Colorado Helps Advanced Manufacturing Program

Advanced Manufacturing Education in the Context of Local Labor Markets: Understanding Regional Dynamics of Workforce Development in Colorado

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RUTGERS
Education and Employment Research Center

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INTRODUCTION

Historically, manufacturing has been critically important to the United States' economy providing many high wage jobs, supporting innovation, and helping to reduce the US trade deficit.[1]. In 2015, manufacturing employed 12 million people,[2] and in 2016 it contributed 18.5 percent to the gross domestic product (GDP). [3] Like many industries, manufacturing is a sector that has experienced a great deal of change due to new technologies, automation, and changes in production processes. Additionally, manufacturing is also a graying field –where many workers are on the verge of retirement.[4]

In this context, employers are experiencing multiple challenges to recruit and hire workers who have the requisite skills and knowledge. The current "skills gap" includes the absence of workers with: a) relevant knowledge and skill sets for advanced manufacturing including STEM skills (science, technology, engineering and math); b) relevant educational credentials; and/or c) "employability skills such as leadership, effective verbal/written communication, professionalism, project management, dependability, initiative, teamwork, and problem solving skills."[5] In fact, in recent national surveys of manufacturers by the Manufacturing Institute and Deloitte, 82% of manufacturers reported moderate-to-serious gaps in the availability of skilled manufacturing candidates.[6] This included the employers identifying deficient skills in the following areas: technology computer skills (70 percent); problem solving skills (69 percent); basic technical training (67 percent); and math skills (60 percent).[7]

Fifty-six percent of surveyed employers anticipated the shortage to grow worse in the next three to five years.[8] In part, this is a result of the younger generation's negative image of manufacturing[9],[10]– often thinking of the old dark factory floor assembly lines. But it is also the

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[1] BLS (2016) Employment by industry, 1910 and 2015. Retrieved from https://www.bls.gov/opub/ted/2016/employment-by-industry-1910-and-2015.htm

[2] Ibid

[3] Bureau of Labor Statistics, U.S. Department of Labor, *The Economics Daily*, Employment by industry, 1910 and 2015 at https://www.bls.gov/opub/ted/2016/employment-by-industry-1910-and-2015.htm).

[4] "the median age in 2012 was 44.7 years and increasing" Manufacturing Institute (n.d.) Median Age of the Manufacturing Workforce. See http://www.themanufacturinginstitute.org/Research/Facts-About-Manufacturing/Workforce-and-Compensation/Median-Age/Median-Age.aspx

[5] CCCS (2011) CHAMP Proposal to the US Department of Labor

[6] Deloitte & the Manufacturing Institute (2011a). "Boiling point? The skills gap in U.S. manufacturing." Retrieved from www.themanufacturinginstitute.org/~/media/A07730B2A798437D98501E798C2E13AA.ashx.

[7] Deloitte and the Manufacturing Institute. (2015). The skills gap in 2015 and beyond. Retrieved from https://www2.deloitte.com/us/en/pages/manufacturing/articles/boiling-point-the-skills-gap-in-us-manufacturing.html, p.6

[8] Deloitte & the Manufacturing Institute (2011a) p.1

[9] See Deloitte (2017). Manufacturing matters: The public's view of US manufacturing. Retrieved from http://www.themanufacturinginstitute.org/Research/Public-Perception-of-Manufacturing/~/media/1002BE49730C493DADAC0F95D934A32B.ashx

[10] Deloitte & the Manufacturing Institute. (2011b). "Unwavering commitment: The public's view of the manufacturing industry today," Annual Index. p. 3 Retrieved from http://www.themanufacturinginstitute.org/~/media/2AB778520C734D888156A90B667C1E70.ashx

result of a decline in technical education programs in many public high schools,[11] and the active marketing of baccalaureate and higher level degree education in contrast to technical training at the pre-baccalaureate levels.

While Colorado's manufacturing production has increased more than the US average - 29 percent compared to 11 percent - in many ways, Colorado provides a microcosm of what is happening in manufacturing on a national scale.

Like national trends, however, Colorado's manufacturing sector has experienced a skills gap. The state needs a manufacturing workforce trained in sophisticated new manufacturing methods including automation and high-technology equipment. In response, a statewide sectors project, funded by the state's Department of Labor and Employment, was initiated in 2008 to bring manufacturers, the academy (community and four year colleges) and workforce centers together to examine needs and to collaborate on solutions to better prepare workers to meet changing industry needs. The continuation of these efforts was seen in the National Governors Association Policy Academy on advanced manufacturing in 2013.[12]

In 2012, building on the above initiatives, Colorado Community College System (CCCS) applied for, and was awarded, a four-year Trade Adjustment Assistance (TAA) grant from the US Department of Labor. The goal of the grant - Colorado Helps Advanced Manufacturing (CHAMP) - was to establish better alignment between employers and colleges by redesigning and/or expanding training opportunities, and identifying stronger pathways to good jobs in advanced manufacturing within the local economy. The $24 million grant involved 7 community colleges, a technical college and one four year institution.[13] Under CHAMP, the colleges working with industry partners, have a) identified the skills needed by industry; b) revised and developed training curriculum, c) integrated professional and soft skills with training curriculum; d) developed new certificate and associate degree programs; e) identified and purchased new state of the art equipment and program software; f) identified new career pathways allowing for greater flexibility and mobility in the field; g) established new internship opportunities; h) increased college based advising and career support through the employment of a career navigator; and i) began creating a process for Prior Learning Assessment for skills learned in industry. Between 2012 and the fall of 2017, the synergy of schools and industry partners helped CHAMP colleges create dynamic, relevant, training opportunities in advanced manufacturing for Colorado students.

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[11] Deloitte and the Manufacturing Institute. (2015). The skills gap in 2015 and beyond. Retrieved from https://www2.deloitte.com/us/en/pages/manufacturing/articles/boiling-point-the-skills-gap-in-us-manufacturing.html, p.6

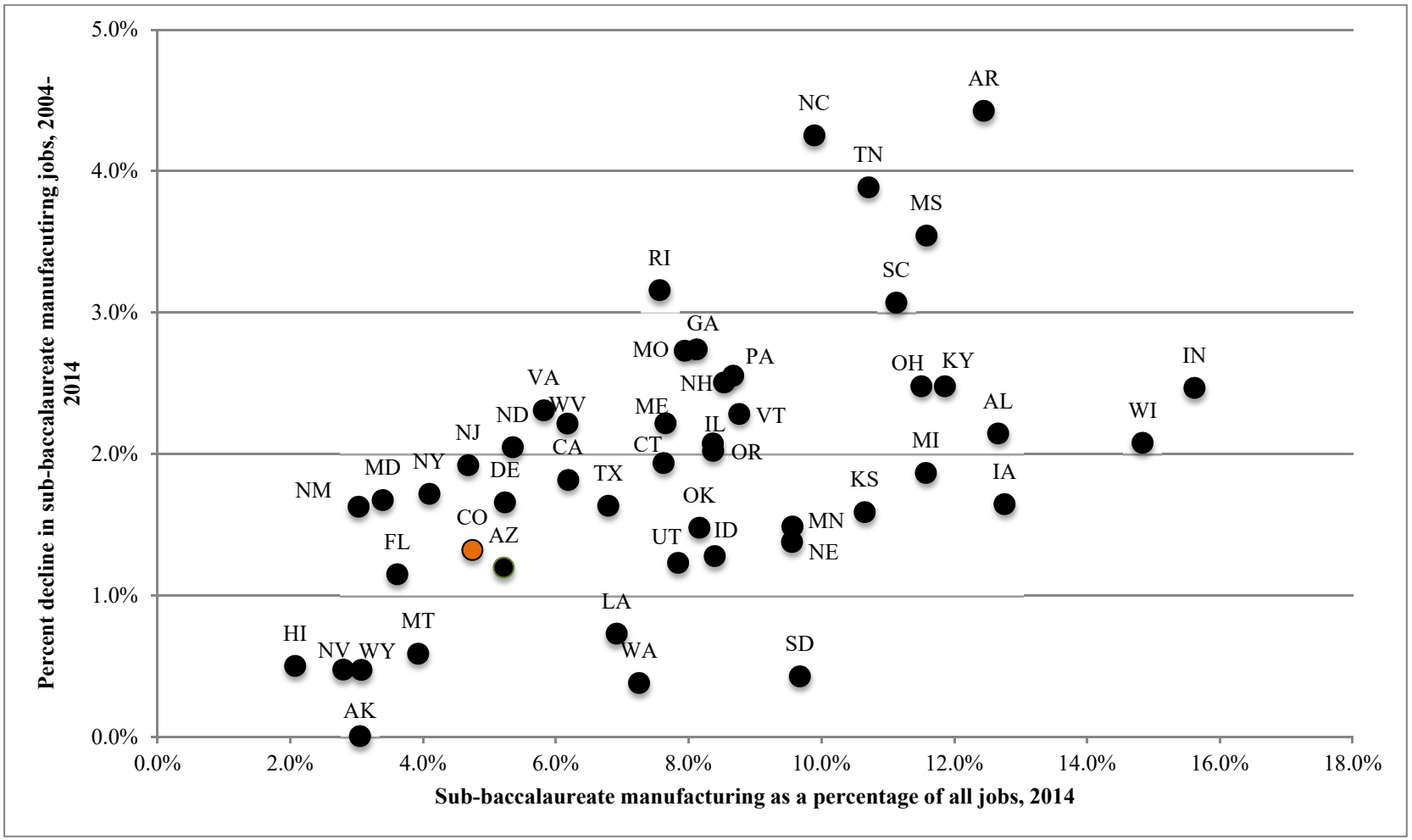
[12] NGA. (2013). Retrieved from http://www.nga.org/files/live/sites/NGA/files/pdf/2013/ 1301NGASSSReport.pdf.

[13] The consortium includes Front Range Community College (FRCC), Aims Community College (), the Community College of Denver (CCD), Emily Griffith Technical College (EGTC), Lamar Community College (LCC), Pikes Peak Community College (PPCC), Pueblo Community College (PCC), Red Rocks Community College/Warren Technical College (RRCC), and MSU Denver (MSU).

This report examines the impact of CHAMP on Colorado community college students at CCCS schools and Aims Community College,[14] and employment-related outcomes for those students in the context of local advanced manufacturing labor markets. After identifying each regional Workforce Development Board (WDB) or Investment Board (WIB) and the CHAMP community college set within it, this report will analyze local patterns of sub-baccalaureate participation in manufacturing, construction, and technology as well as the premium on post-secondary training in these fields. Finally, it takes a close look at patterns of the enrollment, completion, and employment outcomes of CHAMP students in the context of these local trends.

[14] Aims Community College is not part of the Colorado Community College System

Figure 1. State-Level Declines in Sub-Baccalaureate Manufacturing (2004-2014) by Size of Sector (2014)



Source: Quarterly Workforce Indicators (2004-2014).

DATA AND METHODOLOGY

The analysis and findings in this report focus on the geographic areas that are included in Colorado's county and regional Workforce Development Boards (WDB) and Colorado's Workforce Investment Board (WIB).[15] Each WIB and WDB identified in Table 1 below is home to one participating CHAMP community college campus. In considering each WIB/WDB and its associated CHAMP community college program, analyses follow the same three-phase methodology for each pairing.

TABLE 1. Workforce Investment Boards and CHAMP Community Colleges

Workforce Investment Board (WIB) and Workforce Development Boards (WDB)	Participating Community College
Boulder County WDB	Front Range Community College
Denver WDB	Community College of Denver
Pikes Peak WFD (El Paso and Teller counties)	Pikes Peak Community College
Tri-County WDB (Clear Creek, Gilpin and Jefferson counties)	Red Rocks Community College
Pueblo County WIB	Pueblo Community College
Southeastern WIB (Baca, Crowley, Huerfano, Kiowa, Las Animas, Otero and Prowers counties	Lamar Community College
Weld County WDB	Aims Community College

Phase One: Local Labor Markets for Advanced Manufacturing. The first part of the analysis uses public-use Quarterly Workforce Indicators from the Longitudinal Employer-Household Dynamics (LEHD) linked employer-employee microdata and the U.S. Census Bureau to characterize local labor market dynamics within the area served by each Colorado Workforce Investment Board (WIB)/Colorado Workforce Development Board (WDB). These data are first used to detail the percentage of incumbent workers who had less than a bachelor's degree and were working in advanced manufacturing sometime in the last 12 years inclusive of the decade preceding CHAMP through the third year of the CHAMP grant, fall 2016. EERC's analysis of this percentage will be in Figure a's throughout this report. Quarterly Workforce Indicators (QWI) data used in this study rely on 2-digit North American Industry Classification System (NAICS) codes, three of which are related to advanced manufacturing: manufacturing,

[15] In Colorado there are 9 workforce regions and 10 sub-regions in which WIBs and WDBs are located to engage in "strategic planning to meet the employment and training needs of local businesses and industries." CDLE (2013) Orientation Guide for Colorado Local Workforce Investment Boards. Colorado Workforce Development Council, p.10.

construction, and technology.[16] QWI data are used here to examine the premium to sub-baccalaureate postsecondary training in each of the three CHAMP-related NAICS sectors over the same period (Figure b's throughout). EERC uses "premium" to refer to the percentage difference, or advantage, in the quarterly earnings of employees who took college coursework or completed a certificate or an associate degree, but lack a bachelor's degree, and those employees with a high school education or less in each of the specific NAICS coded areas.

Phase Two: CHAMP Participation and Completion in Context. In the second phase of EERC's analysis, CHAMP course enrollment and degree or certificate completion data are used to identify trends in participation over the three completed calendar years of CHAMP, 2014-2016 (Figure c's throughout). This calendar-year approach allows for the most direct comparison to employment and wage data, using calendar-year quarters, rather than academic semesters. Students are counted as participants in each year and at each college where they were enrolled in a CHAMP course. In addition, Figure c's include the number of students who completed a degree or certificate.

Phase Three: Returns to CHAMP Participation in Employment Outcomes. Colorado unemployment insurance (UI) data for CHAMP participants were obtained from the U.S. Department of Labor to shed light on students' labor market participation before and after participating in CHAMP (2013-2016 calendar years). These data allow for measuring both students' employment and their average quarterly earnings in the calendar year before and after enrollment in CHAMP courses (Figures d and e, respectively). Because UI data are only available from 2013 through 2016, some students' data were truncated (i.e. left or right censored). As a result, these students' pre- and/or post-CHAMP information have been omitted from the analysis. To illustrate, if a student enrolled only in 2014, then his/her pre-CHAMP employment and earnings information would be derived from 2013, the year prior to enrollment; by contrast, his/her post-CHAMP information would be drawn from 2015. By contrast, students enrolled in 2016 would have no post-CHAMP employment or earnings information available because the 2017 data is not yet available. Further, it is important to note that because UI data exclude individuals in the military, the self-employed, and those employed out of state, findings in phase three include only civilians working for pay in Colorado. Finally, when reporting average quarterly earnings of CHAMP students in the year before and the year following enrollment (Figure e's), students' earnings are contrasted against the average quarterly earnings of manufacturing workers with different levels of education (high school only, some college, a bachelor's degree) using QWI data from this same period.[17]

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[16] Manufacturing (31-33) includes workers employed in the manufacture of everything from consumer goods to aerospace products. Examples of sectors within construction (23) include building construction, civil engineering construction, and specialty trades. Finally, professional, scientific, and technical services (54), referred to here as technology, is a particularly heterogeneous group and includes architectural, engineering, and related services and specialized design – fields related to the computer-aided design curriculum at several campuses.

[17] Consistent with other CHAMP reporting, earnings are restricted to include only incumbents earning a minimum of $1,000 quarterly, see latest summary report.

RESULTS

Boulder WDB and Front Range Community College

The Workforce Development Board serving Boulder County, within the larger Central Colorado Planning Region, benefits from a diverse and technology-driven economy. Between now and 2020, local industries - professional, scientific, technical services, and manufacturing[18] - are expected to experience the highest rates of growth. Consistent with anticipated growth, the primary goal of Front Range Community College's (FRCC) CHAMP program was to reintroduce and redesign their machining program. A major strength of FRCC's CHAMP program was CHAMP staff 's close ties with and local employers. This facilitated industry's active involvement in the design/redesign of curriculum to meet employer changing needs. One result of these ties has been the job machining students receiving job offers from local manufacturers while they are still in the program. Given these early offers, students felt that they were "all but guaranteed" good jobs at the conclusion of the program.[19]

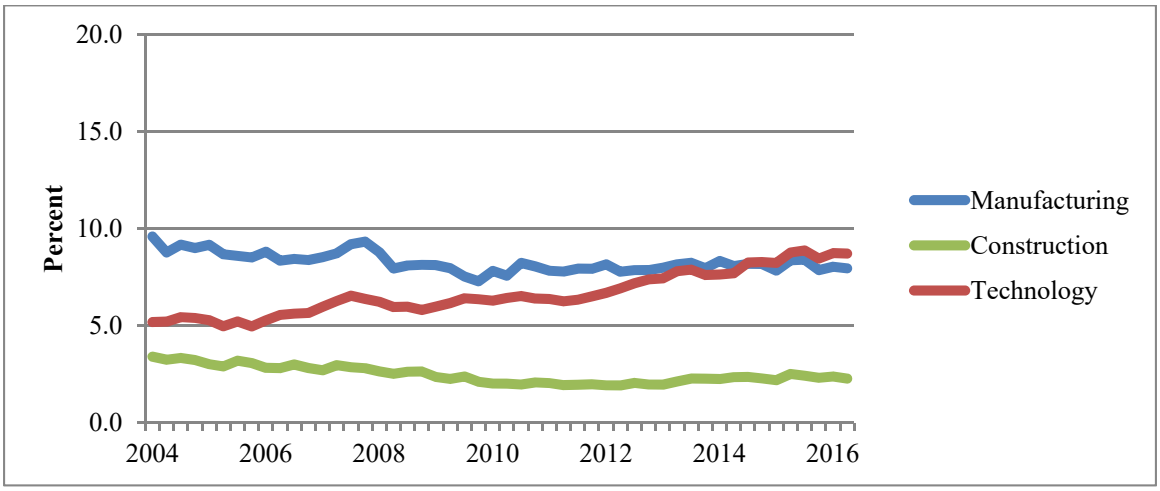
Over the past decade, the local Boulder labor market has been evolving, particularly for workers with less than a bachelor's degree. Figure 2a shows the percentage of the local workforce with less than a bachelor's degree employed in CHAMP-related fields from 2004 through fall 2016, the most recent data available. In 2004, roughly 10 percent of the local labor market was comprised of sub-baccalaureate workers in manufacturing (blue line). By the onset of the Great Recession in 2008, the group had shrunk slightly to about 8 percent, and then held steady through 2016. Over the same twelve-year period, construction jobs (green line) in the Boulder area declined, from 3 percent to 2 percent.[20] On the other hand, sub-baccalaureate jobs in professional, scientific, and technical services (red line) have increased, growing from 5 in 2004 to nearly 9 percent of the workforce in 2016. Thus, although CHAMP-related fields may offer a fast-track toward good jobs within the local economy, local opportunities for sub-baccalaureate workers are increasingly shifting towards scientific and technical areas and away from manufacturing or construction.

[18] https://www.colorado.gov/pacific/sites/default/files/2016_Boulder_County_ Local_Plan.pdf

[19] See EERC's Front Range Community College CHAMP Case Study" at http://smlr.rutgers.edu/sites/ smlr.rutgers.edu/files/ images/Research_documents/frcc_case_study_final_2016.pdf

[20] This may be a result of Boulder's restrictive policies on growth.

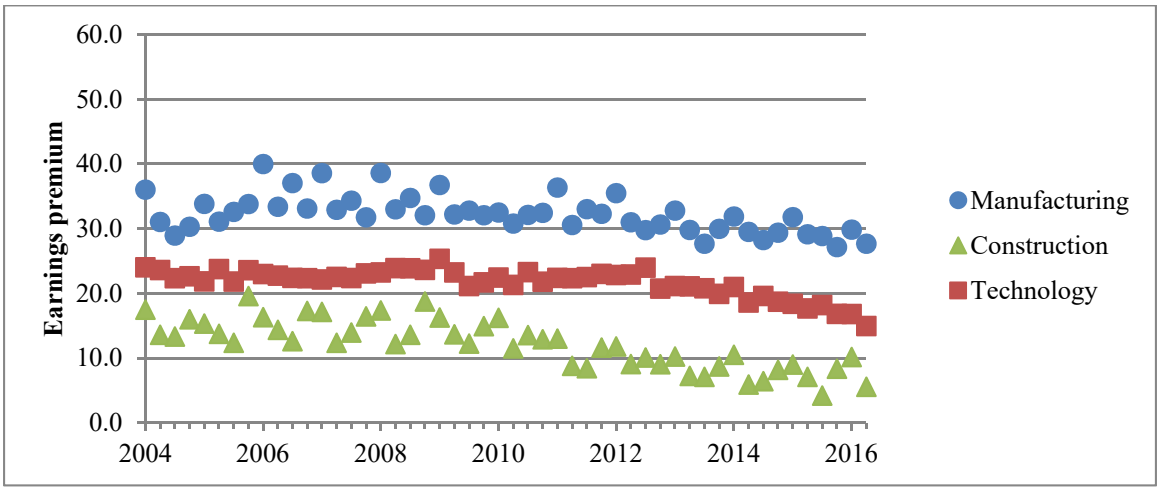
FIGURE 2a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



When evaluating the benefit of pursuing additional education, workers' choices are likely motivated by the premium that additional training will bring them in the workforce. Figure 2b shows the percentage increase from 2004 to 2016 in earnings associated with some postsecondary education including college coursework, a certificate or an associate degree (compared to a high school education or less) for workers in manufacturing, technology, and construction.

Historically and in general, workers in manufacturing with some postsecondary training have enjoyed the largest premium for their advanced training compared to construction and technology, although since the recession some of these benefits have decreased. Nevertheless, the most recent data show that workers in manufacturing with some postsecondary education earn nearly 30 percent more than peers in the same sector with a high school degree or less. By comparison, the premiums for workers in technology and construction were only 15 percent and 6 percent, respectively. Therefore, when considering advanced training in the Boulder area, workers stand to gain the most – on average – from training in manufacturing compared to other CHAMP-related fields.

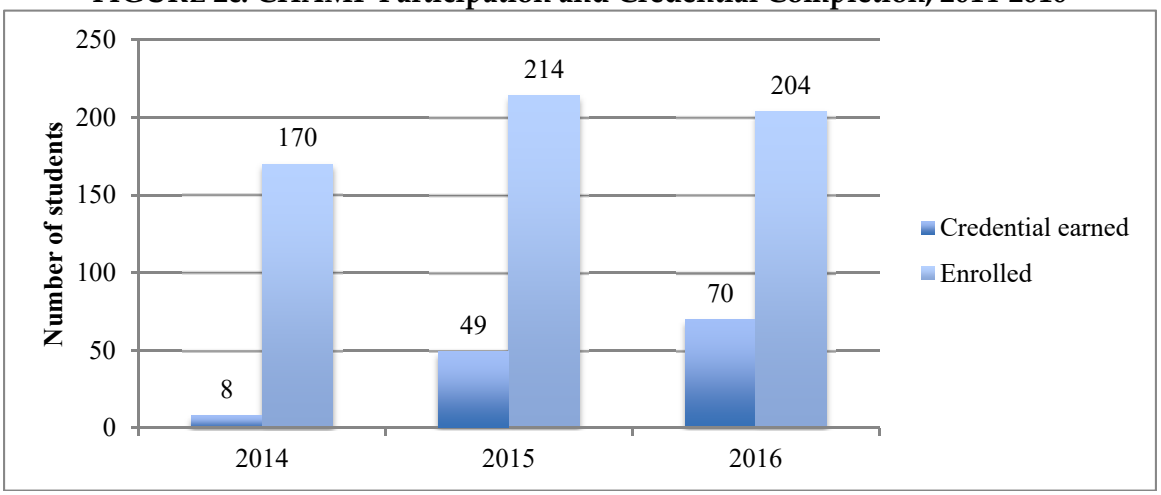
FIGURE 2b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



In the context of increasing opportunities for sub-baccalaureate workers within technology, and steady but sizable returns to postsecondary training, FRCC's CHAMP programs are well positioned. They not only meet the needs of individuals seeking access to good local jobs, but also the demands of employers.

Figure 2c presents participation in CHAMP over three calendar years, 2014-2016, in terms of enrollments in CHAMP courses and the completion of CHAMP related credentials (degrees and certificates). By both measures, participation in FRCC's CHAMP program has grown substantially since 2014. A total of 170 students participated in CHAMP during the 2014 calendar year, growing to 214 students in 2015, and then dropping slightly to 204 students in 2016. On the other hand, an increasing numbers of students earned credentials each year, from only 8 during the first year of CHAMP, to 49 in 2015, and 70 in 2016. Even with the slight dip in enrollment, the general enrollment trends for FRCC's CHAMP courses and students' completion of CHAMP related sub-baccalaureate credentials bodes well for their entrance into a stable (or growing) and profitable areas in the local labor market.

FIGURE 2c. CHAMP Participation and Credential Completion, 2014-2016

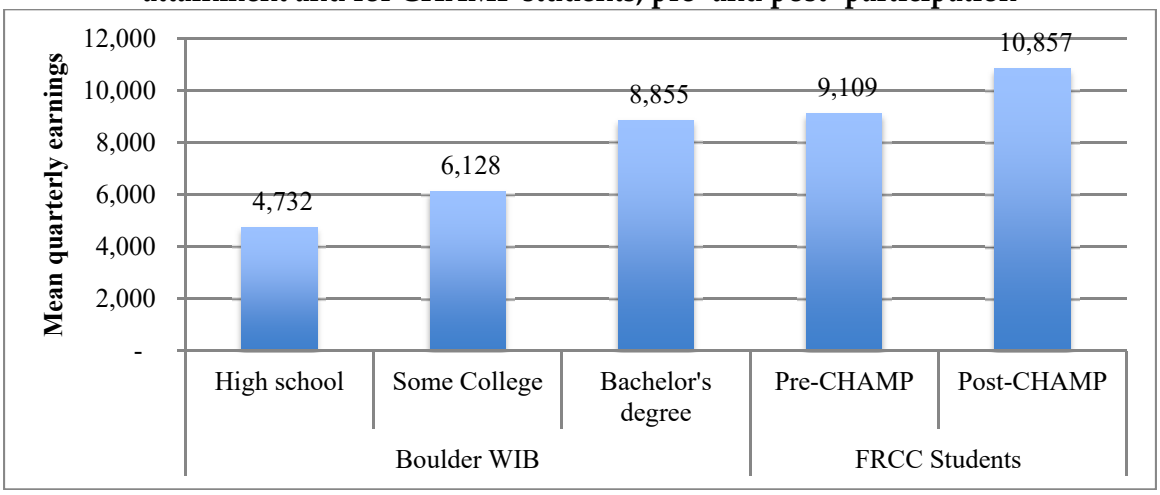


As the final piece of this analysis, Figures 2d and 2e consider how FRCC's CHAMP students have fared in the labor market. Figure 2d contrasts the rate at which CHAMP students were employed the year prior to their enrollment against their employment rate the year following, regardless of whether they completed a degree or certificate. Fifty-eight percent of students were employed prior to CHAMP compared to 64 percent who were employed after enrollment. Across the WIBs/WDBs considered in this report, FRCC had the highest employment rate among participants before becoming CHAMP students, and also had the highest post-CHAMP employment rate.

Figure 2e details the average quarterly earnings of FRCC's CHAMP students before and after participation against the average earnings of workers in the Boulder WDB working in manufacturing who had completed high school, some college, or a bachelor's degree. This comparison shows that FRCC students earned on rough average $9,100 each quarter the year before enrolling in CHAMP and $10,900 each quarter the year following CHAMP regardless of their highest completed academic level. These earnings are considerably higher than the average quarterly earnings of workers with bachelor's degrees in manufacturing in the Boulder area ($8,855). Taken together, FRCC students were among the most strongly positioned in terms their employment and earnings before CHAMP, and they benefitted in both these areas following their participation.

FIGURE 2d. Employment rate of CHAMP students pre- and post-participation

FIGURE 2e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Denver WDB and Community College of Denver

The goal of the Denver Workforce Development Board is to foster economic growth for its diverse range of industries and talent through empowering job seekers and enabling local businesses.[21] The Denver WDB particularly focuses on manufacturing, technology, healthcare, and finance as key economic sectors.[22] Within this context, the Community College of Denver (CCD) developed a range of CHAMP programs including fabrication welding; machine technologies; and engineering graphics and mechanical design. In addition, CCD heavily invested in a new, state-of-the-art Advanced Manufacturing Center (AMC) to house these programs. CCD's CHAMP program, however, faced major delays in the completion of their

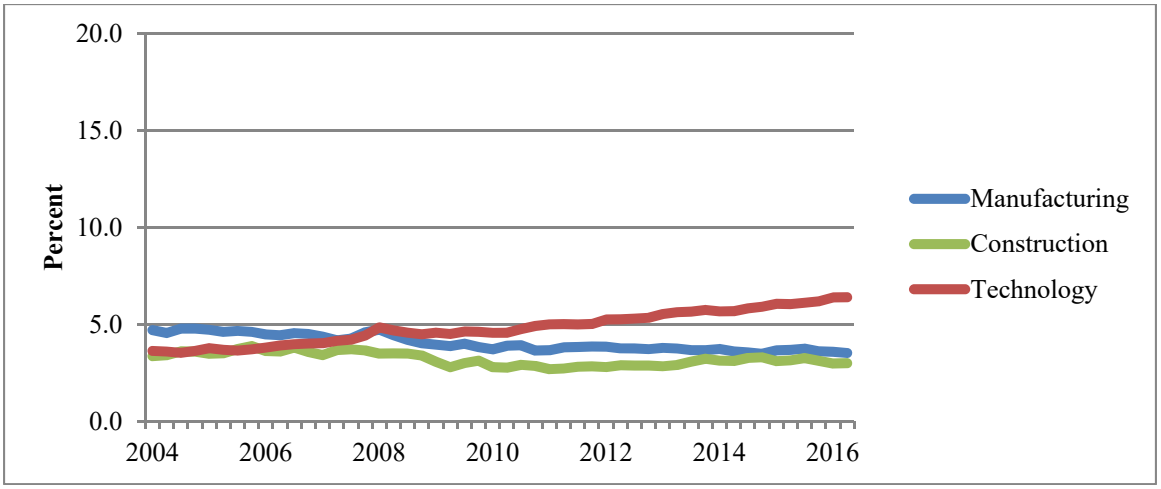
[21]See https://www.denvergov.org/content/dam/denvergov/Portals/690/WorkforceDevBoard/Denver_WDB_StrategicActionPlan_2016-2020.pdf

[22] See EERC's "See EERC's Community College of Denver CHAMP Case Study" at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

new AMC building, as well as the limited engagement from local employers. At the same time, the college noted that local employers were hiring their students before they completed. As a result, some students did not complete their credentials, employment undermining their training.

To situate these dynamics within context, Figure 3a shows the percentage of individuals working in CHAMP related sectors in the Denver WDB labor market from 2004 to 2016 who had less than a bachelor's degree. Compared with Boulder, these CHAMP-related sectors comprise a smaller portion of Denver's local economy. And yet, some similar trends emerge in terms of declines in manufacturing and growth in technology. To illustrate, while the share of the local workforce in manufacturing (blue line) declined slightly from 5 percent in 2004 to just under 4 percent in 2016, the percentage of workers without college degrees in technology and related fields (red line) increased from 4 percent to 6 percent over this same period. Finally, despite population growth in the Denver area which suggests the need for new construction, during the study period 2004 to 2016, only about 3 percent of Denver's workforce with less than a bachelor's degree worked in construction (green line). Taken together, local opportunities for sub-baccalaureate workers in the Denver area seem to be moving slowly away from manufacturing and towards jobs related to technology.

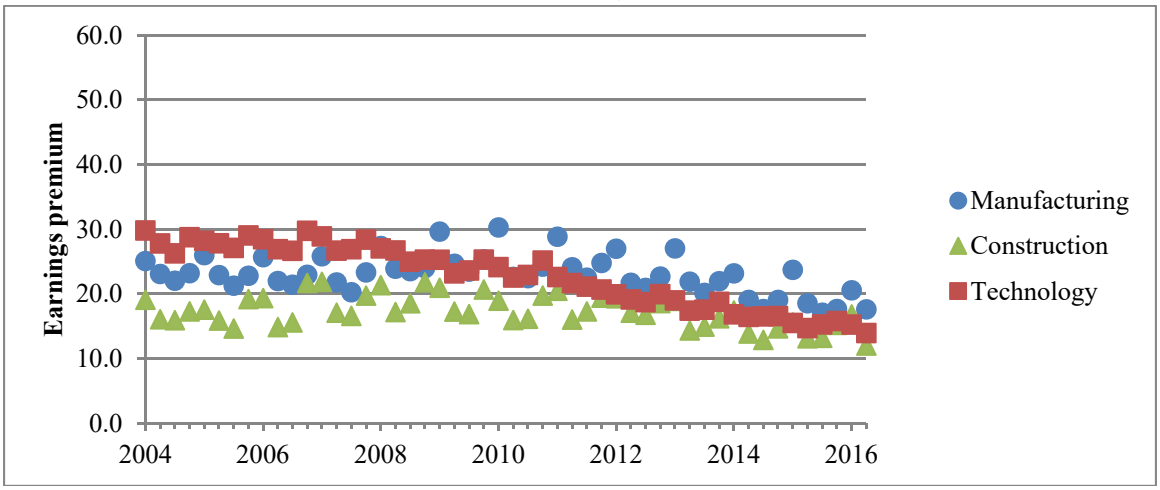
FIGURE 3a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



As before, Figure 3b considers trends over time in the earnings premium for workers within the local labor market with some college experience compared to those with a high school education or less. Figure 3b shows that the quarterly earnings of workers with some college experience compared to those with less education has declined across sectors. And, since the onset of the recession, jobs in manufacturing have evidenced a higher educational premium compared to jobs in construction and technology. For example, the "some college" premium for jobs in technology shows a steady decline from 30 percent to 15 percent during the study period. Earnings premiums for those in manufacturing were more variable, but showed an overall decline. Still, by the beginning of 2016 the quarterly premium for having taken

postsecondary coursework or completing an associate degree was approximately 20 percent greater than those with a high school degree or less.

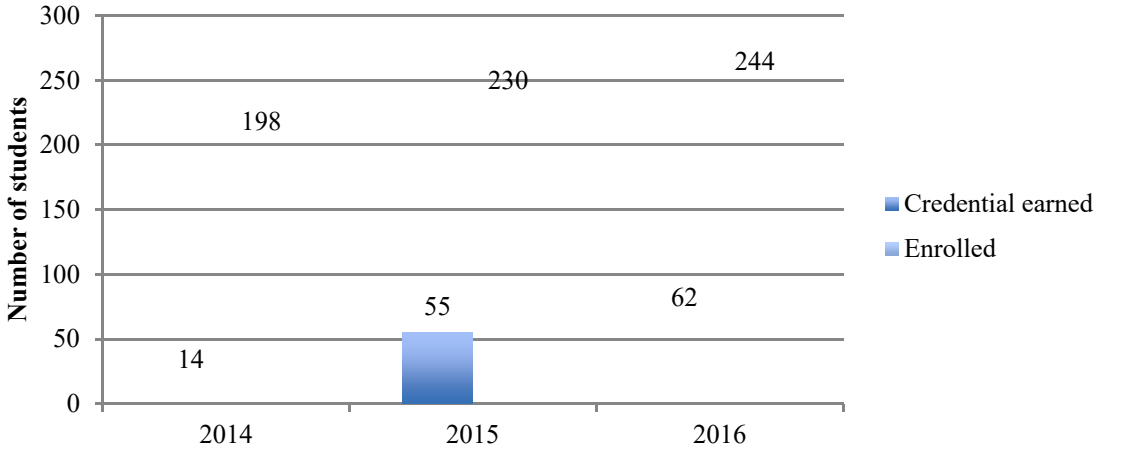
FIGURE 3b. Earnings premium: "Some college" in CHAMP-related sectors (vs. high school or less)



CCD's CHAMP program, with its emphasis on advanced manufacturing technologies, offered students access to these growing opportunities in technology for sub-baccalaureate workers as well as the steady premium to postsecondary training in manufacturing.

Figure 3c details rates of participation in CHAMP at CCD in terms of course enrollment and credential completion between 2014 and 2016. By both measures, CHAMP's reach expanded at CCD each year. In particular, the number of students completing degrees or certificates increased from 14 in 2014 to 62 in 2016. At the same time, while 198 students enrolled in 2014, this number grew to 244 students by 2016. We thus see an alignment between trends within the Denver's local labor market and patterns of student engagement with the CCD's program.

FIGURE 3c. CHAMP Participation and Credential Completion, 2014-2016



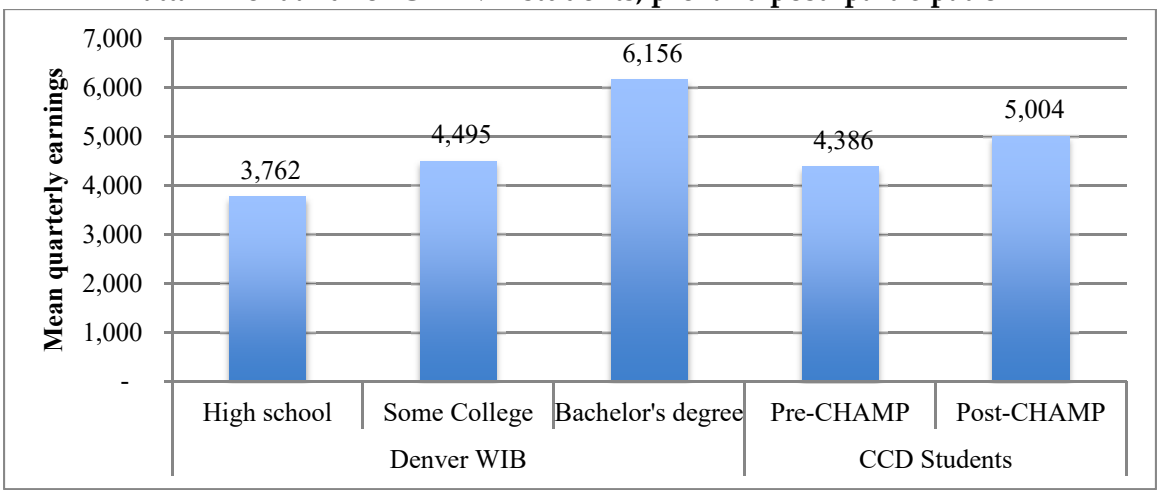
Finally, Figures 3d and 3e present the employment-related outcomes for CCD's CHAMP students reflecting the extent to which those participating in the program were able to leverage their training into jobs and higher wages. Looking first to Figure 3d, employment increased from 38 percent before participating in CHAMP to 46 percent a year after exiting, an 8 percentage point difference.

In Figure 3e the quarterly earnings of CCD students are compared pre- and post- CHAMP enrollment. As before, the figure benchmarks these changes against the earnings of local workers in manufacturing who had completed high school, some college, or a bachelor's degree. In each quarter pre-CHAMP earnings of CCD students averaged $4,386, considerably higher than local manufacturing incumbents with only a high school education ($3,762), but similar to those with some college ($4,495). A year after leaving CHAMP, CCD students were earning a rough average of $5,000 each quarter, or an income that falls approximately between Denver area incumbents with some college ($4,495), and those with a college degree ($6,156).

Looking at Figures 3d and 3e together, the data suggests that not only are CCD students more likely to be employed following participation in CHAMP, but that their earnings within the local labor market receive a boost which lands them somewhere between the wages for those with an associate and a bachelor's degree.

FIGURE 3d. Employment rate of CHAMP students, pre- and post-participation

FIGURE 3e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Pikes Peak WBD and Pikes Peak Community College

South of Denver, is the region covered by the Pikes Peak WDB, El Paso and Teller counties including Colorado Springs and the surrounding rural areas. This is the location of Pikes Peak Community College (PPCC) as well as an army base and several air force bases. The military are a significant presence in this area playing a major role in the community's culture, and economy. Yet, in a recent study of the region's workforce, representatives of local industries including manufacturing, construction, aerospace and defense, healthcare and finance reported an acute shortage of middle-skill jobs – those requiring more than a high school education but less than a bachelor's degree.[23] Consistent with this need, the collaboration between the El Paso/Teller counties WIB and PPCC was notably strong. For example, PPCC administrators and faculty regularly attended monthly meetings of the Pikes Peak Manufacturing Partnership (PPMP) and PPMP advisors weighed in on the development of the manufacturing program.[24] The synergy between PPCC and the El Paso/Teller WIB resulted in CHAMP funded programming around machining technology, computer-aided design, and electronics technology. The focus of the curriculum design was on developing specific job skills, industry qualifications, and short-term certificates rather than multi-year certificates or associate degree programs.

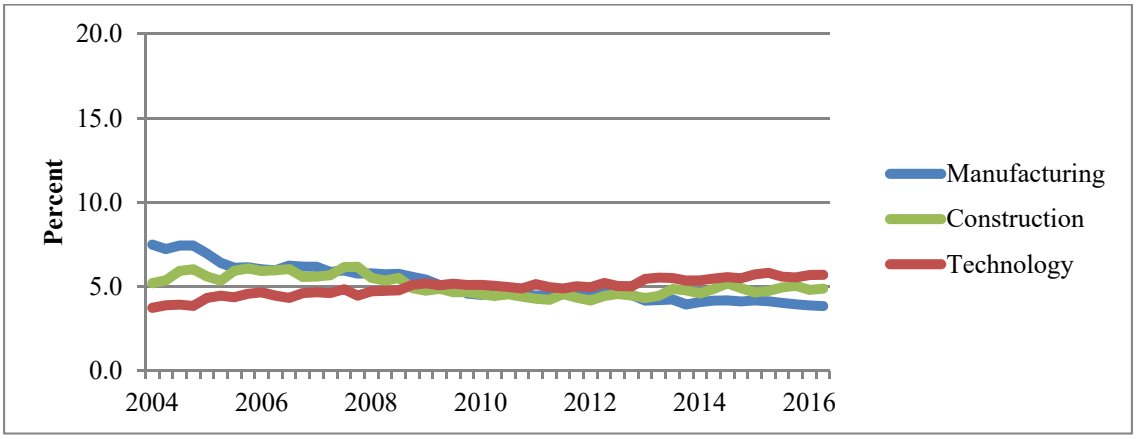
Figure 4a presents the region's labor market trends for workers with less than a bachelor's degree. It shows that between 2004 and 2016, the percentage of the sub-baccalaureate workforce holding jobs in manufacturing (blue line) was roughly halved, falling from 7.5 percent in 2004 to 3.9 percent in the beginning of 2016. By contrast, the share of sub-baccalaureate workers in technology (red line) increased from 3.8 percent to 5.7 percent over the same period. Finally,

[23] See EERC's "Skills Building" at https://www.ppwfc.org/pageFiles/pgDir6167/files/Skills/Employers_Skills_Report_2018.pdf

[24] See EERC's "Pikes Peak Community College CHAMP Case Study" at https://smlr.rutgers.edu/content/ education-employment-research-center-eerc

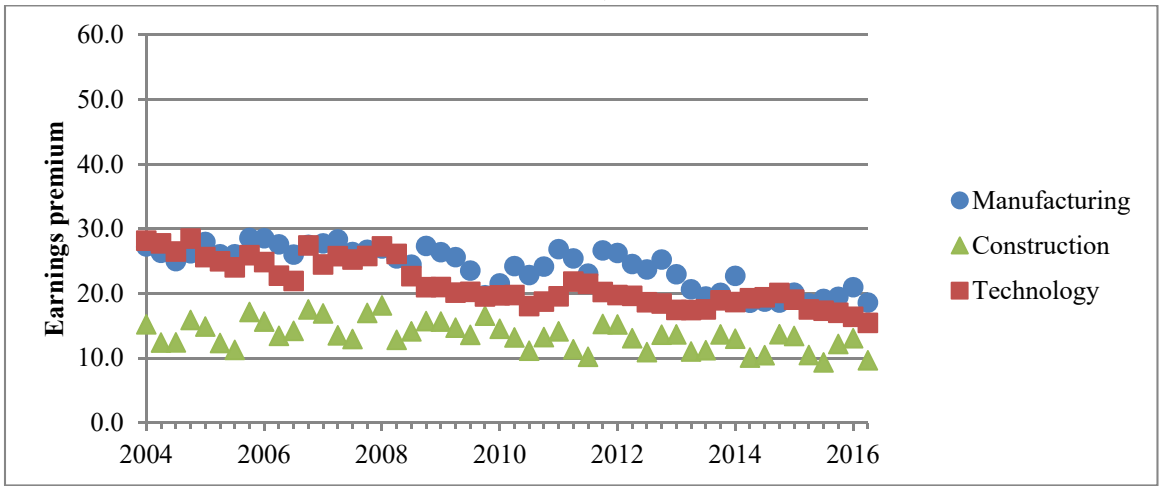
although construction (green line) has fluctuated a bit over time, it has remained steady at about 5 percent. The focus of PPCC's CHAMP program on more technologically-driven aspects of manufacturing therefore appears to be well suited to a local labor market shifting away from manufacturing and towards scientific and technical areas for workers with less than a bachelor's degree.

FIGURE 4a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



In the region, the wage premium of some college education –either postsecondary coursework, a certificate or an associate degree – has also been evolving. Figure 4b, shows for each quarter of 2004 that workers with some college training in the El Paso/Teller area typically earned about 30 percent more than their peers with less education. This premium, however, declined to about 20 percent by 2016. Jobs in manufacturing (blue dots) and technology (red squares) track similarly in respect to the premium of postsecondary experience. But manufacturing jobs had a 5 percent higher return. And, as has been shown elsewhere, construction related jobs typically carried the smallest premium for postsecondary education – somewhere between 10 and 20 percent.

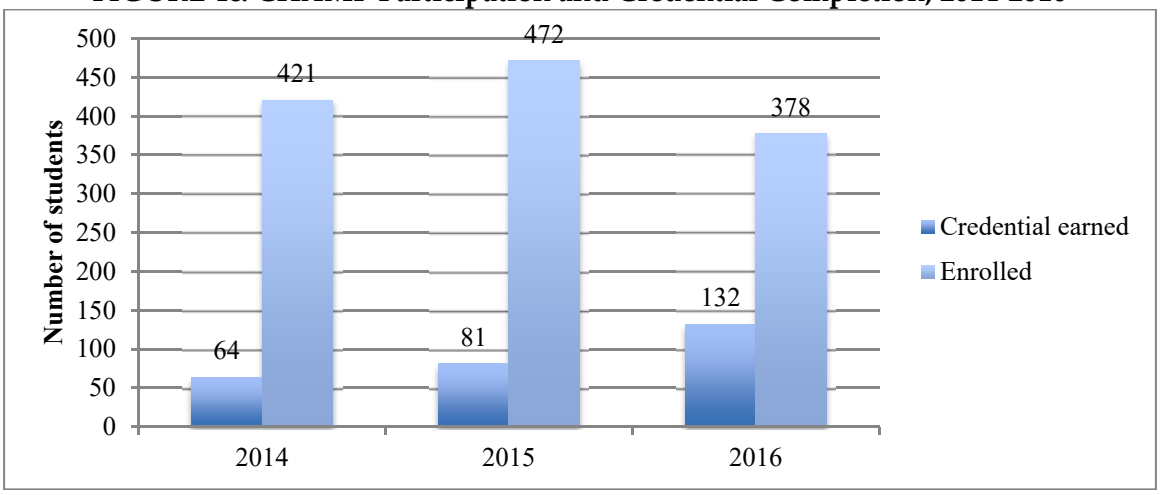
FIGURE 4b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



Reflecting on the above cited trends in the local labor market – a transition from manufacturing to tech jobs concurrent to a declining, but still substantial postsecondary training premiums, PPCC's CHAMP created program seems well positioned. They offer a pathway via training to good jobs in the local economy.

Figure 4c details the number of students who completed degrees or certificates or simply enrolled in CHAMP coursework at PPCC. In the first year of the CHAMP grant, a total of 421 students took CHAMP coursework and 64 students completed CHAMP related degrees or certifications. Though degrees and certificates earned by PPCC students rose steadily each year of the grant reaching 132 in 2016, CHAMP course enrollment peaked in 2015 with 472 students and then declined in 2016 to 387 students. Of interest, across the CHAMP consortium of colleges, PPCC had the highest enrollment, while awarding comparatively fewer degrees and certificates. This skill building without concurrent credentialing is consistent with PPCC's collaborating industry partners' emphasis on skill training then employment, rather than earning longer term credentials.

FIGURE 4c. CHAMP Participation and Credential Completion, 2014-2016



Finally, as before, Figures 4d and 4e examine the payoff to students in terms of increases in employment and earnings following participation in PPCC's CHAMP programs. Figure 4d presents the employment rate of students at PPCC before and after enrolling in CHAMP coursework. In the year prior to enrolling in CHAMP courses, 45 percent of students were employed. By contrast, 55 percent were employed one year after leaving PPCC, a 10 percentage point increase. Figure 4e contrasts the quarterly earnings of PPCC CHAMP students before and after participating against the average quarterly wages of workers with various levels of education in the local labor market. Prior to enrolling in CHAMP courses, the average PPCC student was earning $4,865 quarterly at his or her job, slightly more than the average incumbent in manufacturing with some college or an associate degree. A year following enrollment in one or more CHAMP courses, students were earning on average $6,599 each quarter, about $150 less than manufacturing workers with college degrees. In sum, PPCC's CHAMP students were able

to leverage their educational experience into greater rates of employment and furthermore, had earnings higher than those earned by sub-baccalaureate workers in manufacturing jobs.

FIGURE 4d. Employment rate of CHAMP students, pre- and post-participation

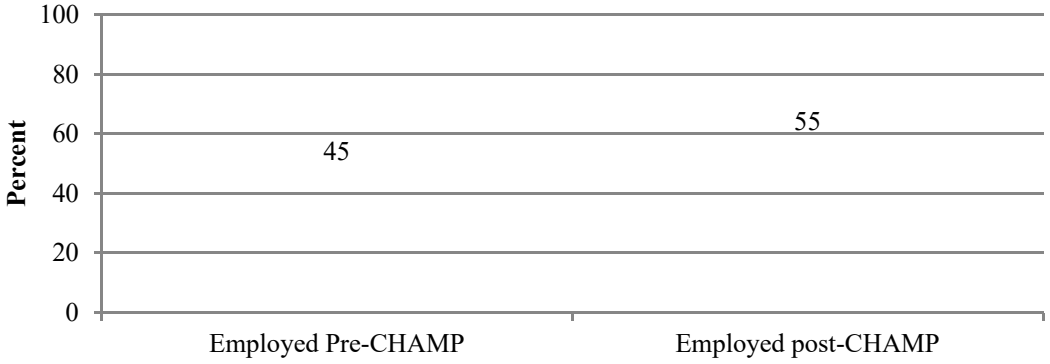
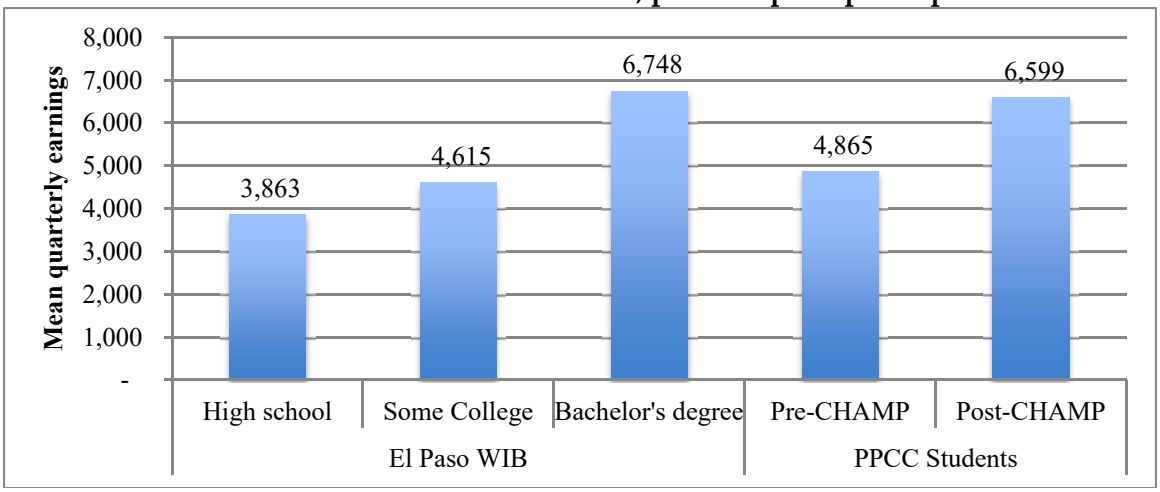


FIGURE 4e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Tri-County WDB and Red Rocks Community College

Workers in Jefferson, Clear Creek, and Gilpin counties, just east of Denver, benefit from a range of in-demand local industries. The Tri-County Workforce Development Board which serves the area, had previously identified three high demand industry sectors – healthcare, IT, and advanced manufacturing. In response to increasing demand for skilled tradespeople,[25] the WDB recently added construction. Prominent employers within the region's advanced manufacturing sector include the aerospace leader Lockheed Martin, which employs engineers as well as machinists and skilled production workers.[26]

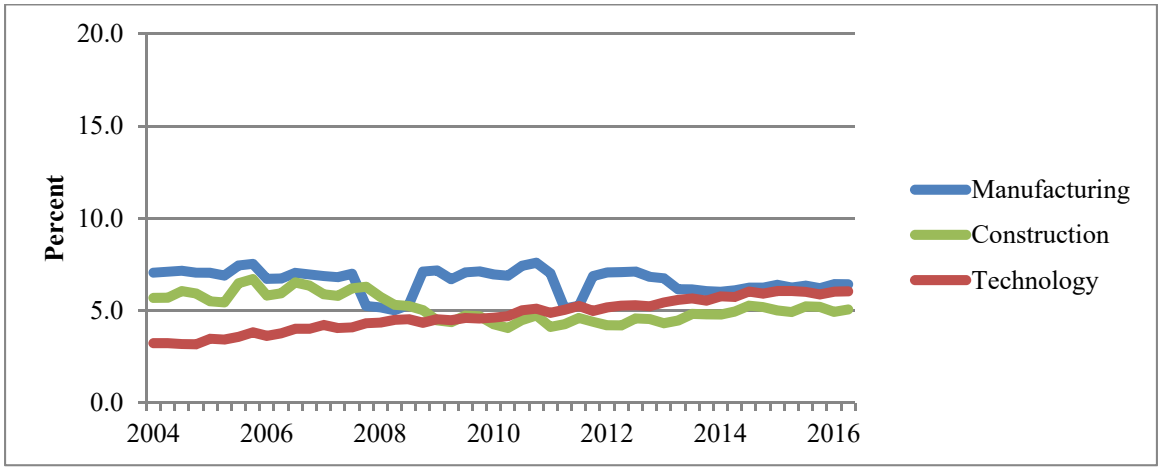
[25] file:///C:/Users/skyte/AppData/Local/Temp/ajc-local-area-plan-PY16-PY19.pdf

[26] Ibid

Red Rocks Community College (RRCC), located in Lakewood, has historically benefitted from strong relationships with local industries. As part of CHAMP, local employers played an active role in the development of curriculum for RRCC's precision machining and engineering graphics technology programs.[27]

Figure 5a presents the percentage of the sub-baccalaureate workforce in the Tri-County area involved in a CHAMP-related sector between 2004 and 2016. In contrast to the steady decline seen elsewhere, the percentage of sub-baccalaureate manufacturing workers in the Tri-County area was only slightly lower in 2016 compared to 2004; 7 percent and 6.5 percent respectively. Of note, the local manufacturing labor market suffered two rapid shocks: in 2008 and 2012. During the study period, the percentage of construction workers with less than a college degree (green line) typically hovered around 5 percent, Figure 5b. At the same time, and as seen elsewhere, over the past 12 years, the percentage of sub-baccalaureate workforce in technology-related jobs (red line) nearly doubled, from 3.2 percent to 6 percent. In summary, within the Tri-County sub-baccalaureate labor market, the manufacturing sector has shown variability but has been steadier in recent years. This is concurrent to a growth in opportunities in technology, which are now at similar levels to manufacturing.

FIGURE 5a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



During the study period, across these three workforce sectors, the premium to pursuing college coursework or obtaining an associate degree has increased. Figure 5b compares earnings premium of those workers with some college education but without a bachelor's degree, with workers with a high school degree or less. Of note is the divergence in premium patterns between 2004 and 2016. In 2004, construction (green triangle) had a 20 percent advantage for workers with some college, compared to technology (red square) with a 22 percent advantage, and manufacturing (blue circle) with a 26 percent advantage. By 2016, the pattern had shifted with the premium for workers with some post-secondary experience manufacturing to be about

[27] See EERC's "Red Rocks Community College CHAMP Case Study" at http://smlr.rutgers.edu/sites/smlr.rutgers.edu/files/images/Research_Documents/frcc_case_study_final_2016.pdf

22 percent compared to technology at 16 percent, and construction dropping to 11 percent. Thus, within the three CHAMP-related sectors, workers with less than a bachelor's degree who completed some college coursework or an associates' degree, can expect the highest return on their training in advanced manufacturing, and the lowest return in construction, with technology-related fields in the middle.

FIGURE 5b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)

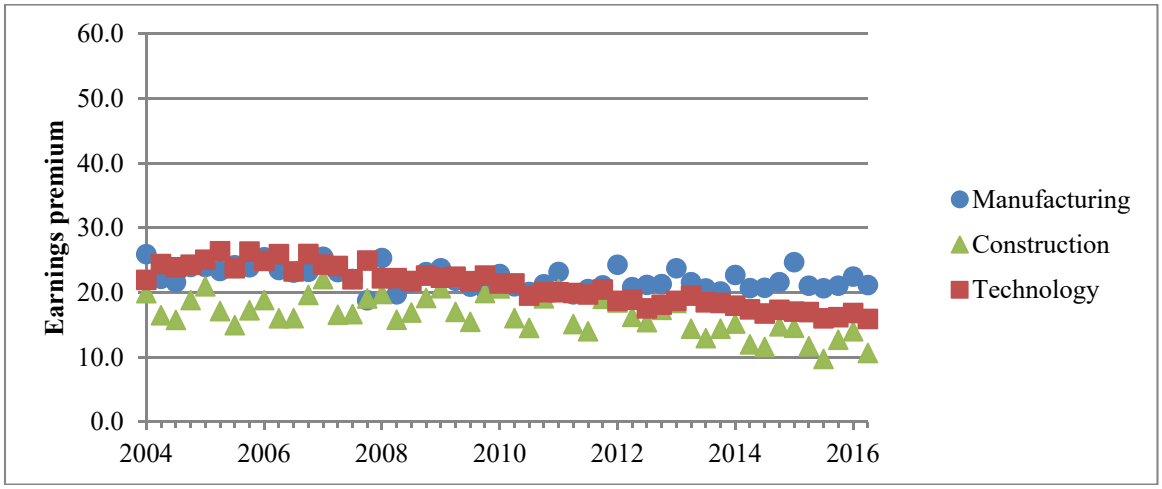
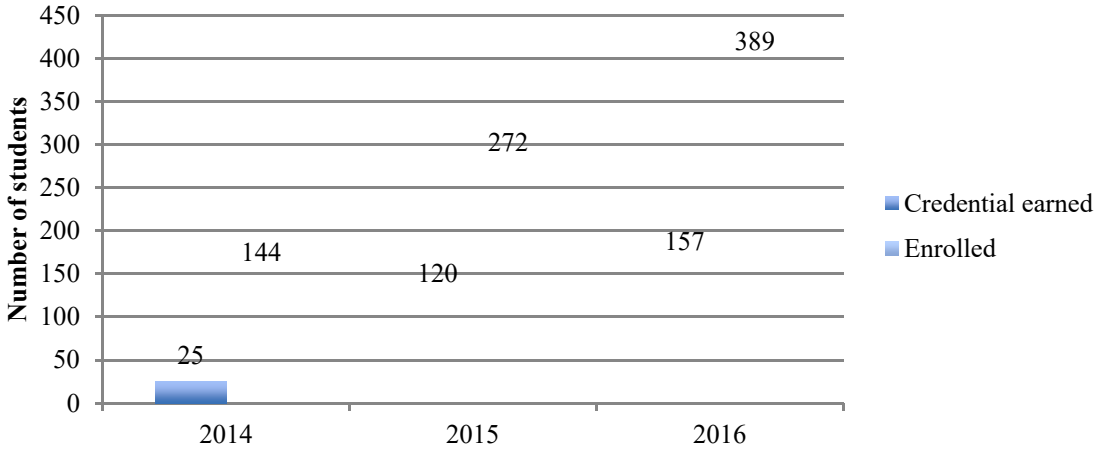


Figure 5c shows the rates of participation – enrollment and credential completion - in RRCC's CHAMP programs during the 2014, 2015, and 2016 calendar years. Enrollment in RRCC CHAMP programs increased each year: 144 in 2014, 272 in 2015; and the largest increase in 2016 to a total of 389; the most of any CHAMP college that year. Twenty-five students completed degrees or certificates in 2014; 120 did so in 2015; and by 2016, 157 had completed a CHAMP related credential. Thus, despite perceptions that local employers were unsure of how to interpret CHAMP certificates, each grant year RRCC's CHAMP program gained momentum in terms of enrollment and credential completion.

FIGURE 5c. CHAMP Participation and Credential Completion, 2014-2016



Finally, Figures 5d and 5e illustrate how RRCC students were doing in the labor market before and after their CHAMP coursework. In Figure 5d, the employment rate of RRCC CHAMP students the year prior to their enrollment is contrasted with their employment rate the year after their participation. Forty-one percent of students were employed before they began CHAMP; 62 percent were employed the year following – a 21 percentage point increase.

Figure 5e examines how CHAMP students' average quarterly earnings before and after participation compared to the average of Tri-County manufacturing workers with various levels of education. Prior to enrolling in CHAMP coursework, students earned an average of $5,115 each quarter, slightly below the average earnings of high school educated workers in manufacturing. However, after enrolling in CHAMP, these students typically earned – quarterly earnings of $7,001 very close to the $7,146 earned by local workers in manufacturing who had taken college-level courses or completed an associate degree. Thus, CHAMP appears to have boosted earnings from below those of high school students to roughly on par with peers with some college experience.

FIGURE 5d. Employment rate of CHAMP students pre- and post-participation

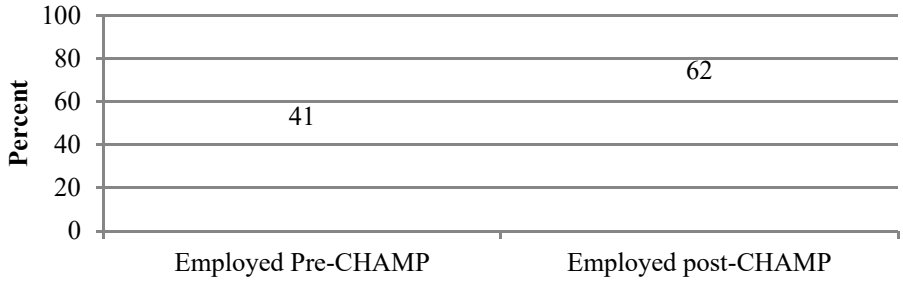
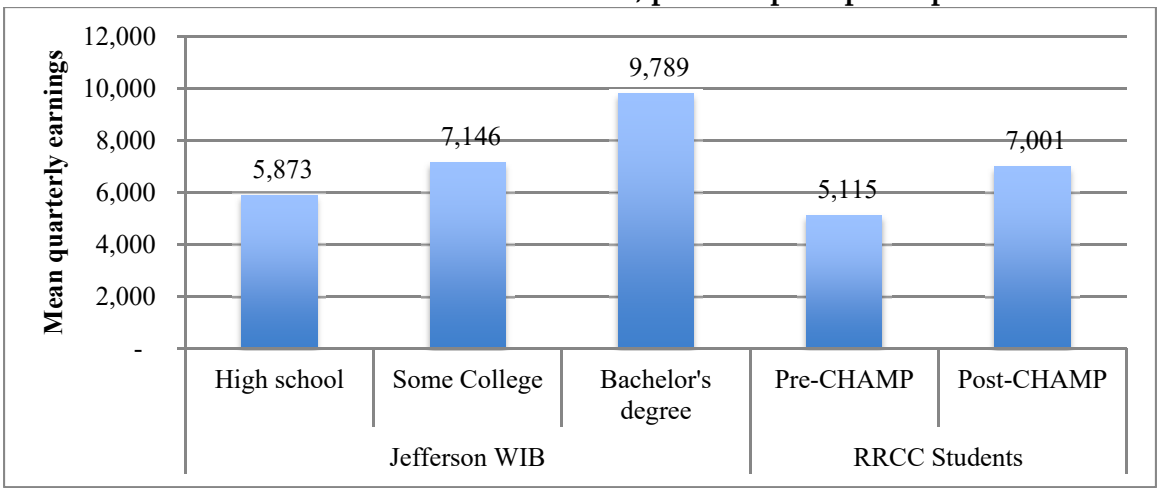


FIGURE 5e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation

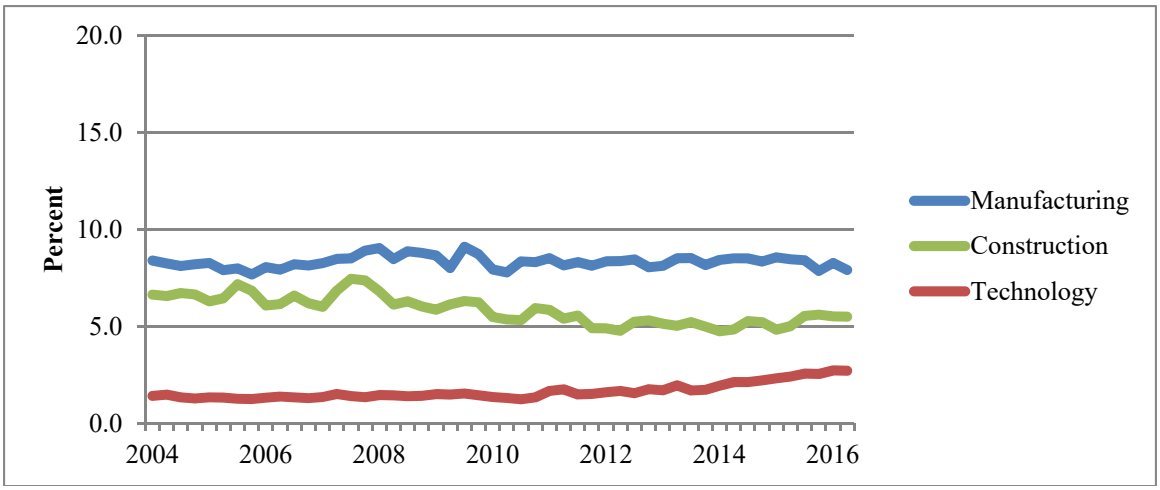


Pueblo WIB and Pueblo Community College

Located in southern central Colorado, Pueblo's history as a transportation and manufacturing hub features prominently in its identity. To meet current and emerging needs in Pueblo, CHAMP programming at Pueblo Community College (PCC) sought to efficiently train students for jobs in welding, electro-mechanical technology, and machining.[28] In addition, PCC students could train for local jobs in wind energy or lucrative oil and gas jobs across the state, e.g., jobs in the Denver and Greeley areas. Adding to the success of CHAMP at PCC was the close relationships between CHAMP personnel and the local workforce center. This relationship facilitated communication with local industry representatives as well as facilitated the employment of PCC students' with local companies.

In the context of Pueblo's history as a manufacturing center, Figure 6a looks at trends in the local labor market for CHAMP-related sectors over the past twelve years. In general, all three sectors – manufacturing, construction, and technology - have not experienced more than a 5 percent change, but the direction of this change has been different for each sector. Manufacturing (blue line) has been the most stable sector employing about 8 percent of sub-baccalaureate workers in the Pueblo area. As such, the Pueblo region is just behind Boulder and Weld counties which have the largest share of manufacturing jobs of all WIBS/WDBs served by CHAMP. Construction (green line) has dipped slightly in the rate of sub-baccalaureate worker employment, from 6.5 percent to 5.5 percent during the study period. The technology sector (red line) has nearly doubled its rate of employment of sub-Baccalaureate employees, going from 1.5 percent in 2004 to nearly 3 percent in 2016. Overall, for sub-Baccalaureate employees, Pueblo offers a steady labor market for sub-baccalaureate jobs in manufacturing and construction, concurrent to increasing opportunities within technology.

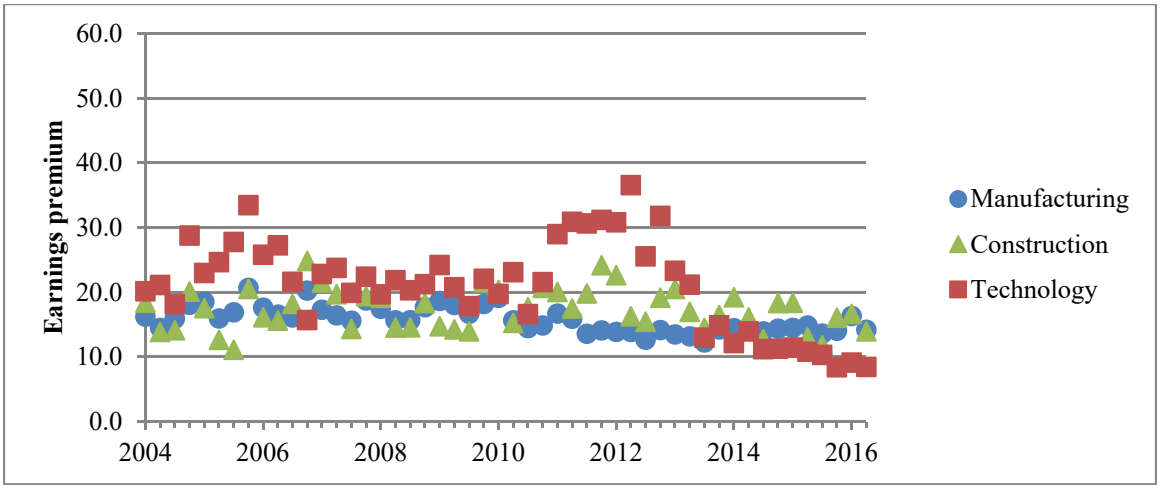
FIGURE 6a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors



[28]See EERC's Pueblo Community College CHAMP Case Study" and EERC's Colorado Sector Strategy Evaluation Case Studies, both at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

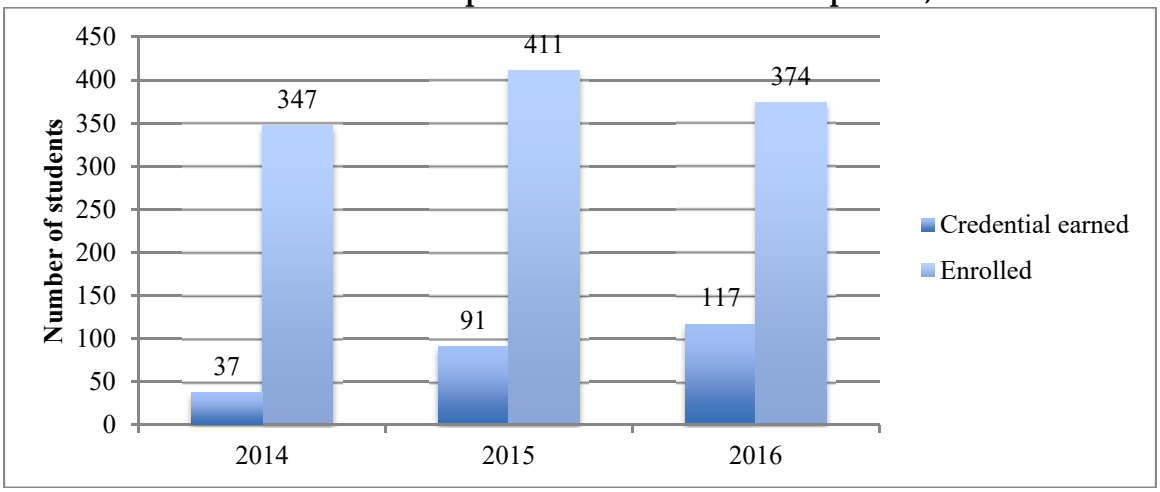
Figure 6b charts the earnings premium enjoyed by workers in the Pueblo area who have completed "some college" – either college coursework, a certificate or an associate degree – over those with a high school education or less. Manufacturing jobs (blue circle) have offered workers with some college experience a steady, although declining, premium over the last several years, dropping from almost 19 percent in 2009 to about 14 percent in the most recent data. By contrast, quarterly earnings in construction (green triangle) and technology (red square) have been more volatile, characterized by sudden increases that generally taper downward over time. To illustrate, the earnings premium in manufacturing hovered around 20 percent from 2008 to 2010, spiked to 37 percent in early 2012, and has declined recently to about 8 percent. Jobs in construction have followed a similar pattern, but to a less dramatic extent. Thus, though premiums in manufacturing have been slowly declining, other CHAMP-related sectors in the Pueblo area have experienced both spikes and declines.

FIGURE 6b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



PCC's CHAMP programs appear to offer the college training needed for an entry level job in the region's fairly stable manufacturing sector and its growing technology sector. Figure 6c shows the rates of enrollment and certificate/degree attainment for those participating in PCC's CHAMP programs. In 2014 enrollment in CHAMP courses was 247, rising to 411 in 2015 and then falling in 2016 to 347. At the same time, an increasing number of degrees and certificates were awarded: 37 awarded in 2014, 91 in 2015, and 117 in 2016. Despite its enrollment, PCC had relatively fewer completers than other campuses in the CHAMP consortium.

FIGURE 6c. CHAMP Participation and Credential Completion, 2014-2016



Finally, Figures 6d and 6e shed light on the impact of CHAMP on participants in the Colorado labor market. First, Figure 6d indicates the extent to which students taking CHAMP courses at PCC were employed the year prior to their participation in CHAMP compared to a year afterward. It shows that while 36 percent of PCC's CHAMP students were employed before starting a CHAMP program, a year after their enrollment ended, 54 percent were working in Colorado.

Figure 6e shows the average quarterly earnings of these students the year before and after CHAMP participation as compared to manufacturing workers in the Pueblo Workforce Investment Board area with different levels of education. Prior to enrolling in CHAMP, PCC students were earning an average of $3,292 – well below the average quarterly earnings of manufacturing workers with a high school degree, $4,435. By contrast, a year after their participation in CHAMP, students were earning an average of $5,079 each quarter, roughly the equivalent of local manufacturing workers with some postsecondary experience or an associate degree. This suggests that by leveraging their CHAMP training, PCC students were able to substantially boost their rates of employment and their earnings.

FIGURE 6d. Employment rate of CHAMP students pre- and post-participation

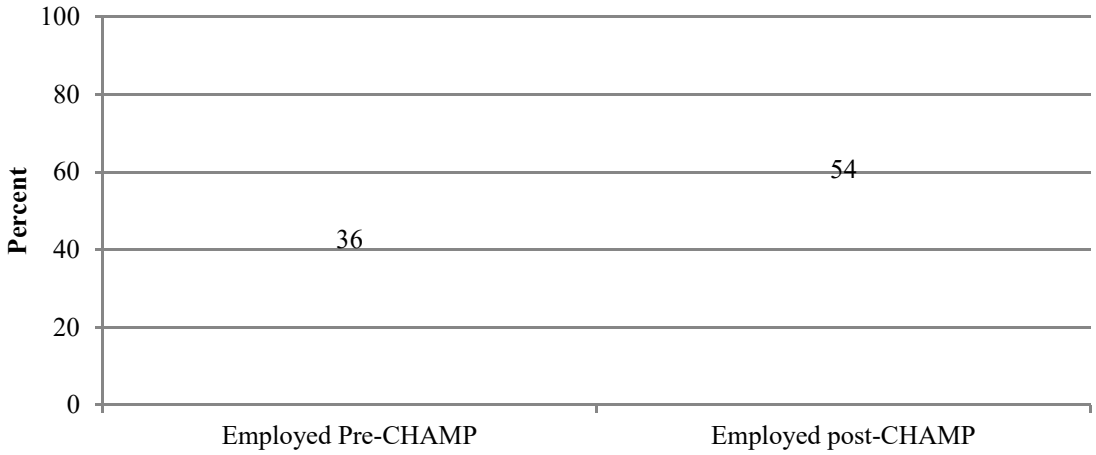
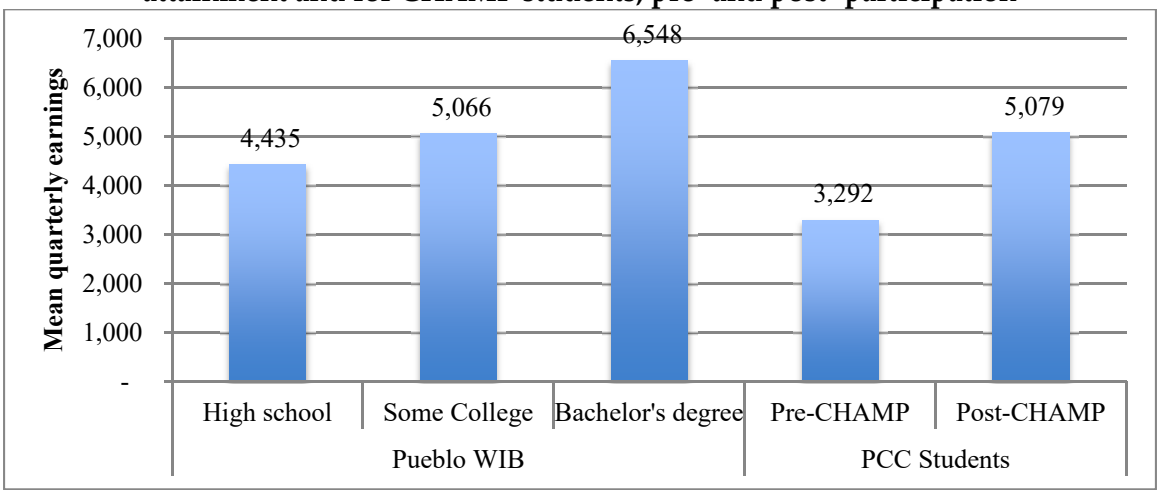


FIGURE 6e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



Southeastern WIB and Lamar Community College

The Southeastern Workforce Investment Board covers an expansive area of rural Southeastern Colorado, including Crowley, Kiowa, Otero, Prowers, Huerfano, Baca, and Las Animas counties. Strategically, the regional workforce center seeks to expand regional opportunities in agriculture, advanced manufacturing, healthcare, as well as in wind energy by fostering partnerships with educational institutions and business.[29] In this context, Lamar Community College's (LCC) CHAMP-supported welding program[30] seems positioned to train workers for an expanding advanced manufacturing sector. However, despite the college's and the

[29] Sector strategies paper, plus https://www.colorado.gov/pacific/sites/default/files/SE Regional Highlight 092414_0.pdf

[30] See EERC's "Lamar Community College CHAMP Case Study" at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

Southeastern WIB commitment to advanced manufacturing, the region's manufacturing sector is far more limited than in other areas in the state. Thus, while CHAMP instructors and staff tried to place welding students with local employers, they encouraged students to consider relocation to other parts of the Colorado or even to other states where welding job opportunities were more robust.

Figure 7a presents the share of all jobs within the local labor market held by sub-baccalaureate workers in CHAMP-related industries in the decade preceding CHAMP. Although manufacturing jobs (blue line) with 8 percent of these workers had the largest share of sub-baccalaureate workers this share fell to roughly 5 percent in 2006, and remained a smaller but stable share through 2016. By contrast, despite some fluctuations, construction (green line) only occasionally surpassed the 5 percent mark. During the study period, technology (red line) had less than 2 percent of jobs, the fewest sub-baccalaureate workers. This limited technology market for workers without bachelor degrees mirrors that seen in other regions in Colorado, e.g., Denver, Tri-County, Pueblo, Pikes Peak.

FIGURE 7a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors

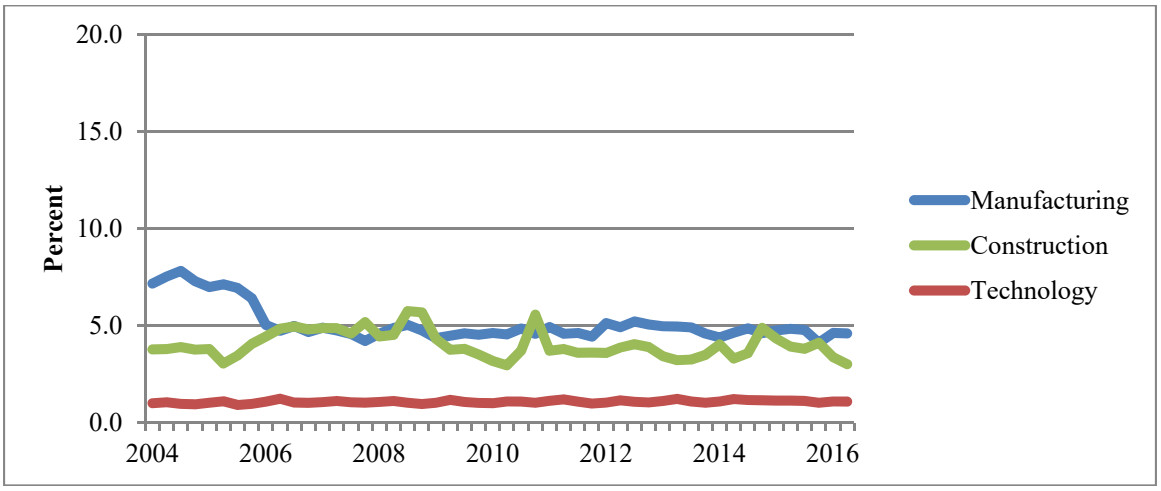


Figure 7b reports the average quarterly earnings of workers in the Colorado's Southeastern region with some college training compared to those without postsecondary experience. The scatter graph showcases a good deal of volatility in premiums across the three sectors, possibly because of the region's relatively small labor market. In the early 2000's, technology experienced some higher returns for post-secondary experience, but its volatility then parallels manufacturing until about 2006 when a steady decline occurs in technology, while the premium for manufacturing workers with post-secondary education, increases. After 2014 when LCC launched its CHAMP programs, premiums for workers in manufacturing (blue circles) with some college training rose to about 20 percent while those for tech workers (red triangles) and those in construction (green triangles) experienced declines - both sectors hovering between 0 and 10 percent. Locally, when students consider their options for postsecondary training, manufacturing clearly emerges as the most attractive financial option among the three sectors.

FIGURE 7b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)

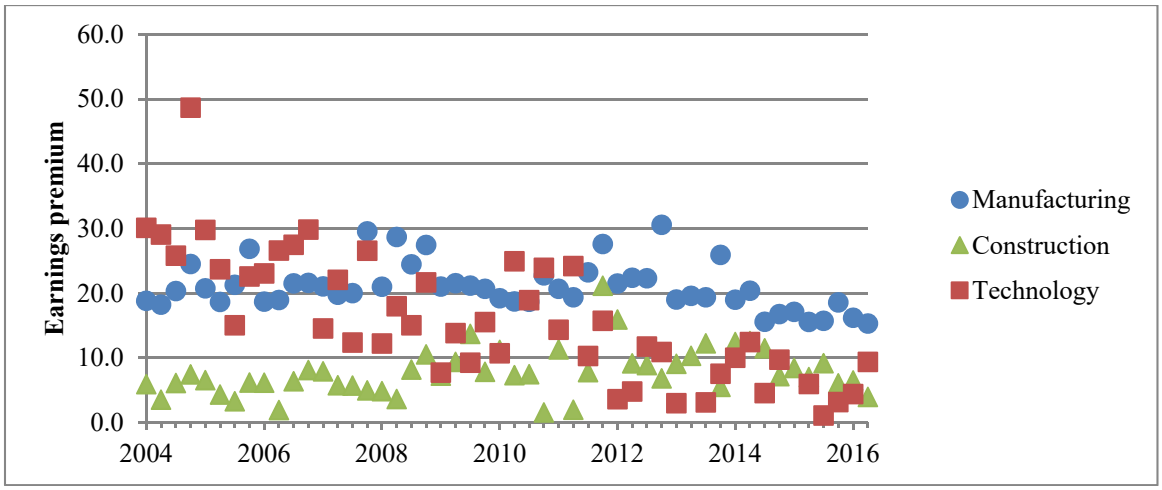
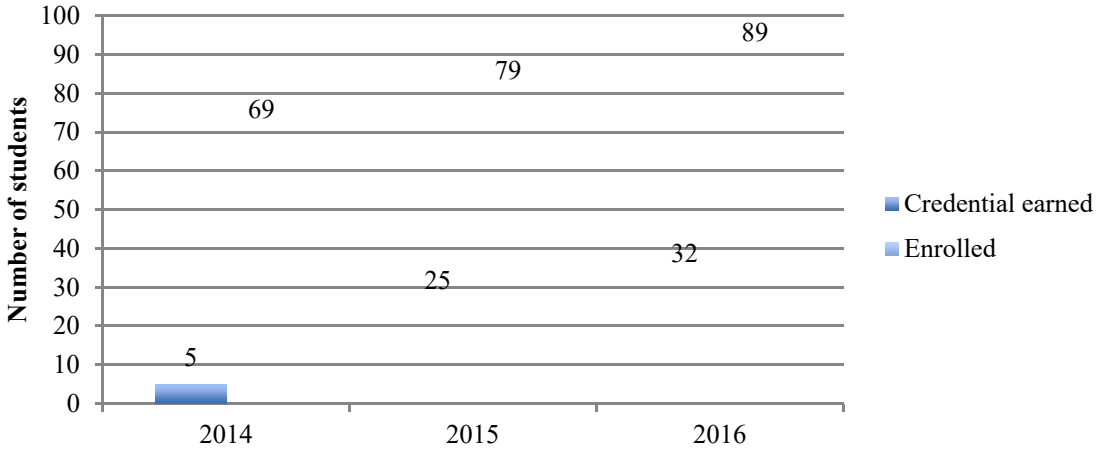


Figure 7c presents rates of participation in LCC's CHAMP program by calendar year. Each year of CHAMP, the college saw increasing enrollments and increasing numbers of certificates and degrees earned by students. Specifically, in 2014 69 students enrolled in CHAMP courses, this number grew to 89 by 2016, with a college waiting list for new enrollees. Similarly, over this same period the number of degrees or certificates awarded increased from 5 to 32. Therefore, it appears despite the local economic landscape, LCC's CHAMP grew each year of the grant.

FIGURE 7c. CHAMP Participation and Credential Completion, 2014-2016



Unfortunately, LLC had a relatively small cohort of CHAMP students; and more significantly, very few could be linked to UI database earnings (less than 100). This paucity of data precluded EERC's analysis of LCC's CHAMP students' employment and quarterly wage premiums. The most likely explanation for the absence of good data for this cohort is that CHAMP students were self-employed, or moved out for state for job opportunities, and Colorado UI data does not include out of state employment outcomes.

Weld WIB and Aims Community College

Weld County's Workforce Investment Board, north of Denver, covers one of the largest and most diverse counties in Colorado in terms of its population and range of industries.[31] Local workforce strategies emphasize manufacturing, a well-established and growing sector, as well as both fossil and renewable energy.[32] To meet labor market demand, Aims Community College developed its CHAMP programs in manufacturing and industrial technology, engineering technology, and building and construction site management.[33] Despite the number and diversity of local industries and the variety of CHAMP programs being offered, Weld county employers were generally less engaged than those in other communities served by colleges in the CHAMP consortium. Nevertheless, networking and interchanges between local industry, CHAMP instructors, and the Weld workforce center benefitted Aims' CHAMP programs.

To shed light on the scale of CHAMP-related fields in the local labor market, Figure 8a presents trends in the percentage of Weld's sub-baccalaureate workforce employed in the CHAMP-related NAICS sectors including manufacturing, construction, and technology. Historically, Weld has had the largest share of its workforce with less than a bachelor's degree employed in both manufacturing and construction. Further, although the percentage of sub-baccalaureate workers employed in each sector was essentially the same in 2004 as in 2016, both sectors experienced volatility in the interim period. For example, 13 percent of sub-baccalaureate workers were employed in manufacturing (blue line) in 2004 and in 2016. However, the sector experienced a brief dip during the Great Recession circa 2008, and then peaked at 14 percent in 2009, followed by a steady decline until 2014 to close to 11 percent. Since 2014 there has been a steady return to 13 percent share in 2016. The construction sector (green line) began with an 8 percent share in 2004, then experienced a downturn at the onset of the Great Recession (about 2008) that continued to 2012, at which time there was a strong recovery in 2014 followed by another downturn. Finally, over the study period, Weld County has had a consistently poor market (less than 2 percent) for jobs in technology (red line) for those without at least some college experience. This contrasts with some other areas in which workers without college education have a higher rate of employment in technology, especially in Tri-County, but also in Denver, Boulder and Pikes Peak areas. In sum, manufacturing remains the largest CHAMP-related sector for sub-Baccalaureate workers in Weld's local labor market, with a considerable number of these workers employed in construction as well.

[31] https://www.colorado.gov/pacific/sites/default/files/2016_Weld_Regional_and_Local_Area_Plan.pdf
[32] Ibid
[33] See EERC's "Aims Community College CHAMP Case Study" at https://smlr.rutgers.edu/content/education-employment-research-center-eerc

FIGURE 8a. Percentage of local workforce in sub-baccalaureate jobs in CHAMP-related sectors

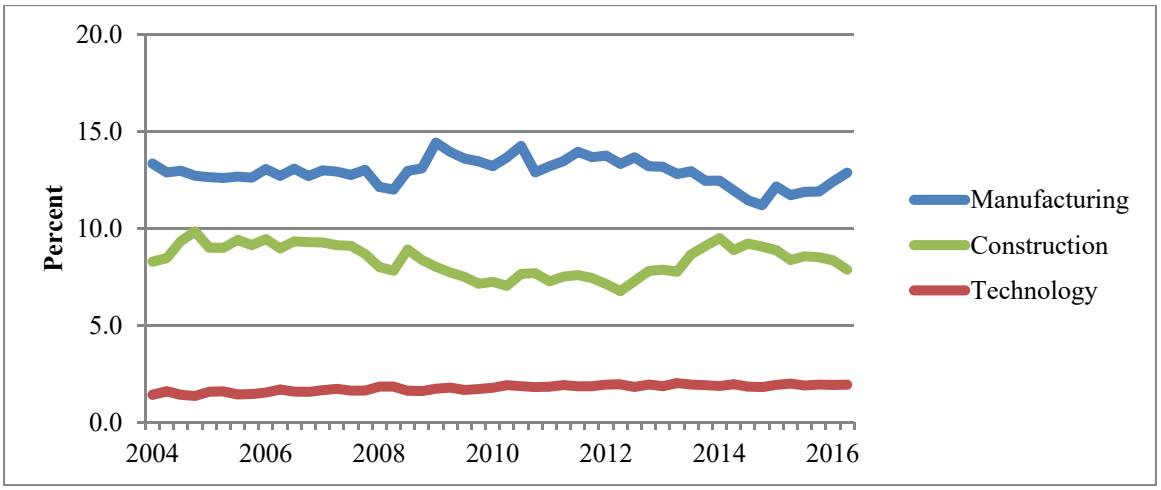
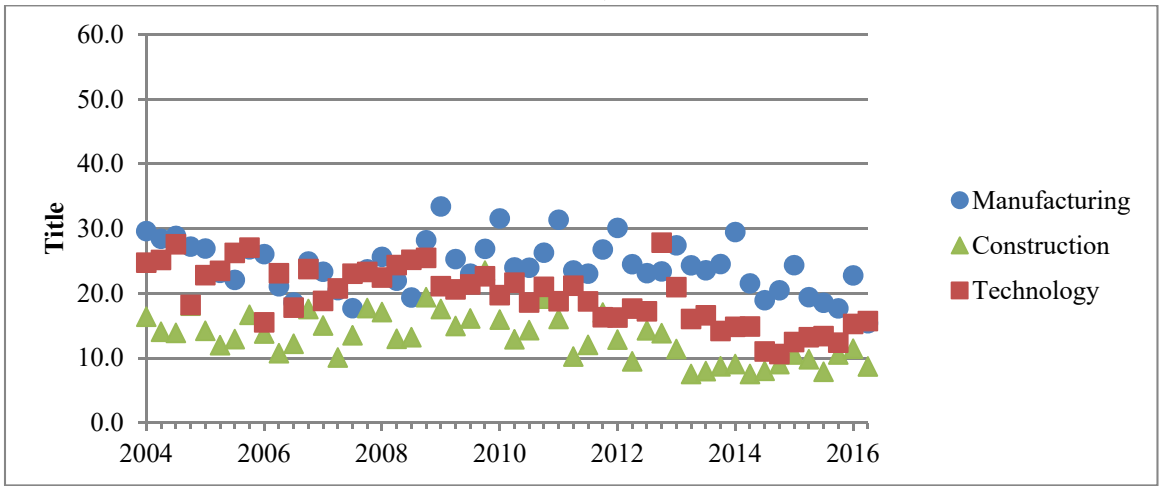


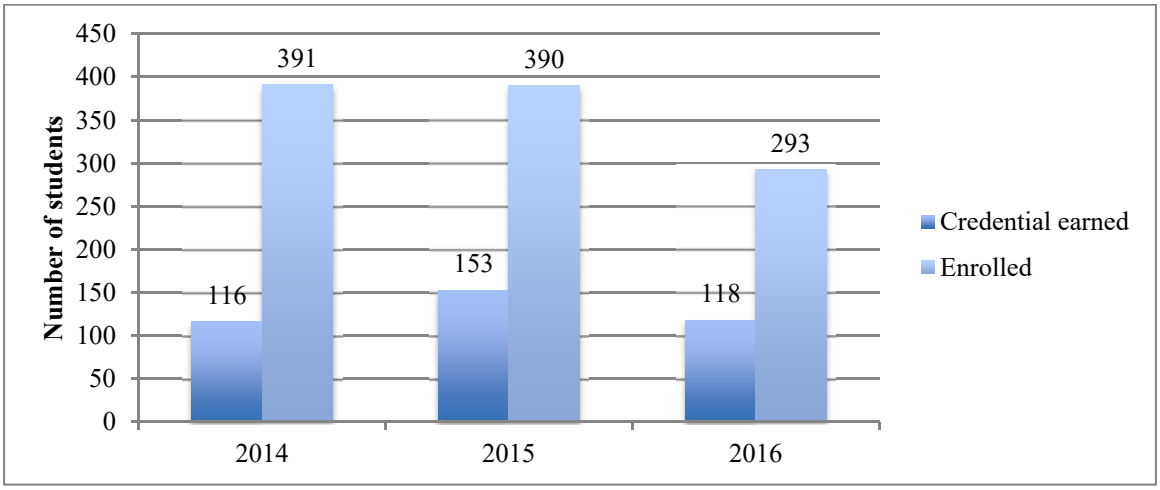
Figure 8b looks at the premium of post-secondary training in Weld during the 12 year study period, by contrasting the earnings for employees who have taken college coursework or completed a certificate or an associates' degree (but less than a bachelor's degree) and those employees with a high school education or less. Although earnings premiums vary in Weld year to year and quarter to quarter, workers in manufacturing (in blue) have typically earned higher premiums over those in technology (red) and those in construction (green). For example, in the first quarter of 2016, manufacturing workers with some college training were typically earning 23 percent higher wages than peers with only a high school education. The premium earnings in construction for workers with some postsecondary training was much lower at 15 percent. Still lower were the premiums for workers in technology, about 9 percent. Finally, it is worth noting that in Weld County, as seen in other WIB/WDB areas, premiums for workers with some college saw a decline between 2004 and 2016.

FIGURE 8b. Earnings premium: "some college" in CHAMP-related sectors (vs. high school or less)



In this context—growing opportunities in manufacturing and higher premiums for postsecondary training—Figure 8c details enrollment and the number of student who earned credentials at Aims. Across the CHAMP consortium Aims had one of the highest rates of enrollment and degree and certificate completion. In both 2014 and 2015, approximately 390 students enrolled in Aims' CHAMP courses. However, enrollment dipped in 2016 to 293 students. In terms of earning a certificate or an associate degree, Aims CHAMP students earned 116 in 2014, and 153 in 2015. By 2016, however, this number fell to 118. Thus, although Aims had a large number of enrolled students, and granted many degrees and certificates, participation rates declined in the final grant year.

FIGURE 8c. CHAMP Participation and Credential Completion, 2014-2016

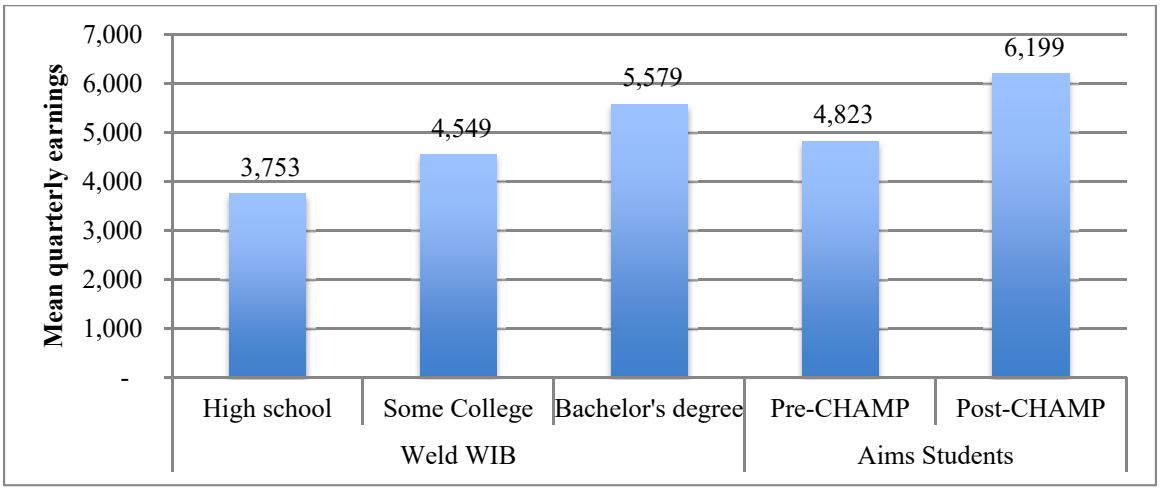


Figures 8d and 8e present pre- and post-employment and average quarterly wage outcomes for Aims CHAMP students. Figure 8d shows that one year prior to enrolling in Aims' CHAMP courses, 53 percent of students were working for pay. By contrast, 64 percent of Aims students were working for pay a year after their CHAMP participation. Thus, participation in CHAMP at Aims was associated with an 11 percentage point increase in employment.

Figure 8e contrasts the pre- and post-CHAMP average earnings of Aims students against the average quarterly earnings of manufacturing workers with different levels of education in the Weld WDB area. It shows that before enrolling in CHAMP courses, Aims' students earned an average of $4,823 each quarter, several hundred dollars more than the average for manufacturing workers in Weld county with some college training ($4,549). However, following their CHAMP experience, Aims' students earned an average of $6,199 quarterly. This was nearly $600 above what bachelor's degree recipients working in manufacturing earned ($5,579). Taken together, Aims' students enjoyed increased employment as well as gains in their earnings subsequent to enrollment in Aims' CHAMP programs.

FIGURE 8d. Employment rate of CHAMP students pre- and post-participation

FIGURE 8e. Mean quarterly earnings for local manufacturing workers by educational attainment and for CHAMP students, pre- and post- participation



THEMES

In this section, we identify several of the themes that emerge from the above data analysis.

- Across the state of Colorado, local labor markets are shifting away from jobs in manufacturing and construction, and toward jobs in technology. Weld county is a notable exception to this pattern – its manufacturing sector holds a larger share of the labor market and is even showing signs of growth over the past two years
- In local labor markets across Colorado, jobs in manufacturing typically offer the greatest returns to sub-baccalaureate postsecondary training – such as that offered through CHAMP programs. However, this premium is now declining.

- During the grant period 2014-2016, students who enrolled in CHAMP courses and/or received a CHAMP-related certificate or associate degree, gained a competitive edge in their local labor markets:
    - They were more likely to be employed a year after their CHAMP enrollment than they were the year previously, AND
    - CHAMP training typically and substantially boosted students' quarterly earnings.
    - In some cases, post-CHAMP earnings for those with some coursework, or a certificate and/or associate degree were on par with peers in the manufacturing local labor market with bachelor's degrees, e.g., Aims and PPCC or higher, e.g., FRCC.
- Over time, all colleges in the CHAMP consortium except for Aims, experienced increasing enrollments in their CHAMP program courses.
- Of the 7 CHAMP colleges studied for this report, three colleges experienced increasing numbers of students who earned credentials/certificates and four colleges experienced decreasing numbers. Among the reasons that may have contributed to declines in students earning credentials is time censoring – students enrolled later in the grant period have yet to complete a credential; staffing changes as the grant sunset so that career navigators[34] were not available to support and advise students in their respective CHAMP programs; and employers hiring students prior to the completion of their credential.

Taken together, the above findings underscore how each WDB/WIB area presents a unique local labor market for advanced manufacturing. The findings also suggest that overall, CHAMP students were able to leverage the training they received at their respective CHAMP community college to find employment in their fields and earn higher wages than they previously earned, as well as wages higher than those typically earned by sub-baccalaureate workers.

[34] See EERC's brief on the Navigators at https://smlr.rutgers.edu/content/education-employment-research-center-eerc