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How and Why Do Adjunct Instructors Affect Students' Academic Outcomes? Evidence From Two-Year and Four-Year Colleges

A CAPSEE Working Paper

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Abstract

Based on a dataset on two- and four-year college students and instructors from an anonymous state that includes detailed instructor employment information, this paper classifies faculty into four types—tenured instructors, tenure-track instructors, long-term adjuncts, and short-term adjuncts—to examine whether adjunct faculty have different impacts on student academic outcomes than tenure-track and tenured faculty. We use two empirical strategies—a two-way fixed effects model and an instrumental variable approach—to examine how initial exposure to a field of study with different types of instructors influences both contemporaneous and subsequent course performance in both two- and four-year colleges, as well as the extent to which the estimated differences on student outcomes may be explainable by observable instructor academic and employment characteristics. Our results suggest that adjuncts have positive impacts on introductory course grades but negative impacts on subsequent course enrollment and performance. Such negative impacts are stronger among supplemental adjuncts hired temporarily than among adjuncts with long-term employment contracts with the college. The estimated differences among instructors can be largely explained by key instructor demographic and employment characteristics, including highest degree attained, whether employed full-time in the college, and whether had previous work experience in non-teaching positions.

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1. Introduction

Over the past few decades, there has been an escalating demand for higher education. Concomitant with the increasing number of freshmen enrollments, however, has been a decline in public financing (Kane & Orszag, 2003). Public postsecondary institutions have responded by raising tuition, increasing class sizes, cutting programs, and otherwise seeking to reduce costs and improve efficiency. One such cost-saving measure has been the increasing reliance on adjunct instructors, most often through part-time and temporary appointments. According to a recent National Center for Education Statistics report (2016, the number of part-time faculty increased by 104 percent in degree-granting postsecondary institutions from fall 1993 to fall 2013, compared with an increase of 45 percent in the number of full-time faculty. As a result, the ratio between part-time and full-time faculty changed from 2:3 to 1:1 during this period. The increasing reliance on a contingent academic workforce is even more pronounced than the narrowing of this ratio may imply. In recent years, many full-time faculty have been hired in non-tenure-track positions, and the movement away from the tenure system has quickened over the past two decades since the abolishment of mandatory retirement for tenure-track faculty (Figlio, Schapiro, & Soter, 2015).

Do college adjunct instructors have different impacts on student outcomes compared with tenure-track and tenured faculty? A small but growing literature has used college administrative data to examine the impact of different types of instructors on student academic outcomes at the postsecondary level (Bettinger & Long, 2010; Bettinger & Long, in press; Carrell & West, 2010; Figlio et al., 2015; Hoffmann & Oreopoulos, 2009). The findings from these studies have been mixed, which may be partly explained by differences in how adjunct instructors were defined. For example, Bettinger and Long (in press) defined adjuncts as part-time instructors, and found that taking an initial course with an adjunct instructor had a negative impact on students' subsequent interest in that field of study. In contrast, Figlio et al. (2015) defined adjuncts as contingent faculty who were not hired in tenure-track positions, where the majority of adjuncts had a long-term relationship with the university and where many might be hired on a full-time basis. They identified positive impacts of adjuncts on students' subsequent interest in that field of study and on course performance. One potential problem with using different definitions of adjuncts is that the relative effects of adjunct instructors may vary by the nature of their employment and by individual characteristics. For example, compared with those hired part-time, adjuncts hired on a full-time basis with longer-term contracts with an institution are more likely to have an office space at the college and to hold longer and more consistently scheduled office hours for students, to be more familiar with the institution and its student services, and to better understand the content and requirements of other courses offered by the same department. In contrast, part-time adjunct faculty, especially those hired in transitory positions, may face more challenges in maintaining "quality and production," a concern that has been cited in literature about other industries that use temporary labor.

In this paper, we analyze a never-previously-used dataset with detailed instructor employment information, which enables us to make the most detailed categorization of college instructors to date, one which recognizes the heterogeneity among adjuncts by the nature of their employment. Specifically, we differentiate between adjuncts with long-term contracts with an institution and adjuncts hired on a temporary basis, and find noticeable distinctions between the two types of non-tenure-track faculty in terms of their characteristics and impacts on students in both two-year and four-year colleges. To the best of our knowledge, this is the first study on instructor effectiveness at the postsecondary level that has access to detailed instructor employment information and quarterly earnings records across different industries before and during their employment as college instructors. Such detailed instructor profile information enables us to explore how differences in student outcomes may be explained by observable instructor academic and employment characteristics. Moreover, our study is also the first to include all public institutions from both the four-year and two-year sectors in an entire state. Most previous studies were carried out in four-year college settings. Using data from all public two-year and four-year colleges in one state, our study not only provides empirical evidence about the impacts of adjunct instructors in an understudied setting, but also documents the heterogeneity in terms of academic and demographic attributes of different types of instructors by sector of institution.

To respond to the changing demand and available resources, colleges often resort to contingent instructors for their lower cost and great flexibility. Yet, there is evidence suggesting that adjunct instructors, especially those employed in part-time temporary positions, differ from tenure-track/tenured faculty across many observable characteristics that might also be correlated with instructional effectiveness and students' academic outcomes. For example, the 2004 National Study of Postsecondary Faculty (NSOPF) survey found that part-time faculty were less likely to have received terminal degrees in their main field of instruction compared with full-time faculty in both two-year and four-year settings, with more salient gaps in two-year colleges.[1] Critics who argue that there is an over-reliance on adjuncts commonly list several potential problems that may be observed with a temporary instructional labor force, such as insufficient engagement with the department; lack of experience, professional training, and institutional support; limited accessibility provided to the students; lack of time to prepare for a course adequately in advance; and the possibility of having teaching commitments at more than one institution (see Balch, 1999; Benjamin, 2002; Wyles, 1998).

On the other end of the spectrum, however, are researchers with a much more optimistic view about the use of adjunct instructors. They tend to argue that adjuncts, unlike their tenure-track/tenured faculty colleagues, do not have to balance other job demands and may benefit students by specializing in teaching (Leslie, 1998; Leslie & Gappa, 2002). Temporary adjuncts may also provide a flexible and low-cost way to screen for effective instructors to be hired on a full-time long-term basis (Autor, 2000). In addition, while fiscal constraints and budget

[1] More detailed information about NSOPF can be found at the NCES website: http://nces.ed.gov/surveys/nsopf/

flexibility may be primary reasons for an increasing reliance on adjuncts, a nontrivial proportion of adjunct instructors are practitioners hired to enhance institutional prestige by bringing to the classroom their knowledge and skills (Jacobs, 1998; Leslie & Gappa, 1995). Therefore, it is critical to disaggregate the roles and reasons for contingent appointments. Relatedly, researchers focusing on the employment conditions of adjuncts (e.g., Gappa, 2000; Gappa & Leslie, 1993) also highlight the possibility and importance of enhancing adjunct instructors' productivity by identifying and addressing problems that typically emerge from contingent appointments.

While researchers and policymakers continue to debate the tradeoffs of using adjuncts, there has been strong agreement on the urgent need for empirical evidence on the impacts of adjunct instructors on student academic interests and performance relative to tenure-track/tenured faculty. Yet, understanding the causal impacts of adjunct faculty on student learning outcomes at the postsecondary level faces several empirical challenges. First, standardized tests are not available at the postsecondary level, and different courses vary substantially in content, requirements, level of difficulty, and grading criteria. As a result, students' course grades alone cannot fully capture actual learning outcomes from a course. The course grade may in fact be a particularly inaccurate measurement of adjuncts' effectiveness, as there is evidence that adjuncts, due to job insecurity, might reduce the difficulty of course content, lower course expectations, or relax grading criteria in order to earn better scores on student evaluations (Greenwald & Gillmore, 1997; Sonner & Sharland, 1993). In addition, college students select courses and professors based on their own preferences, which makes it difficult to tease out the causal effects of instructors from the aptitudes and attitudes of the students.

The possibility that adjunct instructors may influence multiple student outcomes in different ways and that their effectiveness may vary according to individual characteristics and the nature of their employment leads to three concerns in undertaking research on this topic. First, in examining the tradeoffs between different types of labor used in higher education instruction, it is important to look beyond current course outcomes and take into account subsequent academic interests and performance of students. Second, it is important to recognize potential heterogeneity among adjuncts hired with different types of contracts with the institution, especially between those hired with long-term contracts and those hired in transitory positions. Finally, in addition to estimating the average impact of adjuncts, it is desirable from a policy perspective to explain the sources of variation in outcomes. If adjuncts do indeed affect the quality of higher education, to what extent can such impacts be explained by differences between adjuncts and tenure-track/tenured faculty in observable employment and individual characteristics, and what strategies can be developed to enhance the effectiveness of adjunct appointments? Unfortunately, evidence on these important policy questions remains scarce due to a lack of data linking detailed instructor profiles with a comprehensive set of student academic outcomes.

Using a distinctive administrative dataset that includes student transcript records and detailed instructor profiles in both public two-year and four-year institutions in an entire

(anonymous) state, this study links each student's course record with the instructor teaching that course. With detailed employment information, we are able to differentiate between two kinds of adjuncts by the length of their employment contract and thereby divide all faculty into three and sometimes four major categories: (1a and 1b) tenure-track and tenured faculty (referred to as "tenure faculty" hereafter), (2) non-tenure-track, non-tenured faculty who have employment contracts with the institution lasting more than one year (referred to as "long-term non-tenure faculty" or "long-termers" hereafter), and (3) non-tenure-track, non-tenured faculty who have employment contracts with the institution lasting one year or less (referred to as "short-term non-tenure faculty" or "short-termers" hereafter). We then use these data to analyze the estimated impacts of taking an initial course in a field of study with different types of instructors on students' contemporaneous course performance, as well as on subsequent enrollment in courses in the same field and on performance in those follow-on courses.

We begin by documenting the differences between different types of instructors on observable academic and employment characteristics. The descriptive results suggest that colleges were heavily dependent on adjunct faculty in both sectors, but much more so in community colleges. In fact, only one out of the two-year institutions examined in this study employed instructors through tenure-track/tenured positions during the study period (2005–2010). As a result, only 1 percent of faculty in all two-year public colleges within this state were tenure faculty. While the proportion of tenure faculty was much higher in the four-year sector—it was almost one third of all faculty—it was still substantially lower than the proportion of instructors hired in either long-term or short-term non-tenure positions. Comparisons among different types of instructors reveal substantial differences between tenure faculty and long- and short-term non-tenure faculty, as well as between long-term and short-term non-tenure faculty. In general, non-tenure faculty, especially those hired on a temporary basis, tended to be less educated, to be employed on a part-time basis as college instructors at the institution, and to have much higher turnover rates. They also tended to work concurrently in non-college positions and to have worked in non-college positions before beginning their employment at the college. These differences among different types of instructors motivate the main research question of this study: Does taking a course with different types of instructors lead to similar learning outcomes? If not, to what extent are the differences explainable by observable instructor academic and employment characteristics?

To minimize student self-selection in courses taught by different types of instructors, we use two different empirical strategies. The main empirical strategy is a two-way fixed effects model, adapted from Figlio et al. (2015), that controls for both individual-level fixed effects and course-level fixed effects. The key assumption underlying the fixed effects strategy is that students have consistent preferences, if they have any at all, for different types of instructors across subject areas. To examine the possible existence of systematic sorting of students, we regress a rich set of individual characteristics against alternative instructors and do not find systematic sorting. Nevertheless, we further build on an instrumental variable strategy similar to that used by Bettinger and Long (2010) as a robustness check where we use term-by-term

variation in departmental faculty composition as an instrument for student's likelihood of taking a course with different types of instructors in his or her initial term in a certain field of study.

Both analyses, discussed in more detail below, yield similar results in both two-year and four-year colleges: students on average received higher grades when taking courses with short-term non-tenure faculty, lower grades when taking courses with long-term non-tenure faculty, and even lower grades when taking courses with tenure faculty. In contrast to the positive results associated with contemporaneous course performance, however, both types of non-tenure instructors are negatively associated with students' subsequent course enrollment and performance, and taking courses taught by short-term non-tenure faculty is associated with the largest negative effects.

Because we also have several measures of academic and employment characteristics of the instructors, we further explore the second main research question: To what extent can the differences in student subsequent academic outcomes from taking an initial course with different types of instructors be explained by observable differences in instructor characteristics? Our results indicate that differences in observable instructor characteristics are able to explain approximately one quarter of the negative impact of short-term non-tenure faculty relative to long-term non-tenure faculty on students' subsequent interest in a field of study in two-year colleges, and more than half of the impact in four-year colleges. The gap in students' subsequent interest in a field of study between long-term non-tenure faculty and tenure faculty in four-year colleges is no longer significant once we control for observable instructor characteristics.

2. Data, Setting, and Summary Information

Data and Institutional Context

We use data on students who first entered one of the public postsecondary institutions in an anonymous state college system (referred to as ASCS) between fall 2005 and summer 2010: a total of 68,692 students enrolled in public two-year colleges, and a total of 87,212 students enrolled in public four-year colleges.[2] The dataset contains information on student demographics, institutions attended, each student's intended major at college entry, and each student's pre-enrollment academic performance as measured by scores on standardized admissions tests such as the SAT and ACT, and placement test scores (such as COMPASS scores) in reading, writing, and math. It also includes detailed transcript data on each course

[2] All the students were tracked until the summer of 2012. One concern is that students entering at a later time had a shorter follow-up time in the analysis, and that that may influence the accuracy of the estimates on students' subsequent course enrollment if students took additional courses after their initial attempt in a field after the first two years of their college career. However, this concern is somewhat alleviated by the fact that the majority of the students (84.2 percent) took the next course after their initial attempt in a field within two years of initial enrollment. Nevertheless, in a separate robustness check, we restricted the analyses to the 2005 to 2006 cohorts only where students were tracked for at least six years. The estimated effects are not qualitatively different.

taken, grades received, course section number, course subject, whether it was a developmental or college-level course, and whether the course was delivered online or through traditional face-to-face means. Each course record includes a variable indicating the instructor ID, which can be further linked to a separate instructor file.

Both the two-year community college sector and four-year public college sector in ASCS comprised a mix of large and small colleges, as well as institutions located in rural, suburban, and urban settings. Table 1 presents institutional characteristics of ASCS in fall 2005, based on statistics reported to the Integrated Postsecondary Education Data Systems (IPEDS) database. Compared with a nationally representative sample, ASCS institutions tended to be smaller and more instruction-focused (versus research-focused). They tended to have lower graduation rates and to serve a higher proportion of African American students and students eligible for need-based financial aid. The average annual salary for instructional faculty was also lower than the national average by 10 to 20 percent depending on the specific category of academic rank.

During the period of this study, ASCS employed three major types of faculty—tenure, long-term non-tenure, and short-term non-tenure faculty. But as previously mentioned, the use of non-tenure faculty among two year colleges was rare: only one of the two-year colleges employed any tenure faculty at all. The tenure category includes tenure-track assistant professors and tenured faculty (associate and full professors); the adjunct categories includes all instructors hired in non-tenure-track positions, both those with employment contracts with the institution lasting more than one year ("long-term non-tenure faculty") and those hired on temporary basis, with contracts lasting one year or less ("short-term non-tenure faculty").[3]

[3] About 7 percent of the course enrollments were with a graduate student instructor. Since the impacts of adjunct faculty may be substantially different from those of graduate student instructors and because the motivation for hiring adjuncts and graduate students are also distinct from each other, we focus on comparing tenure, long-term non-tenure, and short-term non-tenure faculty in this paper and exclude courses taught by graduate student instructors from the analysis.

Table 1: Institutional Characteristics, 2005 Enrolling Cohort: National Sample Versus ASCS

	National Sample		ASCS	
Characteristic	**Public Four-Year**	**Public Two-Year**	**Public Four-Year**	**Public Two-Year**
Enrollment				
Full-time enrollment	8,141	2,352	5,377	1,011
Percent of GRS cohort[a]	16.29%	12.65%	16.73%	13.32%
12-month undergraduate headcount	10,494	9,533	7,174	3,235
Graduation rate, total cohort	44.18%	25.44%	35.80%	19.23%
Student demographics and SES percent of total enrollment				
White, non-Hispanic	66.9%	66.4%	69.6%	77.4%
Black, non-Hispanic	12.9%	13.7%	22.9%	18.1%
Hispanic	7.0%	9.4%	1.5%	2.2%
Asian or Pacific Islander	4.5%	3.7%	1.4%	0.9%
American Indian or Alaska Native	1.1%	1.5%	1.2%	0.9%
Race/ethnicity unknown	4.6%	4.5%	1.0%	0.5%
Citizenship: Non-resident alien	3.0%	0.8%	2.3%	0.0%
Female	57.1%	59.4%	59.3%	63.6%
Receiving any financial aid	77.9%	65.9%	79.4%	84.0%
Institution finance				
Tuition and fees, 2005–06 ($)	5,240	2,129	4,405	1,732
Expenses per FTE ($):				
Instruction	8,946	4,045	11,306	3,667
Research	7,322	14	4,685	0
Public service	1,488	184	1,323	187
Academic support	1,742	795	1,646	579
Student service	1,159	973	892	878
Institutional support	4,547	1,403	3,605	1,382
Other expenses	12,394	2,534	6,484	3,105
Percent of core revenues				
Tuition and fees	27.4%	18.2%	18.1%	12.3%
State appropriations	36.2%	35.2%	40.2%	42.6%
Local appropriations	0.4%	12.8%	1.0%	5.4%
Average salary equated to 9-month contracts of full-time instructional faculty ($)				
Professors[b]	80,230	62,374	70,855	NA
Associate professors[b]	62,656	52,979	57,919	NA
Assistant professors (tenure track)	53,244	46,161	48,765	NA
Non-tenure faculty[c]	42,995	40,104	31,772	37,697
N	613	1,055		

Note. Author derived data from the IPEDS Data Center 2005 data collection. Both national and ASCS samples include public degree-granting not-for-profit institutions. All dollar figures are CPI-adjusted to 2012 dollars.

[a] GRS cohort refers to full-time, first-time degree/certificate-seeking students.
[b] Only one two-year institution in the state system has faculty members with academic rank as professor or associate professor.
[c] IPEDS does not distinguish between long-term and short-term non-tenure faculty.

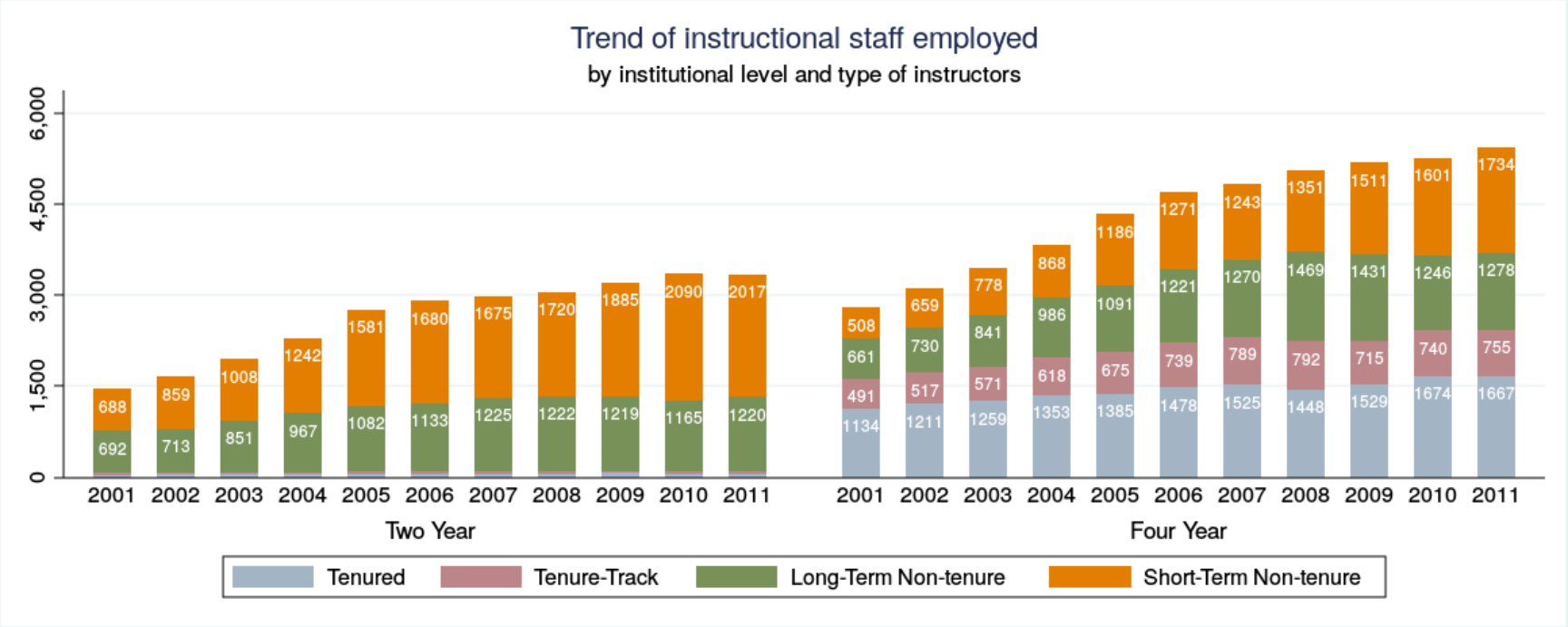
Figure 1 shows the changes in the distributions of different types of instructors over 10 years between 2001 and 2011 in ASCS. The figure indicates that the number of tenure-track and tenured faculty increased gradually over time, with an average annual growth rate of approximately 5 percentage points among tenure-track and tenured faculty in four-year colleges. In contrast, the number of non-tenure faculty, especially short-term non-tenure faculty, increased at a much greater pace: In 2001, short-term non-tenure faculty represented 47 percent of all faculty in two-year colleges and 18 percent in four-year colleges; 10 years later, they increased to 60 percent and 32 percent in these two settings respectively. The increasing reliance on non-tenure faculty in ASCS, especially on those with short-term contracts, echoes the national trends during the past decade.

In addition to academic rank, the instructor information we use includes demographic characteristics such as gender and race/ethnicity, employment status (i.e., part-time versus full-time) during each term of employment, highest degrees attained at the beginning of each term, and quarterly earnings between 2004 and 2012. Importantly, since the earnings data are drawn from the Unemployment Insurance (UI) database that includes quarterly earnings records from each employer in this state, we are able to create indicators for whether an instructor had ever worked in a non-teaching industry position, whether he or she held other non-teaching positions during a term, and whether he or she ever taught in multiple colleges as an instructor.[4] Such rich information on instructors' employment and demographic characteristics allow us to examine not only the overall impacts of different types of instructors on students' outcomes, but also their potential sources.

Another great advantage of the dataset we use is that students can be tracked across colleges within ASCS. Therefore, even if a student transferred to or took courses in a college other than the one he or she started in, we are still able to identify their subsequent course-taking patterns and grades. The ability to track students across colleges is particularly important for understanding the impacts of instructors on community college students, as a substantial proportion of students who start in a community college transfer to a four-year college later.

[4] The match was performed by the college systems; we received de-identified and pre-matched information without being provided with instructors' social security numbers.

Figure 1: Number of Instructional Staff Employed in the Anonymous State College System (ASCS)



Available instructor characteristics reveal noticeable differences between different types of instructors. In general, both short- and long-term non-tenure faculty had fewer years of college teaching experience and were less likely to have received a doctorate compared with tenure faculty hired. Non-tenure faculty also tended to be younger, to have work experience in non-education sectors, and to work on a part-time basis as a college instructor.[5] Unsurprisingly, the average annual earnings of non-tenure faculty from their college teaching positions were substantially lower than the earnings of tenure faculty.[6]

More interestingly, comparisons between short- and long-term non-tenure faculty reveal substantial differences. Short-term non-tenure faculty were dramatically less likely to work full-time during a semester than long-term non-tenure faculty. Moreover, almost one third of short-term non-tenure faculty in both two-year and four-year colleges were not employed for consecutive terms during their first year teaching in a college, and among these instructors, more than half terminated their employment with the college and never returned to teaching after their first year.

Unsurprisingly, short-term non-tenure faculty were more likely than long-term non-tenure faculty to hold concurrent non-college jobs while teaching as college instructors. While it was common for long-termers to have worked outside of colleges intermittently, earnings from non-college positions typically represented only 30–40 percent of their total annual income. In contrast, earnings from non-college jobs tended to be the main source of income for short-termers, representing 55–60 percent of their annual income. Somewhat surprising to us, less than 10 percent of short-termers ever taught at multiple institutions, about the same rate as among long-termers.

[5] Part-time/full-time status is recorded at the instructor-semester level. To present individual-level summary statistics, we define an instructor as "full-time" if he or she worked full-time in more than half of the total terms employed in an institution.

[6] All the earnings records used in this paper are adjusted to 2012 dollars to account for inflation.

Table 2: Instructor Descriptive Statistics

Characteristic	Two-Year College Faculty		Four-Year College Faculty		
	Short-Term Non-tenure	Long-Term Non-tenure	Short-Term Non-tenure	Long-Term Non-tenure	Tenure
Female	56.60%	58.57%	59.55%	62.96%	32.42%
Race/Ethnicity:					
White	87.83%	91.56%	85.80%	85.28%	81.71%
Black	10.04%	6.63%	7.25%	7.65%	6.82%
Hispanic	0.87%	0.76%	1.54%	1.23%	1.11%
Asian	0.90%	0.66%	2.15%	3.20%	6.91%
Other	0.29%	0.39%	3.26%	2.64%	3.45%
Degree attainment[a]: Master's degree	55.50% (0.50)	34.75% (0.48)	62.41% (0.48)	65.22% (0.48)	16.09% (0.37)
Degree attainment: Doctoral degree	6.93% (0.25)	5.32% (0.22)	15.78% (0.33)	15.30% (0.36)	87.96% (0.33)
Age in 2012	49.4 (12.20)	50.3 (10.86)	45.9 (12.49)	49.4 (11.56)	54.7 (12.18)
Taught in more than one institution	8.26%	6.69%	9.49%	7.13%	6.07%
Employed full-time[b]	22.16%	63.58%	30.15%	68.52%	97.69%
Total years of teaching	6.53 (5.17)	8.1 (6.01)	5.48 (4.14)	9.48 (6.19)	12.48 (6.56)
Worked in K-12 sector prior to work in college	29.15%	22.39%	18.34%	6.51%	0.87%
Worked in non-education sector prior to work in college	71.11%	64.48%	47.62%	19.91%	2.48%
Employment status:					
Employed consecutively during first year and continued teaching afterwards	66.13%	77.86%	63.31%	76.17%	96.94%
Employment terminated after first year	19.54%	13.13%	20.02%	11.83%	1.74%
Employed intermittently during first year and continued teaching afterwards	14.34%	9.01%	16.67%	12.00%	1.32%
Average earning from college	$13,253.02 (14,982.43)	$23,132.56 (16,778.74)	$20,328.66 (22,959.41)	$38,749.83 (25,097.82)	$72,139.78 (31,488.38)
Average earning from non-teaching jobs	$29,763.57 (27,929.93)	$23,385.81 (21,518.44)	$23,801.52 (34,225.27)	$13,566.04 (28,311.33)	$2,535.21 (10,491.27)
N	3,728	1,211	3,064	2,320	2,421

Note. Data are on instructors in the analytic sample who taught at least one course between fall 2005 to summer 2012. Standard deviation in parentheses.

[a] Reference category for degree attainment is bachelor's degree or below.
[b] Full-time employed defined as worked as full-time instructor during more than half of the terms employed in the institution.

In view of the prevalence of non-college work experience among both short- and long-term non-tenure instructors, we further examine where these instructors were employed before they started teaching in a college. Appendix Table A.1 presents the main industries of employment among non-tenure faculty who ever worked before they started college teaching

positions by field of study.[7] Interestingly, for almost each field of study, a nontrivial proportion of non-tenure instructors had work experience in the K-12 sector. In the field of education and childcare in particular, more than half of them in two-year colleges and almost two thirds of them in four-year colleges were previously employed in the K-12 sector.

Using the 2012 wage and employment estimates by state and industry reported by the U.S. Department of Labor's Bureau of Labor Statistics, we can also compare earnings of these instructors before they were employed by colleges with all K-12 teachers.[8] When placed within the earnings distribution of all K-12 teachers in this state, the average annual prior earnings from the K-12 sector among non-tenure faculty with previous K-12 experience ($40,300 in 2012 dollars) fall slightly below the median annual income of all elementary and middle school teachers. About half of these non-tenure faculty continued working in the K-12 sector after they were employed by a college mainly through part-time employment, suggesting that many of these K-12 teachers still used their K-12 positions for their main employment and used their college adjunct teaching positions to bump up their total income.

Many non-tenure faculty not drawn from the K-12 sector are drawn from industries relevant to a specific field of study. This is particularly the case in occupation-oriented fields of study, such as health and business. In health-related fields, for example, almost two thirds of the non-tenure instructors worked in either hospitals or medical-service industries before they started teaching at the colleges. When placed within the overall earnings distribution of all medical practitioners in this state, the average annual earnings that non-tenure faculty received from their non-teaching industry positions before they become college instructors ($38,000 in 2012 dollars) typically fall between 25th to 50th percentile of healthcare or technical practitioners.

Summary Statistics

Because the aim of this study is to understand the impact of non-tenure instructors during students' initial exposure to a field of study on their current and later academic outcomes in the same field, we limit our initial analysis to the first college-level course a student takes in each field of study. We choose to focus on the first course that a student takes in a field of study for both applied and methodological reasons. From an applied standpoint, instructional quality in introductory courses can not only affect students' interest and success in subsequent learning in the same field, but may also influence important academic decisions such as choice of major or even the choice to make an early college withdrawal. As a result, colleges, especially two-year colleges, tend to be particularly concerned with instructional effectiveness in entry-level courses and potential ways of improving them. In addition, non-tenure instructors in ASCS are more actively involved in teaching lower-division courses than more advanced courses. In four-year colleges, about half of the total course enrollments between 2005 and 2012 were with non-tenure

[7] In each field, any industries with 10 or fewer non-tenure instructors are not shown in Appendix Table A.1.
[8] Data retrieved from http://www.bls.gov/oes/current/oes_research_estimates.htm, August 2016.

instructors, compared with more than 60 percent when we restrict the sample to include only the first course each student enrolled in in a particular field.

From a methodological standpoint, entry-level courses typically have very large enrollments compared with more advanced courses, yielding a large sample size for analysis. In addition, most students take these courses at an early stage of their college career when they are less likely to have pre-existing knowledge regarding instructors in a particular field at their college. Accordingly, focusing on these introductory courses (rather than more advanced courses) should reduce self-selection bias. Given that students usually take entry-level courses during their initial exposure to a particular field of study, these courses are referred to as "introductory courses" hereafter. If a student attempts a particular introductory course multiple times, only their first attempt is retained for analysis.[9]

The final analytical sample includes 324,883 introductory course enrollments among 68,692 students in two-year colleges and 730,408 introductory course enrollments among 87,212 students in four-year colleges.[10] Summary statistics of the student sample are displayed in Table 3. Students enrolled in four-year colleges consistently outperformed students enrolled in two-year colleges across all pre-college academic measures. For example, four-year students had higher high school GPAs on average (3.2 versus 2.7) and were more likely to have attained a high school diploma (93 percent versus 75 percent).

[9] Among students who take multiple introductory courses during their initial exposure to a field (15 percent of the introductory course enrollment sample), we choose an introductory course randomly to retain for the analysis. We also conduct a robustness check using all introductory courses in the sample and collapse the sample at the student-subject level. The results are fairly consistent.

[10] For analysis on subsequent course enrollment in the same field, we collapse the introductory course sample so each student only has one observation in each field of study, which yields a total of 324,883 observations in two-year colleges and 730,408 in four-year colleges. This is based on the concern that the same subsequent outcomes would be observed more than once for students who took multiple courses during their initial exposure to a field. Around 13 percent of the original introductory course sample in two-year colleges and four-year colleges is dropped (67,154 in two-year colleges and 95,327 in four-year colleges) due to collapsing the data. For students who took multiple introductory courses, we randomly select one course in the analytical model that controls for introductory course fixed effects. Another way to address the concern is to calculate the proportion of course credits with each type of instructor during the student's initial exposure and then use that proportion as the "treatment." In a robustness check we use this alternative approach using the uncollapsed data. The results are fairly similar.

Table 3: Student Descriptive Statistics, Starting Cohort 2005–2010

Characteristic	Two-Year Colleges	Four-Year Colleges
Female	56.19%	53.22%
Age when started	24.28	19.45
	(8.58)	(3.96)
Race/ethnicity:		
White	72.29%	70.94%
Black	21.75%	20.42%
Hispanic	3.75%	2.62%
Asian	1.14%	1.89%
High school diploma	75.16%	92.72%
High school GPA	2.71	3.20
	(0.60)	(0.58)
Enter in fall term	67.53%	89.66%
Placed as college ready in:		
Math	26.20%	65.55%
English	49.73%	75.96%
Reading	58.05%	78.19%
Taken remedial courses	64.68%	40.21%
N	68,692	87,212

Note. Data include students in the analytic sample, who first enrolled in any of the institution in the ASCS and tool at least one college-level course between fall 2005 and summer 2010. Standard deviation in parentheses.

Table 4 uses information from students' college transcripts and summarizes the types of instructors and academic outcomes at the student-course level (focusing on the introductory courses). Panel A summarizes characteristics of course sections taken by each student, including delivery method, credits attempted, and class enrollment size. Sections taught by short-term non-tenure faculty were more likely to be delivered through the online format and tended to have smaller class sizes than those taught by the other two types of instructors.

Panels B and C in Table 4 summarize key outcome measures. Panel B includes four current course outcomes: (a) persisting to the end of the course (as opposed to early course withdrawal); (b) passing the course (as opposed to persisting to the end of the course but failing to earn any credit); (c) earning C or better in the course; and (d) course grade only among those who persisted to the end of the course (on a 0 to 4 grading scale).

Among all the introductory courses, the overall course persistence rate in two-year colleges is 84 percent, with slight differences between those taught by short-term non-tenure faculty (84 percent) and those taught by long-termers (83 percent); in four-year colleges, the average persistence rate is 92 percent and 91 percent among sections taught by short-termers and long-termers, respectively, both of which are higher than the rate in sections taught by tenure faculty (90 percent). The same pattern is also observed among the other three measures, where

students taught by short-term non-tenure faculty are associated with the highest probability of passing a course, earning C or above, and receiving higher grade conditional on persistence, whereas tenure faculty are associated with the lowest probabilities in the current course performance measures.

In terms of subsequent course enrollment and success within a particular field of study, the overall probability that a student takes any additional courses within the same field of study is approximately 37 percent in two-year colleges and 43 percent in four-year colleges. In contrast to the positive impacts of short-term non-tenure instructors on immediate course outcomes, students who were taught by short-termers during their initial exposure to a field of study on average had a lower probability of attempting additional courses in the same field of study by 3–4 percentage points, compared with students who had their introductory courses taught by either long-termers or tenure faculty.

Among students who went on to enroll in another course in the same field, again, short-termers in introductory courses are associated with the lowest probability that the student passed the next course in both settings. In two-year colleges, the next-course completion rate in the same field is 71 percent among students who took their introductory courses with a short-term non-tenure instructor, compared with 74 percent among students with a long-termer. In four-year colleges, short-termers are also associated with the lowest next-class completion rate (80 percent), compared with 82 percent for long-termers and 83 percent for tenure faculty. The negative association between non-tenure faculty, particularly short-termers, with subsequent course outcomes is also observed among the other next-class performance measures. However, as mentioned previously, these effects could reflect student-level and course-level selection.

Table 4: Course Descriptive Statistics, Academic Year (AY) 2005–2012

	Two-Year College Faculty		Four-Year College Faculty		
Characteristic	**Short-Term Non-tenure**	**Long-Term Non- tenure**	**Short-Term Non-tenure**	**Long-Term Non-tenure**	**Tenure**
Panel A: Course-section characteristics					
Face-to-face section	75.35%	85.07%	93.06%	94.58%	92.75%
Number of credits for the course	3.02 (0.509)	3.00 (0.763)	2.89 (0.642)	2.88 (0.681)	2.95 (0.669)
Class size	20.51 (7.259)	22.32 (9.247)	43.89 (45.599)	58.20 (75.463)	57.18 (60.330)
Observations	90,507	234,376	140,577	307,704	282,127
Panel B: Contemporaneous course outcomes					
Persisted to the end of the course	83.96%	83.38%	92.14%	91.29%	90.05%
Passed the course	72.03%	71.98%	82.21%	81.70%	79.67%
Earned a C or better in the course	67.26%	66.86%	77.86%	76.47%	73.50%
Course grade given persistence (0 to 4 grading scale)	2.68 (1.392)	2.61 (1.353)	2.84 (1.292)	2.76 (1.276)	2.62 (1.277)
Observations	90,507	234,376	140,577	307,704	282,127
Panel C: Subsequent outcomes					
Student-field outcomes					
Took additional course in the same field	36.05%	38.63%	40.44%	44.85%	43.56%
Took additional course and passed in the same field	25.62%	28.49%	32.76%	37.06%	36.61%
Observations	90,507	234,376	140,577	307,704	282,127
Student-next class outcomes					
Persisted to the end of the course	82.84%	84.20%	89.95%	90.13%	90.96%
Passed the next course in the subject	70.78%	73.88%	80.46%	81.66%	83.46%
Earned a C or better in the next course	65.61%	68.47%	74.21%	74.72%	76.83%
Course grade given persistence (0 to 4 grading scale)	2.61 (1.391)	2.65 (1.331)	2.72 (1.300)	2.72 (1.273)	2.77 (1.239)
Observations	33,562	95,001	54,984	131,712	119,783

Note. Standard deviation in parentheses. The student-course analytical sample is restricted to the first college-level course taken by each student in each field of study. All student-course level analyses exclude courses on a pass/fail grading system.

3. Empirical Framework

Basic Empirical Model

To assess the impacts of different types of instructors on student learning, we explore two sets of outcomes: current course performance, and subsequent course enrollment and performance in the same field of study. The basic strategy relates student *i*'s outcomes in subject *k* at campus *j* in semester *t* to the type of instructor that the student had during his/her initial exposure to this subject area:

$$Y_{itkj} = \alpha + \beta\ \text{Instructor}_{itkj} + \gamma\ X_i + \pi_t + S_k + C_j + \mu_{itkj} \qquad (1)$$

The key explanatory variable is the type of instructor with whom a student took the introductory course in a field of study. We use long-term non-tenure faculty as the base group for both the two-year and four-year analyses for easier comparisons across settings. In the analysis of four-year colleges, the vector "Instructor" includes three variables: short-term non-tenure faculty, tenure-track faculty, and tenured faculty, where each of the three groups is compared with long-term non-tenure faculty. In the analysis of two-year colleges, there is only one variable in the "Instructor" vector (short-term non-tenure faculty). In addition to the fixed effects for the term of enrollment in the course (π_t), the field of the course (S_k), and the campus of attendance (C_j), the model also incorporates a rich set of controls, denoted by X_i, which includes student demographic attributes (e.g., age at the time of taking the introductory course, gender, race/ethnicity), academic preparedness (e.g., remedial status, high school GPA),[11] term-level information (e.g., total credits taken in current term), and college-course-level information (e.g., number of total enrollments in the course section, whether the course section is online or face-to-face, and whether the course is within the student's declared major).[12]

Addressing Selection Through a Two-Way Fixed Effects Approach

By including college, term, and course subject fixed effects, the basic model in equation (1) addresses the problem that courses taught by a certain type of instructor *i* may be more prevalent within particular colleges, terms, or course subjects. For example, equation (1) addresses circumstances in which students enrolled in a health-related program might be more likely to take courses with short-term non-tenure instructors than those in a math program. However, equation (1) cannot address two remaining sources of selection, the first being between-course selection within a particular field. For example, within a given department in a college, tenure faculty might be more likely to teach more-academically-demanding courses than non-tenure faculty. Although this problem has been partly addressed by focusing on courses that

[11] About one third of the students have missing values for their high school GPA. Therefore we include a dummy variable indicating missingness in the model.
[12] Please see Table 5 for the full list of covariates.

students took during their initial exposure to a field, there may still be remaining variations in difficulty across these introductory courses. To address possible between-course selection, we add college-course fixed effects into the model,[13] thus enabling comparisons among different sections of the same course within a particular college.[14]

The second source is selection due to students' differential sorting by type of instructor within courses. For example, academically more motivated students might prefer tenure faculty for their accessibility and potential research opportunities. We directly explore the extent of this problem by relating different types of instructors to a wide range of student-level and course-section-level characteristics controlling for college-course fixed effects and term fixed effects. Results presented in Table 5 suggests that while there is no consistent relationship between types of instructors and indicators of students' previous academic performance, students who took a course with non-tenure faculty, especially short-termers, tended to be older, were more likely to enroll part-time during their initial term of college enrollment, were more likely to enroll in a course section with a smaller class size, and were more likely to enroll in course sections that were delivered online. To address possible selection bias due to student sorting by type of instructor, we further include student fixed effects into the model, thus controlling for any unobservable student-level characteristics that are constant across courses:

$$Y_{ictkj} = \alpha + \beta\ \text{Instructor}_{ictkj} + \rho_{ckj} + \pi_t + \sigma_i + \mu_{ictkj} \qquad (2)$$

Compared with equation (1), equation (2) includes two new fixed effects: ρ_{ckj} for college-course fixed effects and σ_i for student fixed effects. This identification draws on two sources of variations. The first includes student-level variations, where a student takes introductory courses with different types of instructors in different fields of study. For example, a student may take an introductory physics course with a short-term non-tenure instructor but an introductory math course with a tenured instructor. The majority of the students (68 percent in two-year colleges and 91 percent in four-year colleges) took a mixture of introductory courses taught by different types of instructors.[15] The second source of variation comes from within-course differences in

[13] We also conduct a robustness check controlling for college-course-term fixed effects. The results are consistent with the estimates that control for college-course- and term-fixed effects separately.

[14] Note that academic field and college fixed effects are automatically dropped when college-course fixed effects are added to the model, as these are attributes of the course.

[15] In two-year colleges, 8 percent of the students took their introductory courses only with short-term non-tenure faculty, and another 24 percent took courses only with long-termers; in four-year colleges, the proportion of students who took their introductory courses with only a certain type of instructor are 2.0 percent with short-termers, 4 percent with long-termers, 1 percent with tenure-track faculty, and 2 percent with tenured faculty. It is worth noting that having a proportion of students who have no variation in instructors does not cause a selection bias to the student fixed effects estimator, as long as the selection bias is constant within an individual; the only concern is that there might be insufficient within-individual variations to deliver a precise estimator due to large standard error. However, this issue is less of a concern in the current study, as the majority of the students have variation in the type of instructor.

the type of instructor teaching a specific section, which could be either due to multiple sections offered during a particular term in a college (58 percent of the enrollments in two-year colleges and 66 percent in four-year colleges were in courses with such within-term variation), or due to changes in the type of instructor teaching the same course over time (48 percent of the course enrollments in two-year colleges and 44 percent in four-year colleges were in courses with by-term variation in the type of instructor). This setup supports the use of both student fixed effects and college-course fixed effects, so that the estimates reflect whether introductory courses taught by different types of instructors lead to different concurrent course outcomes, holding constant course-specific characteristics as well as student attributes that are constant across courses.[16]

One concern with estimating the impacts of non-tenure faculty on students' performance in the subsequent course in the same field, however, is that initial experience in a field may influence a student's preference for different types of instructors in the next course in that field. For example, if a student had an unsatisfactory experience with a non-tenure instructor in the introductory course, he might intentionally avoid taking another course in that department with a non-tenure instructor. To address this possible selection, we draw on the Figlio et al. (2015) model, which controls for both student-level fixed effects and next-class fixed effects:

$$Y_{icskjt+1} = \alpha + \beta\, \text{Instructor}_{icskjt} + \rho_{cskjt+1} + \sigma_i + \rho_{ckj} + \mu_{icskjt+1} \qquad (3)$$

which relates student i's outcomes in the next class section s in course c in field k at campus j in time t+1 to the type of instructor that the student has in his introductory course ($\text{Instructor}_{icskjt}$). Since the next course-section fixed effect $\rho_{cskjt+1}$ is a combination of college, course, time, and specific section, and σ_i controls for student-level fixed effects, this model specification compares student performance in exactly the same course section, holding constant all individual-level characteristics that are invariant over time.

The term ρ_{ckj} further controls for course-level fixed effects for students' introductory courses. This term would take care of potential between-course bias rising from students shopping across different introductory courses within a field.[17] In the field of economics, for example, some students take Introductory Microeconomics as their first course while others take Introductory Macroeconomics. Suppose that we examine students' subsequent course performance in a particular section in Intermediate Microeconomics in spring 2009 in a particular college, and suppose that Introductory Microeconomics prepares students better than Introductory Macroeconomics. The estimated effect of β in equation (3) would be biased in favor

[16] We can also add an interaction between time and college-course fixed effects to address the concern that there might be course-specific variations over time in grading criteria; however, this would only draw on courses that offer multiple sections with different types of instructors in a particular term, which represents 57.6 percent of the course enrollment in two-year colleges and 65.7 percent in four-year colleges. In a separate robustness check, we added college-course-term fixed effects into the model; the estimates are fairly similar.

[17] In cases where a student took multiple introductory courses during his initial exposure, we randomly chose a course for course fixed effects for the analysis on subsequent outcomes. This only consists of 16.5 percent of the observations in the analysis on subsequent outcomes in two-year colleges and 17.8 percent in four-year colleges.

of tenured faculty if better students are more likely to choose Introductory Microeconomics as their first economics course and if tenured faculty are also more likely to be assigned to teaching Introductory Microeconomics than the other types of instructors. By adding fixed effects for introductory courses, equation (3) now controls for any between-course selection bias during a student's initial exposure to a field.

Table 5: Probability of Taking an Introductory Course with Different Types of Instructors

	Two-Year College Faculty	Four-Year College Faculty		
Sample	**Short-Term Non-tenure**	**Short-Term Non-tenure**	**Long-Term Non-tenure**	**Tenure**
Demographics:				
Female	0.0004	0.0050***	-0.0009	-0.0033***
	(0.0020)	(0.0010)	(0.0007)	(0.0009)
Race/ethnicity[a]:				
Asian	0.0087	-0.0007	-0.0033	0.0046
	(0.0056)	(0.0030)	(0.0020)	(0.0031)
Black	0.0108***	-0.0086***	0.0017	0.0040**
	(0.0036)	(0.0023)	(0.0014)	(0.0018)
Hispanic	0.0038	0.0001	0.0032	-0.0035
	(0.0034)	(0.0024)	(0.0022)	(0.0027)
Other race/ethnicity	-0.0025	-0.0016	0.0036	-0.0029
	(0.0054)	(0.0043)	(0.0028)	(0.0033)
Age when taking the course	0.0004***	0.0021***	-0.0007***	-0.0009***
	(0.0001)	(0.0003)	(0.0001)	(0.0002)
Residence of the state	-0.0026	0.0046	-0.0045*	-0.0002
	(0.0038)	(0.0037)	(0.0026)	(0.0028)
High school attributes				
Earned high school diploma	0.0016	0.0097**	0.0028	-0.0039
	(0.0031)	(0.0041)	(0.0026)	(0.0037)
Earned GED or equivalent	0.0053	0.0163***	-0.0011	-0.0057
	(0.0038)	(0.0048)	(0.0046)	(0.0043)
High school GPA	0.0020***	0.0002	0.0005	-0.0013
	(0.0007)	(0.0008)	(0.0007)	(0.0008)
Placement test information				
Placed as college ready in math	0.0010	-0.0006	0.0022**	0.0008
	(0.0017)	(0.0016)	(0.0010)	(0.0015)
Placed as college ready in English	-0.0002	0.0010	0.0005	0.0010
	(0.0016)	(0.0018)	(0.0011)	(0.0014)
Placed as college ready in reading	0.0002	-0.0018	-0.0006	0.0010
	(0.0015)	(0.0015)	(0.0010)	(0.0014)
Entered in fall term	0.0010	-0.0030	-0.0010	0.0021
	(0.0016)	(0.0021)	(0.0014)	(0.0018)

College enrollment information				
Enrolled as full-time student in first term	-0.0142*** (0.0024)	-0.0070*** (0.0020)	0.0029** (0.0011)	0.0057*** (0.0014)
First term degree-seeking	-0.0017 (0.0025)	-0.0046** (0.0023)	-0.0012 (0.0011)	-0.0009 (0.0018)
Degree intent[b]: Bachelor's degree	0.0164 (0.0102)	-0.0071 (0.0044)	0.0040 (0.0049)	0.0106** (0.0050)
Degree intent: Associate degree	0.0032 (0.0034)	0.0129* (0.0076)	-0.0191*** (0.0064)	-0.0091 (0.0064)
Degree intent: Transfer	-0.0072 (0.0044)	-0.0039 (0.0076)	0.0034 (0.0064)	0.0085 (0.0074)
Degree intent: Certificate	-0.0029 (0.0051)	0.0534 (0.0401)	-0.0281*** (0.0086)	-0.0392*** (0.0133)
Degree intent: Technical certificate	0.0004 (0.0042)	0.0436*** (0.0142)	-0.0326*** (0.0071)	-0.0467*** (0.0104)
Course-section characteristics				
Credit hours	-0.0071 (0.0332)	-0.0075 (0.0046)	0.0005 (0.0011)	0.0170*** (0.0063)
Face to face section	-0.0481*** (0.0114)	0.0373** (0.0152)	0.0130 (0.0090)	-0.0652*** (0.0126)
Enrollment size	-0.0038*** (0.0005)	-0.0007*** (0.0002)	0.0000 (0.0001)	0.0007*** (0.0002)
Observations	324,883	730,408	730,408	730,408
R-squared	0.6299	0.5236	0.5679	0.5618

Note. All regressions control for high school fixed effects, college*course-term fixed effects, and cohort fixed effects. The base group for regressions in both two-year and four-year colleges are non-tenure-track faculty. Standard errors are clustered at the college level due to multiple observations within a college. Robust standard errors in parentheses.

[a] Base group for race/ethnicity is White, non-Hispanic; other race/ethnicity includes American Indian, Pacific Islander, multiple races, and unknown.

[b] Base group for degree intent is seeking other credential such as diploma.

*** $p < .01$, ** $p < .05$, * $p < .1$.

Remaining Sources of Selection

The remaining concern from the two-way fixed effects model is student-level sorting that varies across courses. That is, students may still sort by different types of instructors within a particular introductory course based on considerations that are also correlated with their academic performance in a particular course. For example, a student may take more important courses with tenure faculty and less important courses with non-tenure faculty. Although the results presented in Table 6 suggests that there are no systematic differences in most of the student-level characteristics among students who took a course with different types of instructors

(especially with respect to the relationship between types of instructors and indicators of student previous academic performance), we are unable to rule out the possibility that students sort by types of instructors differently across courses.

To cross-validate the results, we adapt Bettinger and Long's (2010) empirical approach and use term-by-term variation in different types of instructors in a department as an instrument for the student's likelihood of taking a particular course with different types of instructors in their initial term in a certain field. Specifically, a department is often subject to term-by-term variations in retirements and sabbaticals of tenure faculty, as well as temporary shocks in demand for course offerings. To deal with these fluctuations, departments often use non-tenure instructors to make up the difference, which might be plausibly idiosyncratic once controlling for course and time fixed effects.

To address possible seasonality of non-tenure faculty usage in each department, we construct the instrumental variables as the deviation in the proportion of course sections taught by a specific type of instructor in a department during a certain term from term-specific (i.e., fall, spring, and summer) average proportion of course sections offered by that particular type of instructor between 2005 and 2012.[18] As we show below, fluctuations in faculty composition are highly correlated with students' probability of taking a course with a certain type of instructor.

4. Empirical Results

Current Course Performance

Table 6 presents the estimated effects of adjuncts on a student's first course in a field of study based on three model specifications: columns 1–3 present results from the basic OLS model that controls for available student-level and college-course-level characteristics (equation [1]); columns 4–6 further control for college-course fixed effects; and columns 7–9 show the results of our preferred model that controls for both student fixed effects and college-course fixed effects (equation [2]). Panel A presents results on two-year colleges and Panel B presents results on four-year colleges.

The results tell similar stories about the two-year and four-year sectors: students taking their introductory courses with short-term non-tenure faculty were more likely to have better course outcomes relative to long-term non-tenure faculty, including a higher probability of persisting to the end of the course, passing the course, and receiving higher grades.[19] By focusing on course grades with the preferred model specification (column 9), taking a course with a short-

[18] See Bettinger and Long (2010) for a more detailed discussion of this instrumental variable strategy.
[19] We define course grades as follows: 4 for A and equivalent, 3 for B, 2 for C, 1 for D, and 0 for failing the course. We assign a grade of 0 for students who drop out of the course.

term rather than a long-term non-tenure instructor is associated with an increase in course grades by 0.14 grade points in two-year colleges and 0.16 in four-year colleges.

In contrast, students taking their introductory courses with either tenure-track or tenured faculty were on average are more likely to have lower course persistence and performance relative to long-term non-tenure faculty, where the effect sizes are almost twice as large for tenured faculty than for tenure-track faculty. As a result, focusing on course grade presented in column 9, a student taking an introductory course with a tenured faculty (the category of faculty associated with the lowest average course performance) in a four-year college would see their grade point reduced by 0.33 compared with a student taking the same course with a short-term non-tenure faculty (the category of faculty associated with the highest average course performance). On a 0–4 scale, an increase of 0.33 grade points represents a substantial increase, such as from B to B+.

We further explore the impact of non-tenure instructors on the full distribution of the letter grades in introductory courses. The results presented in Appendix Table A.2 indicate that in both two-year and four-year colleges, the magnitude of the positive impacts of short-term non-tenure faculty on introductory course grades is largest for students receiving a grade of A or the equivalent, and the magnitude of the estimated coefficients decrease steadily as we lower the threshold to "B or better," "C or better," and "D or better." In a similar vein, the estimated gaps between long-term non-tenure faculty and tenure-track/tenured faculty are also largest in terms of a student's probability of receiving "A or equivalent" and smallest in the probability of receiving "D or better." This pattern suggests that the positive effects of non-tenure faculty on the average introductory course grades presented in Table 6 are largely driven by the increased probability of receiving high grades, such as A and B.

Finally, we also estimate the impacts of different types of instructors on introductory course grades conditional on course persistence (column 5 in Table A.2). The effect sizes are slightly smaller than the unconditional effects presented in Table 6 but remain positive and significant, which suggests that non-tenure instructors had positive impacts on both course persistence and course grades among students who persisted to the end of the course.

Table 6: Impact of Type of Instructor on Introductory Course Performance

Panel A: Two-Year Colleges

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1: OLS			Model 2: Course Fixed Effects			Model 3: Course Fixed Effects + Student Fixed Effects		
Outcome	**Persist to End of Course**	**Pass Course**	**Grade**	**Persist to End of Course**	**Pass Course**	**Grade**	**Persist to End of Course**	**Pass Course**	**Grade**
Short-term non-tenure instructor	0.0227***	0.0221***	0.1546***	0.0075**	0.0107***	0.1051***	0.0123***	0.0183***	0.1351***
	(0.0048)	(0.0057)	(0.0240)	(0.0032)	(0.0038)	(0.0180)	(0.0027)	(0.0033)	(0.0161)
Sample mean	0.84	0.72	2.19	0.84	0.72	2.19	0.84	0.72	2.19
	(0.37)	(0.45)	(1.58)	(0.37)	(0.45)	(1.58)	(0.37)	(0.45)	(1.58)
Observations	324,883	324,883	324,883	324,883	324,883	324,883	324,883	324,883	324,883
R-squared	0.0186	0.0524	0.0973	0.0815	0.1118	0.1830	0.4158	0.5031	0.5842
Student characteristics	YES	YES	YES	YES	YES	YES			
College-course characteristics	YES	YES	YES						
Student fixed effects							YES	YES	YES
College*course fixed effects				YES	YES	YES	YES	YES	YES

Panel B: Four-Year Colleges									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1: OLS			Model 2: Course Fixed Effects			Model 3: Course Fixed Effects + Student Fixed Effects		
Outcome	Persist to End of Course	Pass Course	Grade[a]	Persist to End of Course	Pass Course	Grade[a]	Persist to End of Course	Pass Course	Grade[a]
Short-term non-tenure instructor	0.0181*** (0.0037)	0.0224*** (0.0060)	0.1763*** (0.0426)	0.0107*** (0.0025)	0.0181*** (0.0038)	0.1384*** (0.0224)	0.0129*** (0.0020)	0.0226*** (0.0029)	0.1572*** (0.0170)
Tenure-track instructor	-0.0059 (0.0044)	-0.0084 (0.0066)	-0.1115*** (0.0362)	-0.0060* (0.0033)	-0.0149*** (0.0051)	-0.1016*** (0.0249)	-0.0057** (0.0029)	-0.0137*** (0.0042)	-0.0998*** (0.0211)
Tenured instructor	-0.0115*** (0.0042)	-0.0202*** (0.0064)	-0.1801*** (0.0344)	-0.0128*** (0.0029)	-0.0243*** (0.0043)	-0.1732*** (0.0210)	-0.0135*** (0.0025)	-0.0217*** (0.0036)	-0.1702*** (0.0168)
Sample mean	0.91 (0.29)	0.81 (0.39)	2.47 (1.45)	0.91 (0.29)	0.81 (0.39)	2.47 (1.45)	0.91 (0.29)	0.81 (0.39)	2.47 (1.45)
Observations	730,408	730,408	730,408	730,408	730,408	730,408	730,408	730,408	730,408
R-squared	0.0282	0.0931	0.1979	0.0625	0.1374	0.2874	0.3196	0.4473	0.5924
Student characteristics	YES	YES	YES	YES	YES	YES			
College-course characteristics	YES	YES	YES						
Student fixed effects							YES	YES	YES
College*course fixed effects				YES	YES	YES	YES	YES	YES

Note. Base group for both two-year and four-year colleges are long-term non-tenure faculty. Model 1 controls all student and course characteristics in Table 5; Model 2 controls all student characteristics in Table 5 and course section characteristics including enrollment size, delivery method, and term taking the course, and whether the course is within student's declared major; Model 3 controls for student age when taking the course, course section characteristics including enrollment size, delivery method, and term taking the course, as well as whether the course is within student's declared major and other students' average high school GPA in the course section. Standard errors are clustered at student-, intro-class-, and course-level. Robust standard errors in parentheses.

[a] Courses on pass/fail grading system are excluded from all regression analyses.

*** $p < .01$, ** $p < .05$, * $p < .1$

Subsequent Academic Outcomes

We next estimate the effects of different types of instructors on subsequent course enrollment and performance. Table 7 presents results on the probability of (1) taking another course in the same field of study and (2) taking another course and passing it. Columns 1–3 present results based on the OLS model with available individual and course level characteristics and college-subject fixed effects. Columns 4–6 further control for student fixed effects and college-course-level fixed effects for the introductory course.

The results present a completely opposite story to the estimates shown above on current outcomes: students taking their introductory courses with short-term non-tenure faculty are associated with the lowest probability of attempting another course in the same field in both two-year and four-year colleges. In contrast, students taking their introductory courses with tenure-track and tenured faculty are associated with a higher probability of taking another course relative to students taking introductory courses with long-term non-tenure faculty, with a larger effect size identified for tenured faculty than tenure-track faculty. Considering that the average probability of enrolling in another course after an initial attempt in a field of study is 37 percent in two-year colleges and 43 percent in four-year colleges, 1.6–1.7 percentage points based on the preferred model in column 4 represents approximately a 4 percent lower probability for enrolling in another course in the same field in both two-year and four-year colleges, which are both fairly sizable in magnitude.

Once we combine next course enrollment with course completion information, short-term non-tenure faculty are still negatively associated with "taking the next course and passing it" relative to long-term non-tenure faculty, but the effect sizes are about one quarter lower than the impacts on course enrollment alone. One possible explanation for the reduced impact once considering next course performance concerns selection into the next courses with different levels of difficulty due to initial experiences in a field of study. Taking one's introductory course with different types of instructors may influence a student's self-perceived capability in a particular field and influence their choice of subsequent courses. To explore this possibility, we calculate the average course grade for each college-course (excluding the student's own grade) in our dataset and examine the impact of taking one's introductory courses with different types of instructors on the difficulty of a students' subsequent course enrollment in that field, as measured by the average course grade of the next course. The results (presented in column 3 and column 6 in Table 7) supports our hypothesis: students who took their introductory courses with non-tenure instructors, especially short-termers, tended to take courses with higher average grades, or less difficult courses, compared with students taking introductory courses with tenure-track/tenured faculty. This finding also highlights the importance of controlling for next-course fixed effects in examining the impacts of different types of instructors on performance in subsequent courses in a field.

Table 7: Impact of Type of Instructor in Introductory Courses on Subsequent Enrollment in the Subject Area

Panel A: Two-Year Colleges						
	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1: OLS With Subject Fixed Effects			Model 2: Student Fixed Effects + Subject Fixed Effects + Intro Course Fixed Effects		
Outcome	**Take Additional Course**	**Take and Pass Additional Course**	**Average Grade of Second Course**	**Take Additional Course**	**Take and Pass Additional Course**	**Average Grade of Second Course**
Short-term non-tenure instructor	-0.0250***	-0.0191***	0.0159**	-0.0162***	-0.0107***	0.0125**
	(0.0048)	(0.0038)	(0.0069)	(0.0039)	(0.0034)	(0.0061)
Sample mean	0.37	0.27	2.23	0.37	0.27	2.23
	(0.48)	(0.44)	(0.59)	(0.48)	(0.44)	(0.59)
Observations	324,883	324,883	128,563	324,883	324,883	128,563
R-squared	0.1486	0.1061	0.3254	0.4064	0.3752	0.6023
Student characteristics	YES	YES	YES			
Intro course characteristics	YES	YES	YES			
Student fixed effects				YES	YES	YES
Intro course fixed effects				YES	YES	YES
College*subject fixed effects	YES	YES	YES	YES	YES	YES

Panel B: Four-Year Colleges

	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1: OLS With Subject Fixed Effects			Model 2: Student Fixed Effects + Subject Fixed Effects + Intro Course Fixed Effects		
Outcome	**Take Additional Course**	**Take and Pass Additional Course**	**Average Grade of Second Course**	**Take Additional Course**	**Take and Pass Additional Course**	**Average Grade of Second Course**
Short-term non-tenure instructor	-0.0294***	-0.0275***	0.0067	-0.0169***	-0.0164***	0.0118***
	(0.0063)	(0.0056)	(0.0098)	(0.0034)	(0.0034)	(0.0041)
Tenure-track instructor	0.0230***	0.0218***	0.0360***	0.0103**	0.0099**	-0.0044
	(0.0086)	(0.0078)	(0.0134)	(0.0043)	(0.0040)	(0.0054)
Tenured instructor	0.0142*	0.0126*	0.0301**	0.0145***	0.0123***	-0.0116**
	(0.0072)	(0.0066)	(0.0124)	(0.0048)	(0.0045)	(0.0046)
Sample mean	0.43	0.36	2.44	0.43	0.36	2.44
	(0.50)	(0.48)	(0.62)	(0.50)	(0.48)	(0.62)
Observations	730,408	730,408	306,479	730,408	730,408	306,479
R-squared	0.1724	0.1415	0.4301	0.3745	0.3510	0.6418
Student characteristics	YES	YES	YES			
Intro course characteristics	YES	YES	YES			
Student fixed effects				YES	YES	YES
Intro course fixed effects				YES	YES	YES
College*subject fixed effects	YES	YES	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. Model 1 controls all student characteristics in Table 5 and whether the subject was student's initial declared major and whether the student took their introductory course in the subject in an online section; Model 2 controls whether the subject was student's initial declared major and whether the student took their introductory course in the subject in an online section. Standard errors are clustered at student-, intro course-, and subject-level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$.

The impact of non-tenure faculty on student persistence into the next course may be driven by two distinct sources: an uninspiring experience in an introductory course may either reduce the student's probability of taking another course in that particular field or encourage the student to drop out of college completely. While both are undesirable, the latter is particularly worrisome, as college persistence is critical for gaining the economic opportunity associated with program completion, especially among disadvantaged populations. To examine the possible influence of different instructors on college persistence, we conduct a student-level exploratory analysis that relates the proportion of course credits taken with different types of instructors during a student's initial year in college to his/her probability of withdrawing from college by the end of first year. The results from this exploratory analysis are presented in Table 8.

We use three different models to control for selection bias: (1) An OLS model (columns 1 and 4) that controls for student characteristics, the set of courses students took in their first year of enrollment,[20] and college fixed effects; (2) a course-set fixed effect model (columns 2 and 5) that compares the results of students who took the same set of courses in their first year of enrollment, and (3) an instrumental approach similar to the model presented in Section 3, where we use term-by-term fluctuations of faculty composition in each department as an instrument for the average proportion of credits taken with different types of instructors to minimize selection bias (columns 3 and 6). For example, if a student took a three-credit English course in the fall of 2008 and a six-credit math course in the spring of 2009 during his/her first year, the instruments will be calculated by averaging between the proportion of different types of instructors in the English department in the fall of 2008 and the proportion of different types of instructors in the math department in the spring of 2009, weighted by course credits.

The results show an overall negative correlation between the proportion of first-year credits taken with non-tenure faculty and students' probability of persisting in college after their first year. Such negative association is particularly stronger among short-term non-tenure faculty than among long-termers. Based on the preferred instrumental variable approach, taking more course credits with short-termers during a student's first year statistically reduces the student's probability of college persistence by almost 11 percentage points in two-year colleges and 8 percentage points in four-year colleges compared with taking courses with long-term non-tenure faculty. In contrast, taking more credits with tenure-track faculty or tenured faculty increases the probability of persisting into the second academic year by 8 percentage points and 11 percentage points respectively.

[20] They are defined as the number of courses a student took in each subject area during the first year of enrollment, where subject areas are categorized using the two-digit Classification of Instructional Programs (CIP 2000).

Table 8: Impact of Type of Instructor in First Year on Enrollment Persistence

	(1)	(2)	(3)	(4)	(5)	(6)
	Two-Year Colleges			Four-Year Colleges		
Outcome: Persist to Second Academic Year	OLS	Course Set Fixed Effects	IV	OLS	Course Set Fixed Effects	IV
Short-term non-tenure instructor	0.0344	0.0027	-0.1145***	-0.0469	-0.0384**	-0.0758***
	(0.0359)	(0.0107)	(0.0266)	(0.0367)	(0.0175)	(0.0185)
Tenure-track instructor				0.0205	-0.0069	0.0786**
				(0.0359)	(0.0271)	(0.0368)
Tenured instructor				-0.0050	0.0004	0.1056***
				(0.0247)	(0.0207)	(0.0286)
Sample mean	0.60			0.79		
	(0.49)			(0.41)		
Observations	68,692	68,692	68,692	87,212	87,212	87,212
R-squared	0.0631	0.3371	0.1639	0.0938	0.3981	0.1792
Student characteristics	YES	YES	YES	YES	YES	YES
Course set control	YES		YES	YES		YES
Course set fixed effects		YES			YES	
College fixed effects	YES	YES	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. The OLS model controls for student characteristics listed in Table 5; the course set fixed effects model controls for student characteristics and fixed effects for the set of courses student took in the first year of enrollment; the IV model controls for student characteristics and the number of courses student took in their first year within each two-digit CIP code area. Standard errors are clustered at the college level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$.

Table 9 further presents results on subsequent course performance conditional on enrolling in another course in the same field of study. Columns 1–3 use the OLS model controlling for available student and next-class characteristics, as well as fixed effects for the introductory courses; columns 4–6 further add next-class fixed effects into the model; and columns 7–9 present estimates based on the preferred model based on equation (3) that controls for student fixed effects, next-class fixed effects, and fixed effects for introductory courses.

In two-year colleges, the estimated impacts of short-term non-tenure faculty in introductory courses on a student's next class performance in the same field of study are generally small and nonsignificant relative to long-term non-tenure faculty. In four-year colleges, the results echo the patterns presented in Table 7, but the estimated effects also tend to be small in magnitude. Focusing on the estimates based on the preferred model (columns 7–9), among students who did enroll in another class in four-year colleges, non-tenure instructors during their introduction to a field of study significantly decreased student's' probability of passing the next

course in the same field by approximately one percentage point and reduced the course grade by 0.02 grade points compared with long-term non-tenure faculty. No significant differences are identified between long-term non-tenure faculty and tenure-track/tenured faculty in terms of next-class performance. These results on subsequent course enrollment and performance, taken together with those on contemporaneous course outcomes, suggest that while non-tenure faculty excel in promoting contemporaneous course grades, they are comparatively less effective than tenure-track/tenured faculty in inspiring students' interest in a field and preparing students for follow-on learning. Compared with long-term non-tenure faculty, short-termers are positively associated with concurrent course measures but negatively associated with subsequent measures.

Table 9: Impact of Type of Instructor in Introductory Courses on Subsequent Course Grades in the Subject Area

Panel A: Two-Year Colleges									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1: OLS			Model 2: Next Course-Section Fixed Effects			Model 3: Next Course-Section Fixed Effects + Student Fixed Effects		
Outcome	Persist to End of Course	Pass Course	Grade	Persist to End of Course	Pass Course	Grade	Persist to End of Course	Pass Course	Grade
Short-term non-tenure instructor	0.0018 (0.0034)	-0.0041 (0.0038)	-0.0186 (0.0161)	0.0051 (0.0038)	-0.0082* (0.0047)	-0.0479*** (0.0175)	0.0049 (0.0053)	-0.0003 (0.0056)	-0.0200 (0.0176)
Observations	128,563	128,563	128,563	128,563	128,563	128,563	128,563	128,563	128,563
R-squared	0.0684	0.0973	0.1543	0.4123	0.4348	0.5025	0.7427	0.7783	0.8284
Sample mean	0.84 (0.37)	0.73 (0.44)	2.21 (1.57)	0.84 (0.37)	0.73 (0.44)	2.21 (1.57)	0.84 (0.37)	0.73 (0.44)	2.21 (1.57)
Student characteristics	YES	YES	YES	YES	YES	YES			
Next college-course-section characteristics	YES	YES	YES						
Intro course fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Student fixed effects							YES	YES	YES
Next college-course-section fixed effects				YES	YES	YES	YES	YES	YES

Panel B: Four-Year Colleges									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1: OLS			Model 2: Next Course-Section Fixed Effects			Model 3: Next Course-Section Fixed Effects + Student Fixed Effects		
Outcome	**Persist to End of Course**	**Pass Course**	**Grade**	**Persist to End of Course**	**Pass Course**	**Grade**	**Persist to End of Course**	**Pass Course**	**Grade**
Short-term non-tenure instructor	-0.0061*** (0.0019)	-0.0092*** (0.0030)	-0.0275** (0.0140)	-0.0078*** (0.0019)	-0.0120*** (0.0029)	-0.0407*** (0.0099)	-0.0035 (0.0022)	-0.0075*** (0.0027)	-0.0230*** (0.0088)
Tenure-track instructor	0.0010 (0.0019)	-0.0011 (0.0023)	-0.0084 (0.0099)	-0.0002 (0.0021)	-0.0002 (0.0026)	-0.0013 (0.0096)	0.0023 (0.0022)	-0.0010 (0.0027)	-0.0031 (0.0087)
Tenured instructor	0.0019 (0.0023)	0.0046 (0.0032)	0.0102 (0.0114)	0.0026 (0.0025)	0.0071** (0.0036)	0.0231* (0.0128)	0.0018 (0.0026)	0.0045 (0.0033)	0.0162 (0.0102)
Sample mean	0.90 (0.29)	0.82 (0.38)	2.48 (1.45)	0.90 (0.29)	0.82 (0.38)	2.48 (1.45)	0.90 (0.29)	0.82 (0.38)	2.48 (1.45)
Observations	306,479	306,479	306,479	306,479	306,479	306,479	306,479	306,479	306,479
R-squared	0.0507	0.1101	0.2366	0.2641	0.3277	0.4662	0.5556	0.6297	0.7460
Student characteristics	YES	YES	YES	YES	YES	YES			
Next college-course-section characteristics	YES	YES	YES						
Intro course fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Student fixed effects							YES	YES	YES
Next college-course-section fixed effects				YES	YES	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. Model 1 controls all student and next course characteristics in Table 5; Model 2 controls all student characteristics in Table 5; Model 3 controls for student age when taking the course, course section characteristics including enrollment size, delivery method, and term taking the course as well as whether the course is within student's declared major and other students' average high school GPA in the course section. Standard errors are clustered at student-, intro course-, next course*section-level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

IV Estimates and Robustness Checks

One potential threat to the two-way fixed effects strategy is that there might be course-varying sorting by types of instructors within an individual student. Although the available evidence thus far suggests that there is little systematic sorting of students into coursess taught by different types of instructors once controlling for course fixed effects, we further use an instrumental variable strategy to cross-validate the results. Appendix Table A.3 shows the first stage results and indicates that the proportion of different types of instructors in a department is a significant and positive predictor of probability of taking a course with a particular type of instructor in both two-year and four-year colleges. The *F*-statistics on the excluded instrument are all substantially greater than 10, thus ruling out the possibility of weak instrument. Table 10 shows the instrumental variable estimates for alternative instructors in terms of subsequent course enrollment and performance, controlling for introductory course fixed effects and subject fixed effects for next course enrollment and course-section fixed effects for next course grade with all available covariates. The IV estimates echo the estimates based on the two-way fixed effects model, though with noticeably larger effect sizes.

In addition to the instrumental variable approach, we also conduct a series of robustness checks to address several remaining concerns. First, the dataset includes multiple institutions and colleges which vary in terms of both their enrollment sizes and in the proportion of course enrollments with short-term non-tenure instructors (ranging from 5 percent to 63 percent in two-year colleges and 8 percent to 43 percent in four-year colleges). Therefore, we conduct two robustness checks to ensure that the results are not only driven by a small subset of particular schools. Specifically, we re-run analyses based on a sample excluding the three colleges with the largest student enrollments, as well as on a sample excluding the three colleges with the largest enrollments with non-tenure faculty. Despite small variations, the qualitative messages remain the same.

Similarly, since the dataset includes multiple cohorts of students, we also examine whether the pooled effects are driven by a certain cohort and if such effects follow clear trends over time. Among the six cohorts examined, the percentage of introductory courses taken with different types of instructors remains fairly stable over time, fluctuating within a narrow range without demonstrating any apparent time trends. Nevertheless, we conduct the analysis by cohort, and the estimated effects do not show any clear time trends; instead, the effect size only fluctuates slightly around the estimates using the pooled sample.

Finally, we run a robustness check on subsequent course enrollment and performance focusing on courses outside a student's intended major declared upon college enrollment. The out-of-major analysis focuses on fields in which a student's academic decisions, such as course withdrawal and enrollment in additional classes, were most plausibly affected by instructors. All

of the estimated effects are fairly consistent and in most cases larger in magnitude when we restrict the sample to courses taken outside a student's intended major.[21]

Table 10: Impact of Type of Instructors in Introductory Courses on Subsequent Course Enrollment and Grades in the Subject Area—Alternative Identification Strategy With Instrumental Variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Two-Year Colleges			Four-Year Colleges		
Outcome	Grade, Intro-ductory Courses	Take Additional Course	Grade, Next Course in Subject	Grade, Intro-ductory Courses	Take Additional Course	Grade, Next Course in Subject
Short-term non-tenure instructor	0.0577	-0.1196***	-0.2229	0.5788***	-0.3199***	-0.0332
	(0.0791)	(0.0410)	(0.3634)	(0.1242)	(0.0528)	(0.1054)
Tenure-track instructor				-0.4355***	0.0865	0.1655
				(0.1127)	(0.0631)	(0.1618)
Tenured instructor				-0.0899	0.0432	-0.0864
				(0.0876)	(0.0520)	(0.0970)
Observations	324,883	324,883	128,563	730,408	730,408	306,479
R-squared	0.1549	0.1726	0.4919	0.2624	0.1907	0.4605
Intro course fixed effects	YES	YES	YES	YES	YES	YES
College*subject fixed effects		YES			YES	
College*course-section fixed effects			YES			YES

Note. The base group for all regressions is long-term non-tenure faculty. All regressions control for student's demographic information, including race/ethnicity, gender, age, and whether he/she was the residence of the state and academic preparation characteristics, including whether he/she had a high school diploma, GED, and high school GPA. Other controls include whether the student entered college in fall and whether the subject was his/her initial declared major. Standard errors are clustered at intro. course-, and subject-level for columns 2 and 4, and intro-course-, and course*section level for models in other columns. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

Potential Mechanisms

The overall results so far suggest that having one's first course in a field with non-tenure instructors has positive impacts on students' introductory courses but negative impacts on students' subsequent persistence and performance in the same field, where more pronounced impacts are identified on field of study persistence. Yet, there is no definite mechanism by which these effects may operate. As shown in Table 2, different types of instructors are distinct in key

[21] All results from robustness checks are available upon request.

demographic and individual characteristics that are likely to be related to their productivity. To explore the extent to which the impacts of non-tenure faculty on introductory course performance and persistence into the next course can be explained by observable instructor characteristics, we further add a vector of productivity-related instructor variables that are likely to be related to student outcomes into the preferred model used in Table 6 (performance in introductory courses) and Table 7 (persistence into the next course in the same field).

Specifically, we use several individual-term level variables to capture the characteristics of the instructor during the term of teaching the introductory course, including: (1) his/her highest educational credential at the beginning of that term, (2) whether the instructor was teaching in multiple institutions during that term, and (3) whether he/she was employed full-time by the college during that term. We also include two individual-level variables to capture an instructor's industry experience: (1) whether an instructor ever worked in non-teaching industry positions prior to working in the current college, and (2) his /her average annual earnings from non-teaching positions between 2001 and 2012 (inflation adjusted). We do this to explore the possibility raised by some researchers (e.g., Jacobs, 1998) that many adjuncts are in fact skilled professionals in a relevant industry, and are employed to enhance the quality and prestige of institutions and bring skills and talents that complement those possessed by the regular faculty. Although our descriptive information shown in Table 3 does not support this assertion and in fact provides suggestive evidence that non-tenure instructors typically receive limited earnings from non-teaching industry positions and therefore may not be skilled professionals with special expertise and outstanding productivity, we still include the industry work experience indicator to capture potential differences between instructors who came from a non-teaching industry position and instructors who never worked in industry before.

One potential problem with this indicator is that the labor market data only tracks instructors back to 2001. Therefore, if an instructor is hired prior to 2001, we are not able to tell whether he/she worked in a non-teaching industry position before. About one third of non-tenure instructors in both two-year and four-year settings in our analytical sample were hired before 2001; we therefore create a dummy variable indicating whether the instructor was hired during or prior to 2001 and include it as a predictor in the model.

Finally, some researchers point out that one potential benefit of hiring temporary adjuncts is that they may provide a flexible and low-cost way to screen for effective instructors to be hired on a full-time long-term basis (Autor, 2000). To examine whether there might be differences in productivity between instructors who did not continue their employment after the first year and those who did continue teaching in the institution, we include an individual-level variable to indicate whether the instructor continued his/her teaching position in the institution after his or her first-year of employment as a college instructor.

Table 11 presents the impacts of different types of instructors on a student's introductory course grades with and without controlling for observable instructor characteristics. For each setting, the first column (column 1 and column 3) presents the estimated influence of different

types of instructors; the next column (column 2 and column 4) presents the results after further adding instructor characteristics.

Table 11: Impact of Type of Instructor on Introductory Course Grades, With Instructor Characteristics

	(1)	(2)	(3)	(4)
	Two-Year Colleges		Four-Year Colleges	
Sample	Original	Add Instructor Characteristics	Original	Add Instructor Characteristics
Short-term non-tenure instructor	0.1351***	0.0714***	0.1572***	0.0943***
	(0.0161)	(0.0191)	(0.0170)	(0.0205)
Tenure-track instructor			-0.0998***	-0.0534**
			(0.0211)	(0.0212)
Tenured instructor			-0.1702***	-0.1098***
			(0.0168)	(0.0210)
Degree level: Master's (reference: bachelor's)		-0.0124		-0.0182
		(0.0214)		(0.0238)
Degree level: Ph.D. (reference: bachelor's)		-0.0651*		-0.0832***
		(0.0361)		(0.0273)
Taught in more than one institution		-0.0675**		-0.0128
		(0.0314)		(0.0254)
Employed full-time		-0.1214***		-0.1351***
		(0.0155)		(0.0155)
Worked in non-education industry previously		0.0764***		0.0378
		(0.0224)		(0.0242)
Worked in K-12 prior to college		-0.0406		0.0115
		(0.0265)		(0.0290)
Started teaching in the college before 2001		-0.0202		-0.0191
		(0.0229)		(0.0195)
Earnings from non-education industry ($10,000)		0.0076**		0.0012
		(0.0034)		(0.0046)
Employed at ASCS consecutively in the first year		0.0108		0.0172
		(0.0210)		(0.0219)
Observations	324,883	324,883	730,408	730,408
R-squared	0.5842	0.5760	0.5924	0.5907
Student fixed effects	YES	YES	YES	YES
College*course fixed effects	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. All regressions control for student age when taking the course, course section characteristics including enrollment size, delivery method, and term taking the course, as well as whether the course is within student's declared major and other students' average high school GPA in the course section (same from Table 6, columns 7–9). Standard errors are clustered at student-, college-course-level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

In both two-year and four-year colleges, adding observable instructor characteristics reduces the effect size of the estimated difference between different types of instructors by one third to a half. In both settings, educational credentials and full-time employment are negatively correlated with students' grades in their introductory courses. Specifically, instructors who held a doctorate (versus a bachelor's degree or lower as the highest degree) at the beginning of the term when they teach introductory courses are associated with lower average course grades by 0.07 points in two-year colleges and 0.08 points in four-year colleges respectively. Being employed full-time in the college when an instructor teaches the introductory course is also negatively related to students' contemporaneous achievement by 0.12 points in two-year colleges and 0.14 in four-year colleges. Moreover, instructors' previous employment history is positively related to grades in introductory courses in two-year colleges, where instructors who worked previously in non-college industry positions are associated with higher grades by 0.08 points.

Table 12 further presents the impacts of different types of introductory course instructors on a student's probability of taking another course in the same field. Comparing the estimates between Table 11 and Table 12 reveals several interesting patterns: first, similar to the results on contemporaneous student achievement, adding observable instructor characteristics to the model predicting subsequent field interests also substantially reduces the estimated difference between different types of introductory course instructors. In particular, including observable instructor characteristics completely explains away the gaps between long-term non-tenure faculty and tenure-track/tenured faculty.

Moreover, characteristics that significantly explain grades in introductory courses are generally also significant predictors of subsequent field interest; yet, the sign of the predictors are opposite. Specifically, on average, students in part-time introductory courses with instructors who had work experience in the industry sector and who did not possess a terminal degree received higher grades in the contemporaneous introductory courses being taught, but were less likely to persist into the next course in the same field of study.

Table 12: Impact of Type of Instructor on Next Course Enrollment, With Instructor Characteristics

	(1)	(2)	(3)	(4)
	Two-Year Colleges		Four-Year Colleges	
Sample	Original	Add Instructor Characteristics	Original	Add Instructor Characteristics
Short-term non-tenure instructor	-0.0162***	-0.0118***	-0.0169***	-0.0067*
	(0.0039)	(0.0039)	(0.0034)	(0.0038)
Tenure-track instructor			0.0103**	0.0029
			(0.0043)	(0.0044)
Tenured instructor			0.0145***	0.0040
			(0.0048)	(0.0049)
Degree level: Master's (reference: bachelor's)		0.0055		0.0145**
		(0.0051)		(0.0067)
Degree level: Ph.D. (reference: bachelor's)		0.0073		0.0195***
		(0.0070)		(0.0071)
Taught in more than one institution		0.0031		0.0005
		(0.0026)		(0.0024)
Employed full-time		0.0014		0.0112***
		(0.0030)		(0.0033)
Worked in non-education industry previously		-0.0101**		-0.0064*
		(0.0042)		(0.0036)
Worked in K-12 prior to college		-0.0077*		-0.0066
		(0.0041)		(0.0050)
Start teaching in a college before 2001		0.0131***		0.0063**
		(0.0035)		(0.0027)
Earnings from non-education industry ($10,000)		-0.0003		-0.0025***
		(0.0008)		(0.0008)
Employed at ASCS consecutively in the first year		0.0029		0.0037
		(0.0042)		(0.0036)
Observations	324,883	324,883	730,408	730,408
R-squared	0.4064	0.4078	0.3745	0.3793
Student fixed effects	YES	YES	YES	YES
College*subject fixed effects	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. All regressions control for whether the subject was student's initial declared major and whether the student took their introductory course in the subject in an online section (same from Table 7, columns 4–6). Standard errors are clustered at student-, intro. course-, and subject-level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

In addition to the contrasts of how instructor characteristics influence students' contemporaneous achievement and subsequent interests, our results in Table 12 also suggest that instructors who were hired before 2001 are associated with a higher probability of enrollment in additional courses in a particular field of study in both settings. Two possible explanations may contribute to this positive association: first, instructors hired earlier may have higher productivity due to more teaching experience. To more directly explore the impacts of teaching experience on student academic outcomes, we include dummy indicators for accumulative years teaching in the postsecondary sector as additional predictors and add them to the model used in Table 11 and Table 12.[22] The results are presented in column 1 for two-year colleges and 3 for four-year colleges in Table 13, where Panel A presents results on introductory course grades and Panel B presents results on subsequent course enrollment. To better control for unobserved teacher-level characteristics, we further include teacher fixed effects into the model and present the estimates in columns 2 and 4. Somewhat to our surprise, the results generally show negative correlations between years teaching in a college and the student outcome measures.

Table 13: Impact of Instructor Experience on Next Course Enrollment

Panel A: Outcome = Grade in Introductory Courses				
	(1)	(2)	(3)	(4)
	Two-Year Colleges		Four-Year Colleges	
Characteristic	With Instructor Characteristics	With Instructor Fixed Effects	With Instructor Characteristics	With Instructor Fixed Effects
Experience				
1–3 years	0.0087	-0.0438**	0.0132	0.0246**
	(0.0175)	(0.0182)	(0.0129)	(0.0126)
4–6 years	-0.0288	-0.0664**	-0.0149	0.0174
	(0.0223)	(0.0262)	(0.0175)	(0.0187)
7–10 years	-0.0787***	-0.0786**	-0.0211	0.0373
	(0.0295)	(0.0349)	(0.0267)	(0.0234)
Above 10 years	-0.1141***	-0.1113***	-0.0869**	0.0486*
	(0.0400)	(0.0393)	(0.0371)	(0.0287)
Observations	324,883	324,883	730,408	730,408
R-squared	0.5761	0.6176	0.5908	0.6285
Student fixed effects	YES	YES	YES	YES
College*course fixed effects	YES	YES	YES	YES
Instructor fixed effects		YES		YES

[22] We include teaching experience as dummy indicators rather than one continuous variable as the K-12 literature generally indicates a nonlinear relationship between teaching experience and student outcomes.

Panel B: Outcome = Enroll in a Second Course Within the Next Academic Year in the Subject Area				
	(1)	(2)	(3)	(4)
	Two-Year Colleges		Four-Year Colleges	
Characteristic	With Instructor Characteristics	With Instructor Fixed Effects	With Instructor Characteristics	With Instructor Fixed Effects
Experience				
1–3 years	-0.0233***	-0.0590***	-0.0229***	-0.0462***
	(0.0051)	(0.0066)	(0.0041)	(0.0059)
4–6 years	-0.0292***	-0.1040***	-0.0370***	-0.0967***
	(0.0050)	(0.0096)	(0.0047)	(0.0081)
7–10 years	-0.0571***	-0.1601***	-0.0530***	-0.1472***
	(0.0065)	(0.0145)	(0.0055)	(0.0107)
Above 10 years	-0.0808***	-0.2278***	-0.0659***	-0.2033***
	(0.0077)	(0.0172)	(0.0067)	(0.0145)
Observations	324,883	324,883	730,408	730,408
R-squared	0.3722	0.3629	0.3937	0.3772
Student fixed effects	YES	YES	YES	YES
Subject fixed effects	YES	YES	YES	YES
Instructor fixed effects		YES		YES

Note. The base group for all regressions is long-term non-tenure faculty. All regressions in Panel A control for student age when taking the course, course section characteristics including enrollment size, delivery method, and term taking the course, as well as whether the course is within student's declared major and other students' average high school GPA in the course section (same from Table 6, columns 7–9); all regressions in Panel B control for whether the subject was student's initial declared major and whether the student took their introductory course in the subject in an online section (same from Table 7, columns 4–6). Regressions in column 1 and 3 control for all instructor characteristics included in Tables 11 and 12; regressions in column 2 and 4 control for instructor fixed effects. Standard errors are clustered at student-, introductory course-, and subject-level and are presented in parentheses.

*** $p < .01$, ** $p < .05$, * $p < 0.1$

Another possibility is that instructors hired earlier may show different quality characteristics than instructors hired later. Indeed, comparisons between instructors hired before and after 2001 reveal substantial distinctions descriptively—the former were more likely to be White, hold doctoral degrees, and work full-time in a college. Unsurprisingly, such overall distinctions by cohorts of instructors are mainly driven by non-tenure instructors, especially short-timers, while the characteristics of tenure-track/tenured faculty tend to be fairly consistent over time. These results suggest that the hiring criteria and employment terms for non-tenure instructors may have substantially changed over time.

5. Discussion and Conclusion

Understanding the relative impacts of different types of college instructors in students' initial experience in a field of study is of great policy importance, in part because higher education is increasingly relying on adjunct instructors, and in part because early academic experience during one's introduction to a field of study may substantially influence a student's subsequent academic choice and outcomes. This study analyzes student course taking behaviors and performance with a large swath of introductory and subsequent courses using a statewide college administrative dataset that includes all the public two-year and four-year institutions. In contrast to existing literature, where all non-tenure line faculty are typically combined into one group and compared with tenure-track/tenured faculty, we recognize potential heterogeneity in adjuncts by nature of employment and differentiate between adjuncts hired on a temporary basis and those with long-term contracts with an institution.

Although the increasing reliance on adjuncts has been well documented in the existing literature, we are still surprised at the abundant use of adjuncts in this public college system, where less than one third of all faculty in four-year colleges are hired in tenure-track positions and only one of the two-year colleges include tenure-track/tenured positions. Both two-year and four-year colleges are particularly heavily reliant on short-term non-tenure instructors, which comprise 75 percent of all faculty in two-year colleges and 39 percent of all faculty in four-year colleges. The dependence on non-tenure faculty is worrisome, as available instructor characteristics suggest that non-tenure instructors, especially part-timers, are typically not as experienced or educated as tenure faculty.

Our subsequent analysis relating different types of instructors and student academic outcomes supports this concern: while having one's introduction to a field of study taught by a non-tenure instructor is on average associated with a higher course grade, students in this circumstance were less likely to attempt another course in the same field, and among students who did so, non-tenure faculty in introductory courses also had negative impacts on students' next-course performance within the same field of study. The positive impacts on current course performance and negative impacts on subsequent outcomes are especially strong among short-term non-tenure faculty. One potential explanation for this result is that adjunct instructors, especially those employed on a temporary basis, due to job insecurity, may reduce the difficulty of course content, lower course expectations, or relax grading criteria in order to earn good student evaluations. While these measures can help students earn higher and potentially inflated grades in contemporaneous courses, they might harm students' interests in, and preparation for, subsequent learning in more advanced coursework. This story cautions against using student course evaluations or student current course grades as the sole criterion for evaluating instructional effectiveness, and highlights the necessity of employing additional measures of instructional quality to complement student course evaluations.

Considering that optimizing students' college retention is an imperative when it comes to promoting economic opportunity for disadvantaged students, of greater concern is the finding

that taking introductory courses with short-term non-tenure faculty may also increase the chance that students drop out completely from college during their early academic career. If the negative impacts of short-term non-tenure instructors on student college persistence identified in the current study also holds true in other states, it would imply that the continued increase and heavy reliance on supplemental temporary adjuncts could harm student educational outcomes and labor market opportunities. Therefore, while the high proportion of short-term non-tenure faculty warrants policy attention in general, it is particularly worrisome in the setting of open-access and non-selective public institutions, in part because they are much more likely to rely on supplemental temporary adjuncts than selective or private institutions (e.g., Figlio et al., 2015), and in part because these institutions assume a critical role in addressing national equity concerns by disproportionately enrolling students from historically underrepresented groups.

One finding from the current study that may serve to somewhat mitigate our main finding is that the negative impacts of non-tenure faculty on students' subsequent academic interest are substantially reduced or can be even completely explained by observable instructor-level characteristics. First, instructors with higher educational credentials, especially a doctorate, are positively related to student follow-on course enrollment and performance. Yet, the majority of non-tenure faculty hired in ASCS do not have a doctorate. Considering that it is fairly easy to collect information on instructors' educational backgrounds during the hiring process, colleges may wish to include applicants' highest educational credential as an important selection criterion for non-tenure instructors.

In addition, we also find that instructors' full-time employment status positively predicts students' subsequent interest in a field, which is consistent with the widely shared assertion regarding the lower productivity of part-time college instructors due to their limited access to college resources and faculty support, minimal involvement with departmental program alignment and curriculum design, reduced engagement with the students, scant loyalty for the institution, and sense of frustration with their employment circumstances (Brewster, 2000; Jacoby, 2005; Schmidt, 2008). As colleges attempt to encourage faculty to improve their teaching practices and increase faculty–student engagement, institutions that heavily rely on part-time faculty would face additional challenges to improving student persistence. Future studies may wish to explore effective strategies to support and engage part-time faculty.

Moreover, instructors hired earlier in this state college system are associated with better student outcomes compared with instructors hired later. Exploratory comparisons by cohorts of instructors also indicates that adjunct instructors hired before 2001 tended to be better educated and employed full-time in a college, both of which are predictors of positive student academic outcomes. This finding supports the notion that adjunct faculty, in particular visiting scholars and skilled professionals, were once traditionally employed to enhance the quality and prestige of institutions and to bring skills and talents that complement those possessed by the regular faculty, but that this is less often the case in the more recent past. Rather, the nature of use of adjuncts and the quality of these instructors might have changed as their numbers experienced a surge in more recent years. Indeed, our results suggest that the majority of non-tenure faculty

hired after 2001 were from either the non-education sector or K-12 sector. These instructors typically received below-median earnings from their non-college positions, and many of them, especially supplemental adjuncts, continued in their non-college positions while working as adjunct instructors. If these industry workers used college instruction primarily as a means to bump up their total salary, they may have held little loyalty to the institution and devoted limited time to preparing for or teaching their course(s), which may help explain the negative correlation observed between these industry employees and student academic outcomes.

Finally, some researchers point out that one potential benefit of hiring temporary adjuncts is that they may provide a flexible and low-cost way to identify effective instructors (Autor, 2000). Yet, we do not find any difference in students' persistence in a field of study between instructors who continued to be employed in a college after their first year of employment and instructors who did not do so. This finding implies that the feasibility of substantial hiring of temporary adjuncts as a cost-saving screening mechanism may be much more complicated and obscure than expected.

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Appendix

Table A.1: Main Industries of Employment Among Short- and Long-Term Non-Tenure Faculty Before Being Employed in College

Two-Year Colleges		Four-Year Colleges	
Subject Area	**Total**	**Subject Area**	**Total**
Humanities	521	Humanities	457
Elementary and secondary schools	34.74%	Elementary and secondary schools	22.98%
Health care and social assistance	8.02%	Junior colleges	3.50%
Retail trade	6.75%	Newspaper publishers	3.06%
Other	50.49%	Other	70.46%
Social sciences	381	Social sciences	227
Elementary and secondary schools	19.69%	Elementary and secondary schools	19.63%
Health care and social assistance	23.55%	General medical and surgical hospitals	5.48%
Public administration	6.10%	Other individual and family services	5.48%
		Outpatient mental health and substance abuse center	5.02%
Other	50.66%	Other	64.39%
Math/natural science	335	Math/natural science	179
Elementary and secondary schools	30.15%	Elementary and secondary schools	27.93%
General medical and surgical hospitals	6.27%	General medical and surgical hospitals	6.15%
Other	63.58%	Other	65.92%
Computer, information, and engineering	291	Computer, information, and engineering	162
Elementary and secondary schools	11.68%	Elementary and secondary schools	8.02%
		Junior colleges	7.41%
Other	88.32%	Other	84.57%
Health	527	Health	400
General medical and surgical hospitals	46.49%	General medical and surgical hospitals	49.75%
Offices of physicians	6.64%	Offices of physicians	6.25%
Ambulance services	4.93%	Offices of dentists	3.50%
Elementary and secondary schools	3.80%		
Nursing care facilities	2.28%		
Other	35.86%	Other	40.50%
Business	323	Business	194
Elementary and secondary schools	10.12%	Commercial banking	6.45%
Warehouse clubs and supercenters	4.33%	Offices of lawyers	5.38%
Commercial banking	3.41%		
Other	82.14%	Other	88.17%

Education and childcare	224	Education and childcare	316
Elementary and secondary schools	52.68%	Elementary and secondary schools	65.51%
Other	47.32%	Other	34.49%
Other	719	Other	403
Elementary and secondary schools	14.05%	Elementary and secondary schools	15.14%
Executive and legislative offices	8.48%	Junior colleges	5.71%
Offices of lawyers	2.78%	Executive and legislative offices	5.71%
Other	74.69%	Other	73.44%

Note. Table includes data on non-tenure faculty who ever worked in non-college positions before they started in college teaching positions. As a result, some non-tenure instructors in our analytical sample presented in Table 2 are excluded here in Table A.1, including: (1) non-tenure faculty who had never worked in non-college positions before they started teaching in a college (13 percent of all non-tenure faculty in two-year colleges and 36 percent in four-year colleges); and (2) non-tenure faculty who worked in non-college positions before 2001 and therefore could not be observed in the labor market dataset available to us (26 percent of all adjuncts in two-year and 30 percent in four-year). Finally, data from any industries with fewer than 10 instructors are not presented in this table.

Table A.2: Impact of Adjunct on Introductory Course Performance: Grade Distribution

	(1)	(2)	(3)	(4)	(5)
Outcome	**Grade: A or Equivalent**	**Grade: B or Better**	**Grade: C or Better**	**Grade: D or Better**	**Grade Given Persistence**
Two-year colleges					
Short-term non-tenure instructor	0.0489***	0.0419***	0.0261***	0.0183***	0.1314***
	(0.0057)	(0.0050)	(0.0037)	(0.0033)	(0.0145)
Observations	324,883	324,883	324,883	324,883	271,415
R-squared	0.4853	0.5096	0.5081	0.5031	0.6137
Four-year colleges					
Short-term non-tenure instructor	0.0511***	0.0486***	0.0349***	0.0226***	0.1448***
	(0.0072)	(0.0052)	(0.0038)	(0.0029)	(0.0147)
Tenure-track instructor	-0.0355***	-0.0315***	-0.0191***	-0.0137***	-0.0945***
	(0.0070)	(0.0067)	(0.0053)	(0.0042)	(0.0182)
Tenured instructor	-0.0568***	-0.0566***	-0.0351***	-0.0217***	-0.1572***
	(0.0055)	(0.0056)	(0.0047)	(0.0036)	(0.0149)
Observations	730,408	730,408	730,408	730,408	664,499
R-squared	0.4914	0.5009	0.4679	0.4473	0.6172
Student fixed effects	YES	YES	YES	YES	YES
College*course fixed effects	YES	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. All regressions controlled for student age when taking the course, course section characteristics including enrollment size, delivery method, and term taking the course, as well as whether the course is within student's declared major and other students' average high school GPA in the course section (same from Table 6, columns 7–9). Standard errors are clustered at student-, college-course-level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

Table A.3: Impact of Adjunct in Introductory Courses on Subsequent Course Grades: Grade Distribution

Outcome	(1) Grade: A or Equivalent	(2) Grade: B or Better	(3) Grade: C or Better	(4) Grade: D or Better	(5) Grade Given Persistence
Two-year colleges					
Short-term non-tenure instructor	-0.0136**	-0.0048	-0.0014	-0.0003	-0.0531***
	(0.0056)	(0.0065)	(0.0058)	(0.0056)	(0.0176)
Observations	128,563	128,563	128,563	128,563	107,791
R-squared	0.7974	0.7978	0.7842	0.7783	0.8649
Four-year colleges					
Short-term non-tenure instructor	-0.0042	-0.0039	-0.0074***	-0.0075***	-0.0123
	(0.0033)	(0.0035)	(0.0028)	(0.0027)	(0.0080)
Tenure-track instructor	-0.0024	0.0017	-0.0015	-0.0010	-0.0082
	(0.0030)	(0.0032)	(0.0029)	(0.0027)	(0.0070)
Tenured instructor	-0.0025	0.0086**	0.0056	0.0045	0.0173*
	(0.0033)	(0.0040)	(0.0036)	(0.0033)	(0.0089)
Observations	306,479	306,479	306,479	306,479	277,131
R-squared	0.6957	0.6819	0.6490	0.6297	0.7703
Student fixed effects	YES	YES	YES	YES	YES
Intro course fixed effects	YES	YES	YES	YES	YES
Next college-course-section fixed effects	YES	YES	YES	YES	YES

Note. The base group for all regressions is long-term non-tenure faculty. All regressions control for student age when taking the course, course section characteristics including enrollment size, delivery method, and term taking the course, as well as whether the course is within student's declared major and other students' average high school GPA in the course section (same as Table 9, columns 7–9). Standard errors are clustered at student-, intro course-, next course*section-level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$

Table A.4: Results of First Stage IV Regressions (Probability of Taking the First Course in a Subject Area With Different Types of Instructors)

	Two-Year Colleges	Four-Year Colleges		
Outcome	**Short-Term Non-tenure Instructors**	**Short-Term Non-tenure Instructors**	**Tenure-Track Instructors**	**Tenured Instructors**
Panel A. First stage for introductory course grade				
Variation of proportion: short-term non-tenure	0.9973*** (0.0635)	-0.0082 (0.0307)	0.0293 (0.0453)	0.7177*** (0.9055)
Variation of proportion: tenure-track		0.4777*** (0.0414)	0.1564*** (0.0453)	0.0785 (0.0526)
Variation of proportion: tenured		0.0507* (0.0280)	0.5168*** (0.0462)	0.1585*** (0.0374)
F-statistics	246.27	46.83	48.27	21.94
Observations	324,883	730,408	730,408	730,408
R-squared	0.4052	0.3229	0.3632	0.3209
Panel B. First stage for subsequent course enrollment				
Variation of proportion: short-term non-tenure	0.3373*** (0.0313)	-0.0013 (0.0300)	0.0044 (0.0491)	0.7498*** (0.0937)
Variation of proportion: tenure-track		0.4733*** (0.0486)	0.1498*** (0.0402)	0.1047** (0.0515)
Variation of proportion: tenured		0.0788** (0.0282)	0.5205*** (0.0401)	0.1279*** (0.0364)
F-statistics	116.06	35.55	60.82	23.61
Observations	324,883	730,408	730,408	730,408
R-squared	0.4653	0.3209	0.3644	0.3253
Panel C. First stage for next course grade				
Variation of proportion: short-term non-tenure	0.1765*** (0.0258)	0.0456* (0.0247)	0.0282 (0.0274)	0.4923*** (0.0459)
Variation of proportion: tenure-track		0.3581*** (0.0424)	0.1839*** (0.0417)	0.0633** (0.0280)
Variation of proportion: tenured		0.0935* (0.0320)	0.4847*** (0.0402)	0.0687** (0.0243)
F-statistics	46.97	26.82	54.47	38.55
Observations	128,563	306,479	306,479	306,479
R-squared	0.6615	0.3772	0.5191	0.3901

Note. The base group for all regressions is long-term non-tenure faculty. All regressions controlled for student's demographic information, including race/ethnicity, gender, age, and whether he/she was the residence of the state, and academic preparation characteristics, including whether he/she had a high school diploma, GED, and high school GPA. Other controls include whether the student entered college in fall and whether the subject was his/her initial declared major. Regressions in Panels A and C controlled for course fixed effects and standard errors clustered at course level; regressions in Panel B controlled for subject fixed effects and standard errors clustered at subject level. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$