# Limited Contracts, Limited Quality? Effects of Adjunct Instructors on Student Outcomes*

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**Abstract**

In recent decades, U.S. colleges have increasingly hired adjuncts in place of full-time instructors. To the extent teaching quality differs between these groups of instructors, the shift toward adjuncts may have broad effects on student performance and engagement in the college classroom. I use data on first-semester students at public two-year and four-year colleges in Arkansas to investigate the effect of adjuncts versus full-time, non-tenure-track instructors on student outcomes. I then examine the mechanisms underlying differences in outcomes by instructor rank. I employ an identification strategy that accounts for both student selection into instructors and non-random instructor assignment to courses. I find that students have worse academic outcomes when taking courses with adjuncts on several metrics. Specifically, I find that these students are less likely to take a subsequent course on the same subject, less likely to return to college for a second year, less likely to graduate on time, and less likely to transfer to a four-year college if they are attending a two-year college. I find no evidence that supply-side labor factors have affected differences between adjuncts and full-time instructors, suggesting that the difference in student outcomes is not due simply to inherent differences in instructor quality. However, I do find that changing an instructor's rank from adjunct to full-time increases their students' propensity to take a subsequent course in the same subject and first-year retention rates. Overall, my results suggest that institutional differences in the treatment of instructors by rank affect student outcomes, with policy-relevant implications for resource allocation in higher education funding.

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# I Introduction

Over the past 40 years, colleges across the United States have significantly increased their share of adjunct instructors, who are paid per course taught, relative to their share of full-time, salaried instructors. From 1975 to 2011, the use of adjunct instructors increased by over 70%; adjuncts currently make up approximately 41% of instructional staff in colleges (Curtis and Thronton 2013).[1]

Adjunct instructors cost significantly less to hire than their full-time counterparts, making them an attractive solution for colleges, many of which are facing increased financial pressures (Zhang et al. 2015). In fall 2010, the median pay per course for adjuncts was $2,700. At this rate, an adjunct instructor teaching a full course load of eight courses per year would earn one-third or less of the salary of their full-time counterparts (Curtis and Thronton 2013). In addition, most adjuncts do not qualify for employee benefits and have contracts that are more easily terminated than those of full-time instructors (Curtis and Thronton 2013). Furthermore, beginning in 1994, the Age Discrimination in Employment Act eliminated mandatory retirement age policies in higher education, thereby increasing the opportunity cost to hire full-time instructors–and, in turn, increasing the incentive to hire adjunct faculty instead (Ehrenberg 2000).

These hiring trends may have broad-ranging effects on student outcomes. A priori, it is not obvious how adjuncts compare to full-time instructors in terms of teaching quality. On the one hand, differences in educational attainment as well as institutional involvement may make adjuncts less effective teachers than full-time instructors. For example, adjuncts are significantly less likely to hold professional degrees than their full-time counterparts, potentially making them less qualified instructors (Monks 2009). Adjuncts may also be less engaged in their institutions overall, as they are significantly less likely to have workplace benefits, access to private office space, or input in matters of college governance (Curtis and Thronton 2013). In addition, adjuncts are significantly more likely to hold additional jobs, either at other schools or outside of teaching (Monks 2009).

On the other hand, differences in duties, professional affiliations, and teaching incentives may make adjuncts more effective teachers. For example, adjuncts may have more time to focus on teaching than full-time instructors with research or administrative duties. Furthermore, some adjuncts hold concurrent professional appointments, which may allow them to bring useful, industry-relevant job advice and perspectives to the classroom (Monks 2009). Finally, due to the nature

[1] Adjuncts are often referred to as part-time workers, though this term can be somewhat misleading as adjuncts may teach more courses than their full-time counterparts.

of their employment, adjuncts have contracts that are more easily terminated than those of full-time instructors (Curtis and Thronton 2013). Thus, schools may be able to dismiss ineffective instructors more efficiently at the adjunct level.

In this paper, I use student transcript data from public two- and four-year colleges in Arkansas from 2003 to 2011 to empirically assess how instructor rank (adjunct versus full-time, non-tenure-track) affects student outcomes. I focus my comparison of adjuncts to full-time, non-tenure-track instructors since tenure-track positions often place a larger focus on non-teaching duties, such as research. I analyze a range of outcomes, both course-specific (whether students take subsequent courses in the subject or major in the subject) and non-course-specific (whether students return for a second year of college, graduate on time, or transfer to four-year colleges from two-year colleges). To minimize concerns of students selecting non-randomly into different instructors by rank, I focus on outcomes for students in their first semester of college (Figlio et al. 2015). In addition, I include course fixed effects in the analysis to account for the possibility that differences in student outcomes are due to differences in the types of courses that adjuncts and full-time instructors teach.[2] Finally, I minimize concerns that students may sort into instructor ranks non-randomly by employing student-level fixed effects to isolate variation in instructor rank within students. Non-course-specific outcomes do not vary across courses for a given student, so I include a set of observable characteristics and use a bounding method developed by Oster (2017) to account for students sorting on unobservable characteristics instead.

My results suggest students have worse outcomes when they take courses with adjuncts rather than full-time instructors. Specifically, the results indicate that taking courses with an adjunct decreases students' likelihood of taking subsequent courses in the subject, returning for a second year of school, graduating on time, and transferring from a two-year to a four-year school.

Several potential mechanisms could explain these differences. For example, if the labor market sorts instructors into different positions based on teaching quality, then full-time, non-tenure-track hires may simply be higher-quality instructors than their adjunct peers. However, teaching differences could also stem from institutional differences in treatment such as lower pay, fewer benefits, and less access to office space.

To untangle the mechanisms underlying negative teaching outcomes for adjunct instructors, I first look at whether differences in teaching quality between adjuncts and full-time instructors vary

[2] Courses are classified as school-specific classes that have the same course name and course number.

across different subsets of adjuncts. Specifically, I examine whether adjuncts who hold professional job appointments outside of teaching—appointments that may allow them to bring in relevant industry experience—have better outcomes than those who do not. I use lighter course loads as a proxy for these appointments. My results indicate that adjuncts who teach fewer courses have worse student outcomes. These results could imply that colleges give fewer courses to poorer teachers; however, they could also imply that adjuncts with a lighter teaching load face worse teaching conditions (lower pay, less access to office space) than adjuncts with heavier loads.

Next, I examine whether differences in teaching quality between adjunct and full-time instructors are affected by labor market conditions in a given location or within a certain field. If teaching outcomes are driven by inherent differences in instructor quality, then the labor supply of potential adjuncts in a location or field will likely affect the quality of adjuncts at a given school. When potential instructors have better outside labor market employment options, it may be harder to attract higher-quality workers into adjunct positions, given the low compensation and benefits of these positions. To test this possibility, I examine whether the difference in teaching quality between adjuncts and full-time instructors varies by the location of the school, the time-varying unemployment rate in its local labor market, and whether or not an instructor is teaching in a STEM field. I find no differences in student outcomes by instructor rank along any of these margins. Although these findings do not rule out the possibility that inherent differences in individuals hired as full-time versus adjunct instructors lead to differences in teaching outcomes, they do suggest that other external factors may contribute to differences in outcomes by instructor rank.

One such external factor is the institutional treatment of instructors by rank. Adjuncts typically have less favorable employment conditions than full-time instructors, which may negatively affect teaching outcomes. To assess the relevance of this potential factor, the second portion of the analysis examines whether student outcomes differ after an instructor in my data set switches rank. I use instructor fixed effects to isolate the role of changing instructor rank from differences in selection criteria between instructors hired as adjunct versus full-time. I find that when an instructor switches from adjunct to full-time, their students are 1.3 percentage points more likely to take a subsequent course in the subject, a 3.1% increase from baseline rates. Additionally, a one standard deviation increase in the share of adjuncts a student has in their first year of college increases the probability the student will return for a second year of college by 0.9 percentage points, a 1.4% increase. The increases in student outcomes for both of these margins is more than half of the magnitude of overall differences in quality between adjuncts and full-time instructors.

Although results show clear benefits in transitioning instructors from adjuncts to full-time, there are also costs associated with this transition, which are important to consider from a policy perspective. As a starting point to thinking in cost-benefit terms, I perform a back-of-the-envelope cost analysis using average per-course salary by instructor rank. Holding constant workplace benefits and other non-pecuniary compensation, I find that instructors would need a $4,669 increase in per-course salary to achieve this effect. Although this estimation provides a starting point for a cost-benefit analysis of instructional spending, it has limitations. First, this estimate does not take into account the non-salary benefits and resources that full-time instructors typically receive above adjuncts. Second, the estimate does not reflect the service or administrative duties that full-time instructors take on in addition to their course load. Third, I cannot discount the possibility that the instructors who switched in my sample are different in some other way from the instructors who did not. In descriptive analyses, I see that switchers indeed differ from non-switchers before they switch along some observable characteristics, such as number of courses taught and salary. However, I find that the magnitude of differences between adjuncts and full-time instructors do not differ significantly between switchers and non-switchers, suggesting these differences are not driving my results.

This paper contributes to a growing literature exploring the role of instructor rank in higher education outcomes. Griffith and Sovero (2019) analyze how grading patterns differ across instructor rank and gender at a public flagship university and find that instructors with more job uncertainty and risk aversion respond to higher incentives to have positive teaching outcomes by systematically awarding higher grades. Carrell and West (2010) randomly assign students to teachers at the United States Air Force Academy to explore the relationship between student evaluations, contemporaneous achievement, and follow-on achievement across instructor ranks, though they do not look at adjunct instructors. Similarly, Figlio et al. (2015) compare the role of full-time, non-tenure-track versus tenure-track instructors on student learning.

Prior research examining the effect of adjunct versus full-time instructors on student outcomes find mixed evidence. Using national, institutional-level panel data, Ehrenberg and Zhang (2005) find that increasing the proportion of part-time faculty at a school decreases first-year retention rates and graduation rates at four-year colleges. Bettinger and Long (2006) report similar results, finding that students at four-year public colleges in Ohio who take a higher proportion of courses taught by adjuncts in their first year have a lower chance of returning to college for a second year. In a subsequent study, Bettinger and Long (2010) look at finer, course-specific individual outcomes using the same data in the same setting to assess student outcomes for individual instructors. They find that taking a class with part-time faculty actually increases the likelihood a student will take a subsequent course or major in the subject of the course. Finally, using data from a large Canadian public university, Hoffmann and Oreopoulos (2009) find no effect of instructor rank on subsequent course-taking or course performing behaviors, though they do not separately analyze adjuncts and graduate students.

This paper makes two key contributions to research on teaching quality in higher education. First, it expands prior studies by exploring the contexts and reasons for differences in teaching quality across instructor ranks. Prior studies have found mixed results on the effects of adjunct instructors, which may stem from differences the institutional setting and/or outcomes analyzed. This paper analyzes a broader and more comprehensive range of student outcomes compared to prior studies. By incorporating bounding techniques from Oster (2017), I am able to obtain causal estimates for both short-term subject-specific outcomes and aggregate non-subject specific outcomes. Furthermore, the richness of the data allow me to analyze the mechanisms driving these differences by assessing the contexts in which adjuncts are more and less effective as instructors. I do not find significant effects of labor market supply-side factors on the relative teaching quality of adjuncts relative to full-time instructors, suggesting factors other than inherent differences in instructor quality may contribute to the measured gap in teaching quality. This leads to the second contribution of this paper, which is to explore whether an instructor's teaching quality affected by factors related to job compensation and/or environment. I find that changing an instructor's rank from adjunct to full-time does improve teaching outcomes on multiple margins, indicating teaching quality is sensitive to institutional treatment of instructors. These findings have significant policy implications in showing workplace treatment compensation policies (pecuniary and/or non-pecuniary) play a significant role in instructor teaching quality in higher education. This is especially noteworthy since a nationwide survey of adjunct instructors, finds that 35% of adjuncts state they would actually prefer a full-time position (Monks 2009). While there may be some qualification hurdles that prevent some people from attaining full-time status (e.g., if a school requires a doctoral degree for full-time instructors), findings indicate significant institutional effects for those who do switch ranks.

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Second, this paper contributes to the literature by exploring whether an instructor's teaching quality is affected by factors related to job compensation or environment. I find that changing an instructor's rank from adjunct to full-time improves teaching outcomes on multiple margins, indicating teaching quality is sensitive to the institutional treatment of instructors.

These findings have significant policy implications in that they show that workplace treatment and compensation (pecuniary or non-pecuniary) have a substantial effect on teaching quality in higher education. In a nationwide survey, 35% of adjunct instructors stated they would prefer a full-time position (Monks 2009). While qualification hurdles may prevent some adjuncts from attaining full-time status—for example, if a school requires full-time instructors to have a doctoral degree—my results suggest that promoting some adjuncts to full-time instructors may substantially boost student engagement and retention.

In the remainder of the paper, Section II presents the data. Section III discusses the methodology and results of the first portion of the analysis, looking at overall differences between adjuncts and full-time instructors on student outcomes, as well as heterogeneity analyses. Next, Section IV presents the second portion of the analysis, looking at how instructors' teaching outcomes change when they move ranks. Section V concludes.

# II Data

Data for this project come from the Arkansas Department of Higher Education (ADHE) and contain information for all students enrolled in an Arkansas public institution of higher education from 2003-2011. These institutions consist of a total of 10 four-year colleges and 22 two-year colleges. For each student, I observe background characteristics and course transcript data for each term of enrollment. Conditional on graduation, I observe degree information as well. At two-year colleges, I observe whether a student transfers to an in-state four-year college, but I do not observe if a student transfers to a private school or a school out-of-state. Since studies show the majority of community college transfer students transfer to a public four-year college (Jenkins and Fink 2015), I classify a student as transferring to a four year college if they transfer to a four-year public institution in Arkansas within three years of entering college.

This study focuses on degree-seeking, first-time, undergraduate students entering college between 2003 and 2010, approximately 260,000 students. Table 1 displays summary statistics on students in the sample. In alignment with national trends, more females than males enroll in college in Arkansas, a difference that is especially pronounced at community colleges.[3] Additionally, the table indicates four-year college students are less likely to be part-time and more likely to be come from out of state, compared to two-year students. On average, four-year students take 4.1 classes in their first semester of college during the sample period, while two-year college students take an average of 2.9 classes.

Table 1: First-time Student Characteristics

| | Four-year College Students | Two-year College Students |
|---|---|---|
| Male | 0.45 | 0.41 |
| Part-time | 0.13 | 0.32 |
| In-State tuition status | 0.85 | 0.96 |
| Age (median) | 18 | 20 |
| | (5.89) | (9.42) |
| Number of classes taken | 4.12 | 2.87 |
| | (1.41) | (1.43) |
| *N* | 149,884 | 113,306 |

Standard errors in parentheses. Age is imputed from HS graduation year, under the assumption that students graduate high school at age 18. I display age as a median value since the distribution is positively skewed by some outlier older students; otherwise main values denote means.

[3] https://nces.ed.gov/programs/digest/d16/tables/dt16_303.70.asp

Key to this study, the data also contain detailed information on instructors, including employment rank in each term (tenure-track/tenured, full-time non-tenure-track, adjunct, or graduate student). I distinguish between tenure-track/tenured and full-time non-tenure track instructors since tenure-track job duties often differ significantly from non-tenure-track in terms of focus on research and other non-teaching duties. Table 2 displays summary statistics for instructors teaching during the sample period. An observation consists of an instructor-term unit, indicating instructors appear in the sample for each term they teach are teaching. There are 9,787 unique instructors in the four-year school sample and 6,152 unique instructors in the two-year school sample. I separate instructors by institution type and rank. Going left to right from tenure-track/tenured to full-time to adjunct to graduate student, instructors get younger and earn less on average by rank. At both two-year and four-year schools, full-time instructors earn more than twice as much as adjuncts from their institutions, which may be driven by differences in teaching and administrative loads. Additionally, while women make up over half of all full-time non-tenure-track, adjunct, and graduate student instructors at four-year schools, they represent only 32% of tenure-track/tenured faculty.

Table 2: Instructor Characteristics

| | Four-year Schools | | | | Two-Year Schools | |
|---|---|---|---|---|---|---|
| | Ten.-track/Ten. | Full-time | Adjunct | Grad. Stud. | Full-time | Adjunct |
| Male | 0.68 | 0.43 | 0.49 | 0.44 | 0.48 | 0.46 |
| Age | 51.51 | 46.40 | 45.43 | 30.09 | 49.39 | 47.53 |
| | (10.63) | (11.59) | (12.12) | (7.24) | (10.74) | (11.92) |
| Num. Courses Taught | 2.96 | 3.07 | 1.96 | 1.79 | 4.10 | 2.18 |
| | (1.30) | (1.49) | (1.16) | (0.73) | (1.61) | (1.25) |
| Salary (9-month, $) | 63,859 | 40,379 | 18,282 | 10,231 | 40,407 | 11,133 |
| | (19543.51) | (17939.65) | (20578.69) | (3655.75) | (63339.99) | (14789.88) |
| *N* | 17,265 | 10,424 | 8,390 | 3,281 | 14,463 | 15,714 |

Standard errors in parentheses. Observations denote instructor-term units. "Full-time" indicates full-time, non-tenure-track instructors. Two-year colleges do not employ graduate students or use the tenure system, so there are no columns for these instructors. Salaries reported in real 2010 dollars.

Next, I look at differences in student characteristics across instructor employment rank in Table 3. Characteristics of students may vary across instructor rank due to both student selection into instructors, as well as differences in the types of courses taught by instructors of different ranks. Differences between full-time instructors and adjuncts are significant at the .001 level for all characteristics, with the exceptions proportion of in-state tuition students at four-year schools and gender at two-year schools, the latter of which does become significantly different at the .01 level.[4]

Table 3: Student Sorting by Instructor Rank

| | Four-year Schools | | | | Two-Year Schools | |
|---|---|---|---|---|---|---|
| | Ten.-track/Ten. | Full-time | Adjunct | Grad. Stud. | Full-time | Adjunct |
| Gender | 0.46 | 0.46 | 0.44 | 0.48 | 0.43 | 0.43 |
| Part-time | 0.06 | 0.07 | 0.11 | 0.03 | 0.15 | 0.25 |
| Transfer Student | 0.29 | 0.22 | 0.24 | 0.18 | 0.25 | 0.31 |
| In-State Tuition | 0.85 | 0.86 | 0.86 | 0.81 | 0.96 | 0.98 |
| Age | 19.98 | 20.02 | 20.57 | 18.91 | 23.71 | 24.99 |
| | (4.94) | (5.19) | (5.87) | (3.27) | (8.74) | (9.12) |
| *N* | 220,052 | 219,568 | 114,108 | 53,319 | 204,905 | 126,011 |

Standard errors in parentheses. Observations denote student-course units. "Full-time" indicates full-time, non-tenure-track instructors. "Transfer Student" refers to first-time students who were previously enrolled at a different college. Results from two-sampled t-tests and proportions tests indicate full-time and adjunct instructors differ significantly in terms of what types of students they teach significantly at the .001 level for all traits, with the exception of proportion of in-state tuition students at four-year schools and gender at two-year schools.

Tables 4 and 5 show descriptive student outcomes by instructor rank for four-year and two-year colleges, respectively. As in the main analysis in Section III, I focus on courses taken by students in their first year, dropping remedial courses from the sample. I focus on a broad range of academic outcomes, including both immediate course-specific outcomes and bigger picture non-course-specific outcomes to provide a better understanding for the specific margins through which instructor rank affects student outcomes. Numbers in these tables do not represent causal estimates since they do not account for the possibility that students select into instructor ranks based on ability, or that certain ranks of instructors are more likely to teach certain courses, which may be driving outcomes. However, the descriptive trends do provide suggestive evidence of heterogeneous effects in teaching quality across instructor rank. Table 24 in Appendix A displays these statistics aggregated across both four-year and two-year students.

Table 4 focuses on outcomes of interest at four-year colleges: taking another course in the subject, majoring in the subject of the course, persistence after the first year, and four-year graduation

[4] Due to the large sample size, some values are statistically different even though they are similar in magnitude. Adjuncts are significantly more likely to teach part-time students and students who transferred from another college previously.

rate. When looking at whether a student majors in the subject of the course, I limit observations to courses in subjects in which it is possible to earn a major at the school. I classify a student as majoring in the subject if they graduate with a bachelor's degree in the subject of the course within four years of entering college. For the outcomes of interest, descriptive statistics show that students have significantly better outcomes with full-time instructors, compared to adjuncts, with the exception of whether or not they major in the subject of the course. Next, Table 5 looks at outcomes of interest at two-year colleges: taking another course in the subject, persistence after the first year, two-year graduation rate, and rate of transfer to four-year schools. One limitation of the data is that Once again, the descriptive statistics indicate that students with full-time instructors have better outcomes for those with adjuncts, although results cannot be interpreted causally, for the reasons previously discussed.

Table 4: Descriptive Outcomes by Instructor Rank, Four-year Colleges

| | All | Ten.-track/Ten. | Full-time | Adjunct | Grad. Student |
|---|---|---|---|---|---|
| Takes another course in subject | 0.50 | 0.51 | 0.50 | 0.48 | 0.55 |
| Majors in subject | 0.05 | 0.07 | 0.04 | 0.04 | 0.02 |
| Persistence after first year | 0.79 | 0.80 | 0.78 | 0.76 | 0.84 |
| Four-year Graduation | 0.29 | 0.33 | 0.26 | 0.23 | 0.36 |
| $N$ | 624,281 | 221,757 | 224,025 | 114,235 | 53,366 |

Standard errors in parentheses. Observations denote student-class units for students entering college between 2003-2010. For outcomes "Majors in subject" and "Four-year Graduation", I only include students entering between 2003-2008 in order to follow them through four years of school. A two-sample test of proportions shows values for full-time vs. adjunct instructors are significantly different at the .01 level for all outcomes.

# III Instructor Rank on Student Outcomes

This section analyzes the relative effects of adjunct versus full-time non-tenure-track instructors on student outcomes. I first describe the empirical strategy and then present main findings, followed by a heterogeneity analysis.

## III.A Empirical Strategy

I analyze the effects of instructor rank on a broad range of student outcomes. I split outcomes of interest into two main categories: subject-specific and non-subject-specific. Subject-specific outcomes denote outcomes that may vary across courses for a given student and include taking a

Table 5: Descriptive Outcomes by Instructor Rank, Two-year Colleges

| | All | Full-time | Adjunct |
|---|---|---|---|
| Takes another course in subject | 0.41 | 0.44 | 0.34 |
| Persistence after first year | 0.57 | 0.58 | 0.56 |
| Two-year Graduation | 0.09 | 0.10 | 0.06 |
| Transfers to four-year school | 0.16 | 0.16 | 0.15 |
| $N$ | 335,157 | 206,448 | 126,917 |

Standard errors in parentheses. Observations denote student-class units for students entering college between 2003-2010. For outcome "Transfers to four-year school", I only include students entering between 2003-2009 in order to follow them through four years of school. A two-sample test of proportions shows values for full-time vs. adjunct instructors are significantly different at the .01 level for all outcomes.

subsequent course in the subject and majoring in the subject of the course. Non-subject-specific outcomes denote aggregate outcomes that do not vary across courses for an individual and include retention after the first year, on-time graduation, and transferring to a four-year college.[5] I use slightly different empirical approaches to assessing the role of instructor rank on the two types of outcomes, as explained below:

**Subject-Specific Outcomes**

To analyze the effects of instructor rank on subject-specific student outcomes, I employ the following regression:

$$Y_{icrst} = \alpha_i + \rho_r + \mathbf{I}'_{icrst}\beta + \gamma_1 A_{icrst} + \gamma_2 A^2_{icrst} + \epsilon_{icrst} \quad (1)$$

where $Y_{icrst}$ is an indicator for whether individual $i$ in class $c$ of course $r$ in school $s$ at time $t$ takes a subsequent course in the same subject as $r$ or whether $i$ majors in the subject of $r$. Courses, $r$, are school-specific and consist of sets of classes with the same course number and course name. A class, $c$, represents a unique section within a course and is school-specific, year-specific, and term-specific. The variable of interest, $\mathbf{I}_{icrst}$, represents a vector of instructor ranks.[6]

There are a couple of concerns in attributing a causal relationship from a correlation between

[5]Majoring in the subject of a course is only analyzed for students at four-year schools and transferring is only analyzed for students at two-year schools.

[6]At four-year schools, this includes tenure-track/tenured, full-time non-tenure-track, adjunct, and graduate student. At two-year schools, this only includes full-time-non-tenure track and adjunct.

instructor rank and student outcomes. First, it is possible that students select non-randomly into instructors by rank along ability or other factors. To account for this, I include a student fixed effect, $\alpha_i$. Since the sample only tracks students in their first semester of college, $\alpha_i$ implicitly accounts for time-specific trends affecting outcomes as well. Second, instructors of different ranks may systematically be assigned to teach different types of courses, and course attributes could in turn be driving outcomes. Thus, I include a course fixed effect, $\rho_r$, to control for differences in course assignment across instructor rank. Since courses are school-specific, $\rho_r$ also accounts for variation across institutions in outcome variables. Finally, to ensure results are not driven by differences in teaching experience across instructor rank, I include continuous controls $A_{icrst}$ and $A^2_{icrst}$ for the instructor's age and age squared, respectively. I use this proxy since I do not directly observe how many years an instructor has been teaching[7] I cluster standard errors at the instructor level.

### Non-Subject-Specific Outcomes

For non-subject-specific outcomes, I use a similar empirical approach to the one used to assess the effects of instructor rank on subject-specific outcomes. The key difference is that since there is no within-student variation for these outcomes, I cannot use student fixed effects in my analysis.[8] Thus, I employ the following specification:

$$Y_{icrst} = \delta' X_i + \rho_r + \mathbf{I}'_{icrst}\beta + \gamma_1 A_{icrst} + \gamma_2 A^2_{icrst} + \tau_t + (\eta \times \tau)_{st} + \epsilon_{icrst} \quad (2)$$

As in Equation 1, $Y_{icrst}$, represents an indicator for whether student $i$ who takes course $r$ in her first semester either graduates on time, persists in college after the first year, or transfers to a four-year college.[9] The variable of interest, $I_{icrst}$, represents a vector of instructor ranks. As before, a course fixed effect, $\rho_r$, controls for differences in course assignment across instructor ranks, and $A_{icrst}$ and $A^2_{icrst}$ control for the instructor's age and age squared, serving as proxies for teaching experience.[10]

[7] I observe how many years an instructor appears in my data, but I do not see how many years they have been working before my data starts. As a robustness check, I use an experience proxy in which I calculate experience for instructors who start teaching in a year after the first year in my data and control for an indicator in experience, assigning a separate value for instructors who were already working at the start of the data. A detailed explanation and results of this specification are in Appendix C.

[8] For example, whether or not a student graduates will be the same for all classes she takes.

[9] On-time graduation indicates graduating within four or two years for four-year and two-year college students, respectively.

[10] As with subject-specific outcomes, since I rely on this proxy since I do not directly observe how long a teacher has been working at a school in my data. To check robustness, Appendix C uses alternative measure to experience.

The key area in which Equation 2 differs from Equation 1 is in dealing with student selection in instructors by rank. Since non-subject-specific outcomes do not vary within students, I cannot account use student fixed effects to control for selection. Instead, I include a vector of observable characteristics of students, $X_i$, to control for differences between students. While these controls account for any observable differences between students, one concern that remains is that unobservable differences that may be affecting outcomes. To analyze the potential role of unobservable characteristics, I draw from Altonji et al. (2005) in using the degree of selection on observables to inform the degree of selection on unobservables. Specifically, I implement a technique introduced in Oster (2017), which estimates bounds for potentially endogenous point estimates using information on both the amount of selection on student-level observables and how these variables affect the $R^2$ value of a regression. Intuitively, this approach assumes that the ratio ($\delta$) of selection on observables and unobservables is bounded within some range. Altonji et al. (2005) suggest that an appropriate upper bound of selection may be $\delta = 1$, indicating observables to be at least as important as unobservables. Furthermore, the exercise requires setting a maximum $R^2$ value that could be attained with the inclusion of both observable and unobservable characteristics, denoted $R_{max}$. Oster (2017) suggests setting a conservative value of $R_{max}$ by multiplying the $R^2$ value with observables by a factor of 1.3. Following these suggestions, I set bounds on my estimates for the amount of selection on unobservables to be between zero and the amount of selection on observables, or $\delta = 0$ and $\delta = 1$, and I set $R_{max} = 1.3\tilde{R}$ where $R_{max}$ is they hypothetical $R^2$ value of a regression with both observable and unobservable variables and $\tilde{R}$ is the $R^2$ value of the regression with observables only.

Finally, in Equation 1, time-varying environmental factors that potentially affect outcomes were subsumed by student fixed effects, since I only capture students in their first semester of school. Since Equation 2 no longer contains student fixed effects, I include time period fixed effects, $\tau_t$, as well as time period interacted with college fixed effects, $(\eta \times \tau)_{st}$.

## III.B Main Results

In this section, I present the results of the analysis of the effect of instructor rank on student outcomes. I look at the following outcomes: taking a subsequent course in the subject, majoring in the subject of the course, persistence into a second year of college, on-time graduation, and transferring from a two-year college to a four-year college.

### Taking a Subsequent Course in Subject

Table 6 displays results from Equation 1, estimating effects of instructor rank on the propensity for a student to take a subsequent class in the subject of the course using a linear probability model. I analyze results separately for four-year schools and two-year schools in columns (1)-(3) and (4)-(6) respectively and then look at aggregate results across all schools in column (7). Columns (1) and (4) display baseline specifications, which do not include any fixed effects. For both four-year and two-year colleges, estimates suggest adjuncts are associated with a lower propensity for a student to take a subsequent course in the subject, although results are imprecise for four-year schools. With the addition of course fixed effects in columns (2) and (5), results become more precisely estimated at four-year schools with similar magnitudes. At two year schools, the magnitude of estimates decreases by over half, suggesting adjuncts are significantly more likely to be teaching courses that do not tend to lead to subsequent courses taken in the subject of the course, compared to full-time counterparts. In the preferred specifications of columns (3), (6), and (7), I include student fixed effects, in addition to course fixed effects, in order to control for the possibility that students sort into instructor ranks along unobserved characteristics. The addition of student fixed effects further lowers the magnitude of estimates on the effect of adjunct versus full-time instructors on the propensity for a student to take a subsequent course, indicating controlling student sorting into instructor rank is important.

Results from the preferred specifications indicate taking a course with an adjunct decreases the propensity for a student to take a subsequent course in the same subject by 1.0 percentage points at four-year schools, which is equivalent to a 2% decrease from the baseline propensity of taking a subsequent course in the subject. At two-year colleges, taking a course with an adjunct leads to a 1.2 percentage point decrease, equivalent to a 3% decrease from the baseline. Finally, column (7) pools together four-year and two-year schools, restricting the sample to adjuncts and full-time, non-tenure-track instructors. On aggregate, results indicate taking a course with an adjunct instructor decreases the probability that a student will take a subsequent course in the subject by 0.9 percentage points, which is equivalent to a 2% decrease from the baseline propensity for first-semester college students to take a subsequent course in the subject.

Table 6: Instructor Rank on Taking a Subsequent Course in Subject

| | Four-year Schools | | | Two-Year Schools | | | Aggregate |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Ten-Track/Tenured | 0.0086 | 0.0109*** | 0.0045* | | | | |
| | (0.0136) | (0.0026) | (0.0025) | | | | |
| Adjunct | -0.0163 | -0.0178*** | -0.0104*** | -0.1059*** | -0.0334*** | -0.0117*** | -0.0091*** |
| | (0.0149) | (0.0033) | (0.0030) | (0.0110) | (0.0033) | (0.0032) | (0.0024) |
| Graduate Student | 0.0552*** | -0.0004 | -0.0053 | | | | |
| | (0.0149) | (0.0044) | (0.0044) | | | | |
| Instructor Age | -0.0013 | 0.0007 | 0.0008 | 0.0000 | -0.0011 | 0.0001 | 0.0005 |
| | (0.0033) | (0.0006) | (0.0006) | (0.0039) | (0.0011) | (0.0010) | (0.0007) |
| Instructor Age$^2$ | 0.0000 | -0.0000 | -0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 |
| Course FE | | X | X | | X | X | X |
| Student FE | | | X | | | X | X |
| *N* | 495,915 | 494,363 | 484,895 | 257,648 | 256,995 | 232,232 | 463,664 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor rank category: full-time, non-tenure-track instructors.

### Majoring in Subject of Course

Next, I look at the effects of taking a course with an adjunct versus a full-time instructor on the propensity that a student majors in the subject of the course within four years of starting school. I restrict my analysis to students at four-year colleges since students at two-year colleges do not have majors. Table 7 displays results on whether or not a student majors in the subject of the course. Column (1) displays results from a basic regression without any fixed effects. Estimates suggest taking a course with an adjunct is associated with an increased propensity for a student to major in the subject. With the addition of course fixed effects in column (2), this coefficient becomes negative, indicating adjuncts tend to teach courses in which students are more likely to eventually major in the subject of the course. In the preferred specification in column (3), which includes both course and student fixed effects, I find no significant effect of instructor rank between adjunct versus full-time instructors on the propensity for a student to major in the subject of the course within four years of entering a four-year college.

### Persistence into Second Year of College

Next, Table 8 displays results from Equation 2 for analyzing the effect of instructor rank on whether or not a student persists to a second year at a given school. I analyze results separately for four-year schools and two-year schools in columns (1)-(3) and (4)-(6) respectively and then present aggregate results across all schools in column (7). Columns (1) and (4) display estimation results from a basic regression, which do not include any fixed effects or controls. For both four-year

Table 7: Instructor Rank on Majoring in Subject

| | (1) | (2) | (3) |
|---|---|---|---|
| Tenure-Track/Tenured | 0.0319*** | 0.0019* | 0.0005 |
| | (0.0037) | (0.0010) | (0.0010) |
| Adjuncts | 0.0074** | -0.0025** | -0.0009 |
| | (0.0038) | (0.0011) | (0.0012) |
| Graduate Students | -0.0112*** | 0.0025** | 0.0012 |
| | (0.0034) | (0.0013) | (0.0016) |
| Instructor Age | 0.0026*** | 0.0004* | 0.0004* |
| | (0.0009) | (0.0002) | (0.0002) |
| Instructor Age$^2$ | -0.0000** | -0.0000* | -0.0000* |
| | (0.0000) | (0.0000) | (0.0000) |
| Course FE | | X | X |
| Student FE | | | X |
| $N$ | 445,092 | 443,401 | 435,943 |

Outcome of interest: whether student majors in subject of course. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor rank category: full-time non-tenure-track instructors.

and two-year colleges, results indicate taking a course with an adjunct as opposed to a full-time instructor in a student's first year decreases the propensity for a student to persist into a second year of college. These coefficients decrease in magnitude with the addition of course fixed effects in columns (2) and (5), indicating adjuncts tend to teach courses associated with low returns to persistence.

In the preferred specifications in columns (3), (6), and (7), I include a vector of student characteristics to control for student sorting into instructor rank along observable characteristics in ways that are correlated with persistence. I include bounds on estimates using the strategy developed by Oster (2017) to account for sorting on unobservable characteristics. At four-year schools, results are not statistically significant. The estimate indicates taking a course with an adjunct in the first semester decreases the probability of persisting into a second year by 0.7 percentage points, which represents a 0.9% decrease from the baseline rate. At two-year schools, I find taking a course with an adjunct decreases the probability of persistence by 1.7 percentage points, which represents a 3.0% decrease from the baseline rate. Pooling four-year and two-year schools together, estimates in column (7) show taking a course with an adjunct decreases persistence overall by 1.2 percentage points, a 1.8% decrease from the baseline rate of student persistence into a second year of college. Estimates of upper and lower bounds for these coefficient estimates in Table 8 indicate bounds for coefficients of interest do not include zero. This provides further support of estimate robustness to unobservable confounders, given that student fixed effects cannot be included in these specifications.

Table 8: Instructor Rank on Persistence to Second Year

| | Four-year Schools | | | Two-Year Schools | | | Aggregate |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Ten-Track/Tenured | 0.0228*** | 0.0069*** | 0.0055 | | | | |
| | (0.0037) | (0.0021) | (0.0000) | | | | |
| | | | [0.0036,0.0055] | | | | |
| Adjuncts | -0.0093** | -0.0107*** | -0.0070 | -0.0312*** | -0.0273*** | -0.0173*** | -0.0122*** |
| | (0.0047) | (0.0028) | (0.0000) | (0.0065) | (0.0030) | (0.0028) | (0.0021 |
| | | | [-0.0070,-0.0047] | | | [-0.0173,-0.0139] | [-0.0122,-0.0101] |
| Graduate Students | -0.0028 | 0.0000 | 0.0011 | | | | |
| | (0.0047) | (0.0036) | (0.0000) | | | | |
| | | | [0.0010,0.0011] | | | | |
| Instructor Age | -0.0003 | 0.0003 | 0.0002 | -0.0055*** | -0.0012 | -0.0007 | -0.0001 |
| | (0.0009) | (0.0005) | (0.0000) | (0.0019) | (0.0009) | (0.0008) | (0.0006) |
| Instructor Age$^2$ | 0.0000 | -0.0000 | -0.0000 | 0.0001*** | 0.0000 | 0.0000 | 0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | | -0.0432 | | | -0.0549*** | -0.0521*** |
| | | | (0.0000) | | | (0.0025) | (0.0015) |
| Part-time | | | -0.1289 | | | -0.1220*** | -0.1249*** |
| | | | (0.0000) | | | (0.0033) | (0.0026) |
| Age | | | -0.0136 | | | 0.0048*** | 0.0050*** |
| | | | (0.0000) | | | (0.0015) | (0.0012) |
| In-State Tuition | | | 0.1106 | | | 0.0738*** | 0.0987*** |
| | | | (0.0000) | | | (0.0063) | (0.0028) |
| Transfer Student | | | 0.0291 | | | 0.0210*** | 0.0192*** |
| | | | (0.0000) | | | (0.0028) | (0.0022) |
| Course FE | | X | X | | X | X | X |
| Student Controls | | | X | | | X | X |
| $N$ | 606,683 | 606,683 | 585,734 | 321,233 | 321,233 | 319,353 | 644,614 |

Outcome of interest: whether student persists into second year of college. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

## Graduation

Table 9 shows estimation results from Equation 2 on the effect of instructor rank on whether a student graduates on time. I define on-time graduation as obtaining a bachelor's degree within four years at four-year colleges and obtaining an associate's degree within two years at two-year colleges. Columns (1) and (4) display estimation results from a basic regression, which do not include any course-level or student-level fixed effects or controls. At both four-year and two-year colleges, I find adjunct instructors are linked with lower propensities of on-time graduation, compared to full-time non-tenure-track counterparts. For four year colleges, this coefficient increases considerably and becomes statistically significant with the addition of course fixed effects in column (2), indicating a significant amount of within-course differences in outcomes by instructor rank. At two year colleges, I find a decrease coefficient magnitude in column (5), indicating similar adjunct assignment trends to courses.

Columns (3), (6), and (7) display the preferred specification, which includes both course fixed effects and controls for a vector of student characteristics. I include a vector of student characteristics to control for student sorting into instructor rank along observable characteristics in ways that are correlated with graduation rates. I assess the degree of sorting on unobservables using the bounds test from Oster (2017). At four-year colleges, taking a course with an adjunct decreases the propensity a student will graduate with a bachelor's degree within four years by 1.6 percentage points at 5.5% decrease from baseline rates. At two-year colleges, taking a course with an adjunct decreases the propensity a student will graduate with an associate's degree within four years by 1.4 percentage points, a 15.5% increase from baseline. On aggregate, taking a course with an adjunct as opposed to a full-time instructor in a student's first semester of college decreases the propensity of graduating on-time by 1.4 percentage points, representing a 10% decrease from baseline on-time graduation rates. Estimates of upper and lower bounds for these coefficient estimates in Table 8 indicate bounds for coefficients of interest do not include zero, providing further support of estimate robustness.

### Transferring to Four-year College

Next, I look at the effects of adjunct instructors in the first semester of college on the propensity that two-year college students transfer to a four-year college within three years. I only observe students transferring if they go to a public four-year college in Arkansas, as opposed to a college outside of Arkansas or a private college within Arkansas. However, this may still be a useful metric because there is strong incentive for students at two-year colleges to transfer to public four-year colleges since course credits are guaranteed to transfer within public schools in-state[11]. Additionally, conditional on transferring, the majority of community college students transfer to a public four-year college (Jenkins and Fink 2015). Table 10 displays results from Equation 2 on whether or not a student eventually transfers to a four-year college within three years of starting at a two-year school. Column (1) displays results from a basic regression without any fixed effects. Results suggest adjuncts in a student's first semester are associated with a lower propensity of transferring. With the addition of course fixed effects in column (2), this coefficient becomes

[11] https://www.adhe.edu/students-parents/colleges-universites/transfer-info.-for-students/

Table 9: Instructor Rank on Graduating on Time

| | Four-year Schools | | | Two-Year Schools | | | Aggregate |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Ten-Track/Tenured | 0.0629*** | 0.0165*** | 0.0162*** | | | | |
| | (0.0055) | (0.0031) | (0.0030) | | | | |
| | | | [0.0131,0.0162] | | | | |
| Adjuncts | -0.0086 | -0.0210*** | -0.0164*** | -0.0271*** | -0.0183*** | -0.0138*** | -0.0138*** |
| | (0.0058) | (0.0033) | (0.0032) | (0.0027) | (0.0016) | (0.0016) | (0.0017) |
| | | | [-0.0164,-0.0114] | | | [-0.0138,-0.0122] | [-0.0138,-0.0123] |
| Graduate Students | -0.0179** | 0.0027 | 0.0048 | | | | |
| | (0.0072) | (0.0051) | (0.0051) | | | | |
| | | | [0.0048,0.0057] | | | | |
| Instructor Age | -0.0004 | -0.0001 | -0.0001 | -0.0004 | 0.0002 | 0.0004 | 0.0003 |
| | (0.0012) | (0.0007) | (0.0007) | (0.0008) | (0.0005) | (0.0005) | (0.0006) |
| Instructor Age$^2$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Gender | | | -0.0757*** | | | -0.0181*** | -0.0433*** |
| | | | (0.0017) | | | (0.0015) | (0.0017) |
| Part-time | | | -0.1297*** | | | -0.0587*** | -0.0746*** |
| | | | (0.0031) | | | (0.0017) | (0.0016) |
| Age | | | -0.0022*** | | | 0.0160*** | 0.0159*** |
| | | | (0.0008) | | | (0.0005) | (0.0005) |
| In-State Tuition | | | 0.0021 | | | 0.0016 | -0.0012 |
| | | | (0.0022) | | | (0.0035) | (0.0024) |
| Transfer Student | | | 0.0839*** | | | 0.0365*** | 0.0458*** |
| | | | (0.0028) | | | (0.0019) | (0.0017) |
| Course FE | | X | X | | X | X | X |
| Student Controls | | | X | | | X | X |
| *N* | 454,662 | 454,662 | 437,856 | 321,233 | 321,233 | 319,353 | 558,723 |

Outcome of interest: whether a student graduates on time. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

larger in magnitude, indicating the decrease in propensity to transfer associated with adjuncts is not driven by adjuncts teaching courses that are less conducive to transferring. In the preferred specification in column (3), which includes both course and student fixed effects, the magnitude of the coefficient on adjuncts remains negative but decreases, indicating students who are less likely to transfer may be selecting into classes with adjuncts. Results indicate taking a class with an adjunct as opposed to a full-time instructor results in an 8.1% decrease from baseline transfer rates.

### Summary of Results

In this section, I analyzed effects of taking courses with adjunct versus full-time instructors on a variety of student outcomes at four-year and two-year colleges. Overall, I find that adjunct instructors have worse student outcomes on a variety of outcomes. Taking a course with an adjunct reduces the propensity that students will take a subsequent course in the subject, decreases

Table 10: Instructor Rank on Transferring to Four-year College

| | (1) | (2) | (3) |
|---|---|---|---|
| Adjuncts | -0.0157*** | -0.0224*** | -0.0128*** |
| | (0.0044) | (0.0023) | (0.0021) |
| | | | [-0.0128,-0.0097] |
| Instructor Age | -0.0038*** | -0.0007 | 0.0001 |
| | (0.0014) | (0.0007) | (0.0007) |
| Instructor Age$^2$ | 0.0000*** | 0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| Male | | | 0.0044** |
| | | | (0.0019) |
| Part-time | | | -0.0685*** |
| | | | (0.0023) |
| Age | | | -0.0048*** |
| | | | (0.0014) |
| In-State Tuition | | | 0.0683*** |
| | | | (0.0054) |
| Transfer Student | | | 0.0727*** |
| | | | (0.0023) |
| Course FE | | X | X |
| Student Controls | | | X |
| *N* | 273,272 | 273,272 | 271,918 |

Outcome of interest: whether two-year college student transfers to a four-year college. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

propensity of persisting into a second year of college, decreases the probability of graduating on time, and for two-year college students, decreases the probability of transferring to a four-year school. I find no significant effects of instructor rank on whether four-year college students major in the subject of the course .

## III.C Heterogeneity Analysis

Results from the previous section indicate students have worse outcomes when taking courses with adjuncts, compared to full-time, non-tenure-track instructors. To better understand the context and mechanism by which these effects operate, I look at how effects vary across a variety of characteristics in this section.

### III.C.1 Heterogeneity by Adjunct Course Load

I first look at whether adjunct teaching quality varies by instructor course load. One hypothesis that has been put forward is that adjuncts who hold concurrent professional jobs may have positive effects on students if they bring industry-relevant perspectives and advice to the classroom (Monks 2009). I do not observe directly in the data whether instructors work outside jobs, but it is likely they would teach lighter course loads if they have primary employment elsewhere. Alternatively, adjuncts teaching lighter loads may have negative effects if these instructors are negatively selected and generally called in to fill courses that are left over after more preferred adjuncts have filled up their schedules. There could also be negative effects on teaching outcomes if adjuncts themselves are not negatively selected, but having a lighter course load creates more stress for individuals who would like to work more but are underemployed, or if perhaps this exacerbates other institutional differences (even lower likelihood of having office space, less involvement with institutional affairs, etc.), which in turn negatively affects teaching.

To test these hypotheses, I include an interaction term in the main analyses in Equations 1 and 2 for whether the instructor teaches a light course load or a very light load. I classify an instructor as teaching a light load in a given semester if they teach one or two courses in a semester and I classify them as teaching a very light load if they only teach one course. Tables 11 and 12 display subject-specific estimation results looking at heterogeneous results by adjunct teaching load. Table 11 looks at differential effects by whether an adjunct teaches a light load and Table 12 looks at effects by whether an adjunct teaches a very light load. Results from both tables indicate students taking courses from adjuncts with lighter teaching loads have a lower propensity of taking a subsequent course in the subject than those taking courses with adjuncts with heavier teaching loads, even controlling for student and course fixed effects. Students taking courses with adjuncts teaching light loads are .6 percentage points less likely to take a subsequent course in the subject compared to students with adjuncts who teach heavier course loads, a 1.5% decrease. Similarly, students taking courses with adjuncts teaching very light loads are 1.1 percentage points less likely to take a subsequent course in the subject, a 2.7% decrease. I find no difference in effect of adjuncts by teaching load on the propensity for a student to major in the subject of the course. This is not surprising given there were no differences in effects between adjuncts and full-time instructors on that propensity.

Next, Tables 13 and 14 display estimation results for non-subject-specific outcomes by adjunct

Table 11: Heterogeneity by Course Load (Light Load): Subject-Specific Outcomes

| | Next Course | | | Major |
|---|---|---|---|---|
| | Aggregate | 4yr School | 2yr School | 4yr School |
| Adjunct | -0.0079** | 0.0027 | -0.0163*** | -0.0005 |
| | (0.0032) | (0.0049) | (0.0041) | (0.0016) |
| Adjunct×Light Load | -0.0061* | -0.0189*** | 0.0043 | 0.0006 |
| | (0.0032) | (0.0050) | (0.0042) | (0.0017) |
| Instructor Age | 0.0012* | 0.0015 | 0.0012 | -0.0003 |
| | (0.0007) | (0.0010) | (0.0011) | (0.0003) |
| Instructor Age$^2$ | -0.0000* | -0.0000 | -0.0000 | 0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Course FE | X | X | X | X |
| Student FE | X | X | X | X |
| *N* | 389,901 | 200,072 | 189,829 | 185,055 |

Outcomes of interest: whether student takes subsequent course in subject or whether student majors in subject of course. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Light load: teaching ≤2 courses in a semester.

Table 12: Heterogeneity by Course Load (Very Light Load): Subject-Specific Outcomes

| | Next Course | | | Major |
|---|---|---|---|---|
| | Aggregate | 4yr School | 2yr School | 4yr School |
| Adjunct | -0.0081*** | -0.0077* | -0.0097*** | 0.0001 |
| | (0.0028) | (0.0043) | (0.0037) | (0.0014) |
| Adjunct×Very Light Load | -0.0110*** | -0.0021 | -0.0222*** | -0.0007 |
| | (0.0037) | (0.0056) | (0.0050) | (0.0019) |
| Instructor Age | 0.0012* | 0.0015 | 0.0012 | -0.0003 |
| | (0.0007) | (0.0010) | (0.0011) | (0.0003) |
| Instructor Age$^2$ | -0.0000* | -0.0000* | -0.0000 | 0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Course FE | X | X | X | X |
| Student FE | X | X | X | X |
| *N* | 389,901 | 200,072 | 189,829 | 185,055 |

Outcomes of interest: whether student takes subsequent course in subject or whether student majors in subject of course. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted category: full-time non-tenure-track instructors. Very light load: teaching 1 course in a semester.

teaching load. Results from both analyses indicate adjuncts teaching lighter loads have lower student persistent rates than counterpart adjuncts teaching higher loads. Coefficient estimates also indicate taking courses with adjuncts teaching lighter loads leads to lower on-time graduation rates, although bounds on these estimates include zero, indicating estimates may be driven by selection on unobservables. Finally, I also find evidence that taking courses with adjuncts teaching lighter loads decreases the propensity for two-year college students to transfer to a four-year school within three years of starting college, compared to taking courses with adjuncts teaching heavier loads.

Table 13: Heterogeneity by Course Load (Light Load): Non-Subject-Specific Outcomes

| | Persistence | | | Graduation | | | Transfer |
|---|---|---|---|---|---|---|---|
| | Aggregate | 4yr | 2yr | Aggregate | 4yr | 2yr | 2yr |
| Adjunct | -0.0068** | -0.0011 | -0.0124*** | -0.0109*** | -0.0134*** | -0.0105*** | -0.0048* |
| | (0.0031) | (0.0044) | (0.0042) | (0.0022) | (0.0047) | (0.0021) | (0.0028) |
| | [-0.0068,0.0006] | [-0.0011,0.0047] | [-0.0124,-0.0035] | [-0.0109,-0.0064] | [-0.0134,-0.0094] | [-0.0042,0.0023] | [-0.0048,0.0048] |
| Adj.×Light Load | -0.0091*** | -0.0080* | -0.0104** | -0.0041* | -0.0048 | -0.0042** | -0.0124*** |
| | (0.0031) | (0.0043) | (0.0043) | (0.0021) | (0.0048) | (0.0019) | (0.0030) |
| | [-0.0091,-0.0016] | [-0.0080,-0.0046] | [-0.0104,-0.0000] | [-0.0041,0.0034] | [-0.0048,0.0045] | [-0.0042,0.0023] | [-0.0124,-0.0043] |
| Instructor Age | -0.0002 | 0.0005 | -0.0010 | 0.0004 | 0.0004 | 0.0004 | 0.0002 |
| | (0.0007) | (0.0009) | (0.0010) | (0.0006) | (0.0011) | (0.0005) | (0.0007) |
| Instructor Age2 | 0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | -0.0509*** | -0.0499*** | -0.0513*** | -0.0459*** | -0.0755*** | -0.0183*** | 0.0065*** |
| | (0.0015) | (0.0019) | (0.0024) | (0.0017) | (0.0024) | (0.0015) | (0.0021) |
| Part-time | -0.1229*** | -0.1313*** | -0.1190*** | -0.0741*** | -0.1154*** | -0.0574*** | -0.0702*** |
| | (0.0028) | (0.0044) | (0.0035) | (0.0017) | (0.0040) | (0.0017) | (0.0025) |
| Age | -0.0064*** | -0.0098*** | -0.0056*** | -0.0034*** | -0.0117*** | -0.0022*** | -0.0133*** |
| | (0.0007) | (0.0011) | (0.0009) | (0.0004) | (0.0012) | (0.0004) | (0.0006) |
| In-State Tuition | 0.1023*** | 0.1062*** | 0.0871*** | -0.0029 | -0.0011 | 0.0000 | 0.0643*** |
| | (0.0030) | (0.0032) | (0.0068) | (0.0025) | (0.0031) | (0.0037) | (0.0049) |
| Transfer Student | 0.0174*** | 0.0168*** | 0.0215*** | 0.0446*** | 0.0762*** | 0.0340*** | 0.0734*** |
| | (0.0023) | (0.0038) | (0.0030) | (0.0018) | (0.0038) | (0.0019) | (0.0024) |
| Course FE | X | X | X | X | X | X | X |
| Student Controls | X | X | X | X | X | X | X |
| *N* | 559,101 | 291,543 | 267,558 | 483,630 | 216,072 | 267,558 | 229,142 |

Outcomes of interest: whether a student persists into a second year of college, graduates on time, or transfers to a four-year school. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted category: full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Light load: teaching ≤2 courses in a semester. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

Overall, results indicate adjuncts teaching lighter course loads have worse student outcomes on a number of margins compared to adjuncts teaching heavier loads: propensity to take a subsequent course in the subject, college persistence rates, and propensity for two-year college students to transfer to a four-year college. I find no statistically significant effects by adjunct course load on the propensity for students to major in the subject of a course or graduate on time. These findings are consistent with both a story in which adjuncts are negatively selected and one in which they have worse working conditions. The heterogeneity effects by course load are consistent with the first scenario because I would expect adjuncts teaching lighter course loads to have worse outcomes since they are presumably more negatively selected than adjuncts who were given more courses. They are also consistent with the second story because these adjuncts may have less ideal working conditions in terms of compensation and institutional resources/involvement. In the next section, I delve further into understanding the mechanisms driving these effects.

Table 14: Heterogeneity by Course Load (Very Light Load): Non-Subject-Specific Outcomes

| | Persistence | | | Graduation | | | Transfer |
|---|---|---|---|---|---|---|---|
| | Aggregate | 4yr | 2yr | Aggregate | 4yr | 2yr | 2yr |
| Adjunct | -0.0099*** | -0.0049 | -0.0150*** | -0.0130*** | -0.0175*** | -0.0121*** | -0.0091*** |
| | (0.0027) | (0.0038) | (0.0037) | (0.0019) | (0.0041) | (0.0018) | (0.0025) |
| | [-0.0099,-0.0062] | [-0.0049,-0.0029] | [-0.0150,-0.0099] | [-0.0130,-0.0109] | [-0.0175,-0.0169] | [-0.0121,-0.0098] | [-0.0091,-0.0043] |
| Ad×V.Light Load | -0.0072** | -0.0027 | -0.0131*** | -0.0005 | 0.0036 | -0.0028 | -0.0106*** |
| | (0.0032) | (0.0044) | (0.0046) | (0.0026) | (0.0055) | (0.0020) | (0.0032) |
| | [-0.0072,-0.0022] | [-0.0027,-0.0003] | [-0.0131,-0.0064] | [-0.0005,0.0043] | [0.0036,0.0101] | [-0.0028,0.0014] | [-0.0106,-0.0052] |
| Instructor Age | -0.0003 | 0.0005 | -0.0009 | 0.0004 | 0.0005 | 0.0004 | 0.0002 |
| | (0.0007) | (0.0009) | (0.0010) | (0.0006) | (0.0011) | (0.0005) | (0.0007) |
| Instructor Age$^2$ | 0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | -0.0509*** | -0.0499*** | -0.0513*** | -0.0459*** | -0.0755*** | -0.0183*** | 0.0064*** |
| | (0.0015) | (0.0019) | (0.0024) | (0.0017) | (0.0024) | (0.0015) | (0.0021) |
| Part-time | -0.1231*** | -0.1314*** | -0.1191*** | -0.0742*** | -0.1155*** | -0.0575*** | -0.0705*** |
| | (0.0028) | (0.0044) | (0.0035) | (0.0017) | (0.0040) | (0.0017) | (0.0025) |
| Age | -0.0064*** | -0.0098*** | -0.0056*** | -0.0034*** | -0.0117*** | -0.0022*** | -0.0133*** |
| | (0.0007) | (0.0011) | (0.0009) | (0.0004) | (0.0012) | (0.0004) | (0.0006) |
| In-State Tuition | 0.1023*** | 0.1062*** | 0.0871*** | -0.0029 | -0.0011 | 0.0000 | 0.0643*** |
| | (0.0030) | (0.0032) | (0.0068) | (0.0025) | (0.0031) | (0.0037) | (0.0049) |
| Transfer Student | 0.0173*** | 0.0167*** | 0.0215*** | 0.0446*** | 0.0761*** | 0.0340*** | 0.0734*** |
| | (0.0023) | (0.0038) | (0.0030) | (0.0018) | (0.0038) | (0.0019) | (0.0024) |
| Course FE | X | X | X | X | X | X | X |
| Student Controls | X | X | X | X | X | X | X |
| *N* | 559,101 | 291,543 | 267,558 | 483,630 | 216,072 | 267,558 | 229,142 |

Outcomes of interest: whether a student persists into a second year of college, graduates on time, or transfers to a four-year school. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted category: full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Very light load: teaching 1 course in a semester. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

### III.C.2 Other Heterogeneity Measures

To further explore the roles of instructor selection and/or institutional differences in treatment in driving differences in teaching outcomes across instructor rank, I assess how labor supply affects adjunct quality. Namely, I hypothesize that people teaching in fields or locations in which potential instructors have worse outside employment options will be able to get better adjuncts relative to full-time instructors. This is because adjuncts have significantly worse compensation compared to full-time counterparts, so it will be easier to incentivize good workers to be adjuncts rather than full-time employees when there are fewer competing employment opportunities.

To investigate the role of location/field-specific labor market conditions, I look at whether teaching outcomes for adjunct instructors vary by whether they teach in a STEM (Science, Technology, Engineering, Math) field, local unemployment rates, and how urban a school's location is. Since STEM fields on average have better pay (Arcidiacono 2004, Kinsler and Pavan 2015, Melguizo and Wolniak 2012), it may be more difficult to incentivize high ability STEM workers to teach as an adjunct relative to full-time positions since they have higher-paying outside options. Thus, I hypothesize that if inherent differences in instructor quality drive differences in teaching outcomes by instructor rank, the difference in teaching quality between adjunct and full-time instructors should be smaller in non-STEM subjects. In a similar vein, when local labor market conditions are bad, as proxied by time-varying local unemployment rates, colleges may be able to hire better instructors to teach as adjuncts. Similarly, colleges may have better access to high-quality adjuncts in urban locations, where there is more likely to be a large labor supply of highly educated workers to fill these positions.

Results for the above analyses reveal no statistically significant effects of the role location/field-specific labor market conditions on how adjuncts relative to full-time instructors affect student outcomes: I find no difference between STEM vs. non-STEM adjunct instructors, by unemployment rates in the local labor market, or by urban vs. rural locations on teaching effects. Detailed analysis results can be found in Appendix B. While not definitive, these findings do suggest that factors other than inherent differences in labor quality between adjuncts and full-time instructors may drive differences in teaching quality between instructor rank. The next section explores the role alternative an alternative channel leading to differences in teaching outcomes by instructor rank in more detail.

# IV Effects of Changing Instructor Rank

In Section III, I find that adjunct instructors have worse effects on student outcomes than full-time counterparts on a number of different metrics. Furthermore, I find that the relative teaching quality of adjuncts relative to full-time instructors does not vary based on field- or location-specific labor market conditions, which suggests factors other than differences in worker ability are potentially influencing teaching outcomes by instructor rank. One possible mechanism is that adjuncts have worse student outcomes because they have less favorable employment conditions than full-time counterparts, which may negatively affect teaching outcomes. For example, typically they earn less, have less institutional involvement, qualify for fewer workplace benefits, and sometimes do not have their own offices. This mechanism is also consistent with adjuncts teaching lighter course loads having worse outcomes, as these issues are likely exacerbated for these instructors.

In this section, I analyze whether and to what extent instructor teaching quality may be affected by instructor rank by looking at whether changing an instructor's rank improves their teaching outcomes. I first provide an overview of the research question in this section and next discuss the empirical strategy. Finally, I present results and robustness checks.

## IV.A Overview

In the data, 6,924 instructors teach as adjuncts at some point between 2004 and 2011. Of these instructors, 1,301 (19%) also appear as full-time instructors at some point.[12] To identify the effect of changing instructor rank on student outcomes, I exploit variation in rank among the set of instructors who appear as both adjunct and full-time during the sample period in the data. One thing to note is that this is a selected sample, as some instructors in the data may not be able to become full-time if they do not meet certain institution-specific requirements of full-time instructors (having a PhD or first professional degree, for example). Thus, I interpret the analysis results as applying to the set of instructors who are eligible for full-time positions.

Table 15 displays descriptive statistics for adjunct instructors who switch to full time at some point, compared to those who never switch in the time horizon of the data. Instructors appear in Table 15 once for each term in my data in which they are teaching. I find that instructors who switch at some point teach more classes while they are adjuncts and earn significantly more on average while they are adjuncts than their counterparts who never switch. Switchers teach on average 2.39 courses per semester and earn $18,717 for nine months while they are adjunct in the data, compared to Never Switchers, who teach on average 2.03 courses and earn $12,416 for nine months salary.

Table 15: Descriptive Outcomes for Adjuncts by Rank Switching

| | Switchers | Never Switchers |
|---|---|---|
| Male | 0.48 | 0.47 |
| Age | 47.00 | 46.74 |
| | (11.38) | (12.18) |
| Number of Courses Taught | 2.39 | 2.03*** |
| | (1.40) | (1.17) |
| Salary (9-month) | 18,717 | 12,416*** |
| | (18231.21) | (16920.05) |
| *N* | 4,725 | 19,379 |

Observations denote instructor-term units. Standard deviations in parentheses. For each set of outcomes, I perform a two-sample test of proportions or a t-test between adjuncts who switch to full-time at some point and those who never switch. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

[12] Of these instructors, approximately 55% teach at four-year schools and 45% teach at two-year schools.

Next, Table 16 looks at instructors who switch rank and documents descriptively how outcomes for instructors differ between when they were full-time vs. adjunct. Numbers in the table do not represent causal measurements since I do not take into account the possibility that better instructors may spend more time in the data as full-time in the sample, that instructors may get assigned a different set of courses when they are full-time versus when they are adjuncts, or that they may attract a different set of students depending on their employment rank. However, these values do provide an overview of trends in the data. For most outcomes in Table 16, instructors have better outcomes as full-time compared to adjunct, although this does not hold at four-year schools for taking another course in the subject or majoring in the subject of interest.

Table 16: Descriptive Outcomes for Instructors Who Switch Ranks

| | Four-year Schools | | Two-Year Schools | | Aggregate | |
|---|---|---|---|---|---|---|
| | Full-time | Adjunct | Full-time | Adjunct | Full-time | Adjunct |
| Take subsequent in subject | 0.446 | 0.525*** | 0.398 | 0.305*** | 0.422 | 0.418 |
| Persistence after first year | 0.784 | 0.771*** | 0.572 | 0.501*** | 0.677 | 0.637 *** |
| Majors in subject | 0.037 | 0.048 *** | | | | |
| On-time Graduation | 0.186 | 0.185 | 0.091 | 0.060 *** | 0.138 | 0.123 *** |
| Transfer to four-year school | | | 0.160 | 0.145 *** | | |
| $N$ | 55,547 | 28,930 | 56,545 | 28,535 | 112,092 | 57,465 |

Observations denote student-class units. For each set of outcomes, I perform a two-sample test of proportions to analyze whether descriptive statistics differ for full-time vs. adjunct instructors. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

## IV.B Empirical Strategy

This section analyzes the effect of changing an instructor's rank from adjunct to full-time on student outcomes. As in Section III, since the nature of tenure-track jobs often consists of different demands and/or qualifications from non-tenure-track jobs (e.g. academic research), I focus on full-time non-tenure-track instructors. Once again, I look at both subject-specific and non-subject-specific outcomes. Subject-specific outcomes include taking a subsequent course in the subject and majoring in the subject of the course. Non-subject-specific outcomes include retention after the first year, on-time graduation, and transferring to a four-year college.

### Subject-Specific Outcomes

For subject-specific outcomes, I estimate the following equation:

$$Y_{icrjst} = \beta F_{crjst} + \alpha_i + \rho_r + \phi_j + \gamma_1 A_{crjst} + \gamma_2 A^2_{crjst} + \epsilon_{icrsjt} \tag{3}$$

where $Y_{icrjt}$ represents the outcome of interest for individual $i$ in class $c$ of course $r$ in school $s$with instructor $j$ in academic year $t$. The variable of interest, $F_{crjst}$ denotes whether instructor $j$ is full-time at time $t$, and subsequently $\beta$ measures how much a student's outcome would change if her instructor were full-time, as opposed to if that same instructor were an adjunct.

The inclusion of a student fixed effect, $\alpha_i$, accounts for the possibility that students sort non-randomly into certain types of instructors based on rank. Since I focus on students in their first semester of college, the student fixed effects also absorb temporal shocks that may affect outcomes independently of instructor rank. For example, if an institution receives a large grant, this may mean they have the resources to promote more instructors to full-time, as well as to spend more resources on classroom technology.

Additionally, course fixed effects, $\rho_r$, control for the possibility that the types of courses instructors teach change when they become full-time faculty. Since courses are institution-specific, these fixed effects also account for any institution-specific factors that maybe be driving outcomes of interest. I include an instructor fixed effect, $\phi_j$, to control for inherent unobservable differences across instructors by employment rank. This fixed effect restricts the analysis to comparisons of differences in outcomes for the same instructor before and after switching ranks, ensuring that differences are not, for example, due to better instructors getting hired as full-time. Finally, as in Equation 1, I include continuous controls for instructor's age and age squared, $A_{crjst}$ and $A^2_{crjst}$, respectively as proxies for experience. This ensures teaching outcomes associated with changing instructor rank are not being driven by changes in teaching quality over time. Appendix C provides robustness checks using alternative experience proxies. I cluster standard errors at the instructor level.

**Non-Subject-Specific Outcomes**

For non-subject-specific outcomes, I estimate the following equation:

$$Y_{icrjst} = \beta F_{crjst} + \rho_r + \phi_j + \delta' X_i + \tau_t + (\eta \times \tau)_{st} + \gamma_1 A_{crjst} + \gamma_2 A^2_{crjst} + \epsilon_{crjst} \tag{4}$$

where as before, $Y_{icrjt}$ represents the outcome of interest for individual $i$ in class $c$ of course $r$ in school $s$ with instructor $j$ in academic year $t$. The setup of this specification is similar to that of

Equation 3 for subject-specific outcomes, with the variable of interest, $F_{jt}$, denoting an indicator for whether instructor $j$ is full-time at time $t$. Subsequently $\beta$ measures how much a student's outcome would change if her instructor were full-time, as opposed to if that same instructor were an adjunct.

Course fixed effects, $\rho_r$, account for the possibility that the types of courses instructors teach change when switch ranks. I include an instructor fixed effect, $\phi_j$, to control for inherent unobservable differences across instructors by employment rank. This fixed effect restricts the analysis to comparisons of differences in outcomes for the same instructor before and after switching ranks, ensuring that differences are not, for example, due to better instructors getting hired as full-time . Additionally, I include a vector of student characteristics, $\delta' X_i$. As there is no within-student variation for non-subject-specific outcomes, it does not make sense to include student fixed effects in the context of this analysis. Since courses are school-specific, the addition of course fixed effects takes into account any systematic differences across schools that could be driving results. However, without student fixed effects, there are no time controls for time-varying shocks that could be affecting both the propensity for individuals to change rank and student outcomes. Thus, $\tau_t$ denotes time fixed effects , and $(\eta \times \tau)_{st}$ interacts these fixed effects with an individual's school. As in previous specifications, standard errors are clustered at the instructor level.

## IV.C Results

I present results analyzing effects of changing an instructor's rank on the following student outcomes: taking a subsequent course in the subject, majoring in the subject of the course, persistence into a second year of college, on-time graduation, and transferring from a two-year college to a four-year college.

### Taking a Subsequent Course in Subject

Table 17 displays results from Equation 3, measuring the effect of changing instructor rank on whether an instructor's students take a subsequent course in the subject. I first analyze results separately for four-year schools and two-year schools in columns (1)-(3) and (4)-(6) respectively and then look at aggregate results across both types of schools in column (7). Columns (1) and (4) display baseline specifications, which do not include any fixed effects. At both four-year and two-year colleges, baseline estimates indicate a positive effect of instructors becoming full-time on student outcomes, although results are not statistically significant at four-year colleges. With the addition of course and student fixed effects in columns (2) and (5), the magnitude of these effects decrease by more than half at both two-yer and four-year colleges, which suggests the set of courses and/or students instructors teach when the become full-time tends to have a higher rate of taking a subsequent course in the subject. In the preferred specifications in columns (3), (6), and (7), I include instructor fixed effects, in addition to course and student fixed effects. The inclusion of instructor fixed effects ensures differences in the effect of adjunct and full-time instructors are not simply capturing the fact that individuals with different teaching quality tend to get hired as adjunct compared to full-time. At four-year colleges, estimation results with an instructor fixed effect more than double the magnitude of coefficient estimates, indicating changes in teaching quality associated with instructors changing rank actually contribute to increasing the total differences between full-time and adjunct instructors. At two year colleges, the inclusion of an instructor fixed effect produces results that are still positive, but no longer statistically significant.

Overall, results indicate that at four-year colleges, an instructor moving from adjunct to full time increases the propensity students will take a subsequent course in the subject by 1.7 percentage points, which represents a 3.2% increase from the baseline propensity of 52.5% for students to take a subsequent course in the subject, conditional on taking the course with an adjunct who switches to full-time at some point during the sample period. I find no statistically significant effect of instructors changing ranks on student outcomes at two-year colleges, although the estimated coefficient value is positive. On aggregate, pooling four-year and two-year schools together, I find that when an instructor switches from adjunct to full-time, the propensity for students to take a subsequent course in the subject increases by a statistically significant 1.3 percentage points, or 3.1%.

**Majoring in Subject of Course**

Next, I look at the effects of an instructor switching from adjunct to full-time on the propensity for a student to major in the subject of the course within four years. I restrict my analysis to students at four-year colleges since students at two-year colleges do not have majors. Table 18 displays results from Equation 3 on whether a student majors in the subject of the course. Column (1) displays results from a basic regression without any fixed effects. Results indicate instructor rank does not have a statistically significant effect on the propensity for students to major in the subject of the course. With the addition of student fixed effects in column (2), this effect remains statistically insignificant. In the preferred specification in column (3), which includes

Table 17: Changing Instructor Rank on Taking Subsequent Course

| | Four-year Schools | | | Two-Year Schools | | | Aggregate |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Full-time | 0.0179 | 0.0060* | 0.0170** | 0.0789*** | 0.0115*** | 0.0039 | 0.0125** |
| | (0.0141) | (0.0036) | (0.0074) | (0.0101) | (0.0033) | (0.0087) | (0.0054) |
| Instructor Age | -0.0030 | 0.0008 | 0.7822 | 0.0010 | 0.0002 | 0.1771 | 0.4509 |
| | (0.0046) | (0.0010) | (587.7525) | (0.0036) | (0.0010) | (265.8763) | (543.1236) |
| Instructor Age$^2$ | 0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0000 | 0.0000 |
| | (0.0001) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Course FE | | X | X | | X | X | X |
| Student FE | | X | X | | X | X | X |
| Instructor FE | | | X | | | X | X |
| *N* | 249,897 | 215,925 | 215,514 | 241,499 | 216,105 | 215,621 | 431,211 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Units represent instructor-student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. The omitted category is full-time non-tenure-track instructors.

course, student, and instructor fixed effects, I find no significant effect of instructor rank between adjunct versus full-time instructors on the propensity for a student to major in the subject of the course within four years of entering college.

Table 18: Changing Instructor Rank on Majoring in Subject

| | (1) | (2) | (3) |
|---|---|---|---|
| Full-time | -0.0043 | -0.0001 | 0.0031 |
| | (0.0035) | (0.0011) | (0.0029) |
| Instructor Age | 0.0012 | -0.0001 | -0.0501 |
| | (0.0011) | (0.0003) | (112.7570) |
| Instructor Age$^2$ | -0.0000 | 0.0000 | 0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| Course FE | | X | X |
| Student FE | | X | X |
| Instructor FE | | | X |
| *N* | 228,653 | 201,570 | 201,197 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Units represent instructor-student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. The omitted category is full-time non-tenure-track instructors.

**Persistence into Second Year of College**

Table 19 displays results from Equation 4 and analyzes the effect of changing instructor rank on whether an instructor's students take a subsequent course in the subject. I analyze results separately for four-year schools and two-year schools in columns (1)-(3) and (4)-(6), respectively, and then look at aggregate results across both types of schools in column (7). Columns (1) and (4) display baseline specifications, which do not include any fixed effects or student controls. At both four-year and two-year colleges, baseline estimates indicate a positive effect of instructors becoming full-time on student outcomes, although results are not statistically significant at four-year colleges. Next, I add in course fixed effects and controls for student observables in columns (2) and (5). Since persistence is non-subject-specific, there is no variation in outcomes within students, which is why this observation uses student controls rather than fixed effects. As before, student controls include gender, part-time versus full-time status, age, in-state vs. out-of-state tuition, whether or not the individual is a transfer student, and high school graduation year. With the addition of course fixed effects and student controls, the magnitude of these effects decrease by more than half at both two-yer and four-year colleges, which suggests the set of courses and/or students instructors teach when they become full-time tends to have a higher rate of taking a subsequent course in the subject.

In the preferred specifications in columns (3), (6), and (7), I include instructor fixed effects, in addition to course and instructor fixed effects. At four-year colleges, estimation results with an instructor fixed effect more than double the magnitude of coefficient estimates. At two year colleges, the inclusion of an instructor fixed effect produces results that are still positive, but no longer statistically significant. Overall, I find positive coefficient estimates on the effect of an instructor switching from adjunct to full-time on student persistence at both four-year and two-year colleges. However, these results are not statistically significant at four-year colleges and only weakly significant at two-year colleges, which may be due to power limitations since I estimate these results using three high-level fixed effects and work with a restricted samples of instructors who switch rank.

In aggregate results for both four-year both two-year schools, I do find statistically significant positive effects to an instructor switching from adjunct to full-time on student persistence. Namely, when an adjunct becomes full-time, the probability of a student in his or her class persisting into a second year of college increases by 0.9 .percentage points, which represents a 1.4% increase in baseline student persistence rates, suggesting previous insignificant results were affected by sample size issues driving precision.

Table 19: Changing Instructor Rank on Persistence into Second Year

| | Four-year Schools | | | Two-Year Schools | | | Aggregate |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Full-time | 0.0040 | 0.0076** | 0.0044 | 0.0222*** | 0.0174*** | 0.0129* | 0.0091** |
| | (0.0054) | (0.0031) | (0.0061) | (0.0058) | (0.0028) | (0.0075) | (0.0045) |
| | | | [0.0044,0.0051] | | | [0.0129, 0.0175] | [0.0091,0.0107] |
| Instructor Age | -0.0012 | 0.0008 | -0.0120* | -0.0051*** | -0.0008 | | -0.0063 |
| | (0.0015) | (0.0008) | (0.0062) | (0.0017) | (0.0008) | | (20.7720) |
| Instructor Age$^2$ | 0.0000 | -0.0000 | 0.0000 | 0.0000*** | 0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | -0.0495*** | -0.0479*** | | -0.0549*** | -0.0549*** | -0.0516*** |
| | | (0.0018) | (0.0018) | | (0.0024) | (0.0024) | (0.0015) |
| Part-time | | -0.1287*** | -0.1238*** | | -0.1221*** | -0.1159*** | -0.1188*** |
| | | (0.0040) | (0.0041) | | (0.0033) | (0.0032) | (0.0025) |
| Age | | 0.0274 | -0.0023 | | 0.0050*** | 0.0025 | -0.0006 |
| | | (0.0940) | (0.0020) | | (0.0016) | (0.0016) | (20.7357) |
| In-State Tuition | | 0.1077*** | 0.1073*** | | 0.0780*** | 0.0752*** | 0.0997*** |
| | | (0.0032) | (0.0033) | | (0.0061) | (0.0061) | (0.0029) |
| Transfer Student | | 0.0235*** | 0.0226*** | | 0.0184*** | 0.0182*** | 0.0178*** |
| | | (0.0037) | (0.0038) | | (0.0029) | (0.0029) | (0.0023) |
| Course FE | | X | X | | X | X | X |
| Student Controls | | X | X | | X | X | X |
| Instructor FE | | | X | | | X | X |
| *N* | 313,443 | 303,150 | 302,842 | 302,228 | 299,654 | 299,316 | 602,219 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Units represent student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. The omitted category is full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Note: Instructor Age variable omitted in Column 6 due to insufficiency in data variation with high number of controls. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

### Graduation

Table 20 displays results from Equation 4 and analyzes the effect of changing instructor rank on whether a student graduates on time. I analyze results separately for four-year schools and two-year schools in columns (1)-(3) and (4)-(6), respectively, and then look at aggregate results across both types of schools in column (7). At both four-year and two-year colleges, baseline estimates without fixed effects or student controls indicate a positive effect of instructors becoming full-time on student outcomes, although results are not statistically significant at four-year colleges. With the addition of course and student controls, the magnitude of estimates increase at four-year schools and decrease at two-year schools. This suggests that instructors teach courses/students as adjuncts that have a lower propensity of graduating at four-year colleges and a higher propensity of graduating at two-year colleges. In the preferred specifications in columns (3), (6), and (7) with instructor fixed effects, I find no significant effects on the role of instructor rank on the propensity for students to graduate on time at either four-year or two-year colleges.

Table 20: Changing Instructor Rank on On-time Graduation

| | Four-year Schools | | | Two-Year Schools | | | Aggregate |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Full-time | 0.0082 | 0.0164*** | 0.0004 | 0.0272*** | 0.0139*** | 0.0048 | 0.0036 |
| | (0.0063) | (0.0036) | (0.0093) | (0.0026) | (0.0016) | (0.0042) | (0.0045) |
| | | | [-0.0058,0.0004] | | | [-0.0033,0.0048] | [-0.0042,0.0036] |
| Instructor Age | -0.0017 | 0.0003 | 0.0009 | -0.0000 | 0.0004 | | |
| | (0.0017) | (0.0010) | (0.0069) | (0.0008) | (0.0005) | | |
| Instructor Age$^2$ | 0.0000 | -0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | -0.0688*** | -0.0680*** | | -0.0183*** | -0.0184*** | -0.0410*** |
| | | (0.0024) | (0.0024) | | (0.0015) | (0.0015) | (0.0016) |
| Part-time | | -0.1109*** | -0.1034*** | | -0.0586*** | -0.0555*** | -0.0698*** |
| | | (0.0036) | (0.0035) | | (0.0017) | (0.0017) | (0.0016) |
| Age | | -0.0040*** | -0.0007 | | 0.0160*** | 0.0156*** | -0.0102 |
| | | (0.0008) | (0.0017) | | (0.0005) | (0.0005) | (74.9400) |
| In-State Tuition | | -0.0008 | -0.0005 | | 0.0030 | 0.0026 | -0.0010 |
| | | (0.0031) | (0.0031) | | (0.0034) | (0.0035) | (0.0025) |
| Transfer Student | | 0.0803*** | 0.0768*** | | 0.0386*** | 0.0391*** | 0.0485*** |
| | | (0.0036) | (0.0036) | | (0.0019) | (0.0019) | (0.0017) |
| Course FE | | X | X | | X | X | X |
| Student Controls | | X | X | | X | X | X |
| Instructor FE | | | X | | | X | X |
| *N* | 228,653 | 220,636 | 220,405 | 302,228 | 299,654 | 299,316 | 519,768 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Units represent student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. The omitted category is full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Note: Instructor Age variable omitted in Columns 6 and 7 due to insufficiency in data variation with high number of controls. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

### Transferring to Four-year College

Table 21 displays results from Equation 4 estimating the effects of instructor rank whether a two-year college student transfers to a four-year school within three years. Column (1) displays results from a basic regression without any student or course fixed effects and column (2) adds in course fixed effect. Both of these estimates indicate a positive and statistically significant effect of instructors switching from adjunct to full-time on students' propensities to transfer. However, with the addition of instructor fixed effects in the preferred specification in Column (3), estimates become very small in magnitude and statistically insignificant. This indicates that instructors that get hired as adjuncts generally have a lower ability of getting students to transfer, compared to instructors who get hired as full-time. In the preferred specification, which looks at within-instructor variation, I find no effect of instructor rank on the propensity for two-year college students to transfer to a four-year college.

Table 21: Changing Instructor Rank on Transferring to Four-year College

| | (1) | (2) | (3) |
|---|---|---|---|
| Full-time | 0.0166*** | 0.0129*** | -0.0007 |
| | (0.0045) | (0.0021) | (0.0055) |
| | | | [-0.0030,-0.0007] |
| Instructor Age | -0.0035** | -0.0000 | 0.0012 |
| | (0.0014) | (0.0007) | (0.0058) |
| Instructor Age$^2$ | 0.0000** | 0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| Male | | 0.0046** | 0.0052*** |
| | | (0.0019) | (0.0019) |
| Part-time | | -0.0679*** | -0.0627*** |
| | | (0.0023) | (0.0023) |
| Age | | -0.0049*** | -0.0059*** |
| | | (0.0014) | (0.0011) |
| In-State Tuition | | 0.0679*** | 0.0657*** |
| | | (0.0056) | (0.0057) |
| Transfer Student | | 0.0750*** | 0.0750*** |
| | | (0.0024) | (0.0025) |
| Course FE | | X | X |
| Student Controls | | X | X |
| Instructor FE | | | X |
| $N$ | 256,654 | 254,547 | 254,271 |

Outcome of interest: whether student transfer to four-year college. Units represent student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. The omitted category is full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

**Summary and Interpretation of Results**

In my analysis, I find positive and statistically significant effects of changing an instructor's rank on the propensity for their students to take a subsequent course in the subject and to persist to a second year of college and find no statistically significant effects on other outcomes of interest. Here, I assess how much of overall differences in teaching quality between adjuncts and full-time instructors found in Section III can be attributed to employment rank effects found in Section IV, as opposed to underlying differences between individuals who are hired as adjunct compared to full-time.

To look at how changing an instructor's rank affects these subsequent course taking, column

(1) of Table 22 displays the differences in the propensity for individuals to take a subsequent course in the same field if they have a full-time instructor as oppose to an adjunct instructor, aggregating together two-year and four-year colleges. This is identical to the results in column (7) of Table 6, except adjuncts are the omitted category here instead of full-time instructors. Taking a course with a full-time instructor as opposed to an adjunct increases the propensity of taking a subsequent course in the subject by about 0.9 percentage points. Next, since I identify the role of instructor rank in Section IV off of instructors who switch rank, I include an interaction term looking at whether the effects of full-time as opposed to adjunct instructors differ for these set of instructors. I find some evidence that the difference in effectiveness between adjunct and full-time instructors for the set of instructors who switch rank is muted. From column (2), the difference between full-time and adjunct instructors on propensity to take a subsequent course in the subject for switchers is 1.1 percentage points lower than for non-switchers. Finally, in column (3), I include instructor fixed effects to see how changing instructor rank affects outcomes. I find that for the set of instructors who switch rank, moving from adjunct to full-time increases student outcomes by 1.3 percentage points, which is actually a larger effect than the total difference in teaching outcomes between adjunct and full-time instructors who switch rank. This suggests that for instructors who are eligible to work as full-time instructors, changing rank from adjunct to full-time increases the propensity for students to take a subsequent course in the subject by more than the baseline difference between adjuncts and full-time instructors.

Next, Table 23 analyzes persistence rates into the second year. Column (1) replicates results in column (7) of Table 8 looking at overall differences between adjuncts and full-time instructors, with adjuncts are the omitted category here instead of full-time instructors. I find that taking a course with an adjunct instructor decreases the propensity of taking a subsequent course in the subject by approximately 1.2 percentage points. Next, since I identify the role of instructor employment rank in Section IV off of instructors who switch rank, I include an interaction term looking at whether the effects of full-time as opposed to adjunct instructors differ for these set of instructors. I find that differences in outcomes between adjunct and full-time instructors do not differ significantly between switchers and non-switchers. Finally, in column (3), I include instructor fixed effects to see how changing instructor rank affects outcomes. I find that for the set of instructors who switch rank, moving from adjunct to full-time increases student outcomes by .9 percentage points, which accounts for almost all of the total gap in persistence rates between adjunct and full-time

Table 22: Instructor Effects: Taking Subsequent Course in Subject

| | (1) | (2) | (3) |
|---|---|---|---|
| Full-time | 0.0091*** | 0.0120*** | 0.0125** |
| | (0.0024) | (0.0029) | (0.0054) |
| Full-time×Switcher | | -0.0085* | |
| | | (0.0048) | |
| Switcher | | 0.0039 | |
| | | (0.0037) | |
| Instructor Age | 0.0005 | 0.0004 | 0.0327 |
| | (0.0007) | (0.0007) | (17.1030) |
| (Instructor Age)$^2$ | -0.0000 | -0.0000 | 0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| Course FE | X | X | X |
| Student FE | X | X | X |
| Instructor FE | | | X |
| $N$ | 463,664 | 463,664 | 431,211 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Units represent student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1.

instructors.

Overall, results indicate factors in treatment related to instructor rank explain a large portion of the differences between adjuncts and full-time instructors for outcomes in which changing an instructor's rank from adjunct to full-time improves teaching outcomes. For other outcomes, changing rank does not have a large effect on teaching, indicating these differences may be driven by factors other than differences in environment associated with rank.

# V Conclusion

This study makes two significant contributions to the body of work analyzing teaching quality in higher education. First, I expand prior studies by exploring the contexts and reasons for differences in teaching quality across instructor ranks, with a particular emphasis on adjunct instructors. Using statewide student transcript records, I assess effects of instructor rank on a wide range of student outcomes and find that adjunct instructors overwhelmingly perform worse than full-time counterparts. Additionally, results indicate adjuncts who teach lighter course loads have worse teaching outcomes, which is consistent with both a story in which adjuncts are negatively selected relative to full-time counterparts, as well as a story in which differences in institutional

Table 23: Instructor Effects: Persistence into Second Year

| | (1) | (2) | (3) |
|---|---|---|---|
| Full-time | 0.0122*** | 0.0133*** | 0.0091** |
| | (0.0021) | (0.0024) | (0.0045) |
| | [0.0101,0.0122] | [0.0105,0.0133] | [0.0091,0.0107] |
| Full-time×Switcher | | -0.0032 | |
| | | (0.0040) | |
| | | [-0.0219,-0.0032] | |
| Switcher | | 0.0004 | |
| | | (0.0032) | |
| Instructor Age | -0.0001 | -0.0001 | -0.0102* |
| | (0.0006) | (0.0006) | (0.0055) |
| Instructor Age$^2$ | 0.0000 | 0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) |
| Male | -0.0521*** | -0.0521*** | -0.0516*** |
| | (0.0015) | (0.0015) | (0.0015) |
| Part-time | -0.1249*** | -0.1249*** | -0.1188*** |
| | (0.0026) | (0.0026) | (0.0025) |
| Age | -0.0102*** | -0.0102*** | 0.0033** |
| | (0.0039) | (0.0039) | (0.0014) |
| In-State Tuition | 0.0987*** | 0.0987*** | 0.0997*** |
| | (0.0028) | (0.0028) | (0.0029) |
| Course FE | X | X | X |
| Student FE | X | X | X |
| Instructor FE | | | X |
| *N* | 642,721 | 642,721 | 602,219 |

Outcome of interest: whether student persists into second year of college. Units represent student-course observations. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. The omitted category is full-time non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year. Brackets indicate estimated lower and upper bounds for selection on unobservable student characteristics.

treatment by instructor rank drive differences in student outcomes. The second contribution of this paper extends prior studies as the first study to asses whether an instructor's teaching quality is affected by differences compensation and/or access to resources across ranks. I find that changing an instructor's rank from adjunct to full-time improves teaching outcomes on multiple margins, indicating teaching quality is sensitive to job characteristics associated with rank.

The findings in this study have significant policy implications in showing workplace treatment compensation policies, pecuniary and/or non-pecuniary, matter in affecting instructor teaching quality in higher education. This is significant from a policy perspective in understanding how best to allocate limited resources towards student instruction in higher education. Future research on this topic is needed to better understand what aspect(s) of the change in compensation or treatment in going from adjunct to full-time are most salient in affecting teaching quality, as well as to provide a cost-benefit analysis of the marginal dollar allocated towards instructor resources in maximizing student benefits.

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# Appendix A Additional Tables and Figures

Table 24 displays aggregate descriptive statistics by instructor rank for outcomes of interest that apply at both two-year and four-year colleges. The table shows that students taking courses with full-time instructors are significantly more likely to take a subsequent course in the subject of the course, persist to a second year of college, and graduate on-time. While suggestive, these values cannot be interpreted causally since there is a possibility that students select non-randomly into instructors by employment rank, and it may also be the case that instructors tend to get assigned to teach different types of courses along instructor rank.

Table 24: Descriptive Outcomes by Instructor Rank, Aggregate Four-year and Two-year Colleges

| | All | Full-time | Adjunct |
|---|---|---|---|
| Takes another course in subject | 0.45 | 0.47 | 0.41 |
| Persistence after first year | 0.67 | 0.68 | 0.65 |
| On-time Graduation | 0.14 | 0.15 | 0.11 |
| $N$ | 669,530 | 429,184 | 240,346 |

Standard errors in parentheses. Observations denote student-class units for students entering college between 2003-2010. For four-year students, in measuring “On-time Graduation”, I only include students entering between 2003-2008 in order to follow them through four years of school. A two-sample test of proportions shows values for full-time vs. adjunct instructors are significantly different at the 0.01 level for all outcomes.

Table 25 presents descriptive statistics for the aggregate sample of adjunct and full-time instructors at both two-year and four-year colleges. As in Table 2, which looks at instructors separately by whether they work at a two-year vs. a four-year school, Table 25 indicates full-time instructors on average are older, earn more, and teach more courses per semester compared to adjunct counterparts.

Table 25: Instructor Characteristics, Aggregate Four-year+Two-year

| | Full-time | Adjunct |
|---|---|---|
| Male | 0.46 | 0.47 |
| | (0.50) | (0.50) |
| Age | 48.06 | 46.79 |
| | (11.22) | (12.03) |
| Number of Courses Taught | 3.62 | 2.10 |
| | (1.64) | (1.22) |
| Salary (9-month) | 40,223.88 | 13,519.10 |
| | (49390.63) | (17271.29) |
| $N$ | 25153 | 24109 |

Standard errors in parentheses. Observations denote instructor-term units. "Full-time" indicates full-time, non-tenure-track instructors. Two-year colleges do not employ graduate students or use the tenure system, so there are no columns for these instructors. Salaries reported in real 2010 dollars.

# Appendix B Extended Heterogeneity Analysis

This appendix presents and analyzes results from heterogeneity analyses in Section III.C.

## B.A STEM Fields

Table 26 displays estimation results looking at whether adjuncts differ in teaching outcomes based on whether they teach in STEM fields. All outcomes in Table 26 represent aggregate outcomes for combined two-year and four-year colleges, with the exception of majoring in the subject of the course (four-year colleges only) and transferring to a four-year school (two-year colleges only). For all outcomes analyzed, estimates indicate no significant difference in teaching outcomes between adjuncts teaching in STEM fields and those teaching in non-STEM fields.

## B.B Unemployment

Table 27 displays estimation results looking at whether teaching outcomes for adjuncts varies based on local labor market conditions where they are teaching. I capture these conditions using time-varying unemployment rates for the county in which a school is located. All outcomes in Table 27 represent aggregate outcomes for combined two-year and four-year colleges, with the exception of majoring in the subject of the course (four-year colleges only) and transferring to a four-year school (two-year colleges only). For all outcomes of analysis, estimates indicate no significant difference in teaching outcomes for adjuncts based on local unemployment rates.

## B.C Urban vs. Rural

Next, I look at whether the teaching quality of adjuncts relative to full-time instructors varies based on how urban or rural the location of a school is. I test for heterogeneity using two measures of urbanicity: a) county rurality level, (%)[13] and b) Core-Based Statistical Area status (whether the county a school is located in is classified as a metropolitan area, micropolitan area, or not a statistical area).[14] As before, all outcomes represent aggregate outcomes for combined two-year and four-year colleges, with the exception of majoring in the subject of the course (four-year colleges only) and transferring to a four-year school (two-year colleges only).

Table 28 displays estimation results looking at whether teaching outcomes for adjuncts varies

[13] As classified by the 2010 Census

[14] As defined by the US Office of Management and Budget.

Table 26: Heterogeneity by Course STEM Status

| | Subject-Specific | | Non-Subject-Specific | | |
|---|---|---|---|---|---|
| | Next Course | Major | Persistence | Graduation | Transfer |
| Adjunct | -0.0084*** | 0.0001 | -0.0119*** | -0.0157*** | -0.0143*** |
| | (0.0027) | (0.0014) | (0.0025) | (0.0020) | (0.0025) |
| Adjunct×STEM | -0.0015 | 0.0002 | -0.0015 | 0.0056 | 0.0075 |
| | (0.0058) | (0.0029) | (0.0052) | (0.0045) | (0.0050) |
| | | | [-0.0015,0.0062] | [00056,0.0140] | [0.0075,0.0170] |
| Instructor Age | 0.0005 | -0.0000 | -0.0002 | 0.0002 | 0.0004 |
| | (0.0007) | (0.0003) | (0.0006) | (0.0006) | (0.0007) |
| Instructor Age$^2$ | -0.0000 | 0.0000 | 0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | | -0.0523*** | -0.0446*** | 0.0044** |
| | | | (0.0016) | (0.0017) | (0.0020) |
| Part-time | | | -0.1228*** | -0.0771*** | -0.0712*** |
| | | | (0.0027) | (0.0017) | (0.0024) |
| Age | | | -0.0060*** | -0.0034*** | -0.0135*** |
| | | | (0.0007) | (0.0004) | (0.0006) |
| In-State Tuition | | | 0.1019*** | -0.0016 | 0.0704*** |
| | | | (0.0030) | (0.0025) | (0.0056) |
| Transfer Student | | | 0.0189*** | 0.0448*** | 0.0759*** |
| | | | (0.0022) | (0.0017) | (0.0024) |
| Course FE | X | X | X | X | X |
| Student FE | X | X | | | |
| Student Controls | | | X | X | X |
| *N* | 456,500 | 184,002 | 592,714 | 507,061 | 243,145 |

Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Observations represent student-course units, so un-interacted STEM terms are absorbed by course fixed effects. Outcomes represent aggregate results for four-year and two-year college students, with the exception of majoring in the subject of the course (four-year only) and transferring to a four-year college (two-year only). Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year.

based on rurality of the location where they are teaching. I capture these conditions using annual time-varying county-level measures of percent rurality. For both subject-specific outcomes (whether or not a student takes a subsequent course in the subject and whether the student majors in the subject), results indicate no significant differences in the effects of adjuncts based on how rural a location is. For non-subject specific outcomes, estimates using student-level controls indicate slightly negative and statistically significant effects of adjuncts on student outcomes in more rural areas, but bound estimates to account for selection on unobservables include zero, so results do not support a statistically significant prediction on the effect of the intersection of adjunct status

Table 27: Heterogeneity by Local Unemployment Rates

| | Subject-Specific | | Non-Subject-Specific | | |
|---|---|---|---|---|---|
| | Next Course | Major | Persistence | Graduation | Transfer |
| Adjunct | -0.0129 | -0.0058 | -0.0141** | -0.0116** | -0.0070 |
| | (0.0085) | (0.0060) | (0.0070) | (0.0048) | (0.0070) |
| Unemployment Rate | -0.1818** | -0.0518 | -0.0076*** | -0.0001 | -0.0063*** |
| | (0.0812) | (0.0642) | (0.0011) | (0.0007) | (0.0011) |
| Adjunct×UnempRate | 0.0006 | 0.0011 | 0.0004 | -0.0003 | -0.0008 |
| | (0.0015) | (0.0012) | (0.0011) | (0.0007) | (0.0011) |
| | | | [0.0004,0.3470] | [-0.0003,0.2060] | [-0.0008,0.3120] |
| Instructor Age | 0.0005 | -0.0000 | -0.0002 | 0.0004 | 0.0003 |
| | (0.0007) | (0.0003) | (0.0006) | (0.0006) | (0.0007) |
| Instructor Age$^2$ | -0.0000 | -0.0000 | 0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | | -0.0517*** | -0.0433*** | 0.0046** |
| | | | (0.0015) | (0.0017) | (0.0019) |
| Part-Time | | | -0.1237*** | -0.0749*** | -0.0684*** |
| | | | (0.0026) | (0.0016) | (0.0023) |
| Age | | | -0.0036*** | -0.0032*** | -0.0128*** |
| | | | (0.0007) | (0.0004) | (0.0006) |
| In-State Tuition | | | 0.0999*** | -0.0019 | 0.0689*** |
| | | | (0.0028) | (0.0024) | (0.0054) |
| Transfer Student | | | 0.0194*** | 0.0446*** | 0.0732*** |
| | | | (0.0022) | (0.0017) | (0.0023) |
| Course FE | X | X | X | X | X |
| Student FE | X | X | | | |
| Student Controls | | | X | X | X |
| *N* | 463,664 | 219,368 | 642,721 | 556,966 | 271,034 |

Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Outcomes represent aggregate results for four-year and two-year college students, with the exception of majoring in the subject of the course (four-year only) and transferring to a four-year college (two-year only). Unemployment rate refers to year-specific unemployment rate for the county in which a school is located. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year.

and county rurality of school. Finally, there is not statistically significant effect of the intersection between adjunct status and county rurality on the propensity for a two-year student to transfer to a four-year college. Thus, estimation results on all metrics indicate the effects of adjuncts on student outcomes do not vary based on how rural vs. urban the location of a school is.

Next, Table 29 provides an alternative measure of urbanicity by looking at whether adjunct status varies by a county's Core-Based Statistical Area (CBSA) status. As in the previous specification, estimation results from this analysis show no significant interaction effects of instructor rank with CBSA status with the inclusion of bounds for selection on unobservables. These results

Table 28: Heterogeneity by County Rurality

| | Subject-Specific | | Non-Subject-Specific | | |
|---|---|---|---|---|---|
| | Next Course | Major | Persistence | Graduation | Transfer |
| Adjunct | -0.0113** | -0.0004 | -0.0027 | -0.0050* | -0.0104** |
| | (0.0048) | (0.0029) | (0.0043) | (0.0030) | (0.0045) |
| Adjunct×(% Rural) | 0.0001 | 0.0000 | -0.0002** | -0.0002*** | -0.0001 |
| | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| | | | [-0.000,0.032] | [-0.000,0.009] | [-0.000,0.007] |
| Instructor Age | 0.0005 | -0.0000 | -0.0000 | 0.0003 | 0.0001 |
| | (0.0007) | (0.0003) | (0.0006) | (0.0006) | (0.0007) |
| Instructor Age$^2$ | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | | -0.0521*** | -0.0433*** | 0.0044** |
| | | | (0.0015) | (0.0017) | (0.0019) |
| Part-time | | | -0.1248*** | -0.0746*** | -0.0685*** |
| | | | (0.0026) | (0.0016) | (0.0023) |
| Age | | | 0.0050*** | 0.0158*** | -0.0048*** |
| | | | (0.0012) | (0.0005) | (0.0014) |
| In-State Tuition | | | 0.0987*** | -0.0013 | 0.0683*** |
| | | | (0.0028) | (0.0024) | (0.0054) |
| Transfer Student | | | 0.0192*** | 0.0457*** | 0.0726*** |
| | | | (0.0022) | (0.0017) | (0.0023) |
| Course FE | X | X | X | X | X |
| Student FE | X | X | | | |
| Student Controls | | | X | X | X |
| $N$ | 463,664 | 219,368 | 644,614 | 558,723 | 271,918 |

Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Un-interacted controls for rurality of a county are absorbed by course fixed effects, which are school-time specific. Outcomes represent aggregate results for four-year and two-year college students, with the exception of majoring in the subject of the course (four-year only) and transferring to a four-year college (two-year only). Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year.

further bolster the findings that adjunct teaching outcomes do not vary based on how urban or rural the location of a school is.

Table 29: Heterogeneity by CBSA Status

| | Subject-Specific | | Non-Subject-Specific | | |
|---|---|---|---|---|---|
| | Next Course | Major | Persistence | Graduation | Transfer |
| Adjunct | -0.0057 | 0.0032 | -0.0152*** | -0.0141*** | -0.0037 |
| | (0.0063) | (0.0050) | (0.0054) | (0.0030) | (0.0045) |
| Adjunct×Micropolitan | -0.0053 | -0.0054 | -0.0070 | -0.0108** | -0.0221*** |
| | (0.0082) | (0.0063) | (0.0071) | (0.0048) | (0.0058) |
| | | | [-0.007,0.055] | [-0.011,0.030] | [-0.022,0.078] |
| Adjunct×Metropolitan | -0.0034 | -0.0031 | 0.0074 | 0.0050 | -0.0040 |
| | (0.0070) | (0.0051) | (0.0060) | (0.0037) | (0.0054) |
| | | | [0.007,2.008] | [0.005,0.482] | [-0.004,0.037] |
| Instructor Age | 0.0005 | -0.0000 | 0.0000 | 0.0004 | 0.0002 |
| | (0.0007) | (0.0003) | (0.0006) | (0.0006) | (0.0007) |
| Instructor Age$^2$ | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Male | | | -0.0521*** | -0.0432*** | 0.0044** |
| | | | (0.0015) | (0.0017) | (0.0019) |
| Part-time | | | -0.1247*** | -0.0745*** | -0.0684*** |
| | | | (0.0026) | (0.0016) | (0.0023) |
| Age | | | 0.0050*** | 0.0158*** | -0.0048*** |
| | | | (0.0012) | (0.0005) | (0.0014) |
| In-State Tuition | | | 0.0987*** | -0.0013 | 0.0683*** |
| | | | (0.0028) | (0.0024) | (0.0054) |
| Transfer Student | | | 0.0192*** | 0.0458*** | 0.0727*** |
| | | | (0.0022) | (0.0017) | (0.0023) |
| Course FE | X | X | X | X | X |
| Student FE | X | X | | | |
| Student Controls | | | X | X | X |
| $N$ | 463,664 | 219,368 | 644,614 | 558,723 | 271,918 |

Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted instructor category: full-time non-tenure-track instructors. Un-interacted controls for CBSA status a county are absorbed by course fixed effects, which are school-time specific. Outcomes represent aggregate results for four-year and two-year college students, with the exception of majoring in the subject of the course (four-year only) and transferring to a four-year college (two-year only). Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year.

# Appendix C Robustness Checks

In looking at the role of instructor rank on student outcomes, it is important to control for instructor experience to ensure systematic differences in experience across rank are not driving results. However, the data do not contain explicit information on how long an instructor has been teaching. In the preferred specification in the paper, I proxy for experience by including a continuous control for instructor's age and instructor's age squared. The advantage of this proxy is that it captures time-varying teaching quality trends for all instructors in the data, but once concern is that instructor age does not adequately capture experience.

As a robustness check, I run an alternative specification capturing experience more directly. For instructors who begin teaching after the start period of my data, I count the first year in the data as their first year of experience. I then include an indicator variable for instructor experience as a substitute for age controls in the regressions of interest. Since I don't know how long instructors who are already teaching at the start of my data have been teaching, I code these individuals as separate experience indicator.

Table 30 presents results using the alternative experience proxy of the analysis of instructor rank on student outcomes. As in the results from the preferred specification, these findings indicate taking a course with an adjunct instructor decreases the propensity for a student to take a subsequent course in the subject, decreases probability of persistence to the second year, decreases on-time graduation rates, and reduces the propensity for two-year college students to transfer to a four-year school. Furthermore, the magnitudes of findings using the two different experience proxies are similar, providing support that differences in experience profiles by instructor rank are not driving results.

Table 31 assesses the role of changing an instructor's rank on student outcomes using the alternative experience proxy. As in the main specification, I find that switching from adjunct to full-time non-tenure-track increases the propensity for an instructor's students to take a subsequent course in the subject, with similar magnitudes to that found in the main specification. I also find an increase in changing rank on the propensity for students to persist into a second year of college, although these results become weakly significant using the alternative experience specification. Estimate magnitudes remain similar.

Taken together, results using an alternative proxy in Tables 30 and 31 closely mirror the results in the main analyses. These findings provide support that the differences in student outcomes by

Table 30: Instructor Rank: Indicator Experience, Include Missing

| | (1)<br>Next Course | (2)<br>Major | (3)<br>Persist | (4)<br>Graduation | (5)<br>Transfer |
|---|---|---|---|---|---|
| Adjuncts | -0.0078*** | 0.0004 | -0.0109*** | -0.0118*** | -0.0104*** |
| | (0.0025) | (0.0011) | (0.0021) | (0.0018) | (0.0022) |
| | | | [-0.0109,-0.0077] | [-0.0118,-0.0088] | [-0.0104,-0.0057] |
| Male | | | -0.0521*** | -0.0407*** | 0.0051*** |
| | | | (0.0015) | (0.0015) | (0.0019) |
| Part-time | | | -0.1242*** | -0.0730*** | -0.0677*** |
| | | | (0.0025) | (0.0016) | (0.0023) |
| Age | | | 0.0045*** | 0.0160*** | -0.0049*** |
| | | | (0.0012) | (0.0005) | (0.0013) |
| In-state Tuition | | | 0.0999*** | -0.0019 | 0.0682*** |
| | | | (0.0029) | (0.0024) | (0.0053) |
| Transfer Student | | | 0.0182*** | 0.0484*** | 0.0743*** |
| | | | (0.0022) | (0.0017) | (0.0024) |
| Course FE | X | X | X | X | X |
| Student FE | X | X | | | |
| Student Controls | | | X | X | X |
| *N* | 445,012 | 196,961 | 619,705 | 535,850 | 264,398 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted category: full-time, non-tenure-track instructors. Student controls include gender, part-time vs full-time, age, in-state vs. out-of-state tuition, transfer status, and indicators for high school graduation year.

instructor rank and in changing instructor rank are not driven by differences in experience profile across ranks.

Table 31: Changing Instructor Rank: Indicator Experience, Including Missing

| | (1) Next Course | (2) Major | (3) Persist | (4) Graduation | (5) Transfer |
|---|---|---|---|---|---|
| Full-time | 0.0108** | 0.0027 | 0.0081* | 0.0026 | -0.0024 |
| | (0.0053) | (0.0029) | (0.0044) | (0.0044) | (0.0055) |
| | | | [0.0081,0.0088] | [-0.0053, 0.0026] | [-0.00297, -0.0024] |
| Male | | | -0.0513*** | -0.0406*** | 0.0056*** |
| | | | (0.0015) | (0.0015) | (0.0019) |
| Part-time | | | -0.1189*** | -0.0691*** | -0.0623*** |
| | | | (0.0025) | (0.0016) | (0.0023) |
| Age | | | -0.0893 | 0.0204 | -0.0059*** |
| | | | (0.0656) | (163.7280) | (0.0011) |
| In-State Tuition | | | 0.0992*** | -0.0013 | 0.0661*** |
| | | | (0.0029) | (0.0024) | (0.0054) |
| Transfer Student | | | 0.0178*** | 0.0480*** | 0.0743*** |
| | | | (0.0022) | (0.0017) | (0.0024) |
| Course FE | X | X | X | X | X |
| Student FE | X | X | | | |
| Student Controls | | | X | X | X |
| *N* | 444,162 | 205,453 | 617,133 | 533,476 | 263,178 |

Outcome of interest: whether student takes a subsequent course in the subject of the course. Standard errors clustered at instructor level; *** p<0.01, ** p<0.05, * p<0.1. Omitted category: instructor full-time, non-tenure-track instructors.