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Dude, where's my (summer) job? Minimum wages and student employment

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Abstract

We use rich administrative data to study employment and income during a period of minimum wage growth in Washington State for a group of workers who may be particularly sensitive to changes in the minimum wage: college students. Using a within-student estimator and quarterly work records, we consistently find that rising minimum wages are associated with reduced summer employment, the quarter in which students tend to work the most. Students experiencing the largest reductions in employment are those with little or no work experience and non-local students. This is partially mitigated by students working more during the academic year.

KEYWORDS
minimum wage, student employment, student income

JEL CLASSIFICATION
H7, J3, I2

1 | INTRODUCTION

This paper uses novel administrative data to shed light on a widely debated question concerning the effect of minimum wages on employment and income. In many labor markets, the minimum wage is low relative to market wages which makes it difficult to detect its effects on employment outcomes. As a result, many researchers focus on subsamples where the minimum wage is high relative to prevailing wages, such as on teenagers, low-wage industries, or workers with low levels of education. In this paper, we consider the possible effect of minimum wage policy on a group that are simultaneously low-wage, low experience, and possibly entering the labor market for the first time: college students. Our data suggest that most college students are employed at some point in their academic career and these students are concentrated in low-wage occupations that are likely most impacted by the minimum wage. Furthermore, while previous studies generally focus on the impact of the minimum wage on previously employed workers, this may miss the effect of higher minimum wages on those entering the labor market for the first time.

Using detailed data from a public university in Washington State combined with employment records from the Washington State Employment Security Division (ESD), we estimate the relationship between minimum wages and student labor market outcomes. To model this relationship, we use a within-student estimation strategy that controls for student work history, local economic conditions, and allows for flexible employment and income time trends. Essentially, we estimate changes in employment and income for a given student as minimum wages increase, allowing each

Abbreviations: CPI, Consumer Price Index; ESD, Employment Security Division; NAICS, North American Industry Classification System; WWU, Western Washinton University.

student to serve as their own counterfactual (e.g., a student working under lower minimum wages is the comparison for that same student working under higher minimum wages). Despite these model considerations, we refrain from interpreting our results as causal as there may be other (unobserved) economic factors that are correlated with both changes to the minimum wage and student employment. We discuss these threats to causal identification in the conclusion of the paper.

With our data, we make two contributions to the ongoing minimum wage debate. First, detailed student demographic data matched with state employment records allow for rich heterogeneity analysis to determine which workers experience the largest changes when minimum wages increase, something lacking in earlier literature. Second, we observe students with and without previous employment records, which allow us to analyze workers entering the labor market for the first time. Our empirical strategy suggests that hours worked, employment, and wage income decrease as minimum wages rise in the summer quarter, the period in which students are most likely to work, and these declines are strongest for the group of students with no prior work experience prior to college matriculation. However, there are no such declines associated with higher minimum wages during the academic year: student workers appear to experience a modest increase in wage income, especially those workers with pre-matriculation work experience. Consistent with lower search costs, we find that local students are less negatively impacted by minimum wage increases.

This work adds to a large literature regarding the impacts of minimum wage policy.[1] Recent studies of the minimum wage that might apply to students include Clemens and Wither (2019) who find minimum wages have significant negative effects on employment and income of low-skilled workers. Gopalan et al. (2021) argue that the reduction in employment primarily happens at the hiring stage, a period of particular importance to students as they first enter the labor market. Clemens et al. (2021) find that employers increase job requirements as a response to minimum wages, an effect that could negatively impact students who are in the process of acquiring skills to meet those requirements. On the other hand, Cengiz et al. (2019) find that the number of lost jobs slightly below a new minimum wage closely matches the number of excess jobs slightly above the minimum wage and conclude that there are no employment changes of the minimum wage. Cengiz et al. also explore labor-labor substitution between low-skilled and higher skilled workers and conclude that the minimum wage is unlikely to shift employment from one skill level to the other. In a similar study, Cengiz et al. (2022) find no changes in employment due to state-level minimum wage laws and provide new evidence that suggests these laws did not significantly affect worker search effort, a relevant finding for studying new entrants to the labor market. However, a recent study by Jardim et al. (2022) finds that Seattle's minimum wage increases in 2015 and 2016 reduced employment along both extensive and intensive margins, and these effects were strongest for less-experienced workers. We extend this analysis with data derived from the same source as Jardim et al. (2022)—the Washington State ESD—to further analyze the minimum wage and labor outcomes for both low-experience and no-experience workers.

2 | DATA

2.1 | Washington minimum wage

In August 2016, voters approved Initiative 1433 to increase the Washington State minimum wage from $9.47 to $11.00 per hour starting on January 1, 2017. The minimum wage was then set to increase annually by $0.50 per hour until reaching $13.50 in 2020, with subsequent annual increases based on the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W).[2] Table 1 shows the nominal and real minimum wage in Washington state from 2013 to 2019. We use variation in the real minimum wages over time to identify its effect on student labor.

2.2 | Description of the university

We use administrative data from WWU, a regional, comprehensive university located in Bellingham, Washington with a fall undergraduate enrollment of approximately 15,000 students and a graduate population of around 1,000, though for this study we focus on only undergraduate students. Western Washington University operates three quarters during the academic year. In each quarter, instruction lasts for 10 weeks, with an 11th week set aside for final exams. It also operates an optional summer quarter with about one-fourth of its regular enrollment. The summer quarter is typically

TABLE 1 Minimum wage schedule under Washington state initiative 1433.

	Minimum wage	
Effective date	**Nominal**	**Real (2022 dollars)**
January 1, 2013	$9.19	$11.55
January 1, 2014	$9.32	$11.52
January 1, 2015	$9.47	$11.70
January 1, 2016	$9.47	$11.55
January 1, 2017	$11.00	$13.14
January 1, 2018	$11.50	$13.41
January 1, 2019	$12.00	$13.73

Note: Initiative 1433 was approved in August 2016 and went into effect on January 1, 2017. The nominal minimum wage is converted into constant 2022 dollars using Fred Series CPIAUCSL: the US City Average of the CPI for all urban consumers from the St. Louis Fed.

on a shorter, 6-week schedule that concludes at the end of July though some students have the option of extending this to a 9-week schedule.

We obtain detailed academic, demographic, and socioeconomic information about students from the university's Office of Institutional Effectiveness. These data include payroll data which consists of hourly wages and hours worked on campus for students employed by the university, whether in federally funded programs like Work Study or who are simply hired by the university.

2.3 | Description of the employment data

For the purpose of administering the state's unemployment insurance program, most employers in Washington are required to file a quarterly tax and wage report on each employee to the Washington State ESD. For each WWU student, this data is matched to WWU administrative data by student social security number. The ESD provides the name of the student's employer, the total quarterly income paid by that employer and the student's total quarterly hours worked at that employer. The ESD data begins in 2009 and is matched to all WWU students with a valid social security number who started at the university in 2005 or later. As described later, we begin our sample in 2013, 4 years after the ESD data begins which allows us to measure student employment prior to enrolling at WWU (at a time when most students in our sample were enrolled in high school).

State law exempts some occupations and services from the unemployment insurance program and employers of these occupations and services do not provide wage or hour information to the ESD. Most of the exemptions are unlikely to impact students so we believe these exemptions will minimally impact our results. The largest exemption excludes federal government workers (including military service). Other occupations exempted are generally classified as self-employed (e.g., cosmetologists, independent contractors, and salespeople paid solely through commissions). Services exempted include commission-based real estate agents, newspaper agents, and those working for churches or religious organizations. For this study, the most relevant exemption is for students working under financial assistance programs provided by the school.[3] Because these students are not in the ESD data, we supplement the ESD employment records with payroll data for all student-workers provided by the university regardless of whether or not the work was performed under a financial assistance program.[4] Payroll data for university student employees begins in the third quarter of 2013 which represents the beginning of our analytical sample. For all students who work hourly at the university, the data report every hourly wage paid over a 2-week pay period, and hours worked at that wage. The university payroll data also contains total income and hours worked for the small number of salaried student workers. We aggregate the university payroll data to the quarterly level to match that of the ESD data.

Our analytical sample is at the student-by-quarter level and includes all WWU undergraduates who are Washington residents and who entered the university in the fall of 2011 or later. The sample begins in the third quarter of 2013, and ends in the fourth quarter of 2019, the period during which we have complete employment records from both ESD and WWU payroll. We limit our sample to those who first enroll at WWU in 2011 or later so that by 2013, we have a

minimum of 1 year of possible work history for every student. Our analysis ends in 2019 to prevent disruptions associated with Covid from influencing our results. Our dataset therefore covers 26 quarters between 2013 and 2019.

The vast majority of WWU students enter the university in the fall quarter. For students who started in fall 2013 or later, the analytical sample contains quarterly observations beginning with their first quarter of matriculation and ending with either graduation, the fourth quarter of 2019, or during the last quarter they enroll in the university. For students who entered the university prior to fall 2013, the sample begins in the summer of 2013. We include observations in quarters when the student either enrolled in one or more classes, or in the summer, provided the student enrolled in classes in the following fall. Because we only have information on employment in Washington State, we limit the sample to in-state residents on the hypothesis that out-of-state students are likely to return home for the summer and seek employment there and thus would not be included in the ESD data during the summer.[5]

Using the ESD data, we compute the hourly wage that a student receives from a job in a quarter by dividing quarterly pay by total hours worked. Note that this is accurate only if both income and wages are reported correctly, and if the employee received the same wage throughout the quarter without any raise. For consistency, we also do this computation for student employees of WWU, even though the university payroll provides the student's actual wage rate. An informal comparison of the computed and actual hourly wages for student employees suggests that the imputation is broadly accurate.[6]

Prior research has identified larger minimum wage disemployment effects for less experienced workers, so we cumulatively sum hours worked in all jobs to calculate each individual's total hours of work experience in any given quarter. For state residents who enrolled as a student at WWU, we have complete quarterly employment records from ESD starting in the first quarter of 2009. Since our sample only includes those who started at the university in fall 2011 or later, we have employment records for all students for at least 11 quarters preceding enrollment which for the vast majority of students includes at least their prior 2 years of high school. To calculate total work experience in any quarter, we simply add up all hours worked in all prior quarters.

Our measure will understate work experience for any individual who worked before 2009. This is not a serious concern because the modal WWU student begins college at age 18.[7] Most students in the first cohort in our sample were 15 years old at the beginning of 2009, with limited opportunities to work. Those in later cohorts were even younger. A potentially more serious problem is that data on student employment at WWU begins in Fall 2013. Someone who entered the university in Fall 2011 and worked exclusively as a student employee will incorrectly be assigned no work experience. However, this issue is only relevant for the first two cohorts in our sample, and our results are not sensitive to their inclusion. One final problem concerns students with prior out-of-state work experience. To address this, we restrict the sample to Washington residents, assuming that relatively few residents work outside of the state before enrolling in college.

Table 2 presents descriptive statistics for the 31,384 students included in our analytical sample. On average, students are present in the sample for just over eight quarters. Although most students attend the university for four or more years, approximately 30% leave the university before graduation, with most attrition at the end of the first year. We also observe a truncated number of quarters for cohorts who entered the university in later years.

Students enter the university with 824 h of prior work experience on average. About 27% of students enroll at WWU without prior employment experience. In our analysis, we use a binary indicator of employment for students who work 1 hour or more in a quarter. Based on this measure, approximately 24% of students work in every quarter while taking classes and about 21% are never observed working. We designate a student as being "local" if their permanent address is in Whatcom County, WA, which is county-level location of WWU.

Table 2 also shows that about 57% of all students work in the typical quarter though, in the summer quarter, this increases to almost 69%. On average, students have 1361 h of experience across the entire sample. About one quarter of all students who work are student-employees on campus. Students earn about $2315 and work 171 h per quarter, for an average real hourly wage of about $13.40 per hour across the entire sample.

To complement Table 2, we present some important information concerning compliance with minimum wage changes, seasonal patterns of employment, and industry-level employment among students. Figure 1 shows the distribution of hourly wages across students in four selected quarters, along with a vertical line indicating the level of the minimum wage. Since individuals might work in more than one job in a quarter, this figure shows the hourly wage at the main job, defined as the job where the student works the most hours. In all four quarters, the minimum wage is the modal hourly wage received by students. Its effect on the distribution of wages can be seen in Figure 1. Most students earn between the minimum wage and $20 per hour, although higher wages are more common in later years. We rarely

TABLE 2 Descriptive statistics.

	Mean	Std. Dev	Min	Max
Panel A: Individual-by-quarter level data				
Employed	0.566	0.495	0	1
Employed (summer quarters)	0.687	0.463	0	1
Total experience (hours)	1361	1628	0	30,412
Conditional on employment				
Employed on campus	0.243	0.428	0	1
Total hours	171.3	132.9	0.5	1298
Total income (2022 dollars)	2315	2301	4.66	88,308
Hourly wage in main job	13.44	10.75	8	500
Observations	259,990			
Panel B: Individual level data				
Quarters in sample	8.28	5.24	1	24
Age at entry	19.46	1.30	16	24
Prior work experience upon enrollment (hours)	824	1309	1	29,610
No prior experience	0.271	0.445	0	1
Works every quarter	0.242	0.428	0	1
Never works	0.206	0.405	0	1
Male	0.435	0.496	0	1
Local	0.108	0.311	0	1
Observations	31,384			

Note: The data are comprised of continuing students from 2013q3 through 2019q4. A detailed description of the analytical sample is given in Section 2.3. A student's main job is defined as the job in which the student works the most hours within a quarter. "Prior Work Experience" is total hours of work before the student matriculates. "Local" is binary indicator for whether the student has a permemant address in Whatcom County, WA, the location of WWU.

observe wages below the minimum, even in the first quarter of 2017 where some reported work might have been done at the end of the fourth quarter of 2016 at the lower $9.47 minimum wage and reported as earnings in 2017.[8]

Figure 2 displays aggregate hours worked and income earned among all students in our sample across quarters. During the fall, winter or spring quarters, WWU students collectively supply about 850,000 h of labor on average. This increases dramatically in the summer, to around 1.5 million hours. Total real income for this labor has increased steadily to approximately $29 million in the summer of 2019. Figure 2 also shows that students typically work about 150,000 h per quarter on campus as student-employees during fall, winter and spring, with student labor on campus declining substantially during the summer. This is consistent with a migration pattern, whereby students attend classes at the university and work on campus and the surrounding community in the academic year and return to their home addresses and concentrate on work there during the summer. It also suggests the need to include controls for long-term trends in hours per week to not erroneously conclude that higher minimum wages cause more work in later years. We do this by including linear time trends, though our results are robust to higher order polynomial trends.

Figure 3 shows how student employment is distributed across industries during the academic year versus summer. The ESD data include the six-digit NAICS industry classification code for each employer.[9] The Census Bureau defines 20 industrial sectors based on the first two digits of the NAICS code. We further consolidate these into eight categories, with one catch-all category labeled "Other" to encompass sectors that employ relatively few students. Figure 3 graphs average hours worked per quarter within each industry category separately for summer quarters and quarters during the academic year (fall, winter, and spring) over our sample period. Most students work for employers in Food Services, Retail, and Education Services. These three categories account for 72% and 54% of hours over the academic year and summer, respectively.[10] Work in other sectors, especially construction, manufacturing, administration and support, and

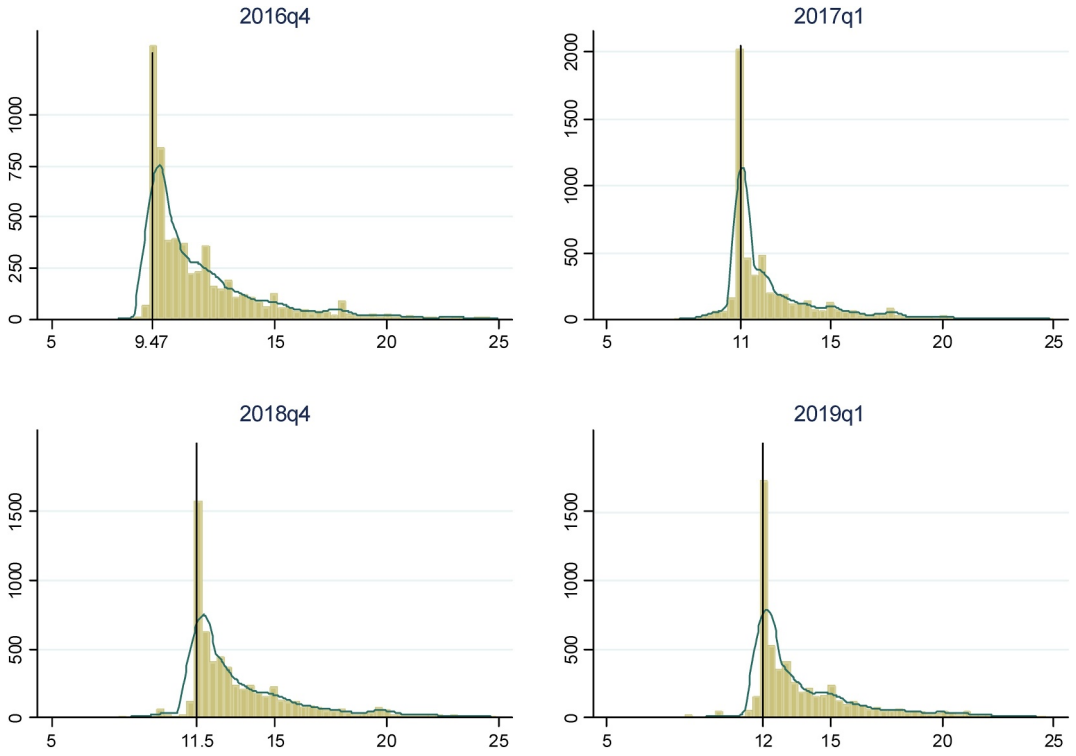

FIGURE 1 Distribution of hourly wages at the main job. These figures show the distribution of hourly wages in the students' main job across four quarters, where the main job is defined as the job in which the student works the most hours within a quarter. The y-axis measures the number of workers and the x-axis measures the hourly wage. The vertical line in each figure shows the minimum wage in that quarter. The minimum hourly wage increased from $9.47 in 2016 to $11.00 in 2017, and from $11.50 in 2018 to $12.00 in 2019.

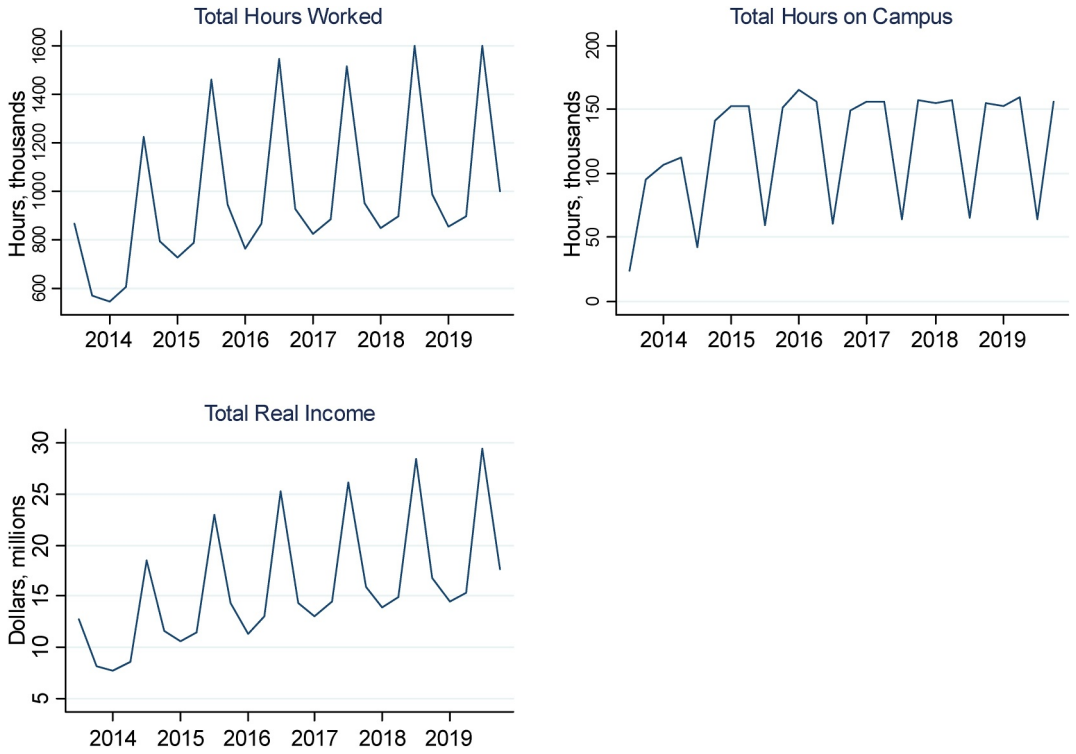

FIGURE 2 Aggregate hours worked and income by quarter. These figures show total hours worked and total real income (measured in 2022 dollars) across all jobs by academic quarter (winter, spring, summer, and fall) as well as total hours worked across all campus jobs by quarter.

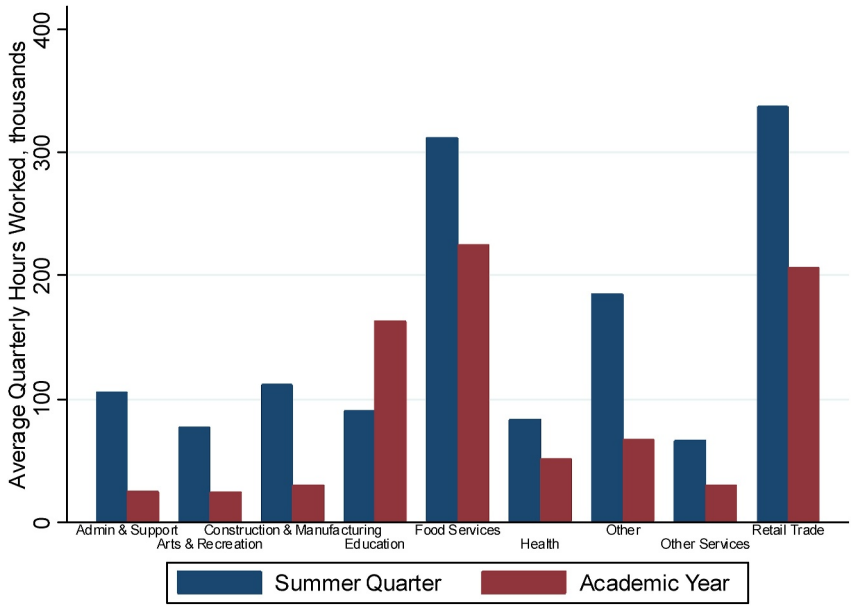

FIGURE 3 Student employment across industries. This figure shows the aggregate hours worked by students for employers within industries across the academic year (fall, winter, and spring quarters) and summer quarters between 2013q3 and 2019q4. Industries are classified using the first two digits of the employer's NAICS code. The 20 NAICS sectors defined by the Census Bureau are consolidated into nine categories of student employment. The "Admin & Support" category includes NAICS sectors 56 and 92, "Construction & Manufacturing" contains sectors 23–33, and "Other" includes sectors 11, 21, 22, 42, and 48–55. All the other categories correspond to the NAICS sector with the same name. For a list of NAICS sectors, see: https://www.census.gov/programs-surveys/economic-census/year/2022/guidance/understanding-naics.html.

arts and recreation, is much more common during the summer. Overall, the seasonal pattern in both the intensity and the industry composition of student employment across the year motivates us to conduct separate analyses of the minimum wage's effects during the academic year and summer.

3 | ESTIMATION FRAMEWORK

We use a within-student analysis to understand the relationship between minimum wages and student employment and income. This framework uniquely allows us to estimate outcomes for individuals with little or no prior labor market experience. Unlike previous studies, our sample is not restricted to individuals who were already working prior to a minimum wage hike, allowing us to estimate whether the minimum wage influences the decision to enter the labor force. We estimate quarterly (q) employment outcomes (y) for student i in year t with the following model:

$$y_{iqt} = \alpha_i + \beta_1 \log(\text{minwage}_{it}) + \beta_2 t + \boldsymbol{X_{iqt}\gamma} + \delta_q + \varepsilon_{iqt}, \quad (1)$$

where the employment outcomes are hours worked, wage income, and binary indicator for working non-zero hours. Given that students who work likely have observable (and unobservable) characteristics that differ from students who do not work, we make use of the panel nature of our data and include a student fixed effect, α_i, which controls for time-invariant student-level characteristics and allows each student to serve as their own counterfactual. Our primary interest is estimating β_1, which represents the change in y_{iqt} associated with a 100 percent increase in the minimum wage. To make our results comparable across time, we modify all dollar values (i.e., minimum wages and income) with the CPI to be in real terms of 2022 dollars.

A threat to identifying β_1 in Equation (1) as causal is economic conditions that are correlated with changes in the minimum wage that also affect student work. To mitigate this concern, we include a matrix of control variables $\boldsymbol{X}$, which include the accumulated hours of student work experience (measured at the beginning of each quarter) and the quarterly unemployment rate of Whatcom County, the county in which WWU resides. While these controls help

alleviate concerns of omitted variable bias, we proceed with descriptive rather than causal language, recognizing that without a suitable contemporaneous control group there may still be confounding factors that prohibit a causal interpretation. We also consider that hours of student work and earned income have increased over time, as show in Figure 2. To avoid spurious correlations between rising hours and a rising minimum wage, we include a year time trend (t).[11] Because of the quarterly variation apparent in Figure 2, we also include a series of quarterly indicator variables, δ_q, representing fall, winter, spring, or summer quarters. Finally, ε_{iqt} is a stochastic error term adjusted for clustering by year, the level at which policy changes occur.[12]

One possibility highlighted by Jardim, et al. (2022) is that minimum wages have a different effect on those entering the labor force for the first time relative to those who have already been employed. To investigate this, we create subsamples based on initial work experience upon matriculation to WWU. Since we observe employment data back to 2009, and our sample starts in 2013, we use work histories data to calculate pre-matriculation work experience and divide the main sample into those with and without work experience before entering WWU. In an alternative specification, we treat prior work experience as a dynamic rather than fixed characteristic and interact a binary variable indicating no prior work experience (i.e., prior to that quarter rather than prior to university matriculation) with the minimum wage. We additionally analyze student subgroups that may be differentially impacted by the minimum wage based on gender and job search costs, using a student's permanent home address (typically where the students' family lives) to proxy for the latter.

4 | RESULTS

The columns of Table 3 present estimates of Equation (1) for the three main outcomes of interest: hours worked, wage income, and the binary variable indicating a student worked any hours. The estimates for the full sample in Panel A of Table 3 suggest that minimum wage changes were not, overall, predictive of changes to work along extensive or intensive margins for the full sample. The linear quarter time trend in this model suggests that employment and income were increasing over this time period.[13] However, the full sample masks considerable variation in students' propensity to work across the academic year: compared to fall, winter, and spring, average hours worked per quarter are nearly twice as large in the summer and the probability of working is about 20% higher. Panels B through E in Table 3 show the coefficient estimates from Equation (1) by quarter. In summer, when students are most likely to work, higher minimum wages significantly predict reduced work hours and the probability of employment, whereas the relationship with income is negative but imprecisely measured. In particular, the coefficient estimates imply that a 100% increase in the minimum wage is associated with 90.08 fewer hours worked in the summer and a reduction in the probability of work by 34.2% points. This suggests that the 16% minimum wage increase experienced in 2016–2017 was linked to a 14.4 h decrease in summer hours worked (an 8.5% decrease relative to the average) and a 5.5% point decrease in summer employment (an 8% decrease).[14] Minimum wage policy does not appear to predict disemployment in non-summer quarters, leading wage income to rise with increasing minimum wages in winter and spring. For example, a 16% minimum wage increase in winter quarter corresponds to an increase in quarterly earnings by about $169. This estimate is consistent with Jardim et al. (2022) who find that increases in the Seattle minimum from $9.47 to $11.00 and then subsequently to $13 increased low-wage earnings by about $10–$12 per week, or $130–$156 per quarter.

We next turn our analysis to groups of students who may be differentially impacted by the minimum wage. We begin by comparing students with and without work experience prior to enrolling in WWU, on the hypothesis that those with no experience may find it harder to enter the labor market as minimum wages rise. The first three columns of Table 4 estimate Equation (1) for the sample of students who enter without work experience, and the last three columns for the sample of students who enter with work experience. Similar to the results in Table 3, there does not appear to be an overall negative relationship between rising minimum wages and employment outcomes in Panel A (the full sample). The quarter-by-quarter analyses in Panels B through E reveal that the higher wage income in winter and spring quarters when minimum wages increase only holds for students with prior work experience. However, there is statistically significant drop in employment in summer for both students with and without work experience. We estimate that a 100% minimum wage increase for workers with no pre-matriculation work experience is associated with 115 fewer hours of work and a 38.8% point decrease in the probability of employment during the summer quarter. These estimates imply that the 16% minimum wage increase in 2017 corresponded with inexperienced students working 18.1 fewer hours and being 12.8% points less likely to be employed in the summer. These results are attenuated for those who entered WWU with work experience: a 100% minimum wage increase corresponds to 21.4% point reduction in

TABLE 3 Estimated effects of minimum wages on employment and income, by quarter.

Dependent variable	Hours worked	Wage income	Work
Panel A: Full sample			
Log (min. wage)	−11.70	376.39	−0.004
	(24.82)	(433.26)	(0.109)
Time trend	5.37***	77.22***	0.025***
	(0.30)	(4.63)	(0.001)
Whatcom county U.R.	0.51	23.94	0.007
	(2.61)	(44.21)	(0.011)
Observations	259,990	259,990	259,990
Mean of dep. var.	97.01	1568.10	0.566
Panel B: Fall			
Log (min. wage)	−11.48	565.78	−0.014
	(45.02)	(614.06)	(0.168)
Observations	78,528	78,528	78,528
Mean of dep. var.	78.49	1259.11	0.532
Panel C: Winter			
Log (min. wage)	39.05*	1049.34**	0.217*
	(17.01)	(301.84)	(0.107)
Observations	63,951	63,951	63,951
Mean of dep. var.	71.16	1114.95	0.505
Panel D: Spring			
Log (min. wage)	7.34	1205.74**	−0.049
	(27.31)	(417.77)	(0.21)
Observations	61,132	61,132	61,132
Mean of dep. var.	80.55	1274.98	0.562
Panel E: Summer			
Log (min. wage)	−90.08**	−481.20	−0.342***
	(26.05)	(594.17)	(0.044)
Observations	56,379	56,379	56,379
Mean of dep. var.	169.98	2830.32	0.687

Note: Each column within each panel represents a separate OLS regression, with panels designating either the full sample or subsamples by academic quarters. Hours worked and wage income (measured in 2022 dollars) represent totals across all jobs in the year or quarter. Work is a binary variable indicating non-zero hours worked at any job. The minimum wage is measured in 2022 dollars. The full-sample regressions contain quarter fixed effects, and all regression models contain student fixed effects, a linear time trend (measured quarterly), the Whatcom County unemployment rate (measured quarterly) and hours of work experience. Standard errors clustered at the year level are in parentheses.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

summer employment for this group whereas the relationship between minimum wages and hours worked is negative but statistically insignificant. These results suggest that those with no initial work experience (and may be entering the labor force for the first time) are more sensitive to minimum wage changes.

We now examine the possibility that minimum wages may differentially affect employment by changing job search costs. If higher labor costs make jobs scarcer, we would expect to see more disemployment for students with higher search costs as minimum wages rise. We proxy for search costs using the students' permanent home address under the assumption that students who reside closer to the university should have less difficulty finding a job due to being able to

TABLE 4 Estimated effects of minimum wages on employment and income, by quarter and work experience upon matriculation.

	Sample: No prior work experience			Sample: Has prior work experience		
Dependent variable	**Hours worked**	**Wage income**	**Work**	**Hours worked**	**Wage income**	**Work**
Panel A: Full sample						
Log (min. wage)	−22.82	117.37	−0.027	−4.10	533.45	0.025
	(26.41)	(441.02)	(0.165)	(24.73)	(420.59)	(0.092)
Observations	77,552	77,552	77,552	182,438	182,438	182,438
Mean of dep. var.	56.78	867.85	0.376	114.11	1865.77	0.647
Panel B: Fall						
Log (min. wage)	−3.20	546.37	0.036	−14.05	592.38	−0.006
	(39.21)	(596.25)	(0.232)	(48.82)	(641.04)	(0.149)
Observations	22,970	22,970	22,970	55,558	55,558	55,558
Mean of dep. var.	45.18	680.91	0.338	92.26	1498.16	0.613
Panel C: Winter						
Log (min. wage)	36.41	815.02	0.238	39.97*	1157.49***	0.212*
	(25.35)	(434.30)	(0.182)	(15.69)	(272.63)	(0.088)
Observations	19,134	19,134	19,134	44,817	44,817	44,817
Mean of dep. var.	39.85	586.27	0.321	84.52	1340.66	0.584
Panel D: Spring						
Log (min. wage)	−21.85	483.06	−0.097	26.21	1624.95***	0.013
	(47.16)	(716.69)	(0.323)	(22.60)	(332.30)	(0.173)
Observations	18,267	18,267	18,267	42,865	42,865	42,865
Mean of dep. var.	46.71	692.88	0.377	94.97	1523.04	0.640
Panel E: Summer						
Log (min. wage)	−115.35**	−983.38	−0.388***	−70.87	−161.93	−0.214**
	(42.51)	(681.26)	(0.084)	(39.54)	(825.96)	(0.075)
Observations	17,181	17,181	17,181	39,198	39,198	39,198
Mean of dep. var.	101.87	1617.41	0.484	199.84	3361.96	0.775

Note: Each column within each panel represents a separate OLS regression, with panels designating either the full sample or subsamples by academic quarters. The first three columns are the sample of students who did not work in Washington State prior to matriculation to WWU, and the last three columns are the sample of students who worked non-zero hours prior to matriculation. Hours worked and wage income (measured in 2022 dollars) represent totals across all jobs in the year or quarter. Work is a binary variable indicating non-zero hours worked at any job. The minimum wage is measured in 2022 dollars. The full-sample regressions contain quarter fixed effects, and all regression models contain student fixed effects, a linear time trend (measured quarterly), the Whatcom County unemployment rate (measured quarterly) and hours of work experience. Standard errors clustered at the year level are in parentheses.
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

leverage their local professional or social networks. Additionally, if students return home during the summer, students with permanent addresses close to the university do not necessarily need to change jobs if they worked near campus during non-summer quarters. We therefore designate students as either local or non-local based on whether their permanent address is Whatcom County, the county in which WWU resides, and present our full sample and quarter-by-quarter estimates of Equation (1) in Table 5. In the full sample in Panel A, higher minimum wages are associated with more hours of work and wage income for local students but not for non-locals. Moving to the quarterly analysis, note that the negative relationship between minimum wages and summer employment only occurs for non-locals, with estimates comparable to those experienced by students with no prior pre-matriculation work history in Table 4. Taken together, the full sample and quarterly results indicate that those with higher search costs may be more negatively impacted by minimum wage changes.

TABLE 5 Estimated effects of minimum wages on employment and income, by quarter and student permanent home address.

	Sample: Address in whatcom county			Sample: Address not in whatcom county		
Dependent variable	**Hours worked**	**Wage income**	**Work**	**Hours worked**	**Wage income**	**Work**
Panel A: Full sample						
Log (min. wage)	46.68**	972.67**	0.095	−16.74	325.87	−0.010
	(28.68)	(310.53)	(0.079)	(27.31)	(463.14)	(0.122)
Observations	25,219	25,219	25,219	234,771	234,771	234,771
Mean of dep. var.	147.31	2442.76	0.69	91.61	1474.14	0.554
Panel B: Fall						
Log (min. wage)	8.69	350.14	−0.007	−11.97	598.84	−0.007
	(46.92)	(785.93)	(0.116)	(47.17)	(647.98)	(0.181)
Observations	7535	7535	7535	70,993	70,993	70,993
Mean of dep. var.	136.69	2281.02	0.676	72.31	1150.65	0.517
Panel C: Winter						
Log (min. wage)	99.74*	2037.99***	0.332***	34.05	959.56*	0.210
	(40.29)	(507.53)	(0.069)	(22.23)	(382.56)	(0.120)
Observations	6218	6218	6218	57,733	57,733	57,733
Mean of dep. var.	123.09	1996.31	0.647	65.56	1020.03	0.490
Panel D: Spring						
Log (min. wage)	102.48**	2211.85**	−0.254	0.96	1149.09*	−0.020
	(35.21)	(668.80)	(0.215)	(31.10)	(454.15)	(0.220)
Observations	5967	5967	5967	55,165	55,165	55,165
Mean of dep. var.	134.63	2208.84	0.690	74.70	1173.97	0.548
Panel E: Summer						
Log (min. wage)	48.92	1307.88	0.115	−103.76***	−657.60	−0.385***
	(54.03)	(1019.46)	(0.117)	(25.64)	(611.44)	(0.049)
Observations	5499	5499	5499	50,880	50,880	50,880
Mean of dep. var.	202.99	3423.02	0.727	166.42	2766.26	0.682

Note: Each column within each panel represents a separate OLS regression, with panels designating either the full sample or subsamples by academic quarters. The first three columns are the sample of students who have a permanent home address within Whatcom County, and the last three columns are the sample of students whose address is not in Whatcom County. Hours worked and wage income (measured in 2022 dollars) represent totals across all jobs in the year or quarter. Work is a binary variable indicating non-zero hours worked at any job. The minimum wage is measured in 2022 dollars. The full-sample regressions contain quarter fixed effects, and all regression models contain student fixed effects, a linear time trend (measured quarterly), the Whatcom County unemployment rate (measured quarterly) and hours of work experience. Standard errors clustered at the year level are in parentheses.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

We continue our analysis of student subgroups by looking at employment outcomes by gender, given in Table 6. Overall, women tend to work and earn slightly more than men in our sample: women are about 10% points more likely to work, working about 13 more hours and earning about $150 more per quarter. Panel A of Table 6 shows that neither men's nor women's employment outcomes significantly change with minimum wage increases in the full sample. The results by quarter tell a more nuanced story: women appear to earn more in winter and spring but experience significant declines in hours worked and the probability of employment in summer as minimum wages increase. For men, the drop-off in summer employment as minimum wages increase is even more stark but the resulting reduction in wage income is not statistically significant.

We next consider an alternative econometric specification to capture the potential dynamic effect of experience and its interaction with changing minimum wages to influence employment and income. Instead of labeling work

TABLE 6 Estimated effects of minimum wages on employment and income, by quarter and gender.

	Sample: Male			Sample: Female		
Dependent variable	**Hours worked**	**Wage income**	**Work**	**Hours worked**	**Wage income**	**Work**
Panel A: Full sample						
Log (min. wage)	−23.75	9.53	−0.057	0.06	713.94	0.041
	(20.58)	(387.73)	(0.092)	(27.82)	(470.17)	(0.122)
Observations	115,241	115,241	115,241	144,749	144,749	144,749
Mean of dep. var.	89.55	1487.35	0.513	102.96	1632.39	0.609
Panel B: Fall						
Log (min. wage)	−23.01	158.37	−0.120	−2.11	900.76	0.068
	(45.09)	(601.05)	(0.173)	(45.96)	(645.32)	(0.188)
Observations	34,607	34,607	34,607	43,921	43,921	43,921
Mean of dep. var.	67.37	1109.36	0.470	87.26	1377.10	0.582
Panel C: Winter						
Log (min. wage)	18.47	803.64**	0.159	56.44**	1268.00**	0.264
	(17.99)	(263.20)	(0.105)	(19.95)	(368.68)	(0.131)
Observations	28,339	28,339	28,339	35,612	35,612	35,612
Mean of dep. var.	60.78	964.17	0.439	79.42	1234.93	0.558
Panel D: Spring						
Log (min. wage)	−28.12	306.57	−0.178	37.27	1971.16***	0.058
	(26.79)	(449.90)	(0.273)	(30.90)	(471.25)	(0.187)
Observations	27,177	27,177	27,177	33,955	33,955	33,955
Mean of dep. var.	69.47	1117.81	0.505	89.42	1400.77	0.607
Panel E: Summer						
Log (min. wage)	−108.90*	−982.84	−0.358**	−69.57***	13.11	−0.321***
	(53.56)	(1193.53)	(0.101)	(13.72)	(402.43)	(0.061)
Observations	25,118	25,118	25,118	31,261	31,261	31,261
Mean of dep. var.	174.28	2998.23	0.664	166.53	2695.40	0.705

Note: Each column within each panel represents a separate OLS regression, with panels designating either the full sample or subsamples by academic quarters. The first three columns are the sample of male students, and the last three columns are the sample of female students. Hours worked and wage income (measured in 2022 dollars) represent totals across all jobs in the year or quarter. Work is a binary variable indicating non-zero hours worked at any job. The minimum wage is measured in 2022 dollars. The full-sample regressions contain quarter fixed effects, and all regression models contain student fixed effects, a linear time trend (measured quarterly), the Whatcom County unemployment rate (measured quarterly) and hours of work experience. Standard errors clustered at the year level are in parentheses.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

experience as a static feature of a student (namely, experience before matriculation), we instead interact a binary variable indicating relatively low work experience before the given quarter with the minimum wage for the full sample. We consider two ways a student could be inexperienced: by having no prior work experience or having "low" work experience based on having fewer hours of work experience than the sample median of 889 h[15] The results for these models, based on a slightly modified Equation (1), are given in Table 7. The first three columns of Table 7 include the interaction with the no-experience indicator and the last three columns include the interaction with the low-experience indicator. The results show that higher minimum wages only predict disemployment and lower income when students have no work experience; there is no significant relationship between minimum wages and work or income for students once they gain experience. A similar pattern can be seen when examining models in the last three columns of Table 7 with the low-experience interaction.

TABLE 7 Estimated effects of minimum wages on employment and income with experience interactions.

Dependent variable:	Hours worked	Wage income	Work	Hours worked	Wage income	Work
Log (min. wage)	−4.84	467.19	0.042	−9.99	397.44	−0.001
	(23.34)	(412.09)	(0.97)	(25.11)	(438.46)	(0.109)
Log (min. wage) × (no experience)	−13.56***	−179.68***	−0.092***	-	-	-
	(0.53)	(6.34)	(0.005)			
Log (min. wage) × (low experience)	-	-	-	−3.82***	−47.06***	−0.009***
				(0.52)	(8.25)	(0.002)
Observations	259,990	259,990	259,990	259,990	259,990	259,990
Mean of dep. var.	97.01	1568.10	0.566	97.01	1568.10	0.566

Note: Each column represents a separate OLS regression. Hours worked and wage income (measured in 2022 dollars) represent totals across all jobs in the year. Work is a binary variable indicating non-zero hours worked at any job. No experience is a binary variable indicating no prior work hours. Low experience is a binary variable indicating less than the sample median of 889 h worked. The minimum wage is measured in 2022 dollars. The full-sample regressions contain quarter fixed effects, and all regression models contain student fixed effects, a linear time trend (measured quarterly), the Whatcom County unemployment rate (measured quarterly) and hours of work experience. Standard errors clustered at the year level are in parentheses.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

5 | DISCUSSION AND CONCLUSION

We use administrative data from Washington state consisting of university academic and employment records combined with private sector employment data from the state unemployment insurance agency to analyze minimum wage changes from 2013 to 2019 and the associated employment changes for college students. Washington is one of only four states that collects data on hours worked through its unemployment insurance program. Our results suggest that minimum wages particularly hurt inexperienced workers in summer, the quarter in which students tend to work most. The overall relationship between minimum wage hikes and labor outcomes across the academic year, though, does not appear to be negative, even for students with relatively little or no work experience. Some models and subgroups do suggest a decline in work hours as minimum wages rise, but this does not appear to be substantial enough to reduce income. Overall, we believe the summer quarter results are consistent with Neumark and Shirley's (2022) summary that the minimum wage has "strong and consistent evidence of negative employment effects for teens...{and}...young adults."

Though we believe these results offer an important contribution to the minimum wage literature, especially for new labor market entrants, we do offer caveats for interpreting our findings as causal. Our within-student empirical strategy compares employment outcomes of the same student subjected to different minimum wage levels. We further include students' accumulated work experience to capture students' propensity to work in a dynamic way, quarterly local unemployment rates to control for economic conditions, and time trends to capture employment patterns that are independent of the minimum wage. However, there could still be other confounding factors that are correlated with both changes to the minimum wage and student employment. For example, economic shocks not captured by time trends or local unemployment rates, perhaps due to a change in the presidential administration that occurred in the middle of our sample. A standard way to address this issue is by employing a difference-in-differences framework that includes a contemporaneous control group who is not affected by the minimum wage. However, our analysis has led us to believe that there is no such suitable control group in our sample of undergraduate students.

A number of potential explanations for our findings are possible, each of which requires additional exploration. The most common textbook argument is that the minimum wage increases the cost of employing workers, and we have simply documented that this applies to college students, especially in the summer months and especially among college students with little prior work experience and those whose permanent address is not near the university. However, alternative explanations are possible. Given that our approach focuses only on students, one should also consider labor-labor substitution. For instance, it is possible that increases in the minimum wage cause businesses to hire more non-students leading to no changes in total work but a substitution from student to non-student employees. This labor-labor substitution is consistent with evidence that firms increase job requirements after minimum wage hikes[16] and that firms may substitute away from less skilled to more skilled workers.[17] Each of these actions may adversely impact the market for student workers.

Firms may adapt to absorb the cost of minimum wage increases in other ways that do not lead to changes in employment, such as reducing fringe benefits, reducing non-pecuniary benefits, or increasing effort requirements. For example, Coviello et al. (2022) and Ku (2022) find that increasing the minimum wage improves worker productivity, though the former only observe this increase in productivity when workers are monitored more intensely.[18] If firms are making these adaptations so as to leave employment unchanged in our context, it would only apply during the academic year as we observe a significant reduction in employment during the summer as the minimum wage rises.

One possible explanation for differential minimum wage effects in the summer involves product demand elasticity. Businesses can more easily pass through costs associated with higher minimum wages when they sell products with a low demand elasticity. Since higher labor costs can be passed on to consumers through higher prices, employment in these industries is less sensitive to minimum wage changes.[19] It is possible that students at a public university are more likely to work in industries with a higher product demand elasticity in the summer rather than during the academic year. As a result, summer employment may be more impacted by minimum wage increases than employment during the academic year. According to Figure 3, the only industry with less student employment during the summer is educational services, a category mostly consisting of on-campus student employees of WWU, which may be price insensitive. It is also possible that non-profit entities (like the university studied here) have different objective functions than for-profit firms. To the extent that WWU's objective function explicitly includes the employment of students, we would expect student employment during the academic year (when students are more likely to be employed in educational services) to be less impacted by minimum wage increases than during the summer.[20] A more thorough exploration of these mechanisms using firm- or industry-level data is a promising avenue for future research.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from WWU. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from Adam Wright, Darius Martin, and John Krieg with the permission of WWU.

ENDNOTES

[1] In this section, we focus our review on more recent minimum wage studies relevant to the present study. Earlier studies of increasing minimum wages at the federal (e.g., Belman & Wolfson, 2010; Card, 1992; Katz & Krueger, 1992), state (e.g., Card & Krueger, 1994; Dube et al., 2010, 2016; Meer & West, 2016; Neumark & Wascher, 1995) and local (e.g., Dube et al., 2007; Potter, 2006; Schmitt & Rosnick, 2011) levels generally find small or no measurable effect on employment. See Jardim et al. (2022) for a review of this literature.

[2] From 2001 to 2016, Washington had a minimum wage indexed to CPI-W that was higher than federal minimum wage. Throughout this paper, nominal quantities are converted into constant 2022 dollars using the CPI-U.

[3] For a complete list of exempted occupations, see here: https://esdorchardstorage.blob.core.windows.net/esdwa/Default/ESDWAGOV/employer-Taxes/ESD-exempt-professions-chart.pdf

[4] Of course, students who work in the informal labor market do not appear in either the ESD data or payroll data. To gauge the size of this, we use an annual university survey which asks students if they had worked during the prior academic year. We were able to match 6516 survey answers to the ESD/Payroll data and found that 11.6% of students claimed to have worked in the past academic year who were not in the ESD/Payroll data. This work may have been at volunteer jobs (and not covered by the ESD), in an employment category deemed exempt by ESD, or in the informal labor market. Students might also have misinterpreted the survey question.

[5] One interesting question, which we defer to later research, is whether higher minimum wages change the likelihood that out-of-state students return home during the summer.

[6] A related problem is that pay reported in one quarter might be compensation for work done in earlier quarters. For example, a company may pay workers in early January for work done at the end of December. In this case, a fraction of total hours reported as worked in the first quarter of the year actually occurred in the fourth quarter of the previous year. This is problematic because the minimum wage in Washington typically increases on January 1st resulting in some January payrolls that indicate wage rates below the minimum wage. However, lacking more detailed information about the timing of pay throughout the quarter, we are unable to determine how many hours reported in one quarter were worked earlier.

[7] For instance, in 2013, 83.1% of freshmen were aged 18% and 16.2% were 19.

[8] For instance, the university payroll system pays 2 weeks after the work is completed so a student working during the final 2 weeks of 2016 might be paid the lower minimum wage after the new year and have this lower wage attributed to the later year.

[9] NAICS is the North American Industry Classification System. We associate student employment at the university with a NAICS code of 611,310, corresponding to educational services from a colleges and university. Recall that this data comes from the university rather than ESD.

[10] Note that the educational services category mostly consists of student employees of WWU, many of whom work in university dining halls and retail establishments on campus.

[11] We also experiment with higher order polynomials in t with no significant differences in the coefficients on minimum wage.

[12] Clustering at the student or term (quarter-year) levels produce similar standard errors.

[13] The results presented here and throughout the paper are robust to the inclusion of quadratic or cubic time trends.

[14] Note that $14.4 \approx -90.05 \times 0.16$, and $5.5 \approx 34.2 \times 0.16$. The largest minimum wage change over the course of the sample (2013–2019) occurred from 2016 to 2017, when the minimum wage increased from \$9.47 to \$11.00, a 16 percent increase.

[15] Note that with a student fixed effect, the interaction of the minimum wage with "no experience" is identified from the first quarter a student works. As this may create statistical power issues, we run these regressions without a student fixed effect and the results are essentially unchanged.

[16] See Clemens et al. (2021).

[17] See Horton (2018).

[18] When workers are less closely monitored, Coviello et al. (2022) find that worker productivity decreases after a minimum wage increase. The authors suggest this as an explanation for the findings in Hill (2018), where a minimum wage hike leads to lower worker productivity.

[19] Link (2024) provides evidence that in response to a nation-wide minimum wage in Germany, firms with a smaller export share, goods and services traded more locally, and less competition through imports (i.e., first that likely face a smaller elasticity of demand) demonstrate a larger price effect and smaller employment effect. Similarly, Cengiz et al. (2019) find that state-level minimum wages in the U.S. did not negatively impact employment in the non-tradeable sector, where demand elasticity is likely lower, and find some disemployment in tradeable sectors. Further evidence of larger disemployment effects in tradeable sectors is documented by Harasztosi and Lindner (2019).

[20] Kim et al. (2024) find that higher minimum wages do not negatively affect employment at nonprofit firms for workers with disabilities, possibly because nonprofits' objective functions include supporting such workers. The same may be true of student employment at educational institutions.

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