See https://www.whitehouse.gov/briefing-room/statements-releases/2023/03/17/the-white-house-task-force-on-worker-organizing-and-empowermentupdate-on-implementation-of-approved-actions

Despite the growing relative importance of unions in the public sector, little is known about their causal impact on the wage structure (Card, Lemieux, and Riddell 2020). Freeman (2005) writes that "If one were to analyze the impact of unionism by sector proportionate to collective bargaining coverage or membership today, nearly half of one's research effort would be devoted to the public sector". In fact, Freeman laments that the omission of the public sector is one of the three serious errors of omission in WDUD.

These trends in unionization coverage and the lack of empirical evidence underscore the importance of studying the wage impacts of unions in the public sector. In this paper, we fill this gap by estimating the causal effect of unions on the wage distribution of full-time faculty at Canadian universities. Our focus on higher education is motivated by several considerations. First, most Canadian universities are public. In recent years they represent a $40 billion enterprise providing employment to over 400,000 workers.[4] Over much of our sample period employment in the tertiary education sector represented between 7 and 11 percent of total public sector employment in Canada.[5] Therefore, higher education represents a sizeable share of the public sector. Second, there are administrative data on salaries for the full population of faculty in Canadian universities for the years 1970 through 2022, along with detailed information on unionization events and features of first contracts. A key feature of the data is that it begins in a period with no faculty unions and ends with over 80 percent of faculty covered by union contracts. Thus, this data allows us to empirically examine the unionization of an entire sector of the economy over a 50-year period.

[4] See https://univcan.ca/universities/facts-and-stats/#:~:text=Source%3A%20Universities%20Canada%20approximation%20based,Labour%20Force%20Survey%20data%2C%202022.&text=As%20a%20%2440%20billion%20enterprise,for%20close%20to%20410%2C000%20people

[5] See CANSIM table 10100025, for the years 1981 through 2012.

Our setting is one with staggered treatment. Under the common trends assumption and a no anticipation condition, standard difference-in-differences (DID) methods can be used to identify the average treatment effect on the treated (ATT). We use this approach to estimate the causal effect of unionization on the wages of faculty at Canadian universities, controlling for worker selection into treatment since we have panel data on all faculty members. We also examine the effect of unionization on the entire distribution of salaries. Finally, available information on "salary floors" (that vary by experience or experience and rank) contained in union contracts allows us to directly examine whether this contract feature contributes to compression at the lower end of the salary distribution.

Our empirical analysis leads to four key findings. First, we find that unionization increases salaries on average. In the first two years post unionization, we find an impact of 2-3 percent. Six years after union certification, the estimated relative advantage to unionized faculty grows to over 5 percent. Second, we find that unionization compresses faculty salaries. In the unconditional salary distribution, salary gains are concentrated at the lower percentiles. Six years post certification they range from over 10 percent at the 10^{th} percentile to close to 0 at the 75^{th} and 90^{th} percentiles. Interestingly the heterogeneity in salary gains is not as pronounced by academic rank, indicating the compression occurs both within and across ranks. Consistent with this evidence, we provide direct evidence of how the salary floors specified in the first union contracts push lower paid faculty up the salary distribution. Third, we find no impacts of unionization on faculty employment either on the stock of faculty employed or in the proportion of faculty newly hired. Finally, we find that the effects of unions on wages are concentrated primarily in the first half our sample (1970-1989). There is essentially no union wage premium in the second half of our sample (1990-2018). One explanation for this difference is selection on

gains into treatment: universities with the largest treatment effects selected into unionization first. This is related to Allcott's notion of "site selection bias" (2015). Another one is that the bargaining power of unions declined over the period with the overall decline in unionization in the labor market.

Our paper contributes to a large literature on the effects of unions on the wage structure. Most of this literature focuses on the private sector. Key studies include Freeman (1984), Card (1996), DiNardo, Fortin and Lemieux (1996), Lemieux (1998), Card (2001), DiNardo and Lee (2004), Frandsen (2021), Fortin, Lemieux and Floyd (2021) and Farber et al (2021). Taken together, most studies find a positive impact of unions on wages.[6] Our analysis of wage floors relates to Card and Cardoso (2022) who examine the responsiveness of wages to changes in wage floors in collective bargaining agreements in Portugal.

Less studied is the effect of unions on wages in the public sector. While studies of the union salary effect in the wider public sector have a long history (e.g., Ashenfelter 1971, Robinson and Tomes 1984) they are much fewer in number. A useful summary of this literature is Lewis (1990). Reviewing the literature, he concludes that the public-sector union wage gap is between 8-12 percent. In their 2004 reflections on the impact and continuing relevance of WDUD, Blanchflower and Bryson (2004) note the unequal number of private sector versus public sector studies, and present evidence of public sector union wage effects in the 1980s and 90s that rival those in the private sector. A more recent example is Card, Lemieux and Riddell (2020) who present evidence that the impact of unions on wage inequality is much larger in the public sector than in the private in both the US and Canada.

[6] Farber et al (2021) report a positive family income union premium of between 10 and 20 percent over a 9 decade period.

A feature of many of these studies is that they are based on cross-sectional comparisons between union and non-union workers (controlling for observable differences between union and non-union members). Thus, the estimates may be confounded by selection on unobservables. Others employ parametric corrections to the selection problem. Fewer studies estimate the wage gap using quasi-experimental designs. Hoxby (1996) uses an instrumental variables and difference-in-differences method and finds that teacher unions increase teacher pay by over 5 percent. Another example is Lovenheim (2009) who uses a difference-in-differences model to examine teachers' union election certifications on teacher pay, among other outcomes, and finds little impact.

Our paper also relates to a smaller literature which considers the impact of unionization on Canadian faculty compensation. Key papers include Rees, Kumar and Fisher (1995), Hosios and Siow (2004) and Martinello (2009). These studies find small to no impacts of unionization on salaries. Relative to analysis here, they use data aggregated up to the university/year level which focus on specific provinces (e.g., Ontario) and/or shorter periods. More generally, studies of the impact of unionization on faculty salaries have yielded mixed results. Hedrick et al. (2011) conclude past studies have produced positive, zero and negative estimates of the union salary difference, although a comparison across studies is made difficult by any differences in data and methods. Their own analysis based on four years of the US National Study of Postsecondary Faculty yields estimates that are mostly positive but small and statistically insignificant.

Our main contribution to this literature is to consider a quasi-experimental research design which relies on timing assumptions surrounding unionization events. The setting we consider is unique since it spans the entire period over which all unionization effects occur in an

entire sector. As such, we can relax the selection-on-observables assumption that is commonly made in applied work in this literature. The other advantage of our setting is we have administrative data containing salary information for *all* faculty in Canada which we combine with newly collected records of unionization events. Since we collected the original union contracts at the time of certification, our analysis avoids concerns related to mismeasurement of union status which has plagued earlier studies of the public sector (see Lewis 1990).

The rest of the paper is organized as follows. Section 2 describes the institutional context and rise of faculty unions in Canada. Section 3 discusses our data. Section 4 discusses our empirical section. Section 5 presents our empirical results and Section 6 concludes.

2. Faculty Unions in Canada

While at the start of our sample period (1970) no university faculty in our sample was unionized, the union movement at Canadian universities had its roots in the preceding decades. Documentation of this period suggests that governance rather than economic issues were at the forefront of this development (e.g., Savage 1994).[7] The Canadian Association of University Teachers (CAUT), which came together in the 1950s primarily to air grievances about salaries and pensions, was one catalyst of a focus on university governance, as was the publication *A Place of Liberty: Essays on the Government of Canadian Universities* (Whalley 1964) in 1964 (Horn 1994). Commentators on the state of universities at the time use terms like autocratic, oligarchic, and paternalistic to describe the rule of university presidents and boards of governors (Heron 2015). However, any absence of collegiality in governance did not lead all faculty to the necessity of unionization. Concurrent with the growing dissatisfaction with university

[7] The first union event in our sample is in 1974. Note that the faculty at some of the universities not included in our sample (see Appendix) were unionized at dates as early as 1970 (i.e., Universitié du Québec à Montréal)

governance was debate whether unions, which codified the employer/employee relationship, might rule out the possibility of collegial management (Horn 1994, Heron 2015).[8]

Against this background, however, it is also important to note that economic considerations also played a role. Government funding of post-secondary typically followed enrolment and the budget balance, and consequently so did faculty grievance over compensation. The 1960s were a period of rising enrolments, university expansion and relative plenty, but the advent of the 1970s brought dips in enrolment, the effects of the withdrawal of direct federal government funding in the mid 1960s, and the impacts of macroeconomic stagnation on provincial budgets. The Ontario Minister of Colleges and Universities' statement in 1971 that the province sought "more scholar for the dollar" (Axelrod 1982), encapsulates the economic threat that faculty faced in this period of rising inflation and unemployment. In turn many may have come to accept the economic argument to unionize even if still uncertain if it was an answer to questions of governance.

Therefore, the initial wave of unionization of university faculty in the 1970s, just over 40 percent of the union events in our sample, reflected both the maturation of a growing dissatisfaction with the way universities were managed and a period of economic hardship for university budgets following a period of relative abundance. Subsequent union certification reflected these same themes, as well as the example of the faculties that had already unionized (Heron 2015).

3. Data

Our data on faculty salaries come from the Statistics Canada's University and College Academic Staff System (UCASS), for the years 1970 through 2022. This is an annual collection

[8] See also Mackinnon (2015).

of population level data on all full-time teaching staff at degree-granting Canadian universities and their affiliated colleges, as of October 1 in each year. The survey captures all professors/teachers within faculties, academic staff in teaching hospitals, visiting academic staff, and research staff who have academic rank and salary similar to teaching staff, for all those whose term of appointment is not less than twelve months. It excludes administrative and support staff, librarians, and research and teaching assistants.

Participation in UCASS is mandatory and it is administered directly to institutions. The unit of observation in the data is the individual but the survey unit is the institution. Information on the economic and demographic characteristics of staff—including pay—are obtained directly from payroll records. Individuals are assigned (anonymized) internal identification numbers so they can be followed over time within institutions, but not across institutions. Statistics Canada works closely with institutions to maintain consistent reporting each year and to ensure the data are comparable across institutions.[9]

We include all individuals holding appointments at the rank of assistant, associate or full professor, excluding those in a faculty of medicine or dentistry. Salary determination in medicine and dentistry may be partly affected by the availability and amounts of "soft money" which would not, in the first instance, be directly affected by unionization. Our analysis sample also omits private, theological, and military institutions.

Our measure of compensation is "base salary". This is the annual (12 month) rate of pay contractually negotiated and agreed upon between the employee and employer. Because the data are collected typically in October, they provide a view of salaries for the fiscal year at this time. Statistics Canada has worked closely with the institutions to obtain a measure of base salary that

[9] Baker et al. (2023) provide further detail of these data including the suspension of collection between 2011 and 2015 which has been remedied by Statistics Canada using the National Faculty Data Pool.

is comparable across institutions and over time. It excludes other components/factors of actual salary including unpaid leave (including maternity or parental leave) and stipend pay for senior administrative duties. It also excludes income paid out of research grants and other external funding sources.[10]

Our data on the dates of unionization and the date and terms of the first contract, are in the first instance based on direct contact with the faculty union at a given university. In most instances we obtained a copy of the first contract which is the source of information on the salary floors we use in the analysis. In some cases, missing information was obtained from websites maintained by the faculty unions, as well as university newspapers which reported the dates and terms of the first agreements. For certain institutions we were able to discover the date of unionization but no other details. A list of these universities for which we were not able to acquire full information for the analysis is provided in Table A1 of the Appendix. These institutions are included in our analyses of salary, but excluded for our analysis of salary floors. We provide evidence below that this sample restriction has little impact on our inference for salary effects.

4. Empirical Specification

We use an event-study specification to estimate the causal effect of unionization on wages. We define an individual as treated in a given year if, during that year, the individual works at a university at which a faculty union has been certified.

[10] The data set does have a variable for actual salary but it is not observed for all the relevant years. In the available years we find there a close relationship between base and actual salary in practice; base salary accounts for 102.0 percent of actual salary on average within institutions and years for which actual salary is observed. Base salary exceeds actual salary due to unpaid leave.

To formalize our approach, we consider a panel of $i = 1, \dots, N$ individuals working at $j = 1, \dots, j$ institutions, in which salary Y_{ijt} is observed for $t = 1, \dots, T$ years or for some, a subset thereof. We also observe a binary treatment variable $D_{jt} \in \{0,1\}$: $D_{jt} = 0$ if the j^{th} institution has not been treated by year *t* and $D_{jt} = 1$ if *j* has been treated by year *t*. In our setting, treatment is an absorbing state and the treatment path $\{D_{jt}\}_{t=0}^{T}$ is a sequence of zeros and then ones. In this case, the treatment path is uniquely characterized by the time period of the initial treatment, which we denote by $E_j = \min\{t: D_{jt} = 1\}$. This is typically referred to as the "event time" and we denote $K_{jt} = t - E_j$ as the "relative time".

The baseline dynamic specification is

$$(1) \qquad log(Y_{ijt}) = \alpha_i + \beta_t + \sum_{k=-A}^{B} \gamma_k 1\{K_{jt} = k\} + \varepsilon_{ijt},$$

Where Y_{ijt} is in the base specification the salary of individual *I* at institution *j* in year *t*, $A \geq 0$ leads of the treatment are included together with $B \geq 0$ terms that capture the short-run effects. Controlling for individual fixed effects also absorbs institution effects given that we do not observe mobility across institutions. Our baseline specification limits the sample to the relative years $A = 4$ through $B = 6$. We normalize $\gamma_0 = 0$ in the year of union certification. Therefore, we denote this year as untreated reflecting the fact that certification can occur at any month over the year.[11] In all specifications, our model controls for an individual fixed effects (α_i) and year fixed effects (β_t). We also explore sensitivity by including controls for rank, administrative responsibilities, years of experience, and other pay.

[11] Note our results are not sensitive to this choice. If we set $\gamma_0 = 0$ in the year before certification, the estimates indicate that the impacts of unionization appear with a one-year lag.

Our identifying assumption is the standard common trends condition; namely, that there are no shocks correlated with unionization that *differentially* affect the salaries of faculty within unionizing and non-union universities. The coefficients of interest are the parameters $\{\gamma_k\}_{k=-A}^{B}$. These indicate the causal effect of unionization on salaries and other outcomes. We can test for the presence of pre-trends by plotting the $\hat{\gamma}_k$ for $k < 0$ and examining whether $\hat{\gamma}_k = 0$.

Our empirical setting involves staggered treatments over time. A recent literature shows that standard two-way fixed effects estimators may deliver biased estimates if there is heterogeneity in treatment effects across cohorts. To address this, we adopt the estimator developed in Callaway and Sant'Anna (2021) and report the sensitivity of our main results to other methods in the appendix. Finally, the standard errors estimates are clustered by institution.

5. Results

We observe 53 certifications of faculty unions over the sample period (Table 1, panel A). While they are spread out across the country, faculty in Ontario and Quebec are early movers while universities in BC do not start to unionize until the 2010s. The percentages of faculty and institutions unionized move in tandem, reaching over 40 percent by the early 1980s and close to 80 percent by the end of our sample period. The descriptive statistics of our sample are contained in panel B of Table 1. The statistics are broken down by whether individuals are based at institutions that never unionized during our sample period (columns 3-4) and institutions that unionized at some point (columns 5-6). We see that faculty at unionized workplaces are slightly younger, more likely to be male, less likely to hold a PhD, hold a lower rank position, and have lower wages.

Our main event study estimates of the impact the impact of unionization on faculty salaries are presented in panel A of Figure 1 and Figure 2. The estimates are the γ_k in equation

(1), which are expressed relative to the year of certification which is normalized to 0. In the pre-unionization period we see that the pre-trends are statistically insignificant and tightly centered around 0. This indicates that faculty which unionized were not experiencing differential salary growth prior to certification relative to faculty which were not unionized. In contrast, in the year after certification we observe a relative jump in the average salaries of unionized faculty of over 2 percent (panel A of Figure 1 and Figure 2). This dynamic pattern provides some validation of our interpretation that the estimates are causal rather than a result of differential pre-trends. The impact of unionization grows briskly over time reaching over 4 percent by year 5.

We investigate whether our estimates are sensitive to including additional controls in Figure 2. This is potentially important because there are some differences in the characteristics of faculty, across the union and non-union sectors (Table 1, panel B). The addition of controls for rank and responsibilities, a cubic in experience or dummy variables for additional stipends, sabbaticals, reduced pay or unpaid leave has very little effect on all of the estimates.[12]

As discussed, our main event-study estimates are based on Callaway and Sant'Anna (2021). In Figure A1 of the Appendix we report an analogue of Figure 1, in which we also present estimates from a standard two-way fixed effects model as well estimates from other methods that have been proposed in the literature.[13] Reassuringly, our estimates are very similar across the different estimators.

Our treatment effect estimates are for the initial years of unionization. Some evolution of the wage premium might be expected if the first contract followed certification, subsequent contracts achieved larger gains or certain details of the contract took time to implement. That

[12] Note that we do not expect many of the controls in the latter set to matter as the definition of the base salary measure that use excludes thee sorts of adjustments.
[13] These include de Chaisemartin-D'Haultfoeuille (2020), Borusyak, Jaravel and Spiess (2022), and Sun and Abraham (2021).

said, these results provide clear evidence that, on average, the unionization of faculty in Canada led to short-term relative salary growth.

An advantage of our empirical setting is that we observe all unionization events that took place over a 50-year period in Canadian universities. Thus, we are well suited to testing whether the effects of unions on wage varies over time. In panel B of Figure 1, we split our sample into two time periods and report event-study estimates for each period. The estimates indicate that the wage effects of unionization are primarily concentrated in the first period. One account of this finding is, all else equal, early selection into unionization based on gains. However, another account is the bargaining strength and militancy of unions declined over time due to, for example, the aggregate decline of unionization in the labor market in the latter period, or tighter government budgets post the expansionary fiscal policies of the 1970s and 1980s.[14]

There is long standing interest in the impact of unionization on the wage structure of the firm and on overall inequality in the labor market (e.g., Card, Lemieux and Riddell 2020). The conclusions from past research are heterogeneous, as there appears to be important distinctions within and across the union/non-union and private/public sectors, and across women and men. The evidence from these studies is based on a variety of empirical approaches that span examining job switchers and constructing counterfactual salary distributions by, for example, reweighting based on observables and/or assumptions about unobservables. We directly observe the impact of unionization on the structure of faculty salaries at the university level.

To examine the impact of unionization on wage inequality, in panel C we present the event study estimates at different percentiles of the unconditional faculty salary distribution

[14] Aggregate unionization fell from near 40 percent to under 30 percent over our sample period (https://www150.statcan.gc.ca/n1/daily-quotidien/170908/cg-a003-png-eng.htm), while the hours not worked due to strikes and lockouts per 1000 employees fell from over 100 in the late 1970s to less than 10 in 2021. (https://www150.statcan.gc.ca/n1/pub/14-28-0001/2020001/article/00017-eng.htm).

using the re-centered influence function (RIF) method of Firpo et al. (2009). The estimates for the pre-trends are mostly small and statistically insignificant. Post unionization the magnitude of estimated effects are inversely monotonic in the percentile—indistinguishable from zero at the 90th percentile and eventually over 10 percent for the 10th percentile. These results indicate that the distribution of faculty salaries becomes more compressed when a faculty becomes unionized.[15] Appendix Table A4 presents the full set of regression estimates corresponding to this figure.

In our setting a natural question is whether this compression has implications for salary differences by academic rank. In panel D of Figure 1 we do observe some compression across ranks, although it takes some time to emerge. In the initial years post unionization, the impact of unionization is marginally higher at the associate level. This suggests that the salary compression occurs both within and across academic rank. [16]

Unions have several mechanisms they might avail to compress salaries—simply negotiating higher cost of living adjustments (COLAs) than in the non-union sector for all members will not accomplish this outcome. One possibility is to negotiate standardized career salary ladders that are solely a function of rank and experience. Absent any allowance for "market adjustments" or merit, this method of rewarding career advancement might lead to compression across, for example, academic disciplines. In the current context, however, it is

[15] A simpler view of this compression is presented in Figure A2 in the appendix for a 0/1 indicator that faculty member's salary is below the 25th percentile of the (inflation-adjusted) distribution of salaries for the treatment group in the pre-treatment period. The relative probability of being below this salary declines rapidly post unionization from a reduction of over 5 percentage points in the year after certification to over 10 percentage points by year 6. The set of regression estimates corresponding to these results are available in appendix Table A3.
[16] Goolsbee and Syverson (2019) find that universities have significant labor market power over their tenure track faculty with the magnitude being monotonic in rank. Monopsony power is greatest over full professors and smaller for associate and assistant professors. As Robinson (1933) noted, unions can substantially increase wages in the presence of monopsony. Our results are nominally at odds with this line of reasoning as they tend to suggest the opposite pattern.

unlikely these sorts of reward systems would have a large impact in the first years post unionization, unless the first contract prescribed salary reductions for some faculty.

Another possibility is to structure COLAs to advantage lower paid faculty. This could be accomplished by either negotiating that part of the salary adjustment be made as a lump sum, or that there is a multi-tiered percentage adjustment that favours lower paid faculty. While either of these options might undermine union solidarity, again, and more importantly, it is hard to see how they would have a large impact in a short period of time.

A more promising explanation is the implementation of wage floors, especially if they are set to affect a non-trivial number of faculty's salaries. These floors stipulate an overall minimum salary for all faculty, or floors that vary by rank and/or experience. They are a common feature of the first contracts of the faculty unions we study: they are present in 85 percent of the union contracts we observe covering over 89 percent of union observations.

In Figure 3 we provide an analysis of the impact of the salary floors using the framework of Autor et al. (2006) and Cengiz et al. (2019). Starting with the sample of universities with first contracts specifying salary floors and universities that never unionized, we create counts of the total number of workers within institution-year-rank-$1000 wide salary bin cells. This dependent variable is regressed on a set of relative-bin indicators, their interactions with a post-treatment indicator, as well as year-bin and institution-bin fixed effects. Each relative-bin indicator takes the value of "1" if the salary in that bin is within $\$x$ of the salary floor that took effect in the year of unionization, and "0" otherwise, where x varies in $1000 dollar increments. For institutions where salary floors vary within cell (e.g., by experience), the smallest salary floor is used. The estimates of the relative-bin indicator/ post-treatment indicator interactions are reported in the

figure.[17] Each bar reveals the average employment change in the indicated bin over the 6 years following certification, relative to universities that never unionized.

The results demonstrate how these salary floors push faculty up the salary distribution. First, the estimates below the salary floor are uniformly negative, with larger reductions in bins further below the salary floor. Second the estimates for the bins just above the salary floor are uniformly positive, with the largest changes at $6000 above the floor. Third, as might be expected, the effect peters out: the estimates are small and statistically insignificant by roughly $12000 above the salary floor. Finally, as indicated in the upper right of the figure the net effect of these changes is an increase in employment of just over 10 faculty, though not significantly different than 0 at conventional levels.

This estimate of the overall employment change across wage bins raises the question of the impact of unionization on employment. Because the union wage gains we estimate presumably move universities up the labor demand schedule, some overall negative impact on employment might be expected. However, given the academic institution of tenure, the ability to make such an adjustment in the short term might be limited. Investigating the impact of unionization on employment also addresses suspicions that our estimated salary effects are the result of some corresponding change in the composition of faculty, although we note these estimates are conditional on individual fixed effects.

In Figure 4 we present estimates of the impact of unionization on total faculty employment and the percentage of faculty who are new hires. We implement a modification of our event study framework, collapsing the data to institution/year cells, and replacing individual

[17] Inclusion of year-bin and institution-bin FEs requires treatment effects to be expressed relative to at least one pre-treatment relative-bin indicator. The highest relative-bin indicator is used, as it is the furthest from the salary floor where direct effects of the floors should be negligible.

fixed effects with institution fixed effects. In panel A, we report the estimates for total employment. There is little evidence here of an impact of unionization on this outcome. In panel B, we present estimates for new hires, on the reasoning that given tenure this is a more flexible margin of adjustment. Again, we to not find any impact of unionization.

Our figures provide little evidence of violations of our assumption of common pre-trends. For the outcomes studied, unionizing and control faculties appear very similar. To further assess this assumption and test for robustness, we have constructed robust confidence intervals for our estimates of the impact of unionization following the methods of Rambachan and Roth (2023). As an example, in Figure A3 of the appendix we report the confidence intervals for the first period treatment effect as multiples of the maximum deviation from common trends observed in the pre treatment period. The so called "breakdown value" is around 0.4. This indicates some sensitivity of the estimate to pre trends. With reference to Figure 1, panel A, this might be expected since the original confidence interval of the estimate of γ_1 spans an interval very close to 0. We balance this evidence against the very strong documentation in Figure 1 of union effects that are visually distinct from any estimated deviation from pre trends.

6. Conclusions

We use an event-study to estimate the impact of unionization on the salaries of faculty at Canadian universities. Our analysis uncovers an initial positive impact of unionization on average salaries of over 2 percent, which grows to over 5 percent after 6 years. The impact is primarily for faculties that unionized in the first half of our sample period. This suggests either a selection of faculties into unionization on gains, or a secular change in the bargaining environment.

We also find that unionization leads to compression of salaries with the effects concentrated at the bottom of the salary distribution. This effect is evident in the percentiles of the unconditional distribution of faculty salaries. Interestingly, the impact of unionization is less directly associated with academic rank, suggesting that the compression occurs both within and across ranks. Salary floors, present in many of the first union contracts we study, are a natural mechanism driving the salary compression in the first years after unionization. We document how these floors push faculty up the salary distribution in the first 5 years post certification.

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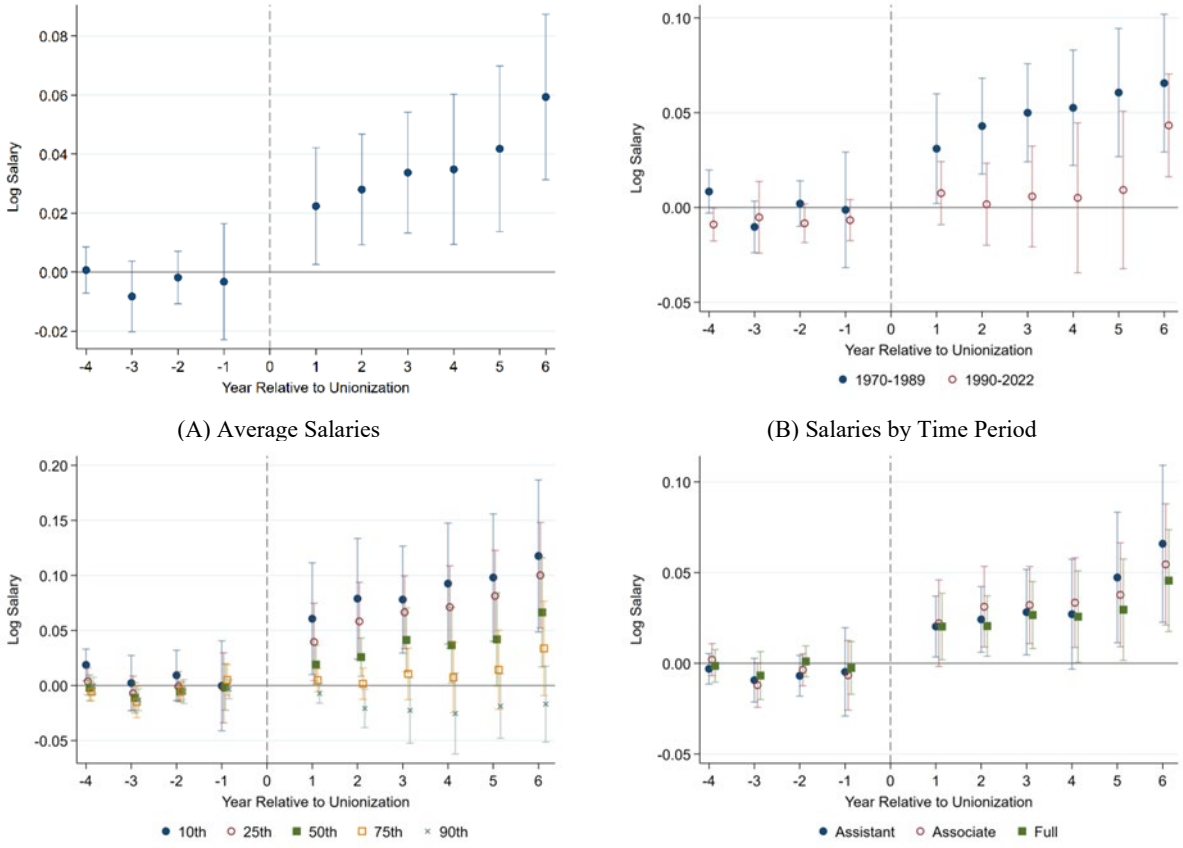
Figure 1: Effect of Unionization on Salaries



(A) Average Salaries

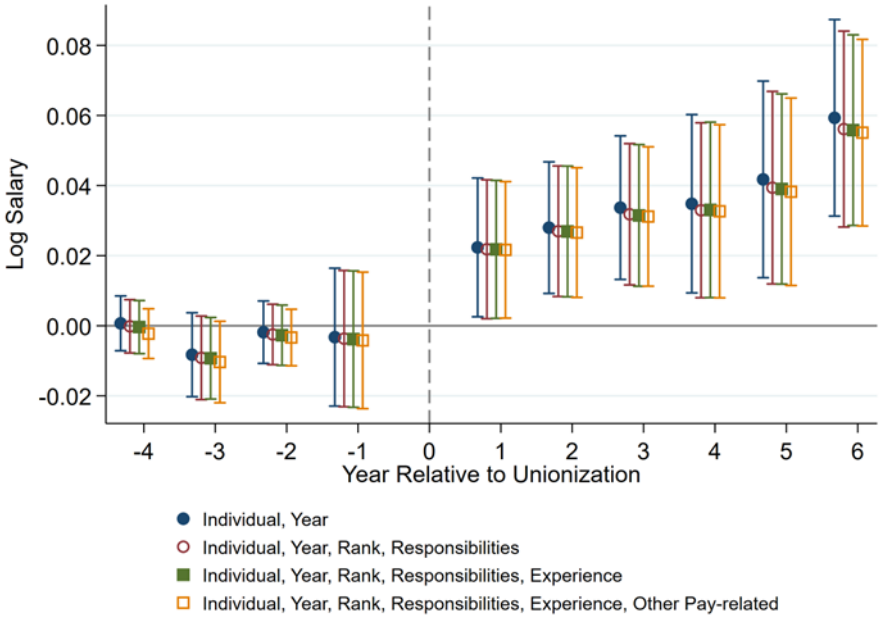
(B) Salaries by Time Period

(C) Percentiles of Salaries

(D) Salaries by Academic Rank

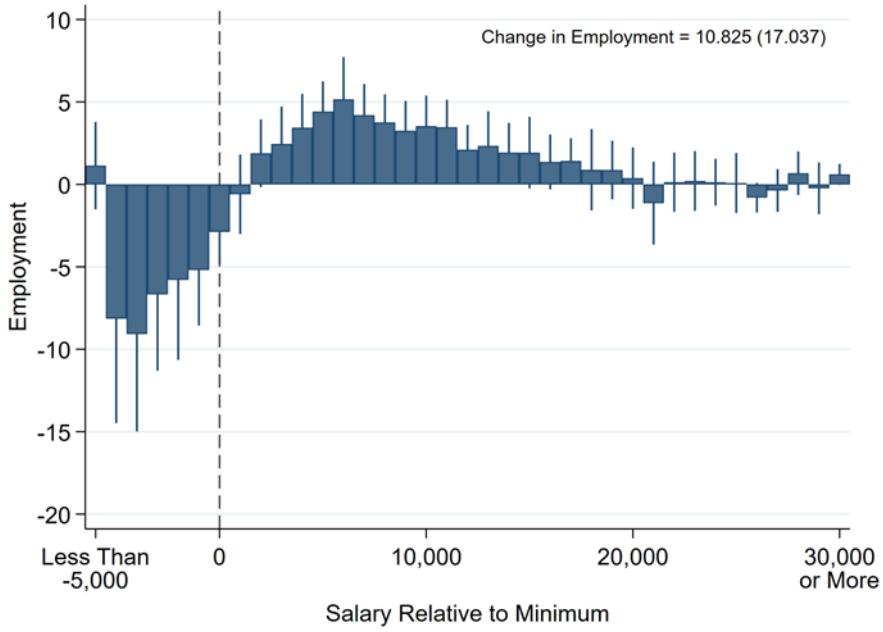
Notes: The Callaway and Sant'Anna estimator is used. The dependent variable uses base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. Specifically, the dependent variable in panel A is the log of base salary. The dependent variable in panel B is an indicator equal to "1" if the income for the year is below the 25th percentile and "0" otherwise, where this percentile is based on total (inflation-adjusted) earnings for the treatment group in the pre-treatment period. The dependent variable in panel (C) is the re-centered influence function (RIF) of earnings evaluated at each percentile shown. The model specification includes individual and year fixed effects. The corresponding regression results for panels (C) and (D) are shown in Tables A4 and A5 of the Online Appendix, respectively. The 95% confidence intervals are shown as vertical bars, with standard errors clustered by institution.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Figure 2: Effect of Unionization on Average Salaries with Various Controls



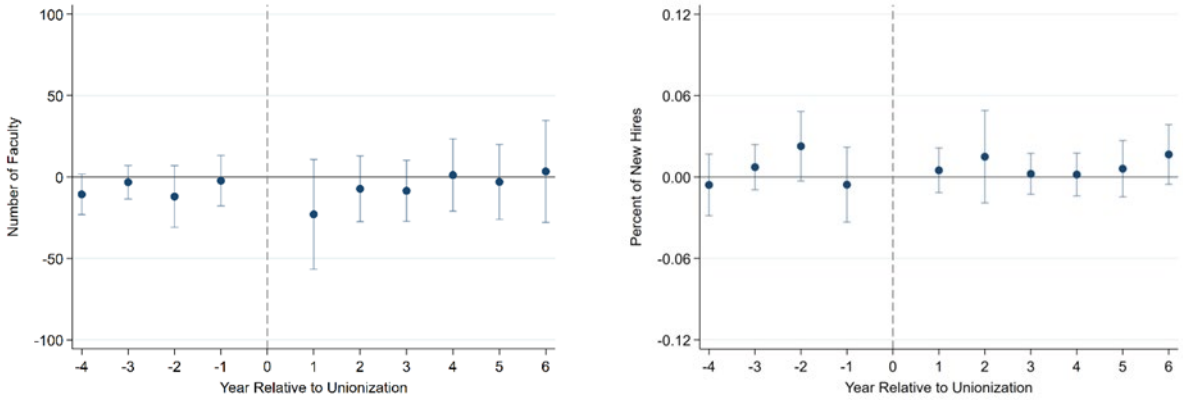
Notes: The Callaway and Sant'Anna estimator is used. The dependent variable is the log of base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. The model specification includes individual and year fixed effects as well as additional controls as stated in the legend. The categories for administrative responsibilities are: none; Chairs/Heads/Directors; Associate/Vice Deans; and Deans. Years of experience is controlled for using a cubic polynomial. Other pay-related fixed effects (FE) consist of indicators for: receiving a stipend; being on sabbatical; having reduced pay; and taking unpaid leave. The corresponding regression results are shown in Table A2 of the Online Appendix. The 95% confidence intervals are shown as vertical bars, with standard errors clustered by institution.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Figure 3: Effect of Salary Floors at Unionization on Employment by Relative Salary



Notes: Restricted to institutions that unionized and has salary floor information or that never unionized and to the years used in the event-study analysis. The model is estimated on data collapsed to institution-year-rank-salary bin cells. Salary bin widths of $1,000 are used, beginning at $0 and increasing to the maximum salary. The dependent variable is the total number of workers within each cell. The dependent variable is regressed on a set of relative-bin indicators as well as a set of relative-bin indicators interacted with a post-treatment indicator. Year-bin and institution-bin fixed effects (FE) are included. Each relative-bin indicator takes the value of "1" if the salary in that bin is $\$x$ distance from the salary floor that took effect in the year of unionization, and "0" otherwise, where x varies along the horizontal axis (also in bins of width $1,000). For institutions whose salary floors vary within cell (e.g., by experience), the smallest salary floor is used. The coefficients on the relative-bin indicators interacted with a post-treatment indicator are shown in the figure. Inclusion of year-bin and institution-bin FEs requires treatment effects to be expressed relative to at least one pre-treatment relative-bin indicator. The highest relative-bin indicator is used, as it is the furthest from the salary floor where direct effects of the floors should be negligible. Each bar is the effect of unionization on the change in the percent of workers earning $\$x$ from the salary floor. The change in employment reported in the top-right is the sum of all bars, with standard error in parentheses. The 95% confidence intervals are shown as vertical bars, with standard errors clustered by institution.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Figure 4: Employment Effects of Unionization



(A) Number of Workers (B) Percent of New Hires

Notes: The Callaway and Sant'Anna estimator is used. The model is estimated on data collapsed to institution-year cells. The dependent variable in panel A is the number of faculty by institution and year. The dependent variable in panel B is the percent of faculty who are new hires in the reference year expressed relative to the total number of faculty by institution and year. The model specification includes institution and year fixed effects. The corresponding regression results for both panels are shown in Table A6. The 95% confidence intervals are shown as vertical bars, with standard errors clustered by institution.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Table 1: Characteristics of Institutions and Data Sample

Panel A: Unionization Events

	1970s		1980s		1990s		2000s		2010s	
	Number	Ratio	Number	Ratio	Number	Ratio	Number	Ratio	Number	Ratio
Canada	24	45.3	11	66.0	6	77.4	4	84.9	8	100.0
By Region										
Atlantic	4	44.4	3	77.8	0	77.8	2	100.0	0	100.0
Quebec	8	53.3	4	80.0	2	93.3	0	93.3	1	100.0
Ontario	7	46.7	2	60.0	4	86.7	2	100.0	0	100.0
Prairies	5	45.5	2	63.6	0	63.6	0	63.6	4	100.0
British Columbia	0	0.0	0	0.0	0	0.0	0	0.0	3	100.0

Panel B: Data Sample Characteristics

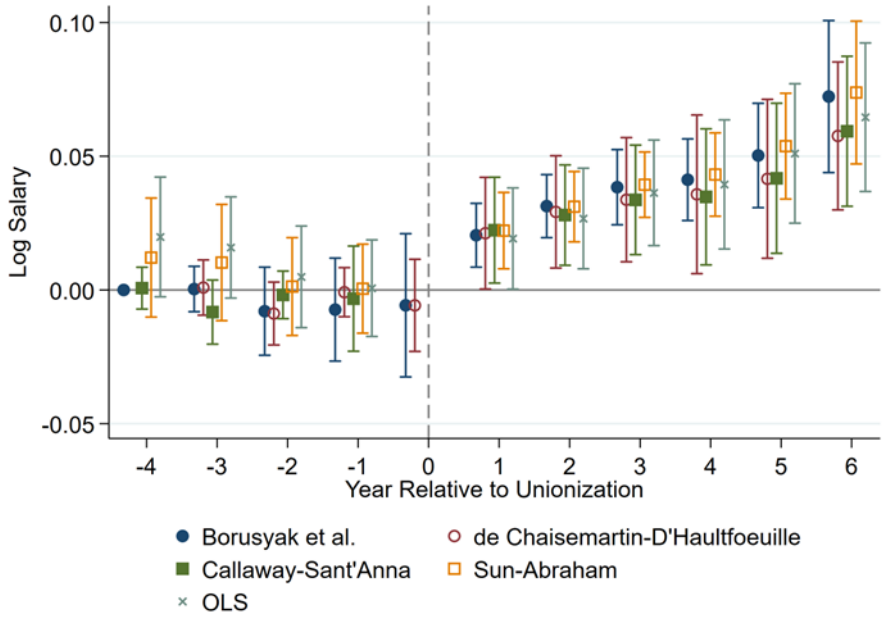
	Full Sample		Never Unionized		Unionized	
	Mean (1)	Standard Deviation (2)	Mean (3)	Standard Deviation (4)	Mean (5)	Standard Deviation (6)
Demographics						
Age (in Years)	47.2	9.9	48.0	10.0	45.8	9.6
Women (Percent)	21.8	41.3	23.1	42.2	19.6	39.7
Highest Degree (Percent)						
PhD	77.8	41.6	80.7	39.5	73.1	44.3
Professional	7.2	25.8	8.3	27.6	5.4	22.6
Master's	11.8	32.3	8.4	27.7	17.4	37.9
Below Master's	3.2	17.6	2.7	16.1	4.1	19.8
Rank (Percent)						
Assistant Professor	24.2	42.9	23.3	42.3	25.7	43.7
Associate Professor	37.5	48.4	36.0	48.0	40.0	49.0
Full Professor	38.2	48.6	40.6	49.1	34.3	47.5
Other Job Traits (Percent)						
Unionized	21.3	40.9	0.0	0.0	55.5	49.7
Has Responsibilities	10.1	30.1	9.6	29.4	10.9	31.2
Compensation						
Salary (Dollars)						
Full Sample	142,750	46,050	149,650	48,650	131,650	39,050
Assistant Professor	106,700	31,050	108,050	32,600	101,350	23,400
Associate Professor	132,750	31,800	135,000	33,350	125,250	24,450
Full Professor	175,450	44,200	178,650	45,600	163,000	35,750
Salary Growth (Percent)						
Full Sample	2.4	12.3	2.6	14.2	2.2	8.0
Assistant Professor	3.3	13.3	3.3	14.0	3.3	10.1
Associate Professor	2.7	13.7	2.7	15.1	2.6	8.0
Full Professor	1.8	10.2	1.8	10.8	1.7	7.4
Number of Individuals	64,137		30,127		34,010	
Number of Observations	552,604		341,053		211,551	

Notes: Panel A reports the number of union formation events per decade and by region. The "ratio" refers to the cumulative percent of institutions that were unionized by the end of the corresponding decade in that region. Panel B reports descriptive statistics of the sample of workers included in the analysis. The reported values are averages over all observations (i.e., averages both across individuals and within individuals over time) used in the event-study analysis. The salary measure used is a base annual rate, which offers a consistent measure of employees' annual earnings over time and across institutions. Currency values are rounded to the nearest $50,expressed in 2022 constant dollars. To control for outliers, salaries are winsorized at the 0.5th and 99.5th percentiles. In Panel B, columns (3) and (4) pertain to individuals at institutions that never unionize and columns (5) and (6) pertain to the remaining institutions that eventually unionize, using observations from both before and after unionization.

Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

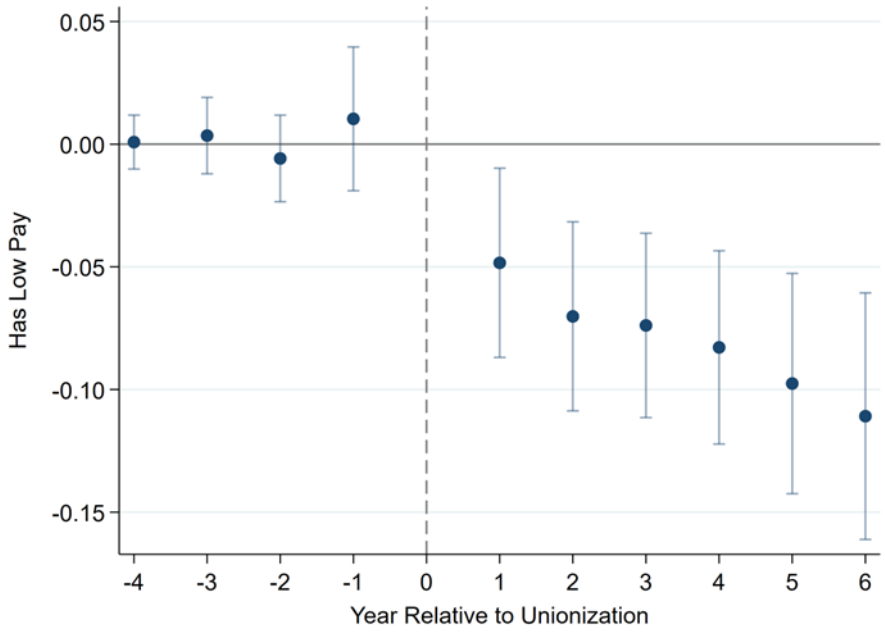
Online Appendix

Figure A1: Effect of Unionization on Average Salaries using Five Estimators



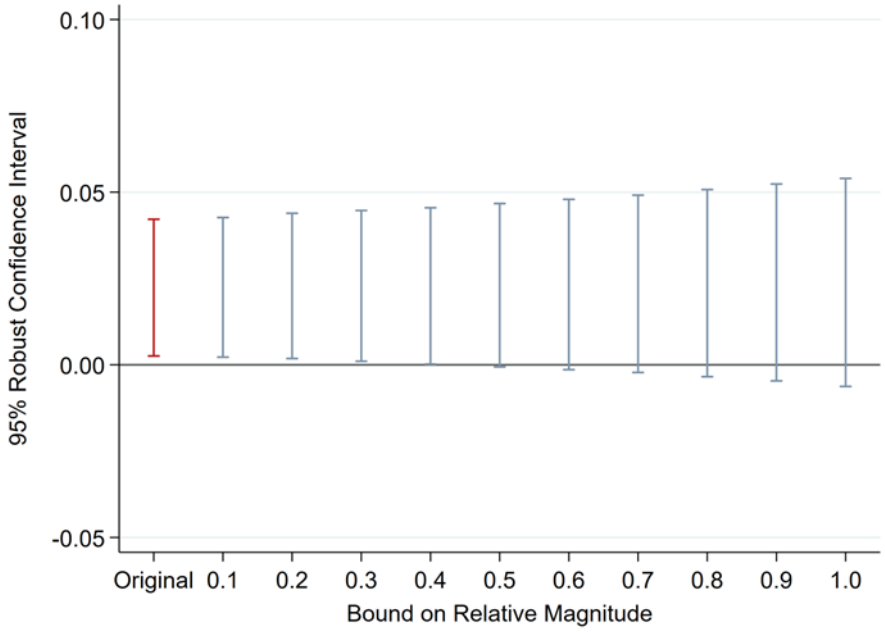
Notes: The Callaway and Sant'Anna estimator is compared to other common event-study estimators. The dependent variable is the log of base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. The ordinary least squares (OLS) estimator refers to the conventional two-way fixed-effect model. By design, several estimators use event-time −5 as the reference period and others use event-time −1, as shown. The model specifications include individual and year fixed effects. The 95% confidence intervals are shown as vertical bars, with standard errors clustered by institution.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Figure A2: Effect of Unionization on Low-Income Status



Notes: The Callaway and Sant'Anna estimator is used. The dependent variable uses base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. Specifically, the dependent variable is an indicator equal to "1" if the income for the year is below the 25th percentile and "0" otherwise, where this percentile is based on total (inflation-adjusted) earnings for the treatment group in the pre-treatment period. The model specification includes individual and year fixed effects. The 95% confidence intervals are shown as vertical bars, with standard errors clustered by institution. The corresponding regression results are shown in Table A3 of the Online Appendix
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Figure A3: Robust Inference Using Honest DiD



Notes: The robust inference approach in Rambachan and Roth (2022) is implemented using the Honest DiD postestimation Stata command to the Callaway and Sant'Anna estimator. The model specification is that of panel A in Figure 1. The 95% confidence intervals are shown as vertical bars.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Table A1: List of Universities with Information on Date of Unionization but No Information on First Contract.

University	Date of Unionization
Algoma University College	3/24/1976
Carleton University	6/18/1975
Capilano University	11/271973
First Nations University of Canada	12/18/1990
Lakehead University	9/27/1979
Laurentian University of Sudbury	7/9/1979
St. Mary's University	4/25/1974
St. Thomas More University	5/2/1977
Thompson Rivers University	2/12/1974
Thorneloe University	9/10/1990
Universitié de Moncton	1976
Universitié du Québec à Montréal	1/25/1971
Universitié du Québec en Abitibi-Témiscamingue	11/29/1972
Universitié TÉLUQ	1/29/1981
University of Sudbury	Sep-02
Wilfrid Laurier University	10/3/1988

Table A2: Effect of Unionization on Average Salaries with Various Controls

	(1)	(2)	(3)	(4)
Event-Time −4	0.001	-0.000	-0.000	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)
Event-Time −3	-0.008	-0.009	-0.009	-0.010*
	(0.006)	(0.006)	(0.006)	(0.006)
Event-Time −2	-0.002	-0.002	-0.003	-0.003
	(0.005)	(0.004)	(0.004)	(0.004)
Event-Time −1	-0.003	-0.004	-0.004	-0.004
	(0.010)	(0.010)	(0.010)	(0.010)
Event-Time 1	0.022**	0.022**	0.022**	0.022**
	(0.010)	(0.010)	(0.010)	(0.010)
Event-Time 2	0.028***	0.027***	0.027***	0.027***
	(0.010)	(0.010)	(0.010)	(0.009)
Event-Time 3	0.034***	0.032***	0.031***	0.031***
	(0.010)	(0.010)	(0.010)	(0.010)
Event-Time 4	0.035***	0.033***	0.033***	0.033***
	(0.013)	(0.013)	(0.013)	(0.013)
Event-Time 5	0.042***	0.039***	0.039***	0.038***
	(0.014)	(0.014)	(0.014)	(0.014)
Event-Time 6	0.059***	0.056***	0.056***	0.055***
	(0.014)	(0.014)	(0.014)	(0.014)
Individual FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Rank FE		✓	✓	✓
Responsibilities FE		✓	✓	✓
Years of Experience			✓	✓
Other Pay-related FE				✓
Observations	358,319	358,319	358,312	358,073

Notes: The Callaway and Sant'Anna estimator is used. The dependent variable is the log of base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. The categories for administrative responsibilities are: none; Chairs/Heads/Directors; Associate/Vice Deans; and Deans. Years of experience is controlled for using a cubic polynomial. Other pay-related fixed effects (FE) consist of indicators for: receiving a stipend; being on sabbatical; having reduced pay; and taking unpaid leave. Standard errors are clustered by institution. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Table A3: Effect of Unionization on Low-Income Status with Various Controls

	(1)	(2)	(3)	(4)
Event-Time −4	0.001	0.004	0.004	0.006
	(0.006)	(0.005)	(0.005)	(0.005)
Event-Time −3	0.003	0.006	0.007	0.008
	(0.008)	(0.008)	(0.008)	(0.008)
Event-Time −2	-0.006	-0.004	-0.003	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)
Event-Time −1	0.010	0.013	0.013	0.014
	(0.015)	(0.015)	(0.015)	(0.015)
Event-Time 1	-0.048**	-0.046**	-0.046**	-0.046**
	(0.020)	(0.019)	(0.019)	(0.019)
Event-Time 2	-0.070***	-0.066***	-0.066***	-0.065***
	(0.020)	(0.019)	(0.019)	(0.019)
Event-Time 3	-0.074***	-0.068***	-0.068***	-0.066***
	(0.019)	(0.019)	(0.019)	(0.018)
Event-Time 4	-0.083***	-0.077***	-0.078***	-0.076***
	(0.020)	(0.020)	(0.020)	(0.020)
Event-Time 5	-0.098***	-0.090***	-0.091***	-0.088***
	(0.023)	(0.023)	(0.023)	(0.023)
Event-Time 6	-0.111***	-0.101***	-0.102***	-0.099***
	(0.026)	(0.027)	(0.027)	(0.026)
Individual FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Rank FE		✓	✓	✓
Responsibilities FE		✓	✓	✓
Years of Experience			✓	✓
Other Pay-related FE				✓
Observations	358,319	358,319	358,312	358,073

Notes: The Callaway and Sant'Anna estimator is used. The dependent variable is derived from base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. Specifically, the dependent variable is an indicator equal to "1" if the income for the year is below the 25th percentile and "0" otherwise, where this percentile is based on total (inflation-adjusted) earnings for the treatment group in the pre-treatment period. The categories for administrative responsibilities are: none; Chairs/Heads/Directors; Associate/Vice Deans; and Deans. Years of experience is controlled for using a cubic polynomial. Other pay-related fixed effects (FE) consist of indicators for: receiving a stipend; being on sabbatical; having reduced pay; and taking unpaid leave. Standard errors are clustered by institution. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Table A4: Effect of Unionization on Salaries by Percentile

	10th	25th	50th	75th	90th
	(1)	(2)	(3)	(4)	(5)
Event-Time −4	0.019**	0.004	-0.002	-0.006	-0.000
	(0.007)	(0.006)	(0.006)	(0.004)	(0.004)
Event-Time −3	0.002	-0.007	-0.011	-0.015**	-0.013**
	(0.013)	(0.008)	(0.007)	(0.007)	(0.005)
Event-Time −2	0.009	-0.001	-0.005	-0.005	-0.005
	(0.012)	(0.007)	(0.005)	(0.004)	(0.006)
Event-Time −1	-0.000	-0.002	-0.001	0.005	-0.003
	(0.021)	(0.016)	(0.011)	(0.007)	(0.004)
Event-Time 1	0.061**	0.040**	0.019**	0.005	-0.007
	(0.026)	(0.018)	(0.009)	(0.005)	(0.004)
Event-Time 2	0.079***	0.058***	0.026***	0.002	-0.021**
	(0.028)	(0.018)	(0.009)	(0.007)	(0.009)
Event-Time 3	0.078***	0.066***	0.041***	0.011	-0.023
	(0.025)	(0.017)	(0.015)	(0.012)	(0.015)
Event-Time 4	0.093***	0.071***	0.037**	0.007	-0.025
	(0.028)	(0.019)	(0.018)	(0.016)	(0.019)
Event-Time 5	0.098***	0.081***	0.042*	0.014	-0.019
	(0.029)	(0.021)	(0.022)	(0.018)	(0.015)
Event-Time 6	0.118***	0.100***	0.066***	0.034	-0.017
	(0.035)	(0.024)	(0.025)	(0.022)	(0.018)
Individual FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
Observations	358,319	358,319	358,319	358,319	358,319

Notes: The Callaway and Sant'Anna estimator is used. The dependent variable is derived from base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. Specifically, the dependent variable is the re-centered influence function (RIF) of earnings evaluated at each percentile shown. Standard errors are clustered by institution. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Table A5: Effect of Unionization on Average Salaries by Academic Rank

	Assistant	Associate	Full
	(3)	(4)	(5)
Event-Time −4	-0.003	0.002	-0.001
	(0.004)	(0.004)	(0.005)
Event-Time −3	-0.009	-0.012*	-0.007
	(0.006)	(0.006)	(0.007)
Event-Time −2	-0.007	-0.004	0.001
	(0.006)	(0.005)	(0.004)
Event-Time −1	-0.005	-0.007	-0.003
	(0.012)	(0.010)	(0.007)
Event-Time 1	0.020**	0.022*	0.020**
	(0.009)	(0.012)	(0.009)
Event-Time 2	0.024***	0.031***	0.021**
	(0.009)	(0.011)	(0.009)
Event-Time 3	0.028**	0.032***	0.027***
	(0.012)	(0.011)	(0.009)
Event-Time 4	0.027*	0.033***	0.026**
	(0.015)	(0.013)	(0.013)
Event-Time 5	0.047***	0.038***	0.030**
	(0.018)	(0.015)	(0.014)
Event-Time 6	0.066***	0.055***	0.046***
	(0.022)	(0.017)	(0.014)
Individual FE	✓	✓	✓
Year FE	✓	✓	✓
Observations	73,715	125,831	136,903

Notes: The Callaway and Sant'Anna estimator is used. The dependent variable is the log of base annual salary, which excludes additional pay such as stipends and reduced pay due to leave, reflecting a consistent measure of earnings over time. The analysis is carried out separately by level of responsibilities in the reference year. The omitted category for each level of responsibility is the log of salary at event-time −1 conditional on that rank. Standard errors are clustered by institution. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.

Table A6: Employment Effects of Unionization

	Number of Workers	Percent of New Hires
	(1)	(2)
Event-Time −4	-10.684*	-0.006
	(6.368)	(0.012)
Event-Time −3	-3.229	0.007
	(5.256)	(0.008)
Event-Time −2	-11.993	0.023*
	(9.681)	(0.013)
Event-Time −1	-2.279	-0.006
	(7.909)	(0.014)
Event-Time 1	-22.952	0.005
	(17.214)	(0.008)
Event-Time 2	-7.250	0.015
	(10.316)	(0.017)
Event-Time 3	-8.491	0.002
	(9.573)	(0.008)
Event-Time 4	1.180	0.002
	(11.337)	(0.008)
Event-Time 5	-3.022	0.006
	(11.746)	(0.011)
Event-Time 6	3.414	0.017
	(15.984)	(0.011)
Institution FE	✓	✓
Year FE	✓	✓
Observations	641	641

Notes: The Callaway and Sant'Anna estimator is used. The model is estimated on data collapsed to institution-year cells. The dependent variable in column (1) is the number of faculty by institution and year. The dependent variable in column (2) is the percent of faculty who have administrative responsibilities expressed relative to the total number of faculty by institution and year. Standard errors are clustered by institution. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Statistics Canada, University and College Academic Staff System, 1970 to 2022.