Unions Without Rents: The Curious Economics of Faculty Unions*

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Abstract

Since the faculty is the *de facto* residual claimant of the university, any earnings gain must come from an increase in university revenue. A model is developed to explain the fact that faculty unions have a negligible positive (and oftentimes negative) effect on average faculty wages. A union that aims to promote the interests of the median faculty member negotiates wage redistributions and more onerous working conditions (e.g., greater teaching loads), despite the negative impact these changes have on research output. Union formation may sometimes appear to raise average wages, but only because the benchmark non-unionized university fails to maximize average wages when scholars derive non-pecuniary benefits from research and teaching. Using Canadian data, we estimate that there is no gain in faculty earnings or university revenue after a public university unionizes. Nevertheless, there is evidence for earnings redistribution within a unionized faculty, from high- to low-paying academic disciplines and from assistant to full professors, and for a decrease in research output.

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1. Introduction

The faculties of Canadian universities began to unionize in the 1960s. As shown in Figure 1a, unionization increased rapidly in the 1960s and slowed in the 1970s. It spread first among less research-intensive universities and then to more research-intensive universities. While two-thirds of Canada's 15 major research universities have faculty unions, the fractions of comprehensive universities and primarily undergraduate universities that have unions are even higher; see Figure 1b.[1] And, despite a well-defined upper bound, the process has not quite stalled; Queen's University and the University of Western Ontario were unionized in 1996 and 1998, respectively. While the proportions are considerably smaller, the overall pattern of faculty unionization in the U.S. is similar to that in Canada.[2]

This paper aims to provide an explanation for why faculty at some universities and colleges form unions. Our starting point, as in other industries, is that workers in higher education agree to form a union to increase the expected welfare of a majority of the voters at a point in time, presumably, by increasing their lifetime compensation, benefits, and improving their working conditions. Since it is costly to form a union and to implement these changes, professors agree to form a union only if they anticipate that rents are available which can, in part, be redistributed towards them. But, where are the rents in higher education?

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[1]We use the *Maclean's Magazine* definitions in its annual ranking of Canadian universities: Medical-Doctoral universities have a broad range of PhD programs and research, as well as medical schools. Comprehensive universities have a significant amount of research activity and a wide range of undergraduate and graduate programs, including professional degrees. Primarily undergraduate universities focus on undergraduate education with relatively few graduate programs.

[2] Part of the difference is attributed to the 1980 Supreme Court ruling in *National Labor Relations Boeard v. Yeshiva University* which banned unionization by faculties in private universities.

Public universities and the overwhelming majority of private universities are operated as non-profit organizations. Setting aside for-profit universities, there are no shareholders to retain university earnings; after accounting for fixed costs and support staff, university revenue is distributed to faculty. As a first approximation, then, the faculty itself is the residual claimant of the university. From this perspective, a university is effectively a partnership that sells the research and teaching services of its members, and divides the resulting revenue among the faculty. Of course, once we reject the view of a university as a profit-maximizing firm, and of faculty members as simply another input to production, we necessarily reject the conventional view of a faculty union as an indifference map confronting a demand curve or iso-profit line.

In this paper, we develop a model of union formation in higher education. We assume that non-unionized universities determine compensation rules and workloads to maximize the welfare of the representative faculty member, whereas unionized shops aim to maximize the welfare of the median faculty voter.[3] In this situation, there is no gain or rent for the faculty of a given university from unionization.[4] The view that rents are

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[3]The effects on wages and employment of unions that have distributional preferences are described by a number of researchers, including Blair and Crawford (1984), Freeman and Medoff (1984), and Grossman (1983); Kuhn (1988) and Kuhn and Robert (1989) attribute many of the same effects to price discrimination by unions in the absence of distributional concerns. In our case, as in Blair and Crawford (1984) and Grossman (1983), the union preferences are induced by the self-interested behavior of individual workers under majority voting (and change with the distribution of worker ability). Here, however, the firm is a partnership rather than profit-maximizing employer, and workers do not have firm-specific capital.

[4]This assertion may appear inconsistent with the observation that non-academic staff unions are widespread, and that union/nonunion salary differentials in some staff occupations are comparable in size to the differentials estimated for other industries (Ehrenberg and Klaff, 2002). In fact, the absence of rents that can be appropriated by faculty is consistent with a situation in which there a fixed pie to be divided, the faculty is the residual claimant, and staff unions serve to redistribute income from faculty members to the non-academic staff. Additionally, the absence of rents is not a statement about the degree of competition in the output market. There is nothing left for a union to extract for *all* faculty because the non-unionized university already makes choices to equate the corresponding marginal revenue and cost of the overall institution.

absent for individual non-profit universities, whether public or private, does not deny that faculty at several public universities and colleges in a given jurisdiction may choose to organize together to enhance their bargaining position vis-à-vis government. Indeed, this is why many public-sector workers (including grade school and high-school teachers) organize. Of course, acknowledging that there is a gain from collusive behavior does not explain why the faculties at individual institutions choose to unionize.

The overall absence of rents appears to be consistent with the data. While the union wage advantage across all industries in North America ranges from 10 to 20 percent, the situation in higher education is very different. Recent estimates of the union wage gain in Canada and the US range from marginally positive to strictly negative.[5] However, these estimates are based on samples that include public institutions in state-wide systems that bargain collectively, and these systems include large numbers of junior colleges and comprehensive universities. Many of the larger reported wage gains are specifically associated with junior colleges and comprehensive universities.[6]

The average faculty wage gain following unionization, net of union dues, appears quite modest, and yet we observe that some faculties choose to become unionized. The obvious question is, why? In section 2, we describe a model of a university, with a heterogeneous faculty, in which relatively low-ability scholars may benefit from union formation if compensation schemes are subsequently negotiated that redistribute income away from their high-ability colleagues. Ability is used here as a proxy for a scholar's marginal value product, reflecting the combined effects of effort, productivity and

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[5]See Wu and Leslie (1982), Barbezat (1989), Kesselring (1991), Rees (1993), Rees, et. al. (1995), and Ashraf (1997).

discipline-specific relative output prices. Though it may be difficult to directly test whether redistribution is the primary aim of those in favor of unionization, as claimed here, it is clear that redistribution is a consequence. There is ample U.S. evidence that full professors gain more than other ranks following unionization, and that unionization is associated with less wage dispersion across fields (Barbezat, 1989; Kesselring, 1991; Monks, 2000; Ashraf , 1997).[7]

A union redistributes wage income from high- to low-ability scholars in our model by imposing compensation rules that are less sensitive to performance than those at non-unionized universities.[8] This is consistent with evidence that research output (publications) has a smaller impact on wages at universities with faculty unions (Barbezat, 1989; Monks, 2000; Ashraf, 1997). In turn, the resulting attenuation of research incentives has two effects: first, research output per scholar falls following unionization (as documented for the U.S. in Meador and Walters (1994)); and second, *per capita* university income falls to the extent that university income is sensitive to research output.[9] Since *per capita* university income is the average faculty wage in our model of an income-sharing partnership, union formation is expected to lower average wages. Some, but not all, U.S. studies report a negative union wage gain.

Our model thus predicts that faculty unions negotiate compensation schemes that discourage research and, as a result, that average faculty wages will be reduced as

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[6] Monk (2000) reports estimates in the 7 to 14 percent range based on a sample with amajority of individuals employed at junior colleges. See also Ashraf (1997,1998).
[7]Wage compression is a common result of unions in other industries (Ehrenberg and Smith, 1997), but is generally not viewed to be a leading motivation for unionization.
[8]In the limit, without any performance pay, we get a standard income-sharing partnership in which all faculty receive the same fixed wage, which equals average output.
[9]University income includes research grants and donations, while research output is taken to be synonymous with research reputation.

research output falls. While the first prediction seems to be robust, the second depends on two simplifying assumptions: first, the only income-generating activity in which scholars engage is research and, second, the non-pecuniary benefits of research are nil. In a multi-tasking version of our model, in which scholars engage in research and teaching and enjoy non-pecuniary benefits from both, union formation can cause average wages to increase.[10]

When unions negotiate compensation and working conditions, including teaching loads, unions again promote less performance pay, which discourages research, but they also favor heavy teacher loads that enhance university income. The key insight here is that non-unionized universities choose relatively light teaching loads for their faculty, below the level that maximizes *per capita* income, because their faculties receive non-pecuniary benefits from research, and teaching raises the marginal disutility of supplying research effort. Recognizing that non-unionized universities fail to maximize *per capita* income, the alternative compensation-teaching package negotiated by a faculty union can lead to a wage increase.

The Canadian data and experience with faculty unions are examined in Sections 3 and 4, with a panel of 45 universities over a 20-year period.[11] This experience is informative largely because the Canadian and U.S. institutional environments are different. First, and most importantly, there is no country-wide counterpart to *NLRB v. Yeshiva* in Canada, and so the experiment with faculty unions was not cut short. Second, unions are formed independently on a university-by-university basis in Canada, unlike

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[10] Teaching is used here as short-hand for any non-research, income generating activity that imposes a cost on individual scholars.

[11] U.S. studies primarily use cross-sectional data, describing either institutions or individuals.

many U.S. state systems. Third, some Canadian faculties have opted to bargain collectively but forgo the right to strike. This arrangement is called a "Special Plan." It represents an intermediate institutional arrangement, somewhere between a non-unionized faculty and a certified union, which allows us to estimate the marginal impact of the strike threat. Finally, while previous U.S. studies separately examine the impact of faculty unions on wages, wage redistribution and research productivity using different data sets and sample periods, the Canadian data allow us to examine all three effects among a given set of institutions over a common period.

Union formation at Canadian universities is shown to have a very small positive effect on average faculty wages, but no effect on university income. We find evidence of income redistribution towards senior faculty, and of less wage dispersion across disciplines, following union formation. Information on the rank-discipline composition of union executive boards is presented that is consistent with the underlying voting model developed elsewhere in the paper. Finally, we show that research output, but not quality, decreases when the faculty is unionized. We find no evidence in our data that unions are able to raise wages by forcing a reallocation of non-wage portions of the university budget to faculty. It is possible that a faculty union causes universities to reduce their use of part-time labor. For the same total number of students, fewer part-time instructors causes full-time teaching loads and wage incomes to rise. Unfortunately, our data describe full-time faculty alone.

We extend our model in Section 5 to explain why universities that participate in more competitive markets for faculty are less likely to be unionized. As individual income is positively related to performance pay, the re-distributive gains for low-ability

scholars from forming a union and reducing performance pay are, in part, offset by the potential departure of more-able colleagues. If a university's more-able faculty members are mobile, a faculty union will opt for more performance pay than otherwise. Competition from other universities for able scholars thus reduces the net benefit of forming a union, which, in part, explains why research universities (which are relatively well-endowed with more-able researchers) are less likely to unionized.

Concluding remarks appear in Section 6.

2. A Model

Our view of union formation, at universities and elsewhere, is the standard one; a worker is willing to join a union when she expects to be made better off. To describe the corresponding benefit-cost calculus, we need to specify workers' preferences and determine the alternative payoffs for workers, with and without a faculty union.

On the preference side, a scholar who receives wage *w* and expends effort *e* enjoys a payoff of $w + \lambda e - C(e)$, where λ is the marginal non-pecuniary benefit of effort and $C(e)$ is a conventional strictly increasing, strictly convex cost-of-effort function satisfying $C(0) = C'(0) = 0$. Effort *e* can be thought of as the discretionary component of faculty member's total job effort; *e* is devoted to research activities and is private information, while any remaining job effort is public, fixed and suppressed for now. We assume that $\lambda \geq 0$, so that scholars enjoy engaging in research.

A scholar with ability *a* who supplies effort *e* produces verifiable output $ae + \varepsilon$, where ε is the realization of a mean-zero random variable; ε represents the effects of luck in both production and appraisal.

A university employs scholars. For our purposes, a university is a non-profit partnership that sells the teaching and research services of its members, and redistributes the resulting revenue among these workers (fixed costs of production are set to zero); related models of producer cooperatives include Pauly and Redisch (1973) and Pauly and Gaynor (1990). A university is populated by two types of scholars, having ability levels a_H and $a_L < a_H$, who enjoy corresponding marginal research benefits λ_H and λ_L. The average income of a faculty member at this university, $\overline{w}$, can be decomposed into two terms, only one of which is sensitive to research effort:

$$\overline{w} = q + \alpha a_H e_H + (1-\alpha) a_L e_L \ .$$

q is the portion of $\overline{w}$ that does not depend on research output, α is the fraction of high-ability scholars in the university, and e_i is the effort supplied by a scholar of type i=H,L; the relative price of research services is normalized to one. For now, we take $\{q, \alpha\}$ as fixed.

The contribution of an individual faculty member to aggregate income is $ae + \varepsilon$. A faculty member's wage is assumed to be a linear function of her contribution, $w = s + \beta(ae + \varepsilon)$, where $0 \le \beta \le 1$. Since income is shared, we can solve for the base salary, $s = q + (1-\beta)(\overline{w} - q)$. Then, taking her colleagues' effort levels, $\{e_H, e_L\}$, as given, a scholar of type i chooses an effort level to maximize

$$V_i(\beta, e) = q + (1-\beta)[\alpha a_H e_H + (1-\alpha) a_L e_L] + \beta a_i e + \lambda_i e - C(e) .$$

The scholar's optimal level of effort, e_i, satisfies $\beta a_i + \lambda_i = C'(e_i)$, $i = H, L$.

Compensation with and without a Union

Compensation is designed to promote different objectives at non-unionized and unionized universities. We adopt the following characterization of these objectives: At non-unionized universities, the optimal value of β is chosen to maximize the joint faculty surplus; at unionized universities, the optimal value is chosen to maximize the payoff of the median faculty voter.

Let β^* denote the optimal compensation parameter at a non-unionized university. Then, β^* solves

$$\underset{\beta\in[0,1]}{\text{Max}}\, V(\beta) = \alpha V_H(\beta, e_H) + (1-\alpha) V_L(\beta, e_L) \text{ , s.t. } \beta a_i + \lambda_i = C'(e_i), \; i=H,L.$$

$V(\beta)$ is increasing on $\beta \in [0,1)$ and flat at $\beta = 1$; this gives, $\beta^* = 1$. Non-unionized scholars are paid the value of the marginal product of their research effort. As scholars are risk neutral, this efficient outcome is not surprising.[12]

Let β_i^u denote the optimal compensation parameter at a unionized university where the median voter has ability level a_i. Consider a union shop where the majority of scholars have ability level a_i. In this case, β_i^u solves

[12]If scholars are risk averse, we get $\beta^* < 1$, but otherwise nothing substantive changes.

$$\underset{\beta\in[0,1]}{\text{Max}}\, V_i(\beta, e_i) \quad \text{s.t.} \quad \beta a_i + \lambda_i = C'(e_i)\,, \quad i=H,L.$$

Increasing β has two effects on the payoff of a scholar with ability level a_i: First, increasing β increases the effort levels of all scholars, which increases base salaries by $(1-\beta)[\alpha \mathrm{d}e_H / \mathrm{d}\beta + (1-\alpha)\mathrm{d}e_L / \mathrm{d}\beta]$ and makes all scholars are made better off. Second, it increases reliance on performance pay, increasing income by $a_i e_i - [\alpha a_H e_H + (1-\alpha) a_L e_L]$, which is beneficial for high-ability scholars but detrimental for low-ability scholars. Combining these effects, it is easy to show that

$$\left.\frac{\mathrm{d}V_H}{\mathrm{d}\beta}\right|_{\beta=1} > 0 \text{ and } \left.\frac{\mathrm{d}V_L}{\mathrm{d}\beta}\right|_{\beta=1} < 0\,.$$

It follows that situations where the majority of scholars have ability level a_H are less interesting because a union controlled by more-able scholars finds itself at a corner solution and chooses the same compensation rate as does a non-unionized university. On the other hand, a union controlled by less-able scholars prefers to attenuate incentives and redistribute income away from the more-able members of the faculty. That is,

$$\beta_L^u < \beta_H^u = \beta^* = 1.$$

Observe that these results are independent of the non-pecuniary benefits scholars receive from research activity. Absent these benefits, scholars will undertake research only for financial gain. In fact, it can be shown that

$$\left.\frac{\mathrm{d}V_L}{\mathrm{d}\beta}\right|_{\beta=0} > 0 \quad \text{if} \quad \lambda_i = 0,\ i=H,L.$$

Thus, without non-pecuniary research benefits, a union controlled by low-ability scholars will opt for some performance pay to raise average wages. If $\lambda_i > 0,$ however, $e_i > 0$ even when $\beta = 0$, and so the benefits of wage redistribution may exceed the cost of lost research effort, and the same union may then optimally set $\beta_L^u = 0$.

Union Formation

The faculty at a university forms a union if the majority of its members prefer this arrangement. Forming a union is generally disruptive. The one-time *per capita* cost of doing so in the current period is assumed to be given by the realization of a positive random variable. This gives:

RESULT 1: (a) T*he gain to forming a union is strictly positive only if the majority of the scholars in a university are less able, as* $\beta_L^u < \beta_H^u = \beta^* = 1$*; and a union results in this case when the realized cost of forming one is sufficiently small.* (b) *Following the introduction of a union, performance pay becomes less important as wages are redistributed from high- to low- ability scholars, and individual and aggregate research output falls.*

Thus, one possible explanation for the lower incidence of unions at research universities is that they have higher proportions of more-able scholars, i.e., $\alpha \geq 0.5$.

Since research effort is the only decision variable that affects the average wage, the introduction of a union also causes average wages to fall. As an empirical matter, however, faculty wages sometimes rise after a faculty becomes unionized. Allowing another decision variable, called teaching load, to affect average wages explains why wages may rise in some circumstances and fall in others.

Teaching

"Research" can be viewed as a catchall to describe income-generating activities that are difficult to monitor, and which therefore require incentives. Of course, many tasks that faculty members perform can be monitored and mandated. We use "teaching" as the representative example, in the sense that course loads and student-faculty ratios are easy to negotiate and enforce, and are determinants of university income. We argue that union and non-union universities tend to choose different teaching loads.

Introducing teaching to the model is straightforward: Letting *t* denote the teaching load of each scholar at a given university, we assume that

$$q = q(t), \quad q' > 0, \quad q'' < 0, \quad q'(0) > a_H + \lambda_H ,$$

so that *per capita* income increases with teaching load at a decreasing rate; the last inequality ensures an interior solution. We also assume that the individual cost of research and teaching efforts, $\{e,t\}$, is given by $C(e+t)$. Taking the university's

teaching load and her colleagues' effort levels as given, a scholar of type *i* chooses an effort level to maximize

$$V_i(t,\beta,e) = q(t) + (1-\beta)[\alpha a_H e_H + (1-\alpha)a_L e_L] + \beta a_i e + \lambda_i^t t + \lambda_i^r e - C(e+t).$$

We distinguish the non-pecuniary benefits of teaching and research with parameters λ_i^t and λ_i^r. The scholar's optimal level of effort, e_i, satisfies $\beta a_i + \lambda_i^r \le C'(e_i + t)$, $i = H, L$.

As in other multi-task problems, $t > 0$ implies that the marginal cost of research effort is strictly positive for all $e \ge 0$. Thus, for some $\{\beta, a_i\}$, certain scholars (the less-able ones, in particular) may choose to supply zero research effort, especially when a union lowers the marginal private benefit of research effort, β. Whether research effort is reduced or set to zero is a second-order effect that we ignore by restricting attention to parameters that deliver $e_i > 0$ for *i=H,L* , with or without a union.

The non-union case is again straightforward:

$$\underset{\beta\in[0,1],t\ge 0}{\text{Max}}\ V(t,\beta) = \alpha V_H(t,\beta,e_H) + (1-\alpha)V_L(t,\beta,e_L)\ ,\ \text{s.t.}\ \ \beta a_i + \lambda_i^r = C'(e_i + t)\ ,\ i=H,L.$$

This gives $\beta^* = 1$ and an optimal teaching load, t^*, that satisfies

$$q'(t^*) = [\alpha a_H + (1-\alpha)a_L] + [\alpha\lambda_H + (1-\alpha)\lambda_L]\ ,$$

where $\lambda_i = \lambda_i^r - \lambda_i^t$, i=H,L. t^* equates the marginal revenue gain from teaching to the sum of the average marginal pecuniary and net non-pecuniary costs of teaching. These cost terms represent the forgone benefits of research; this is because a scholar's optimal research effort decision implies that e_i falls one-for-one with an increase in t.

The teaching load that maximizes average wage income is denoted by $\hat{t}$ and satisfies

$$q'(\hat{t}) = [\alpha a_H + (1-\alpha)a_L] \ .$$

Thus, when the average net non-pecuniary benefit of research is zero, so that $\alpha\lambda_H + (1-\alpha)\lambda_L$=0, we have $t^* = \hat{t}$ and, in this case, a non-unionized university chooses the income-maximizing teaching loads for its faculty. Otherwise, if the marginal non-pecuniary benefits of research are larger (smaller) than the corresponding benefits of teaching, $\lambda_i = \lambda_i^r - \lambda_i^t$>0 (<0), teaching loads are reduced (increased), and the institution fails to maximize wage income.

Consider a faculty union controlled by less-able scholars. Let β_L^{ut} denote its optimal choice of β, and let t_L^u denote the corresponding teaching load. $\{\beta_L^{ut}, t_L^u\}$ are found by maximizing $V_L(t, \beta, e_L)$, where $\beta a_i + \lambda_i^r = C'(e_i + t)$, i=H,L. As teaching reduces research effort, it also reduces the benefit for less-able scholars of redistributing research-generated income away from more-able scholars towards themselves. In consequence, the union negotiates more pay-for-performance when research and teaching are substitute activities (i.e., $\beta_L^u < \beta_L^{ut}$ as t_L^u>0). The first-order condition for t_L^u is

$$q'\left(t_L^u\right) = [\alpha a_H + (1-\alpha)a_L] - \alpha\beta_L^{ut}\left(a_H - a_L\right) + \lambda_L .$$

Since $\beta_L^{ut} > 0$, we have $t_L^u > t^* > 0$.

The higher teaching loads adopted by unionized universities does not require that scholars enjoy a non-pecuniary benefit from research or teaching. That is, $t_L^u > t^* > 0$ even when $\lambda_L = \lambda_H = 0$. This is because higher teaching loads that reduce research effort across-the-board are less costly for a low-ability scholar than for the representative scholar of concern at non-unionized universities. The critical implication of non-pecuniary research-teaching benefits is that non-unionized universities will choose teaching loads that fail to maximize average faculty wage income ($t^* \neq \hat{t}$). Moreover, to the extent that scholars prefer research over teaching, so that $\lambda_i > 0$, non-unionized universities will choose "light" teaching loads for their faculty, at least relative to the income-maximizing level. Since a faculty union dominated by low-ability scholars will choose higher teaching loans, it is possible that average faculty wages rise following union formation despite the consequent fall in research effort.

RESULT 2: *Faculty unions increase teaching loads and may explicitly discourage research by reducing performance pay for research. Even if* $\beta_L^{ut} = 1$, *research output still decreases because of higher teaching loads. The average faculty wage may rise at universities where faculty prefer research to teaching, but will certainly fall at universities where scholars find teaching to be at least as enjoyable (*$\lambda_i \leq 0$*).*

Even when the average faculty wage decreases, the compensation-teaching package negotiated by a faculty union makes its median member better off.

We now describe the Canadian experience in light of Results 1 and 2.

3. Data

The base sample consists of 45 Canadian universities with data from 1973 to 1995.[13] There are 14 medical-doctoral universities, 11 comprehensive universities, and 20 primarily undergraduate universities. The average faculty size per university was 686; faculty size ranges from 58 to 2575.[14] This interval reflects the heterogeneity in a sample that includes exclusively undergraduate teaching universities as well as major research universities. Faculty size grew at an average of 1.5% per annum.[15] The average fraction of full and associate faculty members per faculty was 0.68.

The average full-time faculty wage was $66.4K in 1992 Canadian dollars. The standard deviation was $7.4K. Over the period, real earnings grew at an average rate of 0.35% per annum.[16] Average university revenue was 184 million in 1992 dollars; the standard deviation was 169 million. Real revenue per faculty grew at an average rate of 0.90% per annum.[17]

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[13] Documentation for data sources is contained in Appendix B. Altogether, there are 810 observations. Due to limited data availability, however, the sample sizes for different regressions vary.
[14] Faculty includes full, associate and assistant professors. Lecturers and part-time faculty are not included.
[15] All growth rates reported in this section are calculated with university fixed effects.
[16] The growth rate fell to 0.26% per annum when we control for the proportion of full and associate professors at a university.
[17] Since real revenues per faculty grew at a faster rate than real earnings per faculty, some professors may have believed that unionization would help them obtain a larger share of university revenues.

The average number of papers published per annum, as tracked by the Institute for Scientific Information, was 572 per university. The standard deviation was 739. This large standard deviation again reflects the heterogeneity in the sample. The number of papers per university grew at 5% per annum. The average number of papers per faculty was .57, and it grew by 3.4% per annum. The citation count, again tracked by the Institute for Scientific Information, is the total number of citations that a paper obtained from the year of publication until 1995. Thus, papers that were published in earlier years will receive more citations than those published in later years. By this measure, the average number of citations per university was 5020.

Overall, there is substantial heterogeneity across our sample. Universities expanded over the sample period, 1973-1995, and publications per university grew rapidly. On the other hand, average earnings per faculty member and revenues per university grew very slowly over the same period. Labor income per worker in Canada also grew minimally over the same period.

4. Empirical Results

We describe the effects of union formation at Canadian universities, for the period 1973-1995, on faculty income and university revenue in Table 1, on income redistribution among faculty within universities in Table 2, and on faculty research output in Tables 3. As an alternative to forming a certified union, Canadian faculties can choose to organize themselves into a faculty association that bargains collectively with the university but does not have the right to strike. Universities covered by these collective

agreements are said to have "special plans." By the end of the nineties, most universities were either unionized or covered by special plans.

In all columns, we record the estimated coefficients of only four explanatory variables, CERT, CERT2 and CERT3, and SP. CERT takes a value of 1 if the faculty is unionized and is zero otherwise; CERT2 takes a value of 1 if the faculty is unionized and the university is a comprehensive university (group 2), and is zero otherwise; CERT3 takes a value of 1 if the faculty is unionized and the university is a primarily undergraduate university (group 3), and is zero otherwise; and SP takes a value of 1 if the faculty has a special plan and is zero otherwise. The remaining coefficient estimates are suppressed.

Institution fixed effects and year effects are included in all reported regressions. Additional explanatory variables include (i) POP18, the fraction of 18-24 year olds in the province, (ii) PINC, the log average labor income in the province, (iii) FULLPROF, the log of the ratio of full plus associate professors to all professors, in the previous year, and (iv) TPROF, the log of the number of professors of all ranks in the university in the previous year. The latter two variables represent time-varying school effects. The same subset of {POP18,PINC,FULLPROF,TPROF} is included in all reported regressions in a given table; the subset varies by table because of the nature of the dependent variables.

A potential problem with the estimates of the effects of a union and a special plan is that almost all university faculties adopted one of these arrangements by the end of the sample period, and so the omitted group of universities is becoming smaller over time. As a result, the point estimates of the year effects for the later years of the sample are increasingly imprecise, and we may inadvertently obtain unusual point estimates for the

effects of a union or a special plan. To check for robustness, we created a separate short-run sample by truncating the observations for a university three years after its faculty forms a union or adopts a special plan, and then estimated the short-run effects of certification or a special plan. In each and every case, the short-run coefficient of CERT or SP has the same sign, a smaller magnitude and is less significant than the corresponding long-run (non-truncated sample) coefficient reported in Tables 1-3.

Another potential problem with the OLS results is that there may be a correlation between the error terms of the regression equations and unionization. We attempt to address this endogeneity problem by instrumenting CERT and SP. The instruments we employ are province-level variables: PUNION, the provincial unionization density; PGDP, log per capita provincial GDP; PGEXPD, log per capita provincial government's discretionary budget; PEDEXP, log per capita provincial education expenditure; PINCHS, provincial average income of health and education workers); and PINCPA, provincial average income of public administration workers. We also use {POP18,PINC,FULLPROF} to explain the decision to form a faculty union or special plan. These variables capture the income of the province, the preferences of the provincial government toward educational and other expenditures, and the degree of unionization in the province.

Table A in Appendix A contains the estimates of the linear probability first-stage regressions. Column (A1) shows that the instruments have power in predicting unionization. The F-test shows that the set of instruments, PUNION, PGDP, PGEXPD, PEDEXP, PINCHS and PINCPA are statistically significant at the 1% level. CERT is negatively correlated with per capita provincial income and discretionary expenditure.

On the other hand, it is positively correlated with average income of the provincial public administration workers and per capita educational expenditure in the province. Column (A2) shows the first-stage estimates for SP. Many of the estimated coefficients have the opposite signs as the estimates in the CERT equation; this is not surprising as CERT=1 (SP=1) implies SP=0 (CERT=0), though not *vice versa*. It is thus difficult to provide any economic interpretation to the coefficient estimates of either first stage regressions.

For columns (1)-(2) and (4)-(5) in Tables 1-3, we also found the instrumental variables (IV) coefficient estimates of CERT and SP, using the same additional explanatory variables introduced to obtain the OLS estimates. In most instances, however, over-identification tests show that the instruments are not valid. For this reason, where appropriate, summary descriptions of these IV results are relegated to footnotes.

A. Wages

Columns (1)-(3) of Table 1 describe OLS regressions of log of average annual faculty earnings at a university (LNEARN) on attributes of that university.[18] Previous research on the effects of faculty unionization on earnings has found significant differences in the estimates depending on whether or not school fixed effects are included.[19] We have found similar differences (recall that institution fixed effects and year effects are included in all reported regressions).

The OLS estimated wage impact of a faculty union is about 1.5 % and is statistically significant. The estimated coefficients of SP are statistically insignificant.

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[18] Robust t-statistics are presented in all regressions in this paper.

These results are consistent with those found by Rees, *et. al.* (1995) for Canada. They are also consistent with estimates of the impact of unionization on faculty earnings in the U.S. (Ashraf, 1997; Barbezat, 1989; Kesselring, 1991; Rees, 1993). Annual earnings are measured gross of any union or faculty association membership dues. As a result, union dues of, say, one percent reduce the estimated net returns to unionization to 0.5 % and make the gain from a SP negative.[20]

Column (3) of Table 1 describes the effect of unionization on earnings at different types of universities: the coefficient of CERT is the estimated effect at medical-doctoral universities, CERT plus CERT2 is the estimated effect at comprehensive universities, and CERT plus CERT3 is the estimated effect at primarily undergraduate universities. As predicted by the theory (Result 2), the wage increase following unionization is smaller at universities where the faculty places greater emphasis on teaching activities.

B. Rents

Our theoretical model predicts that a faculty union will cause the average faculty wage to fall unless the union is able to enhance or extract revenue from some non-

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[19] E.g. Rees (1993), Rees, et. al. (1995).

[20] The IV estimates of the determinants of LNEARN show that the instruments cannot be regarded as exogenous to the earnings regression for any specification at the 5% significance level. The IV estimates of the coefficient of CERT range from –2% to –17%, are marginally significant. One potential explanation for these wide differences is the lack of exogeneity of our instruments; we experimented with other instruments without success. In general, researchers have argued that the OLS estimate of the effect of unionization on earnings is biased upward because the employer systematically chooses higher-quality workers if union jobs pay an above market premium; see Chamberlain (1982) , Jakubson (1984) and Mincer (1981). Some studies that control for both measurement error and self-selection argue that the OLS estimates are close to the true estimate (Card, 1996; Robinson, 1989). Given the small union premium estimated by OLS, the economic significance of any upward bias in the OLS estimate is at best slight. Moreover, the case for selective hiring in the academic labor market is less plausible. Thus, we consider the OLS estimates of the union premium as an upper bound measure of the pecuniary gains from unionization.

research source. One possibility is that an organized university extracts more resources from the provincial government. Another possibility is that revenue from tuition is raised by admitting more students (lower admissions standards may be required). At this stage, the precise source of the additional revenue is unimportant; the key question is whether or not the formation of a union or special plan has positive revenue effects for a university.

To answer this question, we undertook OLS estimates of the determinants of the log of total university revenues in thousands of 1992 dollars (LNREV).[21] The results are reported in columns (4)-(6) of Table 1. In all specifications, faculty unions and faculty special plans are not associated with an increase in total real university revenues.[22]

Overall, there is no support for the view that unionized or special plan universities obtain higher revenues. Together with the hypothesis that the faculty is the residual claimant of a university, this lack of additional revenues may explain the small positive (if any) earnings gain from unionization.

C. Redistribution

Table 2 provides evidence on the redistributive activities of faculty unions. We consider two types of redistribution, across fields in columns (1)-(3) and across professorial ranks in columns (4)-(6).

Wage Compression Across Fields: Our data set has average earnings in a university for 9 separate fields: education, fine/applied arts, humanities, social science,

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[21] The results are essentially unchanged when the dependent variable is either the log of total expenditure, the log of operating expenses, the log of university revenue per faculty member or the log of university expenditure per faculty member.

[22] Concerning the IV estimates, the instruments can be regarded as valid at the 5% significance level in the first two specifications. In these cases, CERT and SP have insignificant effects on revenue.

agriculture, engineering, health, math and science, and other. For university *i* in period *t*, we let H_{it} denote the highest average earning by field, L_{it} denote the lowest average earnings by field, so that $\log(H_{it} / L_{it})$ is the percentage difference between the average earnings in the highest and lowest earning fields in university *i* in period *t*. Notice that the highest (lowest) earning field can differ within a university over time and between universities.

Table 2 presents OLS estimates of the effects of a faculty union and special plan on $\log(H_{it} / L_{it})$. Columns (1) and (2) show that, on average, among all universities, there is no significant redistribution of earnings across fields at universities with a faculty union or special plan.[23] Comparing university groups, however, column (3) shows that there is in fact significant income redistribution: $\log(H_{it} / L_{it})$ falls by 7% at medical-doctoral universities, is unchanged at comprehensive universities, and increases by 3% at primarily undergraduate universities.

Result 1b predicts that faculty unions redistribute income from high- to low-ability scholars. Since ability is synonymous with marginal value product in our model, evidence for this redistribution should be greatest at universities with professional graduate and undergraduate programs (law, medicine, engineering and business), i.e., the medical-doctoral universities in our sample. This is confirmed in column (3). Elsewhere, the apparent redistribution of income *towards* the higher-earning fields is initially puzzling, and is discussed further below.

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[23] The exogeneity of the instruments for the IV estimates is not rejected at the 10% significance level for these two specifications. The corresponding effects of CERT on $\log(H_{it} / L_{it})$ are estimated to be –9% and -8%, respectively, and are different from zero at the 5% significance level. This estimated earnings

Wage Compression Across Ranks: Researchers have argued that senior workers differentially benefit in unionized firms. For university *i* in period *t*, we let F_{it} denote the average full professor's salary, A_{it} denote the average assistant professor's salary, so that $\log(F_{it} / A_{it})$ is the percentage difference between the average earnings of full and assistant professors in university *i* in period *t*. We use $\log(F_{it} / A_{it})$ as the dependent variable in columns (4)-(6) of Table 2. The estimated effect of CERT in (4)-(5) is 2% and is statistically different from zero.[24] The effect of SP is negative in (5) and significant. Again, the comparison of university groups is interesting: $\log(F_{it} / A_{it})$ falls by 2% at medical-doctoral universities, and rises by 2% at comprehensive universities and by 3% at undergraduate universities.

The results in Table 2 confirm that faculty unions redistribute income. The beneficiaries of redistribution appear to be junior professors in relatively low-earning fields at research universities and senior professors in relatively high-earning fields at undergraduate universities. This may be due to the historical application of different criteria for wage increases and promotions at research and undergraduate institutions. We conjecture that at universities where raises and promotions are based on research productivity, the low-ability median voter is less likely to be a higher-earning full professor; however, at universities where raises and promotions are based on other criteria (e.g., seniority), the low-ability median voter is as likely to be a full professor. In the latter case, moreover, with non-output based rules in place, junior professors are less

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compression across fields is larger than the estimated average earnings gain from unionization, suggesting that high earnings fields experience absolute earnings losses upon unionization.

[24] This seniority effect is consistent with those found by Rees, *et. al.* (1995) for Canada, and by Barbezat (1989) and Hu (1982) for the U.S.

disadvantaged as redistribution is effectively inter-temporal.[25] The results in columns (3) and (6) then make sense if the high earning fields at undergraduate universities, and to a less extent at comprehensive universities, are simply those with higher proportions of higher-paid full professors. Unfortunately, our data do not provide a break down of fields by rank.

D. Output

While faculty organizations may be unable to significantly increase faculty earnings, they may negotiate compensation rules that redistribute income and thereby divert faculty efforts away from research. This sub-section studies the effects of CERT and SP on research productivity. We consider two measures of output, articles and citations, for which we have a base sample of 44 universities from 1981 to 1995 (15 years). In terms of quantity (articles) and quality (citations), we observe that the faculties at medical-doctoral universities in our sample out produce those at comprehensive universities, which, in turn, out produce those at primarily undergraduate universities.[26]

Articles: Table 3 shows results for two dependent variables: the log of the number of articles published in current year (LNP1), corresponding to columns (1)-(2), and the log of the number of articles published in the current and next 4 years (LNP5),

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[25] Moreover, at universities that place a smaller weight on research, the likelihood of being tenured is greater, and so inter-temporal redistributions are more acceptable to junior faculty. At universities that place a greater weight on research and where the likelihood of being tenured is lower, junior faculty will prefer to increment their current wages.

[26] In 1981, medical-doctoral, comprehensive and undergraduate universities published an average of 0.71, 0.45 and 0.19 articles per faculty member, respectively. By 1995, medical-doctoral, comprehensive and undergraduate universities received 11.6, 4.9 and 1.7 citations per faculty for articles published in 1981, respectively.

corresponding to columns (3)-(4).[27] The latter variable is meant to adjust for the effects of publication lags. Looking across the coefficient estimates for CERT in the top panel, all specifications show that CERT affects publications negatively. There is about a 10% drop in publications after union certification. The evidence on the effect of SP on research productivity is slightly less negative; a special plan reduced the number of publications by about 6-9%.[28]

Citations: Columns (5)-(8) of Table 3 reports OLS estimates of the effects of CERT and SP on two measures of research quality: the log of total citations to 1995 per article published in the current year (LNC1), corresponding to columns (5)-(6), and the log of total citations to 1995 per article published in the current year and next four years (LNC5), corresponding to columns (7)-(8). Across all specifications, the estimated effect of CERT on citations per article is positive but not statistically different from zero. One may interpret the positive estimates as the unintended benefit of some increase in quality in response to a lower relative price for quantity. The estimated effect of SP on citations per article is negative and statistically different from zero in columns (7).[29]

In summary, after unionization, there is evidence that research output, as measured by the number of articles published, decreases. Unionization may also reduce

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[27] The values of 1 for R^2 in Tables 3 are due to rounding. The large R^2s are due to the extreme serial correlation of the dependent variables that is captured by the school fixed effects and time. The reported t-statistics have been adjusted for this correlation.

[28] For the IV estimates of the effects of CERT and SP on publications, the first-stage regressions are the same as in Table A, except that we use the smaller 15-year sample described above. The over-identification tests show that the instruments are valid at the 5% level for two specifications, columns (3) and (4); in these cases, the effects of CERT on publications are again significantly negative, with point estimates of –39%, which seems unreasonably large. Unlike the OLS estimates, there is no statistically significant effect of SP on publication counts.

[29] Concerning the IV estimates, for the specifications in columns (5)-(7), the F-tests do not reject the hypothesis that the instruments are valid. The evidence on CERT is mixed. The estimated effect of CERT on citations is negative and statistically different from zero in one equation, but positive and not statistically

the quality of the articles published, but the quantitative impact is smaller.[30] Whether the fall in research output and quality is due to increased leisure for faculty members, a shift in effort from research to other activities, or the exit of relatively more productive faculty is not known. The weaker impact of CERT on quality suggests that exit is not likely to be the dominant explanation. SP had a lesser impact on the number and but a more negative effect on the quality of articles published.

5. Discussion

With modest salary gains and no increase in total university revenues, faculty unions in Canada have not largely increased their members' direct earnings. The Canadian evidence is consistent with the hypothesis that the faculty is the residual claimant of the university, and suggests that unions have two effects consistent with our theoretical model: First, the earnings compression across fields and enhanced salary gap across ranks following unionization may be interpreted as evidence that faculty unions redistribute earnings within a university. And second, the fall in research output after unionization is consistent with the view that unions introduce different incentive schemes and workloads for faculty.

The small wage gain we document requires careful interpretation. If higher quality faculty members disproportionately leave the university after unionization, then

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different from zero the others. The estimated effects of SP on research quality are negative but not statistically different from zero in all specifications.

[30] These results are smaller than those in Meador and Walters (1994). They found that unionization in US public universities reduces research output by 17% and reduces a peer measure of departmental quality by 9%.

our estimated earnings gain from unionization underestimates the true gain (holding faculty quality constant). Since there is some weak evidence for a drop in research quality after unionization, a disproportionate exit of higher quality faculty members after unionization cannot be discounted. This evidence on exits is circumstantial. We do not have Canadian data on the mobility of faculty members which is what is required for a more conclusive test of this hypothesis. Rees (1994) shows that faculty retention rates in U.S. schools fall for the first five years after unionization. This evidence is consistent with the hypothesis that high-quality faculty members disproportionately leave the university shortly after unionization.

Our empirical results also indicate that a union and special plan have quantitatively different effects, and that the effects of a special plan are considerably more modest. The differential right to strike provided to a union is clearly valuable. Since a right to strike to cannot be used to extract rents in any partnerships, including universities, we conjecture that its role is also distributional. That is, strike threats may be used to discipline and silence more-able scholars who oppose the policies of the faculty union (with performance pay, more-able scholars bear a higher cost from a strike). In this view, a special plan is an institution that aims to overcome an indivisibility problem and achieve some of the benefits of a union at a lower cost.

A. Teaching Loads

Our model shows that faculty unions will increase teaching loads and reduce performance pay for research, and that this reorganization of activities may lead to an increase in average faculty earnings (at least when scholars enjoy non-pecuniary benefits

from research). Unfortunately, we do not have much data on teaching loads. We cannot find evidence of increased student-faculty ratios at Canadian universities with faculty unions. This is not surprising. Since the estimated effect of a union on university revenue (including tuition) is nil, it does not appear that more students were admitted relative to trend. One way for unionized full-time faculty members to increase their teaching loads and wages without admitting more students is by terminating some part-time faculty. Unfortunately, we cannot test this hypothesis, as we do not have data on part-time employees.

Another interpretation of what we call teaching load, t, is that working conditions, as measured by $1/t$, are affected by diverting funds from capital maintenance and expenditure to faculty wages. While total revenue is unchanged, the physical plant ultimately deteriorates, which may be especially costly for more research-oriented scholars. Though plausible (in the short run), this hypothesis is not supported with our data, at least not with our one measure of capital expenditures: The OLS and IV estimates of the impact of CERT and SP on the log of the difference between total university expenditure and operating expenditure, our measure of capital expenditures, are zero. Of course, it may be difficult to find significant budgetary adjustments when the overall wage gains with CERT and especially SP are close to zero.

B. Union Preferences

Our model predicts that union officials will act to implement the will of the median voter, that is, to redistribute income from high value marginal product workers to low value marginal product workers. Since the task of the union official is fixed, the

benefit of being a union official is independent of the academic ability of the official. But being a union official reduces the time that a faculty member has for his or her academic activities. As the shadow price of these academic activities fall, the cost of becoming a union official likewise falls. The shadow price may fall because the professor's research is no longer up to date or her discipline has a relatively low market price (e.g. humanities). Since the benefit of being a union official is independent of his or her academic abilities, at the margin, union officials will come disproportionately from faculty members whose academic activities have low shadow prices.

To study these preferences, we gathered data on the disciplines represented by faculty union or faculty association officials for 14 universities.[31] We obtained 86 observations with 23 presidents or past presidents, 10 vice presidents and 53 other officers. In 1995, the latest year for which we have salary data, the average ratio of the salary of these individuals, as represented by the salaries of their disciplines, to the average salary of the university where they work is 0.95, with a standard error of 0.22. This is weak evidence that faculty union and association officials belong to disciplines that have below average earnings within their own university.

In the 14 universities, the average ratio of the number of full to assistant professors is 2.3. Among union and association officials, the average ratio of number of full to assistant professors is 5.3. This relative surplus of full professors among officials may explain the earnings redistribution across faculty ranks in unionized universities.

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[31]These schools have faculty unions or associations with web home pages that were matched to our data set.

C. Competition and Unionization

We conclude this section by showing that competition among universities for faculty can explain the differential incidence of unions between research and undergraduate universities. Our argument is based on a straightforward extension of our earlier model in which the proportion of more-able scholars, α, is endogenous. To simplify this analysis, we suppress teaching loads, assume that non-pecuniary benefits of research are nil, and adopt a specific cost function, $C(e) = .5e^2$.

When scholars are mobile, the distribution of ability distribution within a university may respond to changes in its compensation structure. Because the payoff of a high- (low-) ability scholar is an increasing (decreasing) function of the incentive parameter, β, we assume that the proportion of high-ability scholars, α, is an increasing function of β, $\alpha = F(\beta)$. Let $\xi \geq 0$ denote is the elasticity of α with respect to β.

The value of $\beta \in [0,1]$ that maximizes the joint surplus remains equal to $\beta^* = 1$. Since $e_i = \beta a_i$, the less-able scholar chooses β to maximize $q + (1-\beta)\beta[\alpha D + a_L^2] + .5\beta^2 a_L^2$, where $D = a_H^2 - a_L^2$. Hence,

$$\frac{1-\beta_L^u}{\beta_L^u} = \frac{1}{1+\xi+B},$$

where $B = a_L^2 / \alpha(a_H^2 - a_L^2) > 0$. The benchmark case in Section 2 involves a fixed value for α, in which case ξ=0, and so $\beta_L^u = (1+B)/(2+B) < \beta^* = 1$.

Since β_L^u is an increasing function of ξ, the differential gain from forming a union decreases as ξ increases. Assuming that the distribution of union-formation costs remains unchanged, it follows that faculties at universities characterized by larger values of ξ are less likely to form unions. This parameter can be seen to represent the disciplining effect of the labor market on unions, specifically, the market for faculty. That is,

RESULT 3: *Universities where more-able faculty members are more likely to move in response to a given reduction in performance pay are less likely to have faculty unions.*

The next question, which is an empirical one, is, which universities participate in more competitive markets for faculty. For example, to the extent that the more-able scholars at research universities (who are absolutely and relatively more able) are likely to have more opportunities to move in response to changes in compensation than are the more-able scholars at undergraduate universities, this simple model explains the Canadian experience with faculty unions and some of the early U.S. experience as well.

As the proportion of unionized universities in any given market increases, the consequent loss of attractive job opportunities for more-able scholars and the reduction of research effort at these unionized institutions may lower ξ at the remaining non-union shops. In this situation, union formation can be contagious, as appears to have been the case in Canada. Access to the U.S. academic job market and the Canadian non-academic job market may then account for the residual non-unionized faculty in provinces where there are no legal barriers to union formation.

6. Concluding Remarks

A non-profit university is effectively a faculty partnership. To understand why some of these partnerships have formed unions, we begin with a non-unionized university that aims to maximize the welfare of its representative faculty member. With this benchmark, a faculty union is simply a device for changing the objectives of a university to promote the interests of the median faculty voter. Faculty members agree to form a union in this setting only when the median and representative faculty members differ. If the distribution of productivity among professors is non-degenerate and skewed to the right, the less-productive majority may have an incentive to form a union.

Our model predicts that a faculty union dominated by less-productive scholars will promote compensation schemes to redistribute income away from the more- to less-productive faculty of a university. This type of union discourages research by negotiating less performance pay and larger teaching loads than what are adopted at non-unionized universities. A faculty union may appear to raise average wages, but only in situations where the benchmark non-unionized university fails to maximize per capita income because faculty enjoy non-pecuniary benefits from research. Since the gains from union formation are attenuated at institutions facing competitive markets for faculty and research funds, and since union formation is costly, union incidence is expected to be greater among undergraduate and public universities and colleges. These predictions are largely borne out by U.S. and Canadian experience.

The issue of redistribution of labor earnings within professional service organizations is of course not unique to academia. The presence of professional unions in academia and not in other professional service industries is due to the non-profit nature

of universities. Universities derive pecuniary benefits from their non-profit status such as tax relief, government subsidies, private donations and the like. As a non-profit organization, faculty members cannot legally be the residual claimants of the organization. That is, faculty members can only be employees of the university. Since faculty members are employees, they can form a union in Canada. In a for-profit professional service organization, the owners (partners) are its senior workers. The redistribution of income occurs within the partnership agreement. There is no room for some partners to form a union.

Another feature of professional partnerships, as distinct from universities, is that the more-able members are collectively mobile. Within a given partnership arrangement, attempts to redistribute income from the more- to less-productive partners are likely to induce the more-productive ones to leave, as a group, to establish their own firm. Collective exit is a credible threat that disciplines coalition formation. This mechanism is much weaker at universities. Productive scholars may choose individually to leave a university in response to a prejudicial change in compensation structure.[32] The impact of exit is limited, however, as a group of scholars cannot leave *en masse* to establish their own university. A university, unlike a professional partnership, requires physical capital to supply services, and enjoys a reputation independent of its members' identities. As these physical and reputational assets are fixed in the short run, they facilitate union formation by inhibiting the mobility of more-productive workers.

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[32]According to our model, these anticipated departures inhibit union formation by reducing the gains from unionization

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TABLE 1

	LNEARN			LNREV		
	(1)	(2)	(3)	(4)	(5)	(6)
CERT	0.01616	0.01560	0.03805	0.00944	0.00444	-0.01558
	(2.45)*	(2.30)*	(2.61)**	(0.58)	(0.26)	(0.47)
CERT2			-0.02951			0.00930
			(1.61)			(0.23)
CERT3			-0.02656			0.03110
			(1.66)			(0.86)
SP		-0.00335	-0.00331		-0.02945	-0.03018
		(-0.52)	(0.53)		(1.23)	(1.26)
R^2	0.90	0.90	0.90	0.75	0.75	0.75
Obs	810	810	810	803	803	803

Other regressors: POP18, PINC, FULLPROF, university dummies, year dummies
* 5% significance level, ** 1% significance level

TABLE 2

	Log (H_{it} /L_{it})			Log (F_{it} / A_{it})		
	(1)	(2)	(3)	(4)	(5)	(6)
CERT	0.00690	0.00791	-0.07594	0.02209	0.01951	-0.02550
	(0.85)	(0.95)	(5.08)**	(4.76)**	(4.17)**	(3.25)**
CERT2			0.08032			0.04456
			(4.57)**			(3.94)**
CERT3			0.10813			0.05704
			(6.41)**			(6.77)**
SP		0.00586	0.00445		-0.01498	-0.01315
		(0.56)	(0.43)		(-2.25)*	(2.17)*
R^2	0.68	0.68	0.70	0.77	0.77	0.79
Obs	810	810	810	810	810	810

Other regressors: University dummies, year dummies
* 5% significance level, ** 1% significance level

TABLE 3

	LNP1		LNP5		**LNC1**		**LNC5**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CERT	-0.0975	-0.1020	-0.1247	-0.1321	0.0927	0.0849	0.0753	0.0668
	(-2.32)*	(-2.42)*	(-4.10)**	(-4.39)**	(1.46)	(1.34)	(1.64)	(1.46)
SP		-0.0616		-0.0965		-0.1064		-0.1107
		(-1.53)		(-3.57)**		(1.77)		(-2.69)**
R^2	0.99	0.99	1.0	1.0	0.96	0.97	0.93	0.93
Obs	660	660	484	484	658	658	484	484

Other regressors: TPROF, FULLPROF, university dummies, year dummies
* 5% significance level, ** 1% significance level

Appendix A

Table A1: Linear probability first stage regressions		
	(1)	(2)
Dependent variable	CERT	SP
PUNION	1.07713	-0.71681
	(1.65)	(1.57)
PGDP	-0.02602	0.02208
	(2.77)**	(3.38)**
PGEXPDIS	-0.10088	0.00686
	(2.83)**	(0.28)
PEDEXP	0.44570	-0.34320
	(3.50)**	(3.86)**
PINCHS	-0.00858	0.00532
	(1.52)	(1.35)
PINCPA	0.01302	-0.00718
	(6.11)**	(4.84)**
POP18	7.69184	3.99741
	(2.38)*	(1.78)
PINC	0.02869	-0.01039
	(2.07)*	(1.08)
FULLPROF	0.48332	-0.61261
	(2.53)*	(4.61)**
Obs	810	810
R^2	0.77	0.82
Absolute value of t-statistics in parentheses		
* significant at 5%; ** significant at 1%		

VARIABLES	DEFINITION	SOURCES
CERT	= 1 if a faculty association has been certified under the provincial labour law OR has been voluntarily recognized by the employer as the sole bargain agent and give the association same power as in the former status.	Year of certification/voluntary recognition is from : ▪ Canadian Association of University Teachers. Year of Special Plan is from: ▪ Rees, Daniel I., Pradeep Kumar, and Dorothy W. Fisher. 1993. *Unionization and Faculty Salaries in Canada, Appendix B*. Kingston ON: Industrial Relation Centre, Queen's University. (This paper was later published in the Industrial and Labor Relation Review 1995, 48(3). However, the list of union information did not appear here)
SP	= 1 if a faculty association and the employer entered into a private agreement (special plan) which provide for a dispute resolution upon salary negotiation impasse. The three Universities in Alberta which have been granted under the Universities Act the bargaining right but not the right to strike are incluced in this category.	
LNE	Log of the average earning of faculty of an institution.	Faculty count and average wage in 1992 $ by rank, field is from : ▪ Centre for Education Statistics, Statistics Canada. *University and College Academic Staff System - custom tabulation*. Ottawa.
FULLPROF	Log (ratio of (full+associate) professor to total professors) lagged one year.	
LNRELS	log(highest average earning by field)-log(lowest average earnings by field).	
LF-LA	Log (average full professor's salary) - log(average assistant professors' salary).	
TPROF	Log of total professors.	
LNREV	log of university total income	University income and expenditure is from: ▪ Centre for Education Statistics, Statistics Canada. *Survey of Financial Statistics of Universities - custom tabulation*. Ottawa.
LNP1	Log of articles published in current year, per faculty.	Number of papers published, and number of citations received are from: ▪ The Institute for Scientific Information 1997. *Canadian University Indicators on Diskette, 1981-1995, deluxe version*. Philadelphia, PA. Number of faculty is from: ▪ Centre for Education Statistics, Statistics Canada. *University and College Academic Staff System - custom tabulation*. Ottawa
LNP5	Log of articles published in the current and next 4 years, per faculty.	
LNC1	Log of citations up to 1995 per articles published in the current year.	
LNC5	Log of citations up to 1995 per article published in current and next 4 years	
POP18	Ratio of population 18-24 to total population, by province	Population by province, by age is from: ▪ Statistics Canada. *CANSIM. Matrix no. 6368-6377. Population by single years of age, age groups and sex, by province, July 1*.
PINC	Log provincial labour income per paid worker, all industry.	Labour income, by province is from: ▪ Statistics Canada. *CANSIM Matrix no. 6612-6621. Wages and Salaries and Suppplementary Labour income, not seasonally adjusted*. Number of paid workers, by industry, and by province, annual average is from: ▪ Labour Statistics Division, Statistics Canada. *Labour Force Historical Reivew CD-ROM*, 1997 ed. Note: number of paid workers 1973-1975 is by extrapolation
PINCPA	Labour provincial labour income per paid worker in public admin industry.	
PINCHS	Log labour income per paid worker in health and social services industry.	
PUNION	Provincial unionization density = union membership/paid workers	Union membership, by province is from: ▪ Industrial Organization and Finance Division, Statistics Canada. *Corporations and Labour Unions Returns Act (CALURA), Part 2 - Labour Unions*. Catalogue No. 71-202. Ottawa. Paid worker is from: ▪ Labour Statistics Division, Statistics Canada. *Labour Force Historical Reivew CD-ROM*, 1997 ed. Ottawa. Note: paid workers 1973-1975 is by extrapolation
PGDP	Log provincial gross domestic product, per capita.	Gross domestic product is from: ▪ Statistics Canada. *CANSIM. Matrix no. 2623-2631,6950. Provincial gross domestic product(expenditure based), annually.* Provincial government expenditure is from: ▪ Statistics Canada. *CANSIM. Matrix no. 2782-2791. Provincial government revenue and expenditure fiscal year ending Mar 31st, annual.* Total population, by province is from: ▪ Statistics Canada. *CANSIM. Matrix no. 6368-6377. Population by single years of age, age groups and sex, by province, July 1*.
PGEXPD	Log provincial government discretionary expenditure (govt expenditure - debt charges), per capita.	
PEDEXP	Log provincial govt education expenditure, per capita.	

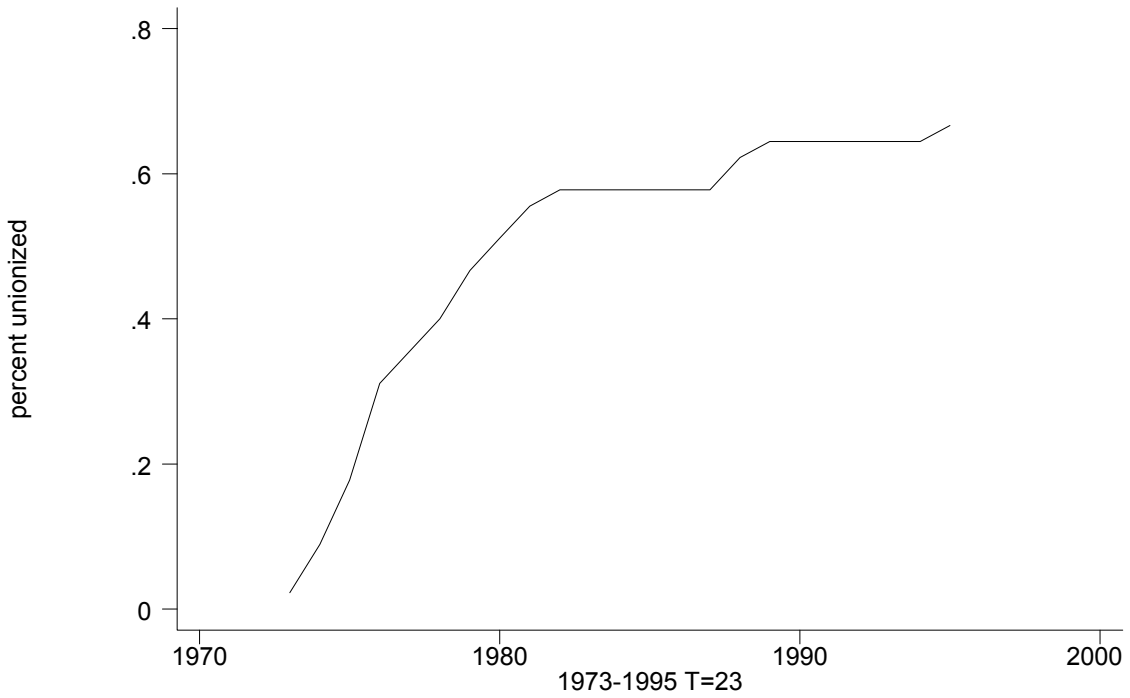

Figure 1a: Unionization Trend

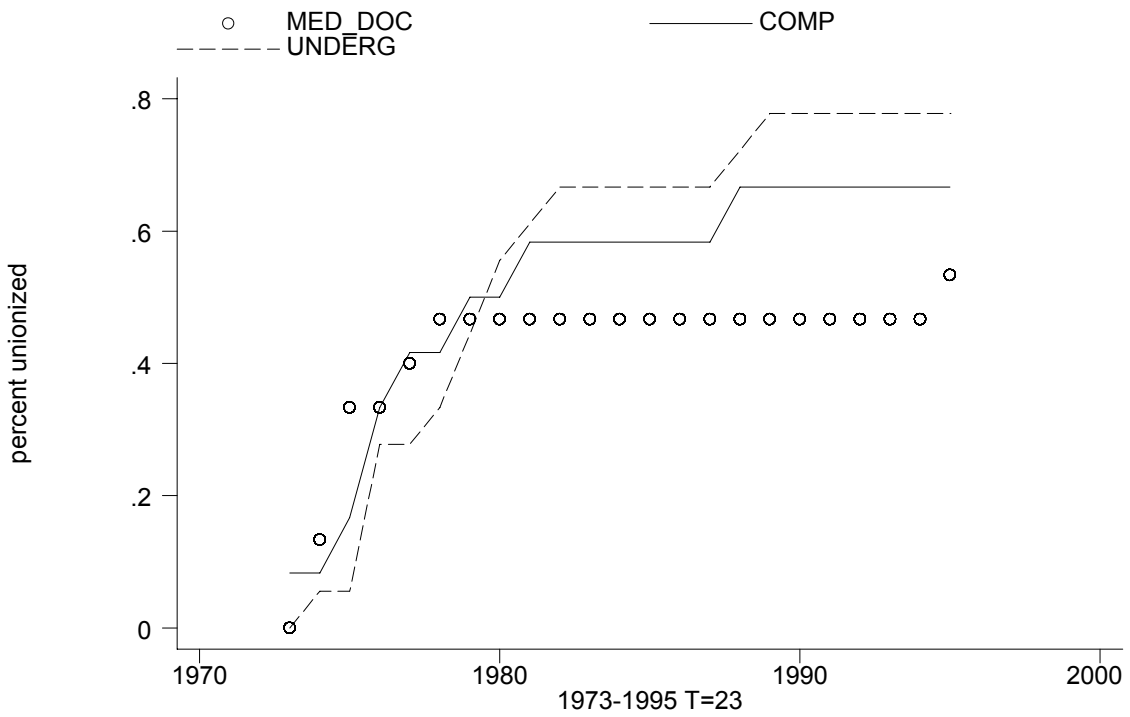

Figure 1b: Unionization Trend By Type