The Impact of Minimum Wage Shocks on Low-Skilled Workers in the United States: Evidence from the H-2A Visa Agricultural Guestworker Program

Zachariah Rutledge[⋆], Marcello Castillo[⋆⋆], Timothy Richards[†], and Philip Martin[††]

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⋆ Postdoctoral research scholar at Arizona State University. Email: zjrutled@asu.edu

⋆⋆Economist, USDA Economic Research Service, email: marcelo.castillo@usda.gov

†Marvin and June Morrison Chair of Agribusiness, Morrison School of Agribusiness, Arizona State University, email: trichards@asu.edu

††Professor Emeritus, Agricultural and Resource Economics, UC Davis, email: martin@primal.ucdavis.edu

Abstract

We deploy a structural dynamic monopsony model to investigate whether the farm labor market is imperfectly competitive. Our structural calculations suggest that the average wage and employment levels are lower than those that would emerge in a perfectly competitive labor market. We also estimate elasticities of domestic farmworker wages and employment with respect to the Adverse Effect Wage Rate (AEWR), which is a minimum wage that is guaranteed to H-2A guest workers. Our reduced-form regression analysis reveals an elasticity of domestic worker wages with respect to the AEWR between 0.24 and 0.42. Our estimates of the effects of the AEWR on employment are typically positive but not always statistically significant, which is consistent with an imperfectly competitive labor market. Our estimates suggest that freezing the AEWR for one year could save agricultural employers between $240 million and $450 million on domestic farm labor costs.

Introduction

U.S. farmworkers provide a critical service to the nation by tending to and harvesting most of the food produced in the country. Farmworkers tend to have low educational attainment, and many are not authorized to work in the U.S., making them among the lowest paid workers. Historically, minimum wages have been used to provide a baseline standard of living and help reduce poverty among low-wage workers. A particular type of minimum wage, known as the Adverse Effect Wage Rate (AEWR), is a super-minimum wage that must be paid to foreign agricultural guest workers working under the H-2A visa program and the corresponding U.S. farmworkers who work for H-2A employers.[1] The AEWR is designed to prevent domestic farmworkers from facing downward wage pressure as a result of competition from foreign workers, many of whom may have low reservation wages due to the relatively poor economic conditions in their countries of origin (UFW v. DOL, 2020, p. 11; Congressional Research Service, 2008). However, little is known about how the AEWR affects the labor market outcomes of domestic workers. In this paper, we use a structural dynamic monopsony model to examine whether the farm labor market is imperfectly competitive and estimate reduced-form regressions to empirically analyze how changes in the AEWR affect the wages and employment levels of non-H-2A workers. We conclude by quantifying the labor-market impacts of using the AEWR as a policy tool.

In November of 2020, the US Department of Labor (DOL) announced a rule that would freeze the AEWR for two years and change the methodology for how it is computed moving forward. Farm employer advocates claim that the AEWR operates as a de facto minimum wage for all agricultural workers and that changes to the AEWR are necessary to keep farmers profitable in the U.S. (Crittenden, 2020; Lewison, 2021). But if the AEWR reflects the competitive market wage, then it seems strange that growers are complaining about the level of the AEWR, as they would have been paying that same wage anyway.

[1]Throughout this article we define U.S. farmworkers as native-born and foreign-born farmworkers who are not working under the H-2A visa program and who are not working for an employer who employs H-2A workers. We refer to these workers loosely as “domestic” farmworkers despite the fact that some of them are foreign-born and are present in the United States without legal authorization to work.

One explanation could be that the farm labor market operates in a state of imperfect competition due to frictions in the labor market and that the rising AEWR affects the bargaining position of employers.

Over the past decade, there has been a dramatic surge in the use of H-2A visa program, and the empirical literature related to it is incipient (Charlton and Castillo, 2020; Udani, 2016; Zahniser et al., 2012). In order to utilize the H-2A program, farm employers must provide evidence that "there are not sufficient able, willing, and qualified U.S. workers available to perform the temporary and seasonal agricultural employment for which nonimmigrant foreign workers are being requested" (DOL, 2021). One of the factors contributing to the rise in H-2A use is the diminishing supply of domestic farmworkers due to the expanding Mexican economy, lower birthrates among rural Mexicans, more off-farm employment opportunities for the rural Mexican population, and increased immigration enforcement (e.g., Taylor et al., 2012; Charlton and Taylor, 2016, 2020; Bampasidou and Salassi, 2019; Zahniser et al., 2018, 2020; Kostandini et al., 2013; Ifft and Jodlowski, 2016; Charlton and Kostandini, 2020). Farm labor shortages (and thus increased demand for H-2A workers) have also been influenced by a reduction in follow-the-crop migration (Fan et al., 2015). As fewer workers travel to work on farms, the geographic range of local labor markets diminishes, making labor shortages more prevalent during peak demand (Fisher and Knutson, 2013). Additionally, as the domestic farm workforce ages, the H-2A program becomes more attractive as employers can select younger, more productive foreign workers (Martin, 2017a, 2017b, 2019). Although there is an emergent literature related to the expansion of the H-2A program, the impacts of the minimum wage that employers have to pay H-2A workers (the AEWR) has yet to be examined in depth.

The minimum wage literature is vast and dates back at least to the early 1900s when U.S. economists debated the merits of a minimum wage (Neumark and Wascher, 2008). Some economists argued that the minimum wage would lead to the unemployment of low-skilled workers (Clark, 1913; Smith, 1907; Taussig, 1916), while others argued that the minimum wage was essential to prevent exploitation (Webb, 1912) and could improve the purchasing power of consumers (Filene, 1923). In terms of the effects of the minimum wage on employment, a number of studies have found evidence consistent with perfectly competitive labor markets in which raising the minimum wage above the market clearing wage reduces employment. For instance, Kim and Taylor (1995) find negative employment effects in the retail trade sector, Singell and Terborg (2007) for eating and drinking workers, and Kandilov and Kandilov (2020) in agricultural sector, to name a few. However, other findings suggest that labor markets, including those in agriculture, are not perfectly competitive (e.g., Card and Krueger, 1994; Singell and Terborg, 2007; Machin and Manning, 1994; Dickens et al. 1999; Richards, 2018). Consequently, the effects of the AEWR on wages and employment may differ from what others have found, and in fundamental ways.

In order to explore the extent to which the farm labor market is imperfectly competitive, we use a simplified version of the Burdett and Mortensen (1998) structural dynamic monopsony model developed by Manning (2003) to examine the link between the rate of farm job recruitment from unemployment and the weight given to the marginal revenue product of labor in the expected wage. In doing so, we are able to produce a relatively simple calculation that quantifies the extent to which the wage is lower than the one that would emerge in a perfectly competitive labor market. Our preliminary structural estimates indicate that the difference between the competitive equilibrium wage and the market clearing wage is equal to 15% of the difference between workers' average marginal revenue product of labor and their reservation wage. For example, if the average farmworker has a reservation wage of \$10 per hour and their marginal revenue product of labor is \$15, the wage would be \$14.25 (\$15 - (.15 × (\$15 - \$10)) or \$0.75 lower than the competitive equilibrium.

In an imperfectly competitive labor market, increases in the minimum wage will tend to increase the market clearing wage and employment. To empirically test for imperfect competition, we estimate the effects of the AEWR on domestic farm labor market outcomes by using reduced-form regressions linking wage and employment data to the AEWR. Because the AEWR represents a measure of lagged farmworker wages, simple OLS estimates would likely suffer from omitted variables bias. We deploy two tactics to address this issue. First we include a host of control variables to help control for potentially confounding factors (see Section 5.1). Second, we deploy an imperfect instrumental variable (IIV) strategy, which is formalized by Nevo and Rosen (2012) (see Section 5.2).

Our preliminary reduced-form results indicate that a 10% increase in the AEWR causes somewhere between a 2.4% and 4.2% increase in domestic farmworker wages. These results are consistent with those in Buccola, et al. (2012) and produce results that are qualitatively similar to the hourly wage results of Moretti and Perloff (2000). When analyzing the effects of the AEWR on employment (in terms of the number of full-time-equivalent (FTE) workers), some of our results are large, positive and statistically significant, which is consistent with a state of imperfect competition. In our most comprehensive regression models, the effects remain positive, but they are small and not statistically significant, suggesting that farm labor markets are imperfectly competitive, but perhaps only modestly so.

Our study makes several contributions. First we demonstrate an application of the Burdett-Mortensen-Manning dynamic monopsony model to quantify the extent to which the farm wage is below the one that would emerge in a perfectly competitive farm labor market. Several other studies have used Manning (2003)'s modeling approach to uncover evidence of imperfect competition in other markets (Ransom and Oaxaca, 2010; Ransom and Sims, 2010; Hotchkiss and Quispe-Agnoli, 2012), but we are the first to apply this method to the U.S. agricultural sector.

Second, we are the first to isolate the causal effects of the AEWR on domestic farmworker labor market outcomes. In all other examples, the minimum wage is an exogenously-imposed policy variable with readily estimable impacts on equilibrium market outcomes. In our case, however, the minimum wage is endogenous to current labor-market conditions. That is, the AEWR is based on a recent measure of wages and affects the labor market outcomes in the current period through channels that are not directly observed. To the best of our knowledge, only a few studies have analyzed the impacts of minimum wages in the U.S. agricultural sector, none of which have produced estimates of the causal effects of the AEWR on wages or employment (Buccola et al., 2012; Kandilov and Kandilov, 2020; Meer and West, 2016; Moretti and Perloff, 2000).

Last, we contribute to the policy discussion around the AEWR methodology by providing insights into the unintended consequences that changes to the AEWR methodology could have on the domestic workers that it was originally designed to protect. Specifically, our findings suggest that the AEWR influences domestic worker wages; therefore, it is not the neutral benchmark it is intended to be. As a result, any changes made to the AEWR methodology could have a significant impact on domestic workers. Furthermore, our results indicate that a higher AEWR could potentially lead to higher levels of domestic farm employment.

The following section provides some background details related to the H-2A visa program and the AEWR. Section 2 provides a theoretical framework to help explore the extent to which the farm labor market is imperfectly competitive. Section 3 describes our data and empirical strategy, Section 4 describes the results, and Section 5 provides some concluding remarks.

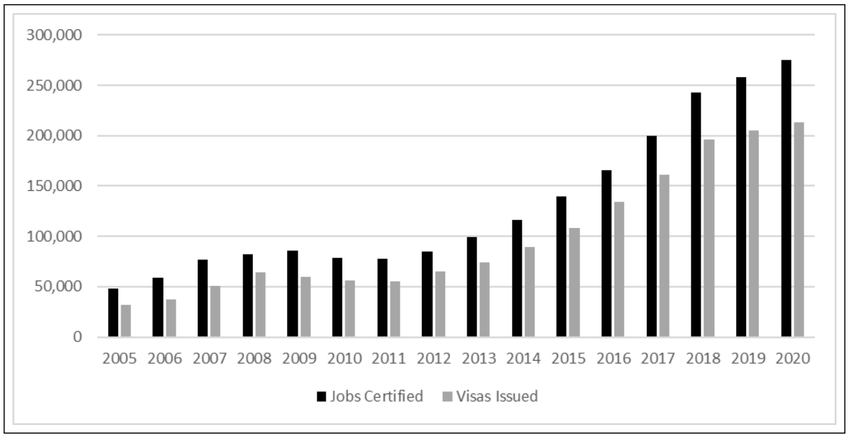
1 Background

Over the past decade, as the farm labor supply has become tighter due to a number of political, economic, and demographic factors (see Section 1), the H-2A program has rapidly expanded. Between 2010 and 2020, the number of H-2A visas issued to agricultural employers increased by 282% from 55,921 to 213,394 (see Figure 1; USDOS, 2021).[2] In 2020, the DOL certified agricultural employers to fill about 10 percent of the full-time equivalent (FTE) jobs on U.S. crop farms with H-2A guest workers, accruing an estimated H-2A wage bill of about $3.5 billion (Martin et al., forthcoming).

Foreign-born workers have been employed in U.S. agriculture for many decades, yet relatively poor economic conditions in their countries of origin have caused them to accept low wages and difficult working environments in the U.S. (Congressional Research Service, 2008). As a result, these workers have been viewed as an economic threat to the domestic workforce. In an attempt to mitigate adverse effects from the employment

[2] Historically between 70 and 80 percent of the jobs certified by the DOL have actually been issued a visa by the DOS.

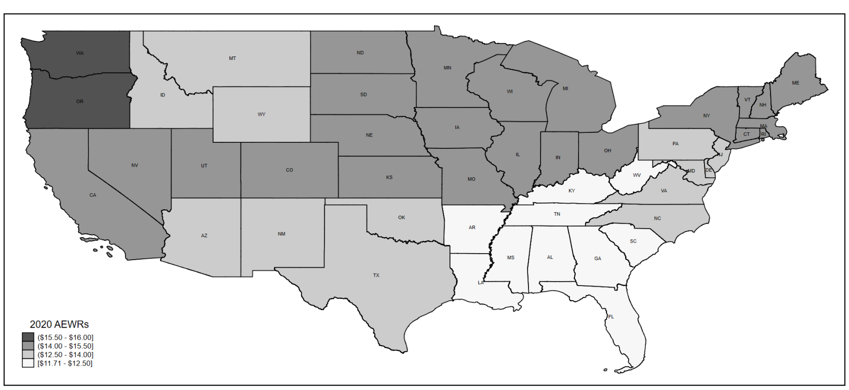
Figure 1: Number of H-2A jobs certified and visas issued, FY2005 – FY2020



of temporary foreign workers in the agricultural sector, H-2A workers and the domestic workers who work for H-2A employers must be paid an amount no less than the AEWR. They also must be paid the highest of the state or federal minimum wage, the prevailing wage, or the state AEWR.

The AEWRs are based on data from the USDA's Farm Labor Survey (FLS), which "provides the basis for employment and wage estimates for all workers directly hired by U.S. farms and ranches (excluding Alaska)" (NASS, 2021). In FY2020, the state-level AEWRs ranged from a low of $11.71 for states in the southeastern part of the country to a high of $15.83 for the state of Washington (see Figure 2). The state-level AEWRs are adjusted on an annual basis (typically upward) and are supposed to reflect the market clearing wage from the previous year.

Figure 2: AEWRs in FY2020



Note: Based on USDA Farm Labor Survey obtained at: `https://quickstats.nass.usda.gov/`.

Some economists have argued that even though the AEWRs act as a wage floor for foreign workers, they effectively act as wage ceilings for domestic farmworkers because employers who advertise employment opportunities to domestic workers at the AEWR can simply recruit H-2A workers if domestic workers are unwilling to perform farm work at that wage rate (Congressional Research Service, 2008). To the extent that the AEWR does, in fact, influence the labor market outcomes of domestic farmworkers, changes in the AEWR may potentially impact their earnings.

On July 26th, 2019, the DOL proposed changes to the way in which the AEWRs are calculated. Their proposal outlined a procedure for ending its reliance upon the FLS to calculate the AEWRs and proposed an AEWR freeze for 2021 and 2022. The DOL estimated that the AEWR freeze would save employers of H-2A workers an estimated $140 million a year (DOL, 2020). Martin et al. (forthcoming) estimate that this proposed wage freeze would also save employers an additional $29 million per year for the corresponding U.S. workers who are employed alongside H-2A workers. Instead of a single AEWR for each state, the DOL's proposed changes included the calculation of occupation-specific AEWRs for production-related jobs and the use of the DOL's Occupations Employment Statistics (OES) to set AEWRs for occupations not directly related to production, such as building construction and transportation. Before the DOL issued their final rule, the USDA terminated the FLS in September of 2020. However, in October of 2020, a federal judge ordered the USDA to continue conducting the FLS, which was used as the basis for calculating the AEWRs in 2021.

Even though the 2021-22 AEWR freeze is not scheduled to take effect, an estimate of the effects of an AEWR wage freeze on domestic workers is relevant and would provide useful information because the bipartisan Farm Workforce Modernization Act (FWMA or H.R. 1603 – 117th Congress), which was approved by the House in March 2021, includes an AEWR freeze and will likely be the subject of negotiations with the executive branch. The FWMA also proposes the use of occupation-specific AEWRs and would limit the annual increases to 3.25 percent through 2030. In addition to the economic impacts associated with the direct employment of H-2A workers, these proposed changes could potentially save farm employers hundreds of millions of dollars if they also slow the wage growth of domestic farmworkers, who make up about 90% of the farm workforce.

2 Theoretical framework

The majority of the work on monopsony power has been in the context of labor markets because it was recognized early on that manufacturing monopolies would also be monopsonists in the types of labor used for the production of the manufactured good (Ashenfelter et al., 2010). Other early examples of monopsony include the "company town," in which a single employer had market power over employees because alternative employment options were unavailable. In that context, workers bear a significant cost of changing jobs (either pecuniary or non-pecuniary). These types of labor market frictions allow employers to retain some wage-setting power. Lowering wages will cause some workers to leave the firm, but the employer is still able to recruit and retain employees over time. Although competition may exist among employers, the competition is not so severe such that workers can extract all the surplus out of the work relationship nor so weak such that employers can extract all the surplus.

In the standard textbook model of monopsony, the firm-level labor supply is modeled as a function of the wage.[3] In the case where the firm must pay all workers the same wage regardless of their reservation wage (i.e., if the firm is a nondiscriminating monopsonist), the firm's optimal labor decision occurs at a point where the relative difference between the marginal revenue product of labor and the wage paid to employees is equal to the inverse of the labor supply elasticity. In this sense, employers may gain surplus if there are labor market frictions that cause the firm to face an upward sloping labor supply curve. This surplus was originally coined by Pigou (1924) and Hicks (1932) as the "exploitation rate." Under a perfectly competitive labor market scenario, the labor supply elasticity facing the firm is perfectly elastic (i.e., approaches infinity), and the exploitation rate collapses to zero (see Equation (A.3)).

[3] A formal description of the textbook monopsony model can be found in Appendix A.

In the dynamic monopsony model, the firm's equilibrium employment level in the current period is a function of the job separation rate and the number of recruits. In the steady state, equilibrium employment is determined by ratio of the number of new job recruits to the job separation rate. Manning (2003) shows that a higher fraction of recruits from unemployment is associated with less competition in the labor market. Intuitively, this result emerges because in a competitive environment, a higher share of recruits should come from other employers rather than from unemployment. Manning estimates the proportion of job recruits coming from unemployment using the CPS and the U.K.'s LFS to provide "back-of-the-envelope" style calculations of the U.S. and U.K. labor markets, finding evidence that is consistent with monopsonistic labor markets in both cases.[4]

Although the number of employers in the labor market has historically been viewed as the sole factor that determines the degree of labor market competition, dynamic monopsony models allow for labor markets that are imperfectly competitive even if there are many competing firms as long as there are labor market frictions that reduce employees' ability to switch employers. Examples of labor market frictions include heterogeneous preferences for work with a particular type of employer, mobility costs, and gender. In light of these considerations, the extent to which workers are able to freely move among employers can provide insight into the level of competition in the labor market. However, the simple threat of employees quitting their job to work elsewhere is insufficient to determine the degree of labor market competition because the fact that workers quit the firm for work elsewhere is irrelevant if the firm can easily hire new workers out of unemployment. Therefore, the level of labor market competition is influenced by the rate at which individuals are offered jobs and the rate at which workers enter unemployment and are thus available to replace the workers who leave a firm for work elsewhere.

A simple statistic that captures this concept is the proportion of job recruits that come

[4]We attempted to conduct a similar analysis with the CPS data on farmworkers; however, there were significant data limitations that prevented us from doing so. Specifically, about 70% of the observations were missing for the variable that identifies whether the individual was recruited out of employment. After conditioning upon the farmworkers, there were too few observations to generate a meaningful estimate.

from unemployment. The higher this proportion, the less competitive the market is because it implies that a firm's employees have a relatively weak bargaining position, as firms can simply replace them with workers who were previously not employed. We use a simplified version of the Burdett and Mortensen (1998) model, developed by Manning (2003) to derive an equation for the recruitment rate from unemployment as a function of the separation rate to unemployment and the job offer rate.

The model, which is presented formally in Appendix B, assumes that there are M_w workers who are all equally productive and place a value on leisure of b. There are M_i employers, each of whom is assumed to be infinitely small relative to the total market. All employers have constant returns to scale where the marginal revenue product of each worker is equal to p. Employers set wages at a value that maximizes their steady state profits, assumed to be the same across all firms, and all workers within a single firm are paid the same wage, denoted by w. The cumulative distribution function (CDF) of wages across employers, which is assumed to be continuous without any spikes, is denoted by $F(w)$, and the probability density function (PDF) is denoted by $f(w)$. Employed and unemployed workers receive job offers at a rate of μ. Job offers are drawn at random from firms from the distribution $F(w)$. Employed workers leave their jobs for unemployment at an exogenous rate of δ. Employed and unemployed workers exit the labor force at an exogenously determined rate and are replaced by an equal amount of workers who initially enter unemployment. Employed workers move to another job when they receive a wage offer greater than their current wage and unemployed workers accept a new job when the wage offer is above their reservation wage b. Employers choose a wage that maximizes their profits according to the profit function $\pi = (p - w)L(w; F)$, where $L(w; F)$ is the steady state employment of a firm that offers wage w when the distribution of wages is $F(w)$.

Under these assumptions, the expected wage can be expressed as follows:[5]

$$\mathbb{E}[w] = \underbrace{\frac{\mu}{\delta + \mu}}_{\alpha} p + \underbrace{\frac{\delta}{\delta + \mu}}_{\beta} b, \tag{1}$$

where α (respectively β) represents the weight on the marginal revenue product of labor p (respectively reservation wage b). In Appendix C.3, we show that the job recruitment rate from unemployment R^u can be expressed as a function of α as follows:

$$R^u = \alpha \frac{1}{\ln(\frac{\delta+\mu}{\delta})}. \tag{2}$$

A simple labor market power calculation can be generated by identifying the value of the weight α that corresponds to the fraction of recruits from unemployment R^u. We present estimates of R^u and α in Section 6.1 for the U.S. farm labor market.

3 Data and methodology

3.1 Data

We bring together data from five sources to conduct our analyses. Our domestic farmworker wage data consists of individual-level data from the 1990-2016 NAWS samples. We restrict our sample to include only those individuals who were between the ages of 18 and 55 at the time of the survey, which retains about 90% of the sample. We adjust the nominal wage data to real 2017 dollar values using a consumer price index. The NAWS data also include a host of individual-level human capital variables that we use as controls in our regression analysis, which are described in Section 3.2. We also utilize the NAWS work grid file included in the confidential NAWS data files, which contain information about each farmworker's work history during the previous 52 weeks that allow us to compute the proportion of workers who were unemployed prior to being hired at their current farm job. We also use a producer price index for fruits, vegetables, and nuts obtained from

[5] See Appendix C.2 for proof.

the BLS covering the period 1990-2016. Our employment data come from the Quarterly Census of Employment and Wages (QCEW), which are aggregated at the state-year level and covers the period 1990 to 2016. Admittedly, this measure of employment has shortcomings due to the fact that it estimates FTE jobs rather than the actual number of workers. Furthermore, some states include H-2A workers in their QCEW employment measures, which may lead to measurement error in the outcome of interest. To address the latter issue, we conduct a separate analysis that subtracts the number of H-2A job certifications from the states we know include H-2A workers in their employment numbers (California, Oregon, and Washington). The H-2A certification data were obtained from the DOL's public H-2A disclosure files. Because the H-2A data are only available as far back as 2008, our supplemental analysis tha uses them only covers the sample period 2008-2016. Finally, the AEWR data were obtained from the USDA's Farm Labor Survey (FLS) through the NASS Quickstats website. Specifically, the AEWR represents the average regional wage for hired crop and animal workers from the previous year, which we assign to the states that belong to each region. A selection of summary statisics can be found in Table 1.

Table 1: Summary statistics

	Mean	Median	SD
Real wage ($2017)	10.39	9.47	3.10
Real AEWR ($2017)	10.92	10.93	0.74
Age (years)	34.20	33	10.26
Male	0.80	1	0.40
Married	0.61	1	0.49
Undocumented	0.52	1	0.50
Migrant	0.26	0	0.44
Speaks good English	0.22	0	0.41
Number of kids in household	0.97	0	1.37
Number of years of education	7.50	6	3.71
Number of observations	37,762	37,762	37,762

3.2 Methodology

The main identification challenge with estimating the effect of changes in the AEWR on the labor market outcomes of domestic farmworkers is omitted variables bias. For example, if the AEWR in the current period is negatively correlated with unobserved farm labor supply shocks in the previous period, then the OLS estimate of the elasticity of domestic farmworker wages with respect to the AEWR will tend to be biased if lagged labor supply shocks are also correlated with domestic farmworker wages and employment in the current period.

3.2.1 Reduced-form regression specifications

To estimate the effect of the AEWR on domestic worker wages, we estimate the following reduced-form regression model:[6]

$$\ln w_{ist} = \alpha_0 + \alpha_1 \ln AEWR_{st} + \mathbf{\Gamma W}_i + \phi_s + \phi_t + PPI_{st} + t_s + t_s^2 + u_{ist} \tag{3}$$

where i denotes the individual, s denotes the state, t denotes the year, $\ln w_{ist}$ denotes the log weekly wage of a domestic farmworker, and $\ln AEWR_{st}$ denotes the log AEWR in the current period. To help address the potential for omitted variables bias, we include a vector of individual-level control variables $\mathbf{W}_i$, which identifies each farmworker's job task (e.g., harvest work), age, gender, marital status, undocumented status, schooling level, migrant status, the number of kids in the household, and ability to speak good English. To the extent that farmworkers have remained in the same FLS region for a year or longer, including the human capital variables would help control for individual characteristics that may be correlated with an individual's wage, and thus the AEWR. The variables ϕ_s are state fixed effects, which should help control for regional differences in the cost of living or other state-specific factors, such as state minimum wages, which are likely correlated with both domestic farmworker wages and the AEWR. The variables $PPI_{st} = \phi_s \times PPI_t$ are a set of state fixed effects interacted with a national-level price index for fruits, vegetables, and nuts PPI_t. If output price fluctuations influence wages, controlling for them should help reduce estimation bias. The variables ϕ_t are year fixed effects, which help control for macroeconomic shocks that are common to all states (e.g., recessions) that may be

[6]Note that this not a panel regression model. The NAWS data come in the form of a repeated cross section.

correlated with domestic worker wages and the AEWR. The variables $t_s = \phi_s \times t$ and $t_s^2 = \phi_s \times t^2$ are state specific time trends, respectively, where t is a continuous time variable and $t_s + t_s^2$ identifies a set of quadratic state time trends. These time trends help control for smooth, yet potentially nonlinear, changes over time, such as local labor supply trends, which may influence wages and the AEWR (Charlton and Taylor, 2016). The error term is denoted by u_{ist}.

To estimate the effect of the AEWR on farm employment, we estimate the following regression model:

$$\ln Emp_{srt} = \alpha_0 + \alpha_1 \ln AEWR_{st} + \mathbf{\Gamma W}_{rt} + \phi_s + \phi_t + PPI_{st} + t_s + t_s^2 + u_{ist} \tag{4}$$

where s denotes the state, r denotes the FLS region, t denotes the year, and $\ln Emp_{st}$ denotes the state-level QCEW employment of direct hires in crop production (NAICS 111) and crop support workers (NAICS 1151). The vector $\mathbf{W}_{rt}$ includes the same human variables as in the wage analysis (excluding the job task variable) but identifies averages aggregated at the FLS region level. The rest of the variables were previously defined in the wage specification, except for u_{srt}, which is the error term. Although the inclusion of fixed effects and control variables plausibly mitigates the omitted variables bias, one may still be concerned about additional confounding factors.

To help address any remaining sources of bias, we deploy an imperfect instrumental variable strategy that permits us to identify two sided bounds for the parameter of interest by utilizing the methodology proposed by Nevo and Rosen (2012). We define our imperfect instrument as $\overline{\ln AEWR}_{st}^{S-s}$, which identifies the log AEWR averaged across all other states, excluding the state of interest. It is plausible that unobservable factors at the state level (e.g., lagged local labor supply and demand shocks) are less correlated with the AEWR in other states than they are with the state's own AEWR (but are correlated in the same direction). For instance, regional labor supply shocks would plausibly have a stronger influence on regional wages than they do on the wages in other regions, but the macroeconomic factors that induce overall labor supply shocks affect wages at the local and national levels in a the same direction. Imagine a scenario in which increased border security causes a decline in the overall supply of farm labor in the country, which subsequently reduces the farm labor supply in California. We believe it is plausible that a reduction in California's farm labor supply would have a more direct impact on California's farm wages (and thus the AEWR in California) than it would on farm wages in other states, but that other states would also experience a decline in the supply of farm workers, so farm wages would increase both in California and elsewhere. In this sense, our instrument may still violate the exclusion restriction, but it is arguably less endogenous than the regressor of interest, producing a viable candidate for an IIV.

3.2.2 The imperfect instrumental variable (IIV) strategy

To make ideas clear, let ρ_{JK} denote the correlation coefficient between two variables J and K, X denote the endogenous variable $\ln AEWR_{st}$, U denote the error term u_{ist}, and Z denote an instrumental variable that satisfies the following conditions:

$$0 \geq \rho_{ZU}| \geq |\rho_{XU}| \tag{5}$$

and

$$\rho_{ZU}\rho_{XU} \geq 0. \tag{6}$$

These two conditions imply that the instrument has the same direction of correlation with the error term that the endogenous regressor has, but that the correlation between the instrument and the error term is smaller in magnitude than the correlation between the endogenous regressor and the error term. In this sense, the instrument may still violate the exclusion restriction (and is thus an "imperfect" instrument), but it is less endogenous than the regressor of interest.

The ratio $\lambda = \rho_{ZU}/\rho_{XU}$ is bounded by the interval [0, 1], so a valid exclusion restriction can be expressed as follows:

$$\mathbb{E}[\sigma_X Z - \lambda\sigma_Z X)U] = \sigma_X\sigma_{ZU} - \lambda\sigma_Z\sigma_{XU} = 0, \tag{7}$$

where σ_{JK} denotes the covariance between two variables J and K, and σ_J denotes the standard deviation of some variable J. If the value of λ was known, one could simply use the variable $V(\lambda) = \sigma_X Z - \lambda \sigma_Z X$ to construct a valid instrument to estimate the true effect. Although the value of λ is unknown, $V(\lambda)$ can be evaluated at the limiting values of λ to identify bounds for the parameter of interest.

To formalize the IIV strategy, suppose one wants to estimate the following regression:

$$Y = X\beta + \mathbf{W}\delta + U, \tag{8}$$

where Y is the outcome variable, X is the log AEWR variable, W is a vector of control variables, and U is the error term, which satisfies $\mathbb{E}[W'U] = 0$. Let Z denote the instrument $\overline{\ln AEWR}_{St}^{S-s}$, $\tilde{Y}$ denote the residuals from a regression of Y on $\mathbf{W}$, and $\tilde{X}$ denote the residuals from a regression of X on $\mathbf{W}$. Nevo and Rosen (2012) provide a testable condition (see Proposition 2) that, assuming conditions (5) and (6) are met, allows the researcher to determine if the IV estimates provide a one-sided bound or two sided bounds by using the sample data to test the sign of $(\sigma_{\tilde{X}Z}\sigma_Z - \sigma_X \sigma_{\tilde{X}Z})\sigma_{\tilde{X}Z}$. In our case, the test results indicate that our IV analysis will produce two-sided bounds.

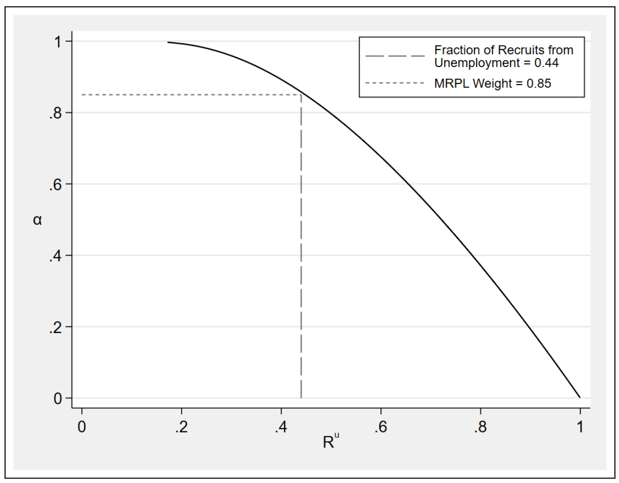
4 Results

4.1 Estimates of imperfect competition

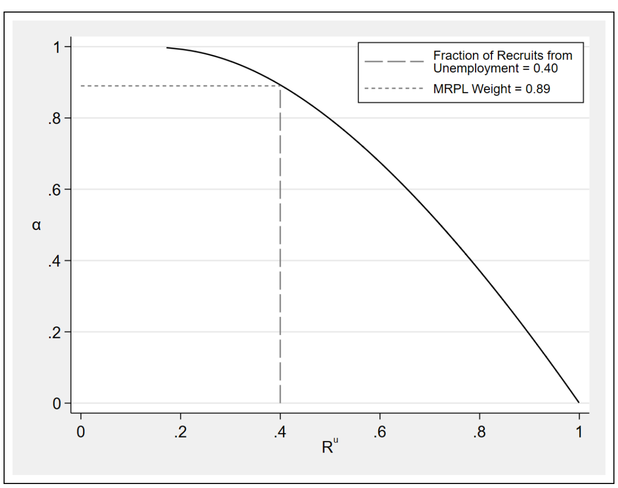
The relationship between α and R^u from Equation (2) is depicted by the downward sloping black curves in Figure 3. Note that the relationship is nonlinear, such that a proportion of recruits from unemployment less than 25% corresponds to a MRPL weight of at least 98%, and a proportion equal to 50% corresponds to a weight of only 80%.

Our analysis of the NAWS work grid data file contained in the restricted access data set determined that the share of farmworker recruits entering into employment from unemployment is approximately 0.44 such that the value of α is 0.85. These calculations suggest that if the average farmworker's reservation wage is below their MRPL, the expected wage is lower than the one that would emerge in a perfectly competitive labor market. Specifically, our estimates indicate that firms are able to pay wages are lower than the competitive equilibrium by an amount equal to 15% of the difference between the average worker's MRPL and their reservation wage. To the extent that the gap between the MRPL and the reservation wage is large, this would imply a significant degree of imperfect competition in the farm labor market.

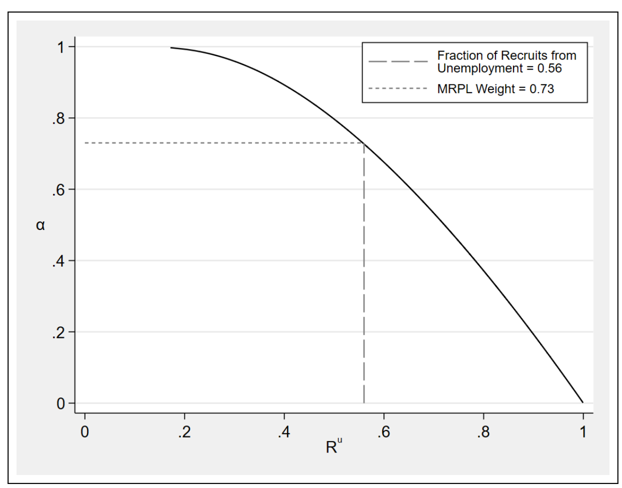
Figure 3: Relationship between the marginal revenue product of labor weight α and the fraction of farmworker recruits from unemployment R^u



a: Full sample



b: Male workers



c: Female workers

Table 2 shows the farm labor market power calculations for male/female workers and for male workers whose spouse does/does not have a nonfarm (NF) job (a proxy for having an off-farm work network). The results from the gender analysis are consistent with previous research, which has found that women tend to be exposed to a higher degree of labor market discrimination due to their less elastic supply of labor to firms (Hotchkiss and Quispe-Agnoli, 2012). Our calculations indicate that the value of α for female (respectively male) farmworkers is 0.73 (respectively 0.89). Similarly, male workers who have a spouse working in a nonfarm job tend to have a higher rate of employment prior to entering their current farm job; thus, they are subject to less downward wage pressure.

Table 2: Farm labor market power calculations

	R^u	α
Full sample	0.44	0.85
Male	0.40	0.89
Female	0.56	0.73
Spouse has NF job (male workers)	0.33	0.94
Spouse does not have NF job (male workers)	0.41	0.88

4.2 Wage-AEWR regression analysis

Our preliminary wage results are presented in Tables 3 and 4. The results in Table 2 are based on all crop workers, and the results in Table 3 are based only on a subset of low wage workers who reported earning less than the AEWR. Each table has 7 columns, each of which corresponds to a model specification that includes a different set of controls. The estimates on the left (respectively right) side of the table are from models that include the least (respectively most) comprehensive set of controls. Each table also has three rows. For a given table, the top row presents the OLS results, and the second (respectively, third) row presents the estimates for the upper (respectively, lower) bounds as determined by the instrumental variables analysis.

Two things are worth mentioning. First, the bounds identified by the instrumental variables analysis are tight for most specifications, which identifies the parameter of interest within a relatively narrow range of values. Second, the IV bounds are very close to the OLS estimates, which suggests that the OLS specification may have adequately dealt with the issue of omitted variables bias.

Table 3: Wage-AEWR elasticity estimates for all crop workers (1990-2016)

	(1) $\ln w$	(2) $\ln w$	(3) $\ln w$	(4) $\ln w$	(5) $\ln w$	(6) $\ln w$	(7) $\ln w$
				OLS			
$\ln AEWR$	0.699***	0.683***	0.341**	0.417**	0.573**	0.535**	0.405**
	(0.0575)	(0.0789)	(0.147)	(0.172)	(0.229)	(0.259)	(0.197)
				IV			
				Upper Bound			
$\ln AEWR$	0.756***	4.121	0.341**	0.422**	0.579**	0.536**	0.423**
	(0.0964)	(5.467)	(0.147)	(0.169)	(0.227)	(0.257)	(0.197)
				Lower Bound			
$\ln AEWR$	0.579***	0.762***	0.341**	0.417**	0.573**	0.535**	0.240*
	(0.154)	(0.110)	(0.147)	(0.172)	(0.228)	(0.258)	(0.130)
N	55,089	55,089	55,089	55,089	55,089	55,089	37,762
State F.E.	–	X	X	X	X	X	X
Year F.E.	–	–	X	X	X	X	X
Linear State Trends	–	–	–	X	–	–	–
Quadratic State Trends	–	–	–	–	X	X	X
Price Index Controls	–	–	–	–	–	X	X
Demographic Controls	–	–	– –	–	–	–	X

Note: All regressions are weighted using the NAWS weighting variable "pwtycrd." Standard errors in parentheses are clustered at the NAWS primary sampling unit level using the NAWS variable "cluster." * $p < .1$, ** $p < .05$, *** $p < 0.01$

The results from our preferred specification are presented in column (7) of Table 3. Our IIV results indicate that the elasticity is bounded between the values of 0.24 ad 0.42. As a result a 10% increase in the AEWR induces a 2.4% to 4.2% increase in the average wage of U.S. crop workers. If we focus only on the subset of crop workers who report making less than the AEWR (see Table 4), the estimates are generally larger in magnitude. For these lower wage workers, the results from our preferred specification (column (7)) essentially point identify the elasticity at 0.40 such that a 10% increase in the AEWR would induce a 4.0% increase in their wages. These results are consistent with Neumark and Washer (2008)'s review of the minimum wage literature, which concludes that the effects of minimum wage increases are more concentrated among workers on the bottom tail of the income distribution.

Table 4: Wage-AEWR elasticity estimates for workers with wages less than the AEWR (1990-2016)

	(1) $\ln w$	(2) $\ln w$	(3) $\ln w$	(4) $\ln w$	(5) $\ln w$	(6) $\ln w$	(7) $\ln w$
				OLS			
$\ln AEWR$	0.842***	0.814***	0.393***	0.481***	0.745***	0.697***	0.399***
	(0.0465)	(0.0613)	(0.0959)	(0.135)	(0.185)	(0.192)	(0.141)
				IV			
				Upper Bound			
$\ln AEWR$	0.908***	3.426*	0.393***	0.485***	0.753***	0.702***	0.399***
	(0.0652)	(1.782)	(0.0941)	(0.133)	(0.181)	(0.187)	(0.140)
				Lower Bound			
$\ln AEWR$	0.695***	0.929***	0.393***	0.481***	0.746***	0.697***	0.397***
	(0.0996)	(0.0761)	(0.0956)	(0.135)	(0.184)	(0.191)	(0.140)
N	39,665	39,665	39,665	39,665	39,665	39,665	27,440
State F.E.	–	X	X	X	X	X	X
Year F.E.	–	–	X	X	X	X	X
Linear State Trends	–	–	–	X	–	–	–
Quadratic State Trends	–	–	–	–	X	X	X
Price Index Controls	–	–	–	–	–	X	X
Demographic Controls	–	–	––	–	–	–	X

Note: All regressions are weighted using the NAWS weighting variable "pwtycrd." Standard errors in parentheses are clustered at the NAWS primary sampling unit level using the NAWS variable "cluster." * $p < .1$, ** $p < .05$, *** $p < 0.01$

4.3 Employment-AEWR results

Our preliminary employment results are presented in Tables 5 and 6. The results in Table 4 use all the available data between 1990 and 2016. When focusing on the full sample, the elasticity estimates are always positive and range from 0.06 to 1.54 depending on the model specification. The estimates from our specification that includes state and year fixed effects (see column (3)) are highly significant and reveal that the employment-AEWR elasticity lies somewhere in the range of 1.47 to 1.54. However, the introduction of state trends leads to a set of results that are small in magnitude and insignificant, although they remain positive. This result could possibly result from the fact state trends explain most of the variation in the AEWR variable, leaving no identifying variation left. A simple regression of the log AEWR on a set of linear (respectively quadratic) state trends reveals an R^2 of 0.76 (respectively, 0.83), suggesting that a model without state trends might be more appropriate.

Table 5 presents the results on the restricted sample of data for which the H-2A certification data is available at the state level (2008-2016). This set of results subtracts the number of H-2A certifications from the QCEW employment measures for CA, OR, and WA. These results are qualitatively similar to those produced with the larger sample, although the coefficients are generally smaller in magnitude. The estimates from the more comprehensive specifications suggest that the elasticity of employment with respect to the AEWR is non-negative. Taken together with the wage results, our reduced-from results suggest that the farm labor market is not perfectly competitive.

Table 5: Employment-AEWR elasticity estimates - full sample (1990-2016)

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln Emp$	$\ln Emp$	$\ln Emp$	$\ln Emp$	$\ln Emp$	$\ln Emp$
	OLS					
$\ln AEWR$	1.103	0.840***	1.468***	0.111	0.008	0.0672
	(0.966)	(0.224)	(0.456)	(0.166)	(0.124)	(0.121)
	IV					
	Upper Bound					
$\ln AEWR$	1.421***	0.756***	1.537***	0.111	0.008	0.0694
	(0.390)	(0.215)	(0.469)	(0.166)	(0.124)	(0.119)
	Lower Bound					
$\ln AEWR$	0.117	0.160	1.470***	0.106	0.007	0.0672
	(3.854)	(0.476)	(0.456)	(0.164)	(0.123)	(0.121)
N	1,115	1,115	1,115	1,115	1,115	1,028
State F.E.	–	X	X	X	X	X
Year F.E.	–	–	X	X	X	X
Linear State Trends	–	–	–	X	–	–
Quadratic State Trends	–	–	–	–	X	X
Demographic Controls	–	–	–	–	–	X

Note: Standard errors in parentheses are clustered at the state level. * $p < .1$, ** $p < .05$, *** $p < 0.01$

5 Conclusion

U.S. farmworkers are on the bottom rung of the wage ladder. Although the use of the H-2A visa program has increased dramatically over the past two decades, the U.S. farm labor force is largely comprised of Mexican workers who have settled in the U.S. For all intents and purposes, these workers are American, although many of them lack the legal

Table 6: Employment-AEWR elasticity estimates - restricted sample (2008-2016)
(H-2A certifications subtracted from QCEW employment measures in Pacific Coast states)

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln Emp$	$\ln Emp$	$\ln Emp$	$\ln Emp$	$\ln Emp$	$\ln Emp$
			OLS			
$\ln AEWR$	-0.313	1.138***	0.716**	0.0525	0.0350	0.0327
	(1.532)	(0.223)	(0.335)	(0.102)	(0.0888)	(0.104)
			IV			
			Upper Bound			
$\ln AEWR$	1.207	1.963***	0.769**	0.0528	0.0349	0.0326
	(0.861)	(0.572)	(0.341)	(0.099)	(0.0888)	(0.104)
			Lower Bound			
$\ln AEWR$	-1.037	1.430***	0.719**	0.0525	0.0343	0.0307
	(2.352)	(0.276)	(0.335)	(0.102)	(0.088)	(0.105)
N	359	359	359	359	359	339
State F.E.	–	X	X	X	X	X
Year F.E.	–	–	X	X	X	X
Linear State Trends	–	–	–	X	–	–
Quadratic State Trends	–	–	–	–	X	X
Demographic Controls	–	–	–	–	–	X

Note: Standard errors in parentheses are clustered at the state level. * $p < .1$, ** $p < .05$, *** $p < 0.01$

authorization to reside or work in the U.S. Because farmworkers are weakly positioned due to their legal status and relatively low educational attainment, they tend to be more vulnerable than other low-skilled workers.

Our simple structural estimates indicate that farm labor market is likely imperfectly competitive. Our analysis suggests that the market clearing wage is lower than the competitive equilibrium by an amount equal to 15% of the difference between the average worker's MRPL and their reservation wage. The extent to which the surplus farm employers gain from the work relationship depends upon the size of the gap between the average worker's MRPL and their reservation wage.

Our reduced-from empirical analysis generally confirms the evidence produced by our structural model. The wage-AEWR elasticity lies somewhere in the range of 0.24 to 0.42, suggesting that higher minimum wages for H-2A workers influence the equilibrium wage of domestic workers. In terms of employment, our analysis points to a positive, or at least non-negative, employment-AEWR relationship. Some of our less comprehensive specifications show large, positive, statistically significant elasticity estimates, although our more comprehensive specifications show relatively small correlations that are not statistically significant.

Nationally, the AEWR has grown at a rate of 3.5% per year over the past decade. Our results suggest that an AEWR freeze could potentially slow domestic farmworker wage growth by 0.8% (3.5% $\times$0.24) to 1.5% (3.5% $\times$0.42) per year. Because domestic farm wages account for roughly $30 billion per year, an AEWR freeze could save employers of domestic workers somewhere between $240 million ($30bil $\times$0.8%) and $450 ($30bil $\times$1.5%) million per year. These domestic farm labor cost savings would be added to the estimated $140 million that farm employers would save on H-2A labor and the $29 million for corresponding domestic workers who work for H-2A employers. Because there appears to be a causal link between the AEWR and domestic farmworker wages, changes to the AEWR could significantly impact the wage bill for domestic farm employers.

6 References

Ashenfelter, Orley C., Farber, Henry, and Ransom, Michael R. (2010). Labor Market Monopsony. Journal of Labor Economics, 28(2):203-210.

Bampasidou, Maria and Salassi, Michael E. (2019). Trends in U.S. Farm Labor and H-2A Hired Labor: Policy and Related Issues. Choices, 34(1).

Bracero History Archive (2019). About. Bracero History Archive. Retrieved February 14th from: `http://braceroarchive.org/about`.

Buccola, S., Li, C., and Reimer, J. (2012). Immigration Control and Minimum-Wage Effects on Agricultural Labor Supply. American Journal of Agricultural Economics, 94(2):464-470.

Burdett, Kenneth and Mortensen, Dale T. (1998). Wage Differentials, Employer Size, and Unemployment. International Economic Review, 39(2):257-73.

Card, David and Krueger, Alan B. (1994). Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania. The American Economic Review, 84(4):772-793.

Card, David and Krueger, Alan B. (2000). Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania: Reply. The American Economic Review, 90(5):1397-1420.

Charlton, Diane, and Castillo, Marcelo. (2020). Potential Impacts of a Pandemic on the US Farm Labor Market. Applied Economic Perspectives and Policy, 43(1):39-57.

Charlton, Diane and Taylor, J. Edward. (2016). A Declining Farm Workforce: Analysis of Panel Data from Rural Mexico. American Journal of Agricultural Economics, 98(4):1158–1180.

Charlton, Diane and Taylor, J. Edward. (2020). Rural School Access and the Agricultural Transformation. Agricultural Economics, 51(5):641-654.

Congressional Research Service. (2008). Farm Labor: The Adverse Effect Wage Rate (AEWR). Congressional Research Service Report RL32861 retrieved February 22, 2021 at: `https://nationalaglawcenter.org/wp-content/uploads/assets/crs/RL32861.pdf`.

Critterden, Allison. (2020). The Adverse Effect of the H-2A Wage Rate. Utah Farm Bureau Federation. Retrieved June 7, 2021 from: `https://www.utahfarmbureau.org/Article/The-Adverse-Effect-of-the-H2A-Wage-Rate`.

Department of Homeland Security (DHS). (2021). H-2A Temporary Agricultural Worker Program. Retrieved from DHS website on February 22, 2021 at: https://www.dhs.gov/h-2a-temporary-agricultural-worker-program.

Dickens, Richard, Machin, Stephen, Manning, Alan, Metcalf, David, Wadsworth, Jonathan, and Woodland, Stephen. (1995). The Effect of Minimum Wages on UK Agriculture. Journal of Agricultural Economics, 46(1):1-19.

DOL. (2020). Adverse Effect Wage Rate Methodology for the Temporary Employment of H-2A Nonimmigrants in Non-Range Occupations in the United States. Employment and Training Division Final Rule. Retrieved May 27, 2021 from: https://www.dol.gov/sites/dolgov/files/ETA/oflc/pdfs/H-2A_AEWR_Final_Rule_With_Disclaimer.pdf.

DOL. (2021). H-2A Temporary Agricultural Program [web page]. Retrieved June 7, 2021 from: https://www.dol.gov/agencies/eta/foreign-labor/programs/h-2a.

Fisher, Dennis U. and Knutson, Ronald D. (2012). Uniqueness of Agricultural Labor Markets. American Journal of Agricultural Economics, 95(2): 463-469.

Frisch R. and Waugh, F. V. (1933). Partial time regressions as compared with individual trends. Econometrica 1:387–401

Giles, DE. (1984). Instrumental variables regressions involving seasonal data. Economics Letters 14:339–343.

Grossman, Jean Baldwin. (1983). The Impact of the Minimum Wage on Other Wages. The Journal of Human Resources, 18(3): 359-378.

Hertz, Tom. (2019). Determination of the Adverse Effect Wage Rate: Levels (Working

Paper).

Hertz, Tom and Zahniser, Steven. (2012). Is There a Farm Labor Shortage? American Journal of Agricultural Economics, 95(2):476–481.

Hotchkiss, Julie L. and Quispe-Agnoli, Myriam. (2012). Employer Monopsony Power in the Labor Market for Undocumented Workers. Federal Reserve Bank of Atlanta Working Paper 2009-14d.

Ifft, Jennifer and Jodlowski, Margaret. (2016). Is ICE Freezing US Agriculture? Impacts of Local Immigration Enforcement on US Farm Profitability and Structure. AAEA Conference Paper.

JBS International. (2018). Findings from the National Agricultural Workers Survey (NAWS) 2015-2016: A Demographic and Employment Profile of United States Farmworkers. NAWS Research Report 13. Retrieved May 20, 2021 from: `https://www.dol.gov/sites/dolgov/files/ETA/naws/pdfs/NAWS_Research_Report_13.pdf`.

Kandilov, Ivan and Kandilov, Amy. (2020). The Minimum Wage and Seasonal Employment: Evidence from the US Agricultural Sector. Journal of Regional Science, 60(4):612-627.

Kostandini, Genti, Mykerezi, Elton, and Escalante, Cesar. (2013). The Impact of Immigration Enforcement on the U.S. Farming Sector. American Journal of Agricultural Economics, 96(1):172–192.

Lee, David and Saez, Emmanuel. (2012). Optimal Minimum Wage Policy in Competitive Labor Markets. Journal of Public Economics, 96:739-749.

Legal Information Institute. (2021). Minimum Wage. Retrieved from Cornell Law School Website on February 22, 2021 at: https://www.law.cornell.edu/wex/minimum_wage.

Lewison, Pam. (2021). Federal Regulations Push Farm Labor Costs Higher at a Difficult Time for Farmers. Washington Policy Center Blog. Retrieved June 7, 2021 from: https://www.washingtonpolicy.org/publications/detail/federal-regulations-push-farm-labor-costs-higher-at-a-difficult-time-for-farmers.

Lovell, MC. (1963). Seasonal adjustment of economic time series and multiple regression analysis. Journal of the American Statistical Association 58:993–1010.

Manning, Alan. (2003). Monopsony in Motion: Imperfect Competition in Labor Markets. Princeton University Press, New Jersey.

Martin, Philip. (2006). Braceros: History, Compensation. Rural Migration News, 12(2).

Martin, Philip. (2017a) The H-2A Farm Guestworker Program is Expanding Rapidly: Here are the Numbers You Need to Know. Economic Policy Institute Working Economics Blog. Retrieved June 6, 2021 from: https://www.epi.org/blog/h-2a-farm-guestworker-program-expanding-rapidly/.

Martin, Philip. (2017b). Immigration and Farm Labor: From Unauthorized to H-2A for Some? Migration Policy Institute Issue Brief. Retrieved June 7, 2021 from: https://www.migrationpolicy.org/sites/default/files/publications/Martin-ImmigrationAgricultureH2AWorkers-FINAL.pdf.

Martin, Philip. (2019). The Role of the H-2A Program in California Agriculture. Choices, 34(1).

Martin, Philip, Rutledge, Zachariah, and Castillo, Marcelo. (Forthcoming). The H-2A Program in 2020. USDA ERS Economic Information Bulletin.

Massey, Douglas. S., Durand, Jorge, and Malone, Nolan J. (2002). Beyond Smoke and Mirrors: Mexican Immigration in an Era of Free Trade. New York: Russel Sage Foundation.

Meer, J. and West, J. (2016). Effects of Minimum Wage on Employment Dynamics. Journal of Human Resources, 51(2):500-522.

Moretti, Enrico and Perloff, Jeffrey M. (2000). Minimum Wage Laws Lower Some Agricultural Wages. CUDARE Working Paper No. 953.

National Agricultural Statistics Service (NASS). Surveys: Farm Labor. Retrieved February 22, 2021 from: `https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Farm_Labor`.

Neumark, David and Wascher, William L. (2008). Minimum Wages. MIT Press, Cambridge.

Neumark, David. (2014). Employment Effects of Minimum Wages. IZA World of Labor.

Nevo, Aviv and Rosen, Adam M. (2012). Identification with Imperfect Instruments. The Review of Economics and Statistics, 94:659–671.

Orrenius, P. (2004). The Effect of U.S. Border Enforcement on the Crossing Behavior of Mexican Migrants. Chapter 14 in Crossing the Border: Research from the Mexican Migration Project. Russel Sage Foundation.

Passel, J. S., Cohn, D., and Gonzalez-Barrera, A. (2012). Net Migration from Mexico Falls to Zero - and Perhaps Less. Pew Research Center - Hispanic Trends, April 23.

Richards, T. J. (2018). Immigration Reform and Farm Labor Markets. American Journal of Agricultural Economics, 100(4):1050–1071.

Riosmena, F. (2004). Return versus Settlement Among Undocumented Mexican Immigrants. Chapter 13 in Crossing the Border: Research from the Mexican Migration Project. Russel Sage Foundation.

Rutledge, Zachariah and Taylor, J. Edward. (2019). Farmworkers and Non-Farm Work: Evidence from the NAWS (Conference Paper). Presented at the Department of Labor's NAWS at 30 Conference in Davis, California, on April 4th, 2019. Retrieved from: https://www.zachrutledge.com/uploads/1/2/5/6/125679559/rutledge-taylor_naws_paper.pdf.

Shultz, M. K. (1965). The Bracero & California Agriculture. Industrial and Labor Relations Forum, 2(2):143–160.

Staiger, Douglas, Spetz, Joanne, and Phibbs, Ciaran. (2010). Is There Monopsony in the Labor Market? Evidence from a Natural Experiment. Journal of Labor Economics, 28(2).

Taylor, J. E., Charlton, D., and Yúnez-Naude, A. (2012). The End of Farm Labor Abundance. Applied Economic Perspectives and Policy, 34(4):587–598.

Udani, Adriano. (2016) The Impact of Temporary Immigrant Workforce Growth on Employee Verification Policies in the United States. The Policy Studies Journal, 44(4): 449–

470.

United Farm Workers of America (UFW). 2020. Order Granting Plaintiff's Motion for a Preliminary Injunction. December 23.

United States Department of Labor (DOL). (2018). National Agricultural Workers Survey [dataset].

United States Department of State (USDOS). (2021). Nonimmigrant Visa Statistics retrieved from: https://travel.state.gov/content/travel/en/legal/visa-law0/visa-statistics/nonimmigrant-visa-statistics.html.

Zahniser, S., Taylor, J. E., Hertz, T., and Charlton, D. (2018). Farm Labor Markets in the United States and Mexico Pose Challenges for U.S. Agriculture. USDA-ERS Economic Research Bulletin, No. 201.

Zahniser, Steven, Hertz, Tom, Dixon, Peter, and Rimmer, Maureen. (2012). Immigration Policy and Its Possible Effects on U.S. Agriculture and the Market for Hired Farm Labor: A Simulation Analysis. American Journal of Agricultural Economics, 94(2):477-482.

Zahniser, S., Taylor, J. E., Hertz, T., and Charlton, D. (2019). Rising Wages Point to a Tighter Farm Labor Market in the United States. Amber Waves. Retrieved August 20, 2020 from: https://www.ers.usda.gov/amber-waves/2019/february/rising-wages-point-to-a-tighter-farm-labor-market-in-the-united-states.

Online appendices

A Standard textbook model of static monopsony

Let the wage be denoted by w, the supply of labor to the firm be denoted by $L(w)$ and the inverse supply of labor be denoted by $w(L)$ such that total labor costs can be expressed as $w(L)L$. Let's also assume that the firm is a nondiscriminating monopsonist that must pay a single wage to all its employees and that the revenue function is denoted by $R(L)$. Under these assumptions, the profit function is defined as

$$\pi = R(L) - w(L)L, \tag{A.1}$$

and the first order condition is

$$R'(L) = w(L) + w'(L)L, \tag{A.2}$$

where $R'(L)$ is the marginal revenue product of labor (MRPL). Notice that the MRPL has two components, the wage of hiring the next worker $w(L)$ and the increase in wages that must be paid to all the existing workers $w'(L)L$. As a result, the optimal equilibrium wage outcome occurs at a value that is lower than the marginal revenue product of labor. By rearranging Equation (1) and dividing by w, the inverse labor supply elasticity facing the firm ϵ can be expressed as follows:

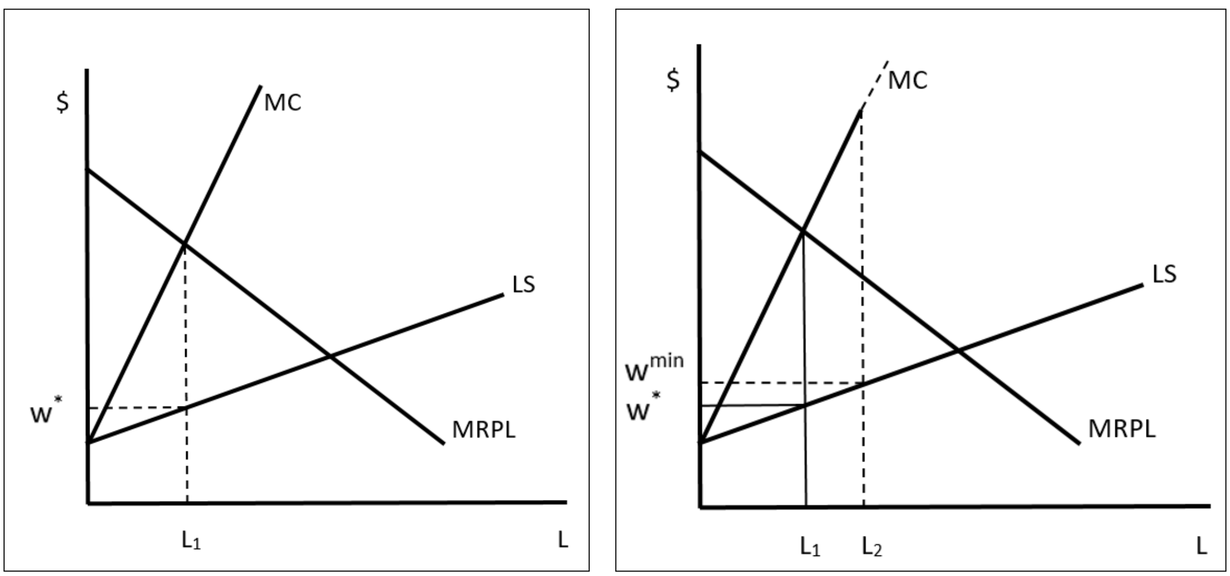
$$\epsilon = \frac{1}{\epsilon_{Lw}} = \frac{R' - w}{w}, \tag{A.3}$$

where ϵ_{Lw} is the firm-level labor supply elasticity, which is equal to the relative difference between the MRPL and the wage paid to employees.

A graphical depiction of a nondiscriminating monopsonist in the labor market can be found in Figure A.1. Because the firm faces an upward sloping labor supply curve, the marginal cost of labor exceeds that of the labor supply. Without a minimum wage, the profit maximizing firm employs the amount of labor equal to L_1, which corresponds to the value at which the marginal cost curve meets the MRPL curve and the wage is set at w^* (see Figure A.1.a). If a minimum wage is set above w^* but below the competitive market wage at w^{min} (see Figure A.1.b), then L_2 units of labor will be employed and the minimum wage is binding for employers. The firm still gains surplus at L_2, but if it hires any more workers, the marginal cost will exceed the marginal value product, which is not profit maximizing. As a result, a higher minimum wage will tend to reduce the amount of surplus that employers gain from the work relationship.

Figure A.1: Impact of minimum wage in a monopsonistic labor market

a: Profit maximization without minimum wage b: Profit maximization with minimum wage



B A Simplified Burdett and Mortensen (1998) Dynamic Monopsony Model[7]

Assume that there are M_w workers who are all equally productive and value leisure at amount equal to b and that there are M_i employers who are infinitely small relative to the aggregate market. All employers have constant returns to scale, and the marginal revenue product of each worker is equal to p. Each employer set their wage at a value

[7]Note that this model is fully developed in Manning (2003) and is only reproduced here for the sake of convenience.

that maximizes their steady state profits, which is assumed to be the same across all firms, and all workers within a firm are paid the same wage w. We assume that the cumulative distribution function of wages across employers $F(w)$ is continuous without any spikes, and the probability density function is denoted by $f(w)$. All workers, both employed and unemployed, receive job offers at a rate of μ. Job offers are drawn at random from firms from $F(w)$. Employed workers' jobs are destroyed (and thus enter unemployment) at an exogenous rate of δ. Employed and unemployed workers exit the labor force at an exogenously determined rate and are replaced by an equal amount of workers who initially enter unemployment. Employed workers switch jobs when they receive a wage offer that is higher than their current wage, and unemployed workers accept a new job when the wage offer is above their reservation wage b. Employers choose a wage that maximizes their profits according to the profit function $\pi = (p - w)L(w; F)$, where $L(w; F)$ is the steady state employment of a firm that offers wage w when the distribution of wages is $F(w)$.

Let the job separation rate be denoted by $s(w; F)$ and the flow of recruits to a firm be denoted by $R(w; F)$ such that in the steady state, the following condition must hold:

$$s(w; F)L(w; F) = R(w; F). \tag{B.1}$$

The separation rate for an individual firm is given by

$$s(w; F) = \delta + \mu[1 - F(w)] \tag{B.2}$$

as workers enter into unemployment at a rate of δ and recieve job offers at a rate of μ, and only a fraction of the job offers $[1 - F(w)]$ are greater than the current wage. The unemployment rate u can be expressed as

$$u = \frac{\delta}{\delta + \mu} \tag{B.3}$$

because workers obtain jobs at a rate of μ and leave employment for unemployment at a rate of δ.

Workers who earn more than w will never accept a wage less than w, and there are $M_w u$ unemployed workers who receive job offers less than w at a rate $\mu F(w)$, so the flow of recruits to jobs that pay less than w is $\mu F(w) M_w u$. We define $H(w; F)$ as the fraction of workers receiving a wage of w or less when the wage offer distribution is $F(w)$ such that the total number of workers employed at wage w or less can be expressed as $(1-u)H(w;F)M_w$. In the steady state, the flow of job separations and recruits among workers who earn w or less must be equal such that the following equality holds:

$$[\delta + \mu(1 - F(w))](1 - u)H(w; F)M_w = \mu F(w)uM_w. \tag{B.4}$$

By substituting Equation (B.3) into Equation (B.4) and rearranging, the fraction of employed workers receiving a wage w or less can be expressed as follows:

$$H(w; F) = \frac{\delta F(w)}{\delta + \mu[1 - F(w)]}. \tag{B.5}$$

There are $\mu u M_w$ unemployed workers that receive job offers, which are distributed evenly among the M_i firms so that the flow of unemployed workers to an individual firm is $\mu u/M$, where $M = M_i/M_w$. Thus the flow of recruits to an individual firm that pays a wage of w is

$$R(w; F) = \frac{\mu}{M}[u + (1 - u)H(w; F)] = \frac{\delta\mu}{M[\delta + \lambda(1 - F(w)]} \tag{B.6}$$

where the second equality in (B.6) is obtained by substituting in Equations (B.3) and (B.5) for u and $H(w; F)$, respectively. By substituting Equations (B.2) and (B.6) into Equation (B.1), the following firm-level labor supply function can be obtained:

$$L(w; F) = \frac{\delta\lambda}{M[\delta + \lambda(1 - F(w)]^2}.$$

Thus, the firm's profit function can be expressed as

$$\pi(w; F) = \frac{\delta\lambda(p - w)}{M[\delta + \lambda(1 - F(w)]^2}. \tag{B.7}$$

Given that the lowest wage offered in equilibrium is the reservation wage b (see Appendix C.1 for proof), and all firms achieve the same level of profit, the equilibrium profit denoted by π^* can be expressed as

$$\pi^* = \frac{\delta\mu(p - b)}{M[\delta + \lambda]^2}. \tag{B.8}$$

Thus, the expected wage can be expressed as follows:[8]

$$\mathbb{E}[w] = \underbrace{\frac{\mu}{\delta + \mu}}_{\alpha} p + \underbrace{\frac{\delta}{\delta + \mu}}_{\beta} b, \tag{B.9}$$

where α (respectively β) represents the weight on the marginal revenue product of labor (respectively reservation wage).[9]

C Proofs

C.1 Proof that the lowest wage firm pays the reservation wage b

Suppose that a firm offers a wage below the reservation wage b. The firm will not be able to hire any workers and would have zero profit, which cannot be an equilibrium outcome. Suppose that the lowest wage offered is higher than b. The lowest wage firm will only be able to recruit workers from unemployment at a rate of $\mu u/M$ and will lose workers at the rate $\delta + \mu$ so that the number of workers employed in the lowest wage firm is equal to

$$\frac{\mu u}{M(\delta + \mu)} = \frac{\delta\mu}{M(\delta + \mu)^2}, \tag{C.1.1}$$

which is independent of the wage. If the lowest wage firm reduces its wage to b, its profit will rise. As a result, offering a wage higher than b is not optimal from a profit maximization standpoint and could not be an equilibrium. Therefore, the lowest wage

[8]See Appendix C.2 for proof.

[9]Note that α is an increasing function μ/δ, the ratio of the job offer rate to the job destruction rate, such that taking the limit of Equation (B.9) as $\mu/\delta \to \infty$ results in a distribution of wages that corresponds to a perfectly competitive market as the job offer rate relative to the job destruction rate for employed workers is infinite.

firm will offer a wage of b.

C.2 Proof that $\mathbb{E}[w] = \frac{\mu}{\delta+\mu}p + \frac{\delta}{\delta+\mu}b$

The expected wage can be expressed as follows:

$$\begin{aligned}
\mathbb{E}[w] &= \frac{M_f}{M_f}\frac{\int wL(w;F)f(w)dw}{\int L(w;F)f(w)dw} && \text{(C.2.1)}\\
&= p - \frac{M_f \int (p-w)L(w;F)f(w)dw}{M_w(1-u)} && \text{(C.2.2)}\\
&= p - \frac{M \int \pi^* f(w)dw}{(1-u)} && \text{(C.2.3)}\\
&= p - \frac{M\pi^* \int f(w)dw}{(1-u)} && \text{(C.2.4)}\\
&= p - \frac{M\pi^*}{(1-u)} && \text{(C.2.5)}\\
&= p - \frac{\delta(p-b)}{\delta+\mu} && \text{(C.2.6)}\\
&= \frac{\mu}{\delta+\mu}p + \frac{\delta}{\delta+\mu}b. && \text{(C.2.7)}
\end{aligned}$$

Equation (C.2.2) is derived from the fact that both denominators in Equations (C.2.1) and (C.2.2) are expressions for total employment. Equation (C.2.3) is derived by using the fact that, in equilibrium, $(p-w)L(w;F)$ must be the same for all firms. We use the fact that π^* is not a function of w and $\int f(x)dx = 1$ to derive Equations (C.2.4) and (C.2.5). We substitute Equations (B.3) and (B.8) into Equation (C.2.5) to derive Equation (C.2.6), and with some algebraic manipulation and rearranging we arrive at Equation (C.2.7). Therefore, $\mathbb{E}[w] = \frac{\mu}{\delta+\mu}p + \frac{\delta}{\delta+\mu}b$.

C.3 Proof that $R^u = \alpha\frac{1}{\ln(\frac{\delta+\mu}{\delta})}$

The number of recruits to position F in the wage distribution can be expressed as follows:

$$R(F) = \mu u M_w + \mu M_w(1-u)H(F) = \frac{\mu\delta M_w}{\delta+\mu(1-F)}, \tag{C.3.1}$$

where $H(F)$ is the fraction of workers employed at or below position F and is defined in Equation (B.5). Because position F is uniformly distributed over the unit interval, the number of recruits flowing into the economy can be expressed as follows:

$$R = \int_0^1 R(f)df = M_w \int_0^1 \frac{\mu \delta df}{\delta + \mu(1-f)} = M_w \delta \ln\left(\frac{\delta + \mu}{\delta}\right). \tag{C.3.2}$$

Since the flow of recruits is $\mu M_w u$, we arrive at Equation (2).