ABSTRACT

COMINOLE, MELISSA BIBER. Employment Outcomes for Graduates of Washington State's Applied Baccalaureate Degree Programs. (Under the direction of Dr. Stephen R. Porter).

As of 2017, 24 states allow community colleges to confer bachelor's degrees, mostly in applied and technical fields. There are several reasons for allowing community colleges to confer bachelor's degrees; to improve access to baccalaureate education for students for whom a public four-year institution is geographically inaccessible, students who face challenges transferring credits to a four-year institution with an applied associate's degree, and those for whom the desired program is not offered by a public four-year institution. Community college bachelor's degrees also provide a more affordable option for obtaining a bachelor's degree. Critics contend that a bachelor's degree conferred by a community college will be of lesser quality than one conferred by a four-year institution, placing graduates at a disadvantage when they seek employment or graduate education. To date, no study has compared employment outcomes of students who graduated with a bachelor's degree from a community college with those who graduated from a four-year institution. Using longitudinal administrative data from Washington State, this study is the first to estimate the causal effect of earning a community college bachelor's degree in nursing or business administration with instrumental variables and fixed effects regressions. Results provide no evidence that community college bachelor's degree graduates suffer a penalty in short-term employment outcomes (employment status and median hourly wages) measured in the year after degree completion. Implications for research and policy are discussed.

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Employment Outcomes for Graduates of Washington State's Applied Baccalaureate Degree Programs

by
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DEDICATION

To Jeremy. Thank you for standing by me every step of the way. I love you. To Miranda and Jacob. May your futures be as bright as the light and love you bring to my heart every day. To my parents, who strive to continue learning every day, and have encouraged me to do so as well. To Halinka. You were a true inspiration and I will always be grateful for our times together. To the many Hidden Figures. And to all of those not given the opportunity.

BIOGRAPHY

Melissa Biber Cominole is a senior research associate at RTI International where she leads a large nationally representative longitudinal study of baccalaureate recipients. Since joining RTI in 1999, Melissa has worked in a range of research activities focused on postsecondary education. Melissa earned a bachelor's degree from Guilford College and a master's degree in Sociology from NCSU. She looks forward to putting these new PhD skills to good use.

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TABLE OF CONTENTS

LIST OF TABLES ..... **vii**

LIST OF FIGURES ..... **ix**

CHAPTER 1: INTRODUCTION **1**

Overview 1
Problem Statement 2
Purpose of Study 4
Research Questions 5
Data 6
Significance of the Study 6
Limitations 8
Summary 8

CHAPTER 2: LITERATURE REVIEW **10**

Introduction 10
The CCB Degree 12
The CCB Degree in Washington. 14
Rationale for the CCB Degree 15
Arguments Against the CCB Degree 17
Postbaccalaureate Employment Outcomes 22
Institution characteristics. 22
Measures of institution quality. 23
Estimation of institution effects. 26
Summary 30

CHAPTER 3: DATA AND METHODS **33**

Introduction 33
Data 33
Analysis Sample. 34
Variables 36
Outcome variables. 36
Treatment variable 45
Estimation with Instrumental Variables 53
Distance measures as instruments for college choice. 56
Summary of instrumental variables diagnostics. 79
Subgroup Analyses. 80
Estimation with fixed effects regression 80

CHAPTER 4: RESULTS **83**

Employed Within One Year of Graduation 83
Median Hourly Wages Within One Year of Graduation 89

Summary 103
CHAPTER 5: DISCUSSION 106
Summary of methods and findings 106
Discussion of Findings 107
Policy Implications 114
Implications for Research 117
Limitations 117
Future Research 120
Conclusions 123
REFERENCES 125
APPENDICES 145
APPENDIX A−Sample proposals for development of new CCB programs 146
APPENDIX B−Tables from PowerStats analyses of B&B:08/12 Data 155
APPENDIX C−Per capita income and inverse ratio, by year 158
APPENDIX D−Characteristics of Washington State, by county 162
APPENDIX E−Consumer Price Index Values for the West Urban Region, 2000-2015 165

LIST OF TABLES

Table 1 *Washington Applied Baccalaureate Degree Programs, CCB Institution, and Year of First Graduating Cohort (2009–2014)* 35

Table 2 *Descriptive Statistics for Analysis Sample, by Treatment Status* 38

Table 3 *Match Rates to Unemployment Insurance Data in Year After Graduation, Overall and by Field* 42

Table 4 *Number of Graduates by Institution, 2009–2014* *46*

Table 5 *Characteristics of Analysis Sample Institutions, by Institution Type* 49

Table 6 *Number of Graduates by Field of Study and Institution Type, 2009–2014* 50

Table 7 *Classification of Instructional Program (CIP) Definitions* 50

Table 8 *Description of Distance Measures Used to Assign Pre-College Location* 59

Table 9 *Descriptive Statistics for Analysis Sample, by Pre-college location* 60

Table 10 *Descriptive Statistics on Instrumental Variables, by Sample Type* 65

Table 11 *Correlations Between Treatment Status and Distance to Nearest Institution,* 66

Table 12 *2SLS First Stage Statistics for Year One Employment Status, By Field of Study and Sample Type* 68

Table 13 *2SLS First Stage Statistics for Year One Wages, By Field of Study and Sample Type* 69

Table 14 *Regression Results Predicting Distance Instruments by Covariates* 75

Table 15 *Characteristics of Washington Counties, by presence of CCB institutions* 78

Table 16 *Employed Within One Year of Graduation, OLS Regression Results* 86

Table 17 *Employed Within One Year of Graduation, IV Regression Results* 87

Table 18 *Wages for Nursing Majors Within One Year of Graduation, OLS Regression Results* 90

Table 19 *Wages for Business Majors Within One Year of Graduation, OLS Regression Results* 91

Table 20 *Wages for Nursing Majors Within One Year of Graduation, IV Regression Results* 93

Table 21 *Wages for Business Majors Within One Year of Graduation, IV Regression Results* 95

Table 22 *High School Subgroup Wages Within One Year of Graduation, OLS Regression Results* 97

Table 23 *Prior Employment Subgroup Wages Within One Year of Graduation, OLS Regression Results* 98

Table 24 *High School Subgroup Wages Within One Year of Graduation, IV Regression Results* 99

Table 25 *Prior Employment Subgroup Wages Within One Year of Graduation, IV Regression Results* 100

Table 26 *Wages Within One Year of Graduation, Fixed Effects Regression Results* 102

Table 27 *Summary of CCB effect on employment status, by field and estimation method* ... 104

Table 28 *Summary of CCB effect on wages for Nursing Majors, by estimation method* 104

Table 29 *Summary of CCB effect on wages for Business Administration Majors, by estimation method* 105

LIST OF FIGURES

Figure 1. States in which community colleges are authorized to confer bachelor's degrees (http://www.accbd.org/resources/baccalaureate-conferring-locations/). 13

Figure 2. Per capita income by county, 2014 (Office of Financial Management, 2014) 44

Figure 3. Predicted probability of graduating from a CCB institution, by distance to nearest institution 62

Figure 4. Map of Washington CCB and TBA institutions included in the analysis sample. Adapted from “Explore Our Colleges” retrieved from https://www.sbctc.edu/our-colleges/explore-colleges/default.aspx. 71

CHAPTER 1: INTRODUCTION

Overview

The need for increased access to and attainment of postsecondary credentials is one of the most common themes currently echoing throughout the higher education policy community. Changes in the global economy have prompted national and statewide goals to increase the number of residents with postsecondary education at all levels but particularly at the baccalaureate level ("Lumina Foundation Goal 2025," n.d.; Ruud & Bragg, 2013). Demand for educated workers has increased, and a bachelor's degree is now required for many occupations that previously required only an associate's degree or less (Carnevale & Rose, 2011). According to the Georgetown Center on Education and the Workforce, a shortage of workers with postsecondary credentials exists, and the U.S. should add an additional 15 million workers who hold a bachelor's degree (Carnevale & Rose, 2011, p. 8). However, significant challenges create barriers for increased postsecondary attainment, including the costs of obtaining a bachelor's degree, geographic access to institutions that provide baccalaureate education, and issues related to articulation for students wishing to transfer from a two-year institution.

In response to the demand for increased baccalaureate attainment, some states have adopted policies that allow community colleges to confer bachelor's degrees (CCB degrees) in certain high demand applied and technical fields. CCB degrees are applied baccalaureate degrees offered in fields such as nursing and allied health, business administration, education, and security ("Applied Baccalaureate Degrees," 2017; Floyd & Walker, 2009; Ruud & Bragg, 2013). CCB degree programs have been developed as a way to meet the needs of students by providing affordable access to baccalaureate education, particularly for

working adults and those who cannot move to attend college (Floyd & Walker, 2009; Fulton, 2015; Poliono & Goldstein, 2015). The CCB is also intended to meet the needs of the local community by providing the baccalaureate-level programming to fill local workforce needs (England-Siegerdt & Andreas, 2012; Floyd, 2005; Phelan, 2016). As of 2015, 23 states had adopted policies that authorize community colleges to confer bachelor's degrees (Fulton, 2015). Bringing the count to 24 in 2017, Ohio became the most recent state to allow bachelor's degrees to be conferred by community colleges with proposals to offer bachelor's degrees in manufacturing technology management and land surveying (Morris, 2017).

Problem Statement

Though the trend of allowing community colleges to confer bachelor's degrees is growing, some critics have expressed concerns, particularly about academic quality. If CCB degrees are actually of lesser quality or are perceived to be of lesser quality, then graduates may be negatively impacted when they enter the labor market.

Several arguments suggest reasons to suspect that a bachelor's degree conferred by a community college could not match the quality of a degree conferred by a four-year college (Eaton, 2005; Russell, 2013; Wattenbarger, 2000). Community colleges have not been designed to offer baccalaureate-level programming and have been offering baccalaureate-level programming for a relatively short time. West Virginia was the first state to allow a CCB in 1989 (Fulton, 2015), but Florida was the first to really implement the CCB in earnest beginning in 2001 (Floyd, Garcia Falconetti, & Felsher, 2012). Townsend (2005) suggested that CCB degrees would not provide a comparable level of rigor compared to a bachelor's degree from a 4-year institution. It has also been suggested that community colleges wishing to offer bachelor's degrees would have difficulty recruiting and retaining qualified faculty

(Daugherty, Goldman, Butterfield, & Miller, 2014; Levin, 2004; McKinney, Scicchitano, & Johns, 2013). The time and resources required to obtain and maintain accreditation could pose significant challenges to community colleges (Russell, 2013). Upgrading facilities, especially libraries, could prove difficult (Fulton, 2015; Russell, 2013). Some have voiced concerns about whether a community college could provide adequate programming for degrees heavy in liberal arts (Daugherty, Goldman, Butterfield, & Miller, 2014; Farnsworth, 2006; Russell, 2013). Despite the arguments against CCB degrees, there has been no empirical comparison of CCB graduates with those who graduated from a traditional 4-year baccalaureate granting (TBA) institution.

Though the aforementioned concerns are largely speculative, a large body of evidence suggests that institution type and quality are important to understand employment outcomes. Several studies of post-college employment outcomes have found that certain characteristics of institutions, including those that reflect student abilities, institutional resources, and instructional quality, are related to subsequent economic outcomes (Black & Smith, 2006; Dale & Krueger, 2002; Mayhew et al., 2016; Zhang, 2009). New research has extended the inquiry of institution type and employment outcomes to compare for-profit institutions with other institution types and has found differential outcomes by sector (Darolia, Koedel, Martorell, Wilson, & Perez-Arce, 2015; Deming, Yuchtman, Abulafi, Goldin, & Katz, 2016).

Descriptive studies of CCB programs have demonstrated growing enrollments, high rates of retention and completion, and high licensure pass rates (Floyd & St. Arnauld, 2007; Kaikkonen, 2013). Several qualitative studies indicate that employers have high regard for CCB degrees (Daugherty et al., 2014; Floyd & St. Arnauld, 2007; Grothe, 2009). Others have found that most CCB graduates are successfully finding employment after degree

completion and that earnings are higher after graduation. One comparative analysis of employment outcomes between CCB and TBA graduates in Florida showed that the CCB graduates in nursing, business administration, and education had higher postbaccalaureate earnings than their peers who graduated from a four-year college (Schneider, 2014). However, these results cannot be interpreted as causal effects because the study did not account for self-selection into choice of institution type. To date, no study has empirically demonstrated that CCB graduates do less well in the labor market than public four-year college graduates, leaving claims that CCB graduates will be at a disadvantage in the labor market unsubstantiated.

Purpose of Study

The purpose of this study was to measure and compare employment outcomes within one year after graduation between students who earned a bachelor's degree from a community college and those who graduated from a traditional 4-year baccalaureate granting institution, controlling for major. The idea is that employment rates and wages serve as a proxy for the value that the credential holds in the labor market; employers will be more likely to hire and offer higher wages to individuals whom they believe to have higher ability, skill, and productivity. It is possible that a degree awarded by a community college and one awarded by a public 4-year institution signal different levels of ability, skill, and potential productivity to potential employers.

Such a comparison is relatively straightforward. The methodological challenge lies in designing the research study in a way that minimizes selection bias, which arises as individuals make decisions about where to enroll in college and what to study and then where to work. If unobservable factors drive the aforementioned decisions and are associated with

employment outcomes, then the estimates of the effect of the institution type will be biased. This study will use an instrumental variables approach that exploits exogenous variation in proximity to public colleges that offer bachelor's degrees in fields that are available at both institution types to identify a valid comparison group.

Research Questions

The questions addressed by this study are:

1. Are employment rates one year after graduation comparable for CCB and TBA graduates?
2. Are earnings one year after graduation comparable for CCB and TBA graduates?

There are three possible outcome scenarios:

1. CCB critics contend that a bachelor's degree conferred by a community college will be of inferior quality to one conferred by a TBA. In this scenario, postbaccalaureate employment rates and wages would be lower for CCB graduates than for TBA graduates.
2. CCB supporters maintain that the CCB degree meets specific local workforce needs. Because employers often have established relationships with the community colleges, it is likely that they will view CCB degrees as having comparable value as TBA degrees. In this scenario, postbaccalaureate employment rates and wages will be comparable for graduates of the two institution types.
3. Another possible outcome scenario is that, for the reasons stated in (2) above, degrees will be perceived *more* positively than TBA degrees. If this is the

case, then it is possible that graduates will exhibit higher postbaccalaureate employment rates and wages.

Data

Washington was selected for this study because it was one of the earlier states to allow CCB degrees, approving a pilot study in 2005 and then in 2010 approving legislation to allow all community colleges to confer bachelor's degrees (Kaikkonen, 2015). Additionally, Washington has the second highest concentration of CCB offerings in the U.S. after Florida, with 17 colleges and 35 degree programs as of 2015 (Poliono & Goldstein, 2015, p. 45). Washington also maintains a longitudinal data system that links education and employment data, allowing the analysis of the effects of educational attainment on employment outcomes.

To examine the research questions, I obtained data from Washington State that includes information about college enrollment, degree completion, and employment for all baccalaureate recipients from a Washington public 2- or 4-year institution between 2007 and 2015. My analysis sample was limited to 6,610 individuals who graduated from a CCB or a non-selective TBA and majored in a field that was offered by both a CCB and TBA (business administration and nursing).

Significance of the Study

To date, there has been no rigorous comparison of employment outcomes between CCB and TBA graduates. This study draws upon existing literature regarding the relationship between institution quality and employment outcomes and applies a quasi-experimental method to the question of the effects of earning a bachelor's degree from a community college. This study uses geographic variation as instrumental variables to identify the effect of CCB receipt on employment outcomes. Furthermore, the analysis uses

longitudinal data from administrative sources (institution and employment records) that provide more complete and accurate measures of employment outcomes than would otherwise be obtained from self-reports through survey data. Both methodological features allow for estimation of the causal effect of the CCB with the most accurate data possible, thereby lending credibility to the findings.

This study contributes to the existing body of research about the relationships between institution characteristics and subsequent employment outcomes. Specifically, results from this study fill the gap regarding empirical evidence about outcomes of CCB graduates relative to their TBA peers.

In light of increasing demands for accountability and transparency on the part of institutions related to employment outcomes (Coughlin, Laguilles, Kelly, & Walters, 2016), this study's findings are relevant to questions about whether institutions are providing students with the knowledge and skills needed to succeed in the labor market. Information about post-graduation earnings can help inform prospective students' decisions about where to enroll and what to study. It can also help institutions make decisions about how to allocate resources and develop instructional programming. Furthermore, information about how CCB credentials are valued in the labor market will help states make decisions about how to allocate scarce resources for higher education to meet increasing demands for access, attainment, and accountability. The findings from this study will provide much-needed data for higher education policy makers as they decide whether to adopt and/or expand CCB policies to address unmet educational needs.

Limitations

This study used administrative data from Washington State to examine the relationship between institution type and postbaccalaureate employment outcomes. Though there are benefits to analyzing longitudinal administrative data, limitations must be acknowledged. Employment outcomes are measured with the state's unemployment insurance data, which does not contain data for graduates who moved to another state after graduation. In addition, a relatively small set of employer types is not required to submit data, so employment outcomes are unobservable for a portion of the analysis sample.

Results from this study are not necessarily generalizable to other contexts beyond Washington residents who graduated from a public college. Also, due to sample size limitations, final analyses focus on two majors: nursing and business administration. CCB degrees are being delivered in an increasing number of fields, and whether the results presented here extend to other fields is unknown.

Summary

In response to students' needs for increased access to baccalaureate education and employers' needs for educated workers with technical knowledge and skills, 24 states have authorized community colleges to confer bachelor's degrees in certain applied and technical fields. Very little is known about how CCB graduates fare in the labor market after earning a bachelor's degree that was conferred by a community college. This dissertation is the first to empirically test whether CCB degrees and TBA degrees hold the same market value in the workforce as determined by employment rates and wage rates one year after graduation. This study employs a quasi-experimental design to isolate the effect of the institution type, providing an answer to the question about the impact of a CCB degree on employment

outcomes for critics, supporters, and also for observers who may consider adopting a policy to allow CCB degrees.

CHAPTER 2: LITERATURE REVIEW

Introduction

The community college initially developed from a need to prepare a trained workforce and to expand access to higher education beyond secondary school (Cohen & Brawer, 2008). However, community colleges have added other functions that have been responsive to the needs of the local communities they serve. An extension of this responsiveness is the community college baccalaureate degree (CCB) in which a bachelor's degree requiring four years of study is conferred by a community college.

The CCB (often also referred to as an applied baccalaureate degree) is intended to increase access to baccalaureate education in communities with unmet need, especially working individuals, those with families, those in geographic locations where public four-year education is not accessible, and those generally underrepresented in higher education. The CCB provides a more affordable option than public four-year institutions (Floyd & Walker, 2009; Fulton, 2015). The CCB is also thought to provide a pathway for those with some college education to return and earn a bachelor's degree and, therefore, be an important tool to increase baccalaureate attainment.

The needs of local employers also play an important role in the justification for CCB degree implementation. As noted, CCB programs address "public demand for academic programs associated with professions such as health care and education—fields that flagship public research universities and many regional comprehensive four-year institutions tend to underserve" (Koch & Gardner, 2013, p. 185).

CCB programs comprise a small portion of baccalaureate programming overall (Floyd & Walker, 2009). However, recent trends suggest that they will continue to expand,

with additional states approving policy proposals to allow CCB degrees, including California in 2014 (Woods, 2015) and Ohio in 2017 (Morris, 2017). Furthermore, states with existing CCB programs are expanding their offerings to additional institutions and/or fields of study ("Washington State Board for Community and Technical Colleges," 2016).

Though intended to help states meet goals for increased levels of baccalaureate attainment, concern exists about the quality of the degree and the potential stigma that CCB graduates may face when they enter the labor market. However, no study compares outcomes of CCB and TBA graduates to empirically test whether a CCB holds the same value in the labor market. The purpose of this study is to compare employment outcomes between students who earned an applied baccalaureate degree that was conferred by a Washington State community college with students who earned a bachelor's degree from a public four-year college or university. Drawing upon research designs based on "natural experiments" (Angrist & Pischke, 2009; Dunning, 2012; Wooldridge, 2013,) this study exploits exogenous variation in proximity to institutions that confer degrees in selected fields to minimize the selection bias that often poses a threat to validity in studies of higher education and employment outcomes.

In this chapter, I review the literature regarding the CCB degree. I describe the purpose of the CCB degree and present information on where CCB programs have been implemented. I also describe the rationale for the development of CCB degree programs and a summary of arguments against the CCB. A description of the CCB in Washington State is also provided, along with a description of its specific higher education context. To frame the inquiry into the effects of earning a CCB on employment outcomes, I review research that has examined variation in postbaccalaureate employment outcomes as a function of the

characteristics of the degree-granting institutions. This review focuses not only on the mechanisms through which institution characteristics influence postbaccalaureate employment outcomes, but also on the methodological limitations that are often present when studying employment outcomes among college graduates. I conclude this literature review with a discussion of the gaps in existing research and the need for studying the correlates of the CCB and post-college employment outcomes.

The CCB Degree

The CCB degree is often referred to as a workforce or applied bachelor's degree because it is "designed in response to local, statewide, and national workforce needs and demands" (Floyd, 2012, p. 1) and is "…externally stimulated, guided, and evaluated…" (Walker & Floyd, 2005, p. 98). These degrees are generally offered in applied fields such as business, education, and nursing (Floyd et al., 2012). Community colleges are not conferring bachelor's degrees in liberal arts, nor are they intended to be a "substitute for what might be called a traditional college experience" (Hagan, 2015, p. 3).

The CCB degree is a bachelor's degree that is conferred solely by a community college (Floyd, 2005; Floyd & Walker, 2009; Townsend, 2005). The CCB is granted by the community college itself. The community college is not a secondary location of a university that grants the degree. The CCB degree is distinct from other delivery models (such as the university centers, articulation agreements, and university extension) in which the community college and university work together to provide baccalaureate education because in those instances, the university awards the degree (Floyd, 2005; Floyd & Walker, 2009; Townsend, 2005).

Figure 1 displays a map of the states in which community colleges have been authorized to confer bachelor's degrees and indicates the years in which the policy was adopted. There is wide variation in the number of institutions and programs in the states in which it is available. For example, Florida began offering CCB degrees in 2001 and currently has 175 bachelor's degree programs in 24 colleges (Poliono & Goldstein, 2015). Alternatively, in 2003, Texas began offering 7 degree programs through 4 institutions. California has the largest community college system in the country with 112 colleges serving 2.1 million students and passed legislation to allow a CCB in 2014 ("California Community College Chancellor's Office," 2014). Most states though have CCB programs in fewer than five institutions (Fulton, 2015), and Idaho has allowed CCB degrees since 1995 but has yet to implement one.

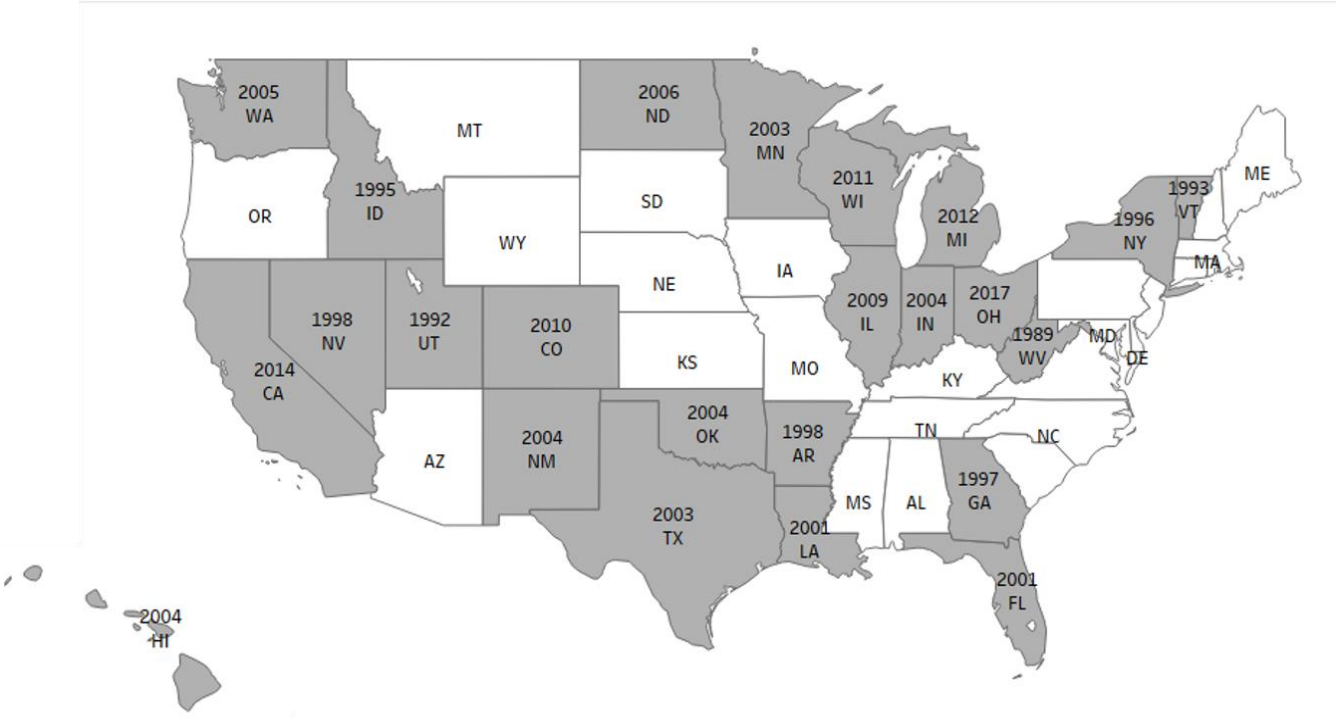

Figure 1. States in which community colleges are authorized to confer bachelor's degrees. Adapted from (Fulton, 2015; Morris, 2017).

The CCB Degree in Washington.

Washington has been offering applied baccalaureate degrees through its community colleges since 2005 when a pilot study was approved. In 2010, S.B. 6355 enabled all campuses to award bachelor's degrees (Fulton, 2015). By the end of the 2012-13 academic year, ten colleges have been approved to award applied baccalaureate degrees in 17 programs, and had enrolled about 475 full-time equivalents (Kaikkonen, 2013).

About 75% of Washington State's bachelor's degrees are produced by public institutions. In 2009-10, Washington led the nation in efficient completion among students who have enrolled (Washington Higher Education Coordinating Board, 2012, p. 29). But in the same year, the rate of bachelor's degree production was in the bottom third of states with 21.5 bachelor's degrees per 1,000 residents compared to the U.S. average of 26.1 (Washington Higher Education Coordinating Board, 2012, p. 50). Inadequate institutional capacity was cited as a major factor behind the lower production rate. This means that once Washington students enroll in college, they successfully complete their degrees. The challenge is getting students to enroll in the first place. Only about 65% of 17-18-year-olds enroll in college in the year after high school graduation, and half of these work while they are enrolled (Washington Higher Education Coordinating Board, 2012, p. 50). Less than one-third of Washington high school graduates earn a postsecondary credential by the age of 26, so the goal is to increase that to 70% by the year 2030 ("Washington Roundtable," 2016, p. 2).

Another specific issue for Washington the projected percentage of jobs that will require postsecondary education. Across the U.S. an average of 63% of jobs will require

some level of postsecondary training by 2018, but Washington is sixth with 67% (Georgetown University Center on Education and the Workforce, 2010, cited in Washington Higher Education Coordinating Board, 2012, p. 85). For instance, it has a concentration of aerospace, software, and biomedical industries, putting it near the top of the list among states in which jobs will require postsecondary education. Washington also ranked second in the 2008 State New Economy index, reflecting the high demand for workers with advanced technical skills (Spaulding, 2010, p. 1). Yet, the Washington education system is producing too few qualified candidates for jobs that require a postsecondary credential and "is overly reliant on importing educated workers from other states and countries" (Spaulding, 2010, p. 1).

The applied baccalaureate degrees offered in Washington are intended to help the state achieve the policy goals stated by Washington State Board for Community and Technical Colleges to: a) increase educational pathways for graduates with technical associate's degrees, b) increase the total number of bachelor's degrees awarded per year, and c) better serve employers by expanding the workforce mission of Washington community and technical colleges (Kaikkonen, 2015). Another important policy goal is to improve equity in educational access and increase diversity for the "workforce student population [that] is comprised of a large portion of people of color, older working, adults, and people (primarily women) who are place-bound with family responsibilities" (Kaikkonen, 2013, p. 1).

Rationale for the CCB Degree

Generally, the CCB degree has been developed as a response to the needs of communities and students. The CCB addresses needs of the community by increasing the

level of baccalaureate attainment to more adequately meet local workforce demand. To address the needs of students, the CCB is intended to:

> increase geographical, financial, and academic access to higher education; promote cost efficiencies by using existing infrastructure; support success among nontraditional or returning students through smaller classes, less rigid sequencing, and greater scheduling options; and respond to community needs for specialized programs. (Walker & Pendleton, 2013, p. 10)

Specifically, it is intended to improve access to baccalaureate education in applied fields, particularly for place-bound, nontraditional students (Daugherty et al., 2014; Fulton, 2015; Walker, 2001). However, the impetus for implementing the CCB is largely dependent on state context. In many cases, the challenge is geography; the public four-year college is not close enough to attend for individuals who are place-bound because they are employed or have a family. Another challenge is capacity; the public four-year college cannot serve the number of potential students or generate enough graduates to meet local workforce demands. Unmet employer demand for fields of study not offered by public four-year colleges and universities is an additional factor cited in the need for the CCB (England-Siegerdt & Andreas, 2012; Floyd & Walker, 2009; O'Connell, 2014).

Policies to allow CCB degrees are a response to the limited opportunities sometimes faced by students who wish to pursue a bachelor's degree. Geographic accessibility is one of the key challenges faced by many students, especially nontraditional students who may be place-bound because they are combining enrollment and employment while supporting families (England-Siegerdt & Andreas, 2012; Floyd & Walker, 2009; Fulton, 2015; Kaikkonen, 2013; Nicastro, 2014; Phelan, 2016). The CCB also provides a more affordable

option due to lower enrollment costs and savings from not paying for on-campus housing (Floyd & Walker, 2009; Nicastro, 2014; Walker, 2001). Community colleges are not only more geographically convenient for many students, but they also provide a different learning environment that is often smaller and less intimidating than a four-year college (Nicastro, 2014; O'Connell, 2014; Walker, 2001). Another benefit of the CCB is that it enables seamless transfer for students who have an applied associate's degree (Daugherty et al., 2014; Floyd & Walker, 2009; Ruud & Bragg, 2013).

Arguments Against the CCB Degree

The CCB is one way that the community college provides a pathway to a baccalaureate degree. However, there are other arrangements in which the community college partners with a four-year college to provide baccalaureate programming to community college students. These include articulation models, university extension models, and university center models (Floyd et al., 2012; Ruud & Bragg, 2013). Critics maintain that these other policy models are "well established and less controversial" (Russell, 2013, p. 68) and that strengthening other arrangements between community colleges and four-year colleges would be a better solution (Wattenbarger, 2000). However, when the decision is made to allow CCB degrees, it is "rarely the first response" (Russell, 2013, p. 70), suggesting that the policy has been proposed because the other models have not achieved the desired outcome.

Furthermore, the CCB may lead to competition with four-year colleges and unnecessarily duplicate efforts (Daugherty, Goldman, Butterfield, & Miller, 2014; O'Connell, 2014; Russell, 2013). Competition with 4-year institutions for student enrollment is a concern, but there is no evidence that CCB implementation negatively affects

enrollments at nearby four-year institutions (Daugherty et al., 2014; Floyd & Walker, 2009; Neuhard, 2013).

Community colleges are historically known for their curricular functions of providing academic transfer, technical education, continuing education, developmental education, and community service (Cohen & Brawer, 2008). Opponents contend that the CCB poses a threat to the traditional mission of community colleges and detracts from the core community college functions such as open access education, awarding associate's degrees for workforce training and academic transfer, remedial and developmental education, and workforce preparation (Eaton, 2005; Farnsworth, 2006; Levin, 2004). Thus, the CCB may divert resources away from community college students who do not intend to earn a bachelor's degree (Farnsworth, 2006; Levin, 2004; Wagoner & Ayon, 2012).

Many of the aforementioned concerns have been addressed in the requirements for approval to develop a CCB program. Specific requirements vary by state, but most include stipulations that require demonstration of need (local workforce demands, limited baccalaureate offerings), stakeholders' interest in CCB degree programs (employers, faculty, and students), and capacity to deliver baccalaureate programming. Community colleges that wish to develop a CCB are often required to communicate with local four-year colleges to offer "right of refusal" to provide the requested programming.

As an illustration of the steps that must be taken to request approval, Appendix A presents an excerpt of the proposals that were submitted to the Washington State Board for Community and Technical Colleges in September 2016 for consideration of new CCB programs. Appendix A also presents a list that documents the status of Washington CCB

programs by college, major, implementation status, number of graduates, and full-time equivalent enrollment counts for 2015/16.

Though some concerns can be addressed proactively through scope-limitations and approval process requirements, others must be assessed through empirical evaluation. One of the primary concerns about the CCB relates to quality—the rigor of the program, the quality of the faculty, and the quality of the students. Critics allege that graduates of CCB programs will have earned an inferior degree (Russell, 2013; Wattenbarger, 2000), that CCB programs will be less rigorous than baccalaureate programs at 4-year institutions (Russell, 2013), and that CCB programs will have difficulty recruiting and retaining qualified faculty (Wattenbarger, 2000). Some have questioned whether applied bachelor's degrees will articulate to graduate programs for students who wish to pursue additional graduate education (Daugherty et al., 2014; Eaton, 2005; Floyd et al., 2012; Nicastro, 2014; Wattenbarger, 2000).

In most cases, CCB degrees have the same educational requirements as TBA degrees (Daugherty et al., 2014; Floyd & Walker, 2009). Aside from the actual quality of the degree, there is a concern that a CCB will lack the perceived quality as one conferred by a four-year institution (Levin, 2004; Skolnik & Floyd, 2005; Townsend, 2005). Even if the CCB is academically comparable, it is possible that perceptions about CCB quality (e.g. a signaling effect) might have a negative impact on employment outcomes. Unfortunately, there has been little empirical examination of CCB graduates' postbaccalaureate outcomes, most of which suggest equivalence in quality to degrees granted by traditional institutions. A qualitative study based on three CCB institutions in different locations found that graduates felt that they had been well prepared by the CCB programs. Perceptions of the employers

interviewed also indicated that CCB graduates had attained the technical and nontechnical skills needed to meet employer demand.

According to surveys conducted with faculty and administrators from 10 community colleges in Florida about baccalaureate teacher education programs across six states, licensure pass rates and employment rates among graduates of CCB teacher education programs have been comparable to those of TBA graduates (Floyd & St. Arnauld, 2007, p. 79). Surveys conducted with key stakeholders in Texas showed that, despite the expressed concerns of four-year colleges about the quality of a CCB degree, employers conveyed no preference for the type of institution that conferred the degree. Employers also "reported strong positive feeling about their local community colleges and said that they would definitely hire graduates if a baccalaureate program were developed" (Daugherty et al., 2014, p. 76).

Washington State has prepared reports on the postbaccalaureate outcomes for CCB graduates but does not compare them with TBA graduates (Kaikkonen, 2013). According to a descriptive evaluation, students who enrolled in CCB programs had an employment rate of 82% seven quarters after graduating with median earnings of $32,253 (Kaikkonen, 2013). Furthermore, within seven quarters after graduation, earnings increased by about 26% among Washington CCB graduates who were working at the time of graduation and for whom pre- and post-enrollment wage data were available (Kaikkonen, 2013). Another report estimated the returns-to-earnings for a CCB relative to an associate's degree in the same applied field using a matching method. This report found that applied baccalaureate students had higher earnings (with an average difference of $3,700 to $27,000 annually depending upon the program) than associate's degree graduates (Kaikkonen, 2015, p. 2).

To date, only a single analysis of Florida graduates has compared the employment outcomes between CCB and TBA graduates (Schneider, 2014). Schneider reports that, based on earnings one year after graduation, CCB graduates do as well as their peers who attended a four-year college and usually paid far less for their education (Schneider, 2014). Specifically, CCB graduates in business administration earned about $3,000 more than their TBA peers ($39,000 vs $36,000), CCB nursing graduates earned $10,000 more than TBA nursing graduates ($61,000 vs $51,000), and CCB teaching graduates earned about $500 more ($37,500 vs $37,000). These results reflect positively on CCB outcomes; however, they are descriptive and cannot be interpreted as causal effects.

To summarize, the CCB is intended to make baccalaureate education more accessible to students and to meet specific workforce needs by increasing baccalaureate attainment in high-need fields. Despite the need to increase baccalaureate attainment, there is concern that a CCB degree will not be viewed as highly as a TBA degree because the degree conferred by the community college might be of lesser quality.

While CCB and TBA postbaccalaureate outcomes have not been rigorously compared, there is a large body of literature that has studied institution effects in other postsecondary contexts. Several studies have compared postbaccalaureate outcomes between four-year colleges by measures of institution quality. Additionally, a recent study identified a set of institutional characteristics that are associated with employment outcomes for community college students. Other studies have compared outcomes by institution sector, comparing for-profit and public institutions. Such studies can help frame the analysis of the effects of the CCB institution type and will be discussed in the next section.

Postbaccalaureate Employment Outcomes

The relationship between postsecondary education and subsequent labor market outcomes has been studied extensively. It is well established that the amount of schooling and level of attainment are important determinants of employment outcomes (Baum, Kurose, & Ma, 2013; Card, 1993; Card, 2001; Carnevale & Rose, 2011). Another key determinant of employment outcomes is field of study (Abel, Deitz, & Su, 2014; Carnevale, Cheah, & Hanson, 2015; Gelblum, 2014). Institution characteristics also help explain variation in employment outcomes (Baum et al., 2013; Black & Smith, 2006; Eide, Hilmer, & Showalter, 2016; Kalleberg & Dunn, 2014; Scott-Clayton, 2016; Zhang, 2009). Results from research on the relationships between institution type, quality, and characteristics provide evidence that employment outcomes differ by various institution characteristics. The next section reviews the research on the effects of institution characteristics on employment outcomes and provides context for whether and how CCB outcomes might differ from TBA outcomes.

Institution characteristics. Employment outcomes have been shown to vary by institution characteristics (e.g. sector, selectivity). How institution characteristics affect employment outcomes is not entirely clear. One possible explanation is that "better" institutions provide a better-quality education, thereby increasing human capital, so that the graduate is more productive (Baum et al., 2013; Bills, 2003; Zhang, 2009). Another possible explanation is that the quality of an institution is a proxy for the ability of the individual—where higher ability students are admitted to higher quality schools (Baum et al., 2013; Doyle & Skinner, 2016; Zhang, 2009). It is also possible that the underlying mechanism reflects a combination of the human capital and signaling effects.

> If college graduates were not more productive than others, the earnings and employment differentials by education level would not persist. Higher education credentials do operate as a positive signal to employers. The evidence is strong that the education behind those credentials also improves the thought processes and capabilities of students. (Baum et al., 2013, p. 41)

Studies that compared graduates with the same level of attainment and the same major have shown that the quality of institution can impact employment outcomes. Results are mixed but generally show that graduating from a higher quality institution is associated with higher earnings (Black & Smith, 2006; Eide et al., 2016; Hoekstra, 2009; Kalleberg & Dunn, 2014). However, two important methodological issues should be considered when interpreting the reported results of institution effects. The observed effects of institution characteristics depend on how institution effects are measured and how the effects are estimated.

Measures of institution quality. Prior studies that examine employment outcomes by institution quality use different definitions. Many studies use institution selectivity as a single proxy for institution quality (see Black & Smith, 2006, for a review). Selectivity is an institution-level index that reflects college admission rates relative to the number of applicants and average scores on college admissions tests for entering students. Other studies have examined average test scores and tuition to capture additional components of institutional quality (Dale & Krueger, 2002). Still other studies of institution effects employ multiple measures of college quality. Black and Smith (2006) include the faculty-student ratio, the rejection rate among those who applied for admission, the freshman retention rate, the mean SAT score of the entering class, and mean faculty salaries (Black & Smith, 2006).

The authors suggest that studies that rely on a single measure of quality may underestimate the institution effect on outcomes. A review of studies that estimated causal effects of postsecondary education on employment and earnings (Mayhew et al., 2016) found that college quality consistently had positive effects on earnings when multiple quality measures were used.

Estimating the value added by institutions is another approach for measuring institution quality. A study based on the 1993/97 Baccalaureate and Beyond Longitudinal study estimated the average quality of state four-year public college systems as measured by the value added to individual earnings (Zhang, 2009). After controlling for individual characteristics, Zhang (2009) found that measures of faculty quality (salary, faculty-student ratio) and measures of expenditures and resource allocation were influential for postbaccalaureate earnings.

The measures mentioned above largely reflect indicators for four-year institutions and may not be applicable to CCB programs. Because community colleges provide open access programming, the four-year selectivity metrics are generally not required by community colleges for admission and are not appropriate for comparison between the institution types. However, research on community college graduates has identified characteristics of public two-year colleges that are associated with employment outcomes. Kalleberg and Dunn (2014) "conceptualize institutional factors in terms of characteristics of the labor market and areas served by the community college, as well as features of the colleges themselves, such as their size, financial resources, demographic characteristics, and instructional portfolios" (p. 2). In their study of North Carolina community college students, they find that, after

controlling for individual student characteristics, certain institution characteristics are related to earnings[1].

Some of the institution characteristics associated with subsequent earnings relate to the composition of the student body. For instance, earnings were higher among students who attended community colleges with larger enrollments, which may reflect availability of greater resources. Earnings were negatively associated with transfer rates, possibly signaling an effect of resource allocation that focuses more heavily on the transfer function and less on workforce-specific programming. Students who attended a community college with a relatively high ratio of applied courses compared to academic courses earned more. Lower earnings were found among students who attended community colleges with relatively high proportions of non-high school completers, indicating possible peer effects (Kalleberg & Dunn, 2014).

Also important were characteristics of the college's service area and the local labor market in which the community college is located. Students who attended a community college that served just one county earned more than students who attended a community college that served more than one county, perhaps indicating that single-county service schools are able to tailor their curricular offerings more specifically to local workforce demands. Earnings were higher in areas with lower unemployment, suggesting that employment opportunities may be higher in areas with lower unemployment. Population density was also examined and was negatively correlated with earnings, though the effect was not statistically significant. The authors speculate that more densely populated areas

[1] Analyses were conducted separately by gender and sometimes the effects were significant for men but not women, or vice versa. In most cases, however, the effect was in the same direction so combined results are summarized here.

have more employment opportunities but may also have greater competition for those opportunities (Kalleberg & Dunn, 2014).

A Brookings report based on government and private data (LinkedIn, PayScale) proposed a method to estimate institution value added based on a set of metrics that reflect institution quality for two- and four-year colleges. This report found that post-college economic outcomes were related to a college's curricular offerings, alumni skills, institution completion rates, and the amount of financial support provided by the institution (Rothwell & Kulkarni, 2015, p. 1-2).

This review shows that, above and beyond individual characteristics, employment outcomes are related to the type of institution attended. In light of the evidence regarding institution effects, this research area should be extended to examine the effects of earning a CCB on employment outcomes.

Estimation of institution effects. Research on the effects of institution characteristics on post-college outcomes is vulnerable to bias due to differential selection. Observing all relevant factors related to the outcomes is difficult, and to the extent that important factors are unmeasured, estimates of treatment effects will be biased. Studies regarding education and employment are particularly challenging because students sort into colleges, majors, and employment, and it is possible that outcomes vary by unobservable factors related to the sorting.

Research designs address this selection bias to varying degrees, and the resulting estimates can be sensitive to the analytic approach. Using nationally representative data from the 1993-2003 Baccalaureate and Beyond Longitudinal Study, Eide et al. (2016) conducted a descriptive analysis of postbaccalaureate earnings by institution selectivity and field of study.

Controlling for a rich set of individual characteristics, they found that earnings were higher for students who graduated from more selective colleges. Within-major earnings varied by selectivity most among business majors and were the most stable within STEM majors. The authors speculate that the curriculum in STEM fields may be more standardized and that earnings for business majors may also be influenced by other factors such as alumni networks and more variation in curriculum (Eide et al., 2016). However, the results of this study cannot be interpreted as causal.

Other studies use research designs that enable the estimation of causality. For instance, Dale and Kreuger (2002) examined the effect of selectivity as measured by SAT scores. They created a comparison group for students who attended a selective institution by identifying students who had applied and been accepted to the selective institution but ultimately enrolled at a less selective institution. Results showed that, after matching on ability (as measured by SAT scores just above and just below the cut-point), earnings did not differ for students who attended the less selective institution overall, though there was a positive effect of selectivity on earnings among students from low-income families. This study also found that earnings varied by tuition, suggesting that higher tuition schools may devote more resources to instruction or other student services that positively impact employment outcomes (Dale & Krueger, 2002).

Using a discontinuity design, Hoekstra (2009) used admissions data to compare earnings between students who attended a state's most selective flagship institution with the earnings of other students who had applied but were not admitted because their admissions test score (SAT) fell below the admission threshold. Comparing flagship graduates with those whose score was just below the required cut-point created a comparison group that was

similar in terms of measured ability but attended a less selective institution. With this analytic strategy, Hoekstra (2009) found that postbaccalaureate earnings were 20% higher for white men who attended the flagship institution.

The research described above reveals that, above and beyond individual characteristics and field of study, institution characteristics are important for understanding post-college employment outcomes. The nature and size of the institution effect is dependent upon how institution characteristics are measured and the estimation strategy. The institution characteristics that matter include elements of the student body that capture information about the abilities of individuals and elements of the institution that reflect institutional resources and academic priorities. Estimates based on multiple measures of quality are preferable to single quality measures (e.g. a selectivity score). For both public two- and four-year colleges, higher earnings are associated with institutions that enroll students with higher ability and with institutions that have greater resources to devote to faculty pay, instructional priorities, and financial aid. Understanding how institution characteristics relate to employment in these contexts can provide guidance for understanding the ways in which CCB and TBA institutions may be comparable and the ways that they may differ. CCB and TBA degree programs may differ in terms of the key characteristics that have been shown to influence employment outcomes in other postsecondary contexts, but this has yet to be examined.

Comparisons between for-profit and public institutions may be the most analogous to an examination of CCB and TBA outcomes. Compared to traditional two- and four-year colleges, both for-profit and CCB institutions are relatively new to the higher education landscape, and both provide an unconventional alternative path to an existing credential

through a different institution type. Two recent experimental studies analyzed the impact of institution sector and selectivity on employer callback rates for interviews with randomized resume studies. The research design held individual characteristics constant and varied only the institution type.

One of the studies compared results for business and health majors across 1) for-profit and public institutions, 2) for-profit online programs with for-profit colleges with a local brick-and-mortar presence, and 3) more selective public colleges with public less selective colleges (Deming et al., 2016). They found that, compared to public college graduates, callback rates were lower for graduates of for-profit institutions by about 22% among business majors and about 57% lower among health majors. However, there was no difference in callback rates for health majors by sector in cases when an external credential such as an occupational license was required. The authors surmise that "employers view for-profit postsecondary credentials as a negative signal of applicant quality, particularly when objective measures of quality such as a licensing exam are unavailable" (Deming et al., 2016, p. 780). Further, the observed differences in callback rates were correlated with measures of school quality, such as completion rates and institution expenditures, suggesting that these quality measures drive the observed differences more than the institution type itself. Whether employers were reacting to the perceived quality of the institution per-se or to the characteristics of students that often attend for-profit institutions is unclear. It has been shown that students who attended for-profit colleges are more disadvantaged than students at public colleges on characteristics that could also be correlated with productivity (Deming, Goldin, & Katz, 2013).

The other study examined callback rates across six occupational categories. Two comparisons were made between students who had attended 1) for-profit colleges and public community colleges and 2) for-profit colleges with students who had not attended college to assess whether some students attended a for-profit college who otherwise would not have enrolled (Darolia et al., 2015). This study found that there was not a significant difference between for-profit and public colleges in callback rates, though the estimates suggested a negative relationship. Further, little evidence existed of a positive effect of attending a for-profit college over no college. Darolia et al. (2015) notes that their estimated effects do not account for any effect from variation in the quality of a college's job-placement services.

Summary

This chapter has defined and described the CCB degree. The CCB, now allowed in over 20 states, is an option to increase access to baccalaureate education in applied fields to meet specific workforce needs. The CCB enables states to improve access to baccalaureate education, especially for nontraditional students who are often working adults and have difficulty attending a college that is not geographically accessible. Another key goal of the CCB is to provide the knowledge and skills needed to meet the increasing demand for baccalaureate-educated workers in technical fields.

Critics have argued that the CCB will be inferior to a bachelor's degree conferred by a four-year college or university, but this has yet to be tested empirically. Experimental studies of institution type comparing for-profit and public institutions have found evidence that institution type sends a differential signal of quality such that an applicant with a for-profit credential is less attractive to prospective employers than an identical applicant with a credential from a public institution. Such a finding opens the possibility that a CCB

credential would be viewed negatively compared to the same credential from a TBA institution.

Prior studies regarding measures of quality at both two- and four-year institutions and their effects on employment outcomes have identified characteristics associated with earnings. In both two- and four-year colleges, characteristics related to the amount and allocation of resources, curricular functions and priorities, and the makeup of the student body are shown to relate to employment outcomes even after controlling for selection bias. Based on findings from analyses of institution quality effects in other postsecondary contexts, it is not unreasonable to question whether CCB programs differ from TBA programs in ways that could negatively impact employment outcomes. However, concerns that the CCB would lead to limited or lower-level outcomes have not been explored by the scant research conducted so far.

Regarding the quality of CCB programs, it is important to note that they have undergone a rigorous vetting process. Prior to implementation, community colleges wishing to confer bachelor's degrees must have demonstrated a) local unmet need, b) that the college has the capacity to provide the required level of programming, c) that local employers are interested in hiring future graduates, and d) that potential students are interested in enrolling in a CCB program. One of the hallmarks of community colleges is their ability to adapt and respond to the needs of the community. Community colleges often have well-established relationships with the members of the local workforce. In fact, many CCB programs have been developed as a result of employer requests, which suggests that employers would not perceive CCB degrees to be of inadequate quality. One way to assess whether CCB degrees

are comparable to TBA degrees is to compare employment outcomes for graduates of the two institution types.

Given the importance of institution quality measures as shown in prior research with other institution types and the lack of evidence regarding CCB quality, empirical evaluation is warranted. This study provides a direct comparison of employment outcomes for CCB graduates with their counterparts who graduated from four-year colleges with the same major. The findings of this analysis will have implications for higher education policy. Evidence regarding the perceived value of a CCB in the labor market can inform decisions about whether to implement new CCB programs or expand existing CCB offerings. Furthermore, this study is the first to employ a quasi-experimental methodology to address the selection bias inherent in analyses that involve college choice as applied to the CCB.

CHAPTER 3: DATA AND METHODS

Introduction

The purpose of this study is to examine employment outcomes of students who earned an applied baccalaureate degree that was conferred by a community college (hereafter referred to as CCB institutions) to determine whether they fare as well in the labor market as their counterparts who graduated from a traditional 4-year college (hereafter referred to as TBA institutions). Instrumental variables were used to address the endogeneity of selection into institution type. I obtained data from Washington State to compare postbaccalaureate employment experiences for about 6,610[2] students who graduated with a bachelor's degree in selected fields between 2009 and 2014. In this chapter, I describe the data source, analysis sample, and variable definitions. I then discuss the instrumental variables estimation strategy, the associated assumptions, and issues of validity.

Data

The Washington State Education Research and Data Center maintains a state longitudinal data system that follows students from preschool through secondary and postsecondary education and into the workforce. These longitudinal data combine information on public high school completions from the Office of Superintendent of Public Instruction, postsecondary enrollment, completions data from the State Board for Community and Technical Colleges, the Public Centralized Higher Education Enrollment System, and quarterly wages from the state's unemployment insurance database.

[2] Counts have been rounded to the nearest 10.

Analysis Sample. From the postsecondary data system, the Washington State Education Research and Data Center created a student-level file containing data on college enrollment and completions for approximately 165,000 students who earned a bachelor's degree from Washington State public 2- and 4-year institutions between 2007 and 2015. The Washington State Education Research and Data Center then matched the college enrollment and completions data file with the other data sources to obtain available information for each baccalaureate recipient on high school completion and employment data.

The first Washington CCB degrees were awarded in 2009. The most recent wage data available are through 2015, so individuals who graduated after 2014 are excluded to allow for observation of outcomes one year after degree completion. Among the analysis sample, about 280 TBA graduates (just under 5%) and fewer than ten CCB graduates (less than 2%) earned more than one bachelor's degree between 2009 and 2014. In such instances, I retained the first completion for analysis purposes. The final analysis sample includes graduates in Business Administration and Nursing from institutions that offered face-to-face programming[3] at both community colleges and minimally or moderately selective[4] public four-year colleges during the study period. Other majors were offered at both institution types during the study period (e.g. Hospitality Administration, Interior Design); however, there are not yet enough graduates to support analysis of these other fields at this time.

Table 1 presents the community colleges in Washington that were authorized to confer CCB during the study period (2009−2014), the year in which they began offering

[3] Programs that were delivered exclusively online were excluded. The Business Administration and Hospitality Administration programs through Washington State University were only available through online programming and served students in all WSU branch campuses.

[4] To maximize comparability across institution types, graduates from the most selective public institution (University of Washington – Seattle Campus) were excluded.

CCB degrees, and the majors in which the CCB degrees were available. To be included in the analysis sample, the majors offered at a CCB institution must have had one or more comparison TBA institutions that were minimally or moderately selective, did not offer the program solely online, and had enough graduates to support statistical multivariate analysis.

Table 1

Washington Applied Baccalaureate Degree Programs, CCB Institution, and Year of First Graduating Cohort (2009–2014)

Bachelor's Degree Program	CCB Institution	First Graduating Cohort
Business Administration	Peninsula College	2009
	Columbia Basin College	2011
Nursing	Olympic College	2009

The sample was further restricted to exclude out-of-state students and students who attended private institutions. One of the primary aims of the CCB degree is to make baccalaureate education more accessible to students who need convenience and affordability, especially nontraditional students and those who are place bound. Students who attend out-of-state institutions and students who enroll in private institutions are generally less constrained by affordability and location when deciding where to attend college. About 490 cases were excluded because there was no available data regarding their pre-college location. The final analysis sample includes 6,610 students who earned a bachelor's degree in business administration or nursing from a public two- or four-year institution between 2009 and 2014.

Descriptive statistics for the analysis sample are presented in Table 2. Results are shown overall and for TBA and CCB graduates. Relative to TBA graduates, CCB graduates are older with average age at time of bachelor's degree completion of 36 compared to 28 for TBA graduates. CCB graduates have approximately one more year of employment prior to

enrolling, averaging about 33 quarters compared to TBA graduates who have about 28 pre-enrollment quarters of employment. Graduates from the two institution types also differ in terms of reported race and ethnicity. Examining the pre-college county locations shows that CCB graduates tend to be from counties with lower median household income, more poverty, more unemployment, and that are less densely populated.

Variables

Outcome variables. Postbaccalaureate employment outcome measures were obtained from Washington unemployment insurance data, which are reported by employers to the state each quarter. The primary use for unemployment insurance data is in the administration of unemployment benefits, but these data are also a valuable source in studies of employment outcomes. Unemployment insurance data provide an objective and accurate source of wage information (Feldbaum & Harmon, 2013; King & Schexnayder, 1999; Radwin & Horn, 2014; Rassen, Booth, Falk, & Wyner, 2013). Alternatively, wage data collected through surveys may be inaccurate or missing due to recall, social desirability bias, or nondisclosure due to privacy concerns (Kreuter, Presser, & Tourangeau, 2008). Researchers interested in post-college employment outcomes increasingly match unemployment insurance data to cohorts of former college students to study the relationship between postsecondary education and employment (Andrews et al., 2012; Gelblum, 2014; Hoekstra, 2009; Kalleberg & Dunn, 2014; Neild & Boccanfuso, 2010; and Schneider, 2014 are a few examples).

Though the presence of information in the unemployment insurance data confirms employment, the converse is not the case. Individuals who are not employed, either due to unemployment or because they are not seeking employment, will not have a record in the

unemployment insurance files. However, an individual could be employed and not be represented in the unemployment insurance data due to the type of employer, the location of the employer, or because of missing or erroneous data in the elements used for file linking (e.g. personally identifying information). First, the unemployment insurance files for a given state generally only include information on individuals employed in that state; therefore, individuals who work for employers in another state are not represented. Though there are some data sharing agreements between states, these data are not always available to researchers. Second, unemployment insurance data are available for a large but incomplete portion of employed individuals because certain categories of employers including self-employed workers, farmers, and individuals employed by a federal agency are not required to report to the unemployment insurance database. In the Washington unemployment insurance files, about 97% of non-farm employees are covered (Education Research and Data Center, 2012). Finally, it is also possible that individuals are not included in unemployment insurance files because the match key information is unavailable (e.g. due to missing Social Security number or name change).

Table 2

Descriptive Statistics for Analysis Sample, by Treatment Status

	Mean			*t*-test	
	Full sample	TBA	CCB		
Student Characteristics					
Age at bachelor's degree completion	28.6	28.2	36.0	-15.7	***
Number of quarters employed before enrolling	28.4	28.2	33.1	-8.0	***
High School GPA	3.4	3.4	3.2	2.7	***
Percent Female	62.0	62.0	66.0	-1.4	
Percent American Indian	3.0	3.0	3.0	0.1	
Percent Asian	14.0	15.0	6.0	3.9	***
Percent Black	4.0	4.0	3.0	1.5	
Percent White	68.0	68.0	72.0	-1.4	
Percent Hispanic	6.0	6.0	11.0	-3.5	***
Characteristics of pre-college county					
2014 Median household income	$ 57,760	$ 57,930	$ 54,050	10.0	***
2014 Population Density	299.3	303.5	207.4	1.4	
2014 Percent in poverty, all ages	12.4	12.4	12.1	-4.6	***
Unemployment averaged over 2009-2015	7.7	7.6	8.1	5.6	***
N	6,610	6,330	280		

Note. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Therefore, the employment status can be confirmed if an individual has a record in the unemployment insurance data, but the set of individuals who are not in the unemployment insurance data include those who are unemployed, out of the labor force (not working and not looking for work), working for an employer that is not required to report to the state unemployment insurance data, and those who work in another state. There is no way to definitively identify the status of those not in the unemployment insurance data. However, information from other studies that have used unemployment insurance data to examine the relationship between postsecondary education and employment outcomes can inform the assessment of data coverage. Estimates of unemployment insurance coverage rates among the general population— that is, the extent to which individuals who are employed are represented in unemployment insurance files—are generally upwards of 90% (Connecticut Board of Regents, 2014; Feldbaum & Harmon, 2013; Schneider, 2014b). This suggests that the portion of employment that is not observable in unemployment insurance data is relatively small.

Though the match rates described above indicated that coverage is good, looking at former college students provides a different perspective. Coverage rates among college students could be affected by migration as graduates move to other stages after college and may differ by institution type, student type, and major (Cunha & Miller, 2014; Groen, 2004; Ishtani, 2011). For instance, students who attended private universities were more likely to move away than graduates of public universities (Groen, 2004). Examining national data, Ishtani (2011) found that graduates of highly selective institutions were more likely to move to another state and that graduates of institutions located in large cities were less likely to move away. Furthermore, a survey of former students from Washington community and

technical colleges found that, among those who did not appear in the unemployment insurance data, about 30% reported that they were employed (The Washington State Board for Community and Technical Colleges, 2014).

Employment status. Employment status was measured in the four quarters after graduation. Employment status was set to equal 1 if wages were reported in any of quarters 1-4. As described above, the presence of unemployment insurance data indicates employment, but lack of unemployment insurance data does not indicate unemployment. The resulting value is not a true employment rate but rather a measure of employment in covered occupations. To allow for estimation of participation in covered occupations, employment status was assigned one of two values: "Employed by a covered employer" and "Not employed by a covered employer" since there is no way to determine the status for this group.

According to the above definition, I calculated that about 88% of the 6,610 individuals in the analysis cohort matched with the Washington unemployment insurance data, indicating that they were employed (by a Washington employer in covered employment) at some time in the first year after degree completion. I then reviewed the reported unemployment insurance match rates in other studies of post-college employment outcomes among former students to assess whether the Washington sample match rate is consistent with that found in other states. About 60% of 2009/10 graduates of Ohio State University – Main Campus were found in the state unemployment insurance database after graduation (The Central Ohio Compact, 2014). Among graduates of Connecticut State Universities, about 75% were employed in Connecticut in the first and third quarters after graduation. About 50% of Charter Oak State College were employed in Connecticut;

however, Charter Oak State College is an entirely online program, so its graduates may be residents of other states (Connecticut Board of Regents, 2014).

In addition to the state-level comparisons, I reviewed the 2008/12 Baccalaureate and Beyond Longitudinal Study (B&B:08/12), which is a nationally representative study of college graduates who completed a bachelor's degree between July 1, 2007, and June 30, 2008 (National Center for Education Statistics, 2012). Appendix B presents the tables that generated the estimates using B&B data. Approximately one year after college graduation:

- about 7% of the sample was out of the labor force - that is, not working and not looking for work,
- about 9% of the sample was unemployed, and
- about 20% of the sample was self-employed, in the military, or employed by a local, state, or federal government agency.

The estimates mentioned above suggest that about 35% of the B&B:08 cohort would fall into a scenario that would not be captured by unemployment insurance data. If the B&B:08 cohort was matched to unemployment insurance files, approximately 65% would likely have records in the unemployment insurance files. Among the 80% of the B&B:08 cohort that was employed one year after graduation whose employer type is likely covered by the unemployment insurance data, the rate varied by field of study. For instance, about 87% of graduates who majored in business or a health care field were employed by a "likely covered" employer type. Though these comparisons provide only a rough approximation, the results from the other states and the B&B:08 cohort indicate that the unemployment insurance match rate among the Washington analysis sample is comparable. Table 3 shows the Washington unemployment insurance match rates by field of study.

Table 3

Match Rates to Unemployment Insurance Data in Year After Graduation, Overall and by Field

Field of study	Match rate in year after graduation
Overall	88.0
Business Administration	86.0
Nursing	91.0

Wages. Wages were measured in the four quarters after graduation. The Washington unemployment insurance data include both total wages earned and total hours worked per quarter from which the hourly wage rate can be derived (Education Research and Data Center, 2012). Employers report actual hours worked each quarter, rounded to the next whole number. Employers are instructed to report 40 hours per week for full-time salaried and commissioned employees whose hours are not tracked (Washington State Employment Security Department, n.d.).

Prior to calculating the hourly wage rate, I adjusted quarterly wages to account for regional variation in economic conditions and the cost of living. The method I used is like that developed by Taylor and Fowler (2006) which estimates a comparable wage index for all school districts from 1997 through 2003. The purpose of the comparable wage index is to account for regional variation in wages with differential cost-of-living values. They first estimate the wages that a nationally representative person would earn in each labor market area and then divide that by the employment-weighted average of local area predicted wages (Taylor & Fowler, 2006).

> The CWI helps confirm that college graduates command different wages in different parts of the country. The CWI is constructed as the local wage level divided by the national average in 1999. The CWI for 1999 ranges from 0.70

> to 1.24, indicating that the wage level for college graduates is 24 percent above the national average in New York City (the nation's most expensive labor market) and nearly 30 percent below the national average in several rural areas. (Taylor & Fowler, 2006, p. 14)

Following the conceptual approach used by Taylor and Francis (2006), I developed an index that is based on data specific to counties in Washington and that correspond to the years of interest in my study. Using county-level measures of per capita income (U.S. Department of Commerce, Bureau of Economic Analysis, 2009-2015), I calculated the inverse ratio of per capita income for each county relative to the average per capita income for the state for years 2009–2015. For example, in 2015, the ratio for King County, one of the state's wealthiest counties and the one that includes Seattle, was 0.72. Therefore, wages paid by an employer in King County in 2015 were decreased by 28% to account for the fact that wages are higher relative to the state average. Conversely, the ratio for Pend Oreille County, located in the far northeast corner of the state, was 1.48, so wages paid to graduates employed in Pend Oreille in 2015 were increased by 48% for comparison purposes. This adjustment was made for each quarter of postbaccalaureate employment. Figure 2 presents the 2014 per capita income by county to illustrate the regional variation. The ratios for years 2009–2015 are presented in Appendix C. Appendix D presents additional detail regarding county-level characteristics.

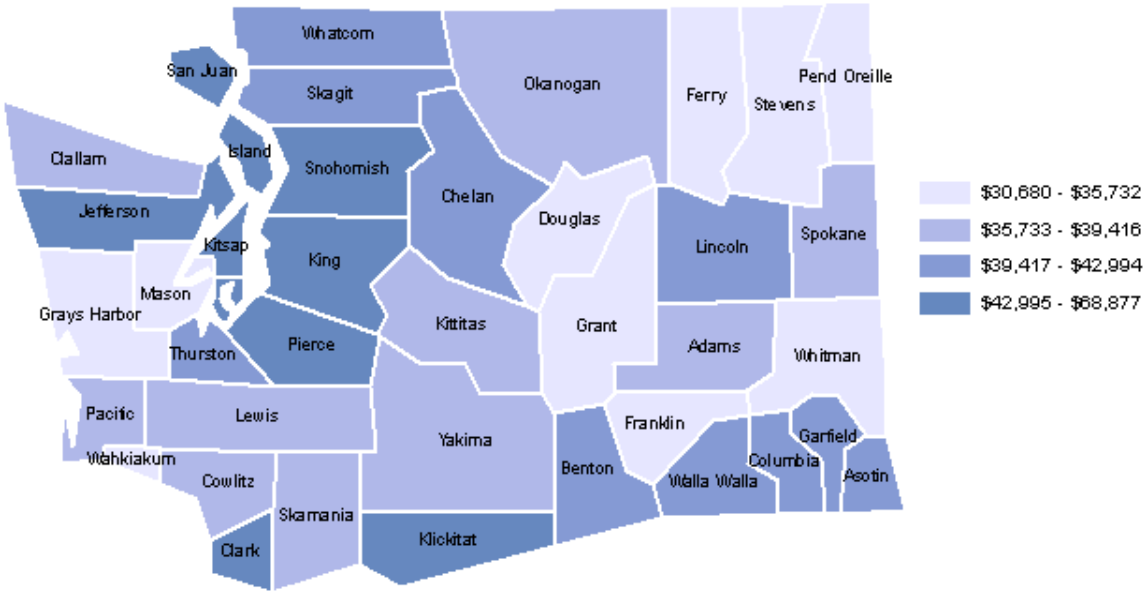

Figure 2. Per capita income by county, 2014 (Office of Financial Management, 2014)

To calculate an hourly wage rate, the regionally-adjusted wages were added across all employment reported for each quarter and then divided by the total number of hours worked in that quarter. Next, I calculated the median hourly rate as the median of the hourly rates across the four post-graduation quarters. Wages were not calculated unless both wages and hours were reported; otherwise they were set to missing.

Wages were adjusted for inflation to 2015 values using the Consumer Price Index using the "West Urban region" rate (http://www.bls.gov/cpi/). The Consumer Price Index is commonly used to index wages from different time points so that they reflect the actual value as of a specific point in time (Abowd, Haltiwanger, & Lane, 2009; Education Research and Data Center, 2012). Appendix E presents the index values for the West Urban region for years 2000 through 2015.

Treatment variable. The purpose of this study was to assess whether postbaccalaureate employment outcomes for students who graduated from a CCB institution are comparable to the outcomes of students who graduated from a TBA institution. The treatment variable, therefore, is an indicator of having earned a bachelor's degree from a CCB institution. Those who earned a bachelor's degree from a public TBA institution constitute the comparison group. A listing of colleges that have been authorized to confer baccalaureate degrees is available through the Washington State Board for Community and Technical Colleges ("Applied Baccalaureate Degrees," 2017). The treatment indicator was set to equal 1 for sample members who graduated from one of the State Board for Community and Technical Colleges institutions between 2009 and 2014. Table 4 presents the institutions that awarded baccalaureate degrees between 2009 and 2014 in both TBA and CCB institutions and the number of graduates in each institution type for the two program areas in this study (Business Administration and Nursing). The analysis sample includes about 280 CCB graduates (the treatment condition,) and about 6,330 TBA graduates (the comparison group.)

In this study, the treatment is the type of institution that confers the bachelor's degree - a TBA or a CCB institution. Differences between public two-year and public-four-year institutions could be relevant in the comparison of employment outcomes between TBA and CCB graduates. There are two main components of institutions that can vary across CCB and TBA institutions, and these differences could be related to graduates' employment outcomes. First, the student populations served by community colleges and public four-year institutions differ on several dimensions including demographic characteristics, academic preparation and achievement, noncognitive factors such as motivation that can influence a

student's level of success in education, and even possibly educational goals (e.g. TBA students may be interested in the "college experience" in addition to earning the degree, while CCB students may prioritize earning the credential for career purposes as quickly and efficiently as possible).

Table 4

Number of Graduates by Institution, 2009–2014

Institution type	Institution name	Number of graduates
TBA institutions		
	Central Washington University	1,270
	Eastern Washington University	600
	University of Washington-Bothell Campus	2,090
	University of Washington-Tacoma Campus	550
	Washington State University	1,400
	Western Washington University	420
	TBA total	6,330
CCB institutions		
	Columbia Basin College	110
	Olympic College	100
	Peninsula College	70
	CCB total	280
Total		6,610

Note. Counts are rounded to the nearest ten.

Second, differences in characteristics of the institutions themselves are important to consider. TBA institutions generally have larger enrollments and larger tuitions. This can be an advantage for TBA institutions because there is more revenue to dedicate to instructional expenditures and academic services for students. However, the smaller enrollments probably translate to smaller class sizes, which could, in turn, provide more individualized attention for CCB students. Faculty qualifications may affect the quality of instruction across the institution types such that it is more rigorous at a TBA institution, but it is more likely that a

student will receive instruction from a graduate assistant rather than a faculty member at a TBA institution.

This set of characteristics across students and institutions constitutes the "treatment" and provides the educational experiences that lead to earning a bachelor's degree. Therefore, the treatment is "bundled" because there are many elements that can be relevant in driving outcomes. So, though outcomes are compared by institution type, it is not within the scope of this study to clearly ascertain how, where, or why the treatment achieves the observed effect.

Table 5 presents institution characteristics for the TBA and CCB[5] institutions in the analysis sample with a focus on the student body and institution resources that have been shown as related to employment outcomes. At first glance, there are some striking differences. Students who attended CCB institutions tend to be more nontraditional than the TBA student population. For example, there is a higher percentage of first-generation students among the group that attends CCB institutions. The percentages of students aged 25 and above and those who are financially independent are much greater for CCB than for TBA institutions.

Conversely, students who attended TBA institutions have some advantages over those who attended CCB students. For instance, TBA institution students have higher average family incomes than do the students who enroll in CCB institutions. There are more Pell Grant recipients among students who attended TBA institutions, likely because of the lower tuition and fees at CCB institutions. Metrics related to institution characteristics show that

[5] The results for CCBA institutions are based on the entire institution and do not necessarily accurately reflect the subset of CCBA students, however, the data needed to subset to CCBA students for these institution characteristics are not available.

the average enrollment size for TBA institutions is more than twice that of the CCB institutions. Tuition and fees and instructional expenditures are higher at TBA institutions. Faculty are paid more and are much more likely to be full-time at TBA institutions. Selectivity metrics for the TBA institutions show that for the schools in the analysis sample, the admissions rate is relatively high. Selectivity metrics are not reported for CCB institutions because they are generally open admission. However, we can see that the four-year institutions in the comparison sample are not very selective, with an average admission rate of 80%.

Field of Study. The six-digit NCES Classification of Instructional Programs (CIP) code identified the field of study associated with the bachelor's degree (National Center for Education Statistics, 2010). Table 6 presents the fields of study in which, as of 2014, students could earn a baccalaureate degree in Washington State at either a TBA or a CCB institution. Results show the number of graduates overall and by institution type. Business administration is the major with the largest number of students, followed by nursing.

Table 5

Characteristics of Analysis Sample Institutions, by Institution Type

Variable label	TBA Institutions	CCB Institutions
Student characteristics (Percentage of undergraduate degree-seeking students)		
Female	54.2	55.7
Aged 25 and above	25.1	55.8
First-generation students	32.2	49.1
White	53.2	62.6
Black	3.4	5.4
Hispanic	6.1	10.7
Asian	8.8	7.3
American Indian/Alaska Native	0.9	1.6
Native Hawaiian/Pacific Islander	0.4	0.2
Two Or More Races	1.5	2.4
Non-Resident Aliens	1.7	2.9
Race is unknown	8.2	6.9
Pell Grant recipients	23.7	13.5
Financially independent	28.9	68.1
Financially independent, family income between $0-30,000	23.1	77.8
Average family income of dependent students in real 2015 dollars	$82,120	$36,035
Average family income of independent students in real 2015 dollars	$26,340	$21,738
Institution characteristics		
Number of undergraduate certificate/degree-seeking students enrolled in fall	9,940	2,670
In-state tuition and fees	$7,030	$3,055
Instructional expenditures per full-time equivalent student	$7,920	$5,090
Average monthly faculty salary	$7,620	$5,850
Percentage of faculty that is full-time	69.4	30.4
Admission rate	79.8	
Midpoint of the ACT cumulative score	22.0	
Average SAT equivalent score of students admitted	1029.0	

Note: TBA institutions include Central Washington University, Eastern Washington University, University of Washington-Bothell Campus, University of Washington-Tacoma Campus, Washington State University, and Western Washington University. CCB institutions include Columbia Basin College, Olympic College, and Peninsula College.

Source: College Scorecard Data (U.S. Department of Education, 2017).

Table 6

Number of Graduates by Field of Study and Institution Type, 2009–2014

Field of Study	CCB graduates	TBA graduates	Total graduates
Business Administration	180	3,780	3,960
Nursing	100	2,550	2,640
Total	280	6,330	6,610

Note. Counts are rounded to the nearest ten.

Table 7 presents the CIP codes, titles, and definitions for the three majors analyzed in this study. To assess the comparability of degree programs across institutions, I reviewed the websites for each degree program with a focus on stated learning outcomes, accreditation, admission requirements to the degree program, credit requirements, and graduation requirements. There is variation across institutions in the way the requirements are described; however, all require either a transfer with an associate's degree in a related field from an accredited institution or application into the degree program after completing some undergraduate work at the institution. All programs require a minimum GPA for admission into the degree program and have minimum GPA requirements for major courses.

Table 7

Classification of Instructional Program (CIP) Definitions

CIP Code	Title	Definition
52.0201	Business Administration and Management, General	A program that generally prepares individuals to plan, organize, direct, and control the functions and processes of a firm or organization. Includes instruction in management theory, human resources management and behavior, accounting and other quantitative methods, purchasing and logistics, organization and production, marketing, and business decision-making.
51.1601	Nursing/Registered Nurse (RN, ASN, BSN, MSN).	A program that generally prepares individuals in the knowledge, techniques and procedures for promoting health, providing care for sick, disabled, informed, or other individuals or groups. Includes instruction in the administration of medication and treatments, assisting a physician during treatments and examinations, Referring patients to physicians and other health care specialists, and planning education for health maintenance.

Source: (National Center for Education Statistics, 2010)

Individual degree programs can also vary in terms of the quality of instruction within and across institution types. Within TBA institutions, selectivity measures such as college admissions test scores and admissions rates can help to establish comparability between institutions. However, even within the subset of minimally selective public four-year colleges, the quality of the educational experience at one institution could be different from that at another institution in the same program. And at this time, there is little information available with which to judge the comparability of programming within a field of study across TBA and CCB institution types, since the CCB institutions do not report the selectivity metrics. One measure that can be used to assess comparability across institutions is the accrediting body. All of the institutions in the analysis sample are accredited by the Northwest Commission on Colleges and Universities.

> Accreditation of an institution of higher education by the Northwest Commission on Colleges and Universities indicates that it meets or exceeds criteria for the assessment of institutional quality evaluated through a peer review process. An accredited college or university is one which has available the necessary resources to achieve its stated purposes through appropriate educational programs, is substantially doing so, and gives reasonable evidence that it will continue to do so in the foreseeable future… Accreditation by the Northwest Commission on Colleges and Universities is not partial but applies to the institution as a whole. As such, it is not a guarantee of every course or program offered, or the competence of individual graduates. Rather, it provides reasonable assurance about the quality of opportunities available to students who attend the institution. ("Columbia Basin College Accreditation," n.d., para. 2-3)

In addition to the regional accreditation by the Northwest Commission on Colleges and Universities, there are specialized accreditations for business and nursing. The TBA institutions that offer degrees in Business Administration are also accredited by the Association to Advance Collegiate Schools of Business. "AACSB accreditation is the benchmark of quality worldwide and most widely sought after by business schools—less than 5% worldwide have earned the achievement" ("Milgard School of Business Accreditation," n.d., para. 5). The fact that the TBA business programs have the additional accreditation that the CCB business programs do not have suggests that there are likely differences in the quality of instruction by institution type.

Among the nursing programs, however, both the CCB and TBA institutions are accredited by the Commission on Collegiate Nursing Education in addition to the regional institution accreditation, suggesting that both the CCB and TBA nursing programs are meeting the same standard requirements for nursing instruction.

> Officially recognized by the U.S. Secretary of Education as a national accreditation agency, the Commission on Collegiate Nursing Education…is an autonomous accrediting agency, contributing to the improvement of the public's health. The Commission on Collegiate Nursing Education ensures the quality and integrity of baccalaureate, graduate, and residency programs in nursing ("American Association of Colleges of Nursing," n.d., para. 1).

Covariates. Individual-level characteristics were obtained from the Washington Education Data Resource Center. Because the data were compiled from different administrative systems (the State Board for Community and Technical Colleges, the Public Centralized Higher Education Enrollment System, and the Office of Superintendent of Public

Instruction), a limited set of variables was available for both CCB and TBA graduates. These included age, sex, race and ethnicity, high school grade point average, and prior employment information. The individual-level data were supplemented with county-level data including population density, median household income, percent of residents in poverty, and the average rate of unemployment.

Estimation with Instrumental Variables

The primary question of this study is whether CCB and TBA graduates experience similar postbaccalaureate employment outcomes. The relationship between institution type and postbaccalaureate employment outcomes can be expressed as shown in equation 1:

$$Employment_outcome_i = \beta_0 + \beta_1 CCBA_i + \beta_2 X_i + \mu_i \quad (1)$$

where *Employment_outcome* represents the dependent variable of interest (employment status or wages one year after graduation) for individual i. *CCB* is the treatment status indicator for individual *i*, and *X* captures observable individual characteristics that are related to the treatment and employment outcomes (e.g. field of study).

Ideally, to answer this question, individuals seeking a bachelor's degree would be randomly assigned to attend either a CCB or TBA, and then employment outcomes would be compared after degree completion. Random assignment would allow for estimation of the causal effect of institution type on postbaccalaureate outcomes since, due to the randomization, the two groups would have an equal chance of selection into the treatment group and would be equivalent with the exception of the treatment assignment. In this study, however, individuals have not been randomly assigned to institution types. Instead, they

chose where to apply to college and what field to study. Therefore, the treatment is likely related to unobservable factors, which violates the assumption that each independent variable is uncorrelated with the error term $E(u|x=0)$, otherwise known as endogeneity (Wooldridge, 2013). Endogeneity is often due to omitted variables, which occurs when unmeasured factors that drive treatment and affect the outcome are not controlled for in the model, leading to biased estimates of the treatment effect. Endogeneity can also be the result of measurement error, simultaneity, or a reciprocal relationship between the treatment and the outcome. Ordinary Least Squares (OLS) regression requires the assumption that there is no correlation between any of the predictor variables and the error term; otherwise, the model estimates will be biased.

The treatment variable, institution type (CCB or TBA), is endogenous because individuals make decisions about where to attend college, and it is likely that there are factors that affect the choice of college that are also related to employment outcomes. For instance, it could be that the types of students who choose to attend a CCB institution are more similar to the community college student population than to the four-year bachelor's degree-seeking population. This difference could be associated with other attributes such as background characteristics (e.g. SES) or academic characteristics (e.g. ability) that could also be responsible for differential employment outcomes. To really understand whether it is the type of institution that confers the bachelor's degree and not something else that also affects employment outcomes, the two groups being compared must be similar in all respects except for the treatment condition. If the two groups being compared are not similar at the baseline (e.g. pre-treatment), then any pre-existing differences between the groups could confound

the relationship between the treatment and outcome and bias estimates of the treatment effect.

Estimation with instrumental variables. The instrumental variables (IV) approach provides an alternative method to address endogeneity when random assignment is not feasible. The IV approach is used to remove the correlation between the treatment and any unmeasured factors that might relate to the outcomes but may also be related to selection into treatment. An instrument is a variable (or set of variables) that is related to the treatment variable such that it can be used to predict the actual treatment condition (Angrist & Pischke, 2009; Card, 1993; Dunning, 2012; Wooldridge, 2013). The instrument helps to simulate random assignment because it is usually something external to or outside the control of the individuals being studied (Dunning, 2012). However, for the instrument to address the problem of the endogenous treatment variable, the instrument must be unrelated to the error term of the outcome equation (Angrist & Pischke, 2009; Card, 2001; Dunning, 2012; Wooldridge, 2013). In fact, an instrumental variable can be thought of as simulating random assignment because it essentially serves the purpose of assigning cases to treatment in a way that is ignorably random, or as good as random conditional on covariates, precisely because it influences treatment condition without having any effect on the outcome (other than through the treatment) or being related to the error term in the outcome model.

In this study, the treatment variable is the institution type (CCB or TBA). The instrumental variables chosen to predict treatment include measures of proximity to the nearest CCB and TBA institutions. Equations 2 and 3 illustrate how the instrumental variables approach works by estimating a two-stage least squares (2SLS) model. In the first

stage, I predict the endogenous treatment variable with the distance instruments using the general equation:

$$CCBA_i = Z_i\alpha_1 + X_i\ \alpha_2 + \upsilon_i \quad (2)$$

where $CCBA_i$ is treatment status indicator for individual i and the Z_i includes the distance to the nearest CCB and TBA institutions from individual i's pre-college location, X_i represents individual-level covariates (such as age, race/ethnicity, sex, employment experience), and υ_i captures unmeasured factors for individual i.

In the second stage, the predicted value for the treatment status (institution type) estimated in the first stage (Equation 2) is used in place of the actual institution type as shown in equation (3):

$$Employment_outcome_i = \beta_1\widehat{CCBA}_i\ +\ \beta_2 X_i\ +\ \varepsilon_i \quad (3)$$

where $\widehat{\mathrm{CCB}_1}$ is the predicted treatment status from the first stage, and ε_i captures unmeasured factors for individual i.

Distance measures as instruments for college choice. To address the endogeneity of the treatment variable, an instrument that is predictive of which type of institution an individual will choose is required, but this instrument must be otherwise unrelated to employment outcomes. The endogenous treatment variable is instrumented by measures related to the proximity of the nearest public two- and four-year institutions that award a bachelor's degree in a major that is available in both public two- and four-year institutions.

Table 8 presents a description of the pre-college locations and sources of data for the distance measures. Up to three pre-college locations were available for the analysis sample: the high school attended, the county of employment, and the county of residence at the time of the college application. I calculated the distance from each available pre-college location to all public two- and four-year institutions that awarded bachelor's degrees in at least one of the majors available at both public two- and four-year institutions. Geographic coordinates for high schools were obtained from the Common Core of Data files (National Center for Education Statistics, 2003/04 - 2009/10). Geographic coordinates for each college were obtained from the Integrated Postsecondary Education Data System files (U.S. Department of Education, National Center for Education Statistics, 2009). For the pre-college county of employment and pre-college residence, I used coordinates that reflect the population center.

> The concept of the center of population as used by the U.S. Census Bureau is that of a balance point. The center of population is the point at which an imaginary, weightless, rigid, and flat (no elevation effects) surface representation of the county would balance if weights of identical size were placed on it so that each weight represented the location of one person. (U.S. Census Bureau, 2011, p. 2)

Most sample cases had more than one pre-college location measure available. To determine the best pre-college location to be used for the instruments, I then ranked the sources as follows:

1. If the measure for the high school attended was available, then it was selected as the primary pre-college location since it is arguably the least endogenous to college choice. Families do make decisions about where to live based on the quality of nearby K-12 schools, but it is unlikely that those decisions are also

influenced by the proximity of public colleges. It is possible that students attended a high school other than their assigned school; however, it is unlikely that this scenario would be very problematic for the distance calculations, assuming that any high school attended would be in generally close proximity to one's assigned school. Coordinates for high schools were obtained from the 2003 Common Core of Data file. The high school attended was available for about 32% of the sample.

2. If the high school attended was unavailable, then the pre-college employment location was used as the best pre-college location when it was available. The pre-college employment location is defined as the county of employment one or more years prior to the college enrollment start date as reported on the unemployment insurance data file. It is certainly possible that a potential student would seek employment in an area because they have plans to enroll in a nearby college, but it is unlikely that an individual would move a year or more before enrolling if their real intentions were to move to that area to work and attend school after a year or more. The county of employment is used for about 37% of the sample.
3. Absent high school and pre-college employment locations, the county of residence at the time of college application was used for the primary distance measure. As with the employment measure described in (2) above, coordinates for Washington county population centers were used to calculate distances to CCB and TBA institutions ("U.S. Census," 2010.) The college application measure was used for about 30% of the sample.

Table 8

Description of Distance Measures Used to Assign Pre-College Location

Location	Source of Coordinates	Number of cases	Percent of cases
Washington CCB institutions	Institution coordinates from 2009 IPEDS Institution Characteristics Header file	6,610	100.0
Pre-college high school	High School coordinates from 2003/04−2009/10 Common Core of Data files	2,230	32.4
Pre-college employment county	Washington county population center coordinates from the U.S. Census Bureau associated with employer id reported in WA unemployment insurance wage data.	2,560	37.2
County of residence at time of college application	Washington county population center coordinates from the U.S. Census Bureau associated with county reported on PSE application	2,090	30.4

Descriptive statistics are presented for the analysis sample by the best pre-college location used for the instruments in Table 9. Compared to students whose best pre-college location was based on county of employment a year or more before enrolling, the cases for whom high school information is available are in general younger and by definition have less pre-college employment history. There was less poverty in pre-college counties for students with high school information. Results are also shown for the set of cases for whom no pre-college location information was available. These cases have been excluded from the analysis, but the descriptive statistics indicate that, though there are some differences in race and ethnicity, the exclusion of these cases does not appear to introduce serious bias.

Table 9

Descriptive Statistics for Analysis Sample, by Pre-college location

Variable label	Full sample (n = 6,610)	Pre-college location: high school (n = 2,230)	Pre-college location: employer (n = 2,560)	Pre-college location: college application (n = 2,090)	No location info (n = 490)
Student Characteristics					
Age at bachelor's degree completion	28.3	22.7	31.5	31.2	25.3
Number of quarters employed before enrolling	19.8	14.0	23.2	22.0	10.3
High School GPA	3.4	3.4	3.4	3.4	3.3
Percent Female	63.2	56.9	67.4	64.7	62.8
Percent American Indian	2.9	2.9	2.8	2.8	3.3
Percent Asian	14.9	14.9	12.6	15.7	23.4
Percent Black	4.0	1.9	5.0	5.4	1.9
Percent White	66.0	73.5	67.7	64.9	26.5
Percent Hispanic	6.1	6.3	6.2	6.7	2.3
Characteristics of pre-college county					
2014 Median household income	$63,680	$64,785	$64,436	$61,957	
2014 Percent in poverty, all ages	13.2	12.8	13.3	13.8	
Unemployment averaged over 2009-2015	8.5	8.5	8.4	8.7	
2014 Population Density	512.5	530.5	564.2	430.2	

Using the Stata *osrmtime* command (Huber & Rust, 2016), I calculated travel distance in miles from the pre-college location to the nearest baccalaureate-granting institution by sector: CCB, non-selective public four-year, private not-for-profit, and private for-profit institutions. The travel distance generated by *osrmtime* uses the public road network and, therefore, captures a more precise measure of how far apart two points are than straight-line distance measures and how long it takes to travel between them. In addition to distance in miles, I calculated various transformations of distance, including squared miles, log miles, and inverse log. Among the transformed versions, the log of miles to the nearest institution by sector is the strongest and is the one that will be discussed in this chapter.

Figure 3 shows the predicted probability of graduating from a CCB institution by the distance from the pre-college location to the nearest CCB, non-selective public four-year, private not-for-profit, and private for-profit institutions. This figure shows that, as distance to the nearest CCB institution increases, the predicted probability of earning a bachelor's degree from a CCB institution decreases. Conversely, as the distance to the nearest non-selective public four-year institution increases, the predicted probability of earning a bachelor's degree from a CCB increases. A similar but weaker relationship is observed for distance to the nearest private not-for-profit institution. Distance to the nearest private for-profit institution does not appear to have much effect on the predicted probability of being a CCB graduate. Though the choice set for an individual includes institutions from all sectors, the two strongest predictors of treatment status, distance to the nearest CCB and the nearest TBA institutions, are used in the final IV regression models.

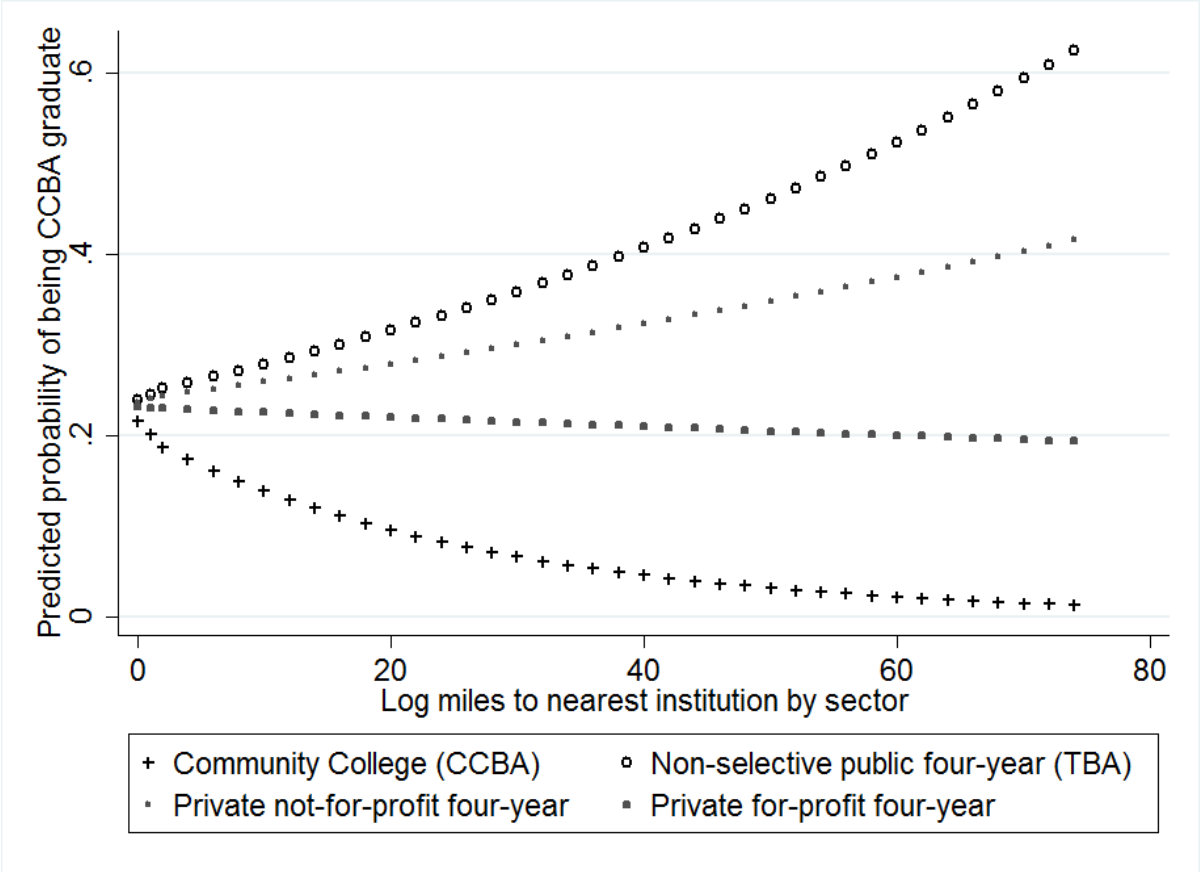

Figure 3. Predicted probability of graduating from a CCB institution, by distance to nearest institution

Instrumental variables assumptions. Several conditions must be met for the instrument to successfully remove the endogeneity. Angrist, Imbens, and Rubin (1996) outline the five key assumptions that must hold in an IV analysis: (a) nonzero causal effect of instrument on treatment, (b) random assignment, (c) exclusion restriction, (d) monotonicity, and (e) stable unit treatment value assumption (SUTVA). Below, I discuss each assumption in the context of the instruments selected for this study.

Nonzero causal effect of instrument on treatment. This assumption states that there must be a relationship between the instrument and treatment assignment. A strong instrument will be correlated such that treatment assignment can be predicted based on values of the instrumental variable. An instrument that is only weakly correlated with the

treatment variable in effect has very little influence over treatment assignment. As a consequence, a weak instrument may produce biased estimates and large standard errors that can impact hypothesis testing (Angrist & Kreuger, 2001; Murray, 2006; Stock & Yogo, 2005).

Much of the research on outcomes related to postsecondary education has used distance to instrument for college choice. Distance is an important determinant of whether and where an individual enrolls in college (Card, 1993; Card, 2001; Dee, 2004; Doyle & Skinner, 2016; Jepsen & Montgomery, 2009; Kane & Rouse, 1993; Long & Kurlaender, 2009). Distance to the nearest college[6] is a good candidate to serve as an instrument for college choice because institutions that are nearby can be more affordable in terms of living expenses and travel costs, less time getting to and from school, and closeness to family, thereby influencing the treatment decision.

Evidence shows that many students attend a nearby college. In their discussion of "education deserts," Sponsler and Hillman (2016) emphasize the importance of geography in the college access conversation, noting that 79% of community college students and 53% of public four-year students attend a college that is within 20 miles of their home, and that location can be particularly important for students who are also juggling work and family (Sponsler & Hillman, 2016). Such students comprise a non-trivial portion of undergraduates; data from the 2011-12 National Postsecondary Student Aid Study (NPSAS:12) show that about 28% of all undergraduates had dependents, 62% worked while enrolled, and 43% were enrolled exclusively part-time (Radford, Cominole, & Skomsvold, 2015). Among 2011-12

[6] There are many variations on distance instruments, including number of nearby institutions, the distance to certain types of institutions, interactions with distance and institutional characteristics such as tuition and enrollment size.

undergraduates overall, the median distance from student's home to their institution was 14 miles, but was 29 miles for traditional students and only 11 miles for nontraditional students, (author calculations using NPSAS:12 data; table specifications are presented in Appendix B.)

Table 10 presents descriptive statistics on the distance measures to the nearest colleges by sector overall and for each of the pre-college location groups. On average, students who earned a bachelor's degree from a Washington public college in business administration or nursing lived about 21 miles from the nearest CCB institution and about 20 miles from the nearest non-selective public four-year college. Distances to the nearest private not-for-profit institution were a bit closer, averaging 11 miles, and to private for-profit institutions at 18 miles.

The strength of an instrument can be assessed by reviewing the magnitude of the correlation between the instrument and the treatment and by the *F*-statistic testing that the instrument coefficient in the first stage equation is equal to zero (Dunning, 2012; Murray, 2006; Stock & Yogo, 2005; Wooldridge, 2013). Correlations between the treatment and the distance measures are shown in Table 11. Results are shown for the full sample and for the subsets of cases for whom high school data are available and the subset with prior employment. In all cases, the relationships are in the expected directions: being in the treatment condition is negatively correlated with distance to the nearest CCB and is positively correlated with distance to the nearest TBA. As the distance to the nearest CCB institution increases, the likelihood of earning a bachelor's degree from a CCB institution decreases. As the distance to the nearest four-year institution (non-selective public, private not-for-profit, and private for-profit) increases, the likelihood of earning a bachelor's degree from a CCB institution increases.

Table 10

Descriptive Statistics on Instrumental Variables, by Sample Type

Sample type	Variable Label	*Mean*	*Median*	*Min*	*Max*	*SD*
Full sample (n=6,610)						
	Miles to nearest CCB institution	21.3	21.2	0.5	203.2	3.5
	Miles to nearest non-selective public four-year institution	20.2	18.8	0.6	156.7	2.5
	Miles to nearest private not-for-profit institution	11.3	7.1	0.4	165.2	3.2
	Miles to nearest private for-profit institution	18.4	10.1	0.3	228.4	3.5
Sample with High School information (n=2,140)						
	Miles to nearest CCB institution	20.1	20.0	0.5	202.4	3.5
	Miles to nearest non-selective public four-year institution	18.4	18.8	0.6	156.7	2.8
	Miles to nearest private not-for-profit institution	11.9	10.7	0.4	165.2	3.2
	Miles to nearest private for-profit institution	15.7	11.6	0.3	207.0	3.8
Sample with prior employment (n=2,470)						
	Miles to nearest CCB institution	18.5	10.7	2.7	203.2	3.4
	Miles to nearest non-selective public four-year institution	23.4	18.8	5.4	148.9	2.2
	Miles to nearest private not-for-profit institution	10.7	7.1	2.9	145.4	3.0
	Miles to nearest private for-profit institution	19.0	10.1	5.2	228.4	3.2
Sample with PSE application (n=2,000)						
	Miles to nearest CCB institution	27.0	21.2	2.7	203.2	3.3
	Miles to nearest non-selective public four-year institution	18.4	18.8	5.4	150.3	2.4
	Miles to nearest private not-for-profit institution	11.3	7.1	2.9	145.4	3.3
	Miles to nearest private for-profit institution	21.1	10.1	5.2	184.0	3.6

Note: The untransformed version of miles is shown here for ease of interpretation.

Tables 12 and 13 present results from the first stage equations for both outcome measures - employment status and wages the year after graduating. First stage results are presented for two specifications: a) estimating the effect of the treatment on the outcome and b) estimating the effect of the treatment on the outcome with covariate controls. As a general rule, the *F*-statistic from the first-stage equation should be statistically significant but should also be greater than the critical value of the highest acceptable error level for the 2SLS Size of nominal 5% Wald test (Stock & Yogo, 2005). These will be discussed further in Chapter 4.

Table 11

Correlations Between Treatment Status and Distance to Nearest Institution, By Sector and Pre-college Location

Institution sector	Full sample (n=6,610)	Pre-college location: high school (n=2,140)	Pre-college location: employer (n=2,470)	Pre-college location: college application (n=2,000)
Nearest CCB	-0.21	-0.11	-0.21	-0.31
Nearest non-selective public four-year	0.25	0.19	0.26	0.31
Nearest private not-for-profit	0.20	0.15	0.24	0.23
Nearest private for-profit	0.17	0.16	0.19	0.17

The *F*-statistics from the first stage equations satisfy the recommended threshold in most specifications, even when covariate controls are included. Among the full sample, the *F*-statistic is 20 or above for both majors. It is strongest for business majors at 277. Among the subsample with high school information, employment outcomes can only be tested for business administration majors with an *F*-statistic of 36. Among the subsample with prior employment, both nursing and business administration exceed 10 with values at 18 and 140, respectively. As a point of comparison, another study that used the inverse log distance to the nearest public two-year institution to instrument for educational attainment in an analysis of earnings yielded a first-stage *F*-statistic that ranged from 58.9 to 43.6, exceeding the minimum eigenvalue of 13.9 for one endogenous regressor and three excluded instruments, (Doyle & Skinner, 2016, table 1).

Furthermore, the partial R^2 values are greater than 0, suggesting sufficient strength (however, note that there are no agreed upon standards on what constitutes a "good" Partial R^2 value). Additionally, the linear probability coefficient for distance to the nearest CCB on

treatment is -0.01, which translates to a 1 percentage point decrease in the probability of enrolling at a CCB for every 10 mile increase in distance.

Ingnorably random assignment. This assumption requires that the instrument must affect assignment to treatment status in a way that is random, or as good as random, such that there is no relationship between the instrument and the error term in the second stage equation, conditional on a set of covariates. Dunning (2012) suggests that the plausibility of whether an instrument is "as-if" random exists on a continuum and can be assessed by considering the following: (1) whether individuals might have information about treatment assignment, (2) whether individuals might have the capacity to control treatment assignment, and (3) whether individuals might have incentives to select into the treatment condition. If this assumption holds, then the treatment and comparison groups will demonstrate baseline equivalence on pre-treatment characteristics.

To address the first point above as to whether individuals might have information about treatment assignment, the CCB degree programs in Washington have been in existence since the pilot study began in 2005 (Kaikkonen, 2013). Therefore, it is possible that prior knowledge of the availability of CCB programs could influence pre-college location; an individual could decide to move to a location near a CCB institution with the intention of enrolling in its CCB degree program. The second point concerns whether individuals have control over the assignment process. With an instrument based on distance from an individual's residence to nearby colleges, individuals do have the capacity to control treatment assignment given that they decide where to live.

Table 12

2SLS First Stage Statistics for Year One Employment Status, By Field of Study and Sample Type

	Full sample			Sample with HS information			Sample with prior employment		
	N	*F*-statistic	Partial *R*-square	*N*	*F*-statistic	Partial *R*-square	*N*	*F*-statistic	Partial *R*-square
Model without covariates									
Business Administration	3,960	**490.13**	0.20	1,680	**94.40**	0.10	1,190	**254.90**	0.30
Nursing	2,640	**98.79**	0.07	460	1.52	0.01	1,280	**48.98**	0.07
Model with covariates									
Business Administration	3,650	**182.71**	0.44	1,510	**23.09**	0.21	1,140	**109.43**	0.61
Nursing	2,430	**45.02**	0.23	390	2.22	0.09	1,190	**30.01**	0.29

Note. Counts have been rounded to the nearest ten. *F*-statistics > 19.93 are in boldface.

Table 13

2SLS First Stage Statistics for Year One Wages, By Field of Study and Sample Type

	Full sample			Sample with HS information			Sample with prior employment		
	N	*F*-statistic	Partial *R*-square	*N*	*F*-statistic	Partial *R*-square	*N*	*F*-statistic	Partial *R*-square
Model without covariates									
Business Administration	3,410	**423.70**	0.20	1,489	**82.95**	0.10	1,040	**214.49**	0.29
Nursing	2,410	**87.37**	0.07	410	1.45	0.01	1,190	**45.24**	0.07
Model with covariates									
Business Administration	2,130	**101.40**	0.49	830	14.33	0.27	700	**57.43**	0.62
Nursing	1,540	**29.86**	0.28	180	1.16	0.12	830	**25.07**	0.38

Note. Counts have been rounded to the nearest ten. F-statistics > 19.93 are in boldface.

The third point addresses whether there may be incentives to select into the treatment condition. The instruments in this study relate to distance to CCB and TBA colleges. For these instruments to be considered random (or "as good as random, conditional on covariates,") then there should be no differences between the types of people who live near CCB institutions and those who live farther away. The question that must be asked here is whether an individual's pre-college location was influenced by a desire to live in a location that is near a CCB institution, and whether individuals who live near CCB institutions differ in important ways from those who live farther away.

Figure 4 presents a map of Washington and highlights the locations of the CCB and TBA institutions. Two of the CCB institutions are located in the Puget Sound area, which encompasses Seattle, Tacoma, and Olympia. This area is home to about two-thirds of the state's population (American Fact Finder, 2011). About 48% of adults over age 25 in this region have a bachelor's degree, one of the highest rates in the U.S. ("Educational attainment in King County," 2015). Appendix D presents additional information on county-level characteristics, including population density, per capita income, unemployment rates, poverty rates, and high school graduation rates. According to these data, counties in the Puget Sound area are more densely populated, have higher levels of education (high school graduation and baccalaureate attainment,) higher income, less unemployment, and less poverty than other parts of the state. The high level of education among residents in this area and the relative wealth would suggest that the quality of its public-school systems is also very good, which could be related to better postsecondary and employment outcomes relative to students from other parts of the state. The individuals who reside in these counties, which are closer to CCB institutions, differ from Washington residents in other parts of the state

that are farther away from CCB institutions. Therefore, county-level measures are included as covariates to account for regional differences in factors that could be related to employment outcomes.

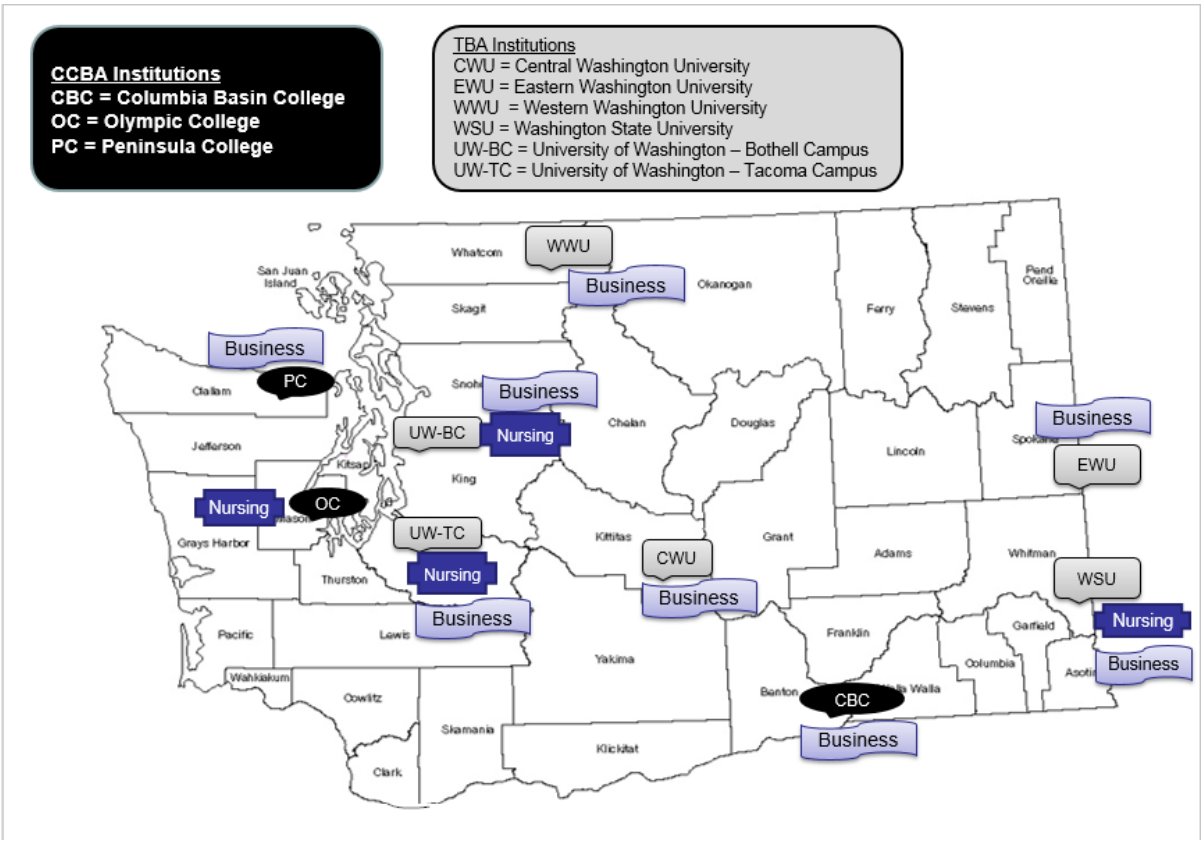

Figure 4. Map of Washington CCB and TBA institutions included in the analysis sample. Adapted from "Explore Our Colleges" retrieved from https://www.sbctc.edu/our-colleges/explore-colleges/default.aspx.

Returning to Dunning's (2012) criteria for assessing the plausibility of whether an instrument is ignorably random, we must judge the instrument according to whether individuals have the knowledge, the capacity, or an incentive to sort into treatment. The proposed distance instruments fall short of definitively meeting the criteria to be considered ignorably random. However, the next section discusses the steps that were taken to maximize the plausibility that the distance instrument is as good as random, conditional on covariates. These include the careful operationalization of the pre-college location measure

and the selection of covariates that are used to control for imbalance on pre-treatment characteristics between the treatment and comparison groups.

The rationale for use of distance as an instrument for institution type rests on the assumption that college choice is at least partly a function of pre-college location. When it was available, distance was calculated as the miles between the high school attended (measured by coordinates attached to the CCD code) and the nearest CCB and TBA institutions. The high school that an individual attends is most often determined by decisions made by the parents about where to live. About 32% of the sample had information on the high school attended. The average age at the time of bachelor's degree completion of the group whose pre-college distance is from their high school is about 22, suggesting that they began college soon after high school graduation, which would indicate that if they relocated to attend college, they did so after high school.

When the pre-college high school location was not available, the pre-college location was set to the county of employment among those who were employed at least one year before enrollment. If high school data were missing, I selected the location of employment one or more years prior to the college enrollment start date as the pre-college location. The fact that distance was calculated based on the location at least one year before enrollment should minimize the chance that the pre-college employment location was related to college choice. Assuming that those who move to be near colleges would do so closer to the beginning of enrollment, going back one year should guard against using the wrong starting point in the distance calculation. Also, for those whose pre-college location is based on prior employment, the average age at bachelor's degree completion is about 31, indicating that the employment location is a better measure of pre-college location than high school since most

in this group would have completed high school several years ago and their place of residence was more likely dictated by their place of employment.

For the remaining 30% of the sample, distances to the nearest CCB and TBA institutions were calculated based on the county of their reported residence at the time they applied for college. This group is the most suspect because it is plausible that an individual lives one place then moves to be closer to a particular college and then applies to that college. However, this group closely resembles the group with prior employment with an average age at bachelor's degree completion of 31 and about 5 years of pre-enrollment employment. In a study of community college enrollment among mature adults (age 25−−49) in Baltimore, distance was found to be an important determinant of the decision to enroll and for school choice (Jepsen & Montgomery, 2009). Given the nontraditional makeup of this group, it is unlikely that many students moved prior to enrolling in college to be closer the institution.

An empirical way to examine whether the instrument serves to randomize the sample to CCB or TBA institutions is to review the regressions between the instrumental variables and pre-treatment covariates (Dunning, 2012). Table 14 presents the regression coefficients between the distance instruments by sector and individual and geographic covariates. If the distance instruments are as good as random, then they should be unrelated to the covariates, indicating that the covariates do not vary as the distance measures change. As shown in Table 14, the regression coefficients between the distance instruments and demographic characteristics are significant but small with the exception of high school GPA and percent Asian.

The regression coefficients for the distance instruments and county-level measures are sizeable, however. These results indicate that there are regional differences between

areas close to and areas far from CCBs. The average rate of unemployment in the pre-college county is moderately and positively related to the distance to the nearest CCB institution, indicating that unemployment is higher in counties that are farther away from CCB institutions. The 2010 pre-college county median household income and poverty rates are strongly correlated with distance and show that the counties closer to CCB institutions are much better off economically. Population density is moderately and negatively related to distance to the nearest CCB institution. As shown in Figure 4 above, the CCB institutions are somewhat clustered in the Puget Sound area. Table 15 displays county-level characteristics for Washington State and for the subsets of counties based on the concentration of CCB institutions. King and Kitsap counties are the most populous areas and have higher earnings and less poverty than other areas of the state. The statistical significance and magnitude of the coefficients vary by instrument and sample type, but the results indicate that the instrumental variables are not ignorably random. Therefore, covariates are included in the 2SLS model to control for regional variation that could be related to employment outcomes.

Table 14

Regression Results Predicting Distance Instruments by Covariates

Instrument	Covariate	*n*	*B*	*SE*	*β*	*p*	
Log miles to nearest CCB institution							
	Age at bachelor's degree completion	6,610	-0.01	0.00	-0.04	0.00	***
	Number of quarters employed before enrolling	6,370	0.00	0.00	-0.02	0.17	
	High School GPA	2,410	0.68	0.05	0.24	0.00	***
	Percent female	6,610	0.16	0.03	0.06	0.00	***
	Percent American Indian	6,610	-0.19	0.09	-0.03	0.04	*
	Percent Asian	6,610	-0.49	0.04	-0.14	0.00	***
	Percent Black	6,610	-0.46	0.08	-0.07	0.00	***
	Percent White	6,610	0.32	0.03	0.12	0.00	***
	Percent Hispanic	6,610	0.08	0.06	0.02	0.21	
	Median household income of county	6,610	0.00	0.00	-0.76	0.00	***
	Percent in poverty, all ages	6,610	0.21	0.00	0.65	0.00	***
	Unemployment averaged over 2009--2015	6,610	0.47	0.01	0.67	0.00	***
	Population Density 2014	6,340	0.00	0.00	-0.71	0.00	***
Log miles to nearest non-selective public four-year institution							
	Age at bachelor's degree completion	6,610	0.01	0.00	0.09	0.00	***
	Number of quarters employed before enrolling	6,370	0.00	0.00	0.04	0.00	***
	High School GPA	2,410	0.16	0.04	0.07	0.00	***
	Percent female	6,610	0.17	0.02	0.09	0.00	***
	Percent American Indian	6,610	0.10	0.07	0.02	0.12	
	Percent Asian	6,610	-0.30	0.03	-0.12	0.00	***
	Percent Black	6,610	-0.23	0.06	-0.05	0.00	***
	Percent White	6,610	0.13	0.02	0.07	0.00	***
	Percent Hispanic	6,610	0.27	0.05	0.07	0.00	***

Table 14 Continued

Median household income of county	6,610	0.00	0.00	-0.18	0.00	***
Percent in poverty, all ages	6,610	0.01	0.00	0.06	0.00	***
Unemployment averaged over 2009--2015	6,610	0.18	0.01	0.36	0.00	***
Population Density 2014	6,340	0.00	0.00	-0.13	0.00	***

Note. Counts have been rounded to the nearest ten. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Exclusion restriction. The instrument must be related to treatment assignment, but there must be only one path between instrument and outcome, and it must pass through the treatment (Angrist & Pischke, 2009; Dunning, 2012). This assumption is named as such because the instrument could be excluded from the causal model since it is unrelated to the outcome (Angrist & Pischke, 2009). There is no empirical way to fully test this assumption, so a strong theoretical justification is required to demonstrate that there are no alternate causal pathways between the instrument and the outcome (Angrist, Imbens, & Rubin, 1996).

As shown in Table 15, economic conditions vary across the counties that have CCB institutions and the areas that do not. It is possible that public K-12 schools in the Puget Sound counties are better resourced than schools in outlying areas, possibly equipping nearby residents with better quality education so they are more academically prepared, which could in turn lead to better employment outcomes. The key point of the exclusion restriction assumption is that there should be no plausible path between distance to nearby institutions and employment outcomes other than through the mechanism of the effect of distance on treatment status; however, in Washington, it appears that economic conditions in the more densely populated areas are different in ways that could lead to better employment outcomes. To the extent that there are county-level differences in terms of population and economic characteristics that could affect employment outcomes, then the exclusion restriction is violated. To address this, county-level covariates are included to minimize the threat of confounding.

Table 15

Characteristics of Washington Counties, by presence of CCB institutions

	Washington State (all counties)	CCB counties in Puget Sound area (King and Kitsap)	Other CCB counties (Clallam and Franklin)	Non-CCB counties
Population density	104.9	800.7	55.7	101.9
Median household income	$61,540	$68,820	$51,100	$49,840
Percent in poverty	13.2	11.3	16.8	16.3
Number of counties	39	2	2	35
Number of CCB institutions	4	2	2	0

Monotonicity. Monotonicity assumes that the effect of the instrument on the treatment condition works in the same way for all individuals. Therefore, being closer to an institution should increase the likelihood of attending that institution. Those who attend the nearest institution are the "compliers". There are also some who would always be in the treatment condition regardless of the instrument (the "always-takers") and those who would never be in the treatment condition regardless of the instrument (the "never-takers"). The "never-takers" would be those who would only attend a four-year college to earn a bachelor's degree and would not go to a CCB even if it were closer than the nearest TBA. This group is the most likely to occur. The "always-takers" are those who would only attend a CCB, regardless of distance, but it is difficult to imagine this scenario, particularly because one of the main justifications for the CCB is to make bachelor's degree programs more geographically accessible. It is also possible that some will take the opposite condition that they were assigned ("defiers,"), though this scenario is not very common and is hard to imagine in the case of college choice. The presence of defiers violates the monotonicity assumption. Therefore, IV results must be interpreted as the local average treatment effect (LATE) which describes the effect of the treatment on the outcome only for those who

comply with their treatment assignment. In this study, I estimate the effect of earning a bachelor's degree from a CCB or a TBA institution for students who enroll in the CCB because it is closer than a TBA, and those who enroll in a TBA because it is closer than a CCB. Interpreting the LATE means that I do not estimate the treatment effect for students who would only attend a CCB, or would only attend a TBA regardless of proximity.

Stable Unit Treatment Value Assumption (SUTVA). The SUTVA assumption, also referred to as "noninterference" or "treatment spillover effects," states that the treatment condition of Person A is unrelated to the outcome of Person B. If the outcomes of Person B are affected by the treatment of Person A, then the consequence is that the treatment effect would be underestimated (Dunning, 2012). Because the treatment in this study is the type of institution attended for the bachelor's degree, it is difficult to imagine a scenario in which the employment outcomes of Person B could be influenced by the institution type attended by Person A.

Summary of instrumental variables diagnostics. One of the main challenges associated with the instrumental variables approach is that good instruments (e.g. that are strong and valid) are difficult to find. The instrumental variables approach to estimation is often illustrated in the context of "natural experiments" that enable researchers "…to exploit situations where the forces of nature or government policy have conspired to produce an environment somewhat akin to a randomized experiment" (Angrist & Kreuger, 2001, p. 73). Assessing the quality of an instrument to determine whether it meets the required assumptions is yet another matter. It is imperative that significant attention be paid to assess the quality of an instrumental variable. Though the mechanics of IV analysis are relatively straightforward, the credibility of the analysis depends upon the argument that the instrument

meets the required assumptions (Dunning, 2012; Murray, 2006). Therefore, much of the effort for an IV analysis involves working through how well an instrument adequately meets the required assumptions.

There are many examples of the use of instrumental variables based on distance in studies of postsecondary education. The distance measures used as instruments in this study demonstrate sufficient strength and validity to produce unbiased estimates of the effect of earning a bachelor's degree on postbaccalaureate employment outcomes. The results of the correlations between covariates and the distance measures and the theoretical arguments about regional variation in resources and opportunities warrant the inclusion of covariates to remove any endogeneity between the distance instruments and employment outcomes.

Subgroup Analyses. The analysis sample contains a set of cases with data on the high school attended and GPA. These additional data elements enable a separate analysis that incorporates a measure of individual academic ability as well as information about quality of the high school attended. Results of this subsample analysis will reveal whether the estimates of the treatment effect are sensitive to additional covariates that control for variation in high school quality, which could possibly impact employment outcomes.

Estimation with fixed effects regression

While the IV method improves upon OLS regression by minimizing selection bias in the treatment variable, it is effective in doing so only to the extent that the instrumental variables meet the required assumptions. The review of the relationship between proximity to the nearest CCB and TBA institutions and the likelihood of being a CCB graduate mentioned above indicates that there may be some lingering endogeneity. I have argued that the distance instruments are ignorably random, conditional on the inclusion of covariates;

however, confidence in results from IV estimation is strongest when covariates are not required to meet the ignorably random assumption. As a robustness check, I also estimated the effect of earning a CCB on wages using fixed effects (FE) regression, which has advantages over OLS and IV regression because it controls for all time-stable characteristics (both observable and unobservable), making it an attractive option when there is concern about omitted variable bias. Similar results from the fixed effects model will strengthen confidence that the IV results are unbiased.

Fixed effects regression is an appropriate method to use with a panel data set that includes multiple measurements of the dependent variable over time (Allison, 2009; Wooldridge, 2013). Another requirement is that there are measures of key predictor variables that do vary in value over time. With these conditions, we can estimate the gains to earnings from college "as the individual-level increase in earnings between time periods "…when individuals have an award compared with time periods when they do not have an award…[and] within-person characteristics that are typically unobserved (e.g., ability) should be differenced out of the identified returns" (Belfield & Bailey, 2017, p. 1).

I used fixed effects to estimate the effect of graduating from a CCB on wages in the year after graduation and ran models separately by major. I limited the sample to the subset of cases with at least 4 quarters of employment prior to enrollment and observed wages through the fourth quarter following graduation. The data includes wages present in the unemployment insurance data files back to 2002 for a maximum of 48 quarters of pre-completion employment. I estimated the fixed effects model using the Stata *xtreg* command with the following equation (4):

$$PostBA\ wage_{it} = \beta_0 + \beta_1(Completion)_{it} + \beta_2(Completion_{it} * CCBA_{it}) + \beta_3(Enrolled)_{it} + \beta_4(Enrolled_{it} * CCBA_{it}) + \beta_5(AshDip2/3/4)_{it} + \beta_{6-8}(AshDip2/3/4_{it} * CCBA_{it}) + \rho_{i+}\ \eta_t + \varepsilon_{it} \quad (4)$$

where $PostBA\ wage_{it}$ is the median hourly wage measured for each individual in each quarter. $Completion$ is an indicator of bachelor's degree completion status; it is coded 0 in all quarters until degree completion and is then coded as a 1 in all subsequent observations. Because all cases in my sample earned a bachelor's degree, I interacted completion status with treatment status. $Completion_{it} * CCBA_{it}$ is an interaction term that allows the effect of degree completion on wages to vary by treatment status. This is the key coefficient of interest and indicates whether there is a differential effect of degree completion on wages between CCB and TBA graduates. $Enrolled_{it}$ is a dummy variable that is set to 1 for all quarters in which an individual was enrolled in college to control for any change in earnings due to enrollment. This is also interacted with treatment status as indicated by $Enrolled_{it} * CCBA_{it}$. To account for the phenomenon in which wages tend to decrease prior to enrolling in college (often referred to "Ashenfelter's Dip", (Ashenfelter, 1978)) and following the model set by Dadgar and Trimble (2015), I include dummy variables in $AshDip2/3/4$ to indicate the 2, 3, and 4 quarters just prior to beginning enrollment. These indicators are interacted with treatment status as indicated by $AshDip2/3/4_{it} * CCBA_{it}$. ρ_i is a dummy variable that captures the individual fixed effect which controls for all time-stable characteristics of that individual. η_t is a dummy variable that captures quarter fixed effects to account for variation in economic conditions over time that would affect all cases. The error term is represented by ε_{it}.

CHAPTER 4: RESULTS

This study examined the relationship between earning a bachelor's degree that is conferred by a community college and post-graduation employment outcomes (as measured by the state unemployment insurance data). Results presented in this chapter are organized by employment outcome and by estimation method. OLS regression results are presented followed by IV estimates using the strongest instruments based on the diagnostic tests described in chapter 3, the distance in log miles to the nearest CCB institution and distance to the nearest non-selective public four-year institution. First, I examined the effect of earning a CCB on the likelihood of being employed in any of the four quarters after degree completion. Next, I examined median hourly wages in the same post-graduation time frame. Results are presented separately by field of study and by subgroup. Estimates of CCB effects varied by model specification but in general provide evidence that CCB graduates fare as well or better than their TBA counterparts in the labor market in terms of employment status and hourly wages in the year after bachelor's degree completion.

Employed Within One Year of Graduation

OLS estimates of employment status within the year after graduation are presented in Table 16. Among graduates who majored in nursing, there was no statistical difference in the likelihood of employment, indicating that CCB and TBA nursing graduates were equally as likely to be employed in the year after graduation. Among business majors, the effect was significant and positive. CCB graduates who majored in business were about 8 percentage points more likely to be employed than TBA business majors.

Employment status was also analyzed for two subgroups (identified by their best pre-college location): the sample with high school information, which allowed the inclusion of

high school GPA as an additional covariate, and the sample with prior employment. The CCB effect was not significant for nursing majors in either the high school or prior employment subgroups. While CCB business majors were significantly more likely to be employed among the full sample, there was no difference between CCB and TBA graduates in the high school subgroup (which added a control for pre-treatment ability) or the prior employment subgroup.

IV estimates of the effect of earning a CCB on post-graduation employment status are shown in Table 17. In the first stage, treatment status was predicted with two instruments: the distance in miles to the nearest CCB institution and distance to the nearest non-selective public four-year institution. The second stage results, presented below, estimate employment status based on the predicted value of treatment status from the first stage. As described in chapter 3, IV estimates the local area treatment effect, or the effect of the treatment on the set of cases whose institution choice is predicted by its proximity.

Among the full sample, the IV estimate of the CCB effect on employment status is similar to the OLS estimate in that it is significant and positive, though the effect is slightly larger at just above 8 percentage points. Though the OLS model did not detect a difference between CCB and TBA nursing majors, the IV model estimates that CCB nursing graduates are about 33 percentage points more likely to be employed than TBA nursing graduates. Like the OLS models, the IV models showed that there was no statistical difference in employment status between CCB and TBA graduates in either nursing or business majors for the high school and prior employment subgroups. The effect observed in the full sample is driven by the remaining cases not included in either subgroup (e.g. the cases whose best pre-college location was based on residence reported at the time of application).

As described in chapter 3, it is important that the instrumental variables are strong predictors of treatment status. IV estimates based on weak instruments can be even more biased than an OLS estimate and are less efficient than OLS. To determine if the instruments are weak, I checked the following for each model:

- The first-stage *F*-statistic is statistically significant at the 0.05 level,
- The first-stage *F*-statistic exceeds the critical value for the 2SLS size of nominal 5% Wald test at the 10% level. This is a test of the null hypothesis at the 5% level that the maximum relative bias is at least 10% (Stock & Yogo, 2005, p. 32).

The first-stage *F*-statistics are shown in Table 17, and can be compared with the 2SLS size of nominal 5% Wald test for the models with one endogenous regressor and two instruments which is 19.9 (Stock & Yogo, 2005, table 2). Weak instruments can lead to bias in estimators and can also result in rejection rates of null hypotheses that exceed 5%. All models can reject the null hypothesis that the instruments are weak except for the nursing graduates in the high school group. Therefore, we should not have confidence in the result for this one specification due to the weak relationship between the distance instruments and treatment status for the high school subgroup that majored in nursing.

Table 16

Employed Within One Year of Graduation, OLS Regression Results

	Full Sample		High School Subgroup		Prior Employment Subgroup	
Variable	Nursing	Business	Nursing	Business	Nursing	Business
CCB Graduate	0.034	0.075***	0.146	0.091	-0.015	0.041
	(0.032)	(0.027)	(0.158)	(0.062)	(0.039)	(0.042)
Age at graduation	0.003	-0.014**	0.133	-0.009	0.009	-0.031***
	(0.005)	(0.006)	(0.272)	(0.055)	(0.006)	(0.011)
Age at graduation, squared	0.000	0.000	-0.003	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.006)	(0.001)	(0.000)	(0.000)
Number of quarters employed before graduation	0.002**	0.002***	-0.001	0.002*	0.002*	0.003**
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Female	0.028*	0.043***	0.065	0.034**	-0.002	0.055***
	(0.016)	(0.010)	(0.049)	(0.015)	(0.021)	(0.020)
Black	0.039	-0.039	0.097	-0.066	0.050	0.056
	(0.027)	(0.032)	(0.154)	(0.051)	(0.035)	(0.063)
Asian	0.007	-0.042**	0.048	-0.057**	0.001	0.003
	(0.023)	(0.018)	(0.067)	(0.027)	(0.030)	(0.036)
American Indian	0.012	-0.005	-0.009	0.006	-0.002	-0.047
	(0.038)	(0.030)	(0.111)	(0.041)	(0.045)	(0.063)
White	0.024	0.013	-0.002	0.010	0.010	0.047
	(0.017)	(0.016)	(0.050)	(0.024)	(0.022)	(0.029)
Hispanic	-0.049*	0.024	-0.019	0.035	-0.049	0.065
	(0.026)	(0.024)	(0.065)	(0.038)	(0.037)	(0.045)
Median household income of county, logged	-0.045	0.106	0.032	0.140	-0.096	0.174
	(0.101)	(0.103)	(0.258)	(0.160)	(0.155)	(0.194)
Percent in poverty, all ages	0.002	0.004	0.013	0.005	-0.003	0.010
	(0.004)	(0.004)	(0.013)	(0.008)	(0.007)	(0.009)
County unemployment rate, 2009	-0.012***	0.004	-0.013	0.007	-0.019***	0.005
	(0.004)	(0.006)	(0.012)	(0.008)	(0.006)	(0.012)

Table 16 Continued

County population density, 2010	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
High School GPA			0.036	-0.004		
			(0.034)	(0.018)		
Constant	1.325	-0.159	-1.238	-0.613	1.933	-0.774
	(1.155)	(1.190)	(4.541)	(1.979)	(1.770)	(2.253)
N	2,440	3,670	410	1,530	1,210	1,150

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 17

Employed Within One Year of Graduation, IV Regression Results

	Full Sample		**High School Subgroup**		**Prior Employment Subgroup**	
Variable	Nursing	Business	Nursing	Business	Nursing	Business
CCB Graduate	0.327***	0.083*	4.469	0.104	0.074	0.070
	(0.093)	(0.050)	(3.501)	(0.170)	(0.103)	(0.061)
Age at graduation	0.000	-0.014**	-0.243	-0.008	0.008	-0.030***
	(0.005)	(0.006)	(0.549)	(0.058)	(0.006)	(0.011)
Age at graduation, squared	0.000	0.000	0.005	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.012)	(0.001)	(0.000)	(0.000)
Number of quarters employed before graduation	0.002***	0.002***	0.001	0.002*	0.002*	0.003**
	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.001)
Female	0.025	0.043***	0.019	0.034**	-0.004	0.056***
	(0.016)	(0.010)	(0.090)	(0.015)	(0.021)	(0.020)
Black	0.036	-0.039	0.133	-0.066	0.050	0.058
	(0.027)	(0.032)	(0.260)	(0.050)	(0.034)	(0.063)

Table 17 continued

Asian	0.000	-0.042**	-0.066	-0.057**	0.000	0.004
	(0.023)	(0.018)	(0.145)	(0.027)	(0.030)	(0.035)
American Indian	0.020	-0.005	0.049	0.006	0.001	-0.047
	(0.038)	(0.030)	(0.191)	(0.042)	(0.045)	(0.063)
White	0.023	0.013	-0.070	0.010	0.010	0.048
	(0.018)	(0.016)	(0.100)	(0.024)	(0.022)	(0.029)
Hispanic	-0.052**	0.023	-0.156	0.034	-0.048	0.064
	(0.026)	(0.024)	(0.155)	(0.038)	(0.037)	(0.044)
Median household income of county, logged	0.058	0.111	0.632	0.142	-0.043	0.193
	(0.107)	(0.106)	(0.650)	(0.161)	(0.164)	(0.195)
Percent in poverty, all ages	0.010*	0.004	0.059	0.005	0.001	0.011
	(0.005)	(0.004)	(0.043)	(0.008)	(0.008)	(0.009)
County unemployment rate, 2009	-0.005	0.004	0.006	0.007	-0.016**	0.004
	(0.005)	(0.006)	(0.025)	(0.008)	(0.007)	(0.012)
County population density, 2010	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
High School GPA			0.153	-0.003		
			(0.111)	(0.017)		
Constant	0.082	-0.214	-4.490	-0.650	1.291	-0.992
	(1.229)	(1.227)	(8.064)	(2.024)	(1.893)	-2.264
Observations	2,440	3,670	410	1,530	1,210	1,150
First Stage F-statistic	162.3	781.0	1.1	113.1	99.7	526.4
Partial *R*-squared	0.12	0.30	0.01	0.13	0.14	0.48

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Median Hourly Wages Within One Year of Graduation

In the next set of models, I examined the effects of graduating from a CCB on post-graduation wages. Here, I included wages in various quarters prior to degree completion in addition to the covariates used in the models of employment status to control for wages associated with employment before or during enrollment that could be related to post-graduation wages. I tested 3 models with different time controls (2, 4, and 6 years before degree completion) because of the variation in age at degree completion and amount of prior work experience among the analysis sample. Wages from two years prior to degree completion could be an important control for students who may have had an associate's degree and were working full-time before enrolling to complete the last two years of the bachelor's degree. For students who were enrolled full-time for four years, wages prior to enrollment (e.g. four or six years before degree completion) might be a better control. Table 18 presents results of OLS regression models estimating median hourly wages for CCB and TBA graduates who majored in nursing, and Table 19 presents OLS estimates for business major graduates. OLS estimates indicate that post-graduation wages are not statistically different for nursing or business majors in any of the specifications controlling for pre-completion wages.

Table 18

Wages for Nursing Majors Within One Year of Graduation, OLS Regression Results

Variable	Model 1	Model 2	Model 3
CCB Graduate	1.709	1.049	1.323
	(1.512)	(1.448)	(1.579)
Age at graduation	0.125	0.654***	0.616**
	(0.255)	(0.245)	(0.311)
Age at graduation, squared	-0.001	-0.007**	-0.007*
	(0.003)	(0.003)	(0.004)
Number of quarters employed before graduation	-0.076*	-0.029	-0.076
	(0.043)	(0.042)	(0.057)
Female	0.223	-0.186	0.313
	(0.800)	(0.770)	(0.907)
Black	-1.009	-0.460	-0.916
	(1.201)	(1.175)	(1.320)
Asian	-0.213	-0.056	1.561
	(1.201)	(1.139)	(1.336)
American Indian	0.617	-0.560	-0.574
	(1.951)	(1.829)	(2.063)
White	-0.073	0.462	1.536
	(0.875)	(0.831)	(0.956)
Hispanic	0.085	0.473	0.567
	(1.324)	(1.261)	(1.426)
Median household income of county, logged	8.218	5.713	9.175
	(5.770)	(5.367)	(6.559)
Percent in poverty, all ages	0.246	0.043	-0.037
	(0.234)	(0.225)	(0.271)
County unemployment rate, 2009	0.545**	0.649***	0.766**
	(0.255)	(0.242)	(0.305)
County population density, 2010	-0.005**	-0.006***	-0.009***
	(0.002)	(0.002)	(0.002)
Quarterly wage - pre-completion Q9	0.072***		
	(0.027)		
Quarterly wage - pre-completion Q10	0.149***		
	(0.034)		
Quarterly wage - pre-completion Q11	0.139***		
	(0.031)		
Quarterly wage - pre-completion Q12	0.161***		
	(0.035)		
Quarterly wage - pre-completion Q17		0.255***	
		(0.044)	
Quarterly wage - pre-completion Q18		0.109**	
		(0.043)	
Quarterly wage - pre-completion Q19		-0.009	
		(0.040)	
Quarterly wage - pre-completion Q20		0.067*	
		(0.036)	

Table 18 Continued

Quarterly wage - pre-completion Q25			0.037
			(0.047)
Quarterly wage - pre-completion Q26			0.274***
			(0.072)
Quarterly wage - pre-completion Q27			0.045
			(0.059)
Quarterly wage - pre-completion Q28			0.070
			(0.059)
Constant	-74.040	-53.340	-87.450
	(65.920)	(61.410)	(75.180)
Observations	1,120	1,300	860

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Model 1 includes controls for wages measured 2 years before degree completion. Model 2 includes controls for wages measured 4 years before degree completion. Model 3 includes controls for wages measured 6 years before degree completion.

Table 19

Wages for Business Majors Within One Year of Graduation, OLS Regression Results

Variable	**Model 1**	**Model 2**	**Model 3**
CCB Graduate	0.734	1.454*	1.420
	(0.835)	(0.873)	(1.294)
Age at graduation	0.283	0.498**	0.062
	(0.221)	(0.232)	(0.376)
Age at graduation, squared	-0.003	-0.005	0.000
	(0.003)	(0.003)	(0.005)
Number of quarters employed before graduation	-0.035	-0.033	-0.044
	(0.032)	(0.034)	(0.065)
Female	-0.362	-0.232	-0.043
	(0.357)	(0.376)	(0.655)
Black	-1.195	-2.080*	-2.239
	(1.176)	(1.193)	(1.860)
Asian	-0.263	-1.121*	-0.944
	(0.632)	(0.678)	(1.179)
American Indian	-0.905	-0.733	-1.527
	(1.109)	(1.224)	(2.258)
White	1.061**	0.630	0.938
	(0.515)	(0.546)	(0.926)
Hispanic	0.699	0.668	1.269
	(0.776)	(0.827)	(1.327)

Table 19 Continued

Median household income of county, logged	0.582	4.993	5.310
	(3.542)	(3.615)	(6.600)
Percent in poverty, all ages	0.008	0.158	0.105
	(0.146)	(0.152)	(0.263)
County unemployment rate, 2009	-0.226	-0.056	0.127
	(0.276)	(0.267)	(0.540)
County population density, 2010	-0.002	-0.002**	-0.002
	(0.001)	(0.001)	(0.002)
Quarterly wage - pre-completion Q9	0.168***		
	(0.027)		
Quarterly wage - pre-completion Q10	0.0515*		
	(0.027)		
Quarterly wage - pre-completion Q11	0.274***		
	(0.034)		
Quarterly wage - pre-completion Q12	0.293***		
	(0.041)		
Quarterly wage - pre-completion Q17		0.157***	
		(0.026)	
Quarterly wage - pre-completion Q18		0.0752**	
		(0.030)	
Quarterly wage - pre-completion Q19		0.181***	
		(0.026)	
Quarterly wage - pre-completion Q20		0.127***	
		(0.028)	
Quarterly wage - pre-completion Q25			0.188***
			(0.058)
Quarterly wage - pre-completion Q26			0.200***
			(0.054)
Quarterly wage - pre-completion Q27			0.217***
			(0.055)
Quarterly wage - pre-completion Q28			0.060
			(0.059)
Constant	-1.577	-52.610	-49.130
	(41.310)	(42.090)	(76.860)
Observations	1,300	1,590	750

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Model 1 includes controls for wages measured 2 years before degree completion. Model 2 includes controls for wages measured 4 years before degree completion. Model 3 includes controls for wages measured 6 years before degree completion.

Tables 20 and 21 provide IV estimates of the effects on median hourly wages one year after degree completion for nursing and business majors, respectively. The 2SLS size of nominal 5% Wald test for the models presented in Tables 20 and 21 is 19.9, and all specifications exceed this threshold. Among the set of cases whose decision to attend a CCB

is influenced by distance (e.g. compliers), CCB graduates earned significantly higher wages by about $7 per hour than TBA nursing graduates in the year after graduation when controlling for wages earned in the 2 years and 4 years before completion. When wages from 6 years before completion were included, the effect was no longer significant, but the size of the coefficient is similar, about $5 per hour. As shown in Table 21, post-graduation wages for CCB and TBA business majors were statistically equivalent.

Table 20

Wages for Nursing Majors Within One Year of Graduation, IV Regression Results

Variable	**Model 1**	**Model 2**	**Model 3**
CCB Graduate	6.895**	7.520**	5.027
	(-3.320)	(-3.499)	(-3.106)
Age at graduation	-0.147	0.611**	0.669**
	(-0.202)	(-0.246)	(-0.272)
Age at graduation, squared	0.002	-0.007**	-0.007**
	(-0.003)	(-0.003)	(-0.003)
Number of quarters employed before graduation	-0.056*	-0.032	-0.076
	(-0.029)	(-0.042)	(-0.053)
Female	0.061	-0.237	0.010
	(-0.655)	(-0.771)	(-0.813)
Black	-0.956	-0.570	-1.286
	(-1.048)	(-1.177)	(-1.256)
Asian	-0.227	-0.176	1.098
	(-0.976)	(-1.141)	(-1.206)
American Indian	0.905	-0.247	-0.438
	(-1.563)	(-1.836)	(-1.925)
White	-0.264	0.470	1.051
	(-0.739)	(-0.832)	(-0.883)
Hispanic	-1.081	0.547	0.711
	(-1.110)	(-1.262)	(-1.320)
Median household income of county, logged	9.319**	8.727	10.570*
	(-4.618)	(-5.570)	(-6.062)
Percent in poverty, all ages	0.453**	0.261	0.151
	(-0.207)	(-0.249)	(-0.276)
County unemployment rate, 2009	0.455**	0.843***	0.691**
	(-0.216)	(-0.260)	(-0.286)
County population density, 2010	-0.004**	-0.004**	-0.008***
	(-0.002)	(-0.002)	(-0.002)

Table 20 Continued

Quarterly wage - pre-completion Q9	0.0915***		
	(-0.023)		
Quarterly wage - pre-completion Q10	0.102***		
	(-0.027)		
Quarterly wage - pre-completion Q11	0.128***		
	(-0.026)		
Quarterly wage - pre-completion Q12	0.192***		
	(-0.029)		
Quarterly wage - pre-completion Q17		0.261***	
		(-0.045)	
Quarterly wage - pre-completion Q18		0.102**	
		(-0.043)	
Quarterly wage - pre-completion Q19		-0.009	
		(-0.040)	
Quarterly wage - pre-completion Q20		0.0698*	
		(-0.036)	
Quarterly wage - pre-completion Q25			0.010
			(-0.042)
Quarterly wage - pre-completion Q26			0.291***
			(-0.063)
Quarterly wage - pre-completion Q27			0.069
			(-0.055)
Quarterly wage - pre-completion Q28			0.035
			(-0.051)
Constant	-83.970	-90.060	-105.800
	(-53.060)	(-64.040)	(-70.010)
N	1,500	1,300	1,030
First Stage F-statistic	137.2	132.8	137.4
Partial *R*-squared	0.15	0.17	0.21

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Model 1 includes controls for wages measured 2 years before degree completion. Model 2 includes controls for wages measured 4 years before degree completion. Model 3 includes controls for wages measured 6 years before degree completion.

Table 21

Wages for Business Majors Within One Year of Graduation, IV Regression Results

Variable	Model 1	Model 2	Model 3
CCB Graduate	0.799	1.013	1.383
	(1.215)	(1.492)	(1.661)
Age at graduation	0.268	0.489**	0.052
	(0.177)	(0.231)	(0.314)
Age at graduation, squared	-0.002	-0.004	0.000
	(0.003)	(0.003)	(0.004)
Number of quarters employed before graduation	-0.035*	-0.032	-0.045
	(0.021)	(0.034)	(0.054)
Female	-0.596**	-0.236	0.038
	(0.276)	(0.374)	(0.539)
Black	-0.449	-2.082*	-1.976
	(0.942)	(1.186)	(1.549)
Asian	-0.554	-1.130*	-1.440
	(0.487)	(0.674)	(0.964)
American Indian	-0.627	-0.745	-1.055
	(0.819)	(1.217)	(1.670)
White	0.905**	0.631	0.290
	(0.412)	(0.542)	(0.769)
Hispanic	1.027*	0.693	0.159
	(0.624)	(0.825)	(1.060)
Median household income of county, logged	3.410	4.677	4.386
	(2.799)	(3.697)	(5.472)
Percent in poverty, all ages	0.069	0.145	0.203
	(0.118)	(0.155)	(0.225)
County unemployment rate, 2009	-0.024	-0.033	-0.055
	(0.190)	(0.274)	(0.438)
County population density, 2010	-0.002***	-0.002**	-0.002
	(0.001)	(0.001)	(0.002)
Quarterly wage - pre-completion Q9	0.161***		
	(0.021)		
Quarterly wage - pre-completion Q10	0.0598***		
	(0.020)		
Quarterly wage - pre-completion Q11	0.270***		
	(0.024)		
Quarterly wage - pre-completion Q12	0.172***		
	(0.025)		
Quarterly wage - pre-completion Q17		0.157***	
		(0.026)	
Quarterly wage - pre-completion Q18		0.075**	
		(0.030)	
Quarterly wage - pre-completion Q19		0.181***	
		(0.026)	
Quarterly wage - pre-completion Q20		0.127***	
		(0.028)	

Table 21 continued

Quarterly wage - pre-completion Q25			0.164***
			(0.050)
Quarterly wage - pre-completion Q26			0.208***
			(0.049)
Quarterly wage - pre-completion Q27			0.231***
			(0.050)
Quarterly wage - pre-completion Q28			0.068
			(0.052)
Constant	-32.790	-49.120	-38.180
	(32.440)	(42.920)	(63.370)
N	2,150	1,590	960
First Stage F-statistic	524.2	400.1	386.8
Partial *R*-squared	0.33	0.34	0.45

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Model 1 includes controls for wages measured 2 years before degree completion. Model 2 includes controls for wages measured 4 years before degree completion. Model 3 includes controls for wages measured 6 years before degree completion.

Table 22 presents OLS estimates of wages among the high school subgroup, and Table 23 includes results for the prior employment subgroup. IV estimates of wages are shown for the high school and prior employment subgroups in Tables 24 and 25, respectively. The subgroup models include wages from four years prior to degree completion. The OLS models for both subgroups show no detectable difference in wages for either major. In the IV model for nursing majors in the high school subgroup, the first stage *F*-statistic of 1.4 is below the with the 2SLS size of nominal 5% Wald test for the models which is 19.9, indicating that the instruments are too weak to estimate the treatment effect. CCB nursing majors in the prior employment subgroup, however, earn about $8 more per hour than TBA graduates. Among business majors, there was no significant difference in post-graduation wages for CCB and TBA graduates in either subgroup.

Table 22

High School Subgroup Wages Within One Year of Graduation, OLS Regression Results

Variable	Nursing	Business
CCB Graduate	-1.979	3.065*
	(8.424)	(1.655)
Age at graduation	-0.331	1.576
	(22.600)	(1.316)
Age at graduation, squared	0.013	-0.027
	(0.481)	(0.026)
Number of quarters employed before graduation	0.202	0.018
	(0.272)	(0.054)
Female	-1.163	-0.389
	(3.837)	(0.459)
Black	1.687	-0.011
	(9.744)	(1.436)
Asian	2.705	-1.394*
	(5.205)	(0.815)
American Indian	15.470	-0.270
	(10.280)	(1.274)
White	1.059	-0.023
	(3.770)	(0.682)
Hispanic	-1.074	0.785
	(5.237)	(1.056)
Median household income of county, logged	42.92**	-0.086
	(20.700)	(4.789)
Percent in poverty, all ages	1.386	0.023
	(1.048)	(0.241)
County unemployment rate, 2009	0.275	0.177
	(0.954)	(0.293)
County population density, 2010	-0.0193**	0.001
	(0.008)	(0.001)
Quarterly wage (earnings/hours) - Q17	0.428	0.482***
	(0.359)	(0.080)
Quarterly wage (earnings/hours) - Q18	-0.050	-0.049
	(0.633)	(0.047)
Quarterly wage (earnings/hours) - Q19	-0.063	-0.034
	(0.392)	(0.058)
Quarterly wage (earnings/hours) - Q20	-0.128	-0.0797*
	(0.510)	(0.043)
High School GPA	-0.155	1.281**
	(2.754)	(0.539)
Constant	-461.300	-13.640
	(388.000)	(58.570)

Table 22 Continued

Observations	150	580
R-squared	0.12	0.12

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 23

Prior Employment Subgroup Wages Within One Year of Graduation, OLS Regression Results

Variable	**Nursing**	**Business**
CCB Graduate	1.586	1.567
	(1.750)	(1.226)
Age at graduation	0.556	0.213
	(0.342)	(0.373)
Age at graduation, squared	-0.007	-0.002
	(0.004)	(0.005)
Number of quarters employed before graduation	-0.067	-0.135***
	(0.055)	(0.052)
Female	0.821	0.377
	(1.003)	(0.619)
Black	-1.194	-2.695
	(1.487)	(2.026)
Asian	-0.089	-2.827**
	(1.475)	(1.175)
American Indian	-0.593	0.394
	(2.139)	(2.150)
White	1.183	-0.287
	(1.059)	(0.942)
Hispanic	-0.644	-0.180
	(1.743)	(1.351)
Median household income of county, logged	0.308	6.347
	(8.369)	(6.047)

Table 23 Continued

Percent in poverty, all ages	-0.174	0.505*
	(0.377)	(0.306)
County unemployment rate, 2009	0.527*	-0.704
	(0.313)	(0.459)
County population density, 2010	-0.005**	-0.004**
	(0.002)	(0.002)
Quarterly wage (earnings/hours) - Q17	0.288***	0.117***
	(0.051)	(0.031)
Quarterly wage (earnings/hours) - Q18	0.059	0.189***
	(0.047)	(0.052)
Quarterly wage (earnings/hours) - Q19	0.005	0.171***
	(0.044)	(0.043)
Quarterly wage (earnings/hours) - Q20	0.063	0.256***
	(0.042)	(0.055)
Constant	12.130	-58.830
	(96.060)	(70.660)
Observations	720	570
R-squared	0.40	0.51

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 24

High School Subgroup Wages Within One Year of Graduation, IV Regression Results

Variable	**Nursing**	**Business**
CCB Graduate	12.390	-1.110
	(54.180)	(3.702)
Age at graduation	-6.636	0.966
	(31.690)	(1.388)
Age at graduation, squared	0.147	-0.014
	(0.674)	(0.028)
Number of quarters employed before graduation	0.196	0.020
	(0.257)	(0.053)
Female	-1.430	-0.405
	(3.741)	(0.454)
Black	2.628	-0.088
	(9.806)	(1.421)
Asian	2.096	-1.434*
	(5.393)	(0.806)
American Indian	15.540	-0.091
	(9.667)	(1.267)
White	1.271	0.038
	(3.630)	(0.675)

Table 24 Continued

Hispanic	-0.444	0.831
	(5.454)	(1.045)
Median household income of county, logged	44.260**	-0.148
	(20.080)	(4.73)
Percent in poverty, all ages	1.567	0.0319
	(1.194)	(0.239)
County unemployment rate, 2009	0.450	0.193
	(1.108)	(0.290)
County population density, 2010	-0.017	0.001
	(0.011)	(0.001)
Quarterly wage - pre-completion Q17	0.436	0.474***
	(0.339)	(0.079)
Quarterly wage - pre-completion Q18	-0.004	-0.052
	(0.619)	(0.046)
Quarterly wage - pre-completion Q19	-0.042	-0.028
	(0.377)	(0.057)
Quarterly wage - pre-completion Q20	-0.174	-0.082*
	(0.508)	(0.043)
High School GPA	1.129	1.173**
	(5.441)	(0.539)
Constant	-411.100	-5.933
	(409.900)	(58.200)
N	150	580
First Stage *F*-statistic	1.4	67.6
Partial *R*-squared	0.02	0.20

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Models include controls for wages measured 4 years before degree completion

Table 25

Prior Employment Subgroup Wages Within One Year of Graduation, IV Regression Results

Variable	**Nursing**	**Business**
CCB Graduate	8.170**	2.525
	(3.752)	(1.776)
Age at graduation	0.503	0.247
	(0.342)	(0.370)
Age at graduation, squared	-0.006	-0.002
	(0.004)	(0.005)
Number of quarters employed before graduation	-0.075	-0.139***
	(0.055)	(0.051)
Female	0.724	0.375
	(1.001)	(0.609)
Black	-1.263	-2.618
	(1.482)	(1.996)

Table 25 Continued

Asian	-0.164	-2.806**
	(1.470)	(1.156)
American Indian	-0.254	0.502
	(2.139)	(2.120)
White	1.223	-0.279
	(1.055)	(0.927)
Hispanic	-0.705	-0.241
	(1.737)	(1.332)
Median household income of county, logged	6.585	7.068
	(8.921)	(6.029)
Percent in poverty, all ages	0.254	0.520*
	(0.433)	(0.302)
County unemployment rate, 2009	0.781**	-0.767*
	(0.337)	(0.460)
County population density, 2010	-0.003	-0.005***
	(0.002)	(0.002)
Quarterly wage - pre-completion Q17	0.291***	0.118***
	(0.051)	(0.031)
Quarterly wage - pre-completion Q18	0.053	0.188***
	(0.047)	(0.052)
Quarterly wage - pre-completion Q19	0.006	0.170***
	(0.044)	(0.042)
Quarterly wage - pre-completion Q20	0.065	0.256***
	(0.042)	(0.054)
Constant	-62.800	-66.700
	(102.900)	(70.330)
N	720	570
R-squared	0.39	0.51
First Stage *F*-statistic	96.3	235.8
Partial *R*-squared	0.22	0.46

Note. Counts have been rounded to the nearest ten. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Models include controls for wages measured 4 years before degree completion

As a sensitivity check, I ran an individual fixed effects model to compare CCB and TBA post-graduation wages. The OLS models relied on observable control variables to estimate the relationship between institution type and post-graduation wages. The IV models relied on measures of proximity to the nearest CCB and TBA institutions to isolate the effect of the CCB on wages. With fixed effects regression, each individual serves as their own control because the outcome is measured over time and compared before and after the treatment occurs. Therefore, the fixed effects model controls for all individual-level

attributes that are constant over time. Table 26 provides results of the fixed effects estimation. Both nursing and business majors experience a significant and positive effect on wages after graduation. The coefficient of interest for this study, however, is the interaction of bachelor's degree completion and treatment status which represents the effect of degree completion for CCB graduates. The fixed effects regression results show that there are no significant differences between CCB and TBA graduates in hourly wages measured in the year after graduation for both nursing and business majors.

Table 26

Wages Within One Year of Graduation, Fixed Effects Regression Results

Variable	**Nursing**	**Business**
Bachelor's degree completion indicator	6.584***	7.418***
	(0.628)	(0.387)
Bachelor's degree completion indicator * treatment status	-1.091	-1.498
	(1.509)	(0.960)
Enrollment status indicator	3.529***	6.227***
	(0.411)	(0.282)
Enrollment status indicator * treatment status	0.512	-0.807
	(0.913)	(0.700)
Two quarters before enrollment	1.123**	1.368***
	(0.446)	(0.356)
Three quarters before enrollment	0.671*	1.468***
	(0.379)	(0.342)
Four quarters before enrollment	0.645*	1.319***
	(0.359)	(0.335)
Two quarters before enrollment * treatment status	-0.191	1.276
	(1.408)	(0.955)
Three quarters before enrollment * treatment status	0.753	2.585
	(1.955)	(1.615)
Four quarters before enrollment * treatment status	1.224	1.615
	(1.527)	(1.025)
Constant	18.45***	11.49***
	(0.560)	(0.732)
N (observations)	51,100	57,030
R-squared	0.16	0.08
N (graduates)	1,300	1,590
Quarter Fixed Effects	Yes	Yes

Note. Counts have been rounded to the nearest ten. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Summary

This study used multiple techniques to estimate the effect of earning a CCB on employment status and wages in the year after bachelor's degree completion and found that the results were sensitive to the estimation strategy. Among nursing majors, the OLS model found no difference in employment status, but the IV model estimated that CCB graduates were over 30% more likely to be employed in the year after graduation. This effect was not observed among either the high school or prior employment subgroups, however, so the effect was driven largely by the sample not classified in either subgroup. Among the full sample of business majors, the OLS model showed that CCB graduates were about 8% more likely to be employed in the year after graduation, but the IV model detected no difference. No differences in employment status were found among business majors in either of the subgroups analyzed.

In terms of wages, OLS models showed no difference between CCB and TBA graduates among business majors. The IV models estimated that CCB nursing graduates earned between $6.90 and $7.52 per hour more than TBA graduates in models that controlled for pre-completion wages in the 2 and 4 years prior to graduation, respectively. However, upon inclusion of 6-year pre-completion wages, the CCB effect became non-significant. Among business majors, there was no observable difference in wages between CCB and TBA graduates in any specification. The FE model also showed no difference in wages between CCB and TBA graduates in both fields. Tables 27, 28, and 29 summarize the effects of graduating from a CCB on employment status and wages one year after degree completion.

Table 27

Summary of CCB effect on employment status, by field and estimation method

	Employed	
Estimation Method	OLS	IV
Nursing		
Full sample	No effect	**Positive**
High school subgroup	No effect	No effect [1]
Prior employment subgroup	No effect	No effect
Business		
Full sample	**Positive**	No effect
High school subgroup	No effect	No effect
Prior employment subgroup	No effect	No effect

[1] *F*-statistic did not exceed the critical value to reject the null hypothesis that the instruments are weak.

Table 28

Summary of CCB effect on wages for Nursing Majors, by estimation method

	Wages		
Estimation Method	OLS	IV	FE
			No effect
Controls for wages measured 2 years prior to degree completion	No effect	**Positive**	
Controls for wages measured 4 years prior to degree completion	No effect	**Positive**	
Controls for wages measured 6 years prior to degree completion	No effect	No effect	
High school subgroup with controls for wages measured 4 years prior to degree completion	No effect	No effect [1]	
Prior employment subgroup controls for wages measured 4 years prior to degree completion	No effect	**Positive**	

[1] *F*-statistic did not exceed the critical value to reject the null hypothesis that the instruments are weak.

Table 29

Summary of CCB effect on wages for Business Administration Majors, by estimation method

	Wages		
Estimation Method	OLS	IV	FE
			No effect
Controls for wages measured 2 years prior to degree completion	No effect	No effect	
Controls for wages measured 4 years prior to degree completion	No effect	No effect	
Controls for wages measured 6 years prior to degree completion	No effect	No effect	
High school subgroup with controls for wages measured 4 years prior to degree completion	No effect	No effect [1]	
Prior employment subgroup controls for wages measured 4 years prior to degree completion	No effect	No effect	

[1] *F*-statistic did not exceed the critical value to reject the null hypothesis that the instruments are weak.

CHAPTER 5: DISCUSSION

Summary of methods and findings

The purpose of this inquiry was to assess whether a bachelor's degree conferred by a community college holds the same value in the labor market as a bachelor's degree in the same field awarded by a 4-year college or university as measured by employment status and median hourly wages in the first year following degree completion. Critics of the CCB contend that a bachelor's degree conferred by a community college will be of lesser quality and will put graduates at a disadvantage in the labor market. Yet, to date, there has been no empirical comparison of employment outcomes between CCB and TBA graduates. The results of this study provide credible evidence that the short-term employment outcomes for graduates of CCB and TBA institutions who majored in nursing and business administration are comparable, which refutes the unsubstantiated concerns of CCB critics.

Using administrative data obtained for students who earned a bachelor's degree from a Washington State public 2- or 4-year institution between 2009 and 2014, I applied quasi-experimental estimation techniques to compare employment outcomes measured in the year after graduation between CCB and TBA graduates. The analysis sample included graduates who majored in the two fields with the most graduates in both institution types: nursing and business administration. In addition to the full sample, I also identified two subgroups of interest based on individual characteristics: cases with high school information available to include a measure of pre-college academic ability, and cases with employment history prior to enrollment. The high school subgroup was analyzed separately because they are on average younger (average age at degree completion is 22.7), have a lower percentage of female graduates than the overall sample (57 vs 63 percent female), and have approximately

3.5 years of prior employment history (see Table 9). The subgroup with prior employment is older (average age at degree completion is 31.5), have an average of 5.8 years of employment experience, and is about 67 percent female.

First, I estimated employment status with OLS and IV regression by field and by subgroup. I then modeled post-graduation wages in the year after degree completion with OLS, IV, and FE. The OLS and IV wage models included measures of wages earned prior to degree completion in addition to the other model covariates. The FE models were run on the sample of cases included in the IV wage models and required pre-completion wage observations.

Discussion of Findings

Employment status. The effects of earning a CCB on employment status were somewhat sensitive to estimation method. As discussed in chapter 3, it is likely that the OLS estimates are biased due to selection into institution type, so the estimates produced by the IV models are the more credible findings when comparing these two approaches. Among business administration majors, the CCB effect on employment status was positive based on the OLS model in the full sample specification, but not significant in the IV model. This suggests that, to the extent that the distance instruments used in the IV model simulated random assignment, the OLS estimate is biased upwards. The positive effect observed in the OLS model of the full sample became non-significant in the high school and prior employment subgroups.

For nursing majors, the opposite was true: OLS showed no difference in employment status, but the IV model estimated a very large positive effect indicating that nursing CCB graduates were about 33% more likely to be employed than their TBA counterparts. It is

possible that this large effect is related to the location of the CCB institution that awarded nursing degrees. For instance, the demand for BSN nurses could be higher in the service area of this institution than in other areas. There could also be a higher concentration of residents who are elderly or very young, both being populations that require more intensive health care than residents. No difference was observed in the subgroup analyses of nursing graduates.

In summary, none of the specifications showed a negative effect of earning a CCB degree. Assuming that the IV estimates are more credible than those from the OLS models, then CCB graduates were as likely or more likely than TBA graduates to be employed in the year after graduation. Thus, there is no evidence to support the hypothesis that potential employers view the CCB as a signal that the degree is of lower quality than a TBA degree in the same major.

As discussed in the literature review, analyses of the effects of education on employment outcomes have often been examined through the lens of signaling effects where the credential is believed to reflect the underlying ability of an individual more so than the knowledge and skills obtained through education (Baum et al., 2013; Bills, 2003; Darolia et al., 2015; Deming et al., 2013; Monks, 2000). In the current study, a negative effect on employment status for the treatment group could suggest that the CCB sends a negative signal of applicant quality to prospective employers. Employers may assume that the TBA would provide a more rigorous program of study, but it could be simply because community colleges are generally open admission. It may be not widely known that CCB programs are not open admission and have admission requirements that are comparable to non-selective TBA institutions.

The lack of a negative CCB effect on employment may seem somewhat surprising in light of the negative signaling effects found in experimental studies of resumes to examine the impacts of graduating from a for-profit institution (Darolia et al., 2015; Deming et al., 2016). Darolia et al., (2015) found no difference in interview request rates between applicants with a for-profit college when compared to a community college, but they also found no difference in rates between applicants who had earned a for-profit credential and applicants with no college at all. On the other hand, Deming et. al. (2016) found a clear negative effect on interview callback rates among for-profit graduates relative to those from a non-selective public institution. Among business majors in Deming's study, relative to graduates of a non-selective public institution, for-profit business majors were 22 percent less likely to receive a call for an interview request. However, they note a qualification to this finding: "…applicants with BAs from smaller brick-and-mortar for-profit colleges with a local presence are not significantly less likely to receive a callback than applicants with BAs from public institutions" (Deming et al., 2016, p. 779).

This allows us to draw a parallel to the CCB analysis. Community colleges are, by definition, physically present in the community, and have historically maintained close relationships with the local employment community. Daugherty et al. (2014) noted that, because of their close relationships with employers, community colleges were better able to develop programs specifically tailored to meet the workforce needs of the local service area, and have generally prioritized local employment needs to a greater degree than regional universities. Often, community colleges and stakeholders from local businesses worked together early in the planning stages to develop programs with the specific knowledge and skills required for the specific occupations of the local business representatives. These

features of CCB programs could partially explain why a negative effect was not observed in the current study.

Another interesting finding from Deming et al., (2016) was that the negative effect of attending a for-profit institution disappeared when there was additional information available. For instance, among those in health fields, a similar negative effect was observed except when there was another piece of information available to indicate applicant quality, such as an occupational license. It is quite likely that a similar mechanism is present in the case of the nursing graduates. The BSN degree, whether conferred by a CCB or a TBA, is held to the same accreditation standards, and nurses are required to pass the same licensing exam, so it makes sense that the specific institution that conferred the degree would hold less relevance when it is not the only indicator of application skill and ability. In the case of business majors, however, there is a broader range of flexibility in curriculum, and there is no comparable licensure requirement as that required for nurses.

Wages. There is currently very little existing information about the post-graduation wages of CCB graduates and how they compare to TBA graduates with which to set the context to understand the findings of this study. Schneider (2014a) reported that earnings of CCB graduates in Florida one year after graduation were higher than those of TBA graduates in nursing, business, and education, however this comparison does not control for bias due to selection into institution type. The results of this study showed that the CCB effect on wages varied by major. None of the OLS specifications found a difference in wages between CCB and TBA graduates in either major, with the exception of a positive effect among nursing majors in the prior employment subgroup. Likewise, no difference in wages was measured among business majors with the IV models. Among nursing majors, however, the IV models

estimated a positive CCB effect in three of the five specifications; all but the full sample model that included wages measured six years before degree completion and the high school subgroup. In the model of the full sample that included controls for wages measured six years before degree completion, the coefficient was in the same direction and of a similar but smaller magnitude, however, the sample size was reduced by about 500 cases, possibly reducing the statistical power to detect a difference. In the high school subgroup model, the sample size was reduced to about 150 cases and the first-stage *F*-statistic did not meet the critical value to yield an unbiased estimate.

As a robustness check, wages were also estimated with FE regression. Assuming that there are no unmeasurable confounders that vary over time and individuals, the FE method produces an unbiased estimate of the effect of graduating from a CCB on wages. When individual-level and quarter fixed effects were included, there was no significant effect of institution type on post-graduation wages.

To summarize the findings of the CCB effect on wages, the IV estimates provide evidence to suggest a positive effect on wages among nursing majors. However, this result was not supported by the FE analysis. When the assumptions of IV analysis are met, all unobservable factors (both time-stable and time-varying) are controlled. When FE assumptions are met, all unobservable time-stable characteristics are controlled. In the context of this study, it is probable that the IV estimates are somewhat confounded by regional characteristics that are not controlled for with the covariates available for this analysis. Therefore, the FE results provide a more conservative estimate of the CCB effect, suggesting that post-graduation wages are not significantly different for CCB and TBA graduates.

As noted in the literature review, one of the most commonly expressed concerns about the CCB is that it will be viewed as inferior to a degree conferred by a 4-year institution, citing difficulties in recruiting and retaining qualified faculty, contending with faculty and resources that might be substandard, and instruction that might be less rigorous than that offered by a TBA (Russell, 2013; Townsend, 2005). Though, Walker (2001) countered such criticisms by noting that,

> Community colleges are accredited by the same regional accrediting associations as universities, and the same standards would apply for our bachelor's degree. Community college students are not taught by graduate assistants in classes with as many as 500 people in them. They will continue to be taught by quality faculty who emphasize learning. For these reasons, the community college baccalaureate degree would become a first class degree. (Walker, 2001, p. 21)

We might expect to find differences in post-graduation wages if differences between TBA and CCB institutions equip their students with different levels of skills and knowledge (Baum et al., 2013; Bills, 2003; Card, 2001). There may be real variations in quality between CCB and TBA institutions that could lead to different levels of productivity in the labor market. The literature review demonstrated that measures of institution quality can affect employment outcomes. While there is wide variation in how institution quality has been operationalized, certain characteristics were shown to be important in understanding the relationship between the quality of education and employment outcomes, especially characteristics related to the student body (Black & Smith, 2006; Eide et al., 2016; Hoekstra, 2009), the availability and allocation of institutional resources (Black & Smith, 2006; Dale &

Krueger, 2002; Kalleberg & Dunn, 2014; Zhang, 2009), and the attributes of the service area in which the institution is located (Kalleberg & Dunn, 2014).

As shown in Table 5, TBA and CCB institutions vary quite a bit on many of the relevant characteristics known to impact employment outcomes, so it stands to reason that these differences might translate to varied levels of instructional quality that could lead to different outcomes. For instance, the student populations are different, with students at TBA institutions being younger, less financially independent, and from wealthier backgrounds. With larger enrollments and higher tuitions, TBA institutions have greater financial resources to devote to instructional spending, including faculty salaries and academic services. On the other hand, CCB institutions are known for their focus on teaching (as opposed to research), and smaller class sizes may enable more individualized instruction. CCB institutions are also renowned for their technical expertise in applied fields, those in which CCB degrees are offered.

Another feature of community colleges is that, apart from programming dedicated to preparing students for university transfer, their terminal applied associate's degrees are generally occupationally specific. Other work has demonstrated a positive effect on earnings among majors that have "…the most functional direct linkage to jobs or occupational sectors (e.g. computer science, social work, nursing, and accounting)" (Mayhew et al., 2016, p. 449). It could be that, because CCB degrees are offered in majors that are generally tightly linked to occupations, the positive effect due to the congruence between major and occupation counteracts any potential negative signal of quality.

The key message from the results of these analyses is that there is no evidence of a penalty in employment status or median hourly wages in the first year after degree

completion for CCB graduates who majored in business administration or nursing. When an effect was detected, it was positive, indicating that CCB graduates fared *better* than their TBA counterparts. Despite differences in the student characteristics and institutional resources of CCB and TBA institutions, employment outcomes for CCB and TBA graduates are comparable.

Policy Implications

The results of this study provide evidence that, once implemented, the CCB equips graduates with a bachelor's degree that yields value in the labor market equivalent to degrees conferred by 4-year institutions, and this finding has important implications for many stakeholders: states, institutions, and students.

Implications for states. Information about successful employment outcomes of CCB graduates will be helpful for state-level higher education policy makers as they consider ways to allocate limited resources while making strides towards achieving state-level access and attainment goals. The decision to implement CCB programming is not trivial, as the process to develop proposals, obtain approvals, and develop and implement CCB degree programs is costly and requires a significant level of effort on the part of many stakeholders (Daugherty et al., 2014; England-Siegerdt & Andreas, 2012; Floyd & Walker, 2009; McKinney, Scicchitano, & Johns, 2013). This study has shown that Washington CCB graduates experienced short-term employment outcomes comparable to graduates of TBA institutions, which can help other states decide if the CCB might be a good option.

This study of the CCB is specific to the geopolitical and economic conditions in Washington, and there will be some similarities and some differences with the conditions in other states. Washington faces challenges with increasing college enrollment among recent

high school graduates and among the population overall. Relative to other states, Washington is predicted to have a higher percentage of jobs that will require postsecondary education (Carnevale & Rose, 2011). As state funding of higher education has decreased and the state population has grown, state higher education leaders have decided that the CCB is a good option for meeting strategic state goals for higher education policy (England-Siegerdt & Andreas, 2012).

For states with the goal to increase access to baccalaureate education may wish to consider CCB programming; it can be a good investment since, while it does require significant effort to start up, it gains efficiencies by making use of existing infrastructure. CCB upper division tuition does cost more than subbaccalaureate community college tuition, but is less than TBAs, and the affordability is an important element of increasing access to postsecondary education (Daugherty et al., 2014; Floyd & Walker, 2009). Washington has also demonstrated that the CCB has helped to increase enrollments and completions among underrepresented student populations and has increased diversity in enrollments, bringing the state closer to meeting the specified strategic goals for increasing equity in education (Kaikkonen, 2015).

Implications for institutions. Washington has demonstrated that close connections between community colleges and local employers and businesses have helped to facilitate successful development of baccalaureate programming that serves the needs of students and employers. One issue in particular for institutions to consider is how to build upon existing applied associates degrees and expand into applied baccalaureates when sufficient demand by students and employers can be demonstrated. This may be one of the reasons why CCB outcomes fare comparably to TBA – that they have been designed with the specific skills

needed by local employers who work with the school to develop the desired programming. This is also important because expanding existing programs to the baccalaureate level will help ensure seamless transfer, which tends to be more problematic for students with applied associate's degrees that often do not articulate well to four-year institutions. The findings of this study suggest that institutions should consider CCB degrees a viable option for expanding programming to meet the needs of the communities in which they are situated.

Implications for students. Students have many options with which to pursue higher education, and face many challenges as well. For students, key decisions revolve around whether to enroll, what level of degree to pursue, where to enroll, what to study, and how to pay for it (e.g. work while enrolled, take out student loans, or both). The CCB gives students another way to earn a bachelor's degree that minimizes some of the challenges associated with attending a TBA. The CCB is more affordable both in tuition and living expenses. For students with an applied associate's degree, a CCB improves transfer success and minimizes credit loss.

Students should recognize that CCB degrees were not designed to "provide the typical college experience" and is not geared towards students who want to study liberal arts or humanities. Rather the CCB was developed to enable students to earn an applied bachelor's degree from a community college that is more affordable, more convenient, and more tailored to specific workforce skills. CCB institutions may provide students with a different educational experience that has smaller classes with more individualized instruction. For students who want an affordable, efficient way to earn a bachelor's degree in an applied field that is tightly linked to employment opportunities in the area, then the CCB may prove to be a good option. The findings from this study regarding CCB employment

outcomes provide valuable information for students and their families as they make decisions about how to invest in higher education by choosing the institution that provides the best fit for their available resources and educational goals.

Implications for Research

The CCB has been growing steadily and looks like it will continue. It still accounts for a relatively small portion of students, but to be good stewards of the precious resources available to be spent on higher education, it is important to investigate CCB outcomes to assess whether it is helping to achieve the goals for which it was developed, and also to ensure that the students who invest in CCB degrees are experience the benefits of earning a bachelor's degree. Therefore, states and institutions that have implemented CCB programs should work with their state data systems to link education and employment records to enable analysis of outcomes. In particular, states should partner with other states to develop regional data sharing agreements to minimize the issues of unemployment insurance data coverage limitations. Institutions should also pursue opportunities to conduct follow-up surveys of former students (including non-completers) to collect data on migration and employment patterns in the short-term and longer-term outcomes at the institution level.

Limitations

The results of the analyses presented here should be interpreted with caution. Students who attend a community college to earn a bachelor's degree differ in many important ways from students who attend 4-year colleges and universities. In fact, this is one of the primary reasons that CCB programming has been justified−CCB programs are designed to improve access to baccalaureate education for students who have been historically underserved by TBA institutions. I took steps to control for these pre-existing

differences in the analysis before comparing outcomes. Using measures of distance as instruments to predict CCB status improved upon the OLS estimation by purging the endogeneity due to the correlation between unmeasured factors that are related to outcomes and the error term, thereby minimizing bias in the resulting estimates. To meet the assumption that the instruments are ignorably random conditional on covariates, I included a set of controls to address the remaining variation, especially with regards to characteristics of the pre-college county. However, it is possible that there is some residual bias in the IV estimates. Thus, as an additional check, I estimated FE regression models of wages and found that the positive CCB effects among nursing disappeared.

With IV estimation, covariates are not needed with an instrument that is ignorably random. The distance instruments used in this study required the inclusion of covariates to meet the assumption of random assignment. Therefore, an important limitation of this study is the limited availability of individual-level covariates to better evaluate and ensure baseline equivalence between the treatment and comparison groups with IV estimation. While high school GPA was available for a subset of my sample, it was missing for most cases. Additional information about pre-college academic achievement and college-level course-taking and academic achievement would improve the ability to control for individual-level cognitive attributes that relate to employment outcomes. Furthermore, to really understand CCB effects on employment outcomes, analyses should include controls for regional characteristics such as local demand for occupations.

Another possible source of bias is the comparability of the quality of instruction in the degree programs I studied. I ran separate analyses by major, but it is difficult to control for the variation in programming and quality of instruction across institutions. I attempted to do

this by limiting the comparison set of institutions to non-selective public 4-year institutions, and reviewing program characteristics including admission requirements, credit requirements, graduation requirements, and accrediting body for each major. However, it is possible that unmeasured differences in program elements such as curriculum, instruction, faculty, internship requirements, etc., have introduced bias to estimates of the CCB effect. A program that provides better instruction may impart human capital that leads to greater productivity which in turn is more desirable for potential employers and will result in better outcomes. CCBIn the current study, this is less likely to be problematic for nursing majors, as the curriculum and requirements are standardized and tightly connected to specific occupational skills. Business administration programs allow for more variation in curriculum and requirements, so it is likely that differences in programming across institutions present more of a threat to internal validity of the comparison between CCB and TBA graduates.

Another limitation relates to the issue of missing data for some unknown portion of the sample where I was unable to observe outcomes. I examined employment outcomes with a data source that linked college enrollment and completion data with unemployment insurance data. As described in chapter 3, unemployment insurance data does not provide perfect coverage, and there may be patterns in what is not captured that are systematic and bias-inducing. It is not possible to report true employment rates because unemployment cannot be determined based on lack of coverage. The unemployment insurance data provide information on individuals who are employed in Washington by an employer that is required to provide reports to the state. Excluded from my analysis sample are individuals who a) moved to another state (or are otherwise employed by an out-of-state employer, perhaps in a neighboring state), b) are self-employed, c) are federal employees, or d) farm workers.

Due to these limitations, my results do not reflect employment outcomes for graduates who meet the above criteria. However, it is likely that the excluded group from my analysis sample of graduates from non-selective public institutions is relatively small. As noted earlier, 75 percent of bachelor's degree recipients in Washington graduated from a public institution (Washington Higher Education Coordinating Board, 2012), and other research on post-college migration has found that those most likely to move out-of-state after completing college include those who attended private or highly selective institutions (Groen, 2004; Ishtani, 2011).

Finally, policies that allow CCB degree programs are inherently dependent on regional context so the findings of this study based on Washington may have limited external validity. The CCB degree programs in Washington have been developed specifically to meet the needs of students and employers in that region. In addition to nursing and business administration, Washington has developed or proposed CCB degrees in fields such as IT application development, teacher education and early learning, behavioral health care, funeral services, digital filmmaking, cyber security, and community health (see Appendix A). California has piloted CCB degrees in fields such as Airframe Manufacturing Technology, Industrial Automation, Emergency Services and Allied Health Systems, and Respiratory Care (California Community Colleges Chancellor's Office, 2015). However, the results of this study can be informative for other states with similar economic, employment, and educational conditions.

Future Research

The research presented here represents an important first step toward understanding the effects on employment outcomes of earning a bachelor's degree from a community

college. These initial results show that CCB and TBA graduates experience similar levels of success in the labor market as measured by employment status and median hourly wages. Since this study is the first, though, additional work is needed before drawing definitive conclusions about CCB effects. Recommendations for future research into CCB outcomes include building upon the current study in the following ways: a) analyze longer-term outcomes, b) make use of experimental designs that examine responses to resumes, c) study CCB effects for graduates in other fields of study and in other locations, d) investigate the benefits relative to costs for CCB relative to TBA degrees, and e) analyze whether allowing CCB degrees significantly increases bachelor's degree production.

The present study examined outcomes within one year of degree completion. It is possible that the results observed within one year change over time. Future research should analyze longer-term outcomes to examine whether the trajectory of wage growth is comparable for CCB and TBA graduates. It could be that short-term employment outcomes are influenced more heavily by signaling effects, but that over time, employers observe productivity and the initial signal becomes less relevant than markers of human capital (Altonji & Pierret, 2001, cited in Zhang, 2009). Such an analysis will be possible with the data obtained from Washington by including data from additional graduates as they become available.

Experimental designs provide the best opportunity to isolate causal effects. Following the models set by Darolia et al., (2015) and Deming et al., (2016), an experimental resume study to designed to compare CCB and TBA institutions would contribute valuable information about how CCB degrees are perceived by prospective employers, and would

supply further evidence with which to assess the credibility of estimates based on quasi-experimental techniques.

Affordability is one of the key benefits of CCB degrees. This study has shown that there is no CCB penalty in employment outcomes, and it is likely that the costs of the CCB degree were less than they would be at a TBA institution. As research on this topic continues, it will be important to incorporate the costs associated with earning the bachelor's degree along with post-graduate wages. Scott-Clayton (2016) examined both employment and debt-related outcomes among baccalaureate recipients, with a focus on institution type and field of study. It would be worthwhile to examine CCB costs and returns within a similar framework.

Despite the fact that West Virginia had the first CCB program nearly thirty years ago, in 1989 (Fulton, 2015), the number of CCB programs and graduates has remained small enough that they comprise just a small portion of all baccalaureate completions. This is changing though as CCB programming continues to expand. For Washington, the number of graduates will also increase, yielding opportunities for additional research on nursing and business majors, but also to study outcomes for CCB graduates in other fields of study. It will also be important to examine CCB employment outcomes in other geographic and economic contexts.

Finally, because this study focused on outcomes among bachelor's degree graduates, it cannot assess the extent to which overall bachelor's degree production in the state of Washington may have been affected since the addition of CCB degrees in 2005. Future work should examine rates of baccalaureate completions by major before and since CCB degrees were implemented to assess whether the addition of CCB degree options has encouraged

those who otherwise would not have completed a degree or whether, due to convenience and affordability, individuals who would otherwise have attended a TBA decided to attend a CCB instead.

Conclusions

Research on the effects of institution quality and post-graduation outcomes is evolving. Higher education researchers and policy makers are paying more attention to the employment and earnings of graduates. Considering the rising cost of obtaining a college degree, the growth in the percentage of students who borrow, and the increasing amounts borrowed among those who take on student loans, institutions are being held accountable for the ability of their graduates to find gainful employment and repay their student loans ("College Scorecard," 2013). At both state and national levels, higher education leaders are making institution-level data on student outcomes to assist the public in college choice decisions. Methodologically, the research is evolving both in terms the increasing use of statistical techniques to control for selection bias, and the increasing availability of unemployment insurance data that enables research designs to study employment outcomes that were not possible not that long ago.

Simultaneously, much of the discussion in higher education policy is devoted to expanding access to postsecondary education and increasing attainment rates. Enabling community colleges to confer bachelor's degrees is one option to help meet those goals. CCB program implementation is continuing to expand as states that already allow the CCB are developing new programs and adding to existing offerings, and other states are approving proposals to develop CCB programs for the first time. Until now, there has only been descriptive information to indicate how well CCB graduates fare after degree completion.

This is the first study to apply quasi-experimental techniques to estimate the causal effect of graduating from a CCB on short-term employment outcomes relative to graduating from a public 4-year institution, and the findings can serve as a baseline assessment for future research. While additional study of CCB effects is required to determine whether the results observed here can be replicated, the results of this study provide valuable insight into the employment outcomes experienced by CCB nursing and business administration graduates in Washington, and how they compare to TBA graduates in the same field of study.

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APPENDICES

APPENDIX A−Sample proposals for development of new CCB programs

SBCTC WASHINGTON STATE BOARD FOR COMMUNITY & TECHNICAL COLLEGES **Regular Item**
September 28, 2016 **Tab 5**

Baccalaureate degree proposals

Brief description

A conceptual discussion will occur among the State Board for Community and Technical Colleges along with the several community and technical colleges proposing to offer applied baccalaureate degrees.

The Statement of Need document addresses six areas:

- Relationship to institutional role, mission and program priorities
- Support of the statewide strategic plans
- Employer/community demand for graduates with baccalaureate level of education proposed in the program
- Applied baccalaureate program builds from existing professional and technical degree program offered by the institution
- Student demand for program within service area
- Efforts to maximize state resources to serve place-bound students

How does this link to the State Board goals and policy focus

The State Board goals are "designed to raise education attainment, open more doors to education–particularly for our fast-growing adult population–and build upon our tradition of excellence." Colleges offering applied baccalaureate degrees meet the needs of changing economies by increasing the number of skilled employees in the areas of greatest need. Through this, colleges create greater access to higher education by enrolling underserved populations, particularly place-bound working adults, and ensure community and technical colleges are affordable and accessible for students. The following three goals are addressed through the approval process of applied baccalaureate degree programs:

- **Promoting student achievement and success** by increasing the number of applied baccalaureate degrees conferred
- **Increasing access to post-secondary education** by enrolling more underrepresented, first generation and adult students, active military, veterans and their dependents and develop means to attract former students needing credits for degrees, certificates, or credentials
- **Building on the system's strength and successes** by ensuring balance among mission areas: basic skills, workforce, transfer and applied baccalaureate

To date, the State Board has approved a total 68 applied baccalaureate/baccalaureate degree programs at 25 colleges with students currently enrolled in 45 programs at 19 colleges. Seventeen proposals are engaged in the approval process, and eight colleges have expressed interest in 17 additional programs. (**Attachment A:** Applied baccalaureate degree programs)

Background information and analysis

5a) Cascadia College – BAS in IT Application Development
Cascadia College proposes a Bachelor of Applied Science degree in Information Technology Application Development-Mobile Platforms beginning fall quarter 2018 and intended to address the distinct workforce needs of its region. A student graduating from the BAS IT Application Development degree program will have career options in a wide variety of organizations including governmental agencies, non-profits and

private sector employers inside and outside of the information technology sectors. The mobile platforms program would build on programming and design experience, adding specific knowledge and skills integral to mobile platform development including portable user interface design, localization, cross-platform experience, API development, monetization, along with specific app testing, deployment and quality assurance over multiple release cycles. This proposed degree would be Cascadia College's second applied baccalaureate degree.

5b) Highline College – BAS in Teacher Education and Early Learning
Highline College proposes a Bachelor of Applied Science degree in Teacher Education and Early Learning beginning fall of 2017 leading to Residency Teacher Certification with endorsements offered in Elementary (K-8), and Early Childhood Education, as well as a non-certification degree option in Education and Early Childhood Education. This degree creates a pathway for para-educators, preschool teachers, and childcare providers to use their Associate of Applied Science degree in human services, early childhood education, or para-education as a foundation for broader job opportunities and higher wages. By enhancing already strong institutional links with target districts (Auburn, Federal Way, Highline, Kent, Renton, and Tukwila), this program will assist in the development of teachers in high-need areas that are primarily from local communities. This proposed degree would be Highline College's fifth applied baccalaureate degree.

5c) Lake Washington Institute of Technology – BAS in Behavioral Healthcare
Lake Washington Institute of Technology proposes a Bachelor of Applied Science degree in Behavioral Healthcare beginning fall of 2017. This degree will prepare students for employment as professionals specializing in behavioral healthcare integration. Lake Washington Institute of Technology proposes to prepare graduates to enter the rapidly changing field of social and human services, with special focus on employment with institutions providing support for clients with substance use disorders and mental health concerns. The college has a strong associate's level program in Social and Human Services from which this proposed degree will build. This proposed degree would be Lake Washington Institute of Technology's fourth applied baccalaureate degree.

5d) Lake Washington Institute of Technology – BAS Funeral Services Education
Lake Washington Institute of Technology proposes a Bachelor of Applied Science degree in Funeral Services Education beginning fall of 2017. This degree will prepare graduates to enter the rapidly changing field of funeral services, with special focus on embalming skills and funeral services management. This applied baccalaureate degree will also create a pathway for students with applied associate's degrees in funeral services education related fields to receive advanced training and earn credentials preparing them for the position of funeral service manager. Currently, students in Washington state have no baccalaureate degree option in the funeral service education field and frequently choose other degree pathways, notably business and accounting, or to leave the state to further their education. This proposed degree would be Lake Washington Institute of Technology's fifth applied baccalaureate degree.

5e) Olympic College – BAS in Digital Filmmaking
Olympic College proposes a Bachelor of Applied Science degree in Digital Filmmaking beginning fall of 2017. This applied baccalaureate degree would prepare students for positions in the rapidly changing field of digital film, including jobs in video production, directing, cinematography, screenwriting, and performance. This proposed degree would build on the existing Olympic College's Associate of Applied Science-Transfer (AAS-T) degree in Digital Filmmaking. The Bachelor of Applied Science in Digital

Filmmaking would build on the technical expertise required to thrive in commercial video production, incorporate the artistic sensibilities needed for visual storytelling, and add preparation in areas such as project management, advertising and marketing, business, and interpersonal communication. This proposed degree would be Olympic College's fourth applied baccalaureate degree.

5f) Spokane Falls Community College – BAS in Cyber Security
Spokane Falls Community College proposes a Bachelor of Applied Science in Cyber Security beginning fall of 2017. Recent high-profile cyber-attacks on government and commercial enterprises highlight a growing need for security in a world increasingly built on digital infrastructures. Currently, the Information Systems and Computer Science department offers a Bachelors of Applied Science in Information Systems and Technology degree, an Associate of Applied Science in Information Technology, an Associate of Science-Transfer degree in Computer Science Pre-Major and several related certificates (including computer forensic/network security) which provide a basis for the BAS program development. The BAS in Cyber Security will allow students to focus their learning and skills on an important emerging field within the dynamic world of digital information exchange and commerce. This proposed degree would be Spokane Falls Community College's third applied baccalaureate degree.

5g) Tacoma Community College – BAS in Community Health
Tacoma Community College proposes a Bachelor of Applied Science in Community Health beginning fall of 2018 which builds from Associate in Applied Science degrees in diagnostic medical sonography, radiologic science, respiratory therapy, and emergency medical and health services. The Affordable Care Act (ACA) of 2010 included many enhancements to the healthcare delivery system including expanded health insurance coverage and access to healthcare, mandated improvements in the quality of care delivered, and incorporated enhancements in prevention and health promotion measures. All of the ACA requirements increase the need for employees with broad spectrum knowledge of the healthcare system, to include the unique circumstances of population health and community health activities coupled with the ability to measure and analyze data in a meaningful way to help make impactful healthcare decisions. This proposed degree would be Tacoma Community College's second applied baccalaureate degree.

5h) Yakima Valley College – BAS in Teacher Education
Yakima Valley College is proposing to develop a Bachelor of Applied Science in Teacher Education with teacher certification and early childhood (P-3) and elementary (K-8) endorsements beginning fall 2018. This proposed degree is a concerted effort by Yakima Valley College, Education Service District 105, and local school districts to respond to the teacher and substitute shortage in the college's service district and provide a pathway to a baccalaureate degree with teacher certification for place-bound working adults already working in the K-12 system and school districts needing to meet the teacher and substitute teacher shortages. The proposed Bachelor of Applied Science in Teacher Education degree will also provide a pathway toward certification for students enrolled in feeder Associate in Applied Science degrees in early childhood education, early childhood education preschool special education option, and para-educators. This proposed degree would be Yakima College's fourth applied baccalaureate degree.

Tab 5

Potential questions

- Do the college proposals for applied baccalaureate degrees meet the vision, mission and goals of their respective colleges?
- Do the proposed applied baccalaureate degrees serve the current and future needs of the colleges' regions and the state?
- Do the proposed applied baccalaureate degrees support the State Board for Community and Technical College goals and policy focus?

Recommendation/preferred result

Staff will provide a brief overview of applied baccalaureate degree proposals. Board members will have an opportunity to discuss the applied baccalaureate proposals with college representatives in the context of meeting college and system goals.

Policy Manual change Yes ☐ No ☒

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Washington's Community and Technical Colleges
Applied baccalaureate degree programs

September 2016

College	BUSINESS/MANAGEMENT	Status	Outcomes thru August 2016	Projected Cohort Size	Annual FTE 2015/16
Bates	Public Safety Administration	Intent expressed			
Bellevue	**Applied Accounting**	**Began fall 2015**		**14/52 FTE**	**12**
Bellevue	Digital Marketing	Board Review Feb. 2016		15 FTE	
Bellevue	Entrepreneurship	Intent expressed			
Bellevue	Organizational Leadership	Intent expressed			
Bellevue	Public Administration	Intent expressed			
Bellingham	**Operations Management**	**Beginning fall 2016**		**25/57 FTE**	
Centralia	**Applied Management**	**Began 2012**	**67 graduates**	**30/62 FTE**	**56**
Clark	**Applied Management**	**Beginning fall 2016**		**33/99 FTE**	
Clover Park	**Operations Management (formerly Manufacturing Operations)**	**Began 2014**	**6 graduates**	**25/50 FTE**	**13**
Clover Park	Facility Management	Intent expressed			
Columbia Basin	**Applied Management**	**Began 2009**	**209 graduates**	**35 FTE**	**87**
Columbia Basin	**Project Management**	**Began 2013**	**45 graduates**	**40 FTE**	**71**
Grays Harbor	**Organizational Management**	**Began fall 2016**		**25 FTE**	
Green River	**Marketing and Entrepreneurship**	**Began winter 2015**	**9 graduates**	**48/72 FTE**	**58**
Highline	**Global Trade and Logistics**	**Began 2014**		**10/15 FTE**	**14**
Lake Washington	**Transportation, Logistics, & Supply Chain Management (formerly Transportation and Logistics Management)**	**Began 2014**	**3 graduates**	**25/50 FTE**	**16**

Olympic	**Organizational Leadership & Technical Management**	**Began fall 2015**		**20 FTE**	**24**
Peninsula	**Applied Management**	**Began 2007**	**143 graduates**	**20/40 FTE**	**52**
Seattle North	**International Business**	**Began 2013**	**13 graduates**	**50 FTE**	**45**
Seattle North	Residential and Commercial Property Management	Board Review October 2014		20 FTE	
Seattle South	**Hospitality Management**	**Began 2007**	**158 graduates**	**20 FTE**	**50**
Seattle South	Workforce and Trades Leadership	Board Review May 2016		20 FTE	
Spokane Falls	**Applied Management**	**Beginning fall 2016**		**20 FTE**	**3**
Yakima Valley	**Business Management**	**Began 2014**	**23 graduates**	**28/60 FTE**	**55**
College	**ENVIRONMENT, NATURAL RESOURCES, & OTHER STEM**	**Status**	**Outcomes thru August 2016**	**Projected Cohort Size**	
Bellevue	**Molecular Biosciences (STEM)**	**Beginning fall 2016**		**9/31 FTE**	
Bellingham	**Engineering Technology**	**Beginning fall 2016**		**15 FTE**	
Cascadia	**Sustainable Practices (STEM)**	**Began fall 2015**		**66 FTE**	**16**
Centralia	**Diesel Technology**	**Began fall 2014**	**3 graduates**	**24/53 FTE**	**18**
Columbia Basin	Engineering Technology	Intent expressed			
Green River and Grays Harbor (Joint)	**Forest Resource Management**	**Began winter 2016**		**48 FTE**	**3**
Skagit Valley	**Environmental Conservation**	**Began fall 2014**	**3 graduates**	**20 FTE**	**21**
Seattle South	**Sustainable Building Science Technology**	**Began fall 2014**	**6 graduates**	**20 FTE**	**20**
Wenatchee Valley	**Engineering Technology**	**Beginning fall 2016**			
College	**HEALTH CARE/WELLNESS**	**Status**	**Outcomes thru August 2016**	**Projected Cohort Size**	
Bellevue	**Radiation and Imaging Sciences**	**Began 2007**	**96 graduates**	**20 FTE**	**24**
Bellevue	**Healthcare Infomatics (formerly Healthcare Technology and Management)**	**Began 2011**	**25 graduates**	**30/61 FTE**	**57**
Bellevue	**Nursing RN-B**	**Began 2012**	**22 graduates**	**20/30 FTE**	**24**
Bellevue	**Health Promotion and Management**	**Beginning fall 2016**		**15/30 FTE**	

Bellevue	**Healthcare Management and Leadership**	**Beginning fall 2016**		**34/60 FTE**	
Clark	**Dental Hygiene**	**Began summer 2015**	**18 graduates**	**17/53 FTE**	**62**
Columbia Basin	**Nursing RN-B**	**Beginning fall 2016**		**18/36 FTE**	
Columbia Basin	**Dental Hygiene**	**Beginning fall 2017**		**18 FTE**	
Columbia Basin	Health Care Administration	Intent expressed			
Green River	Nursing LPN-BSN	Intent expressed			
Highline	**Behavioral Science - Youth Development**	**Began fall 2014**		**15 FTE**	**26**
Highline	**Respiratory Care**	**Began fall 2014**	**6 graduates**	**15 FTE**	**10**
Lake Washington	Behavioral Healthcare	30-Day Review		15 FTE	
Lake Washington	Funeral Service Education	30-Day Review		15 FTE	
Lake Washington	**Public Health Administration**	**Began fall 2014**	**15 graduates**	**35 FTE**	**32**
Lake Washington	Dental Hygiene	30-Day Review		30/60 FTE	
Lake Washington	Nursing BSN	Board Review May 2016		24/96 FTE	
Lake Washington	Exercise Science	Intent expressed			
Olympic	**Nursing RN-B**	**Began fall 2007**	**169 graduates**	**70 FTE**	**34**
Pierce	**Homeland Security-Emergency Management**	**Beginning winter 2017**		**20/30 FTE**	
Pierce-Ft. Steilacoom	**Dental Hygiene**	**Beginning fall 2016**		**20/40 FTE**	
Seattle Central	**Behavioral Sciences**	**Began fall 2009**	**124 graduates**	**20/40 FTE**	**45**
Seattle Central	**Allied Health Science**	**Began fall 2014**	**32 graduates**	**30/179 FTE**	**76**
Seattle Central	**Nursing RN-B**	**Began fall 2015**		**18/60 FTE**	
Spokane	Respiratory Care	Board Review May 2016		20 FTE	
Tacoma	Community Health	30-Day Review		12 FTE	
Tacoma	**Health Information Management**	**Beginning fall 2016**		**15/30 FTE**	
Wenatchee Valley	**Nursing RN-B**	**Beginning 2017**		**25/38 FTE**	
Yakima Valley	**Dental Hygiene**	**Beginning fall 2016**		**18/24 FTE**	
College	**INFORMATION TECHNOLOGY**	**Status**	**Outcomes thru August 2016**	**Projected Cohort Size**	
Bellevue	**Information Systems and Technology**	**Began fall 2013**	**18 graduates**	**50 FTE**	**48**

Bellevue	**Data Analytics**	**Began fall 2014**		**20 FTE**	**25**
Bellevue	**Computer Science (BS)**	**Beginning fall 2016**		**60 FTE**	
Bellevue	Digital Media Arts	Intent expressed			
Cascadia	Information Technology: Application Development	30-Day Review		18 FTE	
Centralia	**Information Technology: Application Development**	**Beginning fall 2016**		**20 FTE**	
Centralia	Information Technology: IT Networking	Intent expressed			
Clover Park	Computer Integrated Manufacturing	Intent expressed			
Columbia Basin	**Cyber Security**	**Began winter 2013**	**15 graduates**	**40 FTE**	**59**
Columbia Basin	**Information Technology**	**Beginning fall 2017**		**20 FTE**	
Green River	**Information Technology: Network Administration and Security**	**Began fall 2013**	**39 graduates**	**48 FTE**	**61**
Green River	**Information Technology: Software Development (STEM)**	**Began fall 2014**	**10 graduates**	**48 FTE**	**45**
Highline	**Cyber Security and Forensics**	**Began winter 2014**	**3 graduates**	**15 FTE**	**30**
Lake Washington	**Applied Design**	**Began 2009**	**102 graduates**	**22 GRADS**	**44**
Lake Washington	Information Technology: Application Development-Software Development	Board Review Feb. 2016		25 FTE	
Lake Washington	Digital Gaming and Interactive Media	Board Review May 2016		20/40 FTE	
Olympic	Digital Filmmaking	30-Day Review		15 FTE	
Olympic	**Information Systems (STEM)**	**Began fall 2014**	**7 graduates**	**20 FTE**	**31**
Renton	**Application Development (STEM)**	**Began winter 2015**		**20 FTE**	**15**
Renton	Information Technology: Networking	Board Review Feb. 2016		10 FTE	
Seattle Central	**Information Technology: Networking**	**Beginning fall 2016**		**20 FTE**	
Seattle North	**Application Development**	**Began fall 2014**	**10 graduates**	**20 FTE**	**35**
Spokane Falls	Cyber Security	30-Day Review			
Spokane Falls	**Information Systems & Technology**	**Began winter 2016**		**15 FTE**	**5**
Whatcom	**Information Technology: Networking**	**Beginning fall 2017**		**15 FTE**	
Yakima Valley	**Information Technology: Networking**	**Began fall 2015**		**12 FTE**	**17**
College	**EDUCATION**	**Status**	**Outcomes thru August 2016**	**Projected Cohort Size**	

Centralia and Grays Harbor	**Teacher Education: Elementary Education and Special Education**	**Beginning fall 2017**		**15 FTE**	
Edmonds	Child, Youth, and Family Studies	Board Review May 2016		20-25 FTE	
Green River	Early Childhood Education	Intent expressed			
Green River and Highline	Teacher Education	Intent expressed			
Highline	Teacher Education/Early Childhood Education	30-Day Review		15 FTE	
Lake Washington	Early Childhood Education	Intent expressed			
Pierce	**Teaching**	**Beginning winter 2017**		**15/48 FTE**	
Seattle North	**Early Childhood Education**	**Beginning winter 2016**		**20/50 FTE**	**13**
Seattle South	**Professional Technical Teacher Education**	**Began fall 2012**	**12 graduates**	**12/20 FTE**	**21**
Yakima Valley	Teacher Education	30-Day Review		25 FTE	
College	**OTHER**	**Status**	**Outcomes thru August 2016**	**Projected Cohort Size**	
Bellevue	**Interior Design**	**Began fall 2009**	**206 graduates**	**44/83 FTE**	**72**
Green River	**Aeronautical Science**	**Began spring 2016**		**20/40 FTE**	**5**
Green River	Court Reporting and Captioning	Intent expressed			
Total			**1617 graduates**		

APPENDIX B−Tables from PowerStats analyses of B&B:08/12 Data

National Center for Education Statistics PowerStats

Type of employer in 2009 by Gender, Primarily student or employee (including work-study) in 2007-08 and Work intensity while enrolled in 2007-08.

Type of employer in 2009 by Gender, Primarily student or employee (including work-study) in 2007-08 and Work intensity while enrolled in 2007-08.

	School where currently enrolled (%)	A for-profit company (%)	A nonprofit organization (%)	A local, state, or federal government (%)	Military (including civilian employees) (%)	Self-employed (%)	Other (%)	Total
Estimates								
Total	4.7	55.1	14.3	15.8	1.8	2.2	6.1	100%
Gender								
Male	4.5	64.2	8.3	13.8	2.9	2.6	3.7	100%
Female	4.9	48.5	18.6	17.3	1.0	1.9	7.8	100%
Primarily student or employee (including work-study) in 2007-08								
Student working to meet expenses	5.3	55.7	13.7	15.5	1.4	2.0	6.3	100%
Employee who decided to enroll in school	1.6 !	51.2	17.9	18.8	3.6	2.3	4.6	100%
Work intensity while enrolled in 2007-08								
No job	4.9	56.2	13.3	14.5	1.8	3.1	6.2	100%
Part time	5.6	54.6	14.2	15.0	1.5	2.2	6.9	100%
Full time	2.6	55.5	15.1	18.2	2.5	1.7	4.4	100%

! Interpret data with caution. Estimate is unstable because the standard error represents more than 30 percent of the estimate.

The names of the variables used in this table are: B1EMPTYP, GENDER, JOBROLE2 and JOBENR2.

The weight variable used in this table is WTA000.

Source: U.S. Department of Education, National Center for Education Statistics, 2008/12 Baccalaureate and Beyond Longitudinal Study (B&B:08/12).

Computation by NCES PowerStats on 4/29/2017.

National Center for Education Statistics PowerStats

Employment and enrollment status in 2009 by Gender, Primarily student or employee (including work-study) in 2007-08 and Work intensity while enrolled in 2007-08.

Employment and enrollment status in 2009 by Gender, Primarily student or employee (including work-study) in 2007-08 and Work intensity while enrolled in 2007-08.						
	Out of the labor force (%)	Unemployed (%)	Working full time (%)	Working part time (%)	Multiple jobs (%)	Total
Estimates						
Total	7.0	9.2	56.7	13.6	13.6	100%
Gender						
Male	6.4	10.0	60.5	11.2	11.9	100%
Female	7.4	8.5	53.9	15.3	14.8	100%
Primarily student or employee (including work-study) in 2007-08						
Student working to meet expenses	6.3	8.3	56.1	14.4	14.9	100%
Employee who decided to enroll in school	1.7	6.9	70.2	7.9	13.2	100%
Work intensity while enrolled in 2007-08						
No job	13.3	13.7	49.3	14.6	9.0	100%
Part time	6.8	8.5	54.0	15.8	14.8	100%
Full time	2.7	7.2	68.0	7.9	14.2	100%

The names of the variables used in this table are: JOBENR2, GENDER, JOBROLE2 and B1LFP09.

The weight variable used in this table is WTA000.

Source: U.S. Department of Education, National Center for Education Statistics, 2008/12 Baccalaureate and Beyond Longitudinal Study (B&B:08/12).

Computation by NCES PowerStats on 4/29/2017.

National Center for Education Statistics PowerStats

Type of employer in 2009 by Bachelor's degree major (detailed), 2007-08, for Institution sector in 2007-08 (Public 4-year).

	Employer type likely covered by UI data (%)	Employer type likely not covered by UI data (%)	Total
Estimates			
Total	79.1	20.9	100%
Bachelor's degree major (detailed), 2007-08			
Business	87.6	12.4	100%
Health care fields	86.4	13.6	100%
Design and applied arts	97.5	2.5 !!	100%
Communications	93.2	6.8	100%
STEM	85.8	14.2	100%
Education	48.4	51.6	100%
Manufacturing/Military	58.2	41.8	100%
Personal and consumer services	69.6	30.4	100%
Social Sciencs/Humanities	76.7	23.3	100%

!! Interpret data with caution. Estimate is unstable because the standard error represents more than 50 percent of the estimate.

The names of the variables used in this table are: B1EMPTYP, MAJORS23 and SECTOR1.

The weight variable used in this table is WTA000.

Source: U.S. Department of Education, National Center for Education Statistics, 2008/12 Baccalaureate and Beyond Longitudinal Study (B&B:08/12).

Computation by NCES PowerStats on 4/29/2017.

National Center for Education Statistics PowerStats

Distance from student's home (in miles) to NPSAS institution 0, Distance from student's home (in miles) to NPSAS institution 0, Distance from student's home (in miles) to NPSAS institution with (percent <30) by NPSAS institution sector (with multiple) and Index of risk and nontraditional students, modified, for NPSAS institution sector (with multiple) (Public 2-year,Public 4-year non-doctorate-granting,Public 4-year doctorate-granting).

	Distance from student's home (in miles) to NPSAS institution (Avg)	Distance from student's home (in miles) to NPSAS institution (Median)	Distance from student's home (in miles) to NPSAS institution (%<30)
NPSAS institution sector (with multiple) = Totals			
Estimates			
Total	57.1	11.0	74.6
Index of risk and nontraditional students, modified			
Traditional	87.2	22.0	55.5
Nontraditional	46.2	9.0	81.5
NPSAS institution sector (with multiple) = Public 2-year			
Estimates			
Total	33.6	8.0	85.8
Index of risk and nontraditional students, modified			
Traditional	30.1	9.0	83.6
Nontraditional	34.1	8.0	86.2
NPSAS institution sector (with multiple) = Public 4-year			
Estimates			
Total	88.7	18.0	59.5
Index of risk and nontraditional students, modified			
Traditional	108.6	38.0	44.9
Nontraditional	72.3	12.0	71.6

The names of the variables used in this table are: AIDSECT, RISKIND2 and DISTANCE.

The weight variable used in this table is WTA000.

Source: U.S. Department of Education, National Center for Education Statistics, 2011-12 National Postsecondary Student Aid Study (NPSAS:12).

Computation by NCES PowerStats on 4/29/2017.

APPENDIX C−Per capita income and inverse ratio, by year

County	2009		2010		2011		2012	
	Per Capita Income	Inverse ratio	Per Capita Income	Inverse ratio	Per Capita Income	Inverse ratio	Per Capita Income	Inverse ratio
Washington state total	41,844	1.00	42,195	1.00	44,197	1.00	47,324	1.00
Adams	30,356	1.38	31,596	1.34	35,050	1.26	37,888	1.25
Asotin	34,958	1.20	35,635	1.18	36,919	1.20	38,094	1.24
Benton	38,512	1.09	40,598	1.04	41,963	1.05	41,250	1.15
Chelan	35,422	1.18	35,616	1.18	37,398	1.18	40,795	1.16
Clallam	34,321	1.22	34,464	1.22	35,963	1.23	37,802	1.25
Clark	37,242	1.12	37,280	1.13	39,020	1.13	41,363	1.14
Columbia	39,362	1.06	39,323	1.07	43,418	1.02	42,865	1.10
Cowlitz	33,472	1.25	35,169	1.20	35,676	1.24	37,739	1.25
Douglas	29,734	1.41	30,334	1.39	31,880	1.39	32,884	1.44
Ferry	25,986	1.61	27,116	1.56	27,600	1.60	29,003	1.63
Franklin	29,966	1.40	30,622	1.38	31,815	1.39	31,327	1.51
Garfield	35,844	1.17	38,021	1.11	43,206	1.02	42,323	1.12
Grant	29,759	1.41	30,631	1.38	32,611	1.36	34,060	1.39
Grays Harbor	29,794	1.40	30,265	1.39	31,235	1.41	32,496	1.46
Island	39,751	1.05	39,810	1.06	41,414	1.07	43,342	1.09
Jefferson	38,486	1.09	38,888	1.09	41,144	1.07	43,853	1.08
King	55,569	0.75	55,505	0.76	58,685	0.75	65,331	0.72
Kitsap	41,527	1.01	41,920	1.01	42,715	1.03	44,360	1.07
Kittitas	31,547	1.33	33,421	1.26	34,944	1.26	36,826	1.29
Klickitat	34,979	1.20	37,019	1.14	38,717	1.14	41,948	1.13
Lewis	31,640	1.32	32,187	1.31	32,798	1.35	34,015	1.39
Lincoln	36,029	1.16	36,783	1.15	40,580	1.09	41,445	1.14
Mason	32,355	1.29	32,196	1.31	32,984	1.34	33,939	1.39
Okanogan	29,889	1.40	31,130	1.36	31,996	1.38	33,763	1.40

Per capita income and inverse ratio, by year Continued								
Pacific	33,287	1.26	34,435	1.23	35,180	1.26	37,225	1.27
Pend Oreille	30,318	1.38	31,082	1.36	31,736	1.39	32,338	1.46
Pierce	37,416	1.12	38,038	1.11	39,361	1.12	40,569	1.17
San Juan	49,848	0.84	50,244	0.84	53,293	0.83	60,683	0.78
Skagit	37,804	1.11	37,651	1.12	39,259	1.13	41,509	1.14
Skamania	32,963	1.27	32,095	1.31	34,091	1.30	37,202	1.27
Snohomish	39,657	1.06	39,618	1.07	41,626	1.06	43,640	1.08
Spokane	34,532	1.21	34,898	1.21	36,305	1.22	37,635	1.26
Stevens	28,784	1.45	29,344	1.44	30,407	1.45	31,332	1.51
Thurston	39,513	1.06	39,730	1.06	40,288	1.10	41,643	1.14
Wahkiakum	30,299	1.38	31,356	1.35	32,509	1.36	33,820	1.40
Walla Walla	34,077	1.23	34,942	1.21	36,680	1.20	38,283	1.24
Whatcom	35,721	1.17	36,557	1.15	38,211	1.16	40,396	1.17
Whitman	30,271	1.38	30,983	1.36	34,119	1.30	34,250	1.38
Yakima	30,721	1.36	31,981	1.32	33,693	1.31	35,920	1.32

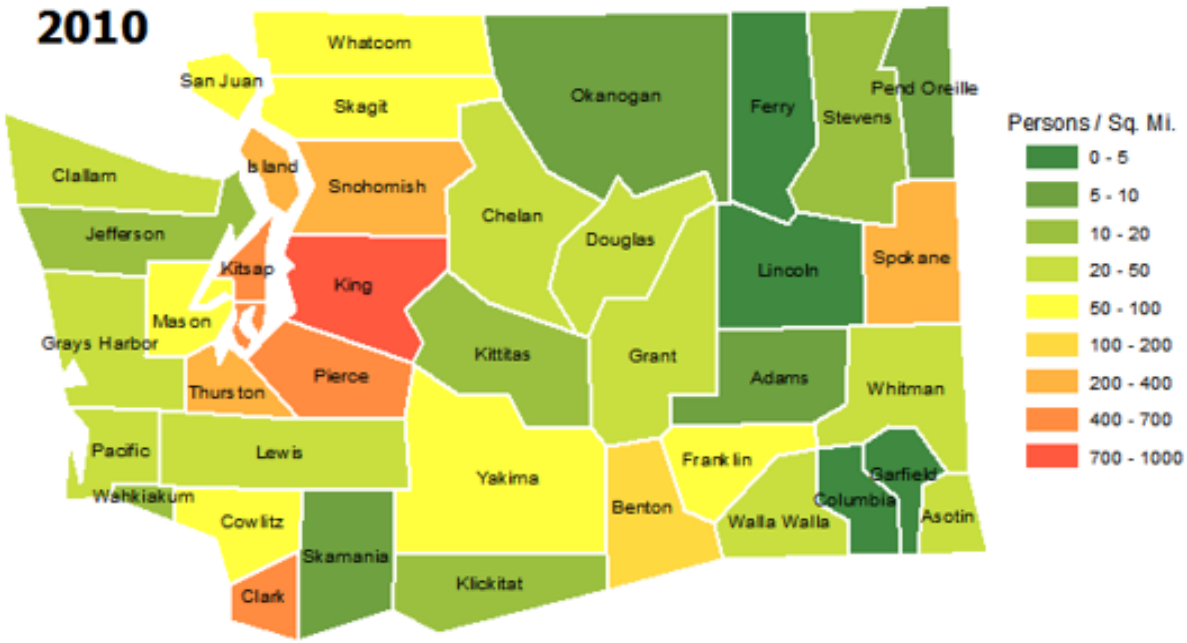
Per capita income and inverse ratio, by year Continued

	2013		2014		2015	
County	Per Capita Income	Inverse ratio	Per Capita Income	Inverse ratio	Per Capita Income	Inverse ratio
Washington state total	47,778	1.00	50,357	1.00	51,898	1.00
Adams	37,986	1.26	38,180	1.32	41,962	1.24
Asotin	38,140	1.25	39,684	1.27	41,162	1.26
Benton	40,257	1.19	40,939	1.23	43,507	1.19
Chelan	41,279	1.16	43,174	1.17	44,797	1.16
Clallam	37,741	1.27	39,038	1.29	39,738	1.31
Clark	41,194	1.16	43,343	1.16	45,070	1.15
Columbia	43,264	1.10	43,817	1.15	48,769	1.06
Cowlitz	37,993	1.26	39,043	1.29	40,371	1.29
Douglas	32,964	1.45	34,076	1.48	36,310	1.43
Ferry	29,014	1.65	30,681	1.64	31,681	1.64
Franklin	31,009	1.54	32,122	1.57	33,955	1.53
Garfield	41,223	1.16	41,500	1.21	45,898	1.13
Grant	34,842	1.37	35,123	1.43	38,081	1.36
Grays Harbor	32,756	1.46	34,832	1.45	35,625	1.46
Island	45,231	1.06	46,722	1.08	48,060	1.08
Jefferson	43,533	1.10	45,663	1.10	47,222	1.10
King	66,016	0.72	70,854	0.71	72,530	0.72
Kitsap	44,614	1.07	46,798	1.08	47,953	1.08
Kittitas	36,972	1.29	37,660	1.34	39,157	1.33
Klickitat	40,948	1.17	42,348	1.19	43,290	1.20
Lewis	34,425	1.39	36,091	1.40	37,486	1.38
Lincoln	45,188	1.06	41,467	1.21	44,958	1.15
Mason	34,077	1.40	35,492	1.42	36,623	1.42
Okanogan	34,170	1.40	35,687	1.41	37,934	1.37
Pacific	38,491	1.24	40,340	1.25	41,560	1.25

Per capita income and inverse ratio, by year Continued

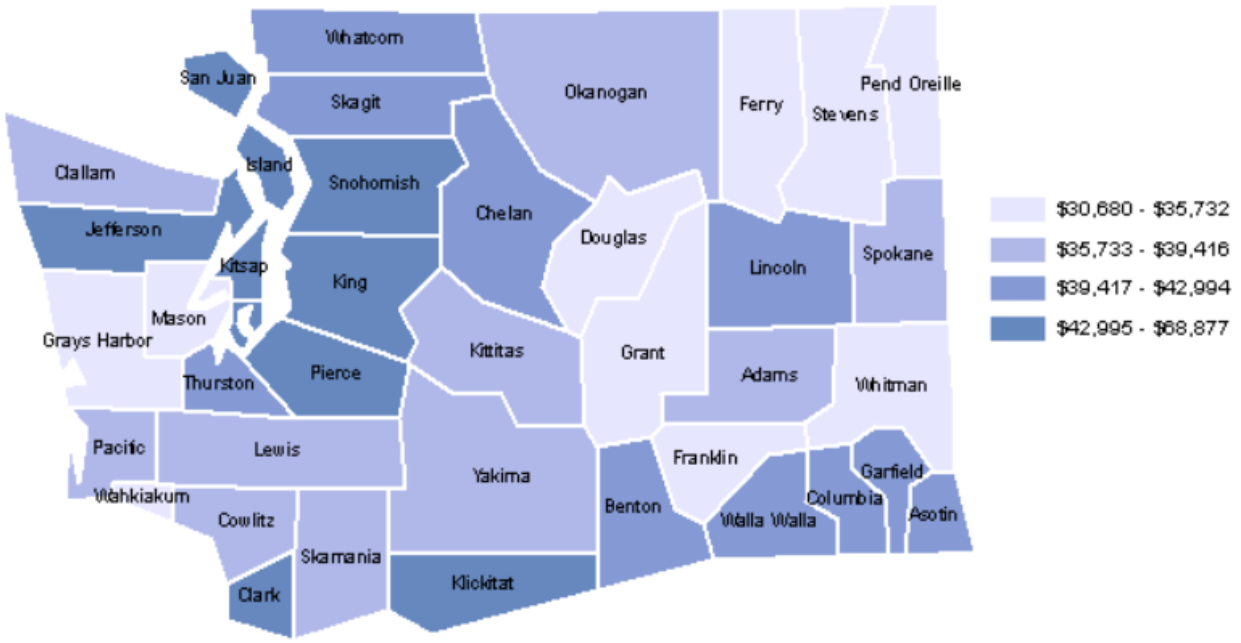
Pend Oreille	32,628	1.46	34,360	1.47	35,151	1.48
Pierce	41,403	1.15	43,212	1.17	44,600	1.16
San Juan	60,177	0.79	65,750	0.58	66,255	0.63
Skagit	41,946	1.14	43,061	0.89	44,470	0.94
Skamania	36,037	1.33	37,256	1.02	38,725	1.08
Snohomish	44,095	1.08	45,950	0.83	47,421	0.88
Spokane	37,656	1.27	39,215	0.97	40,322	1.04
Stevens	32,300	1.48	33,867	1.13	34,694	1.21
Thurston	41,743	1.14	42,861	0.89	44,155	0.95
Wahkiakum	34,262	1.39	35,803	1.07	36,153	1.16
Walla Walla	39,097	1.22	39,950	0.96	41,912	1.00
Whatcom	40,260	1.19	41,456	0.92	42,511	0.99
Whitman	34,647	1.38	34,128	1.12	35,834	1.17
Yakima	35,671	1.34	37,371	1.02	38,527	1.09

APPENDIX D−Characteristics of Washington State, by county



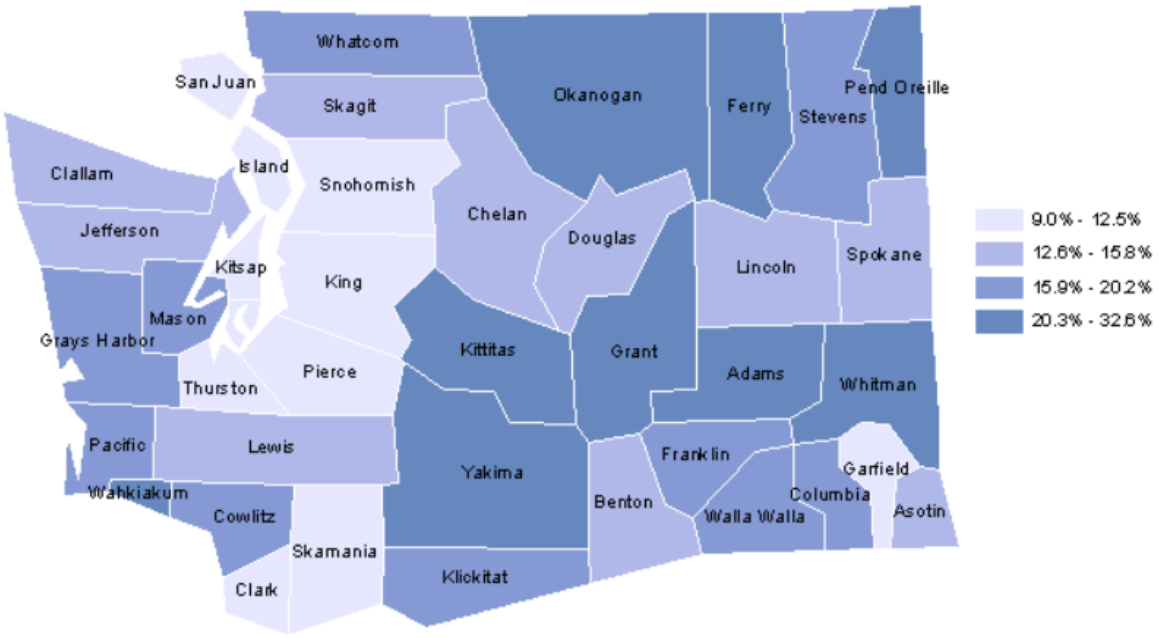
Per Capita Personal Income, 2014

Inflation-Adjusted to 2014 Dollars



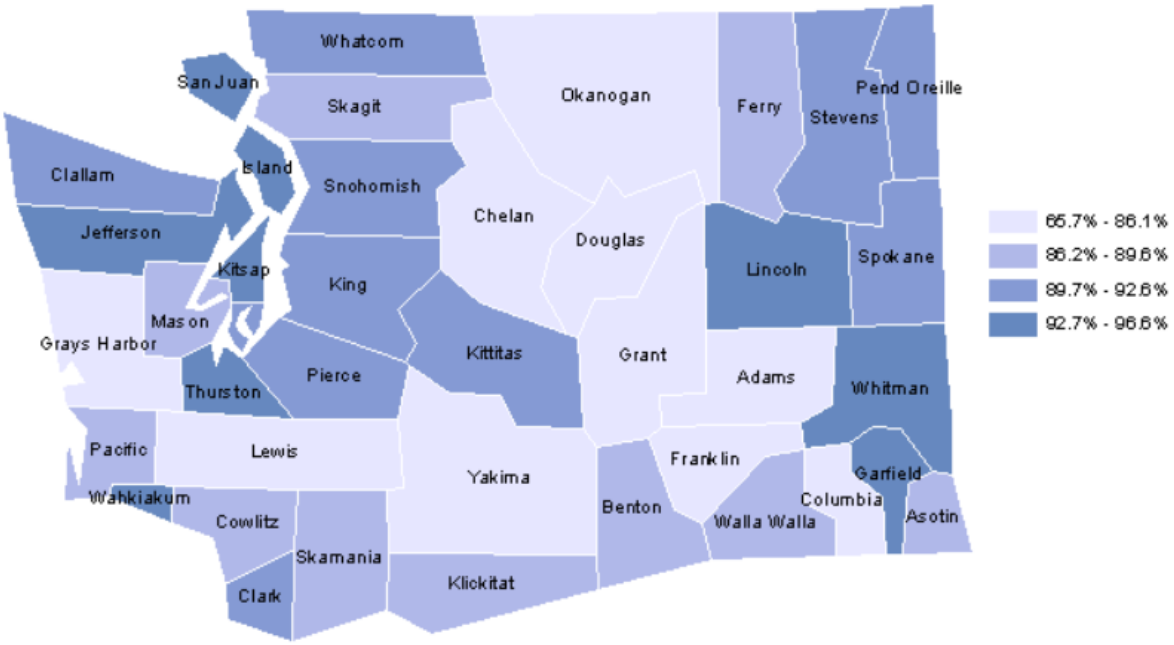
Families in Poverty

2014



Percent High School Graduates

Population Age 25 and Above, 2014



APPENDIX E−Consumer Price Index Values for the West Urban Region, 2000-2015

Year	Index for CPI-West
2000	170.40
2001	176.40
2002	179.80
2003	183.70
2004	188.00
2005	194.00
2006	200.40
2007	206.66
2008	214.32
2009	212.75
2010	215.79
2011	222.58
2012	227.22
2013	230.30
2014	234.20
2015	235.80