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DOES CHEAPER MEAN BETTER? THE IMPACT OF USING ADJUNCT INSTRUCTORS ON STUDENT OUTCOMES

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Abstract—Higher education has increasingly relied on part-time, adjunct instructors. Critics argue that adjuncts reduce educational quality because they often have less education than full-time professors. On the other hand, by specializing in teaching or being concurrently employed, adjuncts could enhance learning experiences. This paper quantifies how adjuncts affect subsequent student interest and course performance relative to full-time faculty using an instrumental variable strategy that exploits variation in the composition of a department's faculty over time. The results suggest that adjuncts often have a small, positive effect on enrollment patterns, especially in fields related to particular occupations.

I. Introduction

DURING the past two decades, many American industries have increasingly relied on part-time, often temporary, labor to save on costs and increase employment flexibility. The shift has been particularly dramatic in higher education. From 1987 to 1999, the use of part-time, adjunct instructors increased by 80% at public doctoral universities and 30% at four-year institutions in general (NCES, 1997, 2001).[1] By 2003, 44% of all faculty and instructional staff were adjuncts (Forrest Cataldi, Fahimi, & Bradburn, 2005), and between 1993 and 1998, 40% of universities admitted to replacing full-time instructor positions with part-time jobs (NCES, 2001).

The reasons for the shift toward part-time, temporary labor in higher education are similar to those cited by other industries. Competitive pressures and public demands have forced colleges to find ways to increase efficiency and reduce expenses,[2] and the cost savings derived from replacing full-time instructors with adjuncts are potentially large. Adjuncts can be up to 80% cheaper than full-time faculty (CUPA-HR, 2001). The cost difference is even more pronounced when considering that 47% of schools do not offer benefits to part-time faculty (NCES, 2001). Additionally, in other sectors of the economy, the use of temporary labor increases as it becomes more difficult for employers to terminate workers (Autor, 2003). This is certainly the case in higher education, where the end of mandatory retirement in January 1994 greatly increased the price of tenure, making part-time, temporary instructors much more appealing (Ehrenberg, 2000). As one study concluded, colleges "actively design and adopt contingent work arrangements to save on labor costs and to manage their resource dependence" (Liu & Zhang, 2007, p. 22).

Many question whether the increased reliance on a more part-time, temporary labor force has lowered worker quality and production. Within higher education, critics argue that alternative instructors have a negative impact on student outcomes due to the fact that they are less likely to have doctorates or other terminal degrees and often are less engaged within a university. For example, the Modern Language Association (MLA, 2003), the National Institute of Education (1984), and the Education Commission of the States (Palmer, 1998) have each issued statements that blame the growing use of part-time instructors for a decline in educational quality. There have also been accusations that adjuncts affect the ability of universities to foster interest in particular subjects.[3] Researchers theorize that early experiences with a discipline influence subsequent decisions (Lifton, Cohen, & Schlesinger, 2007), and so adjuncts could affect the ability of colleges to engage students, particularly in critical fields. If such claims are true, they have implications for the quality of the college-educated labor force as well as the distribution of workers across fields. Because the return to a college education differs by discipline (Hamermesh & Donald, 2004), if instructors affect enrollments and major choice, they also may affect students' future earnings. Several studies support the negative view of adjuncts by suggesting they increase college dropout rates (Bettinger & Long, 2006; Ehrenberg & Zhang, 2005).

But some argue that the ability of adjuncts to specialize in teaching and the fact that they often have concurrent private sector employment could enhance students' educational experiences (Leslie & Gappa, 1995). Alternatively, using adjunct instructors may allow full-time, tenure-track faculty to more effectively focus on research so that production within the department could increase. Finally, adjunct use may allow colleges and universities to screen potential full-time instructors in a low-cost way with no termination costs, unlike the traditional model of tenure (Autor, 2001). They may also choose to hire individuals who otherwise would have difficulty finding employment (Katz & Krueger 1999; Autor & Houseman, 2005; Autor, 2003; Houseman, Kalleberg, & Erickcek, 2003).

Despite the importance and public debate over the relative effectiveness of adjuncts, little research examines the actual impact of these instructors on students. Although

Received for publication June 15, 2006. Revision accepted for publication September 25, 2008.

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Our names are listed alphabetically, and we share authorship equally. We thank the Ohio board of Regents for their support during this research project. Rod Chu, Darrell Glenn, Robert Sheehan, and Andy Lechler provided invaluable help with the data. All opinions and mistakes are our own.

[1] Following the conventions of the literature, we define adjunct instructors as part-time faculty.

[2] The growing costs of instruction, most notably instructor and staff salaries, resulted in a 16% real increase in college expenditures at public four-year colleges during the 1990s (educational and general expenditures per full-time equivalent from 1990–91 to 1999–2000 from NCES, 2003).

[3] Other negative arguments are documented in Leslie (1998), Pisani and Stott (1998), Gappa (2000), Fulton (2000), Leslie (1998), McLeod and Schwarzbach (1993), and Koehnecke (1991).

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many researchers have estimated the effects of teacher characteristics on student outcomes within the primary and secondary school context (Ehrenberg & Brewer 1994; Card & Krueger, 1998; Hoxby, 2002; Temin, 2002), few studies explore the role of instructor quality in higher education. A small literature examines the effect of nonnative-speaking graduate students on student outcomes (Borjas, 2000; Fleisher, Hashimoto, & Weinberg, 2000; Norris, 1991). Several recent studies also try to examine the impact of adjunct instructors, but they rely on data aggregated to the school or subject level (Ehrenberg & Zhang, 2005; Bettinger & Long, 2006). One reason for the lack of research has been the inability to link individual collegiate outcomes to instructors' characteristics, and only recently have researchers been able to measure the relative effectiveness of different types of instructors using the microdata of a particular course. Recent studies by Hoffman and Oreopoulos, (2007) and Carrell and West, (2008) use data from two campuses—a large Canadian university and the U.S. Air Force Academy, respectively—to examine the effects of faculty characteristics. Hoffman and Oreopoulos (2007) find that faculty rank and status have minimal effects on student achievement, but subjective course evaluations are correlated with outcomes. Carrell and West (2008) find that faculty rank is negatively correlated with students' future course-taking behavior but positively correlated with subsequent learning. Neither study, however, focuses on the role of adjuncts, and our data sample of a large, public university system is larger and more closely represents the types of institutions American students typically attend.

This paper examines the impact of adjunct instructors on subsequent student interest in a subject relative to students taught by full-time faculty members in their introductory courses.[4] As noted above, early experiences within a discipline may influence subsequent decisions, and this has implications for future labor market returns as well as the distribution of workers across fields. Future course-taking behavior is significant in that it can be an indication of student interest, an expression of an expectation of future earnings, and a revelation of students' expected success. Additionally, college administrators and policymakers often track course-taking behavior since it is often a determinant of departmental funding and since the distribution of majors has implications for the oversupply or undersupply of certain professions.

This study uses a comprehensive, longitudinal data set based on application and transcript information for over 43,000 students who began at a public, four-year college in Ohio during fall 1998 or fall 1999. To estimate the impact of adjuncts, we compare the outcomes of students who had different types of instructors (adjunct or full-time professor) in their introduction to a particular subject. We focus on subsequent course taking and major choice as outcomes; unfortunately, course grade information is not available. Because students may sort among instructor types in nonrandom ways, we employ an instrumental variables strategy approach using term-by-term changes in departmental faculty composition due to retirements, sabbaticals, hirings, and temporary shifts in enrollment. This variation is related to the likelihood that a student will have an adjunct instructor in a given term but uncorrelated with subsequent engagement.[5] We augment the instrumental variable strategy using course fixed effects in the regressions. Previous analyses have not had a sufficient level of detail to include course fixed effects, and their inclusion allows us to compare students who took the same course but were assigned different sections with different types of instructors, potentially controlling for biases related to course selection.

The results measure the effects of college instructor type on student outcomes while also commenting on the tradeoffs encountered by using different types of labor in the production of higher education. In general, we find that adjunct instructors tend to have positive or no impact on student interest, with the largest impact in fields more directly tied to a specific occupation. The effects of having an adjunct on subsequent credit hours taken in the subject are especially positive in education, engineering, and the sciences. We also find that older adjuncts tend to be more effective than full-time faculty and younger adjuncts in subjects more closely tied to a specific profession. We theorize that these older adjuncts are more likely to have practical industry experience, which has value in the classroom. Younger adjunct instructors produced more positive effects in more academic subjects. Although other research has found that the use of adjuncts may lower overall student persistence (Ehrenberg & Zhang, 2005; Bettinger & Long, 2006), our results suggest that adjuncts may be effectively used in particular disciplines to encourage subsequent en-

[4] An earlier version of this paper is available as an NBER working paper (Bettinger & Long, 2004). However, the current version differs significantly. While the earlier working paper used course fixed effects and a value-added model, this paper instead uses an instrumental variables strategy to deal with issues of selection in which students are assigned an adjunct instructor. We find the IV strategy does a better job addressing the possible bias. However, our results are not entirely different from the working paper. Adjuncts are still found to positively affect students in some of the technical and professional fields. A second major difference from the earlier working paper is that we focus only on adjuncts and do not include analysis on graduate student instructors. We decided to do this for several reasons. First, the dynamics of the increase in adjuncts has been very different and dramatic in comparison to the use of graduate students. The motivation for using adjuncts is also very different from graduate students, who include teaching duties as part of their training rather than just for compensation. Finally, the use of graduate student instructors is largely limited to selective four-year institutions, a subset of the sample we analyze in this paper. By focusing on adjuncts, we are instead analyzing a major development that has affected all students, including the large majority who attend nonselective colleges and universities.

[5] Whether a student has a graduate student instructor rather than a full-time professor is also endogenous, and so we also instrument for this type of teacher. However, this paper focuses on the impact of adjunct instructors relative to full-time professors due to the dramatic recent trends in higher education toward hiring adjuncts and the special issues related to their use.

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rollments. However, further analysis is needed to more fully outline the costs and benefits associated with such a substitution, particularly in terms of other university objectives such as research, service, and student advising.

II. Literature Review

In the primary and secondary schooling literature, researchers routinely use and reevaluate measures of teacher quality. For example, Hoxby (2002) measures what types of teacher characteristics districts value when they are facing strong competitive pressures. To measure teacher quality, researchers often use undergraduate college selectivity, subject matter expertise (measured by test scores and college performance), the completion of advanced degrees, and experience. For example, Figlio and Rueben (2001) use the test scores of education majors to gauge how tax limits affect the quality of new teachers. Other studies directly link proxies for teacher quality to student outcomes. Ehrenberg and Brewer (1994) found that students with teachers from more selective undergraduate institutions scored higher on standardized tests after controlling for student background characteristics. This information has been helpful in larger debates about the trade-offs between different types of investments that could be made by schools (for example, higher-quality teachers versus lowering class size or hiring teacher aides).

Unlike the K–12 literature, research about the effects of instructors on student outcomes in higher education is virtually absent from the literature. The existing research that compares different types of instructors in higher education focuses mainly on the effect of nonnative-speaking graduate assistants. Borjas (2000) compares the outcomes of Harvard undergraduate economics students who did and did not have foreign-born instructors, who were randomly assigned to sections. His results suggest that foreign teaching assistants have negative effects on future student performance. Norris (1991) provides similar analysis and results in examining nonnative, English-speaking teaching assistants at the University of Wisconsin. In contrast, Fleisher et al. (2000) find little evidence that foreign graduate teaching assistants adversely affect student grades in economics courses, and in some cases, they find the impact to be positive. They suggest that proper screening and training can make foreign teaching assistants as effectives as native students.

Beyond the focus on graduate student instructors, little attention has been paid to the relative effectiveness of different kinds of college teachers. A recent study using panel data on institutions compares the outcomes of colleges with more or fewer adjunct instructors. Ehrenberg and Zhang (2005) find that the share of part-time or full-time, non–tenure track instructors is associated with lower college graduation rates and lower persistence rates from first to second year.[6] These findings are particularly relevant to this paper as the effects found were largest for public comprehensive institutions, the bulk of the sample for this study. However, the movement to using more adjuncts may not be random, and so additional investigation of the impact of adjuncts is warranted, taking into account issues of selection at the institutional level. Bettinger and Long (2006) examine the impact of part-time instructors at a finer level by comparing students with more adjunct instructors to those with more full-time faculty. They find that students taking an adjunct-heavy course schedule in their first semester are less likely to persist into their second year. This is consistent with the conclusions of Ehrenberg and Zhang and may suggest that adjuncts do not effectively help integrate first-year students into a university.

While Ehrenberg and Zhang (2005) focus on institutional-level variation and Bettinger and Long (2006) aggregate adjunct exposure to the semester level, our study looks at the effects of instructor type by matching individual student course outcomes to particular instructors. The few studies to date that have considered the effects of adjuncts using student unit record data rely on relatively small samples, do not have much information on student background, and are limited to particular institutions. For instance, Haeger (1998) discusses the problems and solutions associated with adjunct instructors at Towson University. Due to a lack of data, researchers have not been able to perform large-scale analyses of the impact of adjuncts on student outcomes.

Without hard data and analysis at the individual level, one can only speculate about the microlevel effects of adjuncts. There are a number of reasons to expect that adjuncts may negatively affect students. For example, adjuncts typically often do not have Ph.D.s or other terminal degrees, and as a result they may provide inferior instruction (Leslie, 1998). Adjuncts may also affect the quality of advising and the distribution of departmental committees (Pisani & Stott, 1998) leading to worse outcomes for students and increased workloads for full-time faculty. Additionally, adjuncts are generally dissatisfied with their employment conditions (Gappa, 2000; Fulton, 2000), and some researchers question whether this adversely affects their job performance (Leslie, 1998). On the other hand, there are some reasons to believe that adjuncts may positively affect student outcomes. Adjuncts may be better able to foster interest in a subject relative to a full-time faculty member given that they may specialize in teaching and often bring valuable professional experience to the classroom (Leslie & Gappa, 1995). Many are also concurrently employed in industry and may be helpful in securing internships and jobs.

While little is known about the impact of adjuncts on student outcomes, several papers document the growing use of adjuncts. Foremost, Leslie provides a wealth of information on this trend in a series of articles. In *The Growing Use*

[6] Jacoby (2006) finds similar results, concluding that colleges with more full-time faculty members have higher completion rates.

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of Part-Time Faculty (1998), Leslie uses the 1993 National Survey of Postsecondary Faculty to quantify the increase. He finds that 42% of teaching faculty members have part-time appointments only. Moreover, he finds that adjunct usage varies by institution type and discipline. Research universities were least likely to employ adjuncts, while 60% of public, two-year faculties teach part time. Other work provides further evidence of the growing use of adjuncts. Burgan, Weisbuch, and Lowry (1999) find an increase in the use of instructors on term contracts when analyzing a survey of non–tenure track faculty. Similarly, Balch (1999) examines the increased use of part-time faculty as a trend that will continue to persist. Many other papers discuss trends at particular institutions. For example, Jackson (1999) documents the growth of temporary and part-time appointments at Maryland's public colleges from 1981 to 1998.

If students choose their courses and major based on their knowledge and experiences in a given subject, then the instructors they face early in a discipline could influence these decisions. The relative effectiveness of alternative instructors may differ by department depending on the degree to which a discipline values academic versus professional expertise in an instructor. For instance, fields within the humanities presumably favor academic knowledge, while professional fields such as business might value professional knowledge more.[7] It is an empirical matter as to whether adjuncts are more or less effective than full-time faculty members in engaging and preparing students in a given subject, and in the next section we explain our empirical strategy.

III. Empirical Framework and Data

A. Empirical Framework

To identify the effects of alternative instructors on students' course-taking behavior and major choice, we focus on students' experiences by subject (k observations per student corresponding to the k subjects in which each student takes classes). The key explanatory variable is whether students took their initial course in a given department from an adjunct instructor ($Adjunct_{ikjt}$). We focus on the first course because these are often introductory, and knowledge gained in them could affect student interest and success in subsequent courses. The key explanatory variable is defined as the proportion of the courses in subject k that student i took from adjunct instructors during the first semester (t) student i was exposed to the topic. For example, if a student took his or her first course in subject k from an adjunct instructor, the adjunct variable would equal 1. If the student took the course from a full-time faculty member, the variable would equal 0.[8]

Our basic strategy relates student i's outcomes in subject k at campus j at time $(t + 1)$ to their experience with adjuncts during their initial introduction to the subject at time t:

$$y_{ikjt+1} = \alpha + \beta Adjunct_{ikjt} + \varphi GradAsst_{ikjt} + \gamma X_i + \delta Z_{ik} + \pi_t + \tau_k + \sigma_j + \varepsilon_{ikjt+1}. \quad (1)$$

Because graduate students also teach some course sections, we also control for students' experiences with them in initial courses so that β measures the effect of adjunct instructors relative to full-time faculty only. $GradAsst_{ikt}$ is defined similarly to $Adjunct_{ikt}$.[9] We also include student-level controls (X_i), such as demographics (age, gender, race), ability (ACT score), state of residency, year of college entry (a dummy variable for being in the fall 1999 cohort), and controls for individuals' interactions with a particular subject (Z_{ik}), including whether the subject is in the student's intended major and the number of credit hours students attempted in the first term of exposure. We also include fixed effects for the first term of exposure to the subject (π_t), the department of the subject (τ_k), and the campus of attendance (σ_j). Because we have multiple observations per student, we always control for within-student correlation by clustering the standard errors throughout the paper. Since the treatment of interest (what type of instructor teaches the course) varies by section, we also report standard errors that cluster at the section level of a course.

We focus on three outcomes related to subsequent interest in the subject of the course: whether any additional courses are taken in the subject, the total number of subsequent credit hours taken, and whether the student majored in the subject. These outcomes could have important implications on many levels. For the individual student, course-taking patterns lead to eventual career choice and earnings. Introductory courses not only provide information to the student about how interesting a topic and career may be, but they also provide a signal of the student's aptitude in that discipline. Armed with this new information, students are influ-

[7] The appendix presents a simple theoretical framework encapsulating how these competing effects may affect students' course-taking behavior and major choice.

[8] In cases in which students take multiple courses in a given subject during the first semester of exposure, we set $Adjunct_{ikjt}$ equal to the proportion of instructors who were adjuncts as weighted by number of credits for each course.

[9] The relative impact of graduate students on student outcomes is also of potential interest. However, the main motivation for this paper is the growing use of adjuncts, which has been far more dramatic and pervasive in higher education than the use of graduate student instructors. Moreover, the empirical strategy focuses on departments that varied their use of adjuncts, and these differ slightly from departments that varied their use of graduate student instructors. Finally, the framework and results of this paper focus on differences between more academic versus vocational subjects to test some of the assertions made by critics and supporters of using adjuncts, and these issues do not apply to graduate students. The motivation for using graduate students (for example, training them as instructors) is distinct from the motivation for using adjuncts (for example, cost reduction).

enced about which subsequent classes to take. If adjuncts have a positive (or negative) impact on a student's interests or abilities in a field, that student will be more (less) likely to take additional courses in that field, and hence, adjuncts could play an important part in students' early career decision making and development. On a more macrolevel, the ability to influence subsequent interest in a field has implications for distribution of workers across fields. Students' subsequent engagement and performance are also outcomes that departments care about. In many colleges, budgetary allocations are based in part on student enrollment, with departments being financially rewarded for maintaining high enrollment numbers. If adjuncts increase (or decrease) subsequent enrollments, then departments have incentives to use them more (or less) frequently.[10]

B. Concerns about Selection

Our analysis compares student outcomes with the types of instructors they had; however, the distribution of students across courses taught by adjuncts, graduate students, and full-time faculty members may not be random. For example, if adjuncts are more likely to teach in particular majors or during particular times, then certain types of students will be more likely to have them in courses (for example, students with particular interests or abilities or who are more likely to take evening courses). Additionally, students may choose courses based on the type of instructor. Students might prefer full-time professors if they perceive that they are better than alternative types of instructors, and the preferences for particular types of instructors may be stronger within a student's intended major. If students who take adjunct professors systematically differ from other students, then our basic model will be biased, and empirical techniques must be used to account for selection. Below we discuss the multiple ways we address the issue of selection with fixed effects and instrumental variables.

If students are randomly assigned to sections and selection is not a problem within a course or over time, then the OLS results would have a causal interpretation with the inclusion of course fixed effects. The course fixed effects allow us to control for the fact that students differ in the courses they take, and so they enable us to compare students who take the same courses but have different types of instructors due to multiple sections being offered or the fact that the course was taken in different years.[11] If, however, there is also selection across time (students alter when to take a course based on who is teaching it), then the OLS models would also need the addition of term-year effects and course-by-time fixed effects (the interaction of course and term-year fixed effects) to have a causal interpretation. However, as we demonstrate, even with these fixed effects, there still may be selection issues if students systematically sort across sections within a particular course. In other words, when taking a course, students may try to avoid (or encourage) being in a section taught by an adjunct. Therefore, we use an instrumental variables (IV) approach to deal with the remaining concerns about selection.

C. The Instrumental Variables Approach

An appropriate IV is correlated with the likelihood that a student takes a particular course from an adjunct or graduate student but is unrelated to student interest in the subject. We use as instruments the term-by-term variations in courses taught by professors of different ranks in a department. Each term (semester or quarter) departments vary in their proportion of assistant, associate, and full professors due to retirements, sabbaticals, hirings, or temporary shifts in the number of sections offered in a particular course. Therefore, while a particular department may staff 30% of its classes with assistant professors on average, this fluctuates term to term. To deal with these fluctuations in the numbers of full-time professors available to teach courses, departments often choose to employ adjunct instructors. Therefore, we hypothesize that fluctuations in full-time professors are good predictors of the use of adjunct instructors.

Using these fluctuations in faculty composition as an IV, we run the following first-stage equation to explain whether the student has an adjunct instructor:

$$\begin{aligned} Adjunct_{ikjt} = {} & \alpha + \eta(Asst.\ Prof)_{kjt} + \theta(Assoc.\ Prof.)_{kjt} \\ & + \lambda(Full\ Prof.)_{kjt} \\ & + \gamma X_i + \delta Z_{ik} + \pi_t + \tau_k + \sigma_j + \varepsilon_{ikjt}. \end{aligned} \quad (2)$$

"Asst. Prof.," "Assoc. Prof.," and "Full Prof." represent term-by-term variation in the proportion of courses staffed by assistant, associate, and full professors in department k at campus j at time t. To construct our instruments, we calculate the number of professors of each rank teaching in each department in each term in each year.[12] We then

[10] One could argue that if departments care solely about enrollments, they may have an incentive to simplify (or "dumb down") their curriculum. However, departments also have an incentive to develop high-quality graduates, as the placement of students in employment and graduate schools affects the perception of departmental quality and thereby has an impact on the long-run ability of the department to generate additional enrollments. Regardless, the propensity to "dumb-down" the curriculum should not differ for departments that use adjunct instructors versus those that do not, and so there is no reason to believe such behavior would systematically affect our results.

[11] Variation within semester may not be useful, as students may select a particular type of instructor when there were multiple possibilities. Our instrumental variables strategy identifies the effect of adjuncts by taking advantage of variation across years and semesters in what types of faculty are teaching. In the case where students take multiple classes and since we are collapsing our data so that we have one observation per person per subject, we randomly select one of the courses to be represented with the fixed effect.

[12] Using student transcript data, we identify instructors teaching in any semester that a student attended. These formulate the base of our identi-

compute four steady states corresponding to the four terms we observe (winter, spring, summer, fall) by estimating the average number of full-time faculty teaching in the department during the respective terms from 1998 to 2003.[13] Our instruments are hence interpretable as the proportion of courses in the department taught by each rank of instructor relative to the average number of tenure-track faculty who typically teach in that term. For example, we compute the proportion of assistant professors who teach on average in the fall semester for each department at each school. We then compute the deviation from this term-specific average for each department at each school.[14] To get rid of scale effects by departments, we normalize the number of courses taught in the department by the steady-state number of faculty in the department. One advantage of this instrument is that we control for the seasonality of adjunct usage. We discuss this instrument in greater detail later in the paper.

The coefficients η, θ, and λ measure the effect of having more courses taught by assistant, associate, and full professors on the likelihood that students take additional courses from adjuncts. In the covariates, we include controls for school and department so that we are identifying off deviations from a department's average reliance on different types of faculty rather than on differences across subjects or schools. We essentially assume that the variation in the likelihood of students taking an adjunct professor due to our instrument is uncorrelated with student outcomes. As we show below, deviation in the proportion of courses taught by each rank of faculty is highly correlated with the likelihood that a student took his or her initial class in a subject from an adjunct instructor.[15]

One concern is that the proportion of courses taught by each instructor rank in each department could directly affect student outcomes. Suppose, for example, that a department is disintegrating: professors are leaving for other jobs, and the school or department is either unwilling or unable to fill the vacant positions. In this case, there would be a declining proportion of courses taught by tenure-track faculty. Even if the classroom experience is unchanged by the subsequent changes in which type of instructor teaches the course, students who are considering additional enrollments in a given subject may be reluctant to do so if they realize that the department is crumbling. This type of story suggests that our estimates will understate the true impact of adjuncts as a surge in part-time instructors would accompany a decline in student interest under this scenario. However, this scenario is not a major concern because the vast majority (96%) of our departments do not exhibit a significant trend in the types of instructors teaching courses. In our sample, there are 407 unique school and department combinations (37 departments at 11 different institutions). We find only 18 instances (4% of cases) in which there is a significant trend in the number of courses being offered by nonadjunct faculty (either increasing or decreasing).[16] Of the 18 departments with a significant trend, one-third of them are fine arts departments, which we exclude from subsequent analysis. This leaves only 3% of the sample exhibiting any kind of trend that might match this scenario.

D. Data and Summary Statistics

This paper focuses on first-time, full-time freshman who are of traditional age (18 to 20 years old) and entered one of twelve public, four-year colleges in Ohio during fall 1998 or fall 1999. The data include information on student demographics, test scores, courses taken, and major. Additionally, from a student survey completed in high school when taking the ACT, there is information on each student's intended college major. Because this information is vitally important to understanding how college instructors affect student interests, we limit the sample to students who took the ACT. In Ohio, this is the majority of students, and 89% of students at Ohio public four-year colleges take this exam.[17]

One great advantage of these data is that we are able to track students across schools within the Ohio public higher education system (four-year and two-year institutions). Therefore, if a student transfers to another college and then declares a major, we are still able to note the outcome. However, we are able to track only students attending public institutions in Ohio. Students who transfer to out-of-state institutions or private schools are indistinguishable in the data from students who drop out of college. This potential bias, however, should be very small since the percentage of students who likely transferred to private institutions or

fication of steady states in departments for each term. Because of data limitations, our measure of the number of instructors will exclude instructors whose entire teaching schedule consisted of classes that included only students who enrolled before fall 1998 (upperclassmen students).

[13] We are not able to use time-series variation in the use of adjuncts directly. This is because we observe the schedules only for students who entered college in fall 1998 or 1999. As a result, we cannot identify students from other cohorts who are in a course. For example, we can identify the number of first-year students in an economics course during fall 1998, but we cannot observe how many sophomores or juniors are in the same course. As a result, we cannot measure the proportion of students across all sections of the same course who take adjuncts in a given semester.

[14] Some students may avoid taking a class in one semester in order to take it in the summer or some other time. Our instrument does account for this type of seasonal variation. Our instrument is the percentage deviation from the steady-state percentage of faculty types by term.

[15] We also treat taking courses from graduate students as endogenous and use the same instruments.

[16] To test for trends, we estimate for each department at each campus the total number of sections being offered by nonadjunct faculty by semester. Separately for each campus, we regress this variable on the following variables: a campus time trend over the 25 consecutive semesters in our data, year fixed effects, department fixed effects, semester fixed effects, and the interaction between the trend variable and each department. The interaction terms show if any department has a trend that significantly differs from the overall campus trend. We use a 90% confidence interval to detect significant trends.

[17] By imposing the ACT limitation, we lose many of the students who are not Ohio residents. Otherwise, the mean student characteristics, propensity to take an alternative instructor, and outcomes of the sample do not change.

TABLE 1.—FULL-TIME, TRADITIONAL-AGED STUDENTS AT FOUR-YEAR, PUBLIC COLLEGES IN OHIO

	Full Student Sample	Students during the Initial Term
A. Student-level data		
Male	0.4555	0.4675
White	0.8543	0.8530
Black	0.0770	0.0790
ACT composite score (36 max)	22.662	22.576
	(4.136)	(4.142)
Ohio resident	0.9986	0.9985
Entering fall 1999 cohort	0.4124	0.4009
Selective institution	0.6210	0.5635
Observations	43,196	42,761
B. Student-course level data		
Class taken in intended college major	0.0343	0.0510
Number of credits taken in the subject that term	3.0784	3.089
	(1.018)	(1.022)
Adjunct instructor	0.2274	0.2588
Graduate student instructor	0.2054	0.2046
Any additional credits	0.5136	0.6834
Subsequent credits taken within the next year	5.001	5.963
	(3.716)	(3.755)
Total subsequent credits	4.662	7.146
	(8.547)	(10.458)
Majored in the course subject within four years	0.0527	0.0789
Observations	445,609	154,893

Note: Standard deviations are shown in the parentheses. Sample is restricted to first-time, full-time freshmen who are of traditional age (18–20 years old) and entered a public, four-year college in Ohio during fall 1998 or fall 1999. Students must also have taken the ACT. Selective institutions are defined as "competitive" institutions by Barron's Educational Guides (1997) and include Bowling Green State University, Miami University, Ohio State University, Ohio University, and Youngstown State University. The sample of courses is limited to the first courses taken in a subject and students who took courses with at least 10% and less than 90% of the sections taught by adjunct instructors.

those outside the state make up a small fraction of the total number of observed dropouts (Bettinger, 2004).

T1 Summary statistics of the sample are displayed in table 1. The unit of observation in the upper panel is the student. Although this sample is based in Ohio, the characteristics of students are similar to national trends, and so the results could have some external validity. Ohio reflects the complete spectrum of urban to rural communities and has a mixture of selective and nonselective public four-year institutions spread geographically across the state. Moreover, the percentages of Ohio public school students who graduate from high school and enter college the following fall are near the national averages (Mortenson, 2002). Comparable to trends nationally, more women are enrolled than men, and 7.7% of the sample is African American.

The second panel summarizes interactions between the student and a department. This information comes from each student's college transcript, which details information for each section of each course taken, including the topic covered, credit hours, the faculty member chiefly responsible for the student's section, and whether the student passed or failed the course. We drop all remedial or developmental courses from the sample. We also focus only on the first courses taken in a subject that had variation in the type of lecturer. We limit the sample to students who took courses with at least 10% and less than 90% of the sections taught by adjunct instructors (courses in which nearly all or none of the sections are taught by adjuncts are excluded).[18] Fn18 Nearly 52% of the courses taken by students had adjuncts teaching at least some of the sections. The sample of students who took courses in which there was variation in the instructor type is not much different from the overall student body.[19] However, this restriction does affect our Fn19 inclusion of courses in the sciences.

As shown in the bottom panel of table 1, adjunct instructors were the primary faculty in approximately 23% of students' courses, and graduate students taught another 21% of classes; the use of graduate student instructors is concentrated at the selective institutions, which have graduate programs. On average, students take about five additional credits in the subject within the next year; the mean for subsequent credits taken in all future terms is lower, but the variance is much larger.

Table 2 summarizes information about instructors at pub- T2 lic four-year colleges in Ohio. The left side of the table displays the characteristics of faculty who taught courses to any undergraduate student from fall 1998 to spring 2003. The first column shows the raw mean, and the second column weights the means by the number of students taught (course enrollment) so as to reflect the average instructor characteristics faced by a student. About 44% of students had faculty members with Ph.D.s, 21% had part-time instructors, and 14% took courses from graduate students. The right side of the table limits the sample to instructors who taught a course that was a student's introduction to a department. There are dramatic differences in the likelihood that an instructor had a Ph.D. across the groups. Almost 65% of full-time faculty members had Ph.D.s, while less than 23% of part-time faculty had them. In addition, women were more likely to be adjunct instructors or graduate students. While the data set provides a great deal of useful faculty information, we do not observe how many years a particular instructor has been affiliated with a particular school. In addition, we cannot track movements of faculty to other universities or their professional activities at a particular university (including concurrent appointments at other universities).

As shown in table 3, chemistry, physics, and biology have T3 small proportions of adjuncts involved in teaching. The restriction to courses with variation in the types of faculty teaching makes our estimates represent the average treat-

[18] When we estimate the results using the full sample of courses, those in which all sections were taught by the same type of instructor drop out of the analysis due to lack of variation. Therefore, this restriction mainly affects courses in which very few sections were taught by alternative instructors (one section out of eleven offerings). When including these courses, our IV estimates are even larger, suggesting these outliers exert significant influence on the results. Because the aim of this paper is to understand the impact of adjunct instructors in courses in which substitutions have been important, we chose to exclude these outliers and rely on the more conservative results.

[19] The only minor difference found was in mean ACT scores. While the full sample mean is 22.7, students in courses that used adjuncts had a slightly lower mean score of 22.5 (due to the more pronounced use of adjuncts at nonselective colleges).

TABLE 2.—FACULTY CHARACTERISTICS

	All Instructors		Instructors Teaching a First Course in a Subject		
	Raw Means	Weighted by Course Enrollment	Full-Time Instructors	Adjunct Instructors	Graduate Students
Percent with a Ph.D.	24.1	44.1	64.6	22.3	3.5
Percent part time	33.4	21.1	—	100.0	—
Percent graduate students	18.1	14.1	—	—	100.0
Percent non–tenure track	60.6	49.0	30.1	91.8	91.1
Percent female	38.4	35.6	31.6	47.2	53.3
Percent minority	21.8	18.2	18.5	19.9	36.1
	[41,685]	[2,159,524]	[7,422]	[5,380]	[6,326]
Year born	1957.2	1953.8	1952.7	1955.3	1969.0
	[37,419]	[1,953,370]	[6,645]	[4,770]	[5,847]
Observations	49,343	2,366,861	7,947	5,449	6,378

Note: Restricted to active faculty teaching between 1998 and 2003 at the undergraduate level. Statistics calculated using less than the full sample have the observations in brackets.

ment effect for courses currently using different adjuncts. We have little power to identify the effects in courses where adjuncts are rarely or not used. Table 3 also shows how the use of adjuncts differs by discipline. In the sample on which our analysis focuses, approximately 36% of the courses were taught by adjunct instructors. The proportion of courses taught by alternative instructors is especially high in disciplines that are more directly connected to careers. For example, nearly half of the courses with variation in instructor type in the social work, computer science, and journalism departments have adjunct lecturers as the principal instructor.

IV. Empirical Results

A. Ordinary Least Squares Estimates

T4 Table 4 presents OLS estimates of equation (1), which examines the impact of having an adjunct instructor on subsequent credit hours taken in the subject. The left side of the table includes courses taken during any term. The baseline regression (specification 1) does not include any fixed effects and suggests that having an adjunct increases the likelihood of taking additional courses in the subject. However, once differences across campuses, departments, and terms with fixed effects (specification 2) and selection across courses by adding course fixed effects (specification 3) are accounted for, the estimated effect becomes negative. The addition of course-by-time fixed effects to account for the possibility of selection over time increases the magnitude of the estimate suggests that overall adjuncts have a negative effect on subsequent course taking in the subject. This result is robust to clustering at the student or section level; the standard errors for each type of clustering are shown in the parentheses and brackets, respectively. As shown by the other covariates, subsequent interest in a subject is positively correlated with student ability level and ability interacted with whether the student intended to major in the subject.

While using course and year-term fixed effects addresses concerns about selection in the form of students choosing courses or when they take their courses based on the type of instructor, these fixed effects are sufficient only if students are randomly assigned or unsystematically choose their particular section within a course. However, as table 5 T5 shows, the likelihood of having an adjunct instructor is correlated with student characteristics even after including these controls. A simple comparison of students without including fixed effects (specification 1) suggests that students with higher test scores are less likely to have an adjunct instructor, as are students who intend to major in the subject. Even after adding campus, department, and term fixed effects to account for differences in instructors across institutions, subjects, and time (specification 2), the relationships remain. To control for selection across courses, specification 3 includes course fixed effects, but we still find differences by student ability (now a small, positive effect) and whether the student intended to major in the subject (still negative but now smaller in magnitude). Specification 4 also includes course-by-time fixed effects to account for

TABLE 3.—PERCENTAGE OF STUDENTS WITH AN ADJUNCT INSTRUCTOR BY SUBJECT

	Full Sample	Courses with Instructor Variation[a]
All departments	22.73	35.89
Humanities	26.64	36.93
English	38.77	39.93
History	22.01	32.15
Foreign language	24.51	32.54
Social sciences	19.17	31.88
Economics	19.59	26.98
Political science	8.16	23.21
Psychology	10.19	21.78
Sociology	35.99	39.28
Sciences	9.85	25.58
Biology	6.92	23.63
Chemistry	15.36	27.99
Physics	10.78	35.79
Math/statistics	34.24	42.32
Engineering	14.67	39.33
Computer science	45.90	46.49
Journalism	21.43	43.03
Business	27.54	36.66
Education	30.16	41.25
Social work	32.67	50.04

Notes: The subgroups shown under the major school groupings are not a complete list of departments.
[a] At least 10% and less than 90% of sections taught by adjuncts.

TABLE 4.—OLS ESTIMATES OF THE RELATIVE EFFECT OF HAVING AN ADJUNCT (PART-TIME) INSTRUCTOR DEPENDENT VARIABLE: TOTAL SUBSEQUENT CREDIT HOURS

	Courses Taken Any Term				Initial Term Only		
	Baseline (1)	Adding Department and Time Fixed Effects (2)	Adding Course Fixed Effects (3)	Adding Course × Time Fixed Effects (4)	Baseline (5)	Adding Department Fixed Effects (6)	Adding Course Fixed Effects (7)
Adjunct instructor	0.3474**	−0.0192	−0.0737**	−0.1150**	0.3309**	−0.1308**	−0.2300**
	(0.0311)	(0.0304)	(0.0353)	(0.0416)	(0.0586)	(0.0595)	(0.0718)
	[0.0901]	[0.0568]	[0.0428]	[0.0469]	[0.1613]	[0.0974]	[0.0885]
ACT score	0.1145**	0.0873**	0.0329**	0.0319**	0.1971**	0.1450**	0.0738**
	(0.0032)	(0.0034)	(0.0032)	(0.0033)	(0.0075)	(0.0075)	(0.0077)
	[0.0087]	[0.0044]	[0.0042]	[0.0040]	[0.0137]	[0.0088]	[0.0109]
In intended major	−7.4749**	−8.6094**	−8.5029**	−8.4221**	−13.613**	−13.346**	−12.964**
	(0.9766)	(0.9103)	(0.8718)	(0.8913)	(1.4404)	(1.4059)	(1.3734)
	[1.3692]	[0.9890]	[0.9169]	[0.9083]	[1.6600]	[1.3650]	[1.3017]
(In Intended Major) × (ACT)	0.8883**	0.7414**	0.6010**	0.5661**	1.1698**	0.9512**	0.8313**
	(0.0443)	(0.0408)	(0.0391)	(0.0399)	(0.0646)	(0.0624)	(0.0609)
	[0.0658]	[0.0428]	[0.0408]	[0.0404]	[0.0751]	[0.0586]	[0.0557]
Campus and Department Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes
Year-term Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes
Course Fixed Effects	No	No	Yes	Yes	No	No	Yes
Interaction Fixed Effects	No	No	No	Yes	No	No	No
R^2	0.1059	0.2279	0.0413	0.0236	0.1124	0.2023	0.0321
Observations	445,609	445,609	445,609	445,609	154,893	154,893	154,893

Note: Standard errors that cluster at the student level due to the multiple observations per student are shown in the parentheses. However, because the treatment (instructor type) varies by section, we also report standard errors that cluster at the section level in brackets. The models include the following covariates: race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, the total number of credits taken in the subject that term, a dummy variable for the fall 1999 cohort, and a dummy variable for whether the institution is selective.
** Significant at the 5% level. * Significant at the 10% level.

selection across course and time, but statistically significant results are still found, and so we remain concerned that selection bias is still present. Moreover, other unobservable factors, such as student motivation or the desire to attend graduate school, may be related to a student's instructor type. If so, then the OLS estimates shown in table 4 are biased.

Beyond differences in the propensity to have an adjunct instructor across campuses, departments, and terms, which can be addressed with fixed effects, we are most concerned about two remaining sources of selection. First, we are concerned that students may sort nonrandomly into the sections within a course, and we attempt to address this using an instrumental variables strategy. A second concern is that there may be selection across years in the students taking a particular course, which we try to address using course-by-time fixed effects, but observable differences between students in the propensity to have an adjunct are still evident. Another way to deal with the second type of selection is to focus only on the courses a student takes during his or her first term. This is the time when students are least likely to alter the timing of course taking in reaction to the instructor because they know the least about the school, classes, instructor types, or their quality. This is also the time when students are often limited to introductory courses and concentrate on fulfilling requirements so that they can meet future prerequisites. Therefore, as a second way of trying to account for selection over time, tables 4 and 5 also include results focusing only on the courses taken during a student's initial term in college.

On the right side of table 4, we limit the sample to courses taken in a student's initial term (either fall 1998 or 1999). These results do not include a model with course-by-term fixed effects because there would be no variation by term given that the models already include a dummy variable for whether the student was in the fall 1999 cohort. The results for total subsequent hours become larger than when the entire sample of courses is used; however, the overall negative effect is still small. Students who initially had an adjunct instructor in a subject take 0.23 fewer credits in the subject in subsequent terms. However, as shown on the right side of table 5, there is reason to suspect selection bias in the OLS results even when focusing only on the instructors whom students had during their initial semester. We again find observable differences between those who had an adjunct instructor and those who did not (in fact, many of the patterns are stronger than before). For example, in the initial semester of a student's enrollment, there is a relationship between whether the student intended to major in the subject and the likelihood of having an adjunct instructor. The relationship holds even after including course fixed effects.[20] This still does not discount the possibility of unobservable differences between those who do and do not have an adjunct instructor. Fn20

B. Estimates of the Effects on Subsequent Interest

To address additional concerns about selection, our instrumental variable strategy uses fluctuations in faculty composition to predict the likelihood that students have an adjunct in a particular course. Table 6 shows the first-stage T6

[20] We do not include results with course-by-term fixed effects. The reason is that there is no term variation (the models already include a dummy variable for being part of the fall 1999 cohort).

TABLE 5.—OLS ESTIMATES OF THE PROBABILITY OF HAVING AN ADJUNCT (PART-TIME) INSTRUCTOR IN A STUDENT'S FIRST COURSE IN A SUBJECT

	Courses Taken Any Term				Initial Term Only		
	Baseline (1)	Adding Department and Time Fixed Effects (2)	Adding Course Fixed Effects (3)	Adding Course × Time Fixed Effects (4)	Baseline (5)	Adding Department Fixed Effects (6)	Adding Course Fixed Effects (7)
ACT score	−0.0038**	−0.0021**	0.0005**	0.0005**	−0.0056**	−0.0036**	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0003)
	[0.0004]	[0.0003]	[0.0002]	[0.0002]	[0.0008]	[0.0006]	[0.0004]
In intended major	−0.0789**	−0.1017**	−0.0270*	−0.0240*	−0.1734**	−0.1642**	−0.0545**
	(0.0197)	(0.0192)	(0.0151)	(0.0132)	(0.0265)	(0.0267)	(0.0212)
	[0.0306]	[0.0263]	[0.0154]	[0.0127]	[0.0452]	[0.0390]	[0.0224]
(In intended major)* (ACT)	0.0018**	0.0031**	0.0011*	0.0010*	0.0024**	0.0061**	0.0023**
	(0.0008)	(0.0008)	(0.0006)	(0.0006)	(0.0011)	(0.0011)	(0.0009)
	[0.0013]	[0.0011]	[0.00007]	[0.0005]	[0.0017]	[0.0016]	[0.0009]
White student	0.0003	0.0026	−0.0004	−0.0023	0.0054	0.0014	−0.0042
	(0.0027)	(0.0026)	(0.0022)	(0.0020)	(0.0048)	(0.0046)	(0.0041)
	[0.0031]	[0.0025]	[0.0021]	[0.0018]	[0.0058]	[0.0046]	[0.0038]
Black student	−0.0109**	−0.0073**	−0.0030	−0.0041	0.0040	−0.0045	−0.0003
	(0.0038)	(0.0035)	(0.0030)	(0.0028)	(0.0068)	(0.0064)	(0.0056)
	[0.0045]	[0.0038]	[0.0028]	[0.0026]	[0.0081]	[0.0070]	[0.0055]
Male student	0.0017	−0.0023*	−0.0010	−0.0006	−0.0020	−0.0062**	−0.0004
	(0.0014)	(0.0013)	(0.0012)	(0.0011)	(0.0024)	(0.0023)	(0.0021)
	[0.0028]	[0.0022]	[0.0012]	[0.0010]	[0.0051]	[0.0034]	[0.0023]
Number of credits taken that term in the subject	−0.0128**	−0.0011*	0.0002	−0.0009	−0.0146**	−0.0179**	−0.0034*
	(0.0006)	(0.0007)	(0.0008)	(0.0009)	(0.0012)	(0.0013)	(0.0018)
	[0.0054]	[0.0028]	[0.0011]	[0.0012]	[0.0076]	[0.0038]	[0.0028]
1999 cohort dummy	−0.0057**	−0.0132**	−0.0070**	0.0022	0.0028	−0.0062**	−0.0467**
	(0.0014)	(0.0017)	(0.0016)	(0.0015)	(0.0024)	(0.0024)	(0.0110)
	[0.0068]	[0.0050]	[0.0038]	[0.0031]	[0.0139]	[0.0105]	[0.0330]
Selective institution dummy	−0.0766**	−0.0800**			−0.0708**	0.0173**	
	(0.0015)	(0.0044)			(0.0025)	(0.0078)	
	[0.0100]	[0.0192]			[0.0157]	[0.0280]	
Campus and department fixed effects	No	Yes	Yes	Yes	No	Yes	Yes
Year-term fixed effects	No	Yes	Yes	Yes	No	Yes	Yes
Course fixed effects	No	No	Yes	Yes	No	No	Yes
Interaction fixed effects	No	No	No	Yes	No	No	No
R^2	0.0129	0.1071	0.0028	0.0001	0.0165	0.1431	0.0019
Observations	445,609	445,609	445,609	445,609	154,893	154,893	154,893

Note: Standard errors that cluster at the student level are shown in the parentheses. Standard errors that cluster at the section level are shown in brackets. The models also include a dummy variable for being an Ohio resident.
** Significant at the 5% level. * Significant at the 10% level.

results when we estimate equation (2). The left side includes courses taken during any term, and the right side focuses only on courses taken during the initial term. The models include our instruments tracking changes in faculty composition within a department and the covariates used in table 4, including course fixed effects.[21] In general, the likelihood of having an adjunct is negatively related to the deviations from the steady-state proportion of courses taught by early-, mid-, and late-career full-time faculty, and the results become stronger when using course fixed effects to examine sorting within courses. The majority of the estimates are negative, suggesting that adjunct instructors and full-time faculty are substitutes for one another. This confirms our earlier hypothesis that when the proportion of classes taught by full-time professors falls, departments make up the difference by hiring adjunct instructors. The magnitude of the estimates suggests that the greatest level of substitution is between assistant professors and adjunct instructors. This is not surprising, as it might be harder to replace a full professor with an adjunct because higher-ranked faculty often teach more challenging courses. This effect is especially large in courses taken during the initial term.

The F-tests suggest that the instruments help explain which students do and do not have an adjunct instructor. Although the F-statistics are smaller when clustering at the course-section level, all suggest that the instruments are significant except for specification 6 when clustering at the section level. In specification 6, using the most conservative clustering adjustment to the standard errors, the proportion of the department faculty who are assistant professors is still a statistically significant predictor of the use of adjunct instructors.

[21] Because our IV is based on variation within a department that changes over time, we cannot include course-by-time fixed effects when estimating our IV results. The IV would be collinear with department × time fixed effects, and as a result, it would also be collinear with course × time fixed effects (all the course fixed effects from a single department add up to the department fixed effect). Therefore, the IV results include course and year-term fixed effects but not the interaction.

Table 6.—Results of First-Stage IV Regressions: Probability of Having an Adjunct Instructor

	Full Sample			First Term Only		
	Baseline (1)	Adding Campus, Department, and Time Fixed Effects (2)	Adding Course Fixed Effects (3)	Baseline (4)	Adding Campus and Department Fixed Effects (5)	Adding Course Fixed Effects (6)
Proportion assistant professors	0.0706**	0.0421**	−0.1398**	0.3493**	0.1368**	−0.1966**
	(0.0048)	(0.0055)	(0.0077)	(0.0127)	(0.0127)	(0.0191)
	[0.0303]	[0.0232]	[0.0267]	[0.0660]	[0.0545]	[0.0869]
Proportion associate professors	−0.1004**	−0.1191**	−0.0540**	−0.1094**	−0.0562**	−0.0089
	(0.0045)	(0.0052)	(0.0063)	(0.0103)	(0.0112)	(0.0153)
	[0.0234]	[0.0231]	[0.0199]	[0.0548]	[0.0536]	[0.0585]
Proportion full professors	−0.0374**	−0.0980**	−0.0676**	0.0617**	−0.1962**	−0.0659**
	(0.0029)	(0.0037)	(0.0041)	(0.0065)	(0.0089)	(0.0120)
	[0.0242]	[0.0279]	[0.0133]	[0.0560]	[0.0567]	[0.0468]
Campus fixed effects	No	Yes	Yes	No	Yes	Yes
Department fixed effects	No	Yes	Yes	No	Yes	Yes
Year-term fixed effects	No	Yes	Yes	No	Yes	Yes
Course fixed effects	No	No	Yes	No	No	Yes
R^2	0.0151	0.1101	0.0046	0.0231	0.1488	0.0030
Observations	445,562	445,562	445,562	154,893	154,893	154,893
F-test on excluded instruments (clustered at student level)	441.89	121.83	61.06	249.76	84.50	13.54
F-test on excluded instruments (clustered at section level)	23.11	11.27	7.11	17.00	6.77	1.52

Note: Standard errors that cluster at the student level are shown in the parentheses. Standard errors that cluster at the section level are shown in brackets. The models include the following covariates: ACT composite score, whether the course is in the student's intended major, the interaction between ACT and intended major, race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, the total number of credits taken in the subject that term, a dummy variable for the fall 1999 cohort, and a dummy variable for whether the institution is selective (this drops out when using fixed effects).
** Significant at the 5% level. * Significant at the 10% level.

Using the first-stage estimates in specifications 3 (for the full sample) and 6 (for the sample of courses taken in the initial term), table 7 shows the corresponding instrumental variable estimates of the relative impact of adjunct instructors on subsequent enrollments. Each cell represents a separate regression with campus, department, term, and course fixed effects, along with the following covariates: ACT composite score, whether the course is in the student's intended major, the interaction between ACT and intended major, race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, total number of credits taken in the subject that term, and a dummy variable for the fall 1999 cohort. In addition to examining the effects on the total subsequent hours taken in a subject and major choice, we examine whether any additional courses were taken.

When we focus on experiences in courses taken during a student's initial term, adjunct instructors are estimated to have had an overall negative impact on students' subsequent interest in a subject relative to full-time faculty members, but the results are not always statistically significant and the standard errors suggest substantial variation in the effect by course. Looking by type of subject, we see clearer patterns. Students who had an adjunct instructor their initial term in a subject more closely tied to a profession took 9.2 additional credit hours in that subject relative to students who had a full-time instructor; a positive but insignificant effect is found in terms of major choice. In contrast, having an adjunct instructor in a more academic subject had a negative effect on major choice. Broadening the sample to include courses taken any term, the results become stronger. Adjunct instructors appear to have had positive effects on subsequent interest in a subject for both academic and professional subjects, but the effects are again more positive in the subjects more closely tied to an occupation. Students took on average 10.8 more credits in the subject and were more likely to choose it as a major. In comparison, in more academic subjects, students took 7.1 additional credits. The fact that the overall effect of adjuncts is larger in professional fields may provide some confirmation of the hypothesis that adjuncts have more positive effects relative to full-time faculty due to having more industry or vocational experience. However, students who had adjuncts in more academic subjects were more likely to take any additional course in the subject, and these results are robust regardless of clustering method (at either the student level or course-section level).[22] In terms of discipline, the effects of having an adjunct are especially positive in education, engineering, and the sciences, with small but positive effects in the social sciences and in terms of major choice in the humanities.[23]

[22] Due to differences in the use and potential pool of adjunct instructors by campus type, we also explored the impact of adjuncts at selective versus nonselective institutions. The results did not suggest significant differences by selectivity. To capture the fact that the market for potential instructors might differ in urban and rural areas, we also estimated the effects based on the geographic location of the campus. However, no significant differences were found.

[23] In estimating tables 7 and 8, we estimate equation (1) separately for each field, allowing the coefficients and mean of the outcome to vary by field. As a result, the estimated effects across all fields are not a perfect weighted average of the estimated effects in the subfields.

TABLE 7.—IV ESTIMATES OF THE EFFECTS OF ADJUNCT INSTRUCTORS ON SUBSEQUENT INTEREST

	Initial Term Only		Courses Taken Any Term		
	Total Subsequent Credits	Major Choice	Any Additional Courses in Subject	Total Subsequent Credits	Major Choice
All subjects	−0.6992	−0.3197**	3.4565	66.6926	2.7399
	(3.3538)	(0.1326)	(2.8164)	(50.8273)	(2.0396)
	[4.7392]	[0.4198]	[9.0565]	[163.0939]	[6.6178]
All academic subjects	1.4595	−0.6457*	0.8701**	7.1230**	0.3026**
	(6.6884)	(0.3602)	(0.1963)	(1.7433)	(0.0510)
	[7.7152]	[1.2384]	[0.5013]	[3.2526]	[0.1219]
Humanities	38.7072	0.2549	−0.0683	0.8431	0.0428**
	(25.3035)	(0.2479)	(0.0716)	(0.8916)	(0.0169)
	[82.0646]	[0.5611]	[0.1113]	[1.5787]	[0.0202]
Social sciences	−0.6415	−0.1019	0.1800*	1.6792*	0.0415*
	(1.9633)	(0.0629)	(0.0965)	(0.9824)	(0.0244)
	[2.3684]	[0.1021]	[0.1412]	[1.3032]	[0.0305]
Sciences	11.3838*	−0.4903**	1.8849**	18.2425**	0.4832**
	(6.6091)	(0.2026)	(0.9200)	(7.6472)	(0.2347)
	[10.2754]	[0.4447]	[2.3368]	[19.6014]	[0.6037]
Math	0.5667	−0.0093	−0.1118	−0.6059	−0.0120
	(1.4264)	(0.0123)	(0.1154)	(1.7094)	(0.0164)
	[1.3315]	[0.0118]	[0.1268]	[1.6412]	[0.0156]
All professional subjects	9.2437*	0.2282	0.3946**	10.8242**	0.5173**
	(4.9974)	(0.1432)	(0.1251)	(3.2475)	(0.1291)
	[11.3585]	[0.4045]	[0.3974]	[10.8080]	[0.4613]
Business	4.2462	0.4067	−0.0867	−1.8814	−0.3856**
	(31.0319)	(1.3131)	(0.1138)	(2.1909)	(0.1116)
	[69.6722]	[1.9104]	[0.2108]	[3.8084]	[0.1507]
Education	4.9403**	0.0204	0.3793**	12.2388**	0.1675**
	(2.3381)	(0.0485)	(0.0703)	(2.0706)	(0.0552)
	[4.7084]	[0.1086]	[0.1638]	[5.2088]	[0.1109]
Engineering	−7.5019	0.6117*	0.6374**	21.1218**	0.7143**
	(20.7033)	(0.3438)	(0.2533)	(9.5475)	(0.2513)
	[18.7816]	[0.5517]	[0.4229]	[16.8080]	[0.4985]
Computer science	−5.1449	−0.0327	0.7677	9.6055	0.6520
	(4.5025)	(0.1424)	(1.4108)	(13.5283)	(1.5871)
	[4.8166]	[0.2009]	[2.9778]	[27.2176]	[3.7154]
Journalism	−3.3236	−0.0853	0.4805	1.3903	0.3200
	(3.8883)	(0.1202)	(0.3737)	(8.1947)	(0.2601)
	[4.2214]	[0.2079]	[0.5595]	[8.1952]	[0.4653]

Note: Each cell represents a separate regression. Standard errors that cluster at the student level due to the multiple observations we have per student are shown in the parentheses. However, because the treatment (instructor type) varies by section, we also report standard errors that cluster at the section level in brackets. The models are campus, department, term, and course fixed effects. They also include the following covariates: ACT composite score, whether the course is in the student's intended major, the interaction between ACT and intended major, race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, the total number of credits taken in the subject that term, and a dummy variable for the fall 1999 cohort. For the full sample of all subjects, the models have 445,562 observations, and 372,322 and 73,240 observations for the academic and professional subjects, respectively.

** Significant at the 5% level. * Significant at the 10% level.

Ideally we would like to extend these results to measure the impact on students' subsequent success within the same subject. However, only about half of students go on to take additional courses after taking an introductory class, and those who go on to take additional courses are not a random subset of other students. Previous versions of this paper attempted to control for the selection effects in subsequent course-taking behavior. This analysis, based on success rates, did not reveal any significant effect on passage rates; however, it was difficult to draw inference since we had little statistical power.[24] At a minimum, the results show that there is no statistical evidence on which critics can base claims that adjuncts hurt students in subsequent courses.

[24] We lack the statistical power to estimate the effects on subsequent achievement for two key reasons. First, there is little variation in student success. We observe only passage rates, and over 80% of students pass the classes in which they enroll. Second, correlation across observations gives us less statistical power in estimating the effects. If our data did not have correlation across observations, most of our estimates would have been statistically significant.

Having an adjunct instructor could be more beneficial than having a full-time faculty member for several possible reasons. Unlike research faculty, adjuncts are able to specialize in teaching, and gains could be derived from this in terms of student engagement. Additionally, adjunct instructors may have important industry knowledge that they bring into the classroom to the benefit of students. Another possible theory to explain the positive effects of having an adjunct instructor could be related to grading practices. Some surmise that adjuncts are easier graders, particularly at colleges where their contracts are renewable based on student evaluations. Studying students in introductory economics courses, Fournier and Sass (2000) found that instructor grading policies did influence subsequent curriculum choice. However, because we do not have course grades, we are unable to test this hypothesis.

C. *Heterogeneity among Adjuncts*

Our results thus far have highlighted areas where adjunct instructors positively (and in a few cases, negatively) affect

TABLE 8.—RESULTS OF FIRST STAGE IV REGRESSIONS BY AGE OF ADJUNCT INSTRUCTOR

	Adjunct over Age 40 (1)	Adjunct under Age 40 (2)
Proportion assistant professors	−16.5483**	−3.5568**
	(0.8929)	(0.6835)
	[3.6692]	[2.4243]
Proportion associate professors	−6.0476**	−5.4418**
	(0.9097)	(0.6339)
	[3.0046]	[1.7457]
Proportion full professors	−6.3636**	−2.1260**
	(0.6393)	(0.5037)
	[2.1725]	[1.3858]
R^2	0.1148	0.1685
Observations	212,436	82,136
F-test on excluded instruments (clustered at student level)	1395.00	737.03
F-test on excluded instruments (clustered at section level)	95.84	66.75

Note: Standard errors that cluster at the student level are shown in the parentheses. Standard errors that cluster at the section level are shown in brackets. The models include campus, department, term, and course fixed effects. They also include the following covariates: ACT composite score, whether the course is in the student's intended major, the interaction between ACT and intended major, race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, total number of credits taken in the subject that term, a dummy variable for the fall 1999 cohort, and the birth year of the instructor of the course. Courses taken during any term are included, but due to incomplete information on instructor age, the sample is less than complete.
** Significant at the 5% level. * Significant at the 10% level.

student outcomes. However, there is substantial heterogeneity among adjuncts. While the adjunct instructors hired by the school in past decades were often accomplished practitioners, many of the more recent adjunct hires have been young ABDs (all-but-dissertation). Differences across adjuncts may provide some confirmation to the hypothesis that adjuncts with professional experience have a positive impact on students. To separate adjuncts who are young ABDs from those who are accomplished practitioners, we use age as a proxy because we do not have measures of instructor work experience. Adjuncts under the age of forty are assumed to have had little job market experience relative to adjuncts over the age of forty. The following models also include the direct effects of an instructor's age. In other words, we include a control for the birth year of the instructor, whether that person is an adjunct or full-time faculty member. Because the administrative files do not have complete information on instructor characteristics, the inclusion of this variable reduces the sample size.

T8 Table 8 displays the first stage results for the IV approach when we break adjunct instructors into two types. The models include campus, department, term, and course fixed effects. They also include the following covariates: ACT composite score, whether the course is in the student's intended major, the interaction between ACT and intended major, race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, total number of credits taken in the subject that term, a dummy variable for the fall 1999 cohort, and the birth year of the instructor of the course. As shown, the makeup of the department in terms of assistant, associate, and full professors is a good predictor of the use of older and younger adjuncts, with the magnitude of the results being especially strong for older adjunct instructors.[25] The F-tests overwhelmingly suggest that the instruments do help to explain which students do and do not have an adjunct instructor. Fn25

Table 9 presents instrumental variable estimates of the effects of adjunct characteristics on student outcomes. For each specification, we present a separate regression based on equation (1). The only modification is that instead of just including a dummy variable for whether a student had a class from an adjunct, we separate this indicator variable into two parts: an indicator for adjuncts under age forty and an indicator for adjuncts over forty. As before, we report standard errors that control for correlation within individuals and standard errors that control for correlation within sections of the same course in a given year. The top panel (specifications 1–4) includes all subjects, while the middle (specifications 5–8) and bottom (specifications 9–12) panels examine the effects for more academic or professional subjects, respectively. T9

Looking at the experiences in all subjects (specifications 1–4), we find that younger adjuncts appear to have more positive effects relative to full-time instructors in terms of the likelihood of taking additional courses, how many additional credits are taken, and major choice. Meanwhile, older adjuncts appear only to have a relative positive effect on major choice. However, once the courses are separated into more academic or professional categories, the positive effects for younger adjuncts appear concentrated in the more academic courses. Younger adjuncts are estimated to have relative negative effects in the more professional subjects in term of both whether another course is taken and how many additional credit hours are taken within a year. Older adjuncts instead appear to have positive effects in the subjects more closely tied to occupations. Based on our assumption that older adjuncts are more likely to have had work experience in professional fields, the results in table 9 accentuate the importance of practitioner experience, particularly in professional fields, as the older adjuncts were more effective than younger adjuncts (and full-time faculty) in cultivating student majors.

V. Conclusion

Using a unique data set with the ability to link student outcomes to faculty characteristics, this study estimates the impact of using alternative instructors in higher education. Simple comparisons of students with full-time faculty mem-

[25] As before, we find that the greatest level of substitution is between assistant professors and adjunct instructors. From the estimates, we also suspect that hiring practices for older adjuncts are especially sensitive to faculty fluctuations. If older adjuncts have served as instructors repeatedly at the school, they may be the first individuals called to fill positions when a department needs coverage for a course. In contrast, the use of younger adjuncts may also be susceptible to changes in the demand for certain courses from year to year (after all of the older adjuncts have been hired, the departments then turn to the younger adjuncts to fill the remaining slots, which will be dependent on enrollment trends for that year). Therefore, while fluctuations in faculty by rank still help to predict the use of older or younger adjuncts, they do so in to different degrees.

TABLE 9.—INSTRUMENTAL VARIABLES ESTIMATES OF THE EFFECTS OF ADJUNCTS BY AGE

	Any Additional Courses in Subject	Subsequent Credits within a Year	Total Subsequent Credits	Major Choice
	(1)	(2)	(3)	(4)
All subjects				
Adjunct over 40	−0.0009	0.0184	−0.0105	0.0046**
	(0.0037)	(0.0207)	(0.0601)	(0.0021)
	[0.0071]	[0.0430]	[0.1372]	[0.0060]
Adjunct under 40	0.0148**	0.0654**	0.3178**	0.0104**
	(0.0049)	(0.0279)	(0.0798)	(0.0029)
	[0.0095]	[0.0570]	[0.1858]	[0.0080]
Faculty birth year	−0.0071	0.0248	−0.1857	0.0026
	(0.0071)	(0.0400)	(0.1152)	(0.0041)
	[0.0136]	[0.0811]	[0.2625]	[0.0114]
	(5)	(6)	(7)	(8)
Academic subjects				
Adjunct over 40	−0.0037	0.0168	−0.0574	0.0027
	(0.0048)	(0.0253)	(0.0593)	(0.0018)
	[0.0084]	[0.0445]	[0.1242]	[0.0047]
Adjunct under 40	0.0090*	0.0405	0.1422**	0.0057**
	(0.0047)	(0.0251)	(0.0600)	(0.0019)
	[0.0084]	[0.0449]	[0.1253]	[0.0049]
Faculty birth year	−0.0121	0.0204	−0.2072*	0.0004
	(0.0087)	(0.0458)	(0.1077)	(0.0033)
	[0.0149]	[0.0782]	[0.2200]	[0.0083]
	(9)	(10)	(11)	(12)
Professional subjects				
Adjunct over 40	−0.0021	−0.0348	−0.0259	0.0066**
	(0.0039)	(0.0339)	(0.0769)	(0.0027)
	[0.0053]	[0.0474]	[0.0828]	[0.0037]
Adjunct under 40	−0.0050**	−0.0440*	−0.0206	0.0006
	(0.0024)	(0.0229)	(0.0519)	(0.0018)
	[0.0031]	[0.0306]	[0.0576]	[0.0025]
Faculty birth year	−0.0068	−0.0839	−0.0798	0.0087*
	(0.0069)	(0.0580)	(0.1370)	(0.0049)
	[0.0086]	[0.0772]	[0.1508]	[0.0069]

Note: Standard errors that cluster at the student level due to the multiple observations we have per student are shown in the parentheses. However, because the treatment (instructor type) varies by section, we also report standard errors that cluster at the section level in brackets. The models include campus, department, term, and course fixed effects. They also include the following covariates: ACT composite score, whether the course is in the student's intended major, the interaction between ACT and intended major, race dummy variables, gender dummy variable, a dummy variable for being an Ohio resident, total number of credits taken in the subject that term, and a dummy variable for the fall 1999 cohort. Courses taken during any term are included, but due to incomplete information on instructor age, the sample is less than complete. For the full sample of all subjects, the models have 212,436 observations, and 189,073 and 23,363 observations for the academic and professional subjects, respectively.

** Significant at the 5% level. * Significant at the 10% level.

bers to those with adjuncts are likely to be biased because students who take adjuncts differ systematically from other students. The paper provides evidence that students sort by instructor type based on observable characteristics. If sorting also takes place along unobservable characteristics, then research that fails to control for selection bias will be biased. However, by exploiting exogenous variation in faculty composition, we use an instrumental variables approach and are able to attain unbiased estimates of the effects of adjuncts on students.

The analysis suggests that the impact of alternative instructors varies by discipline. However, taking a class from an adjunct often increases the number of subsequent courses that a student takes in a given subject and may also increase the likelihood that the student majors in the subject. These findings contradict assertions by groups that the use of adjuncts reduces student interest. The estimates also suggest that adjunct instructors are especially effective in fields that are more directly tied to a specific profession, like education and engineering, although they also had relative positive effects in the sciences. This seems reasonable given that many adjuncts have professional experience and may have significant prior to concurrent industry experience. We find suggestive evidence that such adjuncts are beneficial, as the results imply that students who have older adjunct instructors, a proxy for professional experience, in a subject more closely tied to a specific occupation are more likely to major in a subject than those with younger adjunct instructors. Younger adjunct instructors had positive relative effects in more academic subjects.

These results can be reconciled with earlier findings on the negative impact of adjuncts by considering that although the use of adjuncts may lower overall student persistence (Ehrenberg & Zhang, 2005; Bettinger & Long, 2006), adjuncts may be effectively used in particular disciplines to encourage subsequent enrollments. The positive effects of adjuncts, especially older adjuncts, may be more pronounced after the initial semester during the later decisions of major choice. However, these results are not a sufficient, full-scale account of all the costs and benefits associated with adjunct instructors, and further analysis is needed to determine the other possible effects of these trends. For

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example, adjuncts may affect departmental outcomes such as the distribution of departmental tasks, like committee work. Moreover, they may increase demands on college administrators by requiring them to spend additional time monitoring teaching and finding replacements due to turnover. Alternatively, using adjunct instructors may allow full-time tenure track faculty to more effectively focus on research so that production within the department could increase. Finally, adjunct use may allow colleges and universities to screen potential full-time faculty members (Autor, 2001). Future work is needed on the effects of alternative instructors on research and service to fully understand the trade-offs between different kinds of instructors. Nonetheless, the paper makes an important first step in calculating the effect of alternative instructors on students' subsequent interest, enrollment, and success.

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APPENDIX

Theoretical Framework

Departments must make human resource decisions using faculty (F_k) to accomplish three goals: teach the necessary classes (T_k), produce research (R_k), and provide service (S_k) to the university in the form of committee work and advising students. Therefore, in a utility-maximizing framework, department k does the following:

$$\max U_k = \alpha_1 T_k(F_k) + \alpha_2 R_k(F_k) + \alpha_3 S_k(F_k)$$
$$\text{such that } C_k = \Sigma C_{jk}(F_{jk}) \leq B_k(T_k(F_k)) + D_k(R_k(F_k)). \quad \text{(A1)}$$

The relative importance of each goal is given by α_1, α_2, and α_3 and may vary depending on whether the institution is a research university or a liberal arts college. Note that the budget of the department must be less than the total amount spent on faculty members (C_k) and is related to student enrollment through the production of teaching (B_k) and funds generated by research (D_k). Implicit in this assumption is that students maximize their current consumption and future returns to education and therefore seek to maximize gains from teaching. Student i's maximization problem can be characterized as

$$\max\ U_i = U_i(\Sigma T_k(F_k); \text{other goods}). \quad \text{(A2)}$$

Suppose that there are two types of instructors: full-time faculty members and alternative instructors (adjuncts and graduate students). While full-time faculty members engage in each of the three tasks of a department, alternative instructors are involved only in teaching. However, the relative proportion of full-time faculty members to alternative instructors may affect the research and service functions of the department. For instance, the research productivity of full-time faculty members may increase if the presence of alternative instructors allows them to specialize in research. However, adjuncts and graduate students may not be required to help with advising and other types of service, and therefore as their numbers grow, there are fewer people left to handle these tasks.

Instructors provide two types of knowledge to students through their teaching. The first type, academic (λ), is rooted in scholastic research, and the second type, professional (θ), develops from a connection to industry and the labor market. In addition, each type of instructor has an optimal amount of time (β_{FT} and β_{ALT}) they wish to devote to teaching. The pool of faculty in a department can be characterized as

$$F_k = \Sigma F_{FT,jk}(\lambda_{FT}, \theta_{FT}, \beta_{FT}) + \Sigma F_{ALT,jk}(\lambda_{ALT}, \theta_{ALT}, \beta_{ALT}). \quad \text{(A3)}$$

The instructor types may differ in their relative stock of each kind of knowledge. In terms of academic knowledge, this may be true for several reasons. First, alternative instructors such as adjuncts and graduate students often do not have terminal degrees and therefore may not be as knowledgeable about a particular subject as full-time professors, the majority of whom have Ph.D.s. Adjuncts are also not as involved in research, so to the extent that research influences teaching quality, full-time faculty may be better teachers and provide more academic knowledge about a subject. Additionally, because alternative instructors serve in a limited capacity, they may not have the same knowledge about the university in comparison to full-time professors. As a result, they may not be as effective in advising students about academic matters. For these reasons, we assume that $\lambda_{FT} > \lambda_{ALT}$.

However, the relative size of β and θ is unclear and will depend on the type of alternative instructor. In the case of adjuncts, one is likely to find $\beta_{FT} < \beta_{ALT}$ because adjuncts do not have research or service requirements and can specialize in teaching. Moreover, because adjuncts are judged according to their teaching, they may have greater incentives to do well at it, although it may be difficult to monitor or measure the quality of teaching. In terms of professional knowledge, older adjuncts may bring current or previous experience in industry, and consequently they may have more practical information and provide better access to future employment than full-time faculty members. Therefore, one could find $\theta_{FT} < \theta_{ALT}$. On the other hand, younger adjuncts, who might not have completed graduate work and could be very inexperienced may have little industry knowledge, so the reverse could be true. In the case of graduate students, one would expect to find $\beta_{FT} > \beta_{ALT}$ since graduate student instructors have other requirements such as course work and research. Moreover, because they have not fully entered the discipline, $\theta_{FT} > \theta_{ALT}$.

These differences in the amount of knowledge affect subsequent student and departmental outcomes. First, the knowledge gained in an introductory class directly affects student success in subsequent courses. Experiences with instructors may also affect future course-taking behavior. If students choose their courses (and major) based on their knowledge and experiences in a given subject, the mix of instructors they face early in a given discipline could influence these decisions. For example, if a course produces additional knowledge that changes the subject in which a particular student has a comparative advantage, the student may change his or her major or choose a different set of courses. Therefore, the size of $\partial T_k/\partial F_{FT}$ and $\partial T_k/\partial F_{ALT}$ depends on the relative stock of each kind of knowledge that each type of instructor has, as well as the amount of effort he or she is able to put toward teaching.

The effectiveness of different kinds of instructors is also likely to vary by discipline as it will depend on the relative importance of academic and professional knowledge in the department. For example, in the humanities, which presumably favor academic knowledge, one may find that $\partial T_k/\partial F_{FT} > \partial T_k/\partial F_{ALT}$ while the relationship may be the opposite in professional fields such as business, in which professional knowledge is much more valued. Therefore, depending on the relative size of λ, θ, and β and the importance of these factors in the discipline, one type of instructor might provide better teaching outcomes (student enrollment) over another. It is important to note that even if alternative instructors are not as effective as full-time faculty members, their use may still be rational. As stated in equation (A1), departments maximize their utility by choosing the optimal mix of instructors to accomplish multiple goals, and adjuncts may have positive indirect effects on research that justify a possible reduction in teaching outcomes.

In this paper, we measure teaching outcomes in two ways: the number of subsequent credit hours taken in a subject and whether a student majors in a subject. Therefore, this paper provides estimates of the relative differences between $\partial T_k/\partial F_{FT}$ and both $\partial T_k/\partial F_{Adjunct}$ and $\partial T_k/\partial F_{GA}$ by discipline.

AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES **1**