The Effects of Graduate–Student Unionization on Stipends

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January 17, 2010

WORKING PAPER[1]

Abstract

Beginning in the 1970s, graduate assistants have organized labor unions. Presently, 38 universities have a graduate–student union. However, the effect graduate–student unions have on wages, wage variance, health benefits, and organizational structure is unknown. This study uses data from the *Chronicle of Higher Education* and government data to estimate the economic effects of unionization. By using a multilevel model is used to control for intra–university correlation of wages, this study concludes graduate unions are effective at raising stipends, but ineffective at lowering fees, providing health–care coverage, and lowering intra–university wage variance.

[1]This paper is substantially based on Schenk Jr. (2007). I would like to thank William Boal, Peter Orazem, Justin Tobias, Anthony Townsend, and James Polk for comments on prior drafts of this paper. I would also like to thank the session participants from the Midwest Economic Association 2005 Annual Meeting for feedback. All errors are my own. This paper does not necessarily reflect the views of Grand View University or any other institutions I am affiliated with. Copies of this paper and additional materials are available from www.tomschenkjr.net/research/.

Even though faculty and staff unions have made unionism more familiar to campuses, graduate students still do not fit the demographic profile of traditional unionized labor. Graduate assistants are, for all intent and purposes, temporary employees—leaving their duties after graduation; young—typically under thirty; and have completed over 16 years of schooling.[2]

The effects of graduate–student unionization on stipend levels, stipend distributions, health benefits, and academic success are largely unknown. The paucity of research is largely due to a lack of systematic reporting of wages, hours worked, fringe benefits, number of strikes, and other labor management issues regarding graduate–student unions. Notwithstanding, a number of scholars have argued the potential beneficial and deleterious effects unionization. This paper will evaluate those arguments against the known empirical data.

This paper will use data set assembled from two surveys conducted by the *The Chronicle of Higher Education*, the U.S. Department of Education, National Research Council, and the National Science Foundation to examine the economic effects of graduate–student unions. In particular, this paper will explore unions impact on wage levels, wage distribution, and fringe benefits.

Graduate assistants are known under a number of labels: teaching assistants (TAs); research assistants (RAs); and graduate assistants (GAs), which usually includes TAs and RAs. Thus, unions composed of graduate assistants also have a number of synonyms: graduate–*student* unions; graduate–*employee* unions; and graduate–*assistant* unions. For reasons that will become clear, union activists usually denote themselves as graduate–employee unions; however, this paper will refer to them as graduate–student unions. The term "employee" is contentious and at the crux of the cases presented to the National Labor Relations Board. Unionization itself will generally refer to, unless otherwise noted, to graduate–student unionization.

History of Graduate–student Unions

Unionization at public universities is governed by state law. States with dense union membership in the private sector were often the first to grant union status to graduate students. The first three graduate unions were in states with union density higher than the national average (see Hirsch et al., 2001). Moreover, most of the graduate–student unions are in the Pacific, West North Central, East North Central, and Middle Atlantic regions—the regions with the most dense union membership (Hirsch and Macpherson, 2003). The University of Wisconsin–Madison's Teaching Assistants' Association (TAA) is generally regarded as the first graduate–student labor union. Originally an informal union, the union won recognition in 1970 after a short

[2]Hirsch and Macpherson (See 2003, Table 5.4) for a description of current unionized workers.

strike. Although TAA was the first union to win recognition as a stand–alone graduate union, it was not the first to receive a contract. In 1968, the City University of New York (CUNY) faculty union included rights for graduate assistants in their contract.

Following Wisconsin and CUNY, the Michigan and the University of Oregon unionized in the 1970s. The 1980s was relatively quite. Only three universities in Florida—University of Florida, South Florida University, and Florida Agriculture & Mechanical University—unionized in the 1980s. Yet, unionization efforts at large university systems, such as the University of California–Berkley and State University of New York (SUNY), begun. By the 1990s seven University of California campuses, SUNY, and six other universities unionized. Unionism also grew rapidly throughout the 2000s. Sixteen universities won recognition, including the California State University System, and two unionized as recently as 2009. Ultimately, 38 universities are unionized in the United States. The trends in graduate–student unions is showed in Figure 1.[3]

[FIGURE 1 ABOUT HERE]

Unionization at private universities is subject to the National Labor Relations Act and the rulings of the National Labor Relations Board (NLRB). The NLRB has debated whether graduate assistants can be considered employees. In a myriad of cases, the NLRB rejected graduate–student unions based on the "primary intent" test. Later in 2000, the NLRB used a broader definition of employment and accepted an appeal by New York University (NYU). NYU's graduate–student union was the first to be recognized by a university. However, in 2004 with a different composition of judges, the NLRB reversed itself again and prohibited excluded graduate assistants as employees. Since then, NYU's administration has refused to renew their union contract with graduate assistants and no other private university has voluntarily recognized a graduate–student union (Gravois, 2005).

Table 1 shows all of the universities where graduate assistants have unionized. The formation date indicates the year a union first formed; the recognized date is when the university administration officially recognized the union; and first contract is when the first union contract was ratified by graduate students.[4]

[TABLE 1 ABOUT HERE]

[3]Seventeen unions have formed but not been formally recognized: Boston University; Brandeis; Brown; Columbia; Cornell; Indiana; Ohio State; Pennsylvania State; Purdue; Rensselaer; Tufts; Maryland; University of North Carolina at Chapel Hill; University of Pennsylvania; University of Southern California; University of Virginia; and Yale University.

[4]A number of events can be counted as a formation of the union. Usually a successful "card signing" drive, an official vote of confidence for a union, or any legal action (e.g., petition) was recorded as a formation.

Antecedents of Unionization

The rise of GA unions can be attributed to the sometimes bleak economic realities that face graduate students, both in school and in the job market. For one, graduate students have been taking longer to complete their degrees (Ehrenberg et al., 2004; Snyder et al., 2006) and spending more time as graduate assistants (Ehrenberg and Mavros, 1995). Meanwhile, outside monies for financial assistance from the federal government has decreased (Snyder et al., 2006; Ehrenberg et al., 1993). After graduation, the outlook is not any more sanguine. Graduate students, particularly in the humanities, are facing a tighter job market (Aronowitz, 1998; Barba, 1994), universities are cutting back on the number of tenured faculty positions being offered, and some real wages have fallen (Snyder et al., 2006). Union gains are also attributable to changing institutional structures. Legislation permitting unionization and the spread of faculty unions have helped graduate unions succeed in gaining recognition (Julius and Gumport, 2003).

[TABLE 2 ABOUT HERE]

The time–to–degree—the amount of time it takes to receive a graduate degree after starting the program—has been steadily increasing since the 1970s. Table 2 shows the median time–to–degree between 1978 and 2003 has risen for all disciplines. However, social sciences, education, and the humanities have had the largest percentage increases. This is on top of their already comparatively high time–to–degree rates from the 1970s. As a result, the student faces higher opportunity costs while in graduate school since they must forgo current job opportunities to finish their studies.

In addition to economic costs, there is also the worry of the accounting costs as a graduate student. The share of graduate students being supported by federal funds has declined (Ehrenberg et al., 1993); meanwhile, the share of graduate students relying on teaching or research assistantships has increased. The type of assistantships assigned depends on the student's major. For example in 2003, 56.6% of engineering students were supported by research assistantships, 16.4% by fellowships, and only 8.1% by teaching assistantships. By contrast, over 32% of the students in the humanities are teaching assistants, 34% were using their own funds, and only 1.8% held research assistantships (Snyder et al., 2006, see Table 18).

Debt levels also tend to be higher for those in social sciences and humanities (see Table 3). The mean debt levels for graduate students in engineering, for instance, was $7,860 in 2003, while the debt burden for social sciences and humanities averaged $18,083 and $15,152, respectively. Humanities and social science graduate students are also the least likely to have no debt (39.6% and 36.6%, respetively) and most likely to have incurred debts exceeding $35,001 (21.1% and 28.2%). Further, it appears this debt is primarily

accumulated during graduate school. As undergraduates, future doctoral recpients in the social sciences and humanities have less than $5,000 in debt and are very likely to have no debt at all.

[TABLE 3 ABOUT HERE]

Graduate assistants are potentially being used as low–cost substitutes for full–time faculty members, especially for menial tasks avoided by tenured faculty (Julius and Gumport, 2003; Lafer, 2003). Faculty salaries range from $55,000 to $110,000 (Snyder et al., 2006), while graduate assistants earn roughly $15,000. Table 4 shows roughly 14% of courses in the humanities are taught by teaching assistants. When looking at first year courses only, the proportion taught by GAs increases to 20%, indicating teaching assistants are more likely to teach introductory courses rather than upper level undergraduate courses.

[TABLE 4 ABOUT HERE]

Spending time away as a graduate student and working as a teaching assistant does appear to have adverse effects on time–to–degree (Ehrenberg and Mavros, 1995). Thus, as federal funding for graduate students has decreased, the need for assistantships has risen, which has contributed to longer time–to–degree and higher opportunity costs of staying in graduate school. In turn, graduate assistants are using unions as a way argue for higher stipends or limited workloads.

In addition to the plight of graduate students in school, students are also concerned about finding jobs after graduation. Graduates in the humanities and the social sciences are facing a tougher job market than their colleagues. First, universities are decreasing the proportion of members. In the past decade, the share of tenured faculty has fallen 10 percent, below 50 percent for the first time (see Snyder et al., 2006, Table 242). Second, humanities doctoral graduates are less likely to participate in the labor market and are less likely to find work in their field. While unemployment is low for humanities graduates, over eleven percent are involuntarily employed outside their field—twice the overall average (Table 5). Moreover, 84% of humanities graduates participate in the labor market, which is 4% lower than the overall average. Third, Table 6 shows faculty salaries in the humanities has also fallen since 1987. The average salary for a faculty member in the humanities, in 2004 dollars, has fallen 1.3 percent between 1987 to 2006; meanwhile, salaries for other disciplines have increased.

[TABLE 5 ABOUT HERE]

The statistical evidence indicates that graduates in the humanities, and to a lesser extent, social sciences, have been hit hardest by longer graduation times, lower tenure rates, and lower salaries. At the same

time, there is evidence graduate students in the humanities and social sciences are the instigators of unions. In a survey of attitudes toward graduate–student unions, an administrator notes, "[t]here is no need [to unionize]. They [in the sciences] have all they want, high compensation and jobs when they graduate..." (Julius and Gumport, 2003, p. 202). It would not be surprising, then, to suspect that graduate students in the humanities fight hardest for unionization and receive the highest comparative benefit.[5]

The catalysts for unionization extends beyond self–interest. Graduate assistants have also objected to the "corporatization" of universities (Rhoads and Rhoades, 2005; Lafer, 2003). Universities are able to generate revenue by patenting research and offering distance learning. Pro-union scholars argue these revenue–generating programs are done in conjunction corporations and benefit administrators, tenured faculty, and corporations. (Lafer, 2003).

[TABLE 6 ABOUT HERE]

Another catalyst for graduate–student unionization is legislation that permits unions to bargain with universities. Faculty unions have also helped graduate assistants establish successful unions, often voicing support for graduate–student union efforts (e.g., Fogg, 2004). GA union drives that occur on campuses with full-time faculty unions have had better success at achieving recognition than union drives that "go it alone" (Julius and Gumport, 2003).

Graduate-student unions have sought a reduce workloads and improve working conditions. Namely, they seek stipend increases; fringe benefits for themselves and their families; lower workloads; additional benefits such as daycare; job security; and an improved grievance process (Rhoades and Rhoads, 2003; DeCew, 2003). These demands have had some success. The NYU graduate union, for instance, has secured annual raises of 3.5% and full health benefits (Smallwood, 2002b). The University of Michigan–Ann Arbor gave their students free daycare for children of GAs.

Opposition to Unions

Opponents to graduate-student unions have argued that graduate assistants are not employees, but rather, apprentices for future jobs. University administrators, who often vigorously oppose unionization efforts, and faculty members fear that unions will interfere with faculty-student relationships (Boghossain and Velleman, 2007) or unions will attempt to gain control and negotiate over academic policy (Cavell, 2000). Lastly, union

[5]This does not imply they will have higher wages compared to other departments on the same campus. There is reason to believe that the intra-university standard deviation of wages will decrease with unionization.

opponents, including graduate students, are concerned increased benefits will come at the cost of higher undergraduate tuition or smaller department sizes (DeCew, 2003; Smallwood, 2002a).

Second, unions may interfere with faculty-student relationships. Under a union regime, tasks are carefully enumerated and grievance processes are outlined. Some faculty and graduate students claim the role of the mentor will decline and the individual faculty member will be looked upon as an employer, and not as someone who gives advice (Gehman, 2001; Boghossain and Velleman, 2007). However, this claim has not been supported in the literature. Case studies have revealed that faculty members do not perceive their relationship with students has been inhibited by unions (Hewitt, 2000). In fact, Julius and Gumport (2003) suggest that carefully enumerating tasks and duties may enhance the mentoring relationship because of clear expectations given to the students.

Lastly, the economic gains made by graduate-student unions will eventually have some economic impact on other areas of the university. Increasing stipends, fringe benefits, or providing other facilities such as daycare, might lead to higher tuition rates for undergraduate students. Similarly, departments may reduce the number of new students who are accepted with funding into a unionized department. First, under unionization, graduate students will be better able to secure more funding and their likelihood to graduate. Second, increased remunerations may reduce the number of incoming students, thereby potentially reducing the number of future faculty members and increasing future faculty wages.[6]

It does not seem to be the case, *prima facie*, that unionization causes catastrophic increases in tuition or reduces department size. In particular, no one to the author's knowledge has blamed unionization at the oldest GA unionized institutions—University of Wisconsin–Madison and University of Michigan–Ann Arbor—for chronic tuition increases or smaller department sizes. Of course, a number of factors possibly stronger than unionization has gone into tuition increases, which does not exclude the possibility of some relationship between unionization and costs.

Literature Review

One previous study was able to analyze the economic effects from graduate–student unions. Graduate stipends are not published regularly to let researchers analyze how unions affect stipends. This paper relies on a survey conducted by *The Chronicle of Higher Education* of stipends in 2001, 2002, and 2004 makes it possible to begin some analysis.

[6]It is possible the labor supply would be unchanged. Departments would be more likely to decline admissions for those least likely to complete a degree, thus, having no effect on the labor market. See Ehrenberg (1992a,b) for a further discussion on the flow of new academic labor supply.

Ehrenberg et al. (2004)—the only study of graduate-student remunerations—showed graduate–student unions were ineffective at increasing stipends. In a five-year period from 1996 to 2001, stipends at nonunionized universities rose 13.9%, while stipends at unionized institutions rose 10.7%. However, unionized schools were better able to reduce the amount of required fees. Total compensation (stipends minues required fees) at unionized schools increased 18.47% compared to 14.5% for nonunionized institutions, implying graduate unions were better able to reduce required fees.

Unfortunately, the authors of the study were bounded by strict confidentiality agreements and were only able to compare averages instead of using traditional econometric analysis. Thus, it is unclear whether differences between unionized and nonunionized institutions or other differences between institutions. Moreover, their study was not able to directly compare health benefits for graduate assistants.

Notwithstanding the paucity of research on graduate-assistant stipends, a number of studies have investigated the economic effects of faculty unionization. The evidence from faculty unions studies were mixed. A number of studies found faculty with unions had higher salary and compensation levels relative to nonunionized universities (Freeman, 1978; Birnbaum, 1974, 1976; Barbezat, 1989; Monks, 2000). A handful of other studies found faculty wages had little or negative effects (Morgan and Kearney, 1977; Marshall, 1979; Guthrie-Morse et al., 1981; Rees, 1993; Hosios and Siow, 2004).

Results from the faculty unionization movement provides some indication about graduate–student unions. Both groups are well–educated and work on university campuses with a department–university organization structure. The main services provided by both are teaching and research. However, graduate assistants (GAs) also differ in important ways; namely, GA's do not have a tenure system. Also, graduate assistantships are short–term employment, terminated when the student graduates. Because of this, unions face high turn over rates that may hamper their ability to effectively bargain.

The length of organization has also played a significant role in unionized faculty salaries. The returns from unionization are generally non-linear (Freeman, 1978). Unions are unable to win salary gains at first, but eventually earn more than their nonunion peers over time. In fact, positive returns from unionization do not appear until the second year. By the seventh year, the salary affect from unionization disappears again and the returns become negative (Barbezat, 1989, Table 1)

Data Set

The data used in this study is collected from a number of sources. Stipend data was collected by *The Chronicle of Higher Education* for the 2000-01, 2001-02, and 2003-04 academic years (Smallwood, 2001, 2004). The *Chronicle* collected the average stipends at the department level for teaching assistants (TAs) and research assistants (RAs) in biology, economics, English, mechanical engineering, and sociology. Additionally, the surveys provided some simple data on health-care benefits. Universities indicated whether the university paid for health benefits for graduate assistants or dependents.

Forty-five universities from the Association of American Universities—an accreditation agency—were observed in the surveys for the 2000-01 and 2001-02 academic years. For the 2003-04 survey, eighty-three "leading universities" were sampled. In total, 101 unique universities were sampled. Twenty-five universities were included in the 2000-01, 2001-02, and 2003-04 surveys.

Stipend data was then paired to institutional and departmental characteristics for that given year. The Integrated Postsecondary Education Data System (IPEDS) was used to find the type of institution (public or private); the cost–of–living for students attending the university; tuition costs; endowment size of the university; and total enrollment. Ranks for academic departments was obtained from the National Research Council (1995).

Union data was obtained from the Coalition of Graduate Employee Unions (CGEU), newspapers, and other writings. Union status has been divided into three categories: *Contract Union*, *Noncontract Union*, and *No Union*. A *contract union* is a union that has secured a labor contract. A *noncontract union*, on the other hand, is one where there is an active union presence, but they have not secured a contract. Some of the noncontract unions are simply not permitted to unionize (e.g., NYU), while others have yet to receive recognition. These unions have no formal bargaining power, but many maintain a presence through strikes, campaigns, and union drives. Finally, *no union* is simply a university without a graduate–student labor union.

When there is a contractual union, teaching assistants are always included. However, some research assistants are not part of a contractual union. Thus, contractual unions have also been decomposed into two groups, *TA union* and *TA+RA union*. *TA union* only includes teaching assistants, while *TA+RA union* included both teaching and research assistants.

Noncontractual unions may strike and protest, but they lack the ability to formally bargain and sign contracts. Since contractual unions *are* able to sign legally binding contracts and can appeal to state labor boards concerning unfair labor practices, they will likely have the strongest impact on stipends, health

benefits, and wage variation. The main negotiating tool for noncontract unions, however, are strikes since they have no negotiating power, thus, noncontract unions are likely to have little or no impact on stipends.

[TABLE 7 HERE]

A summary of the data is listed in Table 7. Roughly 22 percent of departments who reported TA wages in this sample belong to a union and 29 percent of departments who reported RA wages are unionized. Ten percent of the sampled universities are noncontract unions. The mean stipends for nonunion teaching assistants are similar to unionized assistants. Research assistants at nonunionized universities earn more.

Years organized is the length of time since the date of the first union contract and subtracting it from the observed year. For instance, in the 2001, the years organized for the University of Michigan, which unionized in 2001, is zero. University of Wisconsin, the first campus to organize, has a value of thirty. The literature suggests one of two effects may be evident. Unions may garner higher wages as they become older. Unions may witness increasing returns over time because they become more experienced and effective (e.g. Barbezat, 1989; Freeman, 1978). Alternatively, unions may initially bargain for union security provisions and only initially produce small wage gains (Freeman and Kleiner, 1990). Otherwise, unions may experience decreasing returns over time. Douglas (1930) argued unions initially establish large wage gains as a show of effectiveness to union members, but focus on other areas in later contracts.

Key departmental and university characteristics are also likely to affect stipends. First, universities in high cost–of–living areas will be associated with higher wages. Cost–of–living is estimated by summing the estimated housing cost and other expenses for off–campus students (Hoffer et al., 2002). Paradoxically, highly ranked departments pay noticeably more than lower ranked departments (Smallwood, 2001).[7] The rank for each department is included from the somewhat dated ranking from the National Research Council (1995).[8] Finally, wealthier universities will probably pay more. A wealth-per-student ratio was constructed by dividing endowment size by total enrollment.

Finally, some graduate assistants may be more productive. Directly measuring productivity for teaching and research assistants is difficult. Universities typically report graduate assistants work 20 hours a week, but the figures are usually recommended times and not true averages. Some GA's may work more, while others much less. To circumvent this issue, assume universities are perfectly competitive firms and graduate

[7] Graduate school can be viewed as a trade off for present earnings with higher future salaries. Presumably, graduates from highly ranked departments are more likely to be tenured and earn higher salaries. Thus, one would expect graduate students at the best departments to be paid the least; however, going to a top–ranked school is a positive sum move. Higher salaries can be explained by department wealth, where rank and wealth is positively correlated. Additionally, the expected trade-off in temporal earnings implies equivalent lifetime earnings.

[8] At the time of publication the National Research Council released the methodology for new rankings, but has not yet released new rankings. (Glenn, 2009).

assistants are in a perfectly competitive labor market. Under these labor market conditions, the price of labor will equal the marginal product of labor. In a university, the price of labor can be measured by the tuition paid by undergraduate students for classes they take. Therefore, undergraduate tuition can be used to measure the marginal productivity of a graduate assistant.

Model

Even though each department independently reports stipend levels, departments within the same university cannot be assumed to be independent of each other. University policies, economic characteristics, organizational structure, and informal attitudes universally affect all departments. Departments, while unique, are nested within universities. As a result, stipends within a university are likely to be correlated. The relationship can be dichotomized into two levels: level 1 are individual departments in a university. Departments are nested within universities (level 2). Departmental stipends are likely to be correlated within each university, even though inter-university stipends can be distinct. For instance, Emory University reported stipends of $12,235 for economics, English, history, and sociology, while biology received $19,000. While there is some distinct characteristics between social science and humanities departments, the rigid correlation between those departments is likely caused by a university–level policy.

The amount of wage correlation within a university can be measured by the intraclass correlations coefficient (ICC). A straightforward way of obtaining an is through an F-statistic obtained from an Analysis of Variance (ANOVA) table:

$$\rho_{icc} = \frac{F-1}{F+\tilde{n}-1},$$

where F is the F-statistic obtained from an ANOVA table, $\tilde{n}$ is the weighted number of observations within each university, and $p \in [-1, 1]$.

Table 8 shows an ANOVA table between clusters of universities and stipends. Within group mean squared error is lower than between group mean squared error, indicating the distribution of stipends within universities are narrower than the distribution between universities. The weighted average number of observations for each university ($\tilde{n}$) is 13.72 so the intraclass correlation of stipends within universities is 22.7 percent.[9]

[TABLE 8 ABOUT HERE]

Traditional ordinary least–squares (OLS) techniques cannot be used on data sets with an intraclass

[9]Even though there are only six departments observed, $\tilde{n}$ exceeds six because departments were observed over three years. This implies each university reported stipends in each department at least twice on average.

correlation. Specifically, OLS regressions will increase the probability of committing Type I errors (Kreft and de Leeuw, 1998; Barcikowski, 1980) for two reasons. First, the degrees of freedom in the sample will be inflated. In this chapter, there are 1,372 observed stipend levels over three years; however, there are only 101 universities in the sample. While it appears there are $N = 1,372$ independent observations, the error terms between departments in the same university are correlated, violating the OLS assumption that error terms are independent.[10] Second, OLS will also underestimate standard errors of the coefficients (Goldstein, 2002, p. 23). Models with inflated degrees of freedom will have a higher critical value, while the lower standard errors will artificially increase the chance of accepting a coefficient as significant.

We use a multilevel model to capture the variation within universities (between departments) and between universities themselves.[11] A two-level random-intercept multilevel regression model will produce unbiased and consistent estimates with a nested data set. To build the model, first consider a standard OLS model:

$$y_{ij} = \alpha + \sum_{k=1}^{m} \beta_k x_k + \epsilon_{ij} \tag{1}$$

where x is the k^{th} random variable for the i^{th} department and j^{th} university, β_k is the k^{th} regression coefficient, and e_{ij} is the error term. The intercept in equation 1 is always fixed. However, the intercepts for individual universities may differ since unobserved university characteristics can change the overall baseline stipend levels. By adding a random variable, u_j, for each university j to allow for a unique intercept, the multilevel model can be written as:

$$y_{ij} = (\alpha_i + u_i) + \sum_{k=1}^{m} \beta_k x_k + \epsilon_{ij}. \tag{2}$$

The error terms, ϵ_{ij} and u_j have the following properties:

$$u_i \sim \mathrm{N}\left(0, \sigma_{\mathrm{u}}\right)$$

$$\epsilon_{ij} \sim \mathrm{N}\left(0, \sigma_{\epsilon}\right)$$

[10] Obviously, correlation is also important for the success of OLS regressions. One solution is to assign a dummy variable for each university, but using dummy variables will fail to account for "casual heterogeneity." See Steenbergen and Jones (2002) for a further discussion on this issue.

[11] The university system—a university system with multiple campuses (e.g., University of California California, SUNY) could be treated as a level as well; however, of 87 university systems, only five had more than one campus—an insufficient number for a three-level regression. See Schenk Jr. (2007) for alternative formulations.

Given these properties and equation 2, the following can be derived:

$$\mathrm{E}\left(y_{ij}\right) = \alpha + \sum_{k=1}^{m} \beta_k x_k$$
$$\mathrm{Var}\left(y_{ij}\right) = \sigma_u^2 + \sigma_\epsilon$$

Equation 2 is used for the remainder of the chapter to estimate the effect unionization has on stipend levels and health care coverage.[12] Dummy variables representing *Contract* and *Noncontract* unions will be used to measure the union–nonunion gap. The dummy variables *TA Union* and *TA+RA Union* will also be used in the multilevel regression regression. A third model that analyzes the effects of unionization on intra–university wage variances will use traditional OLS regression. For the regressions in this paper, the omitted binary variables are the 2000-01 academic year, biology major, nonunionized and public universities.

Results

Stipends

The first question to be addressed is whether unions are effective at raising stipends. The dependent variable for the regression, which is based on equation 2, is the log of stipends. Year, major, union status, department rank, private university, cost-of-living, log of tuition cost, and the ratio of endowment wealth to total enrollment are included as control variables.

Tables 9 and 10 shows the results using two different union controls for teaching and research assistants, respectively. One regression uses contract union and nonunion contract as the union control. The other uses TA union, TA+RA union, and contract union. Furthermore, since years organized is correlated with union status, each regression is ran with and without the Years Organized variable.

[TABLE 9 ABOUT HERE]

The union wage gap for contractual unions varies between 8 and 24 percent, depending on the inclusion of the Years Organized and Years Organized Squared variables. The results imply returns to unionization are initially around 20 percent, but the gap decreases for the first 19 years. The returns to unionization disappear when unions are about 8.5 years old, bottom out at 19 years, and positive returns resurface at 30.5 years.

[12] See Goldstein (2002) for a more intensive discussion on multilevel models

When Years Organized is omitted, the union coefficient drops to around 8 percent. One possible explanation is the average returns for the nonlinear models (2 and 4) are roughly 8 percent. To test this idea, the Mean Value Theorem for Integrals can be applied. Model 2 from Table 9 indicate the union–nonunion wage gape is $0.23 - 0.038t + 0.001t^2$, where t is years organized, can be evaluated over the Years Organized values observed in this study (between 0 and 34 years). The results indicate implies the average returns to unionization is at a negative 3 percent.

The major caveat with this, however, is most unions have formed during the 1990s. Only a handful of universities unionized before 1990, (see Table 1) thus according to these results, most of them are still earning more compared to nonunion universities. The seemingly apocryphal returns for contractual unions when years organized is included can be attributed to a large union cohort and econometric problems. All of the universities in this study were either organized in the 1990s or before 1981. Thus, Years Organized does not have values between 11 and 19 years and intermittent values between 20 and 34 years.[13] Furthermore, Years Organized and union status is correlated since only unionized schools can have a positive Years Organized value. While this is true for all studies including Years Organized, past studies worked with much larger data sets. It appears this study, with 558 observations for TAs and 410 for RAs, is inhibited by the correlation. The variance inflation factors (VIFs) after estimating Model 2 in Table 9, and, as expected, the values for Years Organized and Years Organized Squared are above the commonly accepted threshold. Due to the interpolation and econometric issues, union estimates with Years Organized are not reliable without obtaining more samples. The subsequent discussion and statistical analysis will exclude Years Organized.

Interestingly, returns for unionization are higher for teaching assistants when only teaching assistants are included in the union. Teaching assistant–only unions earn approximately 2% more compared to when research assistants are included. Noncontract unions, those which do not have collective bargaining agreements with the university, do not earn a statistically significant higher wage than nonunionized universities.

Table 10 shows the regression on the Log of Stipends for research assistants. Contrary to the findings for teaching assistants, contract unions do not help research assistants. Even when unions are explicitly included in unions (Models 3 and 4) they do not see wage gains. Unsurprisingly, noncontract unions also do not increase RA stipends. This finding is in line with the hypothesis that research assistants are not active participants in graduate–student unions.

[TABLE 10 ABOUT HERE]

The Annual variable indicates wages were received over a 12-month period instead of an academic year

[13] Recall the Years Organized values were calculated over the 2000, 2001, and 2003 academic years.

(9-months). If wages were strictly proportional to time worked, stipends for an Annual worker would be 33% more than over an academic year. For a teaching assistant, the coefficient is almost exactly 33 percent. For research assistants, the coefficient indicates stipends are 25% higher; however, the 95% confidence interval includes 33 percent.

The regression outputs also reports estimates of the variation for the random intercept, σ_u, and the model's error term, σ_ϵ, from equation 2. The standard deviation of the intercept indicates the variation in the intercept attributable to unobserved university factors. For TA's and RA's, the random intercept terms are statistically significant. The random intercept variation is higher for research than teaching assistants, which implies there is more variation attributable to unobserved university effects for research assistants. One example is certain universities are better–able to obtain the requisite funding for RAs.

The random intercept variation and model error estimates can also be used to obtain the intraclass correlation of stipends while holding other factors constant (Rabe-Hesketh and Skrondal, 2005, p. 37):

$$\frac{\sigma_{\mathrm{u}}^2}{\sigma_{\mathrm{u}}^2 + \sigma_\epsilon^2} \tag{3}$$

When equation 3 is applied to Model 1 for teaching and research assistants, the intraclass correlation is 30.77 and 33.5 percent, respectively. These correlations are higher than the 22% correlation reported above.

The results from the regression support the earlier asserted notion that science students fare better than the social sciences and humanities. Teaching assistants in biology and mechanical engineering earn approximately 5 percent more than TA's in the humanities and social sciences. Research assistants in biology earn 15% more than engineers, roughly 17% more than social sciences, and 31% more than students in the humanities. These results are consistent with the descriptive analysis presented above. Higher wages may discourage union popularity among science students.

Finally, stipends are only a portion of remunerations. Unions often bargain for tuition waivers and reduction of fees. Fortunately, the *Chronicle* survey for the 2003-04 academic year provided information on tuition waivers and required fees. The sum of stipends and tuition wavers equals the student's total compensation. Subtracting health–care premiums and required fees from total compensation will equal the net compensation. Unfortunately, the survey for the 2000-01 and 2001-02 academic year did not include this information, therefore, the following regression is only a cross-section regression for the 2003–04 academic year.

Table 11 shows the output from the two–level, cross–section, random–intercept multilevel model for total

and net compensation. Union status is controlled by contract and noncontract Union status.[14] Unlike the previous results, the union–nonunion wage gap disappears for total compensation for teaching assistants. Similarly, unions are not particularly effective at increasing net compensation compared to nonunion counterparts. Both of these results imply unions are not comparatively effective at raising fringe benefits, such as tuition remission, or lowering required fees.

[TABLE 11 ABOUT HERE]

Health Benefits

The data set also contains information related to health benefits for students, spouses, and their children. By using a binary variable to denote health care coverage, the effectiveness of unions bargaining for health benefits can be estimated with a multilevel logit regression. The same variables, x_k's, from the previous section are used in this regression.

Health benefits for the student and dependents were measured. Since benefits were observed at the department level, y=1 indicates health benefits are an option, even though students may or may not join the plan. Union is controlled by contract union while noncontract unions has been dropped because it is perfectly correlated with student health. Notwithstanding, the hypothesis is unionized schools will be more likely to give health benefits to students and spouses.

Table 12 shows the output from the logit regression with student and spouse benefits as dependent variables. Neither contractual nor noncontractual unions appear to increase the probability of receiving health–care coverage for students. Similarly, unionized schools are not associated with a higher probability of receiving benefits for the dependents. High ranked departments are more likely to offer health insurance for the student, and teaching assistants, humanities students are slightly less likely to receive health benefits, but neither department rank nor discipline contributes to dependent health–care coverage.

[TABLE 12 ABOUT HERE]

Wage Variance

The hypothesis in this section is unions, particularly contract unions, lower the distribution of income between departments. Lowering the variation of stipends within the university has not been an explicit goal of graduate unions. However, since lower wage variance within a firm has been observed in other industries

[14] The TA and TA+RA variables were perfectly collinear, thus, were excluded from analysis.

(Freeman, 1982; Card et al., 2004) and social science and humanities studies would benefit from a lower wage variance, the rest of this section will explore the possibility.

A reduction in overall wage variance would likely be accomplished by lowering the social science/humanities–to–natural sciences stipend gap. To close the stipend gap, unionization would have to increase stipends more for social science and humanities departments than engineering or biology. Table 13 contains the interaction terms of major and union variables, holding everything else constant. If the intra–university wage variance shrunk, the interaction terms for some majors will be positive and significant. However, the results provide no statistical evidence that individual majors earn atypical higher returns from unionization. The fixed intercept union terms remain significant and relatively close to previous estimate; however, the interaction terms are not statistically significant.

[TABLE 13 ABOUT HERE]

The distribution of income within universities can be explored through other methods. An ANOVA table for the log of stipends is presented in Table 14. Mean–squared variances are presented for contractual, noncontractual, and nonunion universities. The mean–squared variance is a weighted measure of variance within each university. Since the total mean–squared variance is different for each group, the share of Within University mean–squared variation indicates the relative variation within each university.

[TABLE 14 ABOUT HERE]

Indeed, the share of within university variation is lowest for contract and non-contract unions with 15% of the total variation coming from within university variation. Wage variation for nonunion universities, on the other hand, is larger with 18% of the varation from within universities. This suggests unions—even those without bargaining power—lower the distribution of income within universities. Of course, outside factors may be influencing these results, which are not apparent in the ANOVA table.

To control for other factors, an OLS regression can be used to estimate the marginal effects on stipend variation. A multilevel model will not be necessary in this regression since stipend variation will be measured at the university level. Consider,

$$\sigma\left(\ln y_j\right) = \alpha_j + \sum_{k=1}^{m} \beta_{kj} x_{kj} + \epsilon_j \tag{4}$$

where $\sigma\left(\ln y_j\right)$ is a measure for the dispersion of stipends for the j^{th} university. The subscript i has been dropped since the university is the sole unit of observation.

The wage variation is measured by three different coefficients: the standard deviation of stipends, the coefficient of variation, and the ratio of the lowest wage to highest wage. Freeman (1982) used the standard deviation of wages to measure wage variance and found the dispersion generally decreased in unionized companies. Similarly, Hosios and Siow (2004) used the difference of the log of earnings for faculty professors to measure unions impact on wage distribution. This study will also measure wage variation with the standard deviation of stipends within a university. A large standard deviation indicates the spread of wages is *wide*. An alternative measure is the ratio of the lowest average stipend in a university to the highest stipend. The ratio is strictly between 0 and 1 and can be literally interpreted as the percentage the lowest paid department makes relative to the highest paid university. Values close to 1 indicate the dispersion of wages is *low*. Finally, wage variation is also measured by the coefficient of variation, which is the mean of stipends divided by the standard deviation. Larger coefficients imply the dispersion is *low*.

Table 15 shows the results for wage variation. The control variables used in this regression have differed from previous regressions. The Rank Mean is the mean rank for all departments within the university as a measure for university quality. The Rank St. Dev. is a measure of the dispersion of quality within the university since wage variance may be attributable to the dispersion of human capital. Finally, All Major denotes when all majors within the university report stipends.

Contract unions, while effective at increasing wages, do not appear to be effective at lowering the variation of wages. In all three models, the coefficients for contractual unions are statistically insignificant. The results for noncontract union are mixed. For the regression on the standard deviation of wages, the coefficient is positive, indicating wage variance grows. However, when the coefficient of variation is used, the coefficient is also positive, indicating the variation is lower. Finally, the coefficent for the Low–to–High ratio is statistically insignificant.

[TABLE 15 ABOUT HERE]

Conclusion

Four hypothesis are tested in this paper: the union-nonunion stipend gap is positive; union–nonunion gaps for total and net compensation are positive; unions increase the likelihood of graduate assistants and dependents receiving health care benefits; and unions lower the intra–university variation of wages. Graduate–student unions, despite being comprised of "non–traditional" members–appear to successfully negotiate for higher stipends and higher net compensation (total compensation − required fees).

Contractual unions received 8% higher stipends for teaching assistants compared to nonunionized schools. Specifically, unions which only included teaching assistants were the most effective at raising TA wages. However, unions do not increase the total compensation (stipends + tuition remission) for teaching or research assistants. Similarly, unions do not increase net compensation. Thus, The biggest union–nonunion gap was net compensation for teaching assistants. Unionized TA's received a 33% higher net compensation package compared to nonunion schools. The results indicate unions are more effective at lowering required fees for teaching assistants—a salient item in many union negotiations. The reduction of university fees, on the other hand, could be countered by mandatory unions dues, which are not accounted for in this study.

A corollary result from the regressions indicated natural science departments pay more than social science and humanities departments. For teaching assistants, biology and engineering students earned 5% more than English, history, and sociology majors. The difference was even more stark for research assistants where biologists made roughly 16% more than engineering, economics, and sociology and roughly 31% more than English and history.

Contractual unions were not effective at bargaining for student health benefits for both teaching and research assistants. The probability of receiving student health–care benefits and dependent benefits was not higher for unionized universities. Finally, a union's ability to reduce variation of wages had mixed empirical support. Social science and humanities students typically earn less than natural science students; however, the returns to unionization are the same, implying the wage gap remains. An ANOVA table revealed the within university variation of wages is lower for unionized schools. When a formal regression was conducted, unionized schools did not lower the ratio of bottom–to–top salaries.

The data available in the *Chronicle* survey was limiting in several regards. Wages were only available in aggregate. While the *Chronicle* surveyed the number of hours worked, the answers seem to be based on "ideal" conditions instead of observed working hours. The amount of information on fringe benefits was also limited. Coverage was only specified by a binary response and did not provide a dollar value of the coverage. Finally, productivity measures were not available through the survey.

Unions are able to increase wages, which is beneficial to the student but potentially harmful to the academic departments and universities. The attention now becomes on whether the increases in wages are countered through better student outcomes and higher productivity without substantially interferrnig with the education of graduate students. In particular, time–to–degree has significantly increased in the last few decades and is prime for improvement. It is also possible undergraduate student outcomes could improve with happier, higher paid teaching assistants. At the same time, furthur studies will need to explore potential

effects unions may have on graduate–student interactions with their advisors.

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Figure 1: Number of Universities with Graduate–student Unions: 1970–2009

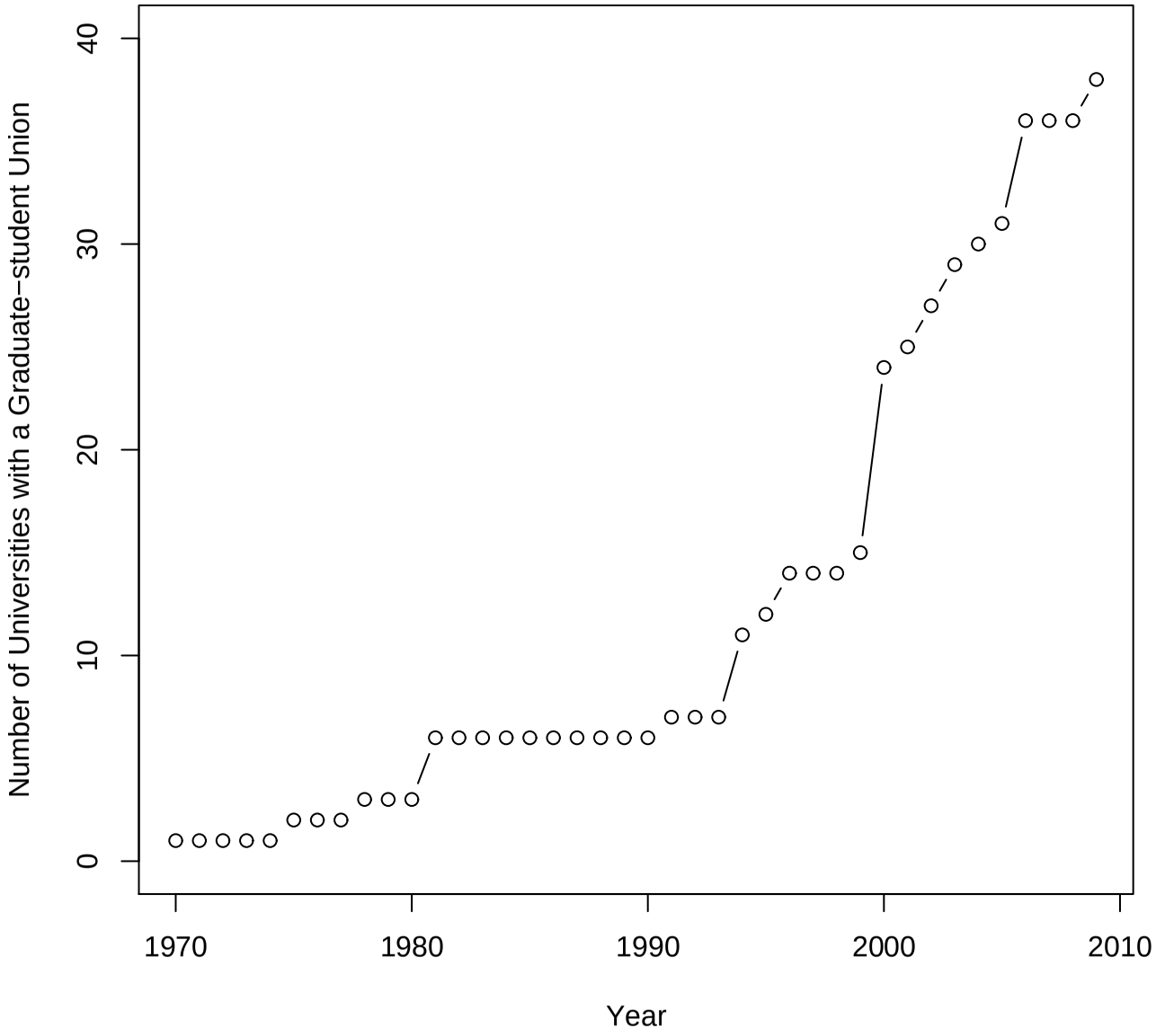

Table 1: Recognized Unions and Important Dates

University	Formation	Recognized	First Contract	Membership
University of Wisconsin, Madison	1969	1969	1970	TA
University of Michigan	1975	1975	1975	TA
University of Oregon	1975	1976	1978	TA
State University of New York, Buffalo	1975	1991	1994	TA[2]
University of Florida	1976	1981	1981	TA & RA
University of South Florida	1981	1981	1981	TA & RA
Florida A & M	1981	1981	1981	TA & RA
University of California, Berkeley	1983	1988	2000	TA
State University of New York, Albany	1984	1991	1994	TA[2]
State University of New York, Binghamton	1984	1991	1994	TA
State University of New York, Stony Brook	1984	1991	1994	TA
New York University (NYU)	1991	2000	2000[1]	TA & RA
University of Iowa	1993	1996	1996	TA & RA
University of California, San Diego	1992	1999	2000	TA
University of Illinois, Urbana–Champaign	1993	2002	2004	TA & RA
University of California, Davis	1993	1999	2000	TA
University of California, Los Angeles	1994	1999	2000	TA
University of California, Santa Barbara	1994	1999	2000	TA
Wayne State University	1997	1998	1999	TA
University of California, Riverside	1997	1999	2000	TA
University of California, Irvine	1998	1999	2000	TA
Temple University	1997	2001	2002	TA & RA
Oregon State University	1999	1999	2000	TA & RA
University of Washington	2000	2003	2003	TA & RA
Michigan State University	2001	2001	2002	TA
University of Wisconsin, Milwaukee	1971	1991	1991	TA
University of Massachusetts, Lowell	1993	1993	1996	TA & RA
University of Kansas	1995	1995	1995	TA
University of Massachusetts, Boston	2000	2000	2001	TA & RA
University of Rhode Island	2001	2003	2003	TA & RA
University of Illinois, Chicago	2004	2004	2006	TA
California State University System	2004	2004	2006	TA
University of California, Merced	2005	2005	2005	TA
Southern Illinois University, Carbondale	2005	2006	2006	TA
University of Illinois, Springfield	2005	2005	2006	TA
Western Michigan University	2005	2005	2006	TA
Central Michigan University	2008	2009	2009	TA & RA
Florida State University	2007	2009	2009	TA & RA

TA denotes teaching assistants, RA denotes Research Assistants.

[1] University refused to renew contract.

Table 2: Median time–to–degree, 1978-2003

	Time to degree (in years)		Percent change
	1978	2003	
All fields[1]	6.3	7.5	19.05
Physical sciences	5.9	6.8	15.25
Engineering	5.8	6.9	19.87
Life sciences	5.9	7.0	18.69
Social sciences	6.2	7.8	25.80
Humanities	7.5	9.0	20.00
Education	6.8	8.3	22.05

Source: Hoffer et al. 2002, Table 15

[1] Includes disciplines not shown here.

Table 3: Debt related to the education of doctorate recipients, 2003

Debt level	Total	Physical Sciences	Engineering	Life Sciences	Social Sciences	Humanities	Education
Cumulative debt							
Mean	$12,478	$8,940	$7,860	$11,478	$18,083	$15,152	$12,834
No debt	50.0%	57.7%	65.6%	50.7%	36.6%	39.6%	51.0%
< $5,000	6.4	7.2	6.1	6.9	5.0	7.3	6.1
$5,001 - $10,000	6.0	6.7	4.5	6.8	6.1	6.7	5.2
$10,001 - $15,001	5.4	5.9	4.0	5.7	5.5	6.8	4.6
$15,001 - $20,000	5.0	5.1	3.7	5.4	5.2	5.9	6.7
$20,001 - $25,000	3.9	3.6	2.7	4.0	4.7	5.2	3.2
$30,001 - $35,000	3.1	2.2	1.9	3.2	4.3	3.8	3.3
$35,001 - $35,000	3.0	2.1	1.6	3.2	4.4	3.6	3.1
$35,001 >	17.2	9.6	9.9	14.1	28.2	21.1	18.9
Debt Share (% of Total)							
Graduate	69.24%	57.27%	63.96%	61.26%	74.39%	73.54%	76.30%
Undergraduate	30.58%	42.73%	36.04%	38.74%	25.61%	26.46%	23.70%

Source: Hoffer et al. 2002, Table 19

Table 4: Percentage of all undergraduate courses taught in program, by type of instructional staff

Rank and course type	Median of Values[1]	Anthropology	English	History	Linguistics	Philology	Philosophy
Full–time tenure track							
All undergraduate courses	59.0%	60.4%	42.2%	59.5%	63.5%	51.4	62.8%
Introductory courses	48.1	50.7	25.4	49.0	48.1	34.6	54.7
Full–time non–tenure track							
All undergraduate courses	9.4	9.4	15.4	7.2	8.8	14.3	9.3
Introductory courses	11.2	10.0	17.6	9.0	8.5	16.3	11.2
Part–time tenure track							
All undergraduate courses	0.9	2.4	0.5	1.0	0.5	1.4	0.9
Introductory courses	0.7	0.8	0.6	1.0	0.1	1.1	0.6
Part–time non–tenure track							
All undergraduate courses	19.1	17.6	28.1	19.1	16.2	18.2	18.4
Introductory courses	26.4	22.0	36.6	23.0	13.4	26.7	26.4
Graduate Assistants							
All Undergraduate Courses	13.9	10.2	13.9	13.2	17.7	14.7	8.6
Introductory Courses	19.8	16.4	19.9	17.0	29.9	21.3	7.0

Source: American Historical Association 2000, Tables 1, 2A

[1] Includes disciplines not shown here.

Table 5: Employment characteristics of doctoral scientists and engineers, 2003

	All[1]	Life sciences	Physical sciences	Social sciences	Engineering sciences	Humanities
Unemployment rate	2.1%	1.8%	2.3%	1.4%	2.7%	1.7%
Out–of–field rate[2]	5.0	3.8	2.7	2.6	3.5	11.6
Labor force participation	88.5	88.7	86.2	88.1	88.8	84.3

Source: Hoffer et al. 2002, Table 28

[1]Includes other disciplines not shown here.

[2]Out–of–field rate measures those involuntarily working out of their field.

Table 6: Average base salary of full–time faculty and instructional staff in degree granting institutions [in 2004–2005 dollars]

	Agriculture & home economics	Business	Education	Engineering	Health	Humanities	Natural sciences	Social sciences
1987 - 1988	$65,167	$60,851	$54,468	$70,225	$87,235	$57,053	$64,304	$62,183
2003 - 2004	66,447	76,216	58,801	78,967	92,472	56,313	72,816	66,532
Percent change	2.0%	25.3%	8.0%	12.4%	6.0%	-1.3%	13.2%	7.0%

Source: Snyder et al. 2006, Table 234

Table 7: List of Variables and Descriptive Statistics

Variable	Averages TA's	RA's
STIPENDS		
Stipend (All)	$12,881	$13,725
Stipend (Non-union)	$12,837	$14,140
Stipend (Covered Unions)	$12,858	$12,831
Stipend (Non-covered Unions)	$13,178	$14,165
Stipend (TA union)	$12,814	$12,831
Stipend (RA union)	$13,148	$13,029
YEAR		
2000-01	0.30	0.27
2001-02	0.25	0.21
2003-04	0.44	0.52
MAJOR		
Biology	0.19	0.21
Economics	0.18	0.17
English	0.16	0.13
History	0.16	0.12
Mechanical Engineering	0.15	0.22
UNION STATUS		
Contract Union	0.22	0.29
Non-contractual Union	0.10	0.09
TA Union	0.27	0.27
TA + RA Union	0.23	0.21
Years Organized[1]	7.6	7.8
INSTITUTIONAL DATA		
Rank	44.78	38.44
Private	0.26	0.24
Cost–of–Living	$9,115	$9,270
Tuition Cost	$10,368	$10,114
Wealth	$1,924,673,422	$1,926,659,179
Total Enrollment	21,832	22,247

Numbers represent department–level averages and proportions for TAs and RAs.

Table 8: Analysis of Variance for Stipends

Variation	SS	DoF	MS	F
Within Universities	2.5 e+12	97	25,737,783.1	5.28
Between Universities	9.6 e+12	696	4,874,079.40	
Total	5.9 e+12	1371	7426133.96	

Table 9: Two-Level Random-Intercept Multilevel Regression on Log of Stipends for Teaching Assistants

Variable	*Contract Union*				*TA and TA+RA Union*			
	Model 1		Model 2		Model 1		Model 2	
Fixed								
2001	0.033*	(0.019)	0.037*	(0.019)	0.046***	(0.022)	0.044***	(0.022)
2003	0.083**	(0.028)	0.101**	(0.027)	0.094**	(0.030)	0.106**	(0.029)
Economics	-0.034	(0.024)	-0.031	(0.024)	-0.033	(0.024)	-0.031	(0.024)
English	-0.046*	(0.025)	-0.044*	(0.024)	-0.045*	(0.025)	-0.044*	(0.024)
History	-0.069**	(0.025)	-0.069**	(0.025)	-0.070**	(0.025)	-0.069**	(0.025)
Engineering	-0.013	(0.024)	-0.012	(0.024)	-0.013	(0.024)	-0.011	(0.024)
Sociology	-0.054***	(0.026)	-0.053***	(0.025)	-0.053***	(0.025)	-0.052***	(0.025)
Annual Pay	0.338**	(0.031)	0.335**	(0.030)	0.338**	(0.031)	0.335**	(0.030)
Contract Union	0.086***	(0.037)	0.230**	(0.049)				
TA Union					0.122***	(0.048)	0.247**	(0.055)
TA+RA Union					0.080***	(0.037)	0.224**	(0.049)
Noncontract Union	0.061	(0.051)	0.070	(0.046)	0.063	(0.050)	0.071	(0.046)
Years Org.			-0.038**	(0.010)			-0.037**	(0.010)
Years Org. Sq.			0.001**	(3.3e-04)			0.001**	(3.4e-04)
Rank	2.8e-05	(3.7e-04)	9.4e-05	(3.6e-04)	3.8e-05	(3.8e-04)	9.2e-05	(3.7e-04)
Private	0.110	(0.110)	0.100	(0.103)	0.105	(0.110)	0.098	(0.103)
COLA-Log	0.094	(0.078)	0.098	(0.074)	0.096	(0.078)	0.098	(0.074)
Tuition-Log	0.005	(0.058)	0.002	(0.054)	0.008	(0.058)	0.004	(0.054)
Wealth Ratio	-1.7e-09	(5.8e-08)	1.6e-08	(5.4e-08)	5.4e-10	(5.76e-08)	1.6e-08	(5.4e-08)
Intercept	8.421**	(0.881)	8.394**	(0.837)	8.367**	(0.885)	8.375**	(0.838)
Random								
σ_u (Intercept)	0.106**	(0.013)	0.096**	(0.012)	0.107**	(0.014)	0.096**	(0.0124)
σ_ϵ (Model)	0.159**	(0.005)	0.158**	(0.005)	0.159**	(0.005)	0.158**	(0.0051)
Observations	558		558		558		558	
University Clusters	82		82		82		82	

Standard errors in parenthesis. Significance levels: *denotes significance at the .10 level; **at the .05 level; ***at the .01 level.

Omitted variables: 2000, biology, 9-month pay, nonunion, and public university.

Table 10: Two-Level Random-Intercept Multilevel Regression on Log of Stipends for Research Assistants

Variable	*Contract Union*				*TA and TA+RA Union*			
	Model 1		Model 2		Model 3		Model 4	
Fixed								
2001	0.023	(0.032)	0.032	(0.032)	0.034	(0.035)	0.033	(0.035)
2003	0.093***	(0.046)	0.127**	(0.049)	0.101**	(0.048)	0.128**	(0.049)
Economics	-0.168**	(0.040)	-0.164**	(0.040)	-0.168***	(0.040)	-0.164**	(0.040)
English	-0.291**	(0.043)	-0.286**	(0.043)	-0.292***	(0.043)	-0.286**	(0.043)
History	-0.330**	(0.043)	-0.328**	(0.043)	-0.331***	(0.043)	-0.328**	(0.043)
Engineering	-0.156**	(0.036)	-0.152**	(0.036)	-0.156***	(0.036)	-0.152**	(0.036)
Sociology	-0.188**	(0.040)	-0.185**	(0.040)	-0.188***	(0.040)	-0.185**	(0.040)
Annual	0.258**	(0.037)	0.260**	(0.038)	0.257***	(0.038)	0.260**	(0.038)
Contract Union	-0.028	(0.058)	0.117	(0.085)				
TA Union					0.013	(0.080)	0.121	(0.094)
TA+RA Union					-0.047	(0.065)	0.115	(0.090)
Noncontract Union	0.032	(0.076)	0.049	(0.078)	0.033	(0.077)	0.049	(0.078)
Years Org.			-0.035***	(0.016)			-0.035***	(0.017)
Years Org. Sq.			0.001*	(0.001)			0.001	(0.006)
Rank	-2.2e-04	(0.001)	-1.4e-04	(0.001)	-2.1e-04	(0.001)	-1.4e-04	(0.001)
Private	0.236	(0.175)	0.292	(0.179)	0.219	(0.177)	0.289	(0.182)
COLA-Log	-0.073	(0.132)	-0.113	(0.134)	-0.065	(0.132)	-0.112	(0.135)
Tuition Cost-Log	-0.042	(0.089)	-0.069	(0.091)	-0.033	(0.090)	-0.068	(0.092)
Wealth Ratio	-1.7e-07***	(8.79e-08)	-1.7e-07*	(8.9e-08)	-1.7e-07**	(8.8e-08)	-1.7e-07*	(8.87e-08)
Intercept	10.540**	(1.457)	11.100**	(1.501)	10.38**	(1.505)	11.07**	(1.524)
Random								
σ_u (Intercept)	0.154**	(0.021)	0.157**	(0.021)	0.156**	(0.0207)	0.157**	(0.0206)
σ_ϵ (Model)	0.217**	(0.009)	0.215**	(0.008)	0.216**	(0.0084)	0.215**	(0.0084)
Observations	410		410		410		410	
University Clusters	76		76		76		76	

Standard errors in parenthesis. Significance levels: *denotes significance at the .10 level; **at the .05 level; ***at the .01 level.

Omitted variables: 2000, Biology, 9-month pay, nonunion, and public university.

Table 11: Two-Level Multilevel Regression Log of Total and Net Compensation

Variable	*Total Compensation*				*Net Compensation*			
	(TA)		(RA)		(TA)		(RA)	
Fixed								
Economics	-0.110***	(0.033)	-0.215***	(0.050)	-0.106***	(0.034)	-0.219***	(0.051)
English	-0.110***	(0.034)	-0.245***	(0.056)	-0.117***	(0.035)	-0.247***	(0.056)
History	-0.164***	(0.034)	-0.306***	(0.057)	-0.164***	(0.036)	-0.307***	(0.057)
Engineering	-0.127***	(0.034)	-0.203***	(0.047)	-0.125***	(0.036)	-0.205***	(0.048)
Sociology	-0.147***	(0.036)	-0.266***	(0.052)	-0.145***	(0.037)	-0.269***	(0.053)
Annual	0.134***	(0.046)	0.121**	(0.050)	0.139***	(0.048)	0.122**	(0.051)
Contract Union	0.011	(0.102)	-0.037	(0.105)	0.074	(0.133)	-0.028	(0.109)
Noncontract Union	0.324	(0.285)	0.331	(0.295)	0.339	(0.377)	0.335	(0.305)
Rank	-0.001*	(0.001)	-0.002***	(0.001)	0.001	(0.001)	-0.002***	(0.001)
Private	0.292	(0.253)	0.379	(0.275)	0.585*	(0.332)	0.441	(0.284)
COLA-Log	-0.491**	(0.221)	-0.586***	(0.226)	-0.495*	(0.289)	-0.590**	(0.234)
Tuition Cost-Log	0.253*	(0.132)	0.199	(0.141)	0.122	(0.173)	0.177	(0.146)
Wealth Ratio	1.5e-07	(1.4e-07)	-1.1e-07	(1.5e-07)	1.7e-07	(1.9e-07)	-1.1e-07	(1.5e-07)
Intercept	12.052***	(2.387)	13.617***	(2.473)	13.113***	(3.118)	13.807***	(2.557)
Random								
σ_u (Intercept)	0.267***	(0.027)	0.252***	(0.029)	0.356***	(0.036)	0.262***	(0.030)
σ_ϵ (Model)	0.131***	(0.007)	0.177***	(0.011)	0.136***	(0.007)	0.179***	(0.011)
Observations	231		183		231		183	
University Clusters	61		55		61		55	

Standard errors in parenthesis. Significance levels: *denotes significance at the .10 level; **at the .05 level; ***at the .01 level. Omitted variables: 2000, Biology, 9-month pay, nonunion, and public university.

Table 12: Two-Level Multilevel Logit Regression on Student and Spouse Health Benefits

Variable	*Student Health*				*Dependent Health*			
	(TA)		(RA)		(TA)		(RA)	
2001	-0.101	(0.150)	-0.083	(0.212)	-0.093	(0.115)	-0.055	(0.108)
2003	-0.884	(0.809)	-1.083	(0.871)	-0.729	(0.593)	-0.135	(0.598)
Economics	-0.632	(0.485)	0.115	(0.513)	0.065	(0.192)	0.860**	(0.358)
English	-1.349***	(0.452)	-1.245***	(0.430)	-0.061	(0.178)	0.805**	(0.363)
History	-0.782*	(0.463)	-0.909*	(0.513)	0.129	(0.179)	0.623*	(0.352)
Engineering	-0.611	(0.453)	-0.350	(0.378)	-0.248	(0.229)	0.224	(0.290)
Sociology	-0.536	(0.511)	-0.017	(0.494)	0.054	(0.235)	0.693**	(0.324)
Annual	-0.714	(0.736)	-0.360	(0.552)	-0.226	(0.482)	0.856	(0.523)
Contract Union	0.562	(1.169)	0.201	(1.297)	0.348	(0.684)	-0.263	(0.736)
Rank	-0.037***	(0.011)	-0.032***	(0.009)	-0.010	(0.008)	-0.012	(0.009)
Private	-3.390	(3.877)	-3.669	(5.001)	-0.368	(1.815)	0.258	(1.801)
COLA-Log	1.298	(1.351)	1.676	(1.867)	1.165	(1.865)	0.769	(1.830)
Tuition Cost-Log	0.927	(2.090)	1.165	(2.483)	-0.508	(0.899)	-0.706	(0.834)
Wealth Ratio	-9.9e-08	(1.3e-07)	-1.4e-07*	(1.0e-07)	2.4e-08	(1.2e-07)	-8.9e-08	(1.4e-07)
Intercept	-13.430	(21.748)	-7.615	(29.458)	-5.958	(19.189)	-1.545	(19.209)
Observations	559		413		523		387	

Standard errors in parenthesis. Significance levels: *denotes significance at the .10 level; **at the .05 level; ***at the .01 level. Omitted variables: 2000, Biology, 9-month pay, nonunion, and public university.

Table 13: Union and Major Interaction Terms for Log of Stipends

Variable	(TA)		(RA)	
Contract*Economics	-0.034	(0.050)	0.062	(0.084)
Contract*English	-0.026	(0.050)	-0.062	(0.085)
Contract*History	-0.009	(0.051)	-0.064	(0.087)
Contract*Engineering	-0.049	(0.054)	-0.046	(0.080)
Contract*Sociology	-0.020	(0.053)	-0.042	(0.083)
Noncontract*Economics	-0.220***	(0.076)	-0.232**	(0.118)
Noncontract*English	-0.094	(0.080)	0.015	(0.143)
Noncontract*History	-0.082	(0.081)	0.059	(0.144)
Noncontract*Engineering	-0.017	(0.077)	-0.024	(0.119)
Noncontract*Sociology	-0.162**	(0.075)	-0.086	(0.111)

Standard errors in parenthesis. Significance levels: *denotes significance at the .10 level; **at the .05 level; ***at the .01 level. Coefficients shown holding year, years organized, department, and university characters held constant in a two–level random intercept multilevel model.

Table 14: Analysis of Variance on Log of Stipends

	Contract Union		*Noncontract Union*		*Nonunion*	
	Mean–squared	Share	Mean-squared	Share	Mean-squared	Share
Between Universities	.323	.23	.368	.28	.217	.09
Within Universities	.057	.15	.065	.15	.049	.18
Total	.073	.38	.078	.43	.062	.27

Total Mean–squared is the sum of between and within university mean–squared error. The share of variance is equal to the mean–squared error divided total mean–squared.

Table 15: OLS Regression on Standard Deviation of Stipends, Coefficient of Variation, and Low–to–High Ratio

	Std. Dev.		Coeff. of Var.		Low–High Ratio	
2001	-2.268	(356.356)	-0.008	(0.028)	0.018	(0.051)
2003	536.557	(335.521)	0.023	(0.026)	-0.056	(0.048)
Rank Mean	-5.627	(6.358)	0.001	(0.001)	0.001	(0.001)
Rank Std. Dev.	-19.810	(14.306)	-0.002	(0.001)	0.003	(0.002)
Contract Union	212.795	(325.993)	0.018	(0.025)	-0.021	(0.047)
Noncontract Union	1147.251**	(479.766)	0.080**	(0.037)	-0.087	(0.069)
Private	434.274	(335.664)	0.009	(0.026)	0.030	(0.048)
COLA-Log	66.343	(622.100)	0.013	(0.049)	-0.074	(0.089)
Wealth Ratio	0.001**	(0.001)	4.3e-08*	(2.4e-08)	-7.8e-08*	(4.39e-08)
All Major	-816.166***	(275.966)	-0.058***	(0.022)	0.096**	(0.040)
Intercept	2192.297	(5627.607)	0.097	(0.440)	1.212	(0.809)
Observations	128		128		128	
Adjusted R^2	.178		.097		.088	

Standard errors in parenthesis. Significance levels: *denotes significance at the .10 level; **at the .05 level; ***at the .01 level.