Official Journal of United Association for Labor Education

Labor Studies Journal
2024, Vol. 49(2) 93–114
© 2023 UALE
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0160449X231218979
journals.sagepub.com/home/lsj

Apprenticeship Program Performance and Macroeconomic Fluctuations: A Case Study of Nevada's Construction Industry

Jeffrey Waddoups[1] and Kevin Duncan[2]

Abstract

Apprenticeship training in construction is an important source of human capital investment for workers, employers, and society. We address the extent to which macroeconomic fluctuations such as building booms and recessions affect apprenticeship completion rates—an important indicator of program performance. Using data from the U.S. Department of Labor, we find that one of the most important determinants of performance is a measure of macroeconomic activity during the apprenticeship period. Apprentices that register into a growing economy, as indicated by falling unemployment rates, are significantly more likely to complete their programs than those who register into a recessionary economy. We also find that apprentices in programs jointly sponsored by trade unions and signatory contractors have higher completion rates and are less affected by conditions in the macroeconomy.

Keywords

apprenticeship, construction, great recession, completion rates, unions

Introduction

Apprenticeship programs in the construction industry combine significant classroom study with thousands of hours of on-the-job training to produce highly

[1]Department of Economics, University of Nevada, Las Vegas, Las Vegas, NV, USA
[2]Hasan School of Business, Colorado State University-Pueblo, Pueblo, CO, USA

Corresponding Author:
Kevin Duncan, Hasan School of Business, Colorado State University-Pueblo, Pueblo, CO, USA.
Email: kevin.duncan@csupueblo.edu

skilled, broadly-trained workers. Although most programs may be completed in three to four years, some take up to five years or even longer to complete. Relying heavily on learning-by-doing, apprentices typically log between 6,000 and 10,000 hours of on-the-job training, along with significant work in the classroom. Construction apprenticeships constitute a significant source of human capital investment for individuals, employers, and economies, imparting valuable skills and production technologies from one generation of workers to the next. Because they represent an important source of skills development, anything that impacts their performance should interest industry leaders, policymakers, and scholars.

The primary goal of our study is to investigate how apprenticeship completion rates —one of the most important measures of a program's performance according to the Office of Apprenticeship Services (USOA 2011)—respond to shocks in the macroeconomy. The issue has received little attention in the literature, making our research among the first to focus directly on how fluctuating macroeconomic conditions affect program completion rates. For information on apprenticeships, we use trainee-level data obtained from the Registered Apprenticeship Partners Information Data System (RAPIDS). The USOA, housed in the U.S. Department of Labor, requires federally registered apprenticeship programs to provide data on performance of programs and apprentices. The publicly available RAPIDS data include information on trainee demographics, particular trade program, and dates when an apprentice registered for, and either canceled or completed their training.

We focus particularly on apprenticeship training in Nevada as a case study because of its unique level of volatility over the first part of the 21st century. Over the period between 2000 and 2006, construction employment in the Silver State increased by 60 percent.[1] With the Great Recession of 2008 to 2009 and subsequent stagnation, by 2012 employment fell by 64 percent from its peak. As of 2016, employment remained at only 53 percent of the 2006 level. Although construction employment at the national level also exhibited volatility over the period, increasing from 2000 to 2006 from 6.8 million to 7.7 million—a 13 percent rise—by 2016 employment it was still at 87.5 percent of its 2006 level.

Because construction apprenticeship programs require thousands of hours of practical on-the-job training lasting several years, it is reasonable to expect that such extreme changes in macroeconomic conditions and accompanying employment opportunities had some effect on program performance as measured by completion rates. Indeed, it would not be surprising to see a reduction in demand for construction labor during recessionary periods to significantly reduce the opportunity for apprentices to accumulate the requisite work hours to complete their programs, causing some to quit who would not have done so otherwise. The U.S Office of Apprenticeship Services suspects as much. In a bulletin released by the office on February 2, 2011, the author concludes "While additional analysis is necessary, the decline in completion rates over the past two years [2009 and 2010] is likely a

result of the economic downturn and the general unavailability of work impacting the ability of apprentices to complete their OJL requirements" (U.S. Department of Labor, OAS 2011, 3).

A counter narrative is also reasonable. At the same time recessionary forces reduce jobs in construction, they also restrict employment elsewhere. Thus apprentices, who may have otherwise left their apprenticeships during more normal economic times, may become more likely to see their apprenticeship program through to completion during recessions. These two forces may work against each other. Suggesting that the net impact of macroeconomic volatility on program completion rates is ambiguous and remains an empirical matter.

Another source of variability in program performance lies in program sponsorship. In Nevada, programs jointly operated by trade unions and construction contractors train a vast majority of apprentices (approximately 91.5 percent). However, unilateral programs also train a significant number of apprentices in electrical and plumbing. In such programs, trade associations or single employers coordinate training without trade union involvement, and without the higher level of funding that generally accompanies jointly managed programs. This suggests that differences in sponsorship may also impact how macroeconomic shocks affect apprenticeship program performance, a question that we also address.

After providing some background on the nature of construction apprenticeship programs, including a brief discussion of the economics behind apprenticeship training, we will discuss previous empirical work, and the construction labor market in Nevada during the period between 2000 and 2017. Subsequent sections of the paper will review the RAPIDS data, the econometric model used to examine the correlation between completion rates and macroeconomic fluctuations, and results.

Economic Rationale for Apprenticeship Training in Construction

Previous writing and research on apprenticeship training in the construction industry has outlined the economic problem experienced by employers considering on-the-job training investments in their workers (e.g., Bilginsoy 2003). Firms in construction, typically smaller than in other industries, bid for relatively *short duration* projects where the skills needed are not specific to individual firms, but general in nature. In this setting, learning-by-doing is often the most effective way to develop skills that often vary widely from project to project. To exacerbate the problem, seasonal and cyclical fluctuations make construction one of the most volatile industries in the economy.[2] Such instability results in a loose attachment between contractors and construction workers (Philips 2003). When work is plentiful, contractors hire additional workers, but typically jettison them after a project is completed, or when seasons or economic conditions change.

Under these conditions—i.e., small firms, short duration projects in a volatile industry, a loose attachment between employer and employee, and the need for flexible and

highly skilled workers with general skills—employers would likely not expect a sufficient return on training investments to unilaterally invest in its workers' skills. If a firm were to invest, workers could conceivably take the recently acquired skills to another firm, especially if the employer who provided the training finds itself between projects. The second firm would then enjoy the benefit of the original firm's training investment.[3] Indeed, Becker (1962) long ago theorized that employers would be reluctant to invest in the general skills of its workforce because of the difficulty in internalizing training externalities. The organization of work in construction leaves employers particularly vulnerable to such market failures. If mechanisms are not found to remedy market failure in training, theory predicts that the industry will experience chronic under-training and shortages of skilled workers.

In the unionized segment of the industry, jointly operated apprenticeship programs can be viewed as a mechanism to address market failures in training. Competing employers join together to bargain with a trade union. The resulting labor agreement between signatory employers and the union contains, among other things, a common wage scale, financing of an apprenticeship program, and a jointly managed apprenticeship training committee with equal representation of employers and the union on a board of directors. The coordination provided by the agreement assures that employers are not being taken advantage of by training their competitors' workers, because their competitors are also participating. It also assures that the skills imparted are relevant to construction needs in the local area and that trained workers will have a fighting chance at regular employment in a volatile industry with one of the many signatory contractors. Through the apprenticeship program, trade unions and signatory employers form an institutional mechanism to create and maintain a pool of skilled construction labor upon which signatories can draw when demand warrants.

Attempts to address market failures in training common to construction are also found in the non-union sector. Such unilateral apprenticeship programs often coordinate competing contractors through trade associations. For example, the Associated Building Contractors (ABC) recruit trainees, fund training, and develop curricula for their apprenticeship training programs. In Nevada unilateral programs accounted for about 8.5 percent of registered apprentices—almost exclusively in electrical and plumbing—during the 2000 to 2017 period.

A key difference between joint and unilateral apprenticeship programs is the hourly contribution to training that is part of the total compensation package negotiated between contractors who are signatories to collective bargaining agreements and trade unions.[4] The funding advantage results in significant differences in training program outcomes. For example, in an examination of apprenticeship funding in Wisconsin, Philips (2015) finds that joint programs were responsible for 95 percent of all training expenditures in Wisconsin between 2010 and 2013. The non-union side of apprenticeship training was responsible for the remaining 5 percent of spending. As a consequence of differences in training expenditures, Philips (2015) reports that from 2002 to 2015, 82 percent of graduating apprentices were from joint programs.

Non-union programs were responsible for 18 percent of graduating construction apprentices. In similar research, Manzo and Duncan (2018) compare training revenue and assets between the 10 largest joint apprentice programs in Minnesota with the Construction Education Foundation of Minnesota that is a multi-employer, unilateral program operated by the ABC. Between 2014 and 2017, the latter program represented 1.0 percent of training total revenues, 0.4 percent of training program assets, and 0.7 percent of registered apprentices of the 10 largest joint programs.

As mentioned previously, not only do unilateral programs train relatively fewer apprentices, they also do not offer the range of trades training as their jointly managed counterparts. In the examination of apprenticeship programs in Ohio between 2004 and 2015, Onsarigo et al. (2017) find that there were 53 jointly managed registered apprenticeship programs. There were 12 registered programs that were either single or multiple employer unilateral programs or training education offered through the ABC. The joint programs offered training in 16 different trades ranging from laborers to operating engineers. At least 75 percent of the unilateral and ABC programs offered training for electricians. Data from Kentucky between 2008 and 2016 indicate a similar trend. Duncan and Manzo (2016) report that unilateral programs offered training for eight different trades with at least 79 percent of these apprentices enrolled in electrical training. On the other hand, jointly managed programs offered training in 13 different trades with 27 percent of apprentices enrolled in training for electricians.

Another difference between jointly operated and unilateral programs is that apprenticeship training is a condition of employment in the union sector, but may be voluntary in the non-union segment of the construction industry.[5] This requirement, along with the funding advantage and union representation of the trainee, likely contribute to other differences in outcomes between jointly managed and unilateral training programs. Bilginsoy (2003) finds that apprentices in unilateral programs are twice as likely to quit training before completion compared to their counterparts in jointly managed training programs. Joint programs also make a larger contribution to the development of formal training, even though unionized construction workers represent a minority in the construction industry.[6] Similar to the present study, this author finds that recessionary macroeconomic conditions affect program performance, lengthening the time spent in training for all trainees. On the other hand, expansions shorten training time. These results are based on a sample of apprentices enrolled in programs for carpenters, electricians, pipefitters, plumbers, and sheet metal workers between 1989 and 1995.

In a follow-up study of apprentices pursuing training as electricians, plumbers, pipefitters, and sheet metal workers between 1996 and 2003, Bilginsoy (2007) finds that completion rates for apprentices in joint programs are more than twice the rate of unilateral programs. The cancellation rate in unilateral programs is about 75 percent higher than in joint programs with those leaving unilateral programs prior to the significant development of skills. However, those who complete unilateral programs do so at a faster rate than apprentices in joint programs.[7] Glover and Bilginsoy (2005) expand the analysis to include apprentices enrolled in all participating trade training programs

as well as information on minority and female trainees. Results from 1996 to 2003 indicate that enrollment and completion rates are higher and cancellation rates are lower for all apprentices enrolled in jointly administered programs, including female and minority trainees.

In one of the only studies that focused explicitly on the interaction between macroeconomic shocks and the performance of apprenticeship programs in construction, Bilginsoy (2018) uses national level RAPIDS data to assess the impact of the Great Recession on both attrition and completion. He reports evidence that for apprentices in jointly sponsored programs, higher unemployment rates (recessionary conditions) lead to longer durations in training compared to lower unemployment rates (booming conditions). When unemployment rates were low, trainees in joint programs who were going to quit, did so more quickly, likely taking advantage of outside employment options that were more readily available in a prosperous economy. For apprentices in unilateral programs, higher unemployment rates led to shorter durations in training for those that would eventually quit. The Great Recession, however, broke the pattern of dependency between attrition rates and unemployment rates for both groups by increasing attrition but weakening the correlation between unemployment rates and attrition rates. Interestingly, Bilginsoy (2018) found no evidence for apprentices in either jointly sponsored and unilaterally sponsored programs that changes in unemployment rates (macroeconomic volatility) influence the time to completion.

Similar to Bilginsoy (2018), the present study approaches the impact of changing macroeconomic conditions as measured by unemployment rates on the performance of construction apprenticeship programs. The novelty in our approach lies first, in the focus on the experience of a single state that faced particularly volatile macroeconomic conditions and severe swings in construction employment, and second in using a methodology that focuses directly on how such volatility is related to the probability of completion. In particular, we construct a measure of volatility that depends on the difference in monthly unemployment rate at the time of an apprentice's registration compared to the rate at the expected half-way point of the training period. The measure produces a unique indicator of macroeconomic conditions faced by each apprentice in the sample.

The Construction Labor Market in Nevada Between 2000 and 2017

The economic shock in the form of the Great Recession exerted significant impact on Nevada's construction industry during the first decade of the 2000s. Table 1 documents the employment trends for the construction sector in Nevada from 2000 to 2017. Construction employment expanded rapidly both in terms of absolute numbers and as a proportion of total employment. Construction firms in Nevada employed approximately 89,500 construction workers in the year 2000. By 2006 approximately 143,100 workers were employed, which represents a 60 percent increase. The percent of total employment accounted for by construction moved from 8.7 percent in 2000 to 11.2

Table 1. Total and Construction Employment in Nevada (Thousands): 2000–2017.

Year	Total All Industries, Nevada (TE)	Construction (CE) Nevada	Ratio Nev (CE/TE)	Registered Apprentices in Nevada (RA)[a]	Total Employment U.S. (thousands)	Construction Employment U.S. (thousands)[b]	Ratio U.S. (CE/TE)
2000	1,027.0	89.5	0.087	1,289	132,018.3	6,787.9	0.051
2001	1,051.2	91.2	0.087	1,240	132,078.3	6,826.5	0.052
2002	1,051.8	92.3	0.088	1,764	130,634.6	6,715.3	0.051
2003	1,088.3	100.2	0.092	1,780	130,327.0	6,735.7	0.052
2004	1,152.5	118.1	0.102	2,866	131,755.1	6,973.2	0.053
2005	1,222.6	134.6	0.110	2,601	134,021.3	7,333.4	0.055
2006	1,279.4	143.1	0.112	3,665	136,432.2	7,689.6	0.056
2007	1,292.1	133.7	0.103	2,859	137,978.8	7,627.3	0.055
2008	1,263.6	116.5	0.092	3,552	137,224.9	7,162.3	0.052
2009	1,148.4	81.3	0.071	1,373	131,290.0	6,017.3	0.046
2010	1,117.9	59.3	0.053	538	130,334.6	5,518.3	0.042
2011	1,125.7	52.2	0.046	508	131,919.5	5,529.9	0.042
2012	1,144.6	51.9	0.045	676	134,154.3	5,645.5	0.042
2013	1,174.1	56.9	0.048	830	136,358.3	5,857.1	0.043
2014	1,215.8	63.3	0.052	915	138,919.5	6,150.8	0.044
2015	1,258.7	70.2	0.056	1,045	141,801.2	6,460.0	0.046
2016	1,298.5	75.7	0.058	1,153	144,332.4	6,726.7	0.047
2017	1,340.0	83.2	0.062	–	146610.9	6967.1	0.048

Source: Bureau Labor Statistics: https://data.bls.gov/timeseries/SMS32000002000000001?amp%253bdata_tool=XGtable&output_view=data&include_graphs=true
[a]RAPIDS data for Nevada 2000-2016. The number of apprentices registered in the year. Figures for 2017 are incomplete and are thus excluded.
[b]Bureau of Labor Statistics (https://beta.bls.gov/dataViewer/view).

percent in 2006. By 2010, construction employment had fallen to 81,300 workers and continued its decline to 51,900 by 2012. To illustrate the relative magnitude of the construction employment boom in Nevada, consider that the peak ratio of construction employment to total employment in the U.S. weighed in at 5.6 percent in 2006. By 2017 the ratio of construction to the total remained elevated in Nevada at 6.2 percent compared to the national figure of 4.8 percent.

The fourth column of Table 1 was compiled using data on Nevada's construction apprentices from RAPIDS. These data show that the number of newly registered apprentices increased along with construction employment, reflecting the increased demand for apprentices during the building boom. The number jumped almost three times from 1,289 in 2000 to 3,665 in 2006 at the peak of the boom. The number of newly registered apprentices remain elevated through 2008 at the height of construction activity on the City Center project on the "Strip" in Las Vegas, and just as the Great Recession was becoming apparent.[8] The number of newly registered apprentices reached a low of 508 in 2011, and has slowly climbed back to about 89 percent of its levels in 2000.

RAPIDS Data Used in the Analysis

As previously mentioned, we use RAPIDS as a primary data source to examine the correlation between performance of construction apprenticeship programs and macroeconomic fluctuations. Recall that for every apprentice who registers with a federally recognized program, the RAPIDS data set observes the trade, apprenticeship program, date of registration into the program, expected time to completion, the date the registrant exited the program, and whether the registrant exited with a completion, a cancellation, or another reason. The data set also observes standard demographic information. When an apprentice exits the program with a completion, it indicates that the trainee has obtained journey-worker status, which is a portable, widely recognized credential signaling high skill in a given construction trade.

Although we have observations on apprentices from January 2000 to April, 2017, we limit our sample to apprentices who registered from the year 2000 to 2012. Excluding the more recently registered is necessary because many of them who commenced their programs after 2012 did not have time to finish their program with either a 'cancellation' or a 'completion.' Consider an apprentice who entered in January 2000. By April 2017, it is virtually a certainty that the apprentice had exited the program either through 'completion' or 'cancellation'. For apprentices who entered their program in 2012, a large majority (approximately 83 percent) had exited their program by April 2017 with either a cancellation or completion. Although it does leave a non-trivial number of apprentices who are still registered and presumably making progress toward successful completion. Most of the later registrants, say those who entered their program in 2015 or 2016, had either cancelled early or still maintain their registration, not having had time to complete the program.

Alternatively, we could have chosen to only consider apprentices that registered in 2011 or earlier. The data show that 94 percent of the 2011 registrants have either

'completed' or 'cancelled' by April 2017. By choosing 2012 as the cut-off, we are balancing the benefits of having a larger data set with the costs of excluding some apprentices who are still registered and who will likely complete their program at some point in the near future.[9] We also exclude observations from our sample that cancel within the first year of entering the program. This follows the conventions of the USOA on how to measure the effectiveness apprenticeship programs (Department of Labor, USOA 2011).[10] After other miscellaneous exclusions based on obvious instances of measurement error, we are left with a sample of 17,851 apprentices, which is used in the estimation regression models assessing the relationship between completion rates and macroeconomic conditions.

Empirical Model

As indicated above, we use the Program Completion Rate to measure effectiveness of apprenticeship programs. To better understand the link between completion of apprenticeship training and macroeconomic fluctuations, we propose the following empirical model:

$$P_{\text{completion}} = \beta_0 + \beta_1 \text{UR}_{\text{diff}} + \beta_2 X + \varepsilon \tag{1}$$

where P is the probability that an apprentice who has just registered will complete the program where the alternative is cancellation. The variable Ri_{ff} is defined as the difference in Nevada's unemployment rate during the month and year that an apprentice registers into a program and the unemployment rate during the month and year at the expected midway point of the apprentice's program.[11] The variable X represents a vector of controls that may also impact the probability of completion. Such variables include education, race, sex, ethnicity, and in some specifications, a series of craft fixed effects.

The study focuses primarily on the variable UR_{diff} that is defined as

$$\text{UR}_{\text{diff}} = \text{UR}_{\text{registration}} - \text{UR}_{\text{mid-program}} \tag{2}$$

Where UR refers to a monthly unemployment rate in Nevada, $\text{UR}_{\text{registration}}$ is the unemployment rate in Nevada during the month and year of an apprentice's registration, and $\text{UR}_{\text{mid-program}}$ represents the unemployment rate in Nevada corresponding to the month and year located midway through the program according to the observed expected completion date. A positive value of UR_{diff} indicates that the apprentice registered into a strengthening economy, meaning that the monthly unemployment rate at registration was higher than the monthly rate at the expected midway point of the program. Similarly, a negative value of UR_{diff} indicates that the macroeconomy weakened after registration, because the monthly unemployment rate upon registration was lower than the rate during the month that marks the expected midpoint of the apprentice's program.

A reasonable hypothesis would be that large negative differences captured by UR_{diff} suggest a higher likelihood that an apprentice may have a more difficult time procuring the work necessary to complete the apprenticeship. Conversely, the hypothesis would

imply that large positive differences captured by UR_{diff} suggest that an apprentice will have a relatively easier time securing the requisite work hours, and would be more likely to complete their program.

Another competing hypothesis is that large negative differences as captured by UR_{diff} indicate reduced outside options, which increase the likelihood that an apprentice will see the program through to completion. Conversely, large positive differences as captured by UR_{diff} indicate more abundant outside options, suggesting a higher likelihood of pursing options other than apprenticeship and thus not completing the program.

Estimation Results

Table 2 contains summary statistics of the variables used to estimate the empirical model's parameters. The first column reports proportions and arithmetic means for the entire sample. To test for robustness of results, the model is also estimated for two sample configurations. The third column reports summary statistics for apprentices in just eleven major crafts. Based on the sample of 17,851 observations, about 47 percent of trainees in programs between 2000 and 2012 successfully completed their programs. Using data on unemployment from the Bureau of Labor Statistics we computed the arithmetic mean difference in unemployment rates between the time of registration and the midpoint of the program to −1.531 percentage points. On average apprentices entered their programs during a time of deteriorating economic conditions, that is where unemployment rates during the month of the program midpoint were 1.531 percentage points larger than the unemployment rate during the month of program registration.[12]

Our findings also show that over half of trainees were white and almost a third were Hispanic. About 8 percent of apprentices were Black with smaller percentages composed of Asian, Hawaiian/Pacific Islanders, and Native Americans. Less than 5 percent of apprentices were female and less than 7 percent were military veterans. With respect to educational attainment, about 75 percent of trainees had at least a high school degree, slightly less than 7 percent had some high school, and 5 percent had less than nine years of education. Twelve percent had a GED degree and very few apprentices had some tech school backgrounds, or did not report their educational attainment. The average age of an apprentice at the time of registration was just over 28. Over 78 percent of apprentices registered in programs located in the Las Vegas metro area, about 15 percent were located in Reno with the remaining 7 percent located in more rural areas of the state. About 6 percent of the sample registered for their program in 2009, which was the year construction employment began to drop precipitously (see Table 1). Less than 3 percent of apprentices started their program during the cut-off year of 2012.

Since the entire sample includes apprentices in all training programs, both large and very small, we do not report the overall distribution. Data from the third column (Eleven Crafts) indicates that carpenter trainees represented about 30 percent of 13,780 registered apprentices over the period. Trainee electricians represented about 17 percent of the overall total. Structural steel workers made up about 12 percent of

Table 2. Summary Statistics of RAPIDS Data Used in the Analysis (2000-2017).

	Entire Sample		Eleven Major Crafts	
Variable	Mean/Prop	Std Dev	Mean/Prop	Std Dev
Completed program	0.473	–	0.472	–
UR difference	−1.531	2.775	−1.647	2.832
White	0.532	–	0.554	–
Black	0.077	–	0.079	–
Native American	0.020	–	0.022	–
Asian	0.026	–	0.025	–
HPII	0.008	–	0.007	–
Hispanic	0.328	–	0.305	–
Female	0.045	–	0.051	–
Veteran	0.065	–	0.067	–
Education < 9 years	0.051	–	0.053	–
Education 9–12 years	0.066	–	0.061	–
Education GED	0.122	–	0.118	–
Education HS or more	0.752	–	0.759	–
Education tech school	0.001	–	0.000	–
Education unknown	0.009	–	0.009	–
Age	28.3	8.1	28.1	8.1
Las Vegas	0.783	–	0.788	–
Reno	0.146	–	0.163	–
Registration in 2009	0.055	–	0.049	–
Registration in 2012	0.022	–	0.015	–
Electrician	–	–	0.169	–
Plumber	–	–	0.074	–
Pipefitter	–	–	0.067	–
Carpenter	–	–	0.298	–
Sheetmetal	–	–	0.047	–
Steelworker	–	–	0.116	–
Roofer	–	–	0.066	–
Tilesetter	–	–	0.029	–
Painter	–	–	0.047	–
Laborer	–	–	0.049	–
Operating engineer	–	–	0.038	–
Number in Sample	17851		13,780	

Source: Estimates generated using RAPIDS data 2000-2017 from Nevada. Data for 2017 is only partial.

trainees. The remaining trades (plumbers, pipefitters, sheet metal workers, roofers, tiles setters, painters, laborers and operating engineers) represented from about 7.5 percent to 3.0 percent of trainees a piece. The means for the demographic measures across the entire sample and subsamples of trainees are similar.

Table 3. Marginal Effects Probit Estimates of the Probability of Completing Apprenticeship.

	Model 1		Model 2		Model 3	
Variable	*dy/dx*	*t* stat	*dy/dx*	*t* stat	*dy/dx*	*t* stat
UR^{a}_{diff}	0.0162	(11.92)	0.0216	(15.89)	0.0239	(15.87)
Black non-Hispanic	−0.1120	(8.12)	−0.1110	(8.21)	−0.0859	(5.65)
Hispanic	−0.0461	(5.40)	0.0054	(0.62)	0.0238	(2.40)
Native American	−0.0854	(3.31)	−0.0764	(3.03)	−0.0691	(2.53)
Asian	−0.0486	(2.13)	−0.0329	(1.47)	−0.0143	(0.56)
Pacific Islander	−0.0131	(0.31)	−0.0149	(0.36)	0.0633	(1.29)
Female = 1	−0.0768	(4.38)	−0.0926	(5.44)	−0.1093	(6.11)
Veteran = 1	−0.0092	(0.60)	−0.0364	(2.46)	−0.0638	(3.91)
Education: 8 years or less	−0.1403	(8.44)	−0.0673	(3.91)	−0.0795	(4.22)
Education: 9–12 years	−0.0698	(4.67)	−0.0201	(1.31)	−0.0134	(0.74)
Education: GED	−0.0703	(6.26)	−0.0618	(5.63)	−0.0516	(4.14)
Education: post-secondary	0.2831	(2.05)	0.2775	(2.03)	–	–
Education: unknown	−0.1262	(3.31)	−0.0937	(2.48)	−0.0506	(1.16)
Age	0.0219	(7.50)	0.0199	(7.02)	0.0104	(3.23)
Age squared	−0.0003	(7.17)	−0.0003	(6.55)	−0.0001	(2.74)
Las Vegas = 1	−0.0158	(1.08)	−0.0325	(2.28)	0.0321	(1.72)
Reno = 1	−0.0580	(3.49)	−0.1127	(7.12)	−0.0320	(1.55)
Registration Year 2009	−0.1202	(7.63)	−0.1282	(8.40)	−0.1037	(5.68)
Registration Year 2012	−0.0696	(2.76)	−0.1154	(4.92)	−0.1721	(5.84)
N	17,851		17,851		13,780	
Estimated with entire sample	Yes		Yes		No	
Controlled for craft fixed effects	No		Yes		Yes	
Included only eleven major crafts	No		No		Yes	

[a]UR_{diff} is defined as the unemployment rate (UR) at the time of registration minus the UR midway into the workers expected completion period. A higher value of the variable (a positive number) indicates registration into a improving macroeconomic conditions, whereas a lower value indicates registration into deteriorating economic conditions. The sample does not include early cancellations. Also excluded from sample were observations with a registration date after the expected completion date and other obvious measurement errors.

We estimate the model for the probability of completion with a maximum likelihood probit procedure to arrive at parameter estimates. For intuitive appeal, the results are displayed in Table 3 as marginal effects. The parameter estimate associated with the primary independent variable, UR_{diff} may be interpreted as the point estimate of the change in the completion probability with respect to a one unit change in the difference between Nevada's monthly unemployment rate at time of registration and the rate at the expected midpoint of the representative apprentice's program.

The sign and statistical significance of estimates of β_1 provide a test of the competing hypotheses about the impact of macroeconomic volatility on apprenticeship completion rates. Let's assume the estimate of β_1 from the model above is positive. This implies that larger positive values of UR_{diff} i.e., registering into improving labor market conditions)

leads to higher probabilities of completion. If the estimate of β_1 is negative, it means that larger positive values UR_{diff} would lead to lower probabilities of completion, thus perhaps more abundant outside options lure registered apprentices away from the construction industry.

Similarly, if we assume the estimate of β_1 is positive, it would imply that smaller and negative values of UR_{diff} (i.e., registering into a bust) leads to a lower probability of completion. If the estimate of β_1 is negative, it means that smaller and negative values of UR_{diff} would lead to higher probabilities of completion, suggesting that perhaps fewer outside options bind apprentices more tightly to the construction sector apprenticeship, which increases the likelihood of completion.

Across the three specifications, the estimates of β_1 are positive and highly statistically significant, suggesting that registering into a booming economy positively affects the likelihood of completion and vice versa. We derived the first estimate 0.0162 from the full sample with no controls for craft fixed effects. The result implies that a one unit increase in the difference between the unemployment rate (UR) at registration and the UR midway through the program leads to a 0.0162-point increase in the probability of completion. For example, if the observed arithmetic mean UR_{diff} of −1.531 increases to −0.531 (a one unit increase), the predicted probability of completion moves from 0.472 up to 0.489.

Other results for Model 1 in Table 3 indicate that, compared to the reference category of white apprentices, Black, Hispanic, Native American, and Asian apprentices were less likely to complete their training programs. Completion by Pacific Islander trainees did not differ in terms of statistical significance from white apprentices. While female apprentices were less likely to complete training than males, there is no statistically significant difference in the probability of completion between veterans and non-veterans. Trainees with education levels less than a high school degree were less likely to complete. Those with some post-secondary education were more likely to complete than high school graduates. Older apprentices were more likely to complete their programs, but at a diminishing rate. Apprentices located in the Las Vegas area were no less likely to complete their training programs compared to apprentices residing outside of the state's two metro areas. However, those in Reno were less likely to successfully finish their programs. Apprentices who registered for their training programs in 2009 or in 2012 were less likely to finish.

To provide additional clarity on how the UR_{diff} measure relates to estimated completion probabilities, we compute predicted probabilities based on means/proportions of the control variables and various levels of the standard deviations of UR_{diff}. The results are presented in Table 4. In our base-line Model 1, which is estimated using the whole data set of apprentices ($N = 17{,}851$) who met the exclusion criteria with no controls for craft fixed effects, completion probabilities are estimated using a UR_{diff} that is −2.0, −1.5, −1.0, −0.5, 0.0, 0.5, 1.0, 1.5, and 2.0 standard deviations from the mean. With UR_{diff} at −2.0 standard deviations, the predicted probability is 0.383, while at +2.0 standard deviations from predicted probability is 0.562. The results suggest that for apprentices who registered into an economy that will has fallen off a cliff by the middle of their program, the probability of completion is substantially lower the for the apprentice who registers into building boom.

Table 4. Predicted Probabilities of Completion at Various Values of the Standard Deviation of the UR_{diff}[a] Variable.

Std Dev of the Indep Var UR_{diff}	All Apprentices: No controls for Craft (Model 1)	All Apprentices: Controls for 11 Major Crafts (Model 2)	Apprentices from Eleven Major Crafts (Model 3)
−2.0	0.3834	0.3551	0.3403
−1.5	0.4053	0.3836	0.3720
−1.0	0.4275	0.4128	0.4046
−0.5	0.4500	0.4425	0.4379
0.0	0.4726	0.4725	0.4718
0.5	0.4953	0.5027	0.5058
1.0	0.5180	0.5329	0.5399
1.5	0.5406	0.5629	0.5738
2.0	0.5631	0.5925	0.6072
	17,851	17,851	13,780

[a]UR_{diff} is defined as the unemployment rate (UR) at the time of registration minus the UR midway into the workers expected completion period. A higher value of the variable (a positive number) indicates registration into a boom, whereas a lower value indicates registration into a bust.

Other models in Table 4 show an even larger effect, the predicted completion probabilities range from 0.351 at −2.0 standard deviations from the mean of UR_{diff} to 0.624 for +2.0 standard deviations. Our Model 3 focuses on the eleven major crafts outlined in the study, including Electrical, Plumbing, Pipefitting, Carpentry, Sheet Metal, Steel Work, Roofing, Painting, Tile Setting, Laborer, and Operating Engineer, with results that are very similar.

Models 1 to 3 tell roughly the same story, that apprentices in Nevada registering into a booming economy experienced a statistically significant and materially meaningful higher probability of completing the program compared to their counterparts who registered into an economy characterized by deteriorating macroeconomic conditions. The predictions from Model 1 indicate a 47 percent improvement in the probability of completion as one moves from −2 to +2 standard deviations in the UR_{diff} measure. For the other specifications, the improvement in probability ranges from 74 percent for Model 2 to 79 percent for Model 3, again, materially meaningful changes.

A more modest comparison at −1.0 and +1.0 standard deviations of the UR_{diff} distribution, shows that the probability of completion increases by 21 percent using Model 1. For Model 3 completion probabilities increase by 33.5 percent. Such results remain meaningful and suggest that for apprentices in Nevada, macroeconomic volatility was certainly one of the most important of the observed factors associated with performance of apprenticeship programs.

Jointly Operated Vs Unilateral Programs

In Nevada, as in many other states, journey-level electricians and plumbers are trained in jointly operated apprenticeship programs and unilateral programs. To determine

differences in completion probabilities in the two approaches to apprenticeship, and to determine whether there is a difference in how completion probabilities are affected by macroeconomic shocks, the following model was estimated using a subsample comprised of electricians and plumbers.

$$P_{\text{completion}} = \beta_0 + \beta_1 \text{UR}_{\text{diff}} + \beta_2 \text{Joint Program} + \beta_3 \text{UR}_{\text{diff}} * \text{Joint Program} + \beta_4 X + \varepsilon \quad (3)$$

The findings in Table 5 show large positive and statistically significant estimates of β_2, indicating that apprentices in jointly operated programs are much more likely to

Table 5. Probability of Completing a Construction Apprenticeship Program: Comparing Joint and Unilateral Programs for Electricians and Plumbers.

Variable	Pooled: Joint and Unilateral	*t*-stat	Joint Program	*t*-stat	Unilateral Program	t-stat
UR_{diff}	0.0229	(5.09)	0.0143	(5.37)	0.0235	(4.72)
Union Program	0.2204	(11.73)	–	–	–	–
UR_{diff}*Union Program	−0.0105	(2.01)	–	–	–	–
Plumber	−0.0776	(4.31)	−0.0560	(2.74)	−0.1232	(3.45)
Black Non-Hispanic	−0.1063	(3.76)	−0.0966	(2.86)	−0.1224	(2.32)
Hispanic	0.0185	(0.83)	−0.0139	(0.51)	0.0704	(1.81)
Native American	−0.1717	(2.82)	−0.1457	(1.98)	−0.2220	(1.81)
Asian	−0.0013	(0.03)	0.0064	(0.10)	−0.0003	(0.00)
Hawaiian/Pacific Islander	0.0101	(0.13)	0.0114	(0.13)	−0.0341	(0.21)
Female	−0.1019	(2.86)	−0.1032	(2.64)	−0.1419	(1.58)
Veteran	−0.0193	(0.70)	−0.0242	(0.77)	−0.0283	(0.50)
Education 8th or Less	0.1980	(1.46)	0.0544	(0.28)	–	–
Education 9–12 No Diploma	0.0473	(1.01)	0.1029	(1.96)	−0.0280	(0.34)
Education GED	−0.0888	(3.39)	−0.0936	(2.83)	−0.0897	(2.07)
Education Tech School	–	–	–	–	–	–
Education Unknown	0.0018	(0.02)	−0.0053	(0.04)	0.0099	(0.04)
Age	0.0107	(1.63)	0.0157	(1.97)	0.0027	(0.24)
Age squared	−0.0002	(1.94)	−0.0003	(2.04)	−0.0001	(0.50)
Las Vegas	0.1111	(2.49)	0.1586	(2.64)	0.0288	(0.40)
Reno	0.0816	(1.94)	0.0503	(0.93)	0.1075	(1.45)
Registration Year 2009	−0.1132	(2.46)	−0.1694	(3.32)	0.1283	(1.02)
Registration Year 2012	−0.2254	(3.75)	−0.4590	(5.90)	−0.0365	(0.42)
Number in Sample	3,351		2,226		1,123	

Source: Estimates generated using RAPIDS data on Nevada: 2000- 2017. Estimated with Data EXCLUDING Early Cancellation

*See footnote of Table 5 for definition.

complete an apprenticeship program. Holding other things constant, combined electrical and plumbing apprentices in joint programs are about 23 probability points more likely to complete a program compared to similar apprentices enrolled in unilateral, non-union training programs. The primary question for the present study, however, is whether apprentices in jointly operated programs are affected differently by macroeconomic conditions compared to their counterparts in unilateral programs. This effect is captured by the estimate of β_3 on the interaction term UR_{diff} *Joint Program in equation (3), where interest is on the partial derivative of the probability of completion with respect to UR_{diff}. The estimate of the interaction term, β_3 is negative and statistically significant, suggesting that macroeconomic conditions exert less impact on completion probabilities among apprentices in jointly sponsored programs.[13]

The results are reinforced in Table 6, which displays predicted probabilities of completion at various standard deviations of the UR_{diff} variable. The findings show higher rates of completion for joint programs, but lower differences in predicted probabilities at standard deviations above and below the mean. Thus, moving from −2.0 to +2.0 standard deviations is associated with an increase in the probability of completion by 57 percent among electrical and plumbing apprentices in apprentices in joint programs. The figure for apprentices in unilateral programs is 99 percent. Similarly, moving from −0.5 to +0.5 standard deviations of the UR_{diff} variable increases the predicted probability of completion by 12 percent for joint program apprentices, but 18.6 percent for apprentices in unilateral programs. The numbers indicate both higher rates of completion and less variability (risk) for apprentices in jointly operated programs as it relates to macroeconomic conditions.

Although we do not have direct evidence of where the differences in jointly operating and unilateral programs emerge, a number of possibilities present themselves. First, apprentices in joint programs have a trade union to help them manage their

Table 6. Predicted Probabilities of Completion at Various Values of the Standard Deviation of UR_{diff}: Comparing Union and Non-Union Programs of Electricians and Plumbers.

Std Dev of UR_{diff}	Joint Program	Unilateral Program
−2.0	0.599	0.340
−1.5	0.628	0.375
−1.0	0.656	0.410
−0.5	0.683	0.446
0.0	0.709	0.482
0.5	0.735	0.519
1.0	0.759	0.555
1.5	0.781	0.591
2.0	0.803	0.626
N=	2,226	1,123

UR_{diff} is defined in the footnote of Table 3.

working relationship with employers. On the unilateral side, there is no union intervention that my help an apprentice to navigate the complexities of their training experience. Second, there may be a selection issue. Contractors who enter into collective bargaining agreements do so, in part, to gain access to a pool of highly skilled workers. Perhaps such contractors hold onto apprentices longer in the face of falling labor demand associated with higher unemployment rates based on an enhanced responsibility to participate in the training of the future workforce.

Third, as described above, the total compensation package negotiated with a union includes contributions to apprenticeship training. This results in greater resources expended on jointly managed programs, but also underscores participating contractors' commitment to training even in the face of recessionary conditions. Fourth, registered apprenticeship programs allow beginning trainees to earn a fraction of the journey worker rate. While this rate increases with progress through the program, there is an incentive to employ apprentices regardless of program completion. Jointly managed programs have mechanisms to ensure that apprentices move through the program to completion, even as their wages approach the journey rate. There are no guarantees of this type of mechanism on the unilateral side where contractors are less constrained to churn apprentices for financial reasons.

Discussion and Conclusions

We analyzed completion probabilities for construction apprenticeship programs as they relate to changes in macroeconomic conditions over the period between 2000 and 2017. Using data on apprentices in Nevada to estimates our multivariate model, we show that apprentices who registered for their program into a period of improving macroeconomic conditions were substantially more likely to complete their program than similarly situated apprentices that registered into a period of deteriorating conditions, who were less likely to complete their program. From an economics standpoint the result is troubling, because less training and fewer skilled workers threatens to reduce the productive potential in the construction sector and the economy more generally, which suggests that policies that could mitigate the wasted productive potential would be indicated. The results of our study support the contention of the U.S. Department of Labor, OAS (2011, 3) that "… the decline in completion rates over the past two years [2009 and 2010] is likely a result of the economic downturn and the general unavailability of work impacting the ability of apprentices to complete their OJL requirements."

Effective policy, however, requires a clear understanding of mechanisms that create the link between macroeconomic instability to apprenticeship completion rates. Finding such mechanisms is beyond the scope of this study, however, because the evidence does not exist in the RAPIDS data set. Fortunately, previous research has explored the determinants of completion and cancellation using a qualitative approach based on interviews with current and former apprentices in Cincinnati and Milwaukee could shed some light on matter (Helmer and Altstadt 2013). They concluded that most common obstacles to apprenticeship completion are related to (a) apprentice's financial

insecurity, (b) the workplace environment, (c) school and academic skills, and (d) personal and life issues. Although each obstacle includes a number of non-economic factors, it is reasonable to expect that recessionary economic conditions could play a role within each category.

Financial Insecurity

The pay of entry-level apprentices is as low as 40 percent of the journey worker rate, and although it climbs after various milestones are reached, for workers living on the edge financially, expectation of future raises may not be enough to warrant completion of the program. In addition to low pay, apprentices often experience frequent layoffs, which are even more frequent during recessions. Layoffs are a natural part of the ebb and flow of construction work; however, not only do they reduce income, but they also slow progression through the program. It is reasonable to expect that apprentices facing such conditions, and not being accustomed to them, will be less likely to complete their program, and that the likelihood of completion only falls during economic downturns.

Workplace Environment

Construction sites can be rough places to work regardless of conditions in the macroeconomy. One of Helmer and Altstadt's (2013) findings on workplace environment, however, may be related to macroeconomic conditions. While interviewing apprentices, researchers found that many of them complained of a lack of meaningful training from journey workers who are their trainers. If apprentices are used primarily as source of cheap labor without exposing them to meaningful training opportunities, the perceived lack of progress in skill acquisition may frustrate apprentices to the point that they do not complete their program. Indeed, during recessionary times when there seems to be a surplus of labor, trainers may be more likely to see apprentices as their replacements and thus be reluctant to provide meaningful training.

School and Academic Skills

Construction apprenticeships require classroom training along with training on the job. Under recessionary conditions when work is scarce, apprentices who have work may take all the hours they can get, even if it means skipping the classroom part of their program. It is reasonable to expect that such behavior, which may reduce the likelihood of completion, becomes more common during periods of recession.

Personal and Life Issues

Challenges such as work life balance emerge regardless of macroeconomic conditions. However, steady work and fewer layoffs during periods of macroeconomic prosperity

are more likely to provide financial resources necessary to deal with life's contingencies as they arise and thus increase the probability that an apprentice will see their program through to completion. For example, most daycare arrangements do not allow for parents to drop their children off only when needed, that is, only when the worker/parent is not on layoff. Thus, if apprentice pay is not enough to cover daycare expenses, especially during recessionary economic conditions, family obligations and completing an apprenticeship program may not be compatible, which leads to a lower likelihood of program completion.

Finally, our results also reinforce the notion that organizational structure of apprenticeship programs can have an impact on the relationship between completion rates and macroeconomic conditions. For example, we found that among apprentice electricians and plumbers, completion rates in jointly sponsored programs are less affected by changing macroeconomic conditions than programs that sponsored unilaterally by employers or employer associations. It would appear differences in organizational structure related to the form of sponsorship exerts materially important effects, which raise the likelihood that apprentices will complete their programs in spite of recessionary economic conditions.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Jeffrey Waddoups https://orcid.org/0000-0002-1199-9089

Notes

1. The statistics on construction employment were taken from U.S. Bureau of Labor Statistics "*State and Area Employment, Hours, and Earnings*.
2. Data on employment separations from 2000 to the period prior to the COVID-19 pandemic illustrate this volatility. Rates of employment separations in construction ranged from a high of 10.2 percent in January 2009 to a low of 3.6 percent in March of 2014. Over the same period, separations for the overall economy experienced a pre-pandemic high of 5.3 percent in January of 2001 and lows of 2.5 percent in February of 2010 and 2011. See Federal Reserve Economic Data "Total Separations: Construction" and Federal Reserve Economic Data "Total Separations: Total Nonfarm."
3. Bilginsoy (2003) provides a good analysis of labor market conditions make it difficult for firms to unilaterally train construction workers. He found a large union training advantage in the construction sector in relative share of apprenticeship programs and rates of retention and completion. Waddoups (2014) also documented a union training advantage, finding

that the construction industry was unique among other major industry categories with a large gap in the incidence of training based on union status.

4. As an example of these contributions, contractors in jointly managed programs in Illinois in 2019 contributed between $0.40 and $1.37 per hour to apprenticeship training. See Manzo, Gigstad, and Bruno (2021).
5. In the jointly managed sector, apprenticeships may be mandatory especially if covered by a Project Labor Agreement. Licensing requirements may also offer incentives for non-union contractors to participate in apprenticeship training.
6. For changes in unionization rates in construction see Hirsch, Macpherson and Even (n.d.).
7. This finding is based on a sample of apprentices who did not receive credit for previous work experience and were enrolled in programs with the same hour requirements for on-the-job training and time spent on related technical (classroom) instruction.
8. See World Construction Network (2013).
9. In the regression model discussed later in the article we control specifically for the registration year 2012, to account for the difference between it and other years. In regressions not reported, excluding apprentices who registered in the 2012 registration year does not materially alter the results.
10. Naturally, as apprentices experience the reality of construction work, for many it becomes apparent rather quickly that construction work is not a good fit. In fact, most who do cancel out of apprenticeships do so during the first year. According to the Aspen Institute's study based on data from 2006 and 2007, 26.5 percent exited in the first year (Helmer and Altstadt 2013). When we exclude early cancellations, the number of observations falls from $N =$ 24,260 to $N = 17{,}851$, a 26.4 percent decline. For the purpose of the present study, it is arguably more important to study completion probabilities among to extent decided that construction may be consistent with their career tastes and preferences, and who then may have been affected by the state of the macroeconomy during their training period.
11. Data on the Nevada's unemployment rate was obtained from the Federal Reserve Economic Data "Unemployment Rates in Nevada."
11. The next section has a more detailed discussion of the construction of the UR_{diff} variable.
13. The partial derivative of P Completion with respect to UR_{diff} is: δ P Completion/ δ $UR_{diff} =$ 0.0229–0.011*Joint Program. For apprentices enrolled in unilateral programs, the effect on the probability of completion with respect to UR_{diff} is 0.0229 (when Joint Program equals 0). For apprentices enrolled in joint programs, the effect on the probability of completion with respect to UR_{diff} is 0.0129, or 0.0229–0.011 (when the Joint Program variable equals one). The results of the interaction term demonstrate that the completion rate of apprentices enrolled in joint programs is less sensitive to changes in economic conditions.

References

Becker, Gary. 1962. "Investment in Human Capital: A Theoretical Analysis." *Journal of Political Economy* 70 (2): 9–49.

Bilginsoy, Cihan. 2003. "The Hazards of Training: Attrition and Retention in Construction Industry Apprenticeship Programs." *Industrial and Labor Relations Review* 57 (1): 54–67.

Bilginsoy, Cihan. 2007. "Delivering Skills: Apprenticeship Program Sponsorship and Transition From Training." *Industrial Relations: A Journal of Economy and Society* 46 (4): 738–65.

Bilginsoy, Cihan. 2018. "Unemployment, the Great Recession, and Apprenticeship Attrition in the US." *Journal of Vocational Education & Training* 70 (2): 171–92.

Duncan, Kevin, and Frank Manzo. 2016. "The Economic, Fiscal, and Social Effects of Kentucky's Prevailing Wage Law." *Illinois Economic Policy Institute*. https://illinoisepi.org/site/wp-content/themes/hollow/docs/prevailing-wage/kentucky-report-duncan-and-manzo-2016-final.pdf.

Federal Reserve Economic Data. n.d.a. "Total Separations: Construction." Total Separations: Construction (JTU2300TSR) | FRED | St. Louis Fed (stlouisfed.org).

Federal Reserve Economic Data. n.d.b. "Total Separations: Total Nonfarm." https://fred.stlouisfed.org/series/JTUTSR.

Federal Reserve Economic Data. n.d.c. "Unemployment Rates in Nevada." https://fred.stlouisfed.org/series/NVUR.

Glover, Robert, and Cihan Bilginsoy. 2005. "Registered Apprenticeship Training in the U.S. Construction Industry." *Education & Training* 47 (4-5): 337–49. https://doi.org/10.1108/00400910510601913

Helmer, Matt, and David Altstadt. 2013. *Apprenticeship Completion and Cancelation in the Building Trades.* The Aspen Institute. https://www.aspeninstitute.org/publications/apprenticeship-completion-cancellation-building-trades/.

Hirsch, Barry, David Macpherson, and William Even. n.d. "Union Membership, Coverage, and Earnings from the CPS." https://unionstats.com/.

Manzo, Frank, and Kevin Duncan. 2018. "The Economic, Fiscal, and Social Effects of Minnesota's Prevailing Wage Law." Midwest Economic Policy Institute. https://midwestepi.files.wordpress.com/2018/07/mepi-csu-examination-of-minnesotas-prevailing-wage-law-final.pdf.

Manzo, Frank, Jill Gigstad, and Robert Bruno. 2021. "The Economic and Fiscal Impact of Collective Bargaining Agreements in Construction: A Northern Illinois Case Study." Illinois Economic Policy Institute. https://illinoisepi.files.wordpress.com/2020/10/ilepi-pmcr-the-impact-of-collective-bargaining-agreements-in-construction-final.pdf.

Onsarigo, Lameck, Alan Atalah, Frank Manzo, and Kevin Duncan. 2017. "The Economic, Fiscal, and Social Effects of Ohio's Prevailing Wage Law." Midwest Economic Policy Institute. https://midwestepi.files.wordpress.com/2016/05/bowling-green-su-kent-state-ohio-pw-study-4-10-17.pdf.

Philips, Peter. 2003. "Dual Worlds: The Two Growth Paths in U.S. Construction." In *Building Chaos: An International Comparison of the Effects of Deregulation on the Construction*, edited by Peter Philips, and Gerhard Bosch, 167–87. London: Routledge.

Philips, Peter. 2015. "Wisconsin's Prevailing-Wage Law: An Economic Impact Analysis." National Alliance for Fair Contracting. https://faircontracting.org/wp-content/uploads/2019/06/Wisconsin%E2%80%99s-Prevailing-Wage-Law-An-Economic-Impact-Analysis.pdf.

U.S. Bureau of Labor Statistics. "State and Area Employment, Hours, and Earnings." https://www.bls.gov/help/one_screen/sm.htm.

U.S. Department of Labor, Office of Apprenticeship Services. 2011. "Bulletin 2011-07—Program Performance-Calculation of Registered Apprenticeship Program Completion Rates." https://www.dol.gov/sites/dolgov/files/ETA/apprenticeship/pdfs/Bulletin_2011-07_Completion_Rates.pdf.

Waddoups, Jeffrey. 2014. "Union Coverage and Work-Related Training in the Construction Industry." *Industrial and Labor Relations Review* 67 (2): 532–55.

World Construction Network. 2013. "CityCenter, Las Vegas." February 13. https://www.worldconstructionnetwork.com/projects/citycentrelasvegas/.

Author Biographies

Jeffrey Waddoups is a professor of economics at University of Nevada-Las Vegas. His research focuses on worker training.

Kevin Duncan is a professor of economics at Colorado State University-Pueblo. His research focuses on construction labor market policy.

Copyright of Labor Studies Journal is the property of Sage Publications Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.