
# Understanding Experiential Learning Through Work-Based College Coursetaking: Evidence From Transcript Data Using a Text Mining Technique

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## Abstract

Experiential learning is critical to a smooth transition from higher education to the workforce. Work-based college courses, such as internships and practicums, may be useful in facilitating this transition. This paper applies an innovative text mining technique to identify and analyze work-based courses from transcript data. The paper examines patterns and post-degree labor market outcomes of taking work-based courses at two-year and four-year colleges in a large public college system. Findings show that approximately 15% of enrollees and 30% of graduates took a work-based course in the six years after college entry. Students typically earned credits from work-based courses, and they typically took the courses in later years of their programs. Moreover, work-based coursetaking varied largely across fields of study as well as colleges. While there was no significant racial disparity, female students, students who were younger at enrollment, and U.S.-born students were more likely to take the courses than their counterparts. Results show a positive association between work-based coursetaking in college and the probability of being employed after degree completion among both two-year and four-year degree completers, a positive association with post-degree earnings among four-year completers, and a negative association with post-degree earnings among two-year completers.

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## 1. Introduction

Decades of empirical research have documented the high returns of a college degree on students' labor market outcomes. On average, college-educated students earn more and suffer a lower incidence of unemployment than their less-educated counterparts (Oreopoulos & Petronijevic, 2013). However, less is known about heterogeneity in labor market outcomes among college graduates or about how students' experiences in college contribute to their labor market success. Experiential learning in particular has been identified as beneficial for students' smooth transition to the labor market.

Earning a degree or a certificate in a specific field without relevant experience demonstrating work readiness to prospective employers may not be sufficient for students to gain post-graduation employment. According to a 2014 national survey of employers (Hart Research Associates, 2015), a large majority emphasized the value of applied learning experiences in college for enhancing both the quality of learning and the quality of students' career preparation. The survey also found that when hiring recent college graduates, employers were more likely to consider a job candidate who had participated in an internship or an apprenticeship or completed a senior project, a collaborative research project, a field-based project in a diverse community, or a service-learning project with a community organization.

One important type of experiential learning that colleges can provide to students is work-based courses. Work-based courses are college courses designed to equip students with practical skills for the workforce and include internships, practicums, and fieldwork courses. Such courses can improve not only students' grasp of theoretical knowledge gained in the classroom but also the ability to apply this knowledge in a real-world setting. Furthermore, through these courses, students can polish their communication and teamwork skills and become more thoughtful about their lifelong career passions and roles in society.

Despite these potential benefits, rigorous and systematic research on work-based courses in college is very limited. Prior literature has analyzed the impact of working while enrolled on academic and post-school labor market outcomes more broadly. Results show mixed-to-negative impacts of student employment on academic outcomes (Scott-Clayton, 2011; Scott-Clayton & Minaya, 2016; Stinebrickner & Stinebrickner,

2003; Tyler, 2003), probably because working while enrolled can distract students from academic activities. On the other hand, research has documented positive relationships between student employment and post-school employment and earnings (Light, 2001; Scott-Clayton & Minaya, 2016). Compared to student employment in general, experiential learning through work-based courses is more connected to and compatible with students' schoolwork and is more accessible, especially for students with no prior work experience.

This paper examines patterns and post-graduation labor market outcomes of taking work-based courses at two-year and four-year colleges using rich administrative data from a large public college system. The paper applies a text mining technique to identify work-based courses from college transcript records, including internship, practicum, fieldwork, co-operative, and service-learning courses. The coursetaking data are linked with students' college data and post-college labor market data. First, the paper examines patterns of taking work-based courses across time, degree areas, and student characteristics. The paper then matches college graduates with similar majors and characteristics in order to compare and understand labor market outcomes associated with taking work-based courses in college. Three primary questions are addressed in this study:

1. What is the current landscape of work-based coursetaking at two-year and four-year colleges?
2. Who takes work-based courses in college? Are there disparities in taking work-based courses by student characteristics or college-related factors (e.g., field of study)?
3. How do post-graduation labor market outcomes of students who took work-based courses in college compare to those who did not take work-based courses?

Results show that 11% of enrollees and 31% of graduates of two-year credential programs and 17% of enrollees and 29% of graduates of four-year credential programs took a work-based course within six years after entering college. Students typically earned credits from work-based courses and took the courses in the later years of their programs. Work-based coursetaking was generally steady over time but varied largely

across fields of study. Apart from the field of study, another major predictor of taking work-based courses was student characteristics. While there was no significant racial disparity in work-based coursetaking, female students were more likely than male students to take the courses. Also, students who were younger at enrollment and U.S.-born were generally more likely to take work-based courses than their counterparts. For labor market outcomes, results show a positive association between work-based coursetaking in college and the probability of being employed after degree completion among both two-year and four-year degree completers. While the association between taking work-based courses in college and post-degree earnings is also positive for four-year degree completers, results suggest a negative association between the two for two-year degree completers.

The paper offers major contributions to research and practice. First, in response to higher education's widespread endorsement of the value of experiential learning, this study provides concrete analyses of one important type of experiential learning—work-based courses. A thorough understanding of work-based coursetaking in college is essential for colleges to better design these courses and for policymakers to better support students during and after their coursetaking. In addition, the study sheds light on how taking work-based courses in college prepares students for the transition to the labor market. Since the selection into taking work-based courses in college depends on a variety of non-random factors, especially for community college students, the study does not use a rigorous causal framework to examine the impact of taking work-based courses on post-graduation labor market outcomes. Nevertheless, the study controls for the effect of a wide range of observables and introduces a text mining technique for analyzing messy transcript records, which contributes to the general education literature that uses transcripts to examine students' coursetaking patterns. Lastly, the findings of the study offer important insights to college practitioners into workforce development as well as future research to identify quasi-experimental opportunities for the study of work-based courses.

The remainder of the paper proceeds as follows: Section 2 provides background on experiential learning in college. Section 3 introduces the data for the study and the empirical strategy for cleaning and analyzing the data. Section 4 presents findings on

patterns of work-based coursetaking in college, and Section 5 discusses labor market outcomes associated with taking work-based courses in college. Finally, Section 6 addresses implications for research and policy.

## 2. Experiential Learning in College

Experiential learning is rooted in long-established theories of human learning and development. According to the philosophy of Dewey (1938), education is conducted on the basis of experience. In the experiential learning theory of Kolb (1984), learning results from the transformation of experience through a cyclic process of experience, concept, reflection, and action. That is, learning occurs when knowledge responds to personal and environmental demands arising from the cyclic process (Kayes, 2002). And when experience interacts with concepts that have been addressed in class—the foundation of experiential learning—students comprehend the experience within a theoretical framework, leading to effective learning and personal development (Jarvis, 1987; Sweitzer & King, 2004). In addition, experiential learning may empower students with increased motivation as it brings about easily identifiable and trackable results (Perrin, 2014).

Ben-Porath (1967) included experiential learning in his model of human capital investment. The model holds that both taking classes and working while enrolled are factors in the production function of human capital. Given the concavity of human capital production, it would be optimal for students to combine school and work at such a level that the marginal benefits of working while enrolled equal the marginal costs to academic performance and progress (Scott-Clayton, 2012). Indeed, empirical research has documented positive impacts of student employment on post-college labor market outcomes. For example, Light (2001) estimated earnings functions using data from the National Longitudinal Survey of Youth and concluded that conventional models that do not control for working while taking classes overstate the wage effects of schooling, indicating the value of in-school work experience for post-school wages. Scott-Clayton and Minaya (2016) compared college students who participated in the Federal Work-Study program and their non-working counterparts and found a positive effect of program

participation on post-college employment. Several studies examined the Integrated Basic Education and Skills Training (I-BEST) program in Washington State, in which basic skills instructors and career-technical faculty jointly design and offer occupational courses for basic skills students at community and technical colleges. The results suggest that I-BEST students achieved better educational outcomes, including increases in enrollment in college-level courses, the number of credits earned, and certificate attainment (Jenkins et al., 2009; Martinson et al., 2018; Wachen et al., 2011). Furthermore, Le Barbanchon et al. (2020) leveraged controlled random variation in job offers through a Uruguayan experiential-learning program and found a 9% increase in earnings over the four post-program years for youth who completed a program-assigned job.

On the other hand, scholarship has also documented mixed-to-negative impacts of student employment on academic performance. For example, using data from a college with a mandatory work-study program, Stinebrickner and Stinebrickner (2003) found that working during the first semester of college had a negative impact on students' GPA. Similarly, Scott-Clayton (2011) exploited institutional variation in access to Federal Work-Study funds and identified negative impacts of program participation on grades and graduation outcomes for women but not for men. Conversely, Le Barbanchon et al. (2020) found that the Uruguayan program offering part-time employment to students while they were enrolled in high school or college had positive effects on enrollment and no significant reductions in study time.

As delineated by Moore (2010), there are various forms of experiential learning programs in higher education. The most common type of experiential learning in college is an internship. An internship may be an independent activity outside the classroom in which students work at a business, a social agency, or a cultural or governmental institution; alternatively, it may be an add-on to a classroom course, such as a practicum or fieldwork conceptually related to the course. The missions of internship programs are typically to link theory and practice and personal and career development, as well as to enhance professional skills such as critical thinking, ethical behavior, and the ability to work with diverse people (Fedorko, 2006; Inkster & Ross, 1995; Moore, 2010; Sweitzer & King, 2004).

Other major forms of experiential learning in higher education are service learning and cooperative education (also known as co-op programs). As discussed in Moore (2010), service learning combines out-of-class community service activities with the study of academic concepts and theories. It is often attached to a course in social sciences or related professions and aims both to enhance student learning and drive social change (Butin, 2005). A co-op program is a structured job experience combining classroom-based education with practical work experience to build students' career skills and knowledge. Most co-op programs serve preprofessional students in engineering, business, and healthcare.

Experiential learning is valuable for college students' career development in a number of ways. First, students gain real-world work experience and job skills that cannot be easily taught in a classroom. For example, employers often find that students who have participated in experiential learning have heightened self-awareness and time management skills (Ghannadian, 2013). Also, experiential learning programs allow students to observe and interact with professionals in the workforce (Fussell Policastro, 2006). As a result, students can be more reflective about their career goals and may obtain networking opportunities or professional references that aid their job search. However, students' participation in experiential learning programs may come at the expense of academic learning. While students can have a short-term advantage in the job search because of their experiential learning experience, some researchers (e.g., Kijinski, 2018) have argued that they will be worse off in the long term because of the loss of important academic knowledge.

This paper examines work-based courses that college students enroll in to gain experiential learning experience. Generally, such experience is closely related to the student's field of study and is supervised by a faculty member. While it is interesting to explore the interaction of work-based courses and academic learning, this paper focuses on the career development aspect of taking work-based courses. Specifically, the paper examines labor market outcomes, including the probability of being employed and post-college earnings, associated with taking work-based courses in college.

## 3. Data and Empirical Strategy

The study utilizes rich administrative data from a large and diverse public college system. The data include demographic information and term-level academic records for college enrollees that are linked to quarterly earnings records from accompanying state's department of labor.

### 3.1 Identifying Work-Based Courses

Based on the categorical definition of experiential learning opportunities at the college system, I examine transcript records and identify work-based courses under five broad categories: (1) internship, externship, apprenticeship, or clerkship courses; (2) practicum, placement, professional practice, or professional experience courses (including clinical practicum and student teaching courses); (3) fieldwork, field experience, or field practice courses; (4) co-operative (co-op) courses; and (5) service-learning courses.

Identifying work-based courses in transcript data is challenging. Course titles are the only identifier for courses in the data but contain abbreviations and misspellings that are not consistent across years or colleges. Therefore, I would not be able to identify all the internship courses in the data if I just searched for the word "internship" in course titles. Also, it would be extremely time-consuming to go through course titles one by one and manually identify all the variations of "internship" in the titles.

To overcome these challenges, I use a text mining algorithm based on edit distance. Edit distance quantifies the similarity between two words by counting the minimum number of operations required to transform one word into the other. I rely on Levenshtein distance, which allows for single-character edits (insertions, deletions, or substitutions) to transform between the two words. For example, the edit distance between "internship" and "intnshp" is three because it takes deletions of three characters to transform from "internship" to "intnshp." Using the algorithm, I calculate the edit distance of every word in course titles with "internship" and record the minimum distance for each title. Starting from the lowest minimum distance, I review corresponding words and flag those that are variations of "internship" until the words become irrelevant. This approach allows me to flag all the variations of "internship" in

course titles and thus identify internship courses in the transcript data systematically. Apart from internship courses, I include all the words listed under the five categories of work-based courses at colleges in the system as keywords[1] and repeat the procedure for each keyword to identify other work-based courses in the data. Last, I manually review all the course titles flagged as work-based courses in the data to ensure the quality of the data cleaning procedure.

One limitation of this approach is that the identification of work-based courses is solely based on course titles. That is, I am restricted from identifying courses with a work-based component that is not reflected in the course title. Most of these courses are classroom based but incorporate a work-based session related to the course during the semester.

### 3.2 Analytical Methods

To understand patterns of work-based coursetaking in college, I include in the analysis sample cohorts of first-time college students entering the system's two-year and four-year institutions in the years 2004-05 to 2013-14. The data track enrollment, coursetaking, and degree outcomes of each enrollee in the sample for six years after college entry. And the study examines patterns of work-based coursetaking in college based on descriptive analyses.

To understand labor market outcomes associated with taking work-based courses in college, descriptive comparisons between work-based coursetakers and non-takers would be problematic due to factors that affect both work-based coursetaking and labor market outcomes of interest. First, work-based coursetaking may be correlated with degree completion or further education decisions (for example, transferring to a four-year institution among community college students or pursuing a graduate school degree among senior college students). To control for the effect of a college degree or further education on labor market outcomes, I restrict the sample to degree completers who were not enrolled in another program in the college system after degree completion. However,

[1] Specifically, I include the following work-based keywords: internship, externship, apprenticeship, clerkship, practicum, placement, professional practice/experience, clinical practice/practicum/experience, supervised/student/clinical/practicum/practice teaching, fieldwork, field work/experience/practice/practicum/study, cooperative, co-op, service learning, and community service.

I cannot observe further enrollment outside the college system from the data, so community college students who transferred to a four-year university outside the system, for example, are still included in the sample. Specifically, the analysis sample to examine labor market outcomes includes first-time college entry cohorts from 2004-05 to 2008-09 who completed a college degree within six years after college entry and were not further enrolled in the college system after degree completion. The data track labor market outcomes of each graduate in the sample for five years after degree completion.

Even within the restricted sample, other factors can still introduce selection bias to simple descriptive comparisons of labor market outcomes between students taking work-based courses and those who are not. For example, if students in fields with better labor market chances are more likely to take work-based courses, the labor market outcomes of work-based coursetakers compared to non-takers will also include the effect of differences in the field of study. In order to mitigate this selection bias through controlling for observable differences, the study employs the propensity score matching (PSM) method. I first match students by the field of study and other observable characteristics such as demographics, academic performance, and employment status at the time of college enrollment. To isolate the effect of work-based coursetaking, I only compare labor market outcomes of matched students whose work-based coursetaking status varies but who have a similar propensity for taking these courses. Although the observables used for the matching may not control for all the factors that affect both the selection and the outcomes of taking work-based courses, the method largely reduces the selection bias arising from these intrinsic differences in students because of the richness of the data.

A student's propensity for taking work-based courses in college is calculated using a logit model:

$$logit(WB_i) = \beta_0 + \beta_1 X_i + \mu_i \quad (1)$$

where $WB_i$ indicates if student i takes work-based courses in college; $X_i$ is a vector of student variables, including gender, race, age at enrollment, instate-residency status, foreign-born status, zip-code level average household income level, degree intent at enrollment, full-time enrollment status in the first term, credits attempted/earned in the

first term, GPA in the first term, employment status (employed, employed full-time, and quarterly earnings) in the first term after college entry, and degree program area based on the two-digit CIP code, college, and cohort; and $\mu_i$ is the error term.

The matching uses a caliper of 0.05 with replacement and excluding observations that violate the overlap assumption. To compare labor market outcomes of work-based coursetakers and non-takers in the matched students, I run the following ordinary least squares regression:

$$Y_i = \alpha_0 + \alpha_1 WB_i + \alpha_2 X_i + \omega_i \quad (2)$$

where $Y_i$ is the labor market outcome for student *i*; $WB_i$ is a dummy variable that equals 1 if student *i* takes work-based courses in college; $X_i$ is the vector of student variables as specified in Eq. 1; and $\omega_i$ is the error term. The analysis is executed using "teffects psmatch" command in STATA.

Under the assumption that the variables used for the matching can control for all the factors that affect the selection and the outcomes of work-based coursetaking, the coefficient $\alpha_1$estimates the average treatment on the treated (ATT) effect of taking work-based courses in college on labor market outcomes of interest. In the context of this study, however, it is challenging to fully satisfy the assumption. First, as noted, the analysis cannot control for further enrollment outside the college system. If the transfer rate from a two-year college within the system to a four-year university outside the system is inherently different between work-based coursetakers and non-takers, the assumption will be violated because the short-term post-graduation labor market outcomes of transfer students will be naturally worse than students who fully enter the labor market after the two-year completion. Also, as the selection into taking work-based courses can be based on a large range of non-random factors, it is challenging to control for all. For example, students are matched by the two-digit CIP code of the degree program area, which is not the most detailed program categorization, in order to allow for adequate samples for the comparison. The assumption may be violated if there are program-specific differences in both the requirement for work-based courses and the labor market returns to the degree within a two-digit CIP area. Therefore, while the PSM

model will control for observable differences, a rigorous causal inference cannot be guaranteed, and results should be interpreted with caution.

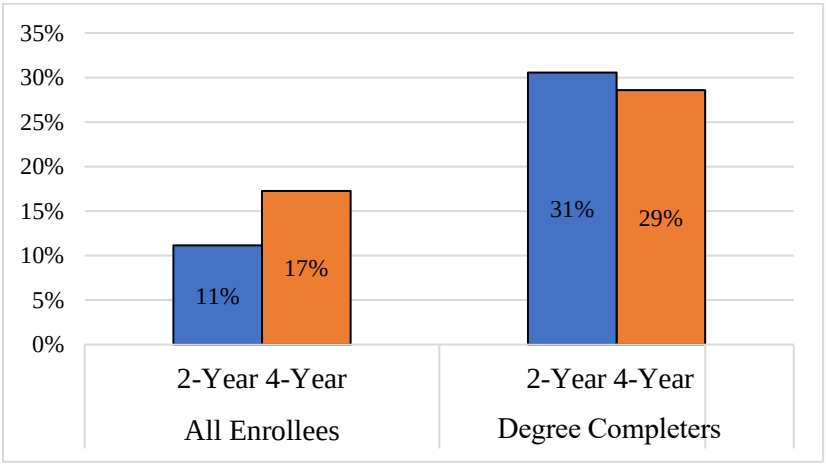
## 4. Patterns of Work-Based Coursetaking in College

In Panel A of Figure 1, the bars on the left show that 11% of two-year enrollees and 17% of four-year enrollees in the analysis sample took a work-based course within six years after college entry. An analysis of course credits indicates that the majority of students earned credits from taking work-based courses. Among work-based coursetakers in the sample, 94% of two-year students and 98% of four-year students took only credit-bearing work-based courses. On average, the two-year students earned 3.6 credits and the four-year students earned 4.4 credits from work-based courses within six years after enrollment.

Panel B of Figure 1 shows the composition of students taking work-based courses in the analysis sample by the year relative to college entry when the course was taken. Students were generally far along in their programs when they took work-based courses. For example, among two-year enrollees in the sample who took a work-based course within six years after college entry, only 2% took the course in the first year. Similarly, among four-year work-based coursetakers in the sample, only 1% took the course in the first year and 5% took the course in the second year after enrollment.

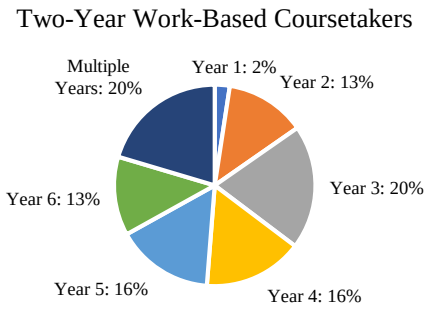
**Figure 1**
**Percentage and Composition of Students Taking Work-Based Courses in College**

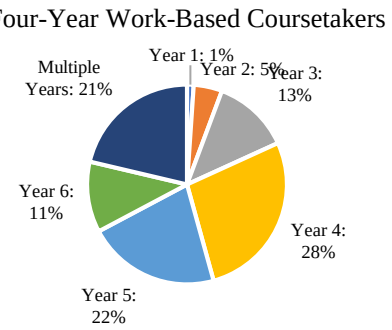
(A) Percentage of students taking work-based courses at two-year and four-year colleges




*Note.* The left bars of the figure show percentages of two-year and four-year enrollees in the analysis sample who took a work-based course within six years after college entry. The right bars of the figure show percentages of two-year and four-year degree completers in the analysis sample who took a work-based course within six years after college entry.

(B) Composition of work-based coursetakers by the year relative to college entry when taking the work-based course



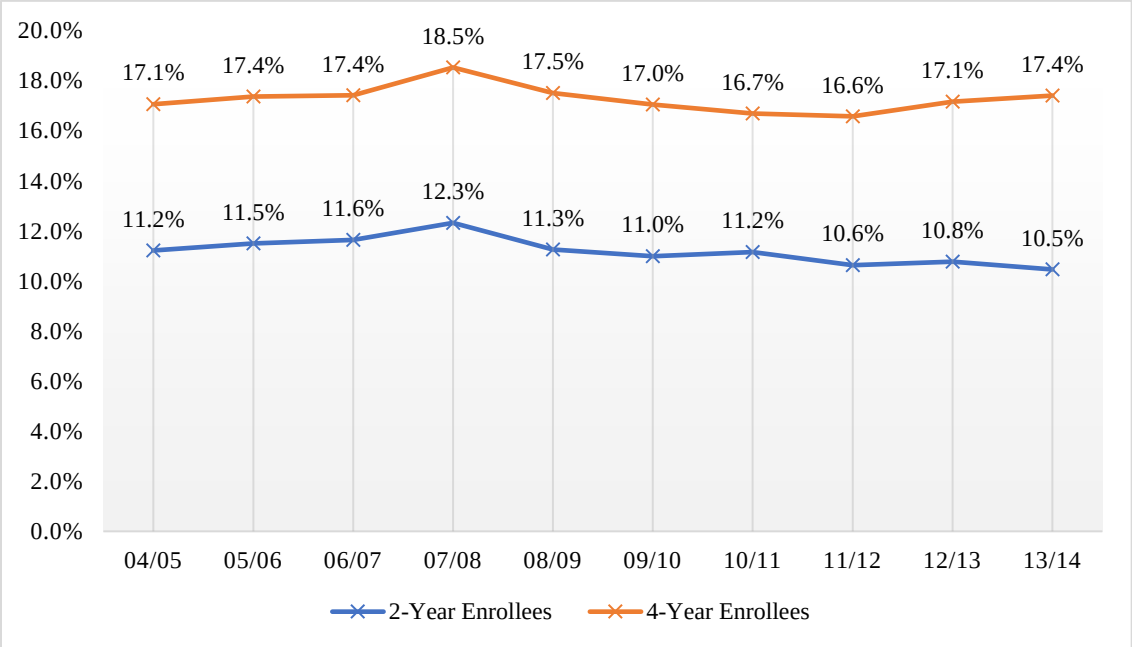

*Note.* The figures show compositions of work-based coursetakers among two-year and four-year enrollees in the analysis sample by the year relative to college entry when the work-based course was taken.

Because students tend to take work-based courses in the later years of their programs, the proportion of students who take work-based courses will be higher if the sample is limited to those who advance to the later years of their programs. In Panel A of Figure 1, the bars on the right limit the analysis sample to students who completed a college degree within six years after college entry. Thirty-one percent of two-year degree

completers and 29% of four-year degree completers in the sample took a work-based course within six years after enrollment.

Figure 2 illustrates trends of work-based coursetaking among two-year and four-year enrollees over time. That is, the figure depicts percentages of enrollees in the analysis sample seeking two-year and four-year credentials who took a work-based course within six years after college entry in each entry cohort. Results show a slight downward trend among two-year enrollees and no significant variation of work-based coursetaking over time among four-year enrollees. Overall, the trend was steady at around 11% among two-year enrollees and 17% among four-year enrollees in the sample.

**Figure 2**
**Trends of Work-Based Coursetaking Over Time**




*Note.* The figure shows percentages of two-year and four-year enrollees in the analysis sample who took a work-based course within six years after college entry by entry cohort.

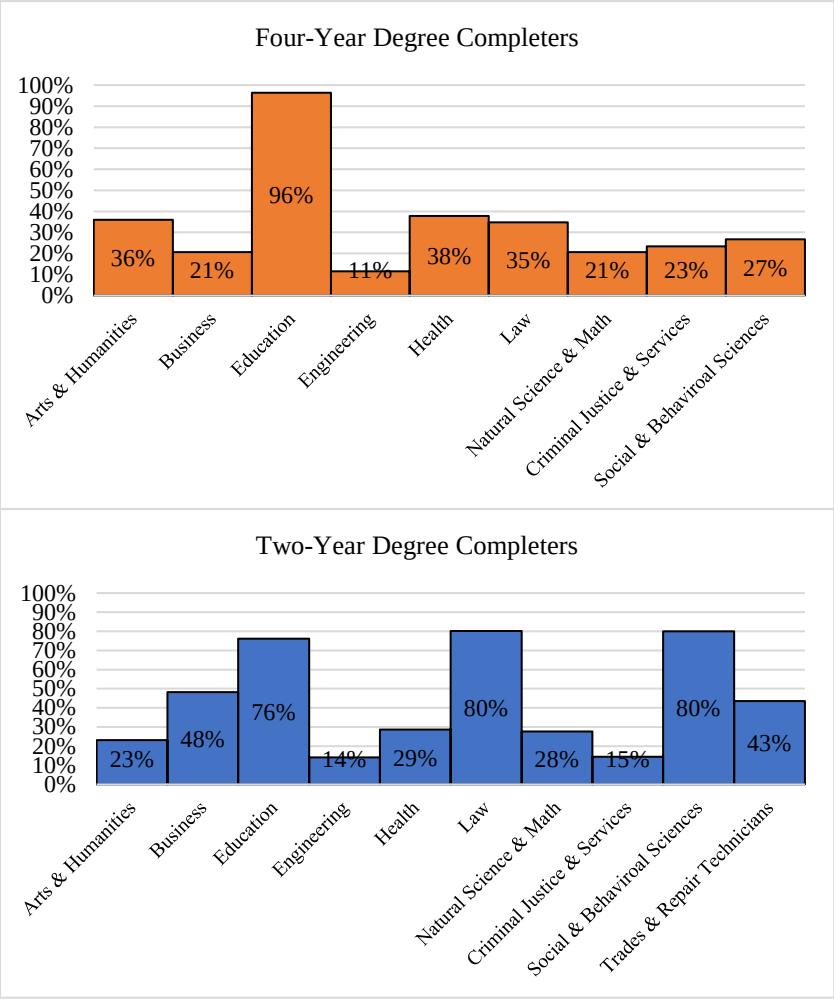
In contrast, work-based coursetaking varied largely across fields of study. Figure 3 shows percentages of degree completers in the analysis sample who took a work-based course within six years after college entry by degree fields. The analysis is focused on students who completed a college degree within six years after college entry for two reasons: First, the field of study is not available for all the enrollees in the sample because

students may not have declared a major in earlier years of study; however, the field information is complete and accurate among degree completers in the degree data. Second, as students tend to take work-based courses in the later years of their programs, limiting the analysis sample to degree completers eliminates potential bias arising from different retention rates across fields of study.

Among two-year degree completers in the sample, students in education, law, and social & behavioral sciences were the most likely to take a work-based course in college, followed by students in the areas of business and trades & repair technicians. Among four-year degree completers in the sample, 96% of students in education took a work-based course within six years after college entry, indicating that the work-based course could be a degree completion requirement for a bachelor's degree in education. Bachelor's degree completers in arts & humanities, health, and law were also more likely than students in other fields to take a work-based course. Among both two-year and four-year degree completers, students in engineering and natural sciences & math were relatively less likely to take a work-based course in college.

It is interesting that while 80% of two-year degree completers in social & behavioral sciences took a work-based course within six years after college entry, the work-based coursetaking rate was only 27% among four-year degree completers in this field area. The disparity may be due to differences in major distribution within the degree field area—the majority of two-year students in social & behavioral sciences completed the degree in community organization and advocacy or human services, while the majority of four-year students in the field area completed the degree in psychology and economics. Therefore, not only does the work-based coursetaking rate tend to vary across degree field areas, but it may also vary across specific majors within a field area. In addition, not a high proportion of students in health, especially among two-year degree completers, took work-based courses in the sample. However, this does not imply that students in health gain little experiential learning experience in college, since the clinical requirement for health programs is not always course based or reflected in the transcript data. This study is limited to experiential learning experience that can be examined through transcript records only, but it would be valuable to expand its scope when other data sources are available.

**Figure 3**
**Work-Based Coursetaking by Field of Study**

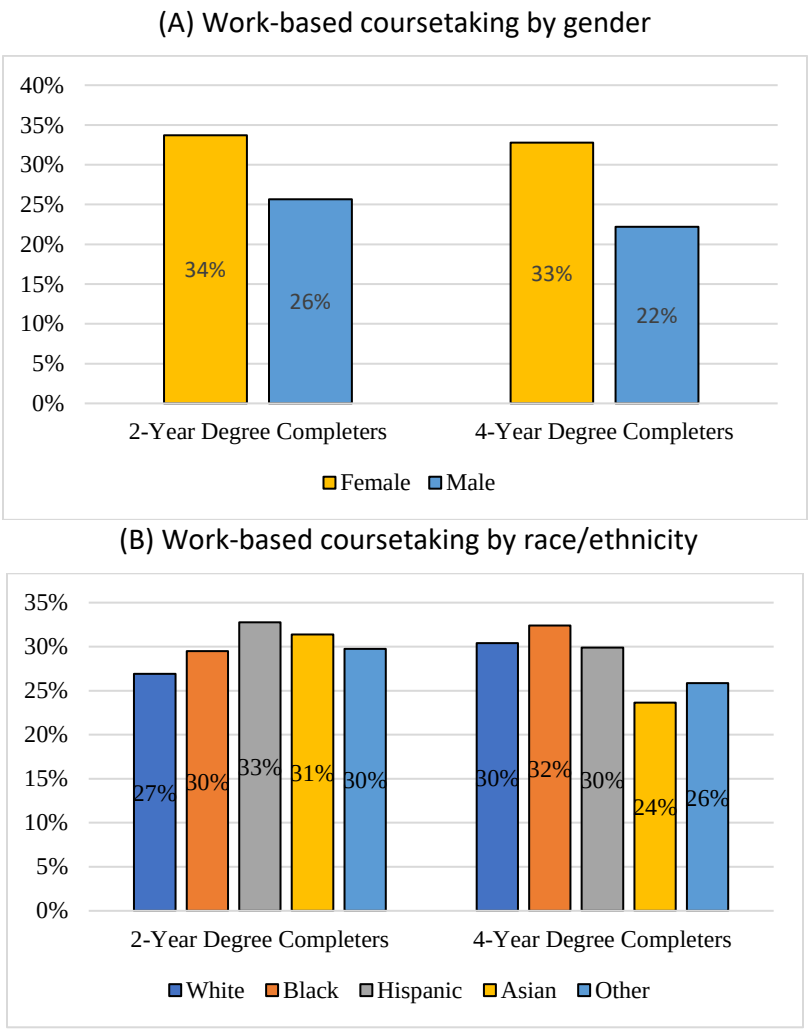



*Note.* The figures show percentages of two-year and four-year degree completers in the analysis sample who took a work-based course within six years after college entry by degree field area.

Last, I examine work-based coursetaking across gender and racial groups. Similar to the analysis by field area, I focus on degree completers in the sample to eliminate potential bias due to different retention rates across student groups. Panel A of Figure 4 shows that female students were more likely than male students to take work-based courses at both two-year and four-year institutions. Among two-year degree completers in the sample, 34% of female students and 26% of male students took a work-based course within six years after college entry. Among four-year degree completers in the sample, the work-based coursetaking rate was 33% for female students and 22% for male

students. The gender disparity in work-based coursetaking may be at least partially explained by major differences across gender groups. Panel B of Figure 4 shows that there were no significant racial disparities in work-based coursetaking at both two-year and four-year colleges. In particular, the rate of work-based coursetaking among minority students was high, implying that work-based courses offer important experiential learning opportunities for underserved minority students and may thus serve as an equity tool in both higher education and the post-college workforce.

**Figure 4**
**Work-Based Coursetaking Across Gender and Racial Groups**




*Note.* The figures show percentages of two-year and four-year degree completers in the analysis sample who took a work-based course within six years after college entry by gender and race/ethnicity.

## 5. Labor Market Outcomes of Work-Based Coursetaking in College

### 5.1 Characteristics of Work-Based Coursetakers

Table 1 presents summary statistics of the analysis sample to examine labor market outcomes associated with taking work-based courses in college. As discussed in Section 3, the sample includes cohorts of first-time college students entering the college system's two-year and four-year institutions in the years 2004-05 to 2008-09 who completed a college degree within six years after enrollment and were not enrolled after the degree completion in the data. The first column represents the overall sample, while the subsequent columns provide the same statistics for work-based coursetakers and non-takers separately. Work-based coursetakers are students in the sample who took a work-based course within six years after college entry, and non-takers are those who did not take work-based courses in college.

Overall, work-based coursetakers were more likely than non-takers to be female for both the two-year and the four-year samples. Among the two-year sample, work-based coursetakers were also more likely to be Hispanic, enrolled full time, and not employed in the first term of study.

## Table 1
## Summary Statistics

| | Two-Year Degree Completers | | | Four-Year Degree Completers | | |
|---|---|---|---|---|---|---|
| Variable | Total | Work-Based Coursetakers | Non-Takers | Total | Work-Based Coursetakers | Non-Takers |
| *Student Characteristics:* | | | | | | |
| Female | 60% | 66% | 57% | 59% | 66% | 56% |
| White | 22% | 18% | 24% | 33% | 35% | 32% |
| Black | 29% | 26% | 31% | 17% | 20% | 16% |
| Hispanic | 32% | 39% | 29% | 23% | 23% | 23% |
| Asian | 17% | 17% | 17% | 27% | 23% | 29% |
| Instate residency | 98% | 97% | 98% | 98% | 98% | 98% |
| Age at enrollment | 22 | 22 | 22 | 19 | 19 | 19 |
| Age at degree completion | 26 | 26 | 25 | 23 | 23 | 23 |
| Zip-code level average household income | 61955 | 60379 | 62636 | 70268 | 70785 | 70094 |
| US born | 32% | 33% | 32% | 36% | 37% | 36% |
| Foreign born | 35% | 41% | 32% | 28% | 25% | 29% |
| Birthplace missing | 33% | 27% | 36% | 35% | 38% | 35% |
| *Academic and Labor Market Outcomes:* | | | | | | |
| Full-time enrollment in first term | 83% | 86% | 81% | 88% | 86% | 88% |
| Credits attempted in first term | 8.0 | 7.5 | 8.2 | 11.6 | 11.4 | 11.7 |
| Credits earned in first term | 7.4 | 6.9 | 7.6 | 11.2 | 11.0 | 11.3 |
| GPA in first term | 2.5 | 2.5 | 2.5 | 2.8 | 2.8 | 2.8 |
| Cumulative credits earned in last term | 70.0 | 70.2 | 69.9 | 127.2 | 127.5 | 127.1 |
| Cumulative GPA in last term | 2.9 | 3.0 | 2.9 | 3.1 | 3.2 | 3.1 |
| Employed in first term | 40% | 37% | 41% | 35% | 37% | 35% |
| Employed full-time in first term (quarterly earning >= 4000) | 12% | 11% | 12% | 4% | 4% | 4% |
| Earning in first term (zeros excluded) | 3652 | 3462 | 3726 | 2179 | 2166 | 2184 |
| *Post-Degree:* | | | | | | |
| Employed, Quarter 1 | 52% | 51% | 53% | 58% | 62% | 57% |
| Employed, Quarter 2 | 54% | 54% | 54% | 61% | 65% | 60% |
| Employed, Quarter 3 | 55% | 55% | 56% | 62% | 67% | 61% |
| Employed, Quarter 4 | 57% | 57% | 57% | 64% | 68% | 62% |
| Employed, Year 1 | 67% | 67% | 67% | 74% | 78% | 72% |
| Employed, Year 2 | 66% | 65% | 66% | 73% | 77% | 72% |
| Employed, Year 3 | 66% | 65% | 66% | 73% | 76% | 71% |
| Employed, Year 4 | 66% | 65% | 66% | 72% | 75% | 71% |
| Employed, Year 5 | 65% | 63% | 66% | 73% | 75% | 72% |
| Earnings, Quarter 1 (zeros excluded) | 5039 | 4895 | 5100 | 5372 | 5183 | 5441 |
| Earnings, Quarter 2 (zeros excluded) | 5782 | 5594 | 5864 | 6417 | 6441 | 6408 |
| Earnings, Quarter 3 (zeros excluded) | 6232 | 5877 | 6386 | 6889 | 6926 | 6875 |
| Earnings, Quarter 4 (zeros excluded) | 6832 | 6301 | 7065 | 7505 | 7594 | 7472 |
| Earnings, Year 1 (zeros excluded) | 19661 | 18580 | 20131 | 21789 | 22000 | 21712 |
| Earnings, Year 2 (zeros excluded) | 25803 | 23639 | 26737 | 29988 | 30613 | 29760 |
| Earnings, Year 3 (zeros excluded) | 29934 | 27032 | 31174 | 35973 | 36485 | 35788 |
| Earnings, Year 4 (zeros excluded) | 33899 | 30214 | 35460 | 41809 | 42311 | 41630 |
| Earnings, Year 5 (zeros excluded) | 38287 | 33852 | 40134 | 47819 | 47294 | 48003 |
| Observations (N) | 9,164 | 2,779 | 6,385 | 26,401 | 6,664 | 19,737 |

*Note.* The analysis sample includes cohorts of first-time college students entering in the years 2004-05 to 2008-09 who completed a college degree within six years after enrollment and who were not enrolled after the degree completion in the state administrative data. Two-year degree completers include those who completed a certificate or an associate degree, and four-year degree completers include those who completed a bachelor's degree. Work-based coursetakers include those who took any work-based courses within six years after college entry. And non-takers include those who did not take work-based courses at college. Earnings are adjusted by CPI to 2015 dollars.

Differences in other student characteristics were not significant between the two groups. On average, work-based coursetakers were slightly less likely to be employed after graduation and to have lower post-degree earnings than non-takers among two-year degree completers in the sample. Among four-year degree completers in the sample, however, both the probability of employment and post-degree earnings were higher for work-based coursetakers than for non-takers.

In order to mitigate selection bias in the comparison of labor market outcomes between the two groups, I first examine selection into work-based coursetaking in college. Appendix Table A1 shows levels of R-squared running OLS regressions with the dummy of taking work-based courses within six years after college entry as the dependent variable and different sets of independent variables. Specifically, I gradually include individual characteristics, ability/preference at enrollment, college, and field of study[2] as independent variables, and changes in R-squared indicate the explanatory power of the independent variables on work-based coursetaking. As Appendix Table A1 shows, the major predictors of taking work-based courses are college and field of study.

Table 2 displays estimates from a logit regression on taking work-based courses in college as specified in Equation 1. Controlling for the effects of college and field of study, female students were still more likely to take work-based courses than male students among both the two-year and the four-year samples. Across racial groups, there was no significant racial disparity in work-based coursetaking among the two-year sample, while White and Black students were more likely to take work-based courses than Hispanic and Asian students among the four-year sample.

[2] Field of study here is based on two-digit CIP codes of degree majors.

## Table 2
## Selection Into Work-Based Coursetaking

| | Two-Year Degree Completers | | Four-Year Degree Completers | |
|---|---|---|---|---|
| Variable | B | S.E. | B | S.E. |
| *Student Characteristics:* | | | | |
| Female | 0.298 | (0.066)*** | 0.400 | (0.035)*** |
| Black | 0.046 | (0.090) | 0.061 | (0.053) |
| Hispanic | 0.027 | (0.093) | -0.129 | (0.050)*** |
| Asian | -0.107 | (0.103) | -0.237 | (0.046)*** |
| Other race/ethnicity | 0.726 | (0.451) | -0.027 | (0.418) |
| Instate residency | -0.194 | (0.292) | 0.059 | (0.205) |
| Age at enrollment | -0.094 | (0.032)*** | -0.052 | (0.026)** |
| Age at enrollment squared | 0.001 | (0.001)** | 0.001 | (0.000)* |
| Zip-code level average household income | 0.000 | (0.000) | 0.000 | (0.000)*** |
| Foreign born | -0.196 | (0.077)** | -0.102 | (0.044)** |
| Missing birth place | -0.131 | (0.076)* | 0.056 | (0.039) |
| Degree intent at enrollment: bachelor's degree | -0.064 | (0.129) | - | |
| Full-time enrollment in first term | 0.240 | (0.094)** | -0.053 | (0.090) |
| Credits attempted in first term | -0.041 | (0.022)* | 0.033 | (0.015)** |
| Credits earned in first term | 0.016 | (0.022) | -0.038 | (0.014)*** |
| GPA in first term | -0.044 | (0.046) | 0.198 | (0.032)*** |
| Missing first term GPA | -0.114 | (0.172) | 0.537 | (0.140)*** |
| Employed in first term | 0.004 | (0.079) | 0.092 | (0.045)** |
| Employed full-time in first term | 0.034 | (0.171) | -0.039 | (0.123) |
| Quarterly earnings in first term | -0.000 | (0.000) | -0.000 | (0.000) |
| *Degree Program Area:* | | | | |
| Natural Resources and Conservation (03) | - | | 1.009 | (0.360)*** |
| Agriculture and Related Science (04) | - | | -3.552 | (0.332)*** |
| Area, Ethnic, Cultural, and Gender Studies (05) | - | | 0.588 | (0.248)** |
| Communications, Journalism, and Related Programs (09) | -0.108 | (0.443) | 1.616 | (0.171)*** |
| Communications Technologies/Technicians and Support Services (10) | 2.215 | (0.274)*** | 2.598 | (0.812)*** |
| Computer and Information Sciences and Support Services (11) | 1.436 | (0.166)*** | -0.434 | (0.192)** |
| Personal and Culinary Services (12) | 2.024 | (1.947) | - | |
| Education (13) | 1.945 | (0.180)*** | 3.785 | (0.230)*** |
| Engineering (14) | -3.078 | (1.054)*** | -3.006 | (0.444)*** |
| Engineering Technologies/Technicians (15) | 1.725 | (0.215)*** | -3.975 | (0.393)*** |
| Foreign languages, Literatures, and Linguistics (16) | - | | -0.087 | (0.241) |
| Family and Consumer Sciences/Human Services (19) | - | | 1.352 | (0.256)*** |
| Legal Professions and Studies (22) | 3.223 | (0.574)*** | -0.948 | (0.237)*** |
| English Language and Literature/Letters (23) | -1.605 | (0.675)** | -0.294 | (0.175)* |
| Liberal Arts and Sciences, General Studies and Humanities (24) | -0.304 | (0.123)** | -0.198 | (0.204) |
| Biological and Biomedical Sciences (26) | -1.357 | (0.600)** | -2.072 | (0.225)*** |
| Mathematics and Statistics (27) | - | | -0.039 | (0.224) |
| Multi/Interdisciplinary Studies (30) | - | | 0.540 | (0.286)* |
| Parks, Recreation, Leisure, and Fitness Studies (31) | - | | 5.783 | (1.032)*** |
| Philosophy and Religious Studies (38) | - | | -0.596 | (0.265)** |
| Physical Sciences (40) | 0.636 | (0.207)*** | -1.272 | (0.243)*** |
| Psychology (42) | -0.032 | (1.258) | -0.639 | (0.165)*** |
| Security and Protective Services (43) | -3.172 | (0.696)*** | -0.630 | (0.178)*** |
| Public Administration and Social Service Professions (44) | 4.320 | (0.349)*** | 3.324 | (0.301)*** |
| Social Sciences (45) | - | | -0.140 | (0.162) |
| Mechanic and Repair Technologies/Technicians (47) | 1.006 | (0.215)*** | - | |
| Transportation and Materials Moving (49) | - | | 0.601 | (0.374) |
| Visual and Performing Arts (50) | 1.127 | (0.173)*** | 0.076 | (0.177) |
| Health Professions and Related Clinical Sciences (51) | 0.917 | (0.139)*** | 0.410 | (0.174)** |
| Business, Management, Marketing and Related Support Services (52) | 1.777 | (0.128)*** | -0.562 | (0.163)*** |
| History (54) | - | | 0.149 | (0.200) |
| Observations (N) | 8,955 | | 25,957 | |

*Note.* The analysis sample includes cohorts of first-time college students entering in the years 2004/05 to 2008/09 who completed a college degree within six years after enrollment and who were not enrolled after the degree completion in the state administrative data. Two-year degree completers include those who completed a certificate or an associate degree, and four-year degree completers include those who completed a bachelor's degree. The analysis runs a logit model, and the dependent variable is if the student took a work-based course within six years after college entry. The model also controls for college and cohort.

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

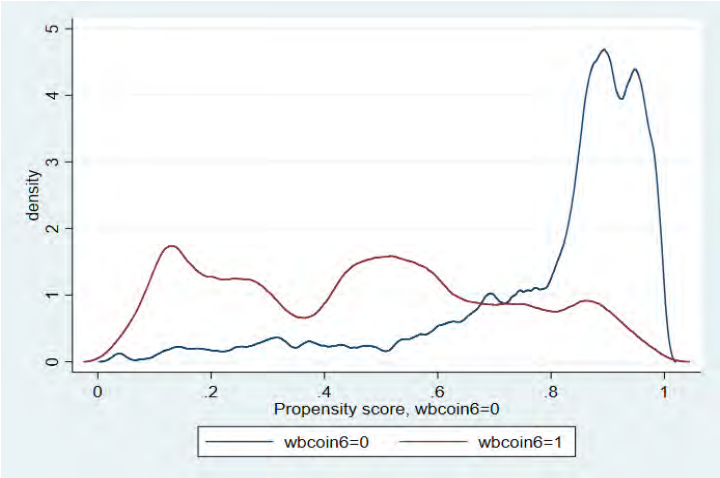
In addition, students who were younger at enrollment and U.S.-born were generally more likely to take work-based courses than their counterparts. Among the two-year sample, students who enrolled full-time in the first term were also more likely to take work-based courses than their part-time counterparts. Students who enrolled part-time in the first term at community colleges or who were older at enrollment in general were more likely to be working students who already had a full-time job when they first enrolled in college. This may explain why they were less likely to take work-based courses in college than their counterparts. Foreign-born students were more likely to be non-U.S. citizens and face legal restrictions to work in the country. This may explain why they were less likely to take work-based courses than US-born students. Furthermore, after controlling for other student characteristics, I find that having a job in the first term of study appears not to have been a strong predictor of taking work-based courses among the two-year sample but was a positive predictor among the four-year sample.

### 5.2 Common Support and Match Quality

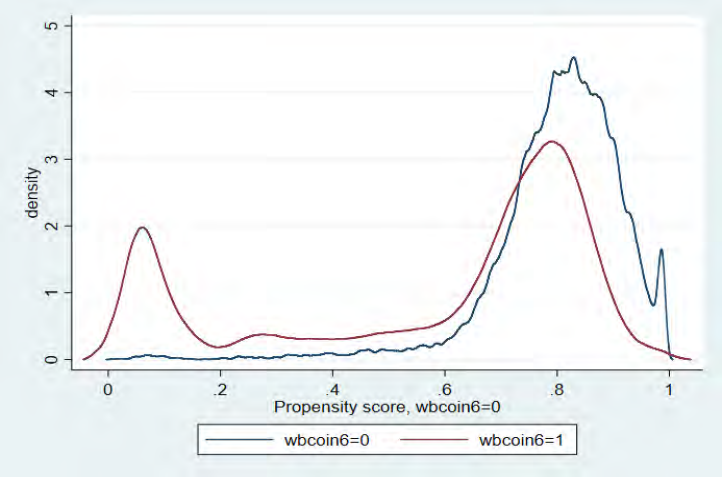
To ensure the validity of PSM, Figure 5 provides evidence of common support. The common support assumption requires sufficient overlap across treatment and control groups to find adequate matches for a range of propensity scores. Figure 5 displays the estimated density of the predicted probabilities that work-based coursetakers (treatment group) and non-takers (control group) in the sample would not take work-based courses in college. Among both the two-year and the four-year samples, neither plot indicates too much probability mass near 0 or 1, and the estimated densities show a broad range of overlap between treatment and control groups. The density plots indicate there is no evidence that the common support assumption is violated (Busso et al., 2014).

**Figure 5**
**Common Support Checks**

(A) Common support check for two-year degree completers




(B) Common support check for four-year degree completers



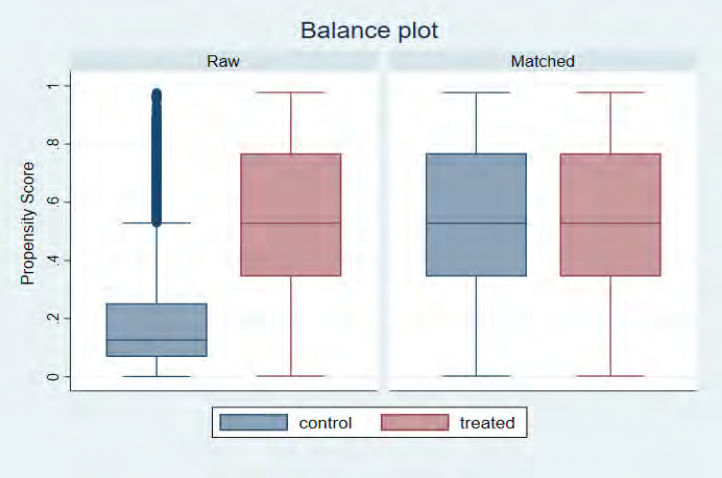

*Note.* The figures show the estimated density of the predicted probabilities that work-based coursetakers (wbcoin6 = 1) and non-takers (wbcoin6 = 0) in the analysis sample are assigned to not taking work-based courses.

In addition, I check the match quality by measuring the balance of the covariates across treatment and control groups in the study. Figure 6 displays balance plots of estimated propensity scores before and after the matching between work-based coursetakers and non-takers. As the raw plots show, there are large differences across the two groups prior to the matching. The differences suggest correlations between work-based coursetaking and the covariates, which lends credence to the concern that selection

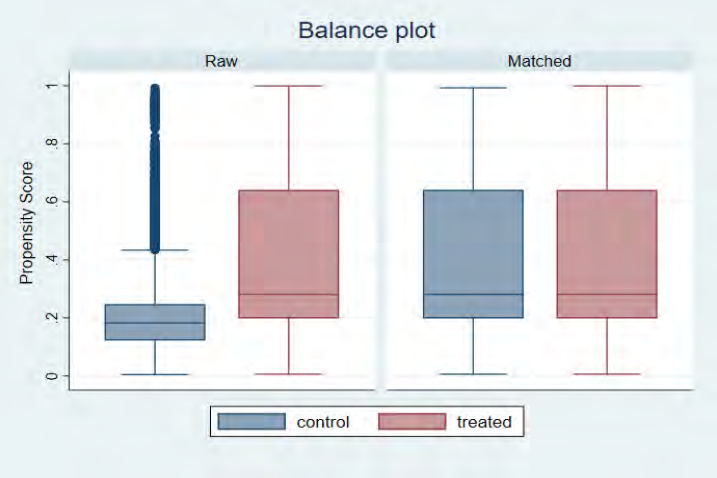
bias may confound findings from simple descriptive comparisons between work-based coursetakers and non-takers. And the box plots after the matching indicate that the matching has balanced the estimated propensity scores.

**Figure 6**
**Balance Plots**

(A) Balance plot for two-year degree completers




(B) Balance plot for four-year degree completers




*Note.* The figures show the balance of estimated propensity scores between work-based coursetakers (treated) and non-takers (control) in the analysis sample before and after the matching.

### 5.3 Main Results

Table 3 presents the main PSM results of post-degree labor market outcomes associated with taking work-based courses in college. Estimations are run separately among two-year degree completers and four-year degree completers in the sample. Panel A presents results on first-year post-degree outcomes, including the probability of being employed and earnings in each quarter of the first year after degree completion as well as the first year overall. Panel B presents results on long-term post-degree outcomes, tracking students' employment and earning outcomes by year up to the fifth post-degree year.

Among two-year degree completers, taking work-based courses in college is associated with a higher employment rate during the first year after degree completion. Specifically, the probability of being employed in the first post-degree year is 4.3 percentage points higher for work-based coursetakers than non-takers from a baseline rate of 66.9%. Coefficients on the employment rate in each quarter of the first year are all positive, but not at a statistically significant level. However, taking work-based courses in college is not associated with higher post-degree earnings during the first year after graduation among two-year degree completers. Coefficients on the first-year earning outcomes are mostly not statistically significant and with negative values, suggesting null to negative associations between taking work-based courses and the first-year post-degree earning outcomes. In the long term, coefficients on the employment outcomes from the second to the fifth post-degree year among the two-year sample are positive but not statistically significant, and coefficients on the earning outcomes for the years are negative. Results suggest that while there was no significant difference in the probability of being employed between work-based coursetakers and non-takers among two-year degree completers, students taking work-based courses in college earned less than their counterparts in the long run.

**Table 3**
**Labor Market Outcomes of Taking Work-Based Courses in College**

| | Two-Year Degree Completers | | | Four-Year Degree Completers | | |
|---|---|---|---|---|---|---|
| Outcome | B | S.E. | Baseline | B | S.E. | Baseline |
| *A. First-year post-degree outcomes* | | | | | | |
| Probability of employment, Quarter 1 | 0.007 | (0.021) | 0.531 | 0.041 | (0.019)** | 0.572 |
| Probability of employment, Quarter 2 | 0.022 | (0.020) | 0.543 | 0.027 | (0.017) | 0.599 |
| Probability of employment, Quarter 3 | 0.022 | (0.021) | 0.558 | 0.035 | (0.017)** | 0.610 |
| Probability of employment, Quarter 4 | 0.029 | (0.020) | 0.570 | 0.043 | (0.015)*** | 0.625 |
| Earnings, Quarter 1 | -193.028 | (175.142) | 2709.397 | -58.461 | (158.829) | 3103.196 |
| Earnings, Quarter 2 | -241.284 | (183.577) | 3172.31 | 163.979 | (187.886) | 3831.425 |
| Earnings, Quarter 3 | -279.196 | (181.855) | 3558.339 | 235.834 | (172.513) | 4188.687 |
| Earnings, Quarter 4 | -378.460 | (204.840)* | 4019.812 | 290.490 | (166.000)* | 4662.968 |
| Probability of employment, Year 1 | 0.043 | (0.020)** | 0.669 | 0.044 | (0.016)*** | 0.728 |
| Earnings, Year 1 | -1,091.967 | (671.507) | 13459.86 | 631.842 | (614.100) | 15786.28 |
| *B. Long-term post-degree outcomes* | | | | | | |
| Probability of employment, Year 2 | 0.033 | (0.021) | 0.665 | 0.040 | (0.014)*** | 0.720 |
| Probability of employment, Year 3 | 0.027 | (0.020) | 0.663 | 0.023 | (0.012)** | 0.718 |
| Probability of employment, Year 4 | 0.022 | (0.020) | 0.669 | 0.009 | (0.011) | 0.717 |
| Probability of employment, Year 5 | 0.018 | (0.020) | 0.666 | -0.016 | (0.010) | 0.722 |
| Earnings, Year 2 | -1,758.193 | (833.730)** | 17769.57 | 2,081.044 | (744.369)*** | 21410.62 |
| Earnings, Year 3 | -1,738.456 | (919.829)* | 20675.41 | 1,522.745 | (823.681)* | 25712.89 |
| Earnings, Year 4 | -2,143.508 | (961.910)** | 23746.24 | 775.737 | (891.377) | 29856.61 |
| Earnings, Year 5 | -2,319.445 | (1,024.628)** | 26701.77 | -328.593 | (928.819) | 34624.1 |
| Observations (N) | 8,955 | | | 25,957 | | |

*Note.* The table shows PSM results of post-degree labor market outcomes associated with taking work-based courses in college. The analysis sample includes cohorts of first-time college students entering in the years 2004/05 to 2008/09 who completed a college degree within six years after enrollment and who were not enrolled after the degree completion in the state administrative data. Two-year degree completers include those who completed a certificate or an associate degree, and four-year degree completers include those who completed a bachelor's degree. The analysis uses "teffects psmatch" command in STATA with a logit model to estimate the propensity score, caliper of 0.05, with replacement and excluding observations that violate the overlap assumption, to execute the matching and the estimation. Earnings are adjusted by CPI to 2015 dollars; missing earnings data are treated as unemployed quarters and are replaced with zeros. Baseline columns show outcomes among the control group who did not take work-based courses in college.

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

Among four-year degree completers, results in Table 3 also show a positive association between taking work-based courses in college and the probability of being employed during the first post-degree year. Specifically, the first-year post-degree employment rate among work-based coursetakers is 4.4 percentage points higher than that of their counterparts from a baseline rate of 72.8%. Coefficients on the quarterly employment outcomes for the first post-degree year are also positive and mostly statistically significant, ranging from a size of 2.7 to 4.3 percentage points. Furthermore, the positive association between taking work-based courses in college and the post-degree employment rate lasts up to three years after graduation among four-year degree completers. As Panel B of Table 3 for the four-year sample shows, the employment rates

are 4 percentage points higher in the second year and 2.3 percentage points higher in the third year after degree completion for work-based coursetakers than non-takers. Last, coefficients on earning outcomes for the fourth quarter of the first, second, and third post-degree years are positive and statistically significant for the four-year sample, suggesting a positive association between taking work-based courses in college and post-degree earning outcomes up to three years after graduation among four-year degree completers.

### 5.4 Alternative Sample

In order to check the robustness of the results, as well as to further mitigate any confounding effects of the field of study, I run the PSM estimation with an alternative sample and drop students in fields with a work-based coursetaking rate higher than 80% from the main analysis sample. The alternative sample includes cohorts of first-time college students entering in the years 2004/05 to 2008/09 who completed a college degree within six years after enrollment, were not enrolled after the degree completion, and were in a field (based on the two-digit CIP code) with less than 80% of the sample taking work-based courses.

Table 4 shows that results on post-degree labor market outcomes using the alternative sample are in general consistent with the main results. Among the two-year alternative sample, the association between taking work-based courses in college and the probability of being employed after degree completion is positive and more significant than the main results. Specifically, the probability of being employed in the first post-degree year for work-based coursetakers is 5.3 percentage points higher than non-takers. The employment rates for each quarter of the first year are also statistically significantly higher for work-based coursetakers than non-takers, at a size of 3.5 to 5.6 percentage points. Furthermore, the positive association between taking work-based courses in college and the probability of being employed lasts through the fourth post-degree year: The employment rate for work-based coursetakers is 4.6 percentage points higher in the second year, 3.5 percentage points higher in the third year, and 4 percentage points higher in the fourth year after degree completion than the employment rates of non-takers. Also, consistent with the main results for the two-year sample, there is no significant association between taking work-based courses in college and post-degree earnings in the

first year. And the associations with post-degree earnings in the second and the third years are negative at a statistically significant level similar to the main results.

**Table 4**
**Labor Market Outcomes of Taking Work-Based Courses in College, Excluding Majors with High Work-Based Coursetaking Rate**

| | Two-Year Degree Completers | | | Four-Year Degree Completers | | |
|---|---|---|---|---|---|---|
| Outcome | B | S.E. | Baseline | B | S.E. | Baseline |
| *A. First-year post-degree outcomes* | | | | | | |
| Probability of employment, Quarter 1 | 0.042 | (0.020)** | 0.531 | 0.022 | (0.017) | 0.568 |
| Probability of employment, Quarter 2 | 0.048 | (0.020)** | 0.543 | 0.017 | (0.014) | 0.595 |
| Probability of employment, Quarter 3 | 0.035 | (0.019)* | 0.558 | 0.025 | (0.013)* | 0.607 |
| Probability of employment, Quarter 4 | 0.056 | (0.020)*** | 0.570 | 0.037 | (0.015)** | 0.621 |
| Earnings, Quarter 1 | 140.180 | (135.594) | 2712.017 | -221.841 | (192.228) | 3092.034 |
| Earnings, Quarter 2 | 29.402 | (160.396) | 3173.707 | 8.223 | (180.076) | 3812.312 |
| Earnings, Quarter 3 | -163.371 | (194.993) | 3561.522 | 113.861 | (184.345) | 4169.824 |
| Earnings, Quarter 4 | -214.391 | (220.102) | 4021.439 | 197.197 | (195.064) | 4638.372 |
| Probability of employment, Year 1 | 0.053 | (0.019)*** | 0.669 | 0.034 | (0.011)*** | 0.724 |
| Earnings, Year 1 | -208.181 | (638.230) | 13468.69 | 97.439 | (704.634) | 15712.54 |
| *B. Long-term post-degree outcomes* | | | | | | |
| Probability of employment, Year 2 | 0.046 | (0.019)** | 0.665 | 0.034 | (0.013)*** | 0.716 |
| Probability of employment, Year 3 | 0.035 | (0.020)* | 0.663 | 0.023 | (0.011)** | 0.714 |
| Probability of employment, Year 4 | 0.040 | (0.020)** | 0.669 | 0.011 | (0.011) | 0.713 |
| Probability of employment, Year 5 | 0.025 | (0.020) | 0.666 | 0.005 | (0.011) | 0.718 |
| Earnings, Year 2 | -1,754.393 | (872.171)** | 17776.19 | 1,747.208 | (986.630)* | 21301.27 |
| Earnings, Year 3 | -1,716.212 | (932.807)* | 20694.12 | 939.394 | (856.973) | 25572.48 |
| Earnings, Year 4 | -1,601.615 | (974.691) | 23764.83 | 643.155 | (917.053) | 29710.93 |
| Earnings, Year 5 | -1,617.838 | (1,082.672) | 26730.51 | -651.180 | (923.072) | 34478.66 |
| Observations (N) | 8,818 | | | 25,065 | | |

*Note.* The table shows PSM estimation results of post-degree labor market outcomes associated with taking work-based courses in college dropping students in majors with more than 80% of the sample taking work-based courses. The analysis sample includes cohorts of first-time college students entering in the years 2004/05 to 2008/09 who completed a college degree within six years after enrollment, who were not enrolled after the degree completion, and who were in majors with a work-based coursetaking rate lower than 80%, in the state administrative data. Two-year degree completers include those who completed a certificate or an associate degree, and four-year degree completers include those who completed a bachelor's degree. The analysis uses "teffects psmatch" command in STATA, with a logit model to estimate the propensity score, caliper of 0.05, with replacement and excluding observations that violate the overlap assumption, to execute the matching and the estimation. Earnings are adjusted by CPI to 2015 dollars; missing earning data are treated as unemployed quarters and are replaced with zeros. Baseline columns show outcomes among the control group who did not take work-based courses in college.

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

Results for the four-year alternative sample are also consistent with the main results, showing positive associations with both post-degree employment outcomes and post-degree earnings. Specifically, work-based coursetakers have a 3.4 percentage-point higher employment rate in the first post-degree year than non-takers, especially during

the third (2.5 percentage points higher) and the fourth (3.7 percentage points higher) quarters of the first year. The positive association lasts through the second and the third post-degree years at a size of 3.4 percentage points and 2.3 percentage points, respectively. In addition, there is a positive and statistically significant association between work-based coursetaking in college and earnings in the second post-degree year.

As noted, results should not be taken as rigorous causal evidence because the identifying assumption may not be fully satisfied. In particular, while students are matched by the two-digit CIP code of the degree program area, there may exist program-specific factors that affect both the selection and the outcomes of work-based coursetaking within a program area. For example, some programs may offer and/or require more work-based courses than other programs in the same program area. If two-year students in these programs are more likely to transfer to a four-year institution outside the college system, pursue further training/apprenticeship, or go into unionized sectors where wages are traded off with non-wage benefits, they will have lower post-graduation earnings than students in other programs under the same program area. All these factors may drive the negative association between work-based coursetaking and post-graduation earnings among two-year students. In other words, results do not indicate that taking work-based courses has an adverse impact on two-year students' labor market outcomes.

## 6. Discussion

The paper applies an innovative text mining technique to identify work-based courses in transcript records of a large urban college system and examines patterns and post-degree labor market outcomes of taking work-based courses in college. The technique identifies that 11% of two-year enrollees and 17% of four-year enrollees took a work-based course within six years after college entry. Among degree-completers, 31% of two-year graduates and 29% of four-year graduates took a work-based course in college. The majority of students only took credit-bearing work-based courses and generally took the courses in the later years of their programs.

The analysis of work-based coursetaking patterns highlights large differences across fields of study. In particular, students in engineering and natural sciences & math were less likely to take work-based courses than students in other fields. This may be explained by the traditional focus of programs in engineering and natural sciences & math on academic learning. As the value of experiential learning in college has been increasingly endorsed by employers, colleges may consider incorporating more applied-learning opportunities for students in engineering and natural sciences & math to prepare them better for the workforce.

In addition, there is no significant racial disparity in work-based coursetaking. The results suggest that work-based courses can provide an opportunity for underserved minority students to participate in experiential learning in college and thus may serve as an equity tool in both higher education and the post-college labor market.

To understand the relationship between work-based courses and workforce preparation in college, the paper uses a PSM model to compare post-degree labor market outcomes between work-based coursetakers and non-takers. A key assumption of the PSM model is conditional independence, whereby the model must control for all the observable covariates that can affect both the decision and the outcomes of the treatment (i.e., taking work-based courses in college). The study relies on the richness of the administrative data and includes a rich set of covariates for the matching. Nevertheless, there may remain unobserved factors that could affect both the selection into work-based coursetaking and post-degree labor market outcomes. The selection bias would be at least partially mitigated through the correlation between the unobserved factors and the observed covariates. However, we should still be cautious about interpreting the PSM results as rigorous causal evidence because the selection into work-based courses can be very non-random. I therefore take the PSM results as suggestive evidence, which still provides valuable insights for college administrators and future research.

First, results show a positive association between taking work-based courses in college and the probability of being employed after degree completion among both two-year and four-year degree completers. The association is strongest during the first year after college graduation and can last through the third post-degree year. The results suggest that work-based coursetakers have better chances of being employed after college

graduation than non-takers, probably as a result of networking opportunities, job skills, or signaling effects gained from taking work-based courses in college. In addition, there are some positive associations between taking work-based courses in college and post-degree earnings in the four-year results; that is, work-based coursetakers at the bachelor's level are more likely to land a high-paying job than non-takers.

In contrast, results among two-year degree completers show null-to-negative associations between work-based coursetaking in college and post-degree earnings. The results imply that work-based coursetakers at community colleges tend to have lower post-degree earnings than non-takers. As discussed, there may exist program-specific factors within a two-digit CIP area driving the negative association between work-based coursetaking at community colleges and post-graduation earnings. When interpreting the results, it is also important to note that a large number of community college students are already working while enrolled. It would thus be valuable for college administrators to understand how work-based courses relate to and interact with students' other working opportunities. For example, if there are any administrative barriers to enrolling in work-based courses while engaging in external job opportunities, students may opt out of work-based courses and take other, higher paying opportunities they find outside school. This may in part explain the higher post-degree earnings associated with students who do not take work-based courses in college. Colleges may consider addressing such barriers if they exist and expanding job opportunities for work-based courses, thereby allowing for a more effective combination of academic learning and experiential learning in college.

The probability of employment and earnings is not the only measure of post-degree labor market success. Another possible reason why work-based coursetaking in college is not positively associated with post-degree earnings for two-year completers is that there may be tradeoffs between earnings and a career of interest among work-based coursetakers. When colleges design and evaluate the effectiveness of work-based courses, it would be advisable for them to consider, beyond average earnings, students' interests and the nature of the jobs they may wish to pursue.

As one of the first quantitative examinations of experiential learning in college, this study has several limitations and also creates directions for future research. First, the study is focused on work-based courses that can be identified through course titles in

transcript records. Experiential learning in college has a broad scope and may not always be course based or reflected in the transcript data. Future research with access to other data sources may apply a text mining technique like the one used in this study to include other types of experiential learning experience in college. Also, while this study examines labor market outcomes associated with work-based coursetaking in college, workforce preparation is certainly not the sole goal of college education. It is beyond the scope of this paper to consider how work-based courses interact with academic learning as well as other aspects of personal development, but it would be fruitful for future research to explore this.

Last, the PSM model used in this paper may not provide a plausible estimate of the causal effect of taking work-based courses, especially among community college students, a large number of whom were already working while enrolled. Future research may explore quasi-experimental opportunities for a more causal analysis. For example, the data shows variation in the rate of taking work-based courses across campuses, even after controlling for field areas of study. Among two-year institutions in the college system I examined, one had a relatively higher rate of work-based coursetaking than other colleges in several field areas, including arts & humanities, business, and natural science & mathematics. In the area of business, students at a different community college were also more likely to take work-based courses than students at other two-year colleges. Among four-year institutions in the system, one college had a higher rate of work-based coursetaking than other campuses in the areas of arts & humanities, business, natural science & mathematics, and social & behavioral sciences. Students in natural science & mathematics at a different college and students in social & behavioral sciences at yet another college were also more likely to take work-based courses than students in the same field areas at other system colleges granting four-year degrees. It would be helpful in future research to understand if the variation across campuses in taking work-based courses is due to exogenous factors, such as different graduation requirements or work-based course/program offerings among the campuses. Future research could compare the outcomes of similar students with different likelihoods of taking work-based courses as a result of such exogenous factors to achieve a more causal understanding of the relationship between work-based coursetaking in college and students' outcomes.

In the current study, I checked trends over time of work-based coursetaking in the top 10 majors/programs (based on 6-digit CIP codes) that enroll the largest number of students at two-year and four-year institutions in the college system. The data shows an increase in the work-based coursetaking rate among two-year students in the teacher assistant/aide field on and after the year of 2010 and a decrease in the work-based coursetaking rate among four-year students in finance on and after the year of 2011. Exogenous policy changes in work-based courses over time may present quasi-experimental opportunities to study the causal relationship between work-based coursetaking and students' outcomes within these majors. While other majors may not have an adequate sample size, future research could combine majors/programs with similar labor market opportunities in a statistical analysis.

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# Appendix

## Table A1
## Selection Into Work-Based Coursetaking, R-squared

| | | | | |
|---|---|---|---|---|
| R-squared | | | | |
| Two-Year Degree Completers | 0.0301 | 0.0455 | 0.2067 | 0.335 |
| Four-Year Degree Completers | 0.0136 | 0.0176 | 0.0688 | 0.2114 |
| Independent variables | | | | |
| Individual characteristics | X | X | X | X |
| Ability/preference at enrollment | | X | X | X |
| College | | | X | X |
| Field of study (two-digit CIP code) | | | | X |

*Note.* The table shows levels of R-squared running OLS with the dummy of taking work-based courses as the dependent variable and different sets of independent variables. Individual characteristics include gender, race/ethnicity, age at enrollment, in-state residency, birthplace (U.S. born vs. foreign born), and zip-code level average household income. Performance/preference at enrollment controls include full-time enrollment in the first term, credits attempted and earned in the first term, GPA in the first term, intent for bachelor's degree at enrollment, flags for employment and full-time employment in the first term, quarterly earnings in the first term, and cohort.

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