The Role of Community College Education in the Employment of Information Technology Workers in Washington State

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July 2010

REVIEW DRAFT: Not for citation or distribution

Abstract

Understanding the role of subbaccalaureate credentials in preparing people for the workforce is increasingly important, particularly in quickly changing fields like information technology (IT). To better understand the role of community colleges in preparing IT workers, we sought to examine two key issues: (1) students' employment outcomes by the type of community college IT preparation they completed, and (2) the type of employers who tend to hire community college IT students. To examine these issues, we analyzed administrative data from the state of Washington for IT students enrolled in community and technical colleges during 2001-2002, including data on their college experiences as well as their work experiences before, during, and after their college enrollment.

Our examination of employment outcomes by type of community college preparation suggests employers prefer workers with higher levels of credentials. Students with both associate degrees and certificates in IT had the strongest employment outcomes in terms of likelihood of employment, hours worked, and earnings, followed by students with IT associate degrees and students with IT certificates. Students who concentrated their study in IT, completing just a few IT courses, had the weakest employment outcomes, underscoring the importance of completing subbaccalaureate credentials, including both associate degrees and certificates.

Furthermore, mid-sized employers are more likely to employ community college IT students than small or large employers. Employers in IT-related industries, temporary placement agencies, and educational agencies were also more likely to employ these students than other industries and agencies. These findings highlight the importance of community college efforts to engage with the full range of employers in their labor market as well as the potential need for different engagement strategies, depending on the employer.

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1. Introduction and Background

With its focus on promoting community college technician education, the Advanced Technological Education (ATE) program has had a long-standing interesting in understanding the role of community college education in preparing technicians, particularly in the field of IT (NWCET, 2005; NWCET, 2006; BATEC, 2007; Germuth, Gullickson, Lawrenz, & Hanssen, 2006). Recently, national initiatives that have focused on helping more Americans attain *credentials of value in the labor market* have placed an even greater emphasis on understanding subbaccalaureate credentials and their role in the workforce (Council of Economic Advisers, 2009; Bill and Melinda Gates Foundation, 2009). As part of a larger investigation of employer perceptions of community college preparation, we examine the employment outcomes of information technology (IT) students in Washington State (WA) after completing their community college studies. We seek to address two questions related to the employment outcomes of community college IT students. (1) Which types of community college preparation in IT are associated with better employment outcomes? (2) Which kinds of employers in which labor markets are more likely to employ students with different types of community college preparation in IT? This analysis is part of the Stem-to-Stern project funded by the ATE program conducted by the Community College Research Center (CCRC) in collaboration with the National Workforce Center for Emerging Technology (NWCET) at Bellevue College (WA).

Because of their relatively high wages and good employment prospects, IT jobs are of particular interest. These jobs are an important part of the economy with projected growth in the coming years for a range of positions (see Table 1). For this analysis, we take a broad view of IT jobs including computer support specialists, network administrators, programmers, and database administrators, since community college programs may prepare students for these IT jobs.[1]

Table 1: Description of IT Job

IT Job	Projected Openings 2008-2018 (in thousands)	Dominant Education	Median Wage
Computer Support Specialists	234.6	Associate Degree	$43,450
Network and Computer Systems Administrators	135.5	Bachelor's Degree	$66,310

[1] We focus on IT occupations, rather than occupations in which IT is embedded.

Computer Programmers	80.3	Bachelor's Degree	$69,620
Database Administrators	44.4	Bachelor's Degree	$69,740

While IT jobs are an important part of the workforce, the role of community college preparation for them is not clear, despite the fact that it is very common. IT is among the top five occupational fields among associate and certificate awards at community colleges nationally (NCES, 2008). And a significant number of ATE programs focus on preparing community college students for IT employment in technician jobs. Complicating the role of community college preparation for IT jobs are the multiple pathways into IT jobs—including both subbaccalaureate credentials and bachelor's degrees. Some research raises questions about the value of subbaccalaureate credentials like the associate degree for IT employment and suggests bachelor's degrees are necessary (NWCET 2005; NWCET 2006). At the same time, other research indicates while some IT jobs may require a bachelor's degree, some IT jobs may still be accessible to workers with community college preparation (BATEC 2007, BLS 2010).

The multiple ways community colleges prepare workers for IT jobs further complicates the role of community colleges. These include associate degrees (typically two years of study), certificates (typically one year of study) or a few classes in a concentrated area of study (Jacobs & Grubb, 2006). Since much of the prior research on IT technician employment has focused on the role of bachelor's degrees versus the associate degrees, little is known about the role of the different types of IT preparation within community colleges. To better understand this issue, this analysis examines the employment outcomes of IT students with different types of community college preparation to determine their relative economic value and the kinds of employers who prefer them.

Broadly speaking, community college education provides valuable returns in the labor market. Prior research indicates completing one year of community college coursework is associated with earnings gains (Kane & Rouse, 1999). Furthermore, across all fields of study, those who complete associate degrees have higher earnings compared to high school graduates who do not attend college (Marcotte, Bailey, Borkoski, & Kienzl, 2005; Grubb, 1999; Kane & Rouse, 1999). While data on certificates are more limited, existing research concludes students with occupational certificates have better employment outcomes than those in academic associate degree programs (Jacobson & Mokher, 2009; Kerckhoff & Bell, 1998). Relative to

associate degrees, certificates may be viewed as providing a more specific set of skills than an associate degree, which would provide a more general set of skills and knowledge.

In addition to associate degrees and certificates, students may complete just enough occupational coursework to obtain the skills they need for employment (Lohman & Dingerson, 2005). Some evidence indicates enrolling in a small number of courses is not associated with any wage returns (Grubb, 1999; Marcotte, et al, 2005). However, more specific examinations of the types of courses taken indicate coursework in more technical and/or quantitative areas provides greater earnings returns, at least among displaced workers (Jacobson, LaLonde, & Sullivan, 2005). Thus, it is quite possible taking a focused set of courses in IT might be associated with positive employment outcomes.

Importantly, the returns of community college preparation are field specific. Prior research has documented that the earnings for community college credentials holders vary significantly by field of study (Grubb, 1999; Kerckhoff & Bell, 1998; Jacobson & Mokher, 2009). For example, health occupations, such as nursing, and other technical fields, such as engineering, are among those with the highest wage returns (Jacobson & Mokher, 2009). This underscores the importance of examining outcomes by field of study. By focusing on IT students only, we can understand differences in their employment outcomes by type of community college program without confounding these with differences by field of study.

Through the examination of IT students' employment outcomes, we seek to uncover employer preferences for different kinds of community college preparation. This understanding may help ATE programs and community colleges focus their efforts on offering and promoting the types of IT programs with greater labor market value. For example, some community colleges may prioritize their efforts on their associate degree programs, others on short-term certifications, and others on just-in-time training of just a few IT courses.

In addition to understanding the relative economic value of different kinds of community college preparation, understanding the types of employers that hire these students will further illuminate the role of community college preparation for IT jobs. IT workers in particular are employed by a wide range of employers in nearly all industries, including those in the IT industry and those in other industries that use IT in their work. Given this wide variation, employers' preferences for community college education may vary depending on their size, industry, and local labor market. Employer size may be associated with hiring practices. For

example, larger employers may be more bureaucratic and thus rely more on formal screening processes and credentials (Bridges and Villemez, 1994) Employers in different industries may also value degrees differently depending on their technical skill needs and the norms within their particular industry (Bridges, 1996). Furthermore, in science and engineering fields, like IT, hiring preferences may vary across industry and geography (Lowell & Salzman, 2007). Since IT is an occupation with no public licensure or regulation, the education needed for IT positions is largely determined by individual employer preferences. Thus, understanding employer preferences through their hiring behavior is particularly important.[2]

Given the wide range of employers of IT workers, a better understanding of how different types of employers favor different types of community college preparation could help guide colleges. With a greater understanding of the employers who hire community college IT students, ATE programs and community colleges may tailor their employer engagement strategies. They may also be able to provide additional information to students when advising them on career options.

In the next section of this paper, we describe the data and methods used in this analysis. We then provide findings on the two key sets of issues addressed by this analysis. First, we describe IT students' employment outcomes across different types of community college preparation in IT, including earning associate degrees, earning certificates, and completing concentrated coursework in IT. Second, we examine IT students' employment outcomes relative to their labor market and their types of employers. Finally, we conclude with some recommendations for community college programs.

2. Data and Methods

CCRC obtained the data used in this analysis from the WA State Board of Community and Technical College (SBCTC) and has been working in collaboration with the SBCTC to analyze these data for a range of research studies and to provide guides on how to conduct these types of analyses (see, e.g., Crosta, Leinbach, Jenkins, Prince, & Whittaker, 2006; Leinbach &

[2] With its lack of regulation and connection to on-going changes in technology, IT occupations may provide information on student outcomes that is applicable to other technician occupations, rather than highly regulated occupations, such as those in the health care industry or less technologically-driven occupations, such as those in business administration.

Jenkins, 2008; Jenkins, 2008). The data used for this analysis were drawn from administrative records data from the SBCTC on students enrolled in the state's community and technical colleges (CTCs) during the 2000 to 2001 academic year. These data are reported to the SBCTC by individual colleges on all students in programs supported by state funds. Students' WA CTC records were supplemented with data from the National Student Clearinghouse and state Unemployment Insurance (UI) wage records. For this analysis, we focus on IT students who completed their program or left the CTC by the spring of the 2004-2005 academic year to examine their employment experiences, including their earnings, hours worked, and employer characteristics.

These data include information on student characteristics and course-taking patterns collected by WA CTCs upon students' enrollment in a CTC and throughout their involvement at the CTCs. They also include complete records of students' transcripts and credential completions while they were enrolled at WA CTCs, as well as demographic information about students. Information on a student's college—used to determine whether the student attended a technical college and whether the student attended a college in the Seattle Metropolitan area—was collected from the last quarter of enrollment. The UI data allowed us to match individual students' educational records with information about their employment in WA and neighboring states before, during, and after their enrollment in WA CTCs through 2006. The National Student Clearinghouse data allowed us to identify students who continued their education at institutions outside of the WA CTC system. These students' educational and employment outcomes were tracked through the spring of the 2005-2006 academic year, four to five years after their enrollment at the CTC.[3]

This analysis focuses on students who have demonstrated a commitment to studying IT in college. We define these IT students as those who have completed either 4 or more classes or 12 or more credits in classes identified as IT by their Classification of Instructional Programs (CIP) code. This definition is consistent with the Perkins definition of a concentrator as a student who takes 4 or more classes in a subject area. The following 4-digit CIP code series were used to define IT classes and awards:

- 1102 – Computer Programming
- 1103 – Data Processing

[3] The amount of follow-up data varies from four to five years depending on which quarter during the 2000 to 2001 academic year the student enrolled at the CTC.

- 1104 – Information Science/Studies
- 1105 – Computer Systems Analysis
- 1108 – Computer Software and Media Applications
- 1109 – Computer Systems Networking and Telecommunications
- 1110 – Computer/Information Technology Administration and Management
- 1199 – Computer and Information Sciences and Support Services, Other

However, after reviewing the list of IT courses identified by these CIP codes, certain classes that are more related to general computer and office skills, not necessarily part of a focused program of study for IT, were excluded from consideration as IT courses.[4]

Based on their educational attainment while enrolled at the CTCs, we categorized IT students in one of the following four groups: (1) IT associate degree completers: students who completed an associate degree in IT by the end of the 2005-2006 academic year; (2) IT certificate completers: students who completed a certificate in IT offered by the colleges by the end of the 2005-2006 academic year; (3) IT associate degree and IT certificate completers: students who completed both an associate degree in IT and a certificate in IT; and (4) IT concentrators: students who earned neither an IT certificate nor an IT associate degree, but took at least four courses in IT or earned at least twelve credits in IT, and stopped attending college at any of the Washington CTCs for one year, meaning they last attended a CTC in 2004-2005. These students may have completed their studies, at least temporarily, and entered the workforce having completed enough study to obtain the necessary IT skills for employment, though some may eventually plan to complete a degree or certificate. Students have been classified into these four categories without regard to prior education or non-IT credentials earned.

Despite the richness of these data, they do have some limitations. First, the assumption is made that students who do not have UI records in a given quarter are unemployed during that quarter. However, this assumption may be compromised by individuals working for the federal government, enrolled in the military, self-employed or working "off the books," or finding employment in locations outside Washington and beyond its neighboring states. It may also be may be compromised by human error in reporting employment records. Second, since these data come from institutional records and not a survey, missing data is potentially more likely to be found in the records of students who have spent less time in school.

[4] Specifically, the course was excluded if the course title included letter combinations, such as: WORD, EXCEL, POWERP, KEYBOARD, SPREADSHEET, LOTUS, TYPEWRITING, SPRDSHT, WORKS, ACROBAT, WRD, WDPROC, OFFICE, and OUTLOOK.

Some students were excluded from both the descriptive analysis and the multivariate analysis because they did not meet the criteria for this analysis. First, students who transferred to another school after their period of enrollment in Washington CTCs were excluded because they had not yet completed their schooling. Second, students who were still enrolled in a CTC during the 2005-2006 academic year (and thus did not have employment outcomes available for one year after their leaving the WA CTC system) were excluded because they, too, had not yet completed their schooling. Third, one student who represented an extreme outlier on prior earnings was removed from the analysis. Finally, students who were missing plausible data on either date of birth or gender (about 5.6% of entire population; 1.6% of IT students) or one of the key outcomes (hours worked or total earnings in the fourth quarter after leaving school) were excluded. In our analyses, for the other categorical variables with high levels of missing data in our sample (race/ethnicity, prior education, and SES quintile), we included a separate dummy variable for "missing", but these cases were not dropped because of their high numbers in the data. Ultimately, after all these exclusions, the final set of students for analysis included 3,053 IT Students out of an original 4,894 IT Students.

We examine student outcomes one year after the end of their enrollment in the CTC, regardless of whether students completed a credential or not. It is important to look at outcomes over a long enough period of time to allow the individuals to settle into the labor market and find employment (Grubb, 1999; Jacobson, 2009). The one-year period allows students enough time to transition into the workforce after completing their studies. While additional quarters of data are available for some students who completed their studies earlier and thus have more follow up data in the labor market, we do not examine these quarters because students who took longer to complete their studies would be dropped from the sample due to lack of follow up data. Thus, the students included in the sample had at least a three year window to complete their studies.

3. Findings

To provide background and context on the IT student population, we first present data on the descriptive characteristics of our population of IT students—those who enrolled for the first time in Washington State CTCs during the 2000 to 2001 academic year and left the CTCs by the

2003 to 2004 academic year. We compare this group of IT students with the wider population of workforce students enrolled in WA CTCs during the 2000 to 2001 academic year. We then focus the analysis exclusively on IT students. We first examine IT students' employment outcomes across different types of community college preparation. We then examine IT students' employment outcomes across labor markets and employer type.

3.1 Characteristics of IT Students

To place them in a wider context, we first compare the characteristics of IT students with the average workforce student, that is, all students enrolled in college-level workforce courses at the CTCs. We then compare IT students with different educational outcomes from the CTCs—that is, IT associate degree completers, IT certificate completers, IT associate degree and IT certificate completers, and IT concentrators. Table 2 summarizes the key characteristics of workforce students, IT students, and IT students with different educational outcomes.

Compared to average workforce students, IT students were a more advantaged group than the wider population of workforce students. They were more likely to be male (72.3% versus 47.4%), from the top two socio-economic status (SES) quintiles (47.2% versus 35.8%), and slightly more likely to be white (75.1% versus 72.8%).[5] IT students are more likely to have some postsecondary education experience before enrolling in a WA CTC than the average workforce student (61% versus 50%). In terms of their experiences while at the CTCs, IT students are more likely to receive financial aid in their last quarter in a Washington State CTC than average workforce students (28.3% versus 18.4%), more likely to have been full-time students than other workforce students (63.3% versus 41.8%), and enrolled for longer periods of time than workforce students in general (7.3 quarters versus 4.8 quarters). They are also less likely to attend technical colleges (18.7%) than workforce students (25.8%) and more likely to attend a Seattle metro area college (69.7% versus 57.9%). In terms of previous employment, IT students have higher rates of previous work experience (64.5% versus 57.1% worked full-time at some point in the five years before enrolling at the CTC), higher hours worked (231 average quarterly hours in the second year before enrolling at the CTC versus 185) and higher previous earnings

[5] The SES variable is based on the average socio-economic indicators for the Census block group of a student's listed residence, calculated using a methodology developed by CCRC researchers (Crosta, Leinbach, & Jenkins, 2006).

($4,319 versus $3,089 average quarterly earnings in the second year before enrolling at the CTC)[6]. These differences suggest that IT students who have completed at least 12 IT credits or four IT classes are a more advantaged group than the broader CTC workforce program population, though this broader workforce population may include students in a wider range of stages within their educational program.

Among IT students with different educational outcomes at the CTC, we observe some differences in their characteristics, suggesting some underlying differences in the groups. IT students who obtain IT certificates, either alone or along with an IT associate degree, had higher previous earnings than those who completed an IT associate degree or concentrated IT coursework ($4,874 and $4,963 versus $3,988 and $4,260, respectively). They are also more likely to attend a technical college (30.9% and 29.8% versus 16% and 16.5%, respectively). IT students who complete certificates only are slightly more advantaged than IT students overall. They are more likely to hold bachelor's degrees (23.9% versus 16.1%) and have a higher SES (52.0% in the top two SES quintiles versus 47.2%); they are also more likely to be older (71.2% over age 27 versus 62.8%) and have higher previous earnings ($4,874 average quarterly earnings in the second year prior to enrollment in a CTC versus $4,319). This might suggest that IT certificate completers are seeking targeted skills offered by the certificate, rather than the more general skills offered by the associate degree. IT students who obtain an IT associate degree may include more relatively new entrants to the labor market, as they have the lowest rates of prior employment compared to other types of IT students (58.9% versus 69.7%, 68.7%, and 64.8%). IT concentrators are more likely to be employed while enrolled at the CTC than IT students in general (49.1% average quarters worked while enrolled versus 44.9%) and have higher average quarterly earnings while at the CTC ($2,714 versus $2,320), supporting the notion that they are pursuing specific skills related to advancement at work.

[6] We examine their prior earnings in the second year before enrollment in the CTC to better measure students' earnings before the potential decline in earnings leading up to their enrollment in the CTCs.

Table 2: Demographics

	All Workforce Students	All IT Students	IT Associate Degree & IT Certificate	IT Associate Degree	IT Certificate	IT Concentrator
N	47241	3053	208	499	278	2068
Sex						
Male	47.4%	72.3%	84.6%	69.9%	70.5%	71.8%
Female	52.6%	27.7%	15.4%	30.1%	29.5%	28.2%
Race/ethnicity						
Asian/Pacific Islander	8.6%	11.8%	8.0%	8.4%	17.9%	12.9%
African-American	6.2%	4.6%	4.7%	3.4%	6.0%	4.7%
Native American	2.1%	1.6%	1.3%	0.9%	0.7%	2.1%
Latino	8.0%	4.1%	5.3%	5.0%	2.2%	3.9%
Other	2.3%	2.8%	3.3%	3.7%	3.7%	2.1%
White only	72.8%	75.1%	77.3%	78.5%	69.4%	74.3%
Missing	74.3%	53.9%	27.9%	35.7%	51.8%	61.3%
SES Quintile (1 highest, 5 lowest)						
Quintile 1	15.6%	22.0%	11.2%	17.5%	22.7%	24.0%
Quintile 2	20.3%	25.2%	31.8%	22.9%	29.3%	24.4%
Quintile 3	22.1%	21.1%	16.8%	23.2%	22.7%	20.9%
Quintile 4	22.0%	18.6%	27.4%	18.7%	16.0%	18.0%
Quintile 5	20.0%	13.1%	12.8%	17.7%	9.4%	12.7%
Missing	12.0%	12.2%	13.9%	18.6%	7.9%	11.0%
Prior education category						
HS grad or less	49.5%	38.5%	42.1%	42.6%	29.8%	38.3%
Some post HS	21.3%	28.7%	27.7%	30.6%	26.5%	28.6%
Certificate (< 2 yrs)	6.1%	7.3%	8.0%	7.4%	8.5%	7.1%
Associate Degree	6.1%	8.6%	13.3%	8.5%	10.3%	7.9%
Bachelor's Degree	13.7%	16.1%	8.5%	10.1%	23.9%	17.3%
Missing	19.9%	13.7%	9.6%	10.4%	15.8%	14.7%
Age category as of first quarter						
Age 18 or younger	9.7%	11.2%	9.1%	11.0%	6.8%	12.0%
Age 19 to 22	17.6%	15.4%	15.4%	15.8%	10.4%	16.0%
Age 23 to 26	11.7%	10.6%	7.2%	11.2%	11.5%	10.7%
Age 27 to 39	31.4%	34.6%	36.1%	34.1%	39.2%	33.9%
Age 40 or older	29.5%	28.2%	32.2%	27.9%	32.0%	27.3%
Average age	32.7	32.3	33.1	31.9	34.0	32.0

	All Workforce Students	All IT Students	IT Associate Degree & IT Certificate	IT Associate Degree	IT Certificate	IT Concentrator
Prior work experience						
Worked FT any quarter in 5 years before enrolled	57.1%	64.5%	69.7%	58.9%	68.7%	64.8%
Average weekly hours worked the 2nd year before enrolled	14.2	17.8	20.7	17.1	19.8	17.3
Average quarterly earnings the 2nd year before enrolled	$3,089	$4,319	$4,963	$3,988	$4,874	$4,260
Received need-based financial aid in last quarter						
	18.4%	28.3%	38.8%	37.9%	29.3%	24.8%
College characteristics						
Attended a technical college	25.8%	18.7%	29.8%	16.0%	30.9%	16.5%
Attended CTC in Seattle metro area	57.9%	69.7%	72.6%	66.7%	89.9%	67.4%
Enrollment status as of last quarter						
Full-time	41.8%	63.3%	60.3%	69.6%	66.1%	61.8%
Part-time	58.2%	36.7%	39.7%	30.4%	33.9%	38.2%
Experiences while in school						
Quarters in school	4.8	7.3	9.5	9.0	7.6	6.6
% of quarters worked	52.3%	44.9%	35.9%	36.3%	36.4%	49.1%
Average weekly hours worked while in school	12.9	10.5	7.4	7.5	8.2	11.9
Average quarterly earnings while in school	$2,679	$2,320	$1,352	$1,409	$1,745	$2,714
Average total credits earned	37.0	92.1	134.6	123.1	104.0	78.7
Completed a certification class	1.7%	26.4%	50.5%	43.7%	38.8%	18.1%

3.2 Employment Outcomes by Type of Preparation

To better understand the role of community college preparation in IT, we examine in more detail the employment experiences among IT students with different types of preparation. We first descriptively examine their general employment outcomes (Table 3). Then, using multivariate techniques, we control for differences among students with different types of community college preparation to better compare their employment outcomes (Tables 9-11). Ultimately, we seek to identify which educational outcomes in IT are associated with greater labor market success, as well as other factors related to students' labor market success.

The differences in employment among IT students with different CTC educational preparation are not substantial, although students who completed both an IT associate degree and an IT certificate seem to have the best outcomes on all measures. The percent employed ranges from 60 percent (for IT associate degree completers and IT concentrators) to 69 percent (for holders of both an IT associate degree and an IT certificate). Median hours worked per week range from 17 (for concentrators without a credential) to 32 (for holders of both an IT associate degree and an IT certificate). Median quarterly earnings ranged from $2,272 (for IT concentrators without a credential) to $4,665 (for holders of both an IT associate degree and an IT certificate). The larger number of employed individuals contributes to these higher median earnings for those who hold both credentials. Students who hold only an IT associate degree have the lowest mean earnings and low median earnings, perhaps reflecting their demographic, since these students are younger on average and less likely to have prior postsecondary education or work experience.

Table 3: Employment Outcomes One Year After Leaving School, By Educational Outcome

	All IT Students	IT Associate Degree and IT Certificate	IT Associate Degree	IT Certificate	IT Concentrators
N	3053	208	499	278	2068
Percent Employed	60.6%	68.3%	59.5%	64.7%	59.5%
Percent Employed Full-time	42.1%	51.9%	41.3%	43.9%	41.1%
Median Hours Worked	19.5	32.2	20.5	22.3	17.2
Mean Hours Worked	19.9	24.2	19.8	20.7	19.4
Median Quarterly Earnings	$2,603	$4,665	$2,570	$3,414	$2,272
Mean Quarterly Earnings	$4,113	$4,419	$3,786	$4,310	$4,135

When examining employment outcomes it is important to account for the effects of other factors, like prior education, prior work experience, and age, which are likely to be intertwined with the type of educational outcomes students pursue and complete. Table 4 illustrates some of the differences in employment outcomes based on these different characteristics. For example, students without prior full-time work experience have worse employment outcomes than those with prior full-time work experience. They are less likely to be employed full-time, and they earn less money per quarter one year after leaving the community college. Given these differences, it is important to note that students coming into community colleges may have vastly different purposes for attending, depending on their age, prior work experience, and prior education. For example, IT concentrators may consist of both students who aspired to attain a credential but failed and students who only intended to take a few classes in order to learn specific IT skills.

Table 4: Employment Outcomes One Year After Leaving School, By Previous Education, Previous Work Experience, and Age

	IT Students without prior certificates or degrees	IT Students with prior certificates or degrees	IT Students who never worked full-time in the 5 years before enrollment	IT Students who worked full-time in the 5 years before enrollment	IT Students aged 22 or younger at time of enrollment	IT Students older than 22 at time of enrollment
N	1792	842	1083	1970	812	2241
Percent Employed	62%	60%	37%	74%	62%	60%
Percent Employed Full-time	42%	45%	21%	54%	39%	43%
Median Hours Worked	21.0	19.3	0.0	32.2	17.3	20.3
Mean Hours Worked	20.3	20.0	10.9	24.9	19.7	20.0
Median Quarterly Earnings	$2,644	$2,974	$0	$4,984	$2,226	$2,928
Mean Quarterly Earnings	$3,733	$4,977	$1,755	$5,409	$3,075	$4,489

To fully account for these differences among the type of students who complete each type of community college preparation, we conducted additional multivariate statistical analyses to account for potential factors related to the hours worked and average earnings observed among these different groups of IT students. Controlling for these relevant factors that may explain differences in employment outcomes allows us to make more complete inferences about the employment outcomes associated with different educational outcomes for community college IT students. In our analysis, we control for factors related to employment including students'

characteristics, such as demographics, age, and prior education; students' employment experiences prior to and during their enrollment at the community colleges; labor market conditions upon their entrance to the labor market after leaving the college; and their educational experiences while at the community college, including credits earned and quarters enrolled. We examine the relationship between students' educational outcomes in IT from the community colleges and their employment status, hours worked, and quarterly earnings, holding these other factors constant. The results from our multivariate analyses are presented in Tables 5 and 6.

Work experience before and during enrollment at the community college is an important factor related to IT students' employment outcomes, including employment status, hours worked, and earnings. In terms of prior employment status, IT students who worked full-time in any quarter during the five years before enrolling at the CTC were more likely to be employed, work more hours, and have higher earnings one year after completing their CTC studies. Likewise, in terms of work intensity and earnings, students who worked more hours and had higher earnings in prior quarters were more likely to work more hours and have higher earnings one year after completing their CTC studies. In addition, IT students' employment experiences while enrolled at community colleges is also an important factor related to their employment outcomes. Rather than detracting from their studies and ultimately their employment outcomes, working while attending a CTC was associated with a greater likelihood of employment, more hours worked, and higher earnings among IT students one year after leaving the CTC.

Prior education is also an important correlate of employment and earnings. IT students with prior bachelor's degrees, associate degrees, or some postsecondary education were more likely to be employed full-time one year after completing their CTC studies. Likewise, the same categories of prior education are important predictors of earnings one year after completing CTC studies.

Students' age is also negatively related to their employment outcomes. Perhaps once we control for prior work experience and education, older workers have a more difficult time entering the IT field relative to younger workers because younger workers either have or are perceived to have more experience with recent technology.

Table 5: Coefficients from Logistic Regressions for Employment Status One Year After Leaving School

	Employed
IT Educational Outcomes Attained at CTC	
Certificate	0.337*
Associate Degree	0.22
Associate Degree & Certificate	0.503*
Student Characteristics	
Female	0.171
Asian	0.106
African-American	0.079
Native American	0
Latino	0.164
Other Race/Ethnicity	0.133
Missing Race/Ethnicity	-0.006
SES quintile 1	-0.099
SES quintile 2	-0.051
SES quintile 3	0.015
SES quintile 4	-0.076
Missing SES quintile	-1.511***
Some Postsecondary Education	0.128
Certification	-0.269
Associate Degree	0.05
Bachelor's Degree	0.164
Missing Prior Education	-0.11
Age	-0.022***
Employment Experiences	
Any Full-time Employment in the 5 Years Before Enrollment	0.159***
Percent of Quarters Employed While Enrolled	0.021***
Labor Market Conditions	
Unemployment Rate Upon Entrance to Labor Market	-0.211*
Summer Upon Entrance to Labor Market	0.075
Fall Upon Entrance to Labor Market	0.124
Spring Upon Entrance to Labor Market	0.230+
Experiences at CTC	
Attended Seattle Area CTC	0.023
Attended Technical College	0.007
Received Financial Aid	-0.022
Took Industry Certification Class	0.155
Total Credits Earned	0.002*
Constant	0.665
N	3053
R2	0.262

Note: + p<.1, * p<.05, ** p<.01, *** p<.001

Table 6: OLS Regressions for Hours Worked and Earnings One Year After Leaving School

	Hours Worked	Earnings
IT Educational Outcomes Attained at CTC		
Certificate	1.573	429.624+
Associate Degree	1.680+	415.418*
Associate Degree & Certificate	4.490***	742.319**
Student Characteristics		
Female	0.545	171.395
Asian	0.674	-60.379
African-American	-1.813	-279.535
Native American	3.048	128.261
Latino	-0.878	71.352
Other Race/Ethnicity	0.419	-281.839
Missing Race/Ethnicity	-1.066	-206.997
SES quintile 1	-2.320*	-323.469
SES quintile 2	-1.646	-55.973
SES quintile 3	-0.273	161.667
SES quintile 4	-1.797	-264.111
Missing SES quintile	-8.848***	-1618.511***
Some Postsecondary Education	0.952	260.772
Certification	-1.845	-224.405
Associate Degree	1.825	731.026**
Bachelor's Degree	0.198	453.595+
Missing Prior Education	-0.677	-14.826
Age	-0.122***	-23.750**
Employment Experiences		
Any Full-time Employment in the 5 Years Before Enrollment	0.633***	77.659***
Average Quarterly Earnings 2nd Year Before Enrollment	--	0.157***
Average Weekly Hours Worked 2nd Year Before Enrollment	0.121***	--
Percent of Quarters Employed While Enrolled	0.074***	4.626*
Average Quarterly Earnings While Enrolled	--	0.652***
Average Weekly Hours Worked While Enrolled	0.359***	--
Same Employer in Before and After Enrollment	-2.276*	-529.690*
Labor Market Conditions		
Unemployment Rate Upon Entrance to Labor Market	-0.782	-189.695
Summer Upon Entrance to Labor Market	-0.068	-46.815
Fall Upon Entrance to Labor Market	0.035	-54.827
Spring Upon Entrance to Labor Market	0.189	131.122
Experiences at CTC		
Attended Seattle Area CTC	0.494	317.927*
Attended Technical College	-0.322	-143.418
Received Financial Aid	-0.116	-142.792
Took Industry Certification Class	1.742*	267.465+
Total Credits Earned	0.018**	3.075*
Constant	16.634***	3003.404**
N	3053	3053
R2	0.314	0.468

Note: + p<.1, * p<.05, ** p<.01, *** p<.001

Controlling for IT students' differences in these other factors, we present adjusted values for employment outcomes for each group of students with different CTC educational outcomes in IT (Table 7).[7] IT students who leave the CTCs with more credentials have better employment outcomes. That is, those who attained an IT associate degree and certificate work more hours and earn more one year after leaving the CTC than those who concentrate in IT. These IT students have higher quarterly earnings ($4,698) and more hours worked weekly (23.7) on average than IT concentrators ($3,955 and 19.2 hours) after controlling for other related factors, including student characteristics, their employment experiences, labor market conditions upon their entrance to the labor market, and their experiences at the community college. Those students who attained IT associate degrees ($4,371 and 20.9) and IT certificates ($4,385 and 20.8) also work more hours and earn more than IT concentrators after controlling for their differences in these other factors.

Table 7: Employment Outcomes One Year After Leaving School, By Educational Outcome, Adjusted for Student Differences

	IT Certificate and IT Associate	IT Associate Only	IT Certificate Only	IT Concentrator
Percent Worked	72.50%	66.50%	69.10%	61.40%
Hours Worked Weekly	23.7	20.9	20.8	19.2
Quarterly Earnings	$4,698	$4,371	$4,385	$3,955

These credentials in IT all have positive value in the labor market, even when controlling for the intensity and duration of the educational experience by including credits earned in our regression models. This finding implies these credentials in IT may have independent value in the labor market aside from the additional credits earned; this value may have to do with the social traits employers might associate with completing a credential, such as motivation or discipline, which would not be conveyed by simply taking courses.

Alternatively, this finding may be attributed to the completion of a particular program of study that is designed to impart a particular set of skills to completers; those students who complete this full program of study may hold unique sets of skills and abilities that are not gained by taking an alternative set of courses (Grubb, 1999). In either case, the finding supports the notion that IT credentials attained at the community college are associated with valuable

[7] In calculating these adjusted values for employment outcomes we assume all other factors are at the mean.

employment outcomes among students upon their entry into the labor market. Given the observational nature of these data, however, we cannot assume causality between educational outcomes in IT and employment outcomes. While we attempted to control for as many relevant factors related to employment as possible in the regression analyses, it is still possible that other unmeasured factors may be at work in leading to the employment outcome. Thus, these findings are merely suggestive of associations we observe based on the data available at this time.

3.3 Employment Outcomes by Local Labor Market and Employer Type

IT students' employment outcomes one year after they left the community colleges (or the fourth quarter after leaving) provide an indication of how they fare in the labor market. To put these outcomes in context, we examine IT students' employment outcomes across labor markets and employer types and compare them with the overall employment structure in their local labor market. That is, we compare their employment outcomes with the full range of employment possibilities that exist in their labor market. While many of these employment opportunities may not be appropriate for this group of IT students, the comparison is intended to illuminate how this group fits into their particular labor market structure and how that differs depending on their local labor market. Ultimately, we seek to identify particular labor market conditions where employment opportunities for community college IT students may be more likely to exist.

We first examine the role of the local labor market in IT students' employment outcomes, given the unique focus on IT in the Seattle metro area, compared to the state of Washington outside the Seattle metro area. We defined the students' labor market according to the CTC they last attended, since this provides an indication of their commuting patterns as well as the set of networks they are likely to access in finding employment. Despite the differences in industry across these local labor markets, the employment outcomes of CTC IT students one year after leaving CTCs in the Seattle metro area are similar to those outside the Seattle metro area (Table 8). They are employed at similar rates (59.8% versus 62.4%) and are employed full-time at similar rates (41.6% versus 43.2%). Furthermore, they work a similar number of hours per week (18 hours versus 22 hours) and have similar quarterly earnings ($2,563 versus $2,678). It may be that CTC IT students face similar employer demand across these labor markets, regardless of industry.

Table 8: Employment Outcomes One Year After Leaving School, By Labor Market

	All IT Students	All IT Students, Seattle Metro Area	All IT Students, Outside the Seattle Metro Area
Percent Employed	60.6%	59.8%	62.4%
Percent Employed Full-time	42.1%	41.6%	43.2%
Median Hours Worked Per Week	19.5	18.3	21.9
Mean Hours Worked Per Week	19.9	19.6	20.6
Median Quarterly Earnings	$2,603	$2,563	$2,678
Mean Quarterly Earnings	$4,113	$4,243	$3,814

The size of employers of IT students' provides insight into employment opportunities they encounter in the labor market upon completing their community college studies (Table 9). IT students in WA and in the Seattle metro area work for employers that range in size: about 40% are in small firms (less than 100 employees), 24% in medium firms (100 to 500 employees) and a little over 35% in large firms (more than 500 employees). While similar percentages of IT students work for small employers compared to the average workers in both Washington state and the Seattle metro area, more IT students work for medium-size employers and fewer work for large employers. This difference may suggest some differences in how middle sized firms utilize IT workers relative to small and large sized firms or a preference for workers with other types of credentials, like bachelor's degrees and/or industry certifications.

Table 9: Employer Size Among Those Employed One Year After Leaving School, By Labor Market

	Washington State Workforce*	All IT Students	Seattle Metro Area*	All IT Students, Seattle Metro Area	Outside Seattle Metro Area*	All IT Students, Outside Seattle Metro Area
Less than 100	40.9%	40.9%	36.6%	39.6%	47.9%	43.9%
100-499	14.8%	23.9%	14.5%	23.9%	15.4%	24.0%
500+	44.3%	35.2%	48.9%	36.5%	36.7%	32.1%

* From U.S. Census Bureau, 2005 County Business Patterns, Washington and Seattle-Tacoma-Bellevue Metropolitan Statistical Area.

In addition to size, the industry of employers provides additional insight into the labor market experiences of IT students. Table 10 summarizes those industries where IT students are found to have been employed just one year after leaving the CTC. In both Seattle and Washington state as a whole, IT students are employed in a wide range of industries after leaving

CTCs, the majority of which are IT-embedded industries rather than IT-related industries. In fact, only 14.7% of IT students in WA and 16.8% of students in the Seattle area are employed in IT-related industries. In general, IT students are employed across a range of industries, including IT-related and IT-embedded industries.

Compared to workers overall in the labor market, CTC IT students are more likely to be employed in IT-related industries, as would be expected. They are also more likely to be employed in temporary services and educational services industries. The relatively high employment in temporary services may reflect students' intentions to use these firms to gain entry into the IT world. The relatively high employment in educational services may reflect IT students' employment at their educational institutions. They are less likely to be employed in the health care and construction industries, perhaps reflecting the higher proportion of industry-specific workers in these industries.

Table 10: Industries Among Those Employed One Year After Leaving School, By Labor Market

	Washington State*	All IT Students	Seattle Metro Area*	All IT Students, Seattle Metro Area	Outside Seattle Metro Area*	All IT Students, Outside Seattle Metro Area
Total with industry code available	2,316,296	1808	1,432,531	1266	883,765	542
Construction	7.1%	4.3%	6.8%	4.5%	7.6%	3.9%
Manufacturing	11.1%	9.0%	11.1%	9.1%	11.1%	8.7%
Wholesale Trade	5.5%	4.5%	5.8%	4.9%	5.1%	3.5%
Retail Trade	13.9%	13.9%	12.2%	13.4%	16.5%	15.1%
Transportation & Warehousing	3.6%	3.8%	4.2%	4.0%	2.8%	3.1%
Information	4.5%	7.3%	6.1%	8.8%	2.0%	3.7%
Finance & Insurance	4.7%	4.6%	5.1%	4.9%	4.1%	3.9%
Real Estate & Rental & Leasing	2.2%	1.8%	2.3%	1.7%	1.9%	1.8%
Professional, Scientific, & Technical Services	6.4%	8.9%	7.0%	9.5%	5.4%	7.6%
Administrative & Support & Waste Management & Remediation Services	4.0%	5.6%	3.9%	5.2%	4.2%	6.5%
Temporary Services	1.6%	7.5%	2.0%	9.0%	1.1%	4.1%
Educational Services	1.9%	6.4%	2.1%	5.9%	1.7%	7.6%
Health Care & Social Assistance	13.7%	6.0%	12.2%	4.5%	16.3%	9.6%
Arts, Entertainment, & Recreation	2.5%	1.8%	2.5%	1.5%	2.5%	2.4%
Accommodation & Food Services	9.3%	6.3%	8.6%	6.0%	10.4%	6.8%
Other	4.6%	3.7%	8.3%	3.6%	7.2%	3.9%
Public Administration	Not available	4.7%	Not	3.3%	Not	7.9%

			available		available	
Total IT-related Industry**	6.4%	14.7%	8.4%	16.8%	3.1%	9.8%

* From U.S. Census Bureau, 2005 County Business Patterns, Washington and Seattle-Tacoma-Bellevue Metropolitan Statistical Area

**Includes NAICS codes for Computer and Software Wholesalers; Computer, Software, and Electronics Stores; Information; Computer Systems Design & Related Services; Computer & Office Machine Repair & Maintenance; Computer & Peripheral Equipment Manufacturing; and Computer Training.

*** For some of the NAICS codes that went into this category, specific employment numbers were withheld, and a range of employee numbers was offered instead. The averages of these ranges were used in calculating the total category percentage.

Beyond the differences between IT students and workers in the overall labor market structure, IT students with different educational outcomes from the CTC may vary in the kinds of employers they end up working for. In terms of employer size, similar percentages of IT students with different educational outcomes are employed across small, medium and large employers (Table 11). Thus, employers of different sizes do not have distinct hiring behaviors that favor workers with different educational outcomes from the CTCs; however, because these data only include subbaccalaureate credentials, it is not possible to assess these credentials relative to other credentials that employers might prefer, such as bachelor's degrees or industry certifications.

Table 11: Employer Size Among Those Employed One Year After Leaving School, By Educational Outcome

	All IT Students	IT Associate Degree and IT Certificate	IT Associate Degree	IT Certificate	IT Concentrators
Mean	2267	2685	2964	2756	1983
Median	201	216	173	146	216
Less than 100	39.8%	38.4%	43.0%	45.5%	38.5%
100 – 499	23.4%	24.5%	21.2%	23.8%	23.7%
500+	37.2%	37.1%	35.3%	32.6%	38.3%

In terms of industry, IT students with different educational outcomes are employed in a similar range of industries (see Table 12). One notable exception is that IT associate degree and certificate holders and IT certificate holders work for temporary services firms at higher rates than IT associate degree holders and IT concentrators (13.6% and 12.2% respectively versus 6.3% and 6.4% respectively). These groups of IT students are also more likely to attend technical colleges, so it is possible these colleges have stronger relationships with temporary placement firms, leading to their greater likelihood of working in this industry. Alternatively, temporary placement agencies may value students' with certificates to the extent they view these as demonstrating specific skills. The implications of higher employment in the temporary

placement firms are unclear, but it may indicate a less stable employment experience as workers move from placement to placement. Alternatively, it may help connect workers to employment opportunities at the sites of their temporary placement, as these employers "try them out" on a temporary basis.

Table 12: Industry Among Those Employed One Year After CTC, By Educational Outcome

	All IT Students	IT Associate's Degree and IT Certificate	IT Associate Degree	IT Certificate	IT Concentrators
Total with industry code available	1808	140	286	180	1202
Construction	4.3%	5.0%	6.3%	3.9%	3.8%
Manufacturing	9.0%	7.9%	12.2%	10.6%	8.1%
Wholesale Trade	4.5%	3.6%	5.9%	1.7%	4.7%
Retail Trade	13.9%	16.4%	12.6%	13.3%	14.1%
Transportation & Warehousing	3.8%	1.4%	3.5%	3.9%	4.1%
Information	7.3%	7.9%	7.0%	5.6%	7.6%
Finance & Insurance	4.6%	2.9%	3.8%	4.4%	5.0%
Real Estate & Rental & Leasing	1.8%	1.4%	2.8%	1.1%	1.7%
Professional, Scientific, & Technical Services	8.9%	12.1%	9.8%	10.6%	8.1%
Administrative & Support & Waste Management & Remediation Services	5.6%	5.0%	4.9%	7.8%	5.5%
Temporary Services	7.5%	13.6%	6.3%	12.2%	6.4%
Educational Services	6.4%	7.1%	8.0%	6.7%	5.9%
Health Care & Social Assistance	6.0%	5.0%	4.2%	5.6%	6.7%
Arts, Entertainment, & Recreation	1.8%	0.7%	1.0%	1.1%	2.2%
Accommodation & Food Services	6.3%	5.0%	5.2%	4.4%	6.9%
Other	3.7%	3.6%	1.4%	4.4%	4.2%
Public Administration	4.7%	1.4%	4.9%	2.8%	5.3%
Total IT-related Industry*	14.7%	17.9%	15.4%	13.3%	14.4%

*Includes NAICS codes for Computer and Software Wholesalers; Computer, Software, and Electronics Stores; Information; Computer Systems Design & Related Services; Computer & Office Machine Repair & Maintenance; Computer & Peripheral Equipment Manufacturing; and Computer Training. Some of these categories are counted under other categories.

4. Conclusion

IT students' employment experiences one year after completing their community college studies provide some insights on the role of community college preparation for IT workers. This analysis highlights the different IT educational outcomes available to IT students and how they relate to students' later employment outcomes. When controlling for a range of factors related to

employment, IT students' attainment of credentials and total credits earned have a positive and independent relationship with employment outcomes. This finding raises questions about the underlying reasons for these relationships, but reinforces the notion that community college education in IT is associated with positive employment outcomes for students. Based on students' employment patterns, employers appear to prefer students with greater community college education. Associate degrees and certificates together have the most value relative to those who complete concentrated IT coursework. This combination may have the combined value of indicating broad skill (via the associate degree) and more specific skill (via the certificate). Completing just an associate degree or just a certificate has similarly moderate value relative to those who complete concentrated IT coursework. They each may have partial value of general skill or specific skill but lack the strength of indicating both as when combined. Nevertheless, the finding that all types of subbaccalaureate credentials have higher employment outcomes than completing concentrated IT coursework underscores the importance of promoting credential completion. This finding provides evidence to support current efforts in community colleges to promote student completion of these credentials to promote greater success in the labor market.

Considering how IT students fit into the Washington labor market structures as a whole, IT students from the CTCs work for employers of a wide range of sizes. However, they are employed by middle-sized employers more frequently than the overall workforce. While they work in a range of industries, IT students are also more likely than other workers to be employed in IT-related industries, as well as temporary services and educational services. These findings raise questions about the implications of these differences in the industries of their employment, particularly the longer-term career implications of working in the temporary services industry.

Further research should examine the career progression of community college students who begin their post-community college employment with different types of employers, such as temporary placement agencies. However, these findings underscore the fact that certain employers a more likely to hire community college IT students, so community college IT program staff may target their employer outreach efforts differently. For example, they may target their placement efforts for their students with the kinds of employers who have been more likely to hire their students in the past. With employers who have not hired as many of their

students in the past, they may also seek to conduct outreach to understand these employers' needs and demonstrate to these employers the value of their programs.

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