

ALIGNING OREGON'S HIGHER EDUCATION WITH A
CHANGING LABOR MARKET: JOB POLARIZATION AND
THE EVOLVING ROLE OF THE COMMUNITY COLLEGE

by

HANS ELLIOTT

A THESIS

Presented to the Department of Economics
and the Robert D. Clark Honors College
in partial fulfillment of the requirements for the degree of
Bachelor of Science

June 2021

An Abstract of the Thesis of

Hans Elliott for the degree of Bachelor of Science
in the Department of Economics to be taken June 2021

Title: Aligning Oregon's Higher Education with a Changing Labor Market: Job
Polarization and the Evolving Role of the Community College

Approved: _____

Professor William Harbaugh

This thesis first analyzes the Oregon labor market over the last decade to determine the impact of job polarization, and then analyzes changes in Oregon community college completions to observe student and program trends. Many of the occupations that community college students are prepared for are classified as “middle skill” due to the routine and manual qualities associated with their labor. Therefore, community colleges must be aware of the impact of job polarization, a theory that associates improving technology with a rising demand for high-skilled and least-skilled labor, but a relative falling demand for middle-skill labor. While there is little evidence of job polarization, this thesis does find a decline in demand for middle-skill workers accompanied by an increase in demand for high-skill workers. Meanwhile, community college students shifted away from programs associated with middle-skill occupations, and towards programs associated with transferring for an advanced degree. Using these results, this report intends to help community colleges determine which programs to invest further resources in so that their students are best prepared to succeed in the Oregon labor market.

Acknowledgements

I would first like to thank my primary thesis advisor, Professor William Harbaugh, who worked with me for close to a year and whose advice and humor were critical to every stage of my research and writing. I would also like to thank Professor Grant McDermott and Professor Trond Jacobsen for taking the time out of their busy schedules to serve on my committee. I must also thank my mom, whose unconditional support and cooking fueled me through the writing of this thesis, and my dad, who taught me to love learning and research. I know he would be proud of this accomplishment.

Table of Contents

Introduction	1
Background	4
Basic Assumptions of the Labor Market	4
Introduction to Job Polarization	6
Community Colleges and Middle-Skill Jobs	11
Data and Methodology	14
Data	14
Oregon Labor Market Data	14
Oregon Community College Data	16
Methodology	18
Job Polarization and Wage Analysis	18
Merging Labor Market and Education Data	19
Results and Analysis	21
Occupational Employment Shares	21
Changes in Median Annual Wages	26
Community College Completion Trends	29
Community Colleges and the Labor Market	33
Discussion of Results	37
Job Polarization or Rising Wage Inequality?	37
The Changing Preferences of Community College Students	39
The Changing Role of the Community College	41
Specific Program Suggestions for Community Colleges	43
2020 Employment Update and the COVID-19 Pandemic	45
Appendix	48
Bibliography	50

List of Accompanying Materials

1. Link to data visualization:
<https://public.tableau.com/profile/hans.elliott#!/>

List of Figures

Figure 2.1: The Simplified Labor Market	4
Figure 4.1: Share of Total Oregon Employment by Wage Categories in 2010 and 2019	21
Figure 4.2: Share of Total US Employment by Detailed Wage Categories in 2010 and 2019	22
Figure 4.3: Smoothed Changes in Share of Total Oregon Employment	24
Figure 4.4: Change in Median Annual Wage (in USD) for 22 Major SOC's in Oregon	26
Figure 4.5: Change in Median Annual Wage (in USD) for 22 Major SOC's: National Averages	26
Figure 4.6: Change in Oregon Community College Completions from 2010 to 2019	29
Figure 5.1: Visualizing Wage Inequality	37
Figure 6.1: 2020 Employment Share Update	45

List of Tables

Table 4.1: Regression Results	33
Table 6.1: 2020 Employment Update for Wage Groups	45

Introduction

Community colleges are important assets to local regions throughout the state of Oregon and across the United States. They provide students with the knowledge and skills necessary to jumpstart a career, shift professions, or prepare to continue their higher education at a four-year institution. Further, they funnel students into important local occupations, including many requiring specific knowledge or trade skills. As the Oregon state economy evolves, community colleges need to adapt for the benefit of their students and communities.

Job polarization describes the impact of improving technology and computerization leading to rising demand within high-skilled jobs and in least-skilled jobs, but a relative falling demand within middle-skill jobs. Many of the occupations traditionally associated with community college programs belong to the middle-skill category, suggesting that community colleges and their students are vulnerable to the negative effects of job polarization. Little research has considered the relationship of job polarization to higher education or examined the impact of the declining demand for middle-skill workers on community college graduates. This thesis will explore how Oregon community colleges are impacted by a changing labor market.

This thesis analyzes Oregon's labor market and community colleges through the lens of changing trends around high-wage/high-skill occupations, middle-wage/middle-skill occupations, and low-wage/low-skill occupations. It first determines the degree to which job polarization has impacted Oregon's labor market over the past decade while also identifying other labor trends. It then evaluates the changing program decisions of community college students over the past decade. Comparing the labor market and

community college trends reveals which programs community colleges should promote and invest in. Aligning student program decisions with the labor market will allow Oregon's community colleges to better serve their students and the economic needs of their communities.

This analysis finds minimal evidence of job polarization over the past decade. It does find a notable decline in demand for middle-wage workers that was accompanied by an almost equal increase in demand for high-wage workers, while demand for low-wage workers remained relatively steady. These results indicate that Oregon's labor market is increasingly demanding high-wage workers over middle-wage workers, which could be tied to wage inequality across different occupations. Meanwhile, community college students are increasingly completing programs correlated to higher-wage occupations, possibly contributing to the decline in the middle-wage share of total employment. Increases in completions were especially large for programs related to the highest wage occupations indicating that students are increasingly using community colleges as pathways to advanced degrees.

When a community college aligns their programs with the labor market, they can ensure that their students have a greater chance of success after graduation and they can optimize their role in the market as a labor supplier, improving their benefit to their communities. Community colleges must embrace their changing role and invest in high-wage programs to improve the success rate of community college transfer students. However, they must also continue to emphasize programs related to middle-wage, middle-skill occupations, which still hold the largest share of Oregon employment. Oregon's government must recognize the importance of community colleges in

providing affordable pathways to advanced degrees and supplying middle-skill workers.

Increasing funding for programs related to these opportunities will help reduce wage inequality throughout the state, benefitting Oregonians and ultimately improving the state economy.

Background

Basic Assumptions of the Labor Market

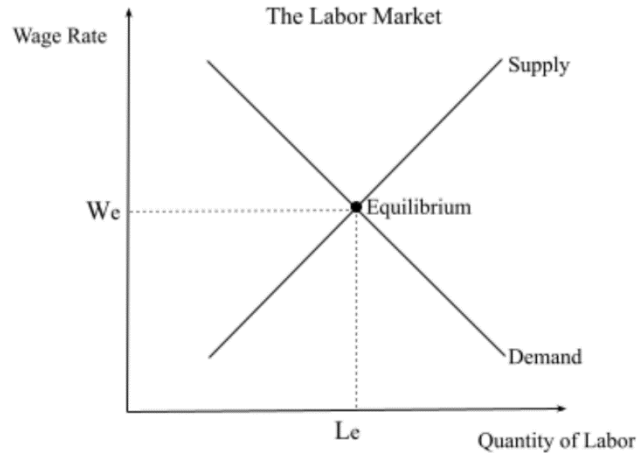


Figure 2.1: The Simplified Labor Market

In the simplified neoclassical model of the labor market, workers prefer to work for as high of a wage as possible, and firms prefer to pay as low of a wage as possible. This is the result of firms seeking to maximize their profits and individuals (i.e., workers) seeking to maximize their utility. The labor market balances these conflicting behaviors, naturally arriving at an equilibrium where demand is equal to supply, thus finding the socially optimal quantity of labor (L_e) and wage rate (W_e) as seen in Figure 2.1. This model assumes perfect competition, which requires that all agents have perfect information and are price takers (not price makers), and also assumes that workers offer a homogenous service.¹

¹Pierre Cahuc et al. *Labor economics* (MIT press, 2014), 188.

Workers can choose between spending time working and spending time not working, and so the labor supply curve is upwards sloping (at higher wage rates there is a higher quantity of workers willing to choose work over leisure).² Demand for labor comes from firms, who use the labor in combination with other factors of production to maximize their profits. The primary cost of labor for firms comes from paying wages, and so the demand curve is downwards sloping (there is a higher quantity of labor demanded at lower wage rates).³ The wage rate that workers receive is equal to their marginal productivity, and the supply of labor is determined by the disutility of working.⁴

This simplified model assumes that all workers offer to firms a service of the same quality. In reality, jobs differ in their degree of difficulty and workers differ in the willingness and ability to perform certain tasks. The theory of *human capital* assumes that workers can increase their wage earnings by improving their productive characteristics.⁵ Workers have a personal set of skills, including any kind of knowledge or personal characteristic, which contributes to their productivity as laborers for firms. Workers can invest in their own capital through schooling, training, job experience, personal health, and so on.⁶

Some labor economists see human capital as an input in the production process, so that workers with more human capital may be worth higher wages because they are

²Cahuc et al. 13.

³Cahuc et al. 77.

⁴Cahuc et al. 187.

⁵Cahuc et al. 245.

⁶Daron Acemoglu and David Autor. "Lectures in labor economics." *Manuscript*. (<http://economics.mit.edu/files/4689> (2011): 22), 3.

more productive and reliable for firms.⁷ Others consider education to be purely a signal to firms, because workers know their own abilities but employers cannot directly observe them.⁸ Investments that workers have made in their set of skills (for example, a community college certificate) signal some other characteristics of themselves (for example, that they are highly skilled at some trade). In this case, signaling allows the most productive workers to demonstrate their worth to firms who have imperfect information.⁹

These basic understandings of labor economics lay the groundworks for the research performed in this thesis. While the Oregon labor market does not work as simply as these theories suggest, this thesis will assume that demand for labor comes from firms who wish to maximize profits and the supply of labor comes from individuals who wish to maximize their utility. Not all workers supply the same quality of labor, and it will be assumed that firms pay higher wages to higher skilled workers because the more human capital a worker has, the more valuable they are to the profit-maximizing firm.

Introduction to Job Polarization

Job polarization is a labor market trend that describes an increasing concentration of job growth in high-wage, high-skill occupations and low-wage, low-skill occupations, accompanied by a relative decline in middle-wage, middle-skill occupations. The polarization effect was first identified in the UK by Goos and

⁷Acemoglu and Autor 3.

⁸Acemoglu and Autor 35.

⁹Cahuc et al. 245.

Manning (2003). Their work was built on several decades of research related to the impact of technological change on the labor market, a rising topic as computerization began to alter and replace certain occupations. Key to the conception of their work was the hypothesis developed by Autor, Levy, and Murnane (ALM), which showed that computer capital “(1) substitutes for workers in performing cognitive and manual tasks that can be accomplished by following explicit rules; and (2) complements workers in performing nonroutine problem-solving and complex communications tasks.”¹⁰ ALM tested their intuitive hypothesis and concluded that this effect of computerization could explain significant shifts in demand towards higher educated labor over the previous three decades.¹¹

The ALM hypothesis was an addition to a growing body of literature on the role of technology in shaping labor markets. It offered an alternative to the skill-biased technical change (SBTC) hypothesis – the idea that “a burst of new technology caused a rise in the demand for highly skilled workers, which in turn led to a rise in earnings inequality.”¹² This hypothesis received significant attention in the early 1990s from labor economists who recognized a rise in wage inequality in the early 1980s, not long after the invention of microcomputers. Later research showed that the SBTC hypothesis is not as useful for explaining wage inequality as was once believed.¹³ In contrast, job

¹⁰David Autor et al. "The skill content of recent technological change: An empirical exploration." *The Quarterly journal of economics* 118, no. 4 (2003), 1279.

¹¹David Autor et al. "The skill content of recent technological change," 1322.

¹²David Card and John E. DiNardo. "Skill-biased technological change and rising wage inequality: Some problems and puzzles." *Journal of labor economics* 20, no. 4 (2002), 733-783.

¹³Card and DiNardo 733-783.

polarization has been studied to a greater extent recently with notable evidence presented.

Goos and Manning provided the first definition and evidence of job polarization in their paper originally published in 2003. They identified an effect where improving technology leads to “rising relative demand in well-paid skilled jobs (that typically require non-routine cognitive skills) and in low-paid least skilled jobs (that typically require non-routine manual skills) and falling relative demand in the ‘middling’ jobs that have typically required routine manual and cognitive skills.”¹⁴ Using median wage as a measure of job quality, Goos and Manning find that between 1975 and 1999 the UK saw a large increase in “well-paid skilled jobs,” a smaller increase in “low-paid least skilled jobs,” and a decline in middle-skill jobs.¹⁵ This is consistent with their concept of job polarization and provides support for the ALM hypothesis.

The ALM hypothesis and later work on job polarization rely on a similar theory of routine and non-routine jobs. This theory assumes that “non-routine manual jobs are concentrated in the lower percentiles of the wage distribution whereas non-routine cognitive and interactive jobs are concentrated in the top end of the wage range with routine jobs concentrated in the middle.”¹⁶ This associates high-skill tasks with high-wage jobs, middle-skill tasks with middle-wage jobs, and low-skill tasks with low-wage

¹⁴Maarten Goos and Alan Manning. "Lousy and lovely jobs: The rising polarization of work in Britain." *The review of economics and statistics* 89, no. 1 (2007), 2.

¹⁵Goos and Manning, 2.

¹⁶Goos and Manning, 5.

jobs.¹⁷ Therefore, if computers or other technologies can replace the routine tasks of middle-skill jobs but complement the nonroutine tasks of high and low-skill jobs, a polarization effect should occur as technology progresses.

It is commonly accepted that technology can replace routine tasks – a reality that most people in the US have faced in the 21st century throughout daily life. Recent research on job polarization has offered other explanations for what is causing the labor market trend, supplementing the theory that computerization substitutes for the routine tasks of middle-skill jobs. Another cause of decline in middle-skill job opportunities may be that many routine tasks can now be outsourced or “offshored” to lower-wage workers around the world, which has also been made possible by improving technology. A decline in labor unions, which traditionally represent middle-skill workers, and the declining real value of the federal minimum wage may also contribute to job polarization.¹⁸ Overall, technological progress seems to be the biggest factor in causing job polarization.

Jaimovich and Siu provide evidence of a relationship between job polarization and economic recessions. They find that the disappearance of middle-skill job opportunities is concentrated in economic downturns, so that “88% of the job loss in these occupations since the mid-1980s occurs within a 12 month window of NBER

¹⁷The remainder of this paper will use skill and wage interchangeably when describing categories of occupations.

¹⁸David Autor. "The polarization of job opportunities in the US labor market: Implications for employment and earnings." *Center for American Progress and The Hamilton Project* 6 (2010), 12-15.

dated recessions.”¹⁹ In addition, they show “that jobless recoveries in the aggregate can be accounted for by jobless recoveries in the routine occupations that are disappearing,” or in the middle-skill, middle-wage occupations.²⁰ In other words, the labor market’s weak performance during the economic recovery after the Great Recession can be attributed to an exaggerated loss in middle-skill jobs. It is likely that firms look to computerize or offshore routine tasks as cost-saving measures during economic downturns, exacerbating the decline of middle-skill jobs.

It is also important to note that the polarization of employment has occurred differently for males and females in the US. In 2010, Autor found that female employment in middle-skill occupations had declined significantly (by 15.8 percent) over the past few decades while female employment in low-skill occupations rose by only 1 percent, so that most of their employment gains were in high-skill occupations.²¹ In contrast, male employment in middle-skill occupations declined by only 7 percent, accompanied by roughly equal increases in high- and low-skill employment. Autor’s findings imply that women were more successful than men in adapting to the shifts in demand that contributed to a decline in middle-skill jobs.²²

While technology is certainly changing the labor market, it may not explain the rising wage inequality seen in recent history. In the US, the employment share of middle-wage jobs has been shrinking since the 1950s, accompanied by a corresponding

¹⁹Nir Jaimovich and Henry E. Siu. "Job polarization and jobless recoveries." *Review of Economics and Statistics* 102, no. 1 (2020), 2.

²⁰Jaimovich and Siu, 2.

²¹Autor. "The polarization of job opportunities in the US labor market," 10-11.

²²Autor. "The polarization of job opportunities in the US labor market," 10-11.

expansion of the high-wage share. Meanwhile, the low-skill share has remained relatively steady at less than 15 percent.²³ Mishel et al. show that this changing distribution of employment has “occurred in decades with both rising and falling wage inequality and in decades with both rising and falling median wages,” suggesting that job polarization cannot alone explain rising wage inequality.²⁴

Community Colleges and Middle-Skill Jobs

Community colleges are important assets to local regions throughout the state of Oregon and across the US. They provide students with knowledge and skills necessary to jumpstart their career, shift professions, or prepare to continue their higher education at a four-year institution. They also funnel students into important local occupations, including many requiring specific knowledge or trade skills. A labor market responsive community college can ensure a higher chance of a successful transition to important local occupations for their students and ultimately better equip workers to serve their local region’s economic needs.

Goos and Manning argue that “the routine tasks in which technology can substitute for human labor include jobs like craft manual jobs and book-keeping jobs that require precision and, hence, were never the least-skilled jobs in the labor market,”²⁵ thus being middle-skill jobs. Community colleges tend to produce workers for these middle-skill, middle-wage jobs that require some post-secondary education but

²³Lawrence Mishel et al. "Don't blame the robots." Assessing the Job Polarization Explanation of Growing Wage Inequality, *EPI-CEPR working paper* (2013).

²⁴Lawrence Mishel et al.

²⁵Goos and Manning, 1.

not typically a full bachelor's degree. Therefore, these institutions should be especially aware of changing trends around middle-skill occupations.

Community colleges are unique institutions of higher education as they serve a variety of roles for their students. They can be a gateway to a bachelor's degree, offering lower-cost classes to students who hope to eventually transfer to a 4-year institution, which are typically more expensive. They also educate a large number of students through vocational training programs or occupation-specific courses, preparing them for specific tasks and providing them with the necessary certificates (which can take from 1 to 4 years to obtain) or degrees (which typically take 2 years to complete).²⁶ Whereas students graduating with bachelor's degrees may use their skills in a variety of different industries, there is often a specific connection between community college programs and the occupations that students are being prepared for. This makes them an interesting case for examining the relationship between higher education and the labor market.

The occupations that correspond to these community college certificates and degrees tend to be middle-skill and middle-wage – they require some level of specific education but consist of relatively routine tasks and not the cognitive and interactive tasks characteristic of higher-skill occupations. For example, some popular community college programs in Oregon include “Accounting Technology/Technician and Bookkeeping” and “Machine Tool Technology/Machinist,” which clearly require some specific knowledge related to mathematics or machinery but correspond to routine

²⁶Henry T. Kasper, "The changing role of community college." *Occupational Outlook Quarterly* 46, no. 4 (2003), 16.

occupations that could be computerized or offshored.²⁷ This suggests that, as demand for middle-skill occupations declines, the role of community colleges must adapt.

²⁷Based on 2019 data from IPEDS.

Data and Methodology

This research first analyzes the Oregon labor market with a focus on job polarization and then explores the relationship of community colleges to labor market trends. The primary focus of the research is on the past decade (2010 to 2019), seeking to observe how the Oregon labor market and community colleges have performed in the expansionary period between the 2009 recession (which ended after June 2009) and the COVID-19 recession (which started March 2020).²⁸ Additional focus is given to 2020 labor market data (the most recently available) to observe how the COVID-19 recession has impacted Oregon's labor market.

Data

Oregon Labor Market Data

To examine the Oregon labor market, I used labor market data from the Occupational Employment Statistics (OES) program provided by the US Bureau of Labor Statistics for 2010 and 2019. This program produces annual employment and wage estimates for nearly 800 occupations on the national and state level, which are released each May.²⁹ The key statistics from this report used for this analysis are *total employment*, which provides the total number of workers employed in each occupation based on the location (i.e., Oregon or the United States), and *median annual wage*, which provides the median annual wage for each occupation based on the location. I

²⁸Based on official recession dates from the National Bureau of Economic Research.

²⁹"Occupational Employment Statistics," *U.S. Bureau of Labor Statistics*, <https://www.bls.gov/oes/#data>.

chose to use annual wage over hourly wage because not all occupations have hourly wage data, but every occupation has a reported annual wage.

Using occupational employment data (rather than industry-level data) was intentional because the granularity of the detailed occupations matches more similarly to the coding of community college programs (as described further below). Occupations are classified through a taxonomic scheme, the Standard Occupation Classification system (SOC), which is the federal statistical standard when working with occupation classifications. There are 22 major SOC groups describing a broad category of occupation, and within each group are a multitude of detailed occupations representing specific jobs.

I focused on the major SOC groups to analyze the Oregon labor market, breaking them into five categories based on their 2019 median annual wage in Oregon. Those categories are upper high-wage, lower high-wage, upper middle-wage, lower middle-wage, and low-wage (see appendix I for a breakdown and full explanation). As detailed in the background section, high-wage occupations require high skill and correspond to non-routine cognitive tasks, middle-wage occupations require middle skill and correspond to routine manual and cognitive tasks, and low-wage occupations require low skill and correspond to non-routine manual tasks.³⁰ Breaking the major SOC groups into these 5 groups allows for a nuanced analysis of how these broader wage-groups have performed over the last decade. I used the same wage-group

³⁰Goos and Manning, 2.

breakdown of major SOC groups when producing national-level statistics for comparison.

I calculated Oregon employment shares for occupations by dividing the total amount of employment for an occupation by the total amount of employment in Oregon for that year, as reported in the OES data.³¹ The same process was repeated using national-level data. It was also necessary to deflate the median annual wage data before comparing 2010 data to 2019 data. I standardized the data based on 2019 purchasing power, using the Consumer Price Index for All Urban Consumers for May 2019 and May 2010 to deflate the data.³² I used the following formula: $[(\text{Nominal Wage 2010}) / (\text{CPI May 2010})] * \text{CPI May 2019}$.³³

Oregon Community College Data

Educational data was obtained from the Integrated Postsecondary Education Data System (IPEDS), a comprehensive data system created and maintained by the National Center for Education Statistics, “the primary federal entity for collecting and analyzing data related to education in the U.S.”³⁴ The IPEDS “Completions” survey contains the headcount for the number of students obtaining an award by type of program. The key statistics from this survey used in this analysis are *total completions*,

³¹In 2019, total Oregon employment was reported as 1,905,860, and in 2010, total Oregon employment was reported as 1,569,700. In 2019, total US employment was reported as 147,838,700, and in 2010 total US employment was reported as 128,150,010.

³²I used data from the “Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (CPIAUCSL)” from the Federal Reserve Economic Data (FRED) database.

³³The CPI for May 2010 is 217.290, and the CPI for May 2019 is 255.371.

³⁴ “About Us,” National Center for Education Statistics, <https://nces.ed.gov/about/>.

which provides the total number of students receiving an award (certificate) or degree for each program type during that academic year, as well as *female completions*, which shows the female share of the total completions, and *male completions*.

Focusing on completions rather than other statistics (for example, enrollment) is justified by the assumption that completing a degree or certificate is necessary to fully increase an individual's human capital. As described in the background, this might be the result of students needing all the knowledge and skills provided by a program before their productivity is increased, or because they need a degree or certificate to signal their competency to employers. In addition, students may enroll in a community college program but eventually decide not to pursue it, perhaps switching to a new program or dropping out. Completions are final and therefore indicate that these students had some desire to pursue a related occupation.

The types of educational programs are categorized by the Classification of Instructional Programs (CIP), a taxonomic scheme developed by the U.S. Department of Education and commonly used since 1980, where every program of study is assigned a unique CIP code. The types of programs are granular and there are over 1400 CIP codes used in the IPEDS completions survey.³⁵ This allows for a detailed analysis of community college enrollment trends. For this analysis, the IPEDS 2018-19 completions report and the IPEDS 2009-10 completions report were used.

³⁵“What is the CIP?” National Center for Education Statistics,
<https://nces.ed.gov/ipeds/cipcode/Default.aspx?y=56>

Methodology

Job Polarization and Wage Analysis

This paper looks for evidence of job polarization in Oregon for the last decade by comparing changes in the share of total employment held by the different wage categories, using the share of total employment for different occupations as a measure of employment demand. This is based on the understanding that out of the total quantity of labor, high-wage, middle-wage, and low-wage occupations each hold a distinct share of employment, which changes as job opportunities shift in and out of their wage categories. If job opportunities increase in high-wage occupations (i.e., there is increased demand for high-wage labor), this will result in the increase of the high-wage share of total employment, while one or all the other wage categories must lose some of their share.

I also graphed changes in employment share from 2010 to 2019 and plotted them based on a ranking system (see Figure 4.3 in the results section). I first ranked both the 22 major SOC groups and the 586 relevant detailed SOC occupations by their 2019 median annual wages in ascending order, so that the lowest wage occupations have the lowest rank. On this plot, I also displayed a smoothed estimate of the relationship between the change in employment share and the median annual wage. This was estimated using LOESS regression, a technique that uses local fitting to fit multiple locally weighted regressions, creating a smooth curve through a scatter plot. I

use this method to look for visual evidence of job polarization in labor market data, a method used in previous literature on job polarization.³⁶

The paper also analyzes changes in median annual wages for the different wage categories. The aim of this analysis is to identify how compensation for labor has changed across the different wage categories. This information is useful for community colleges and their students as it provides information on what occupations have growing or declining wages. It is especially important for community colleges to understand how wages are changing for middle-wage (middle-skill) occupations as many of their programs feed into them.

Merging Labor Market and Education Data

The OES labor market data and IPEDS community college data rely on the SOC and CIP codes described above. This allows for easy matching of the labor market data to community college data because there also exists a standardized code crosswalk from CIP codes to detailed SOC codes (available through IPEDS). By matching the detailed SOC codes to the CIP codes, every instructional program matches up directly to one or more occupations. For every program offered at a community college in Oregon, this data shows the total, female, and male completions by year as well as total employment and median annual wage by year. The detailed occupations belong to the 22 major SOC groups, so they are automatically sorted into the wage categories. This allows for the analysis of community college programs as upper high-wage, lower high-wage, upper middle-wage, lower middle-wage, and low-wage.

³⁶Autor et al. "The Polarization of the U.S. Labor Market." *American Economic Review* 96, no. 2 (2006), 190.

Using this merged dataset, I regressed the change in total community college completions from 2010 to 2019 (ΔC_T) on the change in the median annual wage from 2010 to 2019 (ΔW).

$$\Delta C_T = \beta_0 + \beta_1 \Delta W + \varepsilon$$

This simple linear model aims to determine how community colleges and their students are responding to a changing labor market. The β_1 regression coefficient represents how much the mean of the dependent variable (the change in completions) will change given a one dollar change in the independent variable (the change in median annual wage). I repeated this regression for different samples of the Oregon community college population, based on the wage categories of the college programs and corresponding occupations.

I then completed similar regressions to compare results across sex. I used the change in female community college completions from 2010 to 2019 (ΔC_W) and the change in male completions (ΔC_M) as dependent variables across the same wage category samples to compare how women and men have responded differently to labor market trends. One flaw in this methodology is that the OES employment and wage data is not broken out by sex, so that I am forced to assume that there is no difference in wages for females and males. Since median annual wage is already a standardized estimate for the potential future wage of community college graduates, this does not impede the analysis significantly in achieving its goals of comparing changes in community college completions.

Results and Analysis

Occupational Employment Shares

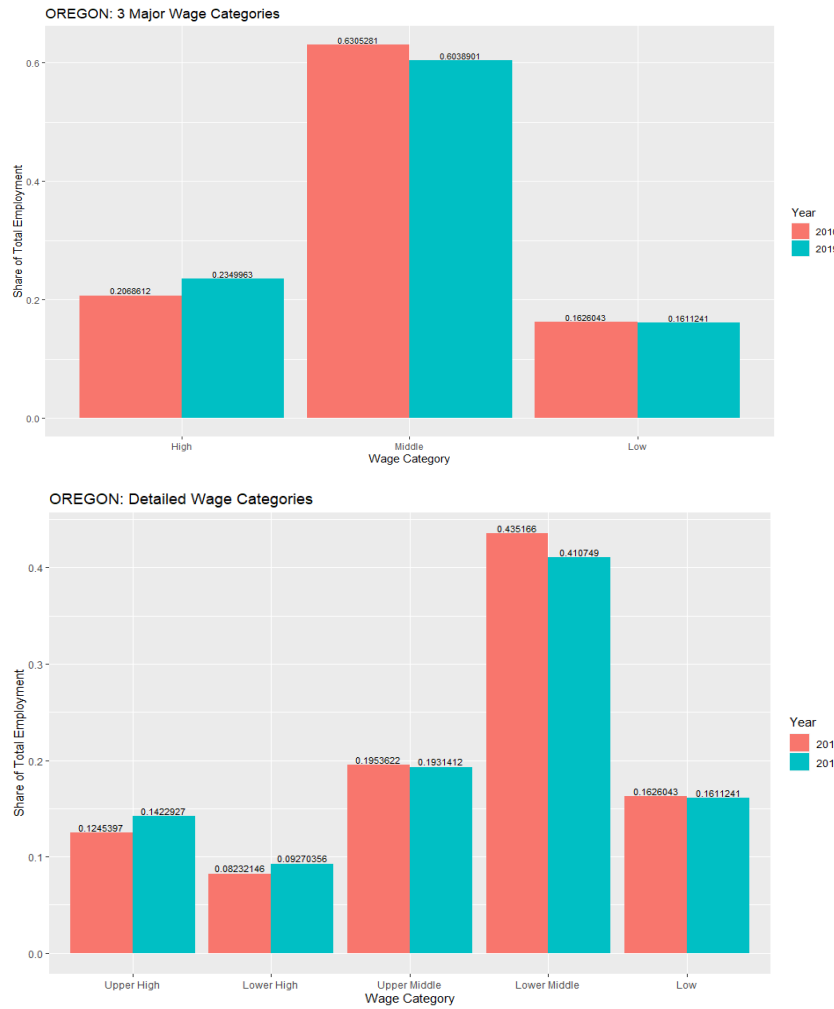


Figure 4.1: Share of Total Oregon Employment by Wage Categories in 2010 and 2019

The first graph shows the data broken out by the three major wage categories, and the second graph shows the data broken out by the five detailed wage categories.

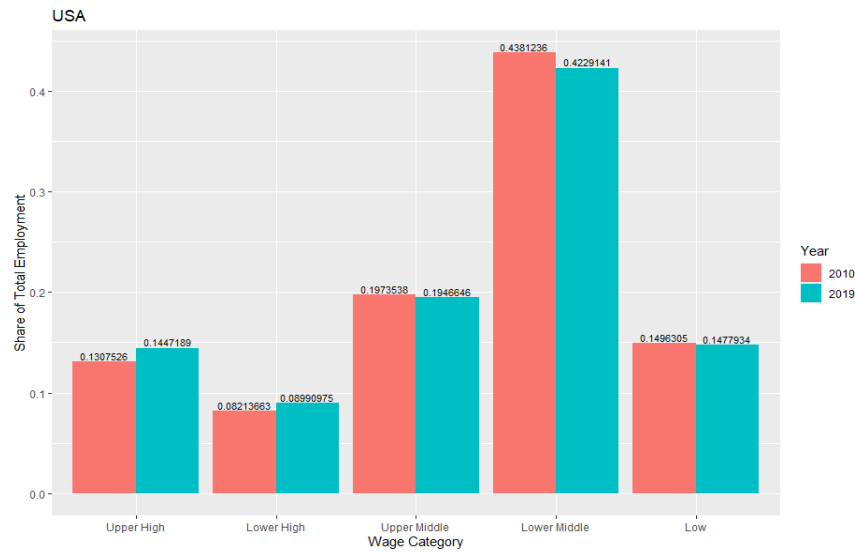


Figure 4.2: Share of Total US Employment by Detailed Wage Categories in 2010 and 2019

Figure 4.1 shows the share of total Oregon employment held by occupations in the three major wage categories and when broken into five detailed wage categories. Figure 4.2 shows the employment share of the detailed wage categories for the US as a comparison. Across the 22 major SOC groups, the high-wage share of Oregon employment grew by 0.4% on average from 2010 to 2019. Meanwhile the middle-wage share declined by -0.2% on average, and the low-wage share declined by -0.04% on average. This suggests some evidence of job polarization over the last decade, considering the relative performance of middle-wage jobs.

Figure 4.1 shows that the middle-wage share of employment in Oregon decreased by about -3% of total employment from 2010 to 2019, while the high-wage share increased by about 3% of total employment. Meanwhile, the low-wage share remained almost unchanged, declining by only -0.1% of total employment. This suggests that about 3% of the middle-wage share of total employment shifted into high-wage occupations. Of the high-wage occupations, the upper high-wage share of

employment increased more than the lower high-wage share (increases of about 1.8% and 1.04% of total employment, respectively). Both the upper and lower middle-wage shares of employment decreased, with the lower middle share falling the most (a drop of about -1.5% of total employment compared to a drop of about -0.2%).

Oregon's upper high-wage share of total employment grew slightly more than the nation's upper high-wage share of total employment, which increased by about 1.4%. The nation's lower high-wage share grew by only 0.8% compared to Oregon's 1.04%. The nation's middle-wage occupations lost similar shares of total employment to Oregon, with its upper middle-wage share declining by about -0.3% and its lower middle-wage share declining by about -1.2%. The national decline of the low-wage share was slightly worse than Oregon's at about -0.2%.

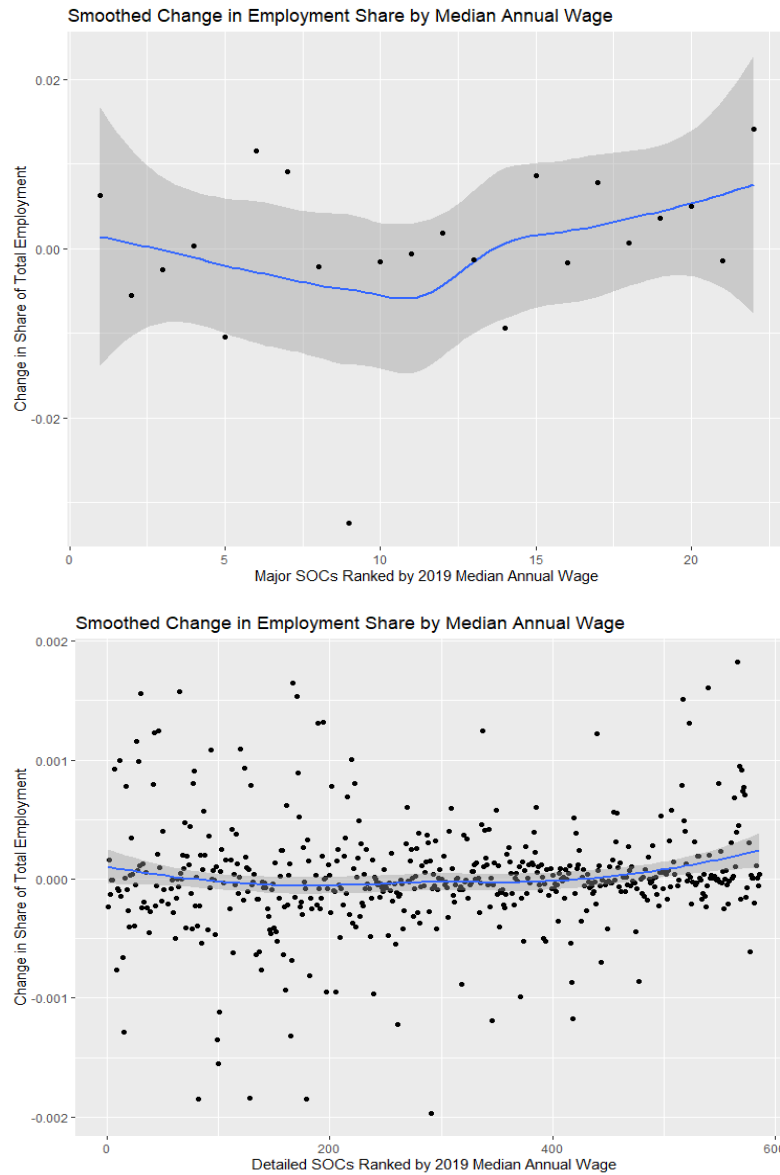


Figure 4.3: Smoothed Changes in Share of Total Oregon Employment

These figures show a smoothed estimate of the change in share of total employment from 2010 to 2019. The occupations are ranked from low to high based on their 2019 median annual wage, so that the horizontal axis starts at the lowest wage occupations and ends at the highest wage occupations.

Figure 4.3 shows the actual changes in employment share and fitted values from LOESS regressions, for both the major SOC groups and the detailed occupations. These plots show visual evidence of polarization as the lowest and highest wage occupations

saw the largest increases in their share of total employment. Observing just the major SOC groups, there is a decline in the change in employment share as wages shift from the low-wage to lower middle-wage range, starting at a positive amount of change and quickly descending into negative change. Then employment share change spikes in the upper middle-wage range back to a positive level and continues to increase as wages rise. The detailed occupations show a similar picture, creating a slight “U” shape that indicates the lowest and highest wage occupations have seen the largest increases in employment share over the last decade.

Changes in employment share suggest some evidence of job polarization in Oregon. Middle-wage occupations have seen declines in their share of total employment, while high-wage occupations have seen increases. Low-wage occupations have also declined, but not to the degree that middle-wage occupations have. Since there have not been major declines in the middle-wage share of employment, it appears that job polarization has not been extreme over the past decade. The next section will explore how occupations’ median annual wages have changed as another method of analyzing the Oregon labor market.

Changes in Median Annual Wages

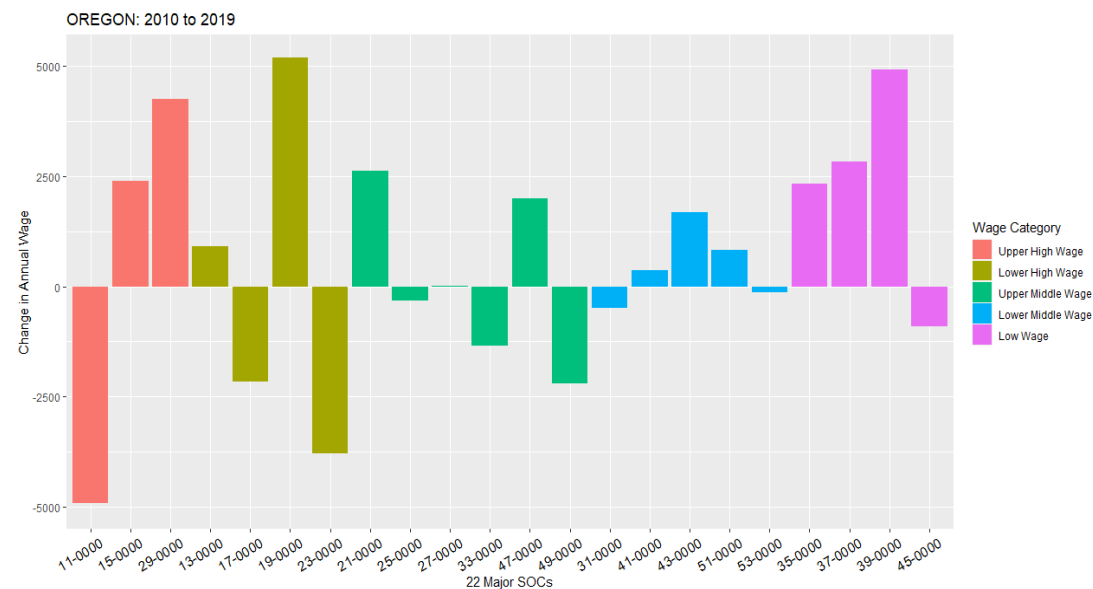


Figure 4.4: Change in Median Annual Wage (in USD) for 22 Major SOC in Oregon

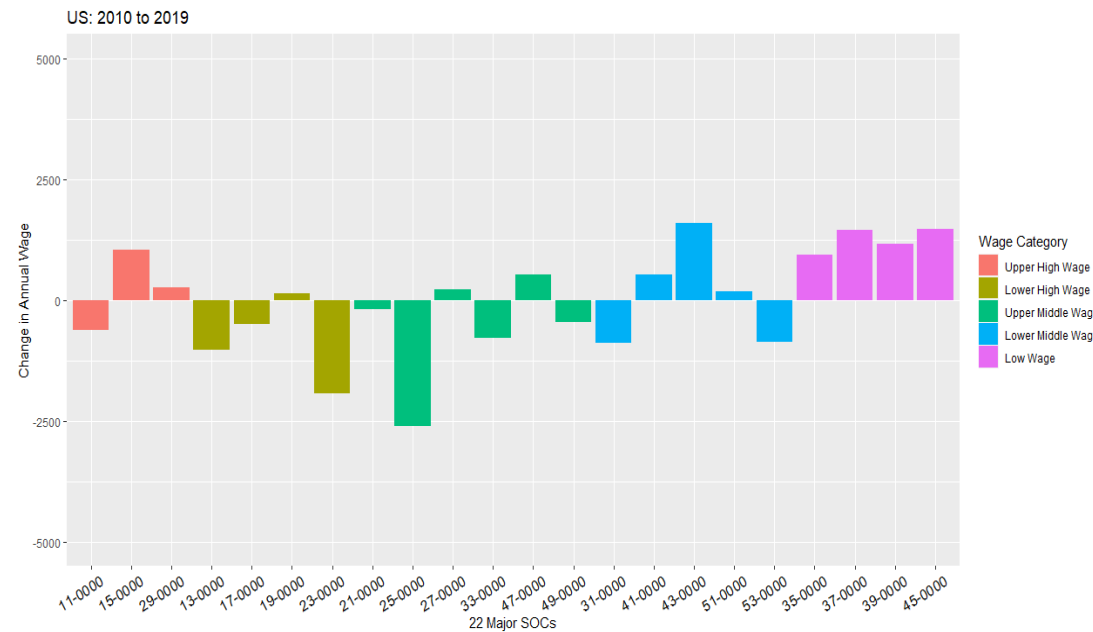


Figure 4.5: Change in Median Annual Wage (in USD) for 22 Major SOC, National Averages

Figure 4.4 shows the change in the median annual wage for the 22 major SOC groups in Oregon. The occupation groups that saw the biggest wage increases were in the upper high-wage, lower high-wage, and low-wage categories. Healthcare Practitioners and Technical Occupations (29-0000) grew the most in the upper high-wage category with an increase in median annual wage of about \$4,245, and Computer and Mathematical Occupations (15-0000) performed well with an increase of about \$2,384. The largest increase in annual wage occurred in the lower high-wage category for Life, Physical, and Social Science Occupations (19-0000), which saw an increase of about \$5,185. It performed the best out of all lower high-wage occupations by far. The largest decrease in annual wage occurred in the upper high-wage category, with Management Occupations (11-0000) seeing a wage decrease of about \$4,910.

After the high-wage occupations, low-wage occupations saw the biggest increase in wages. Most notably, Personal Care and Service Occupations (39-0000) saw a wage increase of about \$4,922, which is the second largest wage increase. The middle-wage occupations did not see as big of wage increases as the high- and low-wage occupations. The best performer was Community and Social Service Occupations (21-0000) in the upper middle-wage category, with a wage increase of about \$2,631. The only other upper middle-wage occupational group that saw a positive change in annual wage was Construction and Extraction Occupations (47-0000). The lower middle-wage occupations saw a wage increase of \$1,692 or less, with Office and Administrative Support Occupations (43-0000) seeing the largest increase.

Figure 4.5 shows the change in median annual wage for the 22 SOC groups across the United States. Compared to Oregon's results, the nation saw much more

subtle changes in median annual wage. Healthcare Practitioners and Technical Occupations (29-0000) saw much larger wage increases in Oregon than across the nation, and the state's Computer and Mathematical Occupations (15-0000) outperformed the nation's as well. Additionally, Oregon saw a much bigger decrease in annual wages for Management Occupations (11-0000) than the nation. Oregon's lower high-wage occupations saw both larger wage increases and decreases compared to the nation. In the upper middle-wage category, Oregon's Community and Social Service Occupations (21-0000) well out-performed the nation's, and in the lower middle-wage category, Oregon saw similar wage increases to the nation. All of Oregon's low-wage occupations outperformed the nation's, excluding Farming, Fishing, and Forestry Occupations (45-0000).

These results offer little evidence of polarization in Oregon's labor market. Oregon saw its largest wage increases in high-wage and low-wage occupations, but many of the occupations in these wage groups also saw declines in annual wage. In addition, Oregon's middle-wage occupations performed relatively well, in some cases outperforming the national average. This suggests there has not been a significant decline in the value of middle-wage workers in Oregon. However, it is possible that high-wage and low-wage workers are increasingly valued more than middle-wage workers, creating a slight polarization effect.

Compared to the national averages, Oregon had more extreme wage changes, especially in the high-wage and low-wage categories. This suggests that the state's labor market was reacting to region specific economic phenomena. Changes in the annual wages for specific occupation groups, such as the large increase in wages for

Life, Physical, and Social Science Occupations (19-0000) and the large decrease in Management Occupations (11-0000), show that there are much stronger influences on Oregon's labor market than job polarization, causing some industries to thrive and others to decline.

Community College Completion Trends

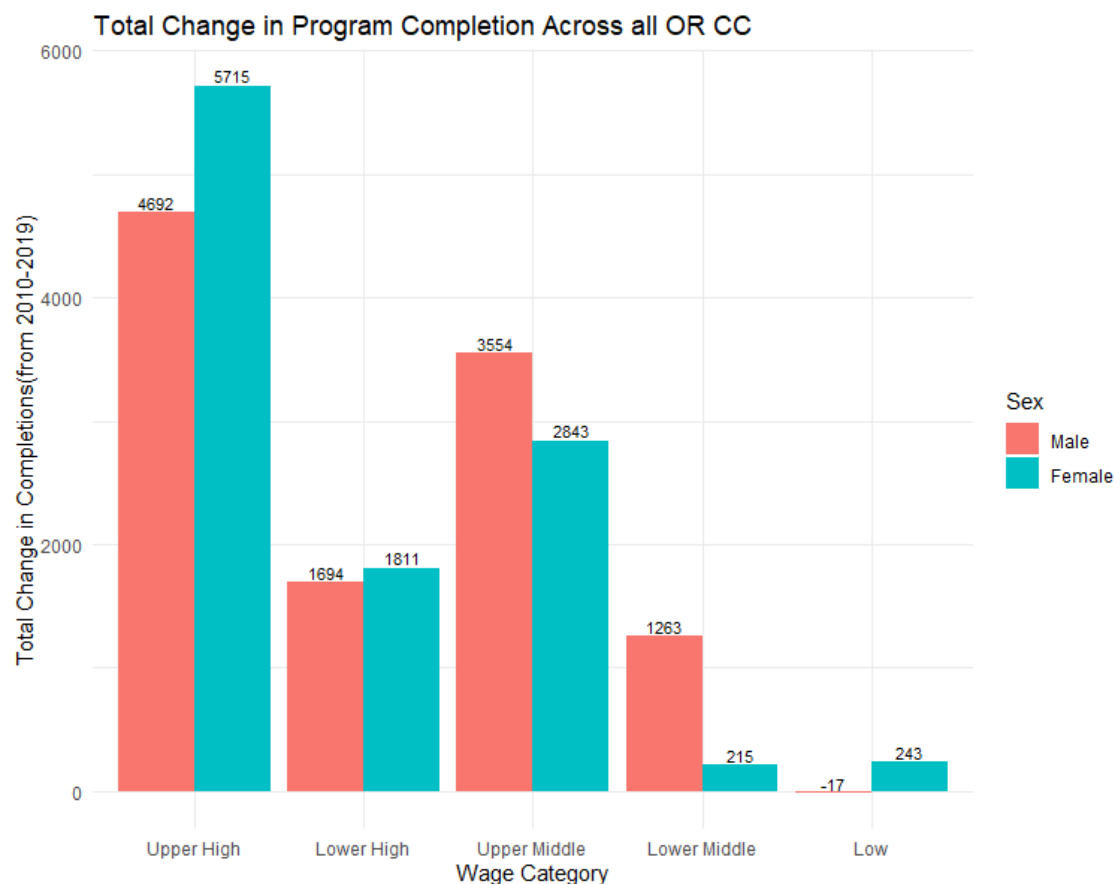


Figure 4.6: Change in Oregon Community College Completions from 2010 to 2019

Figure 4.6 shows the total change in Oregon community college completions (i.e., change in the number of degrees and certificates awarded to students) from 2010 to 2019. For both men and women, upper high-wage programs saw the largest increase in completions by far, of 4,612 male and 5,715 female completions. Upper high-wage programs are related to management, business, computer sciences, and hard sciences,

among other occupations. Lower high-wage programs, which are also related to business and finance as well as engineering, design, social sciences, and more, saw a smaller increase in completions (of 1,694 male and 1,811 female). Female students had greater increases in completions than male students in both high-wage groups.

Upper middle-wage programs, which are related to criminal justice, construction, some healthcare occupations, and technical work, among other occupations, saw a relatively large increase in completions. In this wage group, male completions increased by 711 more students than female completions. Lower middle-wage programs, which are related to healthcare support, production occupations, mechanics, and more, saw an increase in male completions of 1,263, but a female increase of only 215. This is the wage group with lowest increase in female completions and the largest gap between male and female completions, at 1,048 completions. Finally, low-wage programs, related to early childhood education, culinary and other services, retail, and more, saw a disproportionate increase of 243 female completers compared to a loss of 17 male completers, making it the worst wage category for males and second worst for females.

The most interesting results from this analysis are the major sex differences in completion changes for each wage category. 95.8% of the total increase in female completions over the last decade came from increases in the top three wage groups, leaving lower middle-skill and low-skill programs to account for only 4.2% of the increase. 52.8% of the total increase in female completions came from upper high-wage increases alone. In comparison, only 88.8% of total male completions is accounted for by the top three wage groups. Over the last decade, more female students have

gravitated towards community college programs related to higher wage occupations, primarily towards upper high-wage programs but also lower high-wage and upper middle-wage programs.

It is important to note that completers of high-wage programs may not directly enter the labor market, as completers of middle-wage programs might, because these programs tend to correspond to occupations that require further education (such as a bachelor's degree). The large increase in upper high-wage completions for men and women suggests an increase in the number of students using community colleges as a gateway to a bachelor's degree, acquiring low-cost credits before transferring to a 4-year institution.

The second largest increases in completions for men and women occur in the upper middle-wage programs, suggesting that Oregon's community colleges are producing an increasing number of upper middle-wage, middle-skill workers who are ready to fill demand for middle-skill jobs. While completions for upper middle-wage programs increased significantly for both males and females, lower middle-wage completions saw a disproportionate increase in male completions. Female completions in the lower middle-wage category made up just 14.5% of the total increase. This result suggests that over the last decade male students did not shift up the wage groups as much as female students did. Alternatively, this may be the result of socially constructed gender roles which could make males more likely to pursue occupations related to the lower middle-wage group and females less likely.

Low-skill completions rose the least overall, with a slight increase in female completions and a decline in male completions indicating a general avoidance of low-

wage programs. This is logical considering that low-wage, low-skill occupations traditionally do not require the post-secondary education offered by community colleges. Students who do enroll in low-wage programs at community colleges may not be aiming to end up in low-wage occupations, but rather in related occupations that are middle-wage. For example, consider the low-wage program Retailing and Retail Operations. A retail worker in a clothing store does not typically need any post-secondary education to be hired but having a community college certificate or degree related to retail may allow them to become the manager of a store, which is a higher paid position.

Community Colleges and the Labor Market

Regression Results: Estimate of the Change in Median Annual Wage Impact on the Change in Community College Completions								
Model Number	Wage Category	Sex Category	Beta 1 (Slope Coefficient Estimate)	P-value*	Beta 0 (Constant Estimate)	P-value*	R ² Value	F-Test p-value
1	All Wages	Total	2.67E-04	0.000585*	6.47	< 2e-16*	0.003804	0.000585*
2		Male	1.07E-04	0.00309*	3.30	< 2e-16*	0.002817	0.003095*
3		Female	1.60E-04	0.000585*	3.17	2.55e-13*	0.003804	0.0005846*
4	Upper High-Wage	Total	3.79E-04	0.0454*	12.13	1.19e-05*	0.005449	0.04544*
5		Male	1.54E-04	0.0421*	5.50	6.89e-07*	0.005626	0.04207*
6		Female	2.25E-04	0.054272*	6.63	0.000105*	0.005044	0.05427*
7	Lower High-Wage	Total	-1.86E-04	0.0648*	4.50	2.08e-07*	0.004354	0.0648*
8		Male	-8.33E-05	0.153	2.18	1.34e-05*	0.002613	0.153
9		Female	-1.03E-04	0.0551*	2.33	4.52e-07*	0.004698	0.0551*
10	Upper Middle-Wage	Total	2.21E-04	0.0235*	5.00	4.5e-16*	0.004343	0.0235*
11		Male	1.27E-04	0.0791*	2.77	9.32e-10*	0.002611	0.0791 *
12		Female	9.42E-05	0.0466*	2.23	7.96e-14*	0.003353	0.0466*
13	Lower Middle-Wage	Total	-3.68E-05	0.818	3.76	5.25e-06*	0.0001638	0.818
14		Male	-5.93E-05	0.622	3.12	5.57e-07*	0.000749	0.622
15		Female	2.25E-05	0.783	0.64	0.122	0.0002354	0.783
16	Low-Wage	Total	1.18E-03	0.0409*	0.20	0.9173	0.05383	0.0409 *
17		Male	2.51E-04	0.00713*	-0.79	0.01150*	0.09143	0.00713*
18		Female	9.29E-04	0.0898*	0.99	0.5874	0.03741	0.0898*

*Denotes significance at the 10% level.

Table 4.1: Regression Results

Table 4.1 shows the results of 18 individual regressions estimating the impact of changes in median annual wage on changes in community college completion. Each beta 1 coefficient represents the estimated slope on the independent variable (change in median annual wage).³⁷ This is interpreted so that a one dollar increase in the median annual wage of an occupation will alter the number of completers for corresponding community college programs by the value of the beta 1 coefficient. Across all occupations, Model 1 estimates a beta 1 coefficient of 0.0002665, which is statistically significant at the 10% level. Therefore, this model predicts that, from 2010 to 2019, a

³⁷See methodology for regression specifics.

\$10,000 increase in the median annual wage of an occupation correlates to an increase in total community college completions of about 2.7 for related programs.

The R-squared for Model 1 is 0.0038, indicating that only about 0.38% of the variance in the dependent variable (change in community college completions) is explained by the independent variable (change in median annual wage). None of the models had high R-squared statistics, with all of them being less than 1 percent (.01). This suggests that the models are not a good fit for the data, but it does not mean that we must throw out the results, especially since most of the regression coefficients are statistically significant. There is naturally significant variation in the data, and it would be a stretch to assume that the annual wage of a related occupation is a major factor in a student's decision to complete a community college program. It is likely that students do consider the wage of the occupations they wish to work in, but that is just one among many factors that influence student decisions. These models still offer a way to understand the relationship between community college students and the labor market.

Across all wage groups, Models 1, 2 and 3 show a statistically significant positive relationship between changes in annual wage and changes in community college completion, with female's experiencing the highest estimated change in completion (Model 3). The sex inclusive upper high-wage model (Model 4) predicts the largest positive correlation between change in annual wage and change in completions (beta 1 coefficient of $3.79E-04$). Again, the female only model predicts a larger increase in completions per dollar increase of annual wage. The sex inclusive upper-middle wage model (Model 10) predicts the second largest positive correlation, with the male model predicting a larger increase in completions. The sex inclusive low-wage model

predicts the third highest positive correlation, with the female model predicting a much larger increase in completions. All the coefficients in these wage categories are statistically significant.

The lower high-wage and lower middle-wage models differed from the others. The sex inclusive lower high-wage model predicts a negative relationship between change in annual wage and change in completions, and the male model predicts the largest decrease in completions, although only the female model has a statistically significant beta 1 coefficient. The lower middle-wage models also predict a negative relationship, but none of the coefficients are statistically significant.

Overall, these results suggest that, between 2010 and 2019, community college students tended to choose their programs partially based on future wage expectations. Community college programs related to occupations that saw positive increases in wages also tended to see positive increases in completions, and vice versa. This effect was stronger for females than males, suggesting a tendency for females to choose the highest wage programs, which is consistent with the other results in this paper. This behavior did not hold steady across all wage categories. It was strongest for students in upper high-wage programs, where the effect was stronger for females, followed by students in upper middle-wage programs, where the effect was stronger for males. Students in low-wage programs also displayed this behavior, and again the effect was stronger for females.

The results for the female model in the lower high-wage category suggest that when lower high-wage occupations see an increase in annual wage, female completions in related programs tend to decrease. If occupations experience a decrease in annual

wage, female completions in related occupations are predicted to increase. This result is statistically significant but could potentially be circumstantial if wage increases or decreases occurred in occupations related to programs that women have shifted away from or into during the last decade. Still, it is important information for community colleges to consider as it displays a disequilibrium between the decisions of students and the labor market.

Finally, the insignificance of the coefficients in the lower middle-wage models means there is no statistical relationship between wage growth and completions growth for that wage category, suggesting that students do not select these programs based on wage. This might be because some lower middle-wage programs – a category that includes programs related to art, photography, and sport – are connected to occupations that people are willing to accept any wage for. A serious photographer likely knows that the typical salary of a professional is relatively low (the median wage in 2019 was \$33,330), yet they will be determined to pursue their craft.

Discussion of Results

Job Polarization or Rising Wage Inequality?

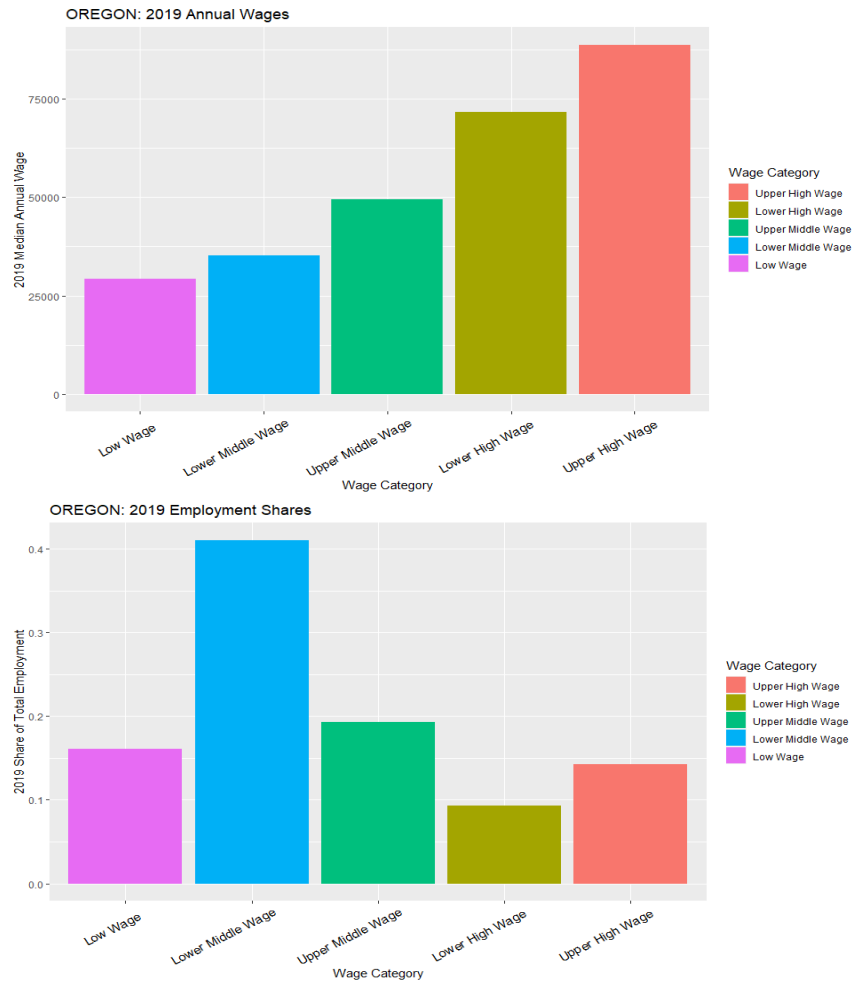


Figure 5.1: Visualizing Wage Inequality

The first graph shows the average Oregon 2019 median annual wage for each wage category, and the second graph shows the share of total Oregon employment for each wage category.

The analysis of the Oregon labor market shows that there was minimal job polarization between 2010 and 2019. Middle-wage occupations saw declines in their share of total employment, but the low-wage share also declined. High-wage

occupations did increase their share of total employment and were the wage group with the most significant change in employment share, indicating that the primary trend in the labor market has been a shift towards high-wage occupations. This increase in the high-wage share of employment came primarily from a loss in middle-wage opportunities, especially from occupations in the lower middle-wage category. Therefore, while changes in employment share do not reflect the definition of job polarization, where demand for both high- and low-wage occupations increases but demand for middle-wage occupations decreases, they do demonstrate a decline in middle-wage jobs. These results suggest that job polarization is not the main catalyst behind changes in the Oregon labor market.

It is important to consider the work of Jaimovich and Siu, who found that 88% of the loss in middle-skill jobs occurs within a 12-month window of a recession.³⁸ For the duration of the time window used for this project (2010 to 2019), the US was in an economic expansion. This indicates that my results, which show that the loss of middle-skill jobs was not severe and job polarization was not extreme, comply with the findings of Jaimovich and Siu. Mishel et al. have shown that, since the 1950s, the middle-skill share of employment has been shrinking, the high-skill share has been increasing, and the low-skill share has remained relatively steady.³⁹ My results, for both Oregon and the US, were consistent with this trend, providing further evidence that other factors are responsible for Oregon's changing labor market.

³⁸Jaimovich and Siu, 2. See background for more details.

³⁹Lawrence Mishel et al.

A potential explanation for the shift towards high-wage occupations is the inequality in compensation across the wage categories. Figure 5.1 shows the average 2019 median annual wages for each wage category and the total 2019 share of Oregon employment for each wage category. Lower middle-wage occupations have the highest share of total employment by far, at about 41% of total employment, but are the second lowest wage group, with an average median annual wage of \$35,128. Overall, the three lowest wage-groups hold about 77% of total employment. These statistics show that most workers in Oregon are paid less than a high-wage salary. Therefore, it is not surprising that the employment shares for middle-wage and low-wage occupations are declining, as workers increasingly aim to obtain higher wages.

The Changing Preferences of Community College Students

Job polarization is typically considered to be the result of changes in the labor market on the demand side. Specifically, it is thought to be caused mainly due to decisions from firms to computerize, offshore, or outsource middle-skill jobs, thus reducing their demand for middle-skill laborers. My results suggest that Oregon's decline in middle-skill employment may also be caused from the supply-side, due to decisions made by laborers.

The largest increases in community college completions were in the three highest wage groups (See figure 4.6), and my regressions show that community college students are motivated by higher wages when selecting programs of study (see table 4.1). Community colleges, who have typically prepared students for middle-wage, middle-skill occupations, have seen their students shift into programs correlated to higher wage occupations over the past decade. This likely contributed to the decline in

the middle-wage share of Oregon employment, which was especially severe for the lower middle-wage category, and the increase in the high-wage share, which was greatest for upper high-wage occupations.

The fact that the largest increase in completions occurred in upper high-wage programs provides further evidence that community college students are contributing to a decline in the middle-wage share of employment. These programs typically feed into higher educational opportunities, such as a bachelor's degree program, so that when these students reach the labor market, they are likely entering high-wage, high-skill occupations. In 2019, the top three most completed programs at Oregon community colleges were Business Administration and Management programs (8,570 completers), Liberal Arts, Sciences/Liberal Studies programs (5,260 completers) and General Studies programs (4,190 completers). These programs are broad in the knowledge they cover and do not correlate to specific, middle-wage occupations. Many of these completers are likely seeking to transfer credits in pursuit of an advanced degree.

These results are consistent with educational attainment trends seen throughout US history, where the percentage of adults completing a bachelor's degree or higher has consistently increased.⁴⁰ The shift towards higher wage occupations was more extreme for females, suggesting that women are shifting away from middle-wage jobs, especially lower middle-wage jobs, more than men. This result is also consistent with

⁴⁰Ryan, Camille L., and Kurt Bauman. "Educational Attainment in the United States: 2015. Population Characteristics. Current Population Reports. P20-578." *US Census Bureau* (2015), 4.

education trends as women have increasingly outpaced men in bachelor's degree attainment throughout the 21st century.⁴¹

The Changing Role of the Community College

These results indicate that students in Oregon are increasingly using community colleges as gateways to advanced degrees. Evidence that the percentage of adults completing bachelor's degrees is constantly increasing⁴² suggests that an increasing number of all post-secondary students, including community college students, are aiming to complete a bachelor's degree. The cost of going to college has increased significantly over the past few decades,⁴³ but community colleges offer lower cost credits that are often transferable to the more expensive 4-year institutions where an advanced degree can be obtained. Many students see community colleges as a chance to save money on their pathway to obtaining an advanced degree, which is often considered the gold standard for a successful career.

Oregon's community colleges should embrace the changing preferences of students while also continuing to fulfill their traditional role as suppliers of middle-skill workers. Providing affordable credits to students who hope to eventually obtain a bachelor's degree is an important role that these institutions can serve for their students and communities. Yet research has shown that while many students entering community colleges hope to earn a bachelor's degree (over 80%), only a few (about 6%) report that

⁴¹Camille and Bauman, 11.

⁴²Camille and Bauman, 4.

⁴³Ethan Henley, "Sticker Shock: The Rising Cost of College." *Journal of Higher Education Management* 29, no. 1 (2014), 16.

they actually earned one within 6 years.⁴⁴ Community colleges should increase support for students hoping to obtain a bachelor's degree and make investments in improving the quality of their high-wage programs so that students are more likely to succeed in advanced degree programs.

Since most community college students do not obtain a bachelor's degree and middle-wage occupations still hold the largest share of Oregon employment, community colleges must continue to promote programs that feed occupations in the middle-wage categories. The middle-wage share of total employment was over 60% in 2019 demonstrating that there is still a significant need for middle-wage, middle-skill workers. Community colleges should emphasize associate degrees and certificates as cost-friendly and attainable methods of increasing human capital. Promoting middle-wage programs encourages students who are not motivated by an advanced degree to increase their potential future wages, ultimately benefiting communities by providing skilled workers for important middle-wage occupations.

Further, Oregon's government must recognize the importance of community colleges. By providing appropriate funding to these institutions, the state can incentivize Oregonians to learn important skills and trades, fueling support for rising occupations and industries. Increased funding can also help community colleges improve their high-wage programs so that students seeking advanced degrees have a higher rate of success. The lower cost credits available at community colleges make them an important avenue

⁴⁴Stacy T. Shaw and Paul Skomsvold. "Pit stops and pitfalls of the Yellow Brick Road: Demographics and characteristics of community college students along the path of degree completion." *RTI International* (2018), 2.

to a degree for lower income households, which the state should see as an opportunity to promote equality throughout urban and rural Oregon.

Specific Program Suggestions for Community Colleges

For community college students hoping to obtain a bachelor's degree, Oregon community colleges should emphasize their programs related to Computer and Mathematical Occupations (15-0000), Healthcare Practitioners and Technical Occupations (29-0000), and Life, Physical, and Social Science Occupations (19-0000), as they saw the largest increases in median annual wages over the past decade. These are high-wage programs and are therefore a sound investment for students. In addition, programs related to these occupations saw some of the highest levels of completion in 2019, indicating significant demand from students.

Of the upper middle-wage programs, Oregon community colleges should emphasize programs related to Community and Social Service Occupations (21-0000) and Construction and Extraction Occupations (47-0000). For example, The Electrical and Electronics Installers and Repairers program was the seventh most completed program in 2019 with 2,094 completers. It is correlated to Automotive Service Technicians and Mechanics occupations which saw an increase in both annual wages and employment share, indicating it would be a good program choice for students.

Overall, programs related to the lower middle-wage category could be scaled back, as this wage category saw the largest decline in employment share and the smallest increases in wages. That said, a few detailed occupations did perform well. The Machine Tool Technology/Machinist program had the fourth largest number of completers in 2019 with 3,692, a significant increase from the 676 completers it saw in

2010. Many of the detailed occupations correlated to this program saw increases in their annual wages and share of total employment over the last decade. The Welding Technology/Welder program had 1,716 completers in 2019 and is correlated to the Welders, Cutters, Solderers, and Brazers occupations that saw significant increases in annual wages and increasing employment share. These are specific lower middle-wage programs that Oregon community colleges should invest in.

Low-wage programs could also be scaled back, as the low-wage share of employment declined slightly, and occupations in this wage group do not typically require post-secondary education. Four out of five low-wage occupations did see decent increases in annual wages, most notably Personal Care and Service Occupations (39-0000) which saw an increase of about \$4,922. Overall, the highest completed program in this wage category was Child Care and Support Services Management (with only 300 completers), correlating to Preschool Teacher occupations which had a declining employment share over the last decade.

2020 Employment Update and the COVID-19 Pandemic

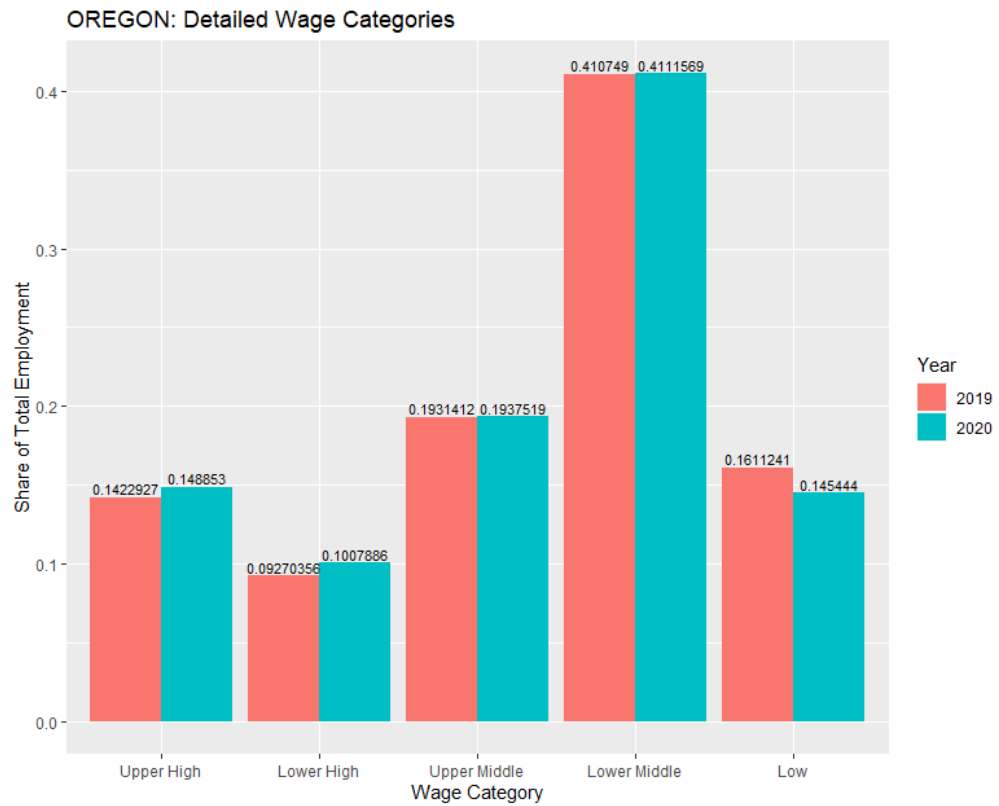


Figure 6.1: 2020 Employment Share Update

This figure shows the 2019 and 2020 shares of total Oregon employment for each of the five detailed wage categories.

Year	Upper High-Wage Employment	Lower High-Wage Employment	Upper Middle-Wage Employment	Lower-Middle Wage Employment	Low-Wage Employment
2019	271,190	176,680	368,100	782,830	307,080
2020	268,970	182,120	350,100	742,940	262,810

Table 6.1: 2020 Employment Update for Wage Groups

The BLS released the 2020 Occupational Employment Statistics report on March 31, 2021, not long before the completion of this thesis. The 2020 update is worth examining considering that the COVID-19 pandemic severely impacted the Oregon economy throughout 2020, leading to an ongoing recession (which began in

April 2020 according to official NBER recession dates⁴⁵). Since most middle-skill job loss occurs within a 12-month window of a recession,⁴⁶ community colleges should be aware of how middle-skill job opportunities are changing over the next few years.

According to the data reported in the OES reports, Oregon lost about 98,910 jobs between May 2019 and May 2020 (a decrease in total Oregon employment from 1,905,860 to 1,806,950). Of the five wage groups, all saw a decline in total employment except for the lower high-wage group, which saw a slight increase in total employment. The lowest two wage groups (lower middle-wage and low-wage occupations) saw the largest decreases in total employment. While most occupation groups saw declines in the total number of workers employed, only low-wage occupations saw a decrease in share of total employment. This indicates that out of all workers employed in Oregon, low-wage workers faced the most significant negative effects from the recession.

The nature of the current recession, induced by the COVID-19 pandemic, explains the patterns of job loss between 2019 and 2020. State restrictions caused firms to close their doors throughout 2020, seeking to reduce the spread of COVID-19 by limiting in-person contact among coworkers and the public. Many higher-wage occupations are adaptable to a virtual format, allowing for firms to continue to operate despite pandemic related closures and thus limiting the impact of the pandemic on the higher wage groups. Meanwhile, lower wage occupations, such as retail or service

⁴⁵See “NBER based Recession Indicators for the United States from the Period following the Peak through the Trough” from the Federal Reserve Economic Data (FRED) database.

⁴⁶Jaimovich and Siu, 2.

occupations, are not adaptable to a virtual format, so the pandemic closures contributed to significant declines in employment within the lowest two wage groups.

Oregon's community colleges do not currently have reason to worry about the impact of the COVID-19 pandemic on their students and programs beyond the general decline in employment caused by the recession. Recessions have historically led to a loss of middle-skill jobs, and community colleges tend to produce middle-skill workers. However, because this recession was caused by the pandemic, it has not led to a decline in the middle-skill (middle-wage) share of employment, and the most significant job losses have been in low-wage occupations. The 2020 OES release reinforces the suggestions made in the sections above, that community colleges should invest in their higher wage programs and continue to promote their middle-wage programs. This is especially important considering that past downturns in the economy have been accompanied by increases in college enrollment, as the unemployed seek to stay in school or go back for further education.⁴⁷ Additionally, community colleges must continue to monitor the Oregon labor market as the recession continues to ensure that they can be responsive to job polarization if it increases in severity.

⁴⁷ Andrew Barr and Sarah Turner. "Out of work and into school: Labor market policies and college enrollment during the Great Recession." *Journal of Public Economics* 124 (2015): 63.

Appendix

Appendix I: Classifying Occupations into Wage Groups

22 Major SOC Groups by Wage Category	SOC Code	2019 Median Annual Wage
Upper High-Wage Occupations (>\$80,000 median annual wage)		
Management Occupations	11-0000	\$94,810
Computer and Mathematical Occupations	15-0000	\$85,380
Healthcare Practitioners and Technical Occupations	29-0000	\$86,360
Lower High-Wage Occupations (Between \$60,000 and \$80,000)		
Business and Financial Operations Occupations	13-0000	\$67,650
Architecture and Engineering Occupations	17-0000	\$78,310
Life, Physical, and Social Science Occupations	19-0000	\$64,900
Legal Occupations	23-0000	\$76,230
Upper Middle-Wage Occupations (Between \$40,000 and \$60,000)		
Community and Social Service Occupations	21-0000	\$48,760
Educational Instruction and Library Occupations	25-0000	\$50,180
Arts, Design, Entertainment, Sports, and Media Occupations	27-0000	\$49,120
Protective Service Occupations	33-0000	\$49,260
Construction and Extraction Occupations	47-0000	\$52,660
Installation, Maintenance, and Repair Occupations	49-0000	\$47,070
Lower Middle-Wage Occupations (Between \$31,000 and \$40,000)		
Healthcare Support Occupations	31-0000	\$32,640
Sales and Related Occupations	41-0000	\$31,490
Office and Administrative Support Occupations	43-0000	\$38,900
Production Occupations	51-0000	\$37,560
Transportation and Material Moving Occupations	53-0000	\$35,050
Low-Wage Occupations (< \$31,000)		
Food Preparation and Serving Related Occupations	35-0000	\$26,340
Building and Grounds Cleaning and Maintenance Occupations	37-0000	\$30,190
Personal Care and Service Occupations	39-0000	\$29,850
Farming, Fishing, and Forestry Occupations	45-0000	\$30,420

The 22 major occupational groups were separated into these five categories based on their 2019 median annual wages. The occupations were split into wage groups primarily based on their 2019 median annual wages, with some consideration for the

perceived skill-level required for each occupation (between non-routine cognitive skill, non-routine manual skill, and routine manual and cognitive skill, which relate to high-, middle-, and low-skill jobs as explained in the background).

The median annual wage for all Oregon occupations in 2019 was \$41,250. The 75th percentile annual wage was \$64,950 and the 90th percentile annual wage was \$99,230. The 25th percentile annual wage was \$29,520 and the 10th percentile annual wage was \$24,720.⁴⁸ The lower high-wage category was created roughly to fit above the 75th percentile wage, and the upper high-wage category incorporates the occupations that are closest to the 90th percentile. The upper middle-wage category sits roughly between the median annual wage and the 75th percentile, while the lower middle-wage category fits below the median and above the low-wage boundary. None of the major SOC groups had a median annual wage below the 10th percentile, so the low-wage category's upper-bound was set at \$31,000 to include the lowest earning occupations that also fit the (admittedly generic) description of non-routine manual. While this methodology is not perfect, it is effective in sorting the major SOCs so that within each wage group, median annual wages are collectively similar while also being distinct from the other wage groups.

⁴⁸This wage data is reported in the annual OES report.

Bibliography

- Acemoglu, Daron, and David Autor. "Lectures in labor economics." Manuscript.
<http://economics.mit.edu/files/4689> (2011): 22.
- Autor, David. "The polarization of job opportunities in the US labor market: Implications for employment and earnings." Center for American Progress and The Hamilton Project 6 (2010).
- Autor, David H., Frank Levy, and Richard J. Murnane. "The skill content of recent technological change: An empirical exploration." *The Quarterly journal of economics* 118, no. 4 (2003): 1279-1333.
- Autor, David, H., Lawrence F. Katz, and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review*, 96 (2): 189-194.
- Barr, Andrew, and Sarah Turner. "Out of work and into school: Labor market policies and college enrollment during the Great Recession." *Journal of Public Economics* 124 (2015): 63-73.
- Cahuc, Pierre, Stéphane Carcillo, and André Zylberberg. *Labor economics*. MIT press, 2014.
- Card, David, and John E. DiNardo. "Skill-biased technological change and rising wage inequality: Some problems and puzzles." *Journal of labor economics* 20, no. 4 (2002): 733-783.
- Goos, Maarten, and Alan Manning. "Lousy and lovely jobs: The rising polarization of work in Britain." *The review of economics and statistics* 89, no. 1 (2007): 118-133.
- Henley, Ethan. "Sticker Shock: The Rising Cost of College." *Journal of Higher Education Management* 29, no. 1 (2014): 16-21.
- Jaimovich, Nir, and Henry E. Siu. "Job polarization and jobless recoveries." *Review of Economics and Statistics* 102, no. 1 (2020): 129-147.
- Kasper, Henry T. "The changing role of community college." *Occupational Outlook Quarterly* 46, no. 4 (2003): 14-21.
- Mishel, Lawrence, Heidi Shierholz, and John Schmitt. "Don't blame the robots." *Assessing the Job Polarization Explanation of Growing Wage Inequality*, EPI-CEPR working paper (2013).

Ryan, Camille L., and Kurt Bauman. "Educational Attainment in the United States: 2015. Population Characteristics. Current Population Reports. P20-578." US Census Bureau (2015).

Shaw, Stacy T., and Paul Skomsvold. "Pit stops and pitfalls of the Yellow Brick Road: Demographics and characteristics of community college students along the path of degree completion." RTI International (2018).