UTAH DATA RESEARCH CENTER

Firm Size and Wages

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Abstract

This research uses a five-year panel of graduates from the Utah System of Higher Education matched with Department of Workforce Services wage and employment data to measure the relationship between firm size and wages. This research shows minor differences in the racial and ethnic composition of large compared to small firms but significant gender composition differences. The study measures the relationship between wages and firm size for technical certificate earners, associate degree earners, and bachelor's degree earners. The research uses a fixed effects estimation to show a positive relationship between wages and firm size after controlling for individual observable and unobserved characteristics. In addition, the study uses a first-difference technique to compare the relationship between wage growth and movement to a large firm and shows a positive relationship between wage growth and movement from a small to a large firm.

Keywords

Large Firms, Wages, Firm Size , Large Firm Wage Premium, Utah

1 | Introduction

The determination of wages is affected by a complex interaction of a multitude of factors. One such factor is the size of the firm in which an individual is employed. In Utah, this relationship may interest job seekers and policymakers. However, no Utah-specific research focuses on the relationship between firm size and wages. This research adds to the understanding of the relationship between the size of a firm and wages for postsecondary graduates in Utah. In addition, this research shows that large firms in Utah are associated with a wage premium.

To understand if and how the size of a firm and wages are related, this research will use data from the Department of Workforce Services (DWS) and the Utah System of Higher Education. Postsecondary graduates' wages and employers were collected for five years after completing a postsecondary program. These were used to create a panel of highly attached workers. The methods use repeated observations of each individual to control for unobservable individual characteristics. The data structure also allows for discussing wage growth and wage levels.

In this research, firm size is operationalized as a binary variable. Firms can either be large or small based on the number of jobs that the firm had in Utah each year of the study. A firm is considered large if it has 250 or more jobs, according to the Quarterly Census of Employment and Wages, which measures the number of jobs in Utah. While definitions of a small or large firm can change, nationally, the cutoff for a small firm is 500 employees though this can change with annual revenue and the industry in which a firm operates (U.S. Small Business Administration, n.d.). Despite this, based on the size distribution of firms in Utah, the definition employed in this study of a large firm is one with 250 or more jobs.

There are discrepancies between the definitions of what constitutes a large firm stemming from mechanisms leading to wage differences between small and large firms. Wages and firm size may be associated through several potential mechanisms. First, large firms may be a monopoly in their respective product market(s).[1]

These firms earn a monopoly profit or profit over what is a usual rate of return. Management splits these monopoly profits between the owners of the firm and the workers in the firm. Profit sharing, in this case, is used to preempt worker demands that historically led to unionization (Brown & Medoff, 1989).

Large firms may have different levels of capital than small firms. Larger firms may invest in newer technology or have more capital per worker. In both instances, each worker in the large firm is more productive due to either the more productive technology embodied in the capital or a higher capital-to-labor ratio. The additional productivity for the workers in large firms with different capital structures is paid higher wages due to the increased productivity. In addition, more advanced technology can require more skilled workers. In this case, the wage premium is an interaction between more productive capital and higher-skilled workers (Brown & Medoff, 1989; Pedace, 2010).

A wage premium can be the result of an efficiency wage. Efficiency wages may solve two separate issues. First, an efficiency wage attracts the most skilled or productive workers. When an efficiency wage attracts more productive workers, it pays for itself through increased productivity, leading to increased output. Second, an efficiency wage is employed to prevent shirking. A large firm is less able to monitor employees to ensure that employees remain productive; this decreases the likelihood of any single employee being caught shirking. However, this creates an incentive to shirk as the expected cost is low. To compensate for this, a large firm pays a higher wage to increase the cost to an employee caught shirking. In the first use of an efficiency wage, the worker has a constant level of productivity transferred from firm to firm, with large firms attracting productivity through wages. In the second use, productivity is variable, while wages are used to keep productivity high (Pedace, 2010).

Large firms may have different organizational structures than small firms. Rather than attempt to discern individual productivity and pay accordingly or pay based on individual human capital, large firms have internal labor markets. Internal labor markets determine a pay scale based on position, job duties, and tenure with a firm. The wage premium accrues to those employed in a large firm that utilizes an internal labor market with raises designed around job description and tenure rather than perceived productivity (Cobb & Lin, 2017; Pedace, 2010).

This research cannot directly test any of the above hypotheses regarding what causes a wage premium. Potential most plausible but untestable mechanisms are internal labor markets and both iterations of efficiency wages. This research did not test internal labor markets and efficiency wages to reduce shirking. Individual productivity was indirectly

1 It is entirely possible for monopolies to exist given that The Federal Trade Commission regulates mergers based on the Consumer Welfare Standard rather than market share. Broadly, "...if consumers are not harmed, the antitrust agency does not act" (Wilson, 2019, p. 1).

controlled for with the methods in this research, which would indirectly control for large firms paying a wage premium to attract the higher productivity workers. Finally, profit sharing to prevent unionization is least relevant for Utah, given national trends in union coverage, the threat of unionization, and the ability to organize in the state.[2]

1.1 | Literature Review

Previous research covering the relationship between large firms and wages has occurred in many institutional contexts. Most studies directly estimate a large firm wage premium (Cobb & Lin, 2017; Lehmer & Möller, 2010; Pedace, 2010; Winter-Ebmer & Zweimuller, 1999). Some studies consider large firms in the broader context of firm size and location (Lehmer & Möller, 2010), while other studies are concerned with how firm size is related to the distribution of wages. These studies are from several different countries. In these studies, wage differences exist based on firm size, showing evidence of a large firm wage premium (Bílková, 2019; Cobb & Lin, 2017; Lehmer & Möller, 2010; Pedace, 2010; Winter-Ebmer & Zweimuller, 1999).

Winter-Ember and Zweimuller (1999) used the Swiss Labor Force Survey to show that firms with greater than 100 workers employed roughly 30.0% of the workforce in the sample. Employment in the largest firms, greater than 100 employees, was associated with a 3.0% wage premium compared to those employed in firms with fewer than five employees. Furthermore, those who moved from the smallest-sized firms to the largest had roughly a 6.0% increase in wages, while those who moved from the largest to the smallest firms saw approximately a 5.0% wage decrease (Winter-Ebmer & Zweimuller, 1999).

Lehmer and Möller (2010) consider firms that employ more than 500 workers as large firms. The data come from Germany and are a sample of everyone who paid into social insurance. Wages were measured by the contribution to social insurance and are top-coded due to a contribution ceiling, similar to Social Security in the United States. The authors included urban status in this study along with the firm-size category. Those employed in a large firm had roughly an 11.0% wage premium. Those who moved from a small to a large firm had initial additional wage growth of 12.0%, and those who went from large to small firms had about 3.0% additional wage growth in the year of movement (Lehmer & Möller, 2010).

Matched employer-employee data from the United States shows that workers in firms with 250 or more employees earn a 9.0% wage premium (Pedace, 2010). With the inclusion of training and nonwage benefits in the dependent variable, the premium shrunk to 4.0%. Controlling for firm revenue and capital structure did not affect the large firm wage premiums (Pedace, 2010).

Bílková (2019) broke firms into six size categories, with the smallest category being fewer than ten employees and the largest greater than 5,000. This research did not test for a single premium given firm size but described the distribution of wages for each firm-size category. To a certain point, larger firms had higher wages than the next smaller size, and the largest firm-size category had wages between the second and third largest categories. The larger firms had lower coefficients of variation, a measure of dispersion around the mean, than the smaller firms (Bílková, 2019).

Cobb and Lin (2017) used the Current Population Survey to test for a large firm wage premium across the wage distribution and if this has contributed to the growing inequality in the U.S. The authors divided firms into four size categories, with less than 100 as the reference category and more than 1,000 as the largest category. Each size category has a wage premium compared to the smallest firms, which grew with each successive size category. The wage premiums occurred at the wage distribution's 10th, 25th, 50th, 75th, and 90th percentile. For example, at the 10th percentile, premiums range from 11.0% for firms employing between 100 and 499 workers to 14.0% for firms employing over 1,000 workers. Between 1989 and 2014, the wage premium decreased (Cobb & Lin, 2017).

Previous research has shown that larger firms have a wage premium from 3.0% to 18.0% (Cobb & Lin, 2017; Winter-Ebmer & Zweimuller, 1999). Further, moving from a small to a large firm is associated with faster wage growth, between 3 and 6.0% in the year of transition to a large firm (Lehmer & Möller, 2010; Winter-Ebmer & Zweimuller, 1999). Previous research has had to account for variable education (Cobb & Lin, 2017; Lehmer & Möller, 2010; Pedace, 2010; Winter-Ebmer & Zweimuller, 1999). The current research is restricted to those who graduated from a postsecondary institution. Other previous research was able to control for some firm or job characteristics (Pedace, 2010), while the present research does not.

Overall, the current research will estimate the relationship between large firms and wages for those who graduate from a USHE institution for

2 In the decade preceding the period of this study (2000-2010) there were 15 successful union drives in Utah (National Labor Relations Board, n.d.). Additionally, Utah enacted a "Right to Work" law in 1969 (Utah Right to Work Law, 1969). These laws are associated with lower organizing success and decreased organizing activity (Moore, 1998).

the five years following graduation. It will estimate both the level of wage differences and the growth of wages. It will not be able to control for firm characteristics but will control for experience, industry, and demographics. Furthermore, this research is restricted to Utah from 2011-2019, where information technology adoption was ubiquitous.

2 | Methods

2.1 | Data

The initial population was those who completed a technical certificate, associate degree, or bachelor's degree from a USHE institution, as currently defined, which includes technical colleges, colleges, and universities, between January 2011 and December 2014. This period was chosen to avoid issues due to COVID. This study excluded those who returned to school during the five-year observation period. Individuals with a major identified by the Classification of Instructional Programs (CIP) major code, designated as a STEM major (U.S. Immigration and Customs Enforcement, 2022), were given an indicator variable for being a STEM graduate. Additional variables from USHE included date of birth, used to calculate age, gender, and race or ethnicity. The Utah Data Research Center's (UDRC) identification and matching algorithm matched these graduates to the wage and employment records.

Wage, firm, the industry of the firm, and size data came from the Department of Workforce Services (DWS). Wage, industry, and firm name data came from the DWS Unemployment Insurance (UI) wage records, part of the UDRC database. The industry in which the firm operated was the first two digits of the North American Industry Classification System (NAICS) code from the six-digit code provided to DWS by the employer. The data were restricted to those highly attached to the labor force, meaning they earned income each quarter after graduation from a postsecondary program. In addition, an experience estimation variable was created to address the overall labor market experience. Each quarter of employment for an individual before graduation was summed and then converted to years of employment. As individuals gained additional years of experience, each year was added to the initial experience. Due to the limited time frame of the wage data, categories were created to account for the right censored (someone may start with more than 15 years of experience, but experience can only be observed up to 15 years initially) nature of experience. These were less than two years of experience, greater than two to greater than five years, greater than five to ten years, greater than ten to 15 years, and greater than 15 years of experience. Individuals with multiple employers in a quarter had two potential designations: firm mover or multiple job holder. If individuals had the same employers during multiple quarters, they were labeled multiple job holders. The firm they earned the most income from each quarter was marked as the primary employer; this methodology is similar to Rao and Knold (2021). To prevent the seasonally employed in multiple firms from being counted as firm movers, only those with a leading or lagging matching firm were coded as firm movers. The primary firm for each individual was matched to the size data through the standardized employer name.

The firm size data comes from DWS but is not in the UDRC database. A large firm is a firm with 250 or more jobs. DWS provided firms with 250 or more jobs during the first quarter of each year from the Quarterly Census of Employment and Wages data. These names were standardized similarly to those from the UI wage record data. The large firms were matched by year with those from the firms in the UI wage records through a dplyr join function (Wickham et al., 2022). The large firms that did not directly correspond with UI firms were manually matched, for many firms changing abbreviations for standard terms such as Inc to Incorporated allowed the firms to match. Other firms were matched by comparing the legal name with "doing business as." Large firms were based on the number of jobs in the first quarter of each year. While some firms might seasonally fluctuate in size, this was not captured, and a firm was considered a large firm or a small firm for the entire calendar year.

2.2 | Method

The size of a firm is one of many variables that codetermine wages. The assumption is that the underlying model is linear. The underlying model that determines wages is:

$$y_{it} = \text{FirmSize}_i\gamma + x_{it}\beta + z_i\delta + g_t\Theta + c_i + \upsilon_{it} \quad (1)$$

In this model, the outcome variable, y_{it}, is the natural log of the real wage for individual i at the standardized observation period t. The outcome of interest is γ, which measures the relationship between firm sizes and wages. Given previous research, the relationship is expected to be positive. To control for confounding variables, the vector x_{it} contains time-varying and measurable characteristics for individual i at period t. Beyond factors that vary with time and that are related to wages z_i is a vector of time-invariant, observable, individual characteristics. Time effects enter into the relationship through g_t. There are additional unmeasurable individual characteristics that relate to wages represented as c_i. The existence of

unmeasurable individual characteristics can lead to a biased estimation of γ. The bias occurs in the estimation when the unobserved characteristics, c_i, are subsumed into the error term, which becomes:

$$\nu_{it} = c_i + \upsilon_{it} \quad (2)$$

Two methods remove the unobservable characteristics from estimating the relationship between wages and firm size. The first method is a fixed effects approach, which estimates the overall relationship between wages and firm size. The second method is the first-difference estimation technique, which explicitly estimates the relationship between moving from one size category to another.

2.2.1 | Fixed Effects

There are two ways to implement the fixed technique. In the first technique, a dummy variable for each individual is added to the estimating equation; in this case c_i is accounted for with the newly created dummy variable. In the second approach, each variable is demeaned. The demeaned estimation is called the "within transformation," which takes the generic form:

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)\beta + (z_i - \bar{z}_i)\delta + \nu_{it} - \bar{\nu}_i \quad (3)$$

Which is rewritten as:

$$\ddot{y}_{it} = \ddot{x}_{it}\beta + \ddot{\upsilon}_{it} \quad (4)$$

In the within estimator, c_i is part of the error in the error term and canceled out since the average of a constant is the constant. For this reason, the time-invariant variables, z_i, also cancel out. The individual unmeasured productivity is assumed constant and, therefore, would shift any individual wages higher or lower than the population average. Demeaning leaves only the variation of varialbes, so any differences in levels are removed (Wooldridge, 2002). The within transformation also removes the effects of social processes that manifest in wage determination. In the case of wages, fixed effects remove the group differences between genders due to differences in wage negotiation or discrimination.

The data were split by the postsecondary award. A separate regression of wages on firm size and other characteristics was run for the graduates with each type of postsecondary award. While this sacrificed degrees of freedom for each regression, it allowed for differing relationships without using many interaction terms. For each level of postsecondary program completed, the fixed effects estimating equation is:

$$\log(\ddot{W}a\ddot{g}e_{it}) = \gamma\ddot{L}a\ddot{r}ge_{it} + \beta_1\ddot{A}g\ddot{e}_{it} + \beta_2\ddot{A}g\ddot{e}^2_{it} + \beta_3\ddot{E}xp\ddot{e}rience_{it} + \beta_4\ddot{N}A\ddot{I}CS_{it} + \Theta_1\ddot{O}bserv\ddot{a}tionYear + \Theta_2\ddot{Y}e\ddot{a}r + \ddot{\upsilon}_{it} \quad (5)$$

The outcome variable is the demeaned natural log of the real wage for each individual at observation period *t*. The relationship of interest is the coefficient γ on the variable Large_{it}, which measures if individual *i* was employed in a large firm during period t. Additional controls are for age and age squared for each individual at each period, Age_i and Age^2_{it}. The square term allows for diminishing returns to age. Experience is a categorical variable for overall labor market experience and is the variable Experience_i. The industry in which an individual is employed during a period is NAICS_{it}. The variable ObservationYear is included to account for general wage growth after graduation and Year accounts for macroeconomic conditions.

2.2.2 | First-differenced

First-differenced estimation measures the year-over-year change in wages. First-differenced estimation removes time-invariant unmeasurable characteristics and estimates a consistent relationship between wages and changing firm size. First-difference estimation cannot estimate the relationship between time-invariant factors and wage changes. The generic first-differenced equation takes the form:

$$y_{it} - y_{it-1} = (x_{it} - x_{it-1})\beta + (z_i - z_{it-1})\delta + \nu_{it} - \nu_{it-1} \quad (6)$$

This is rewritten as:

$$\Delta y_{it} = \Delta x_{it}\beta + \Delta\upsilon_{it} \quad (7)$$

In the first-difference estimating equation, the previous value of a variable is subtracted from the current value, and Δ is interpreted as the change in value between two periods. In the case of c_i, which is constant, is cancelled out of the error term, $\Delta\nu_{it} = \Delta\upsilon_{it} + c_i - (\Delta\upsilon_{it-1} + c_i) = \Delta\upsilon_{it}$. First-differencing also removes the time-invariant characteristics as with fixed effects estimation.

Three first-difference regressions were also run, with a separate regression for each postsecondary award level. The equation for each was:

$$\Delta\log(\text{wage}_{it}) = \gamma\Delta\text{Large}_{it} + \beta_1\Delta\log(\text{Age}_{it}) + \beta_2\Delta\text{ObservationYear} + \beta_3\Delta\text{NAICS} + \beta_4\Delta\text{Experience} + \beta_5\Delta\text{Year} + \Delta\upsilon_{it} \quad (8)$$

The outcome, $\Delta\log(\text{wage}_{it})$, is the change in the natural log of real wages each year after graduation. The change of firm size category is ΔLarge_{it}, a movement from a small to a large firm takes the value of 1only during the year of transition. The additional wage growth associated with the year of moving to a large firm is measured by γ. Other control variables are $\Delta\log(\text{Age}_{it})$ to account for changes in the natural log of age. The transition between experience categories is represented by ΔExperience, which measures if an individual moved from one category to the next. ΔNAICS controls for entering or exiting one of the two-digit NAICS categories. Finally, $\Delta\upsilon_{it}$ is the error term.

2.2.3 | Software

The data cleaning and analysis were completed with R 4.1 (R Core Team, 2021). The packages from the Tidyverse (Wickham et al., 2019) and Lubridate (Grolemund & Wickham, 2011) were used. In addition, the plm package (Croissant & Giovanni, 2008) was used forthe fixed effects and first-difference regressions.

3 | Results

3.1 | Descriptive

The vast majority of firms that employed this cohort of USHE graduates were small firms. Despite the overwhelming majority of firms being small, large firms employed roughly half of the USHE graduates (Table 1). The trends of large firms and employment in large firms are similar to overall employment trends in Utah. In 2011, large firms comprised 0.9% of total Utah firms (Utah Department of Workforce Services, 2012); this is a much smaller percentage than the subset of large firms that employed USHE graduates, which was 3.0%. In Utah, large firms employed 57.5% of all workers (Utah Department of Workforce Services, 2012). This is a larger percentage than 46.0% of USHE graduates employed by large firms. By 2019 large firms comprised 4.0% of USHE employers and employed 56.0% of USHE graduates. Despite being a minority of firms, large firms employed a disproportionate amount of USHE graduates.

Broadly, there are only minor practical differences in the racial and ethnic composition between small and large firms (Table 2), though many of these differences are statistically significant (Appendix A). The starkest difference between small and large firms is the gender difference for bachelor's degree earners. Of the small firms that employed bachelor's earners, 63.0% more of those hired were men, 62.0% compared to 38.0% were women. Of those who earned a bachelor's degree and were employed by large firms, 49.0% were women, and 51.0% were men (Table 2). In this research, it is impossible to establish what accounts for the stark difference in the gender composition of small firms employing bachelor's degree earners. The difference in employment may be due to different preferences for firm size by gender. It is also possible that the difference is due to varying preferences for the gender composition of their workforce between small and large firms. It does raise questions for further research that can address whether this leads to different labor demand elasticities between men and women, which would contribute to gender pay gaps. The gender composition for associate degree earners is similar for small and large firms; both hired more women than men (Table 2). Small firms hired 17.0% more women, and large firms hired 44.0% more women than men. For certificate earners, small firms employed 11.0% fewer women than men, while large firms employed 33.0% more women than men. In 2011, 51% of degree earners were women, while 50.0% were women in the 2013-2014 academic year (Utah Higher Education Assistance Authority, 2012, 2015). Overall, women were underrepresented in employment compared to graduation from USHE institutions.

Regardless of the postsecondary program or firm size category, the majority of those employed were white. For bachelor's degree earners, 87.0% employed by small firms were white, and 86.0% employed by large firms were white. Both are more than the percentage of people who earned bachelor's degrees from USHE institutions. In 2011, 80.9% of bachelor's degree earners were white (Utah System of Higher Education, 2012); in 2014, 80.6% (Utah System of Higher Education, 2015). White associate degree earners had similar overrepresentation in employment. White associate earners accounted for 86.0% of small firm associate employees and 87.0% of large firm associate degree-holding employees. In 2011, 82.8% of associate earners were white (Utah System of Higher Education, 2012), and in 2014, 81.4% were white (Utah System of Higher Education, 2015). Finally, the employment of certificate earners followed the same pattern, where white certificate earners represented a larger percentage of those employed than those who graduated. For the certificate earners employed in small firms, 83.0% were white, and for those employed in large firms, 79.0% were white. In 2011, 77.0% of certificate earners were white (Utah System of Higher Education, 2012); in 2014, 74.0% were white (Utah System of Higher Education, 2015). Hispanic bachelor's and associate degree earners were also overrepresented

Table 1: Overall Large firms

Year	Large Firms	Employed by Large Firms
2011	3%	46%
2012	3%	47%
2013	3%	48%
2014	3%	48%
2015	3%	51%
2016	3%	53%
2017	4%	54%
2018	4%	54%

compared to the percentages of each type of degree earner. They were overrepresented in large firms but underrepresented in small firms compared to the percentage of certificate earners. Black bachelor's, associate, and certificate earners are underrepresented as a percentage of those hired in both small and large firms. American Indian or Alaskan Native associate degree earners are underrepresented as a percentage of employment in both small and large firms. This is partially due to keeping only those who were highly attached to the labor force, where more people from these groups either took longer to find initial employment after graduation or had unemployment spells that lasted a quarter or longer.

The distribution of groups between small and large firms changes between the first and fifth observation years (Table 3). During the first observation year, just over half, 55.0%, of the women who earned a bachelor's degree were employed in large firms. The percentage of women with bachelor's degrees employed by large firms increased by roughly 13.0% during the fifth observation year to 62.0%. The slight majority, 51%, of women who earned an associate degree were employed by a large firm during their first year. By the fifth year, this increased to 56.0%. Only 46.0% of women who earned a certificate were employed by a large firm during the first observation year. The percentage of women who held a certificate employed in large firms increased by 24.0% during the fifth year to 57.0%.

The trend of increasing employment in large firms over the observation period and majority employment in large firms holds for most ethnicities and postsecondary programs. Native Hawaiian or Pacific Islanders who had earned a certificate had a 27.0% increase in employment in small firms. Those who were majority employed by small firms during the fifth observation year were Black associate degree earners, 54.0% of whom were employed in small firms, and 56.0% of certificate earners who were American Indian or Alaskan Native were employed in small firms. For those who identified with multiple races or ethnicities, 67.0% of associate earners and 59.0% of certificate earners were employed by small firms. Finally, for white certificate earners, there was a 50/50 split between small and large firms.

The dynamics of the distribution of experience are similar to those of gender and race/ethnicity. These are harder to interpret as experience changes each year. Table 3 shows the experience category during the observation year. By the fifth observation year, the two years of experience category is empty. This is expected as only those strongly attached to the labor market were included in this study, which

Table 2: Demographic makeup of small and large firms by postsecondary attainment

	Bachelor's		Associate's		Certificate	
	Small	Large	Small	Large	Small	Large
Female	38%	49%	54%	59%	47%	57%
Male	62%	51%	46%	41%	53%	43%
Asian	2%	2%	2%	2%	< 1%	2%
Black	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
Hispanic	5%	5%	6%	5%	7%	9%
American Indian or Alaskan Native	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
Native Hawaiian or Pacific Islander	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
Unspecified	4%	5%	5%	4%	7%	8%
White	87%	86%	86%	87%	83%	79%
Less Than 2 Years	1%	1%	2%	< 1%	5%	4%
2 to 5 Years	11%	11%	11%	9%	23%	20%
5 to 10 Years	49%	44%	42%	36%	35%	38%
10 to 15 Years	34%	37%	38%	43%	27%	29%
Greater Than 15 Years	5%	7%	7%	11%	9%	9%

Table 3: Percentage of each demographic group employed in large firms during the first and fifth observation years. Those with "-" were suppressed for privacy reasons.

	Bachelor's		Associate's		Certificate	
	Year 1	Year 5	Year 1	Year 5	Year 1	Year 5
Female	55%	62%	51%	56%	46%	57%
Male	46%	51%	45%	52%	40%	45%
Asian	51%	61%	49%	59%	57%	66%
Black	55%	65%	-	-	49%	60%
Hispanic	52%	56%	47%	51%	46%	58%
American Indian or Alaskan Native	48%	61%	-	-	31%	44%
Multi	47%	55%	-	-	28%	41%
Native Hawaiian or Pacific Islander	44%	51%	-	-	67%	58%
Unspecified	52%	63%	49%	52%	44%	56%
White	50%	55%	48%	54%	42%	50%
Less Than 2 Years	-	-	-	-	-	-
2 to 5 Years	48%	63%	46%	58%	41%	47%
5 to 10 Years	48%	54%	46%	49%	45%	52%

covered five years after graduation. Those with two to five years of experience and a bachelor's degree shifted from majority employed in small firms, 52.0%, to majority employed in large firms, 63.0%. This dynamic holds for bachelor's degree earners with five to ten years of experience, 48.0% to 54.0% in large firms, and those with greater than 15 years, 47.0% to 62.0% in large firms. Those who earned an associate degree and saw movement from small to large firms were two to five years, 46.0% to 58%, and greater than 15 years, 33.0% to 62.0%. Those with five to ten years of experience did experience an increase in employment in large firms, 46.0% to 49.0%, but were still mainly employed in small firms. Those with between ten and 15 years of experience saw a decrease in large firm employment, from 55.0% to 53.0%, but the majority were still employed by large firms. For those who earned a certificate, the percentage employed in large firms increased between the first and the fifth year. Despite this, only those with five to ten years of experience and ten to 15 years of experience ended with a majority employed in large firms. Both experience categories had 52.0% employed in large firms by the fifth observation year. It is important to note that each experience group is comprised of a different mix of people in the fifth year than in the first year.

Before accounting for any factors, mean and median wages grew each observation year regardless of firm size and postsecondary program. Wages were higher for bachelor's degree earners than associate degree earners, whose wages were higher than certificate earners. The dynamics between wages for small and large firms differ by the postsecondary program completed. Figure 1 shows mean and median wages by firm size for each observation year. Only the median wage for the associate degree earners is higher for those employed in large firms during each observation year. There is a large firm wage premium for the mean wage for associate earners for the first two observation years. In years three through five, there is no observable difference in mean wages between small and large firms. For those who earn a technical certificate, large firms have lower wages for all years for the mean wage and years two through five for the median wage. Finally, for those who earned a bachelor's degree, wages are lower for large firms during observation years two through five for both measures.

The percentage of those employed that change firm size decreases each observation year. Figure 2 shows the percentage of postsecondary completers that changed firm size by observation year. The first observation year was the most common year that firm size was changed regardless of postsecondary program type. Each subsequent year, a smaller percentage of completers changed size category. During the first year, roughly 20.0% of certificate earners changed firm size; this was more than bachelor's degree earners, 17.0%, and associate

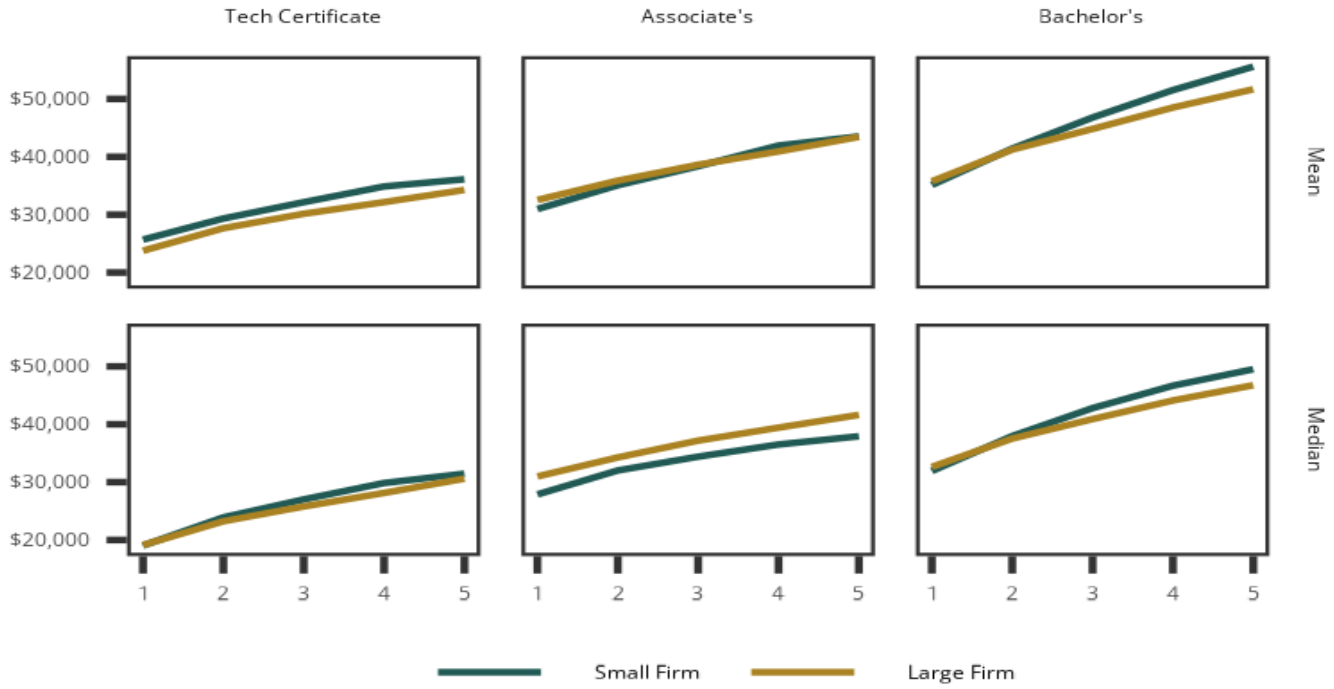

Figure 1: Mean and median wage by firm size and postsecondary program level.

degree earners, 14.0%. By the fifth observation year, 14.0% of certificate earners changed firm size category, 11.0% of bachelor's earners changed firm size category, and 10.0% of associate degree earners changed firm size category.

Wage growth dynamics are different when accounting for those who changed size categories (Figure 3). Notably, those who transitioned from one size category to the other had lower mean and median wages during the first observation year. The difference in wages was most pronounced for certificate earners and smaller for associate and bachelor's degree earners. Those who earned a technical certificate and remained in the same size category throughout the five-year observation window had higher mean and median wages each observation year than those who transitioned size categories. Those who moved from a small to a large firm had marginally higher mean and median wages throughout than those who moved from a large to a small firm. This difference is most noticeable by the fifth observation year. Associate degree earners see a convergence of the mean wage for all four groups by the fifth observation year. However, those who transitioned size categories still earned marginally less than those who did not change size categories. Interestingly, those who moved to a small firm earned the least during the final year of the observation period. The behavior is similar for the median wage, but the differences between those who transitioned from small to large and large to small are more pronounced than the mean wage. Those who moved to a large firm saw wages roughly equal to those who stayed in a small firm. Those who moved to a small firm earned the least during the observation period. The most pronounced wage growth was the mean wage for those who earned a bachelor's degree and changed firm size. Despite starting with the lowest mean wage in the first observation year, those who moved to a small firm had the second-highest wage, behind only those who stayed in a small firm, by the fifth year. Those who moved from a small to a large firm had a higher mean wage than those who stayed in a large firm during the observation period. During the observation window, the median wage for those who changed firm size converges to just more than that for those who stayed in a large firm. It is not possible to test why individuals changed firm or firm size. Given that the initial mean and median wages were lower for those who changed firm size than those who stayed and wages converged for those who changed, wages are a potential motivating factor for firm movement.

Throughout the calendar years covered in this study, small firms comprise the vast majority of firms that employed USHE graduates, between 96.0% and 97.0%. Despite this, 46.0% and 56.0% of the total employment years were in large firms. There are mostly minor differences in how small

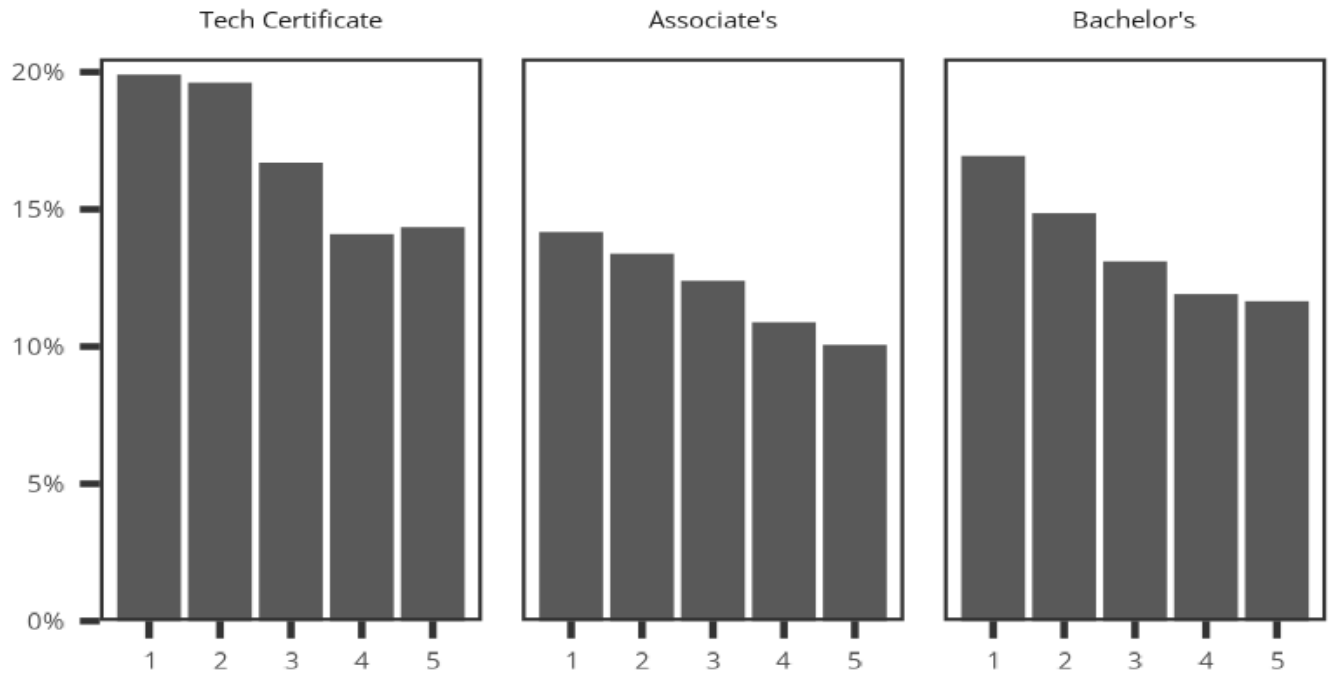

Figure 2: Percentage of graduates that changed firm size by observation year.

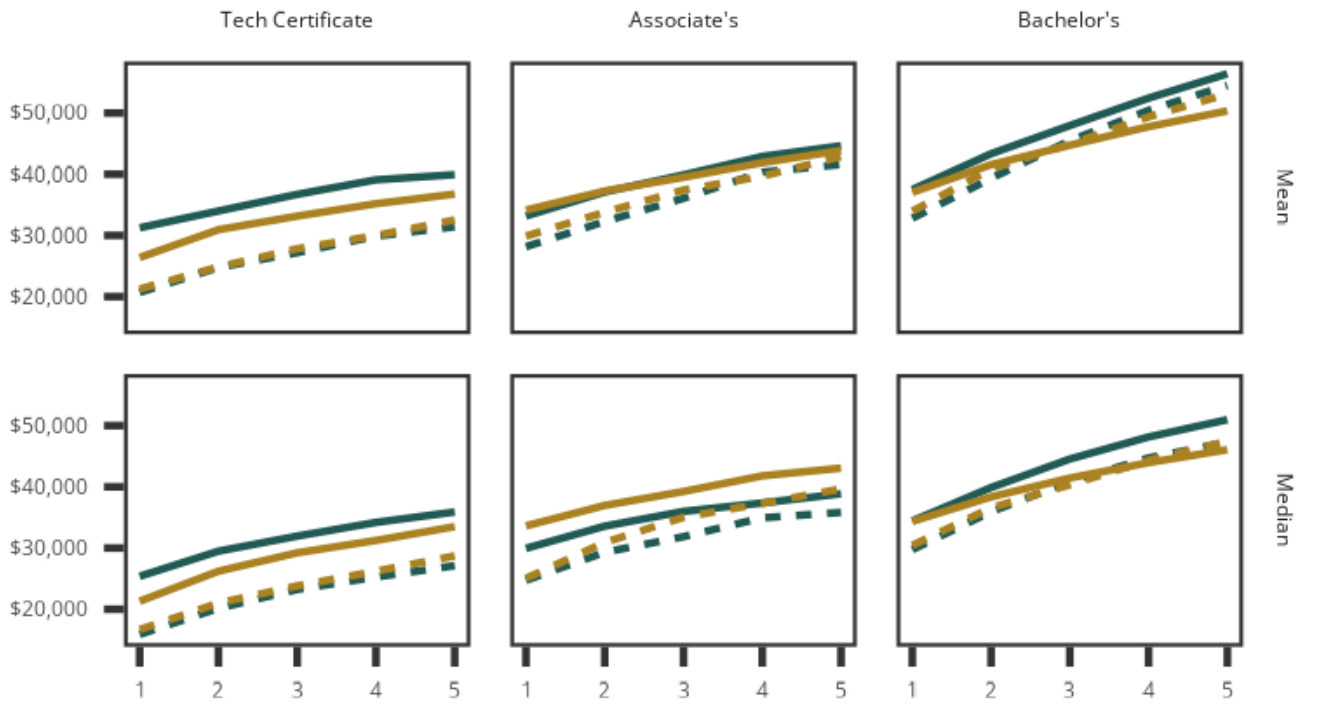

Figure 3: Mean and median wage by firm size, postsecondary program, and firm size.

Table 4: Firm size wage differences by demographic and postsecondary attainment. Stars represent significance: * p <0.05, ** p < 0.01, *** p < 0.001. Differences may not sum to presented differences due to rounding to the nearest dollar amount. Those with "-" were suppressed for privacy reasons.

	Bachelor's			Associate's			Certificate		
	Small	Large	Difference	Small	Large	Difference	Small	Large	Difference
Female	$33,183	$37,073	-$3,890***	$30,247	$33,337	-$3,090***	$20,562	$23,906	-$3,345***
Male	$53,527	$51,812	$1,715***	$46,522	$45,777	$745	$41,170	$37,769	$3,401***
Asian	$42,359	$47,706	-$5,347***	$43,105	$41,736	$1,369	$26,335	$30,769	-$4,433*
Black	$40,536	$40,155	$381	$34,910	$29,201	$5,708	$27,910	$32,187	-$4,277
Hispanic	$40,444	$42,221	-$1,777	$33,484	$38,736	-$5,252***	$27,806	$27,754	$52
American Indian or Alaska Native	$44,339	$37,224	$7,114*	$22,722	$29,508	-$6,786**	$28,820	$25,802	$3,018
Multiple	$38,703	$45,338	-$6,635***	-	-	-	$24,558	$26,436	-$1,878
Native Hawaiian or Pacific Islander	$44,167	$38,010	$6,157*	$41,740	$36,300	$5,442	$38,826	$34,845	$3,981
Unspecified	$47,423	$45,660	$1,763	$34,840	$35,832	-$991	$28,006	$27,738	$267
White	$46,168	$44,709	$1,458***	$38,242	$38,623	-$381	$32,117	$30,221	$1,896***

and large firms employ different races or ethnicities. However, a leaky pipeline exists between USHE graduation and high attachment to the workforce. The most significant difference is that small firms only employed 38.0% of the total years worked by women who earned a bachelor's degree. Average wages grew during the five-year observation window, and mean wages for small firms tended to be higher than those in large firms. Those who changed firm size started with lower wages, but degree earners saw faster wage growth and equalization with those who did not change firm size categories.

Table 4 shows the gender and racial/ethnic breakdown of wages by firm size for each postsecondary education level. Regardless of education level, women employed in small firms earned less than those in large firms. Conversely, men earned more in small firms than in large firms and substantially more than women across the board. Asian, Hispanic, and multiracial/ethnic bachelor's degree earners earned more in large firms than in small firms. In contrast, Black, American Indian or Alaska Natives, Native Hawaiian or Pacific Islander, those who did not specify a race, and white bachelor's degree earners earned more in small firms. Earnings were higher in large firms for Hispanic, American Indian or Alaska Native, white, and those without a reported race or ethnicity for associate degree earners. For Asian, Black, and those who reported multiple races or ethnicities and held a certificate, earnings were higher in large firms than in small firms.

3.2 | Fixed Effects Results

The fixed effects estimation (Equation 5) controlled for individual time-invariant and unobservable characteristics, which are potentially related to both wages. Coefficients on large firms, experience categories, and age variables are within estimators and measure the part of wages that change between years for individuals (Table 5). The within estimators show the relationship between wages and a variable that changes at the individual level over time.

Wages for years that an individual was employed in a large firm are higher than wages for years spent in a small firm. For each postsecondary award level, the relationships were statistically significant at all standard levels of significance. For those who earned a certificate, the large firms were associated with 6.0% higher wages at all levels. This amount is economically significant as an extra $1,262.34 in 2010 dollars. The relationship between large firm employment and wages is 4.7% higher wage for those who earned an associate degree. The additional wages are equal to $1,331.30 in 2010 dollars. Finally, for bachelor's degree earners, the relationship is 3.9% higher wage during the years employed in large firms than in small firms. The wage premium is the smallest practical difference at $1,104. After controlling for confounding variables, time spent employed in large firms was associated with higher wages.

Other variables that are associated with wages are age and experience. Age shows the expected relationship of diminishing returns with a positive coefficient for age and a negative coefficient for age squared. Experience has a slightly different

Table 5: Fixed Effects Regression Table. This table contains the abbreviated output from the fixed effects regression. The coefficients are interpreted as percentages after the transformation (exp(β)-1)*100. Numbers in the parenthesis represent 95% confidence intervals. Stars represent significance: * p <0.05, ** p < 0.01, *** p < 0.001. Additional controls not included in the table are observation year, calendar year, and two-digit NAICS.

	Certificate	Associate's	Bachelor's
Large	0.059*** (0.045, 0.073)	0.046*** (0.027, 0.064)	0.038*** (0.029, 0.047)
Age	0.039*** (0.031, 0.046)	0.052*** (0.041, 0.064)	0.023*** (0.016, 0.031)
Age2	-0.001*** (-0.002, -0.001)	-0.001* (-0.001, 0)	-0.001*** (-0.001, 0)
2 – 5 years	-0.064** (-0.109, -0.019)	-0.155*** (-0.243, -0.068)	-0.079*** (-0.124, -0.035)
5 – 10 years	0.09*** (0.058, 0.122)	0.21*** (0.155, 0.264)	0.102*** (0.075, 0.128)
10- 15 years	0.062** (0.019, 0.104)	0.189*** (0.127, 0.251)	0.089*** (0.058, 0.119)
>15 years	0.019 (-0.035, 0.072)	0.151*** (0.08, 0.222)	0.034 (-0.003, 0.07)
R^2	0.29	0.2	0.27
N	23,835	15,205	53,770

relationship than expected. For those with two to five years of experience, the wages were lower compared to fewer than two years. Each experience category, besides those greater than two to five years, had the expected higher wages compared to fewer than two years of experience. All experience categories were statistically significant except those with more than 15 years of experience.

All three estimating equations are statistically significant at the 0.001% level. The equation estimating the relationship for those who earned a certificate explains 29.0% of the wage variation. The equation estimating the relationship for those who earned an associate degree explains only 20.0% of the wage variation. Explained variance increases to 27.0% for those who earned a bachelor's degree.

3.3 | First-differenced Results

The results of the first difference estimation show how changing firm size is related to wage growth. The coefficients reported in Table 6 show the additional wage growth associated with moving from a small firm to a large firm. All three estimated relationships are significant at any standard level with p-values of less than 0.001. The relationship is largest for those who earned a certificate and smallest for those who earned a bachelor's degree; for those who earned a certificate, movement from a small to a large firm is associated with 4.5% higher wage growth that year. For those who earned an associate degree, movement from a small to a large firm was associated with 3.4% wage growth the year of movement. Finally, those with a bachelor's degree who moved from a small to a large firm saw 2.6% higher wage growth.

Additional control variables show the expected relationships. With age each additional year of age is associated with higher wages, but this decreases as age increases. For example, a 1.0% increase in age is associated with 4.2%, 2.2%, or 2.7% higher wages for those who earned a certificate, associate, or bachelor's degree, respectively. In context, where each additional year becomes a smaller percentage increase in age, those who are 26 years old with a certificate are expected to earn 4.2% more than those who are 25 years old, yet those who are 46 years old would expect to see 4.2% higher wages than those who are 45 years old. The movement to a higher experience category is associated with higher wages. There are diminishing returns to experience as the coefficients become smaller after the five to ten year experience category.

4 | Discussion

This research shows that firms with more than 249 jobs were associated with higher wages. Two distinct estimating techniques, which controlled for individual unobservable characteristics, estimated the existence of a large firm wage premium. First, results from the fixed effects estimation showed that years spent working in large firms were associated with between 3.9% and 6.0% higher wages than years spent working in a small firm. In addition, the first difference estimation showed that moving to a large firm is also associated with higher wage growth. The results presented in this research are consistent with previous research.

The fixed effects estimation found 3.9%, 4.7%, and 6.0% higher wages for bachelor's, associate, and certificate holders, respectively. These wage differentials are similar in size to those of previous research. Winter-Ember and Zweimüller (1999) found a 3.0% large firm wage premium, Lehmer and Möller (2010) found a 13.0% large firm wage

Table 6: This table presents coefficients from the first difference model. The coefficients, except those on log variables, are percent after the transformation (exp(β) - 1)*100. Coefficients on log variables are interpreted as an elasticity, where a 1% change is associated with a β% change in wages. Numbers in the parenthesis represent 95% confidence intervals. Stars represent significance: * p <0.05, ** p < 0.01, *** p < 0.001.

	Certificate	Associate's	Bachelor's
ΔLarge	0.044*** (0.059, 0.112)	0.033*** (0.037, 0.101)	0.026*** (0.029, 0.06)
Δlog(Age)	4.163*** (3.598, 4.727)	2.167*** (1.403, 2.931)	2.705*** (2.197, 3.212)
Δ 2 – 5 years	0.026* (0.002, 0.05)	0.089*** (0.041, 0.136)	0.069*** (0.046, 0.092)
Δ 5 – 10 years	0.018 (-0.012, 0.048)	0.101*** (0.047, 0.154)	0.076*** (0.05, 0.102)
Δ 10- 15 years	-0.004 (-0.041, 0.034)	0.087** (0.029, 0.144)	0.065*** (0.037, 0.093)
Δ >15 years	-0.008 (-0.054, 0.038)	0.071* (0.008, 0.134)	0.06*** (0.028, 0.092)
R^2	0.06	0.03	0.05

premium, and Pedace (Pedace, 2010) found a 4.0% wage premium. Cobb and Lin (Cobb & Lin, 2017) estimated between 4.4% and 6.5% higher wages for larger firms for the median wage. The findings fall in between those of previous research despite the differences in institutional settings, periods, and technology available to firms.

Wage growth for those who moved to large firms is higher than for those who remain in the same size category. For certificate holders, this was 4.5%; for associate holders, it was 3.4%; for bachelor's holders, it was 2.6%. These were lower than the 5.4% found by Winter-Ember and Zweimüller (1999) and the 7.0% found by Lehmer and Möller (2010).

The unconditional mean wages by firm size showed small firms paying more. After controlling for industry, year, and individual characteristics, on average, time spent working in large firms was better remunerated than working in small firms for those employed in small and large firms. Two main factors may drive the large firm wage premium. First, women moved from small to large firms during the observation period. Women, on average, earned less than men, while large firms paid women more than small firms. Women's concentration in large firms may occur for several reasons this research cannot test. However, these may be due to organizational structure, corporate culture and pathways for women, and better human resource policies against harassment. The same movement occurred but was less pronounced for Hispanic, American Indian or Alaskan Native, and Native Hawaiian or Pacific Islander workers. The same reasons that would cause women to move firm size are plausible for racial or ethnic minorities. Both racial and ethnic minorities and women have faced and still face discrimination in pay and hiring (Bertrand & Mullainathan, 2003). Large firms may offer higher wages to attract marginalized groups while still being able to exploit the initially lower wages by paying less than the wage their marginal product would command.

4.1 | Limitations

This research established the relationship between firm size and wages in Utah but has several limitations. The limitations stem from available data available and the methods used. Unavailable data include firm characteristics and total compensation. Therefore, the limitations of this research make these results an upper bound to the relationship between firm sizes and wages.

The primary sources of limitations stem from unavailable data. The UI data does not include federal employees, the self-employed, and those employed by The Church of Jesus Christ of Latter-day Saints. This research was also limited to graduates from a USHE institution, which does not include any university outside of Utah or private colleges or universities in Utah, such as Westminster or Brigham Young University. Additionally, this study did not include those who did not graduate from a USHE institution but were highly attached to the labor force.

This research was unable to control for major firm characteristics outside of the self-reported NAICS. It was not possible to control for a firm's organizational structure or capital structure. The lack of information on capital and organizational structure means that it is not possible to control if a firm has well-defined internal labor markets; this is one suggested reason behind why large firms pay a wage premium. Only wages were available to use as the dependent variable in this study. If this systematically varies by firm size, then part or all of the wage premium may disappear after controlling for firm-level capital structure.

Other studies (Pedace, 2010) have found a smaller premium when nonwage benefits are considered. Nonwage benefits could include standard benefits such as insurance and retirement to less common stock or equity to workplace characteristics such as an office chef, entertainment, or other workplace perks. When the total dollar value of the benefits packages is the dependent variable, the wage premium may still exist but be a smaller percentage of total remuneration, thus leading to a smaller overall premium.

The number of jobs located in Utah determined the size of a firm. For example, if a firm had fewer than 250 jobs in Utah but more than 250 jobs in Utah and outside of Utah combined, this information was unknown, and the firm was considered small. In this case, it is possible that the firm still operates like a large firm with monitoring, internal labor markets, more productive capital, or access to broader monopoly profit sharing that a small firm did not have. If there are enough firms like this, it may bias results downward or understate any potential wage premium.

Finally, the method did not establish a causal relationship between large firms and wages. The relationship reported controlled for individual unobservable characteristics, but did not control for selection into large firms. Future research should attempt to establish a causal relationship between size and wages.

5 | Conclusion

In Utah, firms with 250 or more jobs accounted for roughly 4.0% of all firms that employed USHE graduates. Despite making up a small percentage of total firms, these firms employed over half of all USHE graduates. Those who worked in small and

large firms saw higher wages during their time in large firms. The year of movement to a large firm was associated with higher wage growth than those who did not transition firm sizes.

Large and small firms tend to have a similar demographic composition. The major exception is the gender composition between small and large firms. Large firms were 49.0% female, while small firms were only 38.0% female. There were significant differences in the demographic composition of those who graduated from a USHE institution and those who were employed every quarter during the five years following graduation. The highly attached cohort was more white and more male than the coinciding graduating cohorts. Why this difference occurred was beyond the scope of this research but is worth further investigation.

After controlling for individual fixed effects, time worked in a large firm was associated with 6.0% higher wages for those who earned a certificate, 4.7% higher wages for those who earned an associate degree, and 3.9% higher wages for those who earned a bachelor's degree. These were statistically and economically significantly higher wages than wages earned during time spent employed in small firms. In addition, wage growth was higher during the year of size category movement than in other years. For those who earned a certificate, the year of size category movement is associated with 4.5% higher wage growth. Those who earned an associate degree saw 3.4% higher wage growth, and bachelor's earners saw 2.6% higher wage growth.

Overall, this research described employment patterns between small and large firms for USHE graduates. There was a gender difference between small and large firms. There was a large firm wage premium and faster wage growth in the year of movement from a small to a large firm.

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Appendix A

	Bachelor's			Associate's			Certificate		
	Small	Large	Difference	Small	Large	Difference	Small	Large	Difference
Male	62%	51%	11***	46%	41%	5***	53%	43%	10***
Female	38%	49%	-11***	54%	59%	-5***	47%	57%	-10***
Asian	2%	2%	0	2%	2%	0	< 1%	2%	-1***
Black	< 1%	< 1%	0***	< 1%	< 1%	0	< 1%	< 1%	0
Hispanic	5%	5%	0	6%	5%	1	7%	9%	-2***
American Indian or Alaskan Native	< 1%	< 1%	0	< 1%	< 1%	0	< 1%	< 1%	0*
Multiple	<1%	<1%	0	<1%	<1%	0*	<1%	<1%	0
Native Hawaiian or Pacific Islander	< 1%	< 1%	0*	< 1%	< 1%	0	< 1%	< 1%	0**
Unspecified	4%	5%	-1***	5%	4%	0	7%	8%	-1**
White	87%	86%	1***	86%	87%	-1	83%	79%	4***
< 2 Years	1%	1%	0	2%	< 1%	1**	5%	4%	1***
2 to 5 Years	11%	11%	1*	11%	9%	2***	23%	20%	3***
5 to 10 Years	49%	44%	4***	42%	36%	6***	35%	38%	-3***
10 to 15 Years	34%	37%	-3***	38%	43%	-4***	27%	29%	-2**
> 15 Years	5%	7%	-2***	7%	11%	-4***	9%	9%	0