H-2A Adverse Effect Wage Rates and U.S. Farm Wages

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Abstract

Adverse Effect Wage Rates (AEWRs) are regional minimum wages paid to foreign farmworkers working in the United States under the H-2A temporary agricultural guest worker program. In this paper, we develop a simple theoretical framework that suggests higher AEWRs may induce spillover effects that lead to higher wages for non-H-2A farmworkers. Using confidential wage data from the National Agricultural Workers Survey, we test the labor market spillover hypothesis by comparing changes in domestic farmworker wages and AEWRs across U.S. regions between 1991 and 2022. Our estimates suggest that a 10% increase in the AEWR causes, at most, a 2.8% increase in the wages of non-H-2A domestic farmworkers across the United States. We find that freezing the AEWR for one year would reduce the growth of wages paid to domestic farmworkers by as much as $475 million.

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Introduction

The H-2A program enables U.S. employers to hire foreign workers for temporary or seasonal agricultural jobs. Although not widely used after its enactment in 1986, the program has experienced significant growth in recent years, with the number of H-2A job certifications increasing from about 85,000 in fiscal year (FY) 2012 to over 370,000 by FY 2023. To protect the wages of U.S. farmworkers from being adversely affected by an influx of temporary foreign workers, the U.S. Department of Labor (DOL) mandates that H-2A workers be paid a minimum wage not less than the Adverse Effect Wage Rate (AEWR) (USDOL, 2023). For virtually all H-2A workers, DOL sets the region's AEWR using wage data from crop and livestock workers in the previous year, as measured by the U.S. Department of Agriculture's Farm Labor Survey (FLS). Issues surrounding AEWRs have long been a source of dispute between employers and farmworker advocates. Employers and farmworkers often hold divergent views on several key issues: (1) the appropriateness of using lagged FLS wages to set AEWRs, (2) how AEWRs impact the wages of domestic farmworkers, and (3) whether AEWRs cause domestic wages to increase more rapidly than they should, among others.

In this paper, we examine both theoretically and empirically the potential role of the AEWR on domestic farm labor markets. Our analysis follows in two steps. In the first step, we use a simple model of the local farm labor market to evaluate how setting the AEWR at a particular level could affect domestic wages. Following Bound et al. (2015), we model farm production as a function of domestic workers, who are paid an endogenous market wage, and H-2A workers, who are paid the AEWR, which producers take as given. We incorporate into our model many of the core assumptions that are commonly agreed upon by parties in the public debate. For example, we assume that H-2A and domestic workers are perfect substitutes, but the decision to hire H-2A workers on farms involves a trade-off between H-2A's potentially higher "productivity" and additional non-wage costs specific to H-2A employment such as worker housing and transportation (Escalante, Luo, and Taylor, 2020). Based on these assumptions, our model predicts a clear positive impact of AEWRs on short-run equilibrium domestic wages. Starting from an interior solution, an increase in the AEWR always lowers H-2A demand while increasing domestic labor demand, as employers respond to higher AEWRs by substituting H-2A for domestic workers. Because the domestic labor supply curve is upward-sloping, this leads to higher short-run equilibrium wages and employment for domestic workers.

We use this simple model to clarify many key economic issues that are often debated informally in public discourse. For example, employers contend that FLS-based AEWRs are measured with error and that AEWRs exceed true domestic market wages since FLS wages constitute "gross wages"—encompassing bonuses and piece rates for highly productive workers.[1] Conversely, workers point out that AEWRs, set using the previous year's wages, fail to capture current wage growth, leaving them arguably outdated (Farmworker Justice, 2012).

Using our model, we first clarify that current domestic "market wages," the effective target of the AEWR-setting rule, are market wages but only in a world with a guest worker program with an uncapped supply and a minimum wage pegged to last year's FLS wages. Through this lens, local market wages rarely mirror "no-adverse effect wages" as they hinge on the availability of H-2A workers, which replace some domestic labor when equilibrium H-2A employment is non-zero. Moreover, we show that because AEWRs are measured with a lag, even if measurement error is positive, AEWRs may be higher or lower than current domestic wages. Rapid wage growth can render current AEWRs lower than current domestic wages, suggesting that neither employers' nor workers' perspectives are correct ex ante. This disagreement essentially boils down to a debate over the relative magnitudes of measurement error and domestic wage growth.[2]

[1] They also note the FLS's exclusion of Farm Labor Contractors (FLCs), typically lower-paid than direct hires, and the inclusion of year-round jobs not eligible for H-2A makes the FLS wage exceed the market hourly average (Florida Growers v. DOL, 2023).

[2] Worth noting is that when we discuss wages "being measured with error," we are reflecting the perspective of producers who argue that DOL should set AEWRs based on hourly wages, excluding additional compensation like bonuses and piece rates. From DOL's viewpoint, however, including bonuses and piece rates in AEWR calculations isn't necessarily considered a measurement error. DOL insists that the AEWR does not need to be set at the maximum or minimum conceivable point as long as it meets its intended

Farmworkers and employers generally agree that AEWRs impact domestic wage levels but differ on how. Employers often view AEWRs as wage floors that elevate wages for both H-2A and domestic workers, arguing that domestic workers benchmark their wage expectations against AEWRs. Workers, however, see AEWRs as potentially capping wages for domestic workers, particularly because employers can turn to H-2A recruitment if domestic workers decline farm work at AEWR rates (Congressional Research Service, 2008b). Using our model, we show that AEWRs need not act strictly as ceilings or floors; in the short-run equilibrium, they can be higher or lower than domestic wages. The wages for domestic workers could potentially be higher since the AEWR is just one of the many expenses associated with H-2A employment. Conversely, domestic wages may also be lower if H-2A workers are more productive, as their higher productivity could outweigh the added costs of H-2A employment.

Whether they serve as ceilings or floors, employers and workers often agree that rising AEWRs can push domestic wages upwards, but they disagree on the desirability of these increases. Employers advocate for a cap on AEWR growth, arguing that the rapid increases in recent years are primarily due to FLS-based measurement error (ME). If AEWRs affect domestic wages, ME-induced increases in AEWRs lead to artificially high domestic wages (Florida Growers v. DOL, 2023). Conversely, farmworkers attribute rapid AEWR growth to natural labor market dynamics, suggesting that any cap or freeze on AEWR adjustments would unjustly stifle domestic wage increases (Costa, 2022).

Even if rising AEWRs do push domestic wages higher, it is important to exercise caution before concluding that growth in AEWRs causes domestic wages to rise excessively. This is especially relevant considering DOL's goal to set AEWRs at a level that would induce a domestic market wage that would prevail "absent an influx of temporary foreign workers" (USDOL, 2023). Our model shows that due to the lagged nature of the AEWR, domestic wages might rise more slowly in response to labor market shocks compared to a scenario where DOL could immediately update AEWRs to reflect the current market impact of these

regulatory purpose (USDOL, 2023).

shocks. Moreover, the domestic wages resulting from such real-time AEWR updates would actually be lower than in a scenario where DOL could prevent an influx of temporary foreign workers in response to the shock.[3]

In the second part of our analysis, we quantify the extent to which changes in the AEWR affect domestic farm wages. While we argue that the claim that AEWR growth is artificially raising domestic wage growth may be misguided, understanding the marginal effects of AEWRs on domestic wages is still useful. By analyzing these effects, we can shed light on the potential consequences on domestic wages of enacting current policy proposals, such as capping (or freezing) AEWR growth.[4] To estimate AEWR marginal effects, we compare changes in domestic farmworker wages and AEWRs across 18 FLS regions from 1991 to 2022. Our data on domestic wages comes from restricted-access data from the National Agricultural Workers Survey (NAWS), and our AEWR data come from the FLS.

AEWRs are set using domestic wages in the previous period, so changes in AEWRs in period t are functions of lagged shocks to local labor markets. Accordingly, our main identification challenge stems from the potential presence of unobserved labor market shocks in period $t-1$, which might be correlated with changes in the AEWRs and other determinants of domestic wages in period t. We take several steps to help mitigate this source of bias. First, we adopt an instrumental variables (IV) approach using lagged AEWRs as an instrument for current AEWRs. The main identification assumption underpinning this IV strategy is that

[3]In Appendix B, we show that while employers are almost certainly worse off if measurement error is positive, the argument that measurement error leads to a "ratcheting effect" –a cycle of never-ending domestic wage increases– is likely implausible. This result emerges because the share of H-2A and U.S. workers performing similar jobs for H-2A employers is relatively small in the FLS data and was nearly insignificant until recent years.

[4]Furthermore, estimating these effects offers insights into the potential effect of changing the source of the AEWR to address measurement error issues. Given that employers and workers agree that AEWRs likely influence domestic wages but disagree on whether AEWRs are higher or lower than the current domestic market wage, it is unsurprising that there is a debate on whether this domestic market wage is too high or too low. Specifically, if higher AEWRs result in higher domestic wages, then AEWRs that are set too high due to measurement errors would lead to domestic wages that are too high. Conversely, if lower AEWRs result in lower domestic wages, then AEWRs that are too low due to measurement errors would lead to domestic wages that are too low. As we explain below, by quantifying the equilibrium domestic wage's sensitivity to changes in the AEWR, we could, in theory, infer the domestic wage impact of changing how DOL measures AEWRs.

current shocks are less correlated with shocks two periods in the past. We prefer a leave-one-out version of this lagged AEWR instrument, which is similar to an instrument pioneered by Hausman, Leonard, and Zona (1994). Our second attempt to address our endogeneity problem is to include individual-level covariates in our analysis.

Our results indicate that a 10% increase in the AEWR causes at most a 2.8% increase in real domestic farm wages nationwide and at most a 4.8% increase in the top five H-2A employment states. Our national elasticity estimate is smaller than other estimates using changes in state minimum wages (0.39, Buccola, Li, and Reimer, 2012) and is qualitatively similar to Moretti and Perloff (2000), who find a positive relationship between federal minimum wages and domestic farmworker wages at the national level.

Our study falls within a branch of minimum wage literature that focuses on "uncovered" employees who are exposed to non-binding minimum wages. For example, employees working in "informal" labor markets, such as undocumented immigrants working "under the table," may ask for higher wages when the minimum wage increases. Thus, the minimum wages may serve as a signal and imbue a "*lighthouse e ect*" that provides employees with increased bargaining power (Jones, 1997; Lemos, 2004; Fajnzylber, 2001; Gindling and Terrell, 2007). Moreover, to the extent there are linkages between labor markets presumed to be segmented, minimum wages binding in the covered sector might affect labor demand in the uncovered sector. Notably, AEWRs are legally binding only for H-2A workers and the U.S. farmworkers performing similar work for H-2A employers, but they are not binding for the estimated remaining 85% of the crop farm workforce.

We make several contributions to the agricultural economics literature on farm labor. To our knowledge, we are the first to estimate the marginal effects of the AEWR on domestic farmworker labor market outcomes. While a few studies have analyzed the impacts of state minimum wages in the U.S. agricultural sector, none have specifically estimated a causal effect of H-2A minimum wages on this sector (Ifft, 2021; Buccola, Li, and Reimer, 2012; Kandilov and Kandilov, 2020; Meer and West, 2016; Moretti and Perloff, 2000). Previous academic work on the H-2A program by agricultural economists (Castillo and Charlton, 2022; Arteaga and Shenoy, 2022; Castillo, Rutledge, and Kim, 2023) focused on the causes of the recent growth in H-2A employment while abstracting away from the role of H-2A minimum wages on producer hiring decisions. We contribute to this body of work by being the first to develop a formal economic model showing how AEWRs may cause spillover effects in U.S. domestic farm labor markets.

Lastly, our work adds to the policy literature discussing elements of the AEWR debate that have failed to reach consensus among agricultural stakeholders, including worker and employer groups, academics, and the government (e.g., Costa, 2022). In particular, we use our model to clarify arguments in the public debate that rely on informal economic reasoning, which can be difficult to evaluate and is occasionally contradictory. Moreover, our analysis provides insights into the potential consequences of changing how AEWRs are calculated. The Farm Workforce Modernization Act (FWMA, or HR 4319), reintroduced by the House of Representatives in June 2023, proposes to freeze AEWRs for one year and cap annual increases at 3.25% from 2025 to 2033. This proposal aligns closely with a recent recommendation by the U.S. House Committee on Agriculture to freeze and cap AEWR increases (Ag Labor Working Group, 2024). We contribute to this policy discussion by highlighting the potential unintended effects of freezing the AEWR. Our analysis suggests that an AEWR freeze could affect not only H-2A employers and workers but also non-H-2A domestic farmworkers and agricultural producers.

The following section provides some background details related to the H-2A visa program and the AEWR. Section 2 provides our theoretical framework, Section 3 describes our empirical strategy and data, and Section 4 reports the results. We provide some concluding remarks in Section 5.

1 Background

The H-2A agricultural guest worker program enables U.S. employers to hire foreign workers for temporary or seasonal agricultural jobs. Established by the Immigration Reform and Control Act of 1986, which split the existing H-2 program into H-2A for agricultural workers and H-2B for non-agricultural workers, the H-2A program was not commonly used until recent times. Over the past decade, the H-2A program has expanded dramatically, however. Greater use results from several factors, including a shortage of farm labor supply potentially induced by a number of political, economic, and demographic factors (Castillo and Charlton, 2022). Between FY 2012 and FY 2023, the number of H-2A jobs certified to agricultural employers increased by more than 300% from about 85,000 to over 370,000 (see Figure 1).[5] In FY 2023, DOL certified agricultural employers to fill approximately one out of every six full-time equivalent (FTE) jobs on U.S. crop farms with H-2A guest workers (Martin, 2024), accruing an H-2A wage bill of about $6 billion.[6]

[Figure 1 about here.]

Unlike other major nonimmigrant visa programs, such as the H-1B and H-2B, there is no cap on the number of H-2A visas that can be granted annually. However, before hiring H-2A workers, prospective farm employers must still attest that no U.S. workers are available for the job. Employers must also show that employing H-2A workers will not adversely affect the wages or working conditions of U.S. workers.[7] To comply with the no-adverse-effect rule, DOL mandates that H-2A workers, along with U.S. farmworkers performing similar work for H-2A employers, must be paid an amount no less than the AEWR. They must also be paid the highest of the state or federal minimum wage, the prevailing wage as determined by a state workforce agency, or the negotiated collective bargaining agreement wage, when

[5] Historically, between 70 and 80 percent of the jobs certified by DOL have actually been issued a visa by the Department of State.

[6] The FY 2023 H-2A wage bill was calculated by the authors using DOL's disclosure dataset (DOL, 2024).

[7] This requirement is motivated by concerns that "low-skilled" foreign-born workers, who tend to have low reservation wages, could negatively impact the economic opportunities of the domestic farm workforce (Congressional Research Service, 2008a).

applicable. The AEWR is virtually always the highest of all of these wages, so it is the effective minimum wage of the H-2A program (Castillo et al., 2021).

For almost all occupations, and for all states excluding Alaska, DOL sets the AEWR for a specific state based on the wages of crop and livestock workers in the previous year, as measured by the FLS. The FLS data are used to calculate AEWRs for 15 multi-state regions, and separately for California, Florida, and Hawaii. There are 18 different FLS-based AEWRs, and states in the same region have identical rates.[8] In FY 2024, these FLS-based AEWRs ranged from a low of $14.53 in the southeastern part of the country to a high of $19.75 in California. Figure 2 shows regional AEWRs from 2011 to 2024. AEWRs have risen substantially across all regions of the United States. On average, they increased by 4% per year. However, since 2018, they have grown by close to 6% per year.

[Figure 2 about here.]

According to DOL estimates, an AEWR freeze would have saved employers of H-2A workers an estimated $140 million in FY 2020 (DOL, 2020). Castillo, Martin, and Rutledge (2022) estimate that an AEWR freeze in FY 2020 could have also reduced wage expenditures by an additional $29 million per year for U.S. farmworkers performing similar work for H-2A employers. Beyond the savings associated with the direct employment of H-2A workers, an AEWR freeze might potentially save farm employers hundreds of millions of dollars if the freeze also impacts the wages of non-H-2A domestic workers. These savings, however, could come at the cost of slowing wage growth for domestic farmworkers.

2 Theoretical Model

We use a simple discrete-time partial equilibrium model of the local farm labor market to motivate our empirical approach. Our model also helps clarify arguments in the AEWR

[8] DOL uses the Occupational Employment and Wage Statistics (OEWS) survey to set the AEWRs for Alaska, Washington DC, and U.S. territories. For a small group of workers whose occupations are not sampled in the FLS, DOL also determines AEWRs using the OEWS.

debate, which often rely on informal economic reasoning that can sometimes be challenging to assess. There are two types of workers: domestic workers, L_t, and H-2A workers, H_t. Domestic workers can move between the agricultural sector and the nonfarm sector. At time t, domestic workers are paid the farm wage, W_t. Domestic labor supply is upward sloping in the farm wage and is given by $L_t = \frac{W_t}{w_C}$. Domestic labor supply is decreasing in the nonfarm sector wage, w_C, which we take as exogenous. Farm and nonfarm wages must be greater than or equal to the state minimum wage, (i.e., $W_t; w_C \geq W^{MIN}$).

H-2A workers can only work in the farm sector and are paid the AEWR, A, where $A \geq W^{MIN}$. For now, we assume the AEWR is fixed over time. We assume that the supply of H-2As is perfectly elastic at the AEWR since U.S. farm wages significantly exceed those in Mexico and other H-2A-sending countries. There are additional costs associated with hiring H-2A workers, including housing, transport, and recruitment costs. We assume these costs are increasing in the number of H-2A hired.[9] Specifically, The H-2A wage bill is given by $(A+c_1)H_t+c_2H_t^2$, where c_1 and c_2 capture all other costs associated with H-2A employment.

Aggregate farm output Y_t is produced by combining domestic and H-2A labor using a Cobb Douglas production function given by:

$$Y_t = (L_t + \quad H_t) \; ; \qquad (1)$$

where $\in (0; 1)$. While L_t and H_t are perfect substitutes in production, we assume that H-2A labor is more productive (> 1), motivated by the fact that H-2A workers tend to be younger, are likely highly motivated to earn as much money as they can while in the United States, and are not subject to deportation risks, which can be seen as providing a form of labor insurance to ensure that seasonal work is performed in a timely way (Escalante, Luo, and Taylor, 2020).[10]

[9] This set of assumptions are similar to those of Bound et al. (2015). To model U.S. computer scientist labor demand, they use a similar argument for the H-1B labor supply elasticity and increasing marginal recruitment costs. Other seminal studies that use this modeling technique include Sargent (1978) and Shapiro (1986). Notably, we can get similar results if we assume that H-2A labor supply is upward sloping.

[10] Some farmworker advocates argue that H-2A workers are more likely to meet high productivity standards

2.1 Short-Run Equilibrium

In each period, the representative firm maximizes profits by taking the AEWR, A, domestic wages, W_t, and output price p as given.[11] There are no costs associated with adjusting labor demand over time, so the farmer faces a static maximization problem in each period. Therefore, profits are maximized separately in each period. The short-run equilibrium in each period, requires that labor markets clear. We are interested in solutions where $L_t > 0$ and $W_t > W^{MIN}$ as these conditions are most relevant to the farm labor market situation since the inception of the H-2A program. Equations (2) and (3) are the first order conditions from the profit maximization problem, and (4) corresponds to the labor supply function:

$$p \ (L_t + \ H_t) \ ^{1} = W_t \tag{2}$$

$$p \ (L_t + \ H_t) \ ^{1} = A + c_1 + 2c_2 H_t \tag{3}$$

$$L_t = \frac{W_t}{w_C} \ : \tag{4}$$

We have two types of equilibrium solutions: an interior solution, $H_t > 0$, and a corner solution, $H_t = 0$, which we analyze separately below.

When $H_t > 0$, H-2A labor demand is derived by dividing equation (2) by (3) and rearranging to obtain:

$$H_t = \frac{W_t - (A + c_1)}{2c_2}: \tag{5}$$

Thus, H-2A demand is downward-sloping with respect to the AEWR and the other H-2A-specific costs (c_1 and c_2). Moreover, higher domestic wages lead to substitution towards H-2A labor. We derive an expression for domestic labor demand by substituting equation

set by their employers compared to domestic workers because H-2A workers may want to be invited back to work in the United States by their employer during the next growing season (Farmworker Justice, 2012). The choice to model H-2A labor as being more productive accommodates these claims.

[11] The assumption that producers are price takers is motivated by the fact that agricultural product prices are determined at the national/international level so that no shock from any individual local market can shift these prices.

(5) into (2) and solving for L_t to obtain:

$$L_t = \left(\frac{p}{W_t}\right)^{\frac{1}{1\ \ }} - \left(\frac{W_t - (A + c_1)}{2c_2}\right):$$

In equilibrium, domestic wages are set so that domestic labor demand and labor supply are equal so they satisfy:

$$\left(\frac{p}{W_t}\right)^{\frac{1}{1\ \ }} - \left(\frac{W_t - (A + c_1)}{2c_2}\right) = \frac{W_t}{w_C}:$$

The solution $W_t(A; \Omega)$ to this equation is the short-run equilibrium wage for a fixed AEWR and value of model parameters $\Omega = (\ ;\ ; p; w_C; c_1; c_2; W^{MIN})$.

As previously mentioned, in the AEWR debate, employers often view AEWRs as wage floors, while farmworkers often view them as ceilings for all domestic workers. However, in our model, AEWRs act as neither strictly floors nor ceilings. Short-run equilibrium domestic wages could be higher or lower than the AEWR. Domestic wages could be higher since the AEWR is only one of the many costs associated with H-2A employment (i.e., producers do not incur costs $c_1; c_2$ when they hire domestic workers). Domestic wages could be lower, however, if H-2A worker's higher productivity overcomes these additional costs.

In this simple model, if the marginal cost of hiring the first H-2A worker, $(A + c_1 + 2c_2)$, is high relative to productivity-adjusted domestic wages, $\ W_t(A; \Omega)$, equilibrium H-2A employment is zero. Thus, for a given Ω, if the AEWR exceeds a certain threshold, which we denote as $A^{MAX}(\Omega)$, equilibrium H-2A employment is zero. The equilibrium domestic wage associated with any AEWR level above this threshold, which we denote as $W^{MAX}(\Omega)$, represents the domestic equilibrium wage that would prevail if the H-2A program were abolished. In principle, $W^{MAX}(\Omega)$ could be high enough so that production is so low that only a few producers remain in the market for farm labor.

For what follows, it will be useful to summarize these results by writing the equilibrium domestic wage if the AEWR were set at A, holding Ω constant, as:

$$W_t(A;\Omega) = \begin{cases} g_t(A;\Omega) & \text{if } W^{MIN} \leq A < A^{MAX}(\Omega) \\ W^{MAX}(\Omega) & \text{if } A \geq A^{MAX}(\Omega) \end{cases}.$$

For clarity, in what follows, we write $W_t(A)$ or W_t instead of $W_t(A;\Omega)$ unless it is necessary to do so in our explanation.

Note that in this model, A affects domestic labor demand without affecting domestic labor supply. As such, the function $W_t(A)$ traces the different equilibrium wages that align with the shifting positions of the labor demand curve associated with changes in A. Figure 3 illustrates the change in equilibrium domestic wages induced by a change in the AEWR from A^{MAX} to $A_1 < A^{MAX}$. As explained below, if AEWRs had initially been set at A^{MAX} and subsequently lowered to A_1, equilibrium domestic wages would fall from W^{MAX} to W_1. By encouraging the substitution of domestic labor with H-2A labor, the decrease in AEWRs would reduce domestic labor demand from LD(A^{MAX}) to LD(A_1). Notably, in our model, changing the AEWR from A^{MAX}, which leads to $H_t = 0$, to A_1, which leads to $H_t > 0$, parallels the introduction of the H-2A program at an AEWR that induces uptake of H-2A labor. Introducing the program at such a rate results in lower domestic employment and wages compared to a scenario where H-2A workers are not available.

[Figure 3 about here.]

2.2 AEWR Effects

Our model allows us to clarify the differences between several types of AEWR effects on equilibrium domestic wages. In public debates surrounding the AEWR, it is common for participants to recognize only one of these effects while overlooking the others. The first is the domestic wage effect of *increases* in the AEWR relative to its current level. Given this simple model, it is straightforward to show that the *marginal effect* of the AEWR on equilibrium domestic wages, $\frac{dg_t(A)}{dA}$, is positive for all $A < A^{MAX}$ (see Appendix A.1 for a proof).[12] Moreover, $\frac{dL_t}{dA} > 0$, $\frac{dY_t}{dA} < 0$; and $\frac{dH_t}{dA} < 0$: The intuition for this result is simple. An increase in the H-2A minimum wage lowers H-2A demand while increasing domestic labor demand. Because the domestic labor supply curve is upward-sloping, it leads to higher equilibrium wages and employment. However, the substitution towards domestic labor imposes some costs on production efficiency, which leads to a fall in output.[13]

A second type of causal effect is what we call the AEWR ***adverse e ect*** on domestic wages at A_1, which is the effect of setting the AEWR at level $A = A_1$ relative to setting it equal to A^{MAX} (so that $H_t = 0$). This adverse effect is illustrated in Figure 3 as $-[W^{MAX} - g_t(A_1)] = -(W^{MAX} - W_1)$. This effect indicates how much having the H-2A program in place when the AEWR is set at A_1 affects domestic workers' wages relative to a regime without the H-2A program.

An important but often overlooked consequence of a positive adverse effect at A_1 is that the equilibrium domestic wages, $g_t(A_1) = W_1$, reflect "market wages" but only the market wages in a world where there is a guest worker program, with uncapped supply and a minimum wage set at A_1. These wages are not "no-adverse effect wages" since they depend on the availability of H-2A workers, which replace some domestic labor when equilibrium H-2A employment is non-zero. However, when the adverse effect of the H-2A program is zero, H-2A employment is also zero. This situation highlights DOL's predicament when fulfilling its dual goals of striking a "reasonable balance between ... providing employers with an adequate supply of legal agricultural labor and protecting the wages and working conditions of workers in the United States similarly employed" (USDOL, 2023). The implication is that zero adverse effects might not be a desirable outcome for DOL or producers.

[12] We show in Appendix C that under a modeling exercise with non-increasing H-2A costs and fixed production, a similar result emerges (i.e., $\frac{dW_t}{dA} > 0$).

[13] As we explain below, knowing this effect is interesting for at least two reasons. For simplicity, suppose that $\frac{dg_t}{dA} \approx \beta > 0$ for all A. If β was known, some effects of interest could be computed, such as the effect on domestic wages of freezing the AEWR at its value at t, A_t, when it would have otherwise updated to A_{t+1} at $t+1$. This effect would be approximately $(A_{t+1} - A_t)\beta$. We could also compute the effect of measuring the AEWR with "error" of size u, instead of measuring the AEWR error-free. This effect would be βu.

Distinguishing between the marginal and adverse effects of the AEWR can help to clarify reasons for some of the disagreements in the AEWR public debate. Given that the marginal effect of the AEWR on domestic wages is positive, increasing the AEWR from A_1 to A_2 increases domestic wages by $g(A_2) - g(A_1) = W_2 - W_1$. While employers and workers generally agree that rising AEWRs can lead to higher domestic wages, they disagree on whether these increases are desirable. Employers argue that AEWR increases cause wages to rise higher than they should, while workers contend that wages are still not high enough even with these increases.

Our model helps explain why these disagreements might arise: employers and workers may hold different views on the ideal AEWR level and the equilibrium domestic wage it induces. Producers might believe that FLS-based AEWRs set at A_1 are already too high due to issues related to measurement error. An increase from A_1 to A_2 would push domestic wages even higher than they should be. On the other hand, farmworkers may advocate for setting AEWRs higher than A_2. For example, farmworkers could argue for AEWRs to be set at A^{MAX} since only then is the adverse effect of the H-2A program on their wages zero. Thus, setting the AEWR at A^{MAX} could be seen by workers as aligning most closely with DOL's mandate to prevent any adverse effects. An increase from A_1 to A_2, while desirable, is not as desirable as an increase to A^{MAX}.[14]

A third relevant causal effect is what we call the AEWR \equilibrium adjustment e ect," which emerges from the interaction of the AEWR marginal effect and the rule used to update AEWRs every year. A key feature of the AEWR is that its current value is set based on a measure of equilibrium domestic wages in the previous year. Given this wage-setting rule, the effects of changes in AEWRs over time have a very specific interpretation in our model: they are an equilibrium adjustment process. The fact that AEWRs are entirely determined

[14] Farmworker advocates often argue for setting the AEWRs above the FLS wage on the basis that agricultural wages are "depressed relative to what they would be if only U.S. citizens and authorized immigrants had the job" (Farmworker Justice, 2012). In the context of our model, $W^*(A_1)$ and $W^*(A_2)$ are deemed too low compared to a hypothetical market wage that would emerge if undocumented workers were excluded from U.S. agriculture.

by this rule further complicates the interpretation of whether increases in AEWRs cause wages to rise higher than they should. In the following section, we discuss these issues in more detail.

2.3 Long-Run Equilibrium and Adjustment Dynamics

DOL's strategy to prevent wage depression consists of setting a minimum wage for H-2A employment each year, attempting to induce a hypothetical equilibrium domestic market wage that would prevail "absent an influx of temporary foreign workers" (USDOL, 2023).[15] Perhaps because measuring wages in real-time presents practical challenges, DOL's AEWR-setting rule relies on data from the previous year to approximate this unknown hypothetical domestic wage. Using our model, we show that following a positive wage shock in the current period, DOL's AEWR-setting rule could inadvertently trigger temporary upward adjustments in both wages and AEWRs that last many periods into the future. This might be interpreted as leading to wages that are artificially high. This interpretation is problematic, however, because it overlooks that domestic wages are simply adjusting over time to the level they would reach if DOL could instantly adjust AEWRs in response to current market conditions. Moreover, these domestic wages resulting from real-time AEWR measurement are actually lower than they would be absent an influx of temporary foreign workers in response to the shock.[16]

To see this more clearly, we incorporate into the model the fact that AEWRs for the current year are fully determined by the previous year's FLS wage. To simplify the exposition, we assume there is no measurement error and that the H-2A share of employment (as

[15] Importantly, DOL further states that the AEWR aims to prevent future adverse effects on incumbent farmworkers, with less emphasis on compensating for potential past adverse effects (USDOL, 2023).

[16] More precisely, in our model, an influx of H-2A workers is always associated with lower wages for domestic workers. Therefore, in response to a wage shock, the only way for DOL to ensure domestic wages match those "absent an influx of temporary foreign workers" would be to set the AEWR at a level that would maintain the same number of H-2A workers as before the shock. In practice, however, determining such an AEWR is challenging, making this policy difficult to implement perfectly. Moreover, even if perfectly implementable, it is unclear whether holding H-2A employment fixed would be a desirable outcome given DOL's dual mandate to also provide employers with an adequate supply of labor.

measured in the FLS) is trivial.[17] We define the AEWR updating rule as follows:

$$A_t = W_{t-1}(A_{t-1}; \Omega) = W_{t-1}. \tag{6}$$

Note that when the level of the current AEWR faced by producers affects the current equilibrium domestic wage, as is built into our model, then domestic wages from the previous year indirectly shape current year wages. Unless the lagged domestic wage induces an equilibrium current domestic wage that is equal to it, wages adjust cyclically until they reach a steady state, where the equilibrium FLS wage equals the lagged FLS wages.

For a given Ω, a steady state $\{A'; W'; H'; L'; Y'; \Omega\}$ is one where the variables of the model do not change over time (e.g., $A' = A_t = A_{t+1}$ and $W' = W_t = W_{t+1}$), and the AEWR and the equilibrium wage are equal $A' = W'$.[18] In this simple model, when Ω is fixed, we always reach a unique steady state, which we can find by solving the model and assuming that H-2A and domestic workers are paid the same wage, as in Castillo and Charlton (2022). As before, we can have interior or corner solutions, and our focus is on solutions where $L' > 0$, $W' > W^{MIN}$, and $H' \geq 0$.

2.4 Adjustment to Steady State in Response to Shocks

Why would lagged domestic wages not induce an equilibrium domestic wage that is equal to it? The primary reason is that because AEWRs are measured with a lag, current AEWRs do not capture current shocks to domestic wages. Consider the interior steady state depicted in Figure 4, where $W' = A'$. Suppose that FLS wages are stable over time so that AEWRs are fixed at this steady state from year $-k$ to year 0. Now, suppose the nonfarm wage w_C

[17] The reason behind this modeling choice is that in the current labor market, the proportion of H-2A workers is relatively low. Additionally, the H-2A share in the FLS is expected to be even lower because (1) almost half of all H-2A workers are employed by farm labor contractors (FLCs), which are not sampled in the FLS, and (2) the FLS covers numerous year-round farm jobs (such as most jobs in the livestock sector) that are not eligible for H-2A employment.

[18] Note that at the steady state, production is fixed at Y', and there are no shocks to the labor market since we are holding Ω constant.

increases in year 1. As farmworkers move out of agriculture in response to higher nonfarm wages, domestic farm labor supply falls in year 1, the labor supply curve shifts from LS^0 to LS^∞, and Ω^0 changes to Ω^∞. If domestic wages and AEWRs both adjust instantaneously, equilibrium wages in the domestic labor market would rise from W^0 to W^∞, where $W^0 < W^\infty$.

However, AEWRs are fixed at their initial steady-state value for one period so that following the labor supply shock, domestic wages rise in year 1 to $W_1 > W^0$, while AEWRs during this period remain set at their steady-state value $A_1 = W^0 = A^0$, and so AEWRs in year 1 are now lower than contemporary wages. Because AEWRs do not adjust immediately, it follows that domestic wages do not rise as much as they otherwise would have so that $W_1 < W^\infty$. Intuitively, the delay in AEWR adjustment makes H-2A labor temporarily cheaper than domestic labor, thus dampening the wage increase that might have occurred if it were possible to adjust AEWRs immediately.

Since DOL's policy rule is to set AEWRs equal to the lagged FLS wage, in year 2, AEWRs are updated based on lagged wages so that $A_2 = W_1 > A_1$. As AEWRs increase from year 1 to year 2, domestic labor demand rises, and thus equilibrium wages increase to $W_2 > W_1$.[19] During the next period, AEWRs rise again, and so do domestic wages, and so on and so forth. Eventually, wages and AEWRs adjust up until they converge to A^∞ and W^∞, the steady-state values associated with Ω^∞ (see Appendix A.3 for a proof).

This progression towards equilibrium might be misconstrued as AEWRs artificially raising wages. Yet, these adjustments are more closely aligned with DOL's intention of setting AEWRs to induce a domestic market wage that would prevail "absent an influx of temporary foreign workers." In Figure 4, W^T is the domestic wage induced by setting the AEWR at a level that would maintain the same number of H-2A workers as before the shock, A^T. Adjustments towards the new steady state wage, W^∞, bring equilibrium wages closer to DOL's domestic target wage, W^T, than any wage in the short-run wage sequence leading to the steady state.[20] We call the overall effect of this equilibrium adjustment process, in

[19] To avoid making the figure cluttered, we do not include A_2, W_2, and LD_2 in Figure 4.

[20] Another common misconception our model can help clarify is that recent increases in AEWRs and

which higher AEWRs lead to higher domestic wages, which further lead to higher AEWRs, on domestic wages the AEWR's ***equilibrium adjustment effect***. Formally, the AEWR's total equilibrium adjustment effect stemming from a shock in year 1 is given by:

$$W'' - W_1(A'; \Omega'') = \sum_{j=1} g(A_{j+1}; \Omega'') - g(A_j; \Omega'') = \sum_{j=1} W_{j+1}(A_{j+1}; \Omega'') - W_j(A_j; \Omega'').$$

[Figure 4 about here.]

2.4.1 Fixed AEWR Regime

While we must be careful in interpreting positive marginal effects as implying that AEWRs are pushing domestic wages higher than they should be, it is nonetheless useful to estimate these effects. By analyzing these marginal effects, we can evaluate the potential implications on domestic wages resulting from implementing current policy proposals, such as capping or completely freezing AEWR growth. To see this, suppose AEWRs were fixed at their value at the Ω' steady state (i.e., at $A_1 = A'$). If AEWRs are not allowed to update in response to shocks, then there is no AEWR equilibrium adjustment effect, and thus wages reach a long-run equilibrium right away at W_1, where $W'' > W_1 > W'$. Thus, the wage impact of freezing the AEWR at A_1 instead of letting the AEWR update is simply the total AEWR equilibrium adjustment wage effect:

$$W_1(A'; \Omega'') - W'' = \sum_{j=1} g(A_j; \Omega'') - g(A_{j+1}; \Omega'') = g(A'; \Omega'') - g(A''; \Omega'');$$

domestic wages are solely due to past wage increases stemming from the equilibrium adjustment effect. Indexing Ω with a time subscript to accommodate market shocks each year, the AEWR change from year t to year $t+1$ can be written as $A_{t+1} - A_t = W_t(A_t; \Omega_t) - W_{t-1}(A_{t-1}; \Omega_{t-1})$. Thus, the AEWR change from year t to year $t+1$, as well as the change in domestic wages from year $t-1$ to year t, are a result of the impact of previous labor supply shocks on wages (as indicated by the change from Ω_{t-1} to Ω_t) as well as an AEWR equilibrium adjustment effect (as indicated by the change from A_{t-1} to A_t). Naturally, *changes* in FLS-based measurement error could also drive changes in domestic wages and AEWRs over time. However, to our knowledge, participants in the AEWR debate have not expressed concerns about this issue. See Appendix B for further details on this matter.

As such, knowing what $g(A)$ is would be useful for estimating the impact of freezing the AEWR.

This AEWR-freeze scenario implies that wage growth under a fixed-AEWR regime in response to a positive wage shock is less than wage growth under the other regimes we have considered thus far. In this sense, fixing the AEWR "caps" H-2A wages but also restricts domestic wage growth relative to a regime where the AEWR is updated with a lag, one in which it updates instantly, and one where the number of H-2A visas is capped at the current level or the program is eliminated altogether. Intuitively, access to H-2A labor better cushions wage shocks when the AEWR is fixed since producers can more freely substitute away from domestic labor towards H-2A, which prevents domestic wages from rising as much as they would under these other regimes. Notably, the degree to which they can substitute toward H-2A depends on how costly additional H-2As are to hire. If non-AEWR H-2A costs c_2 are high enough (e.g., if housing is less affordable for producers that are yet to join the program), additional expansion of the H-2A program might be increasingly costly and thus limited. Therefore, AEWR freezes would still fail to prevent meaningful increases in domestic wages.[21,22]

2.4.2 Measurement Error and AEWR Marginal Effects

As a last theoretical exercise, we incorporate into our model the perspective of producers who often argue that FLS-based AEWRs are measured with error. In their perspective, the FLS wage exceeds the domestic market wage because it includes bonuses and piece rates awarded to the most productive workers. Suppose that AEWRs are measured with error $u_t > 0$ for all t, and for simplicity, let this error be constant over time, i.e., $u_t = u > 0$ for all t.

[21] That is, in this case, the AEWR freeze primarily protects employers currently participating in the H-2A program.

[22] Another perhaps interesting point is that fixing the AEWR would effectively decouple AEWRs and domestic wages. Over time, the gap between the two could become quite large.

AEWRs at time time t now satisfy:

$$A_t = W_{t-1}(A_{t-1}, \Omega_t) + u = W_{t-1} + u. \tag{7}$$

Using this simple expression for the AEWR, it is clear to see that even when measurement error is positive, because AEWRs are measured with a lag, it is not necessarily the case that AEWRs are larger than current domestic wages (i.e., $u > 0 \not\Rightarrow A_t > W_t$). Note that $A_t > W_t \iff u > W_t - W_{t-1}$. Thus, if wages are growing rapidly, current AEWRs may still be lower than the current domestic wage, and thus determining if $A_t > W_t$ is an empirical question.[23]

As before, for a given Ω, a steady state $\{A', W', H', L', Y', \Omega\}$ is one where the variables of the model do not change over time. The steady-state AEWR and equilibrium domestic wage must now satisfy: $A' = W' + u$. We can find this unique steady state by solving the model and assuming that H-2A workers are paid u more than domestic workers.

It is straightforward to show that, for a fixed Ω, the difference between the steady state with error (where $A' = W' + u$), and the steady state without error (where $A'' = W''$) is given by:

$$W' - W'' = g(W') - g(W'') = g(A' + u) - g(A'') > 0.$$

Thus, in addition to providing insight into the effects of an AEWR freeze, knowing the shape of $g(A)$ could be useful for estimating the impacts on domestic wages of doing away with measurement error. In the following section, we describe our empirical strategy for estimating the marginal effect of the AEWR on domestic farm wages.

[23]Using this simple measurement error framework, in Appendix B, we show that long-run measurement error-induced "ratcheting" is unlikely in the current labor market environment given that, as explained above, the H-2A share in the FLS will tend to be small.

3 Empirical methodology and data

3.1 Empirical Model

Our primary empirical research objective is to estimate the marginal effect of the AEWR on domestic farm wages. To accomplish this task, we estimate a constant effects linear model of the form:

$$\ln W_{ist} = \ln A_{st} + {}_{s} + {}_{t} + \mathbf{C}'_{\mathbf{ist}} + \varepsilon_{ist}, \tag{8}$$

where $\ln W_{ist}$ is the log of the average real wage (in \$2022) of domestic farmworker i in state s in survey year t, $\ln A_{st}$ is the log of the real AEWR in state s at time t (in \$2022), ${}_{s}$ are state fixed effects, ${}_{t}$ are year fixed effects, and ε_{ist} is the error term. The vector $\mathbf{C}_{\mathbf{ist}}$ contains a set of individual-level controls, which is described in more detail below.

Our main identification challenge stems from the potential presence of unobserved labor market shocks in period $t-1$, which might be correlated with changes in the AEWRs and determinants of domestic wages in period t. Although we include fixed effects that account for labor market shocks common to all states within a given period (such as economy-wide shocks) and for time-invariant differences specific to local labor markets (such as geography and climate), time-varying unobserved shocks may still present barriers to identification.

To see this, suppose the error term can be written as $\varepsilon_{ist} = \omega X_{st} + {}_{ist}$, where X_{st} is an unobserved determinant of our outcome $\ln W_{ist}$, and ${}_{ist}$ is uncorrelated with X_{st} and $\ln A_{st}$. Then, we can express the model (in first differences and omitting $\mathbf{C}_{\mathbf{ist}}$ for clarity) as:

$$\Delta \ln W_{ist} = {}_{t} + \Delta \ln A_{st} + \omega \Delta X_{st} + {}_{ist}. \tag{9}$$

The variable $\Delta \ln A_{st}$ is predetermined, and thus it cannot be caused by ΔX_{st}. However, $\Delta \ln A_{st}$ and ΔX_{st} may still be correlated. Based on the findings in our theory section, we anticipate that shocks in the preceding period will partially determine changes in AEWRs this period (i.e., $\mathrm{Cov}(\Delta \ln A_{st}, \Delta X_{st-1}) \neq 0$). If ΔX_{st} is correlated with shocks in the previous period (e.g., $\text{Cov}(\Delta X_{st}, \Delta X_{st-1}) > 0$), then it is possible for $\text{Cov}(\Delta \ln A_{st}, \Delta X_{st}) \neq 0$. Given that we expect $\text{Cov}(\Delta X_{st}, \Delta X_{st-1}) > 0$ –areas that grew faster last period to do so in the current period – it is straightforward to show that the OLS estimator is expected to be biased upward.

We take several steps to help mitigate the impact of this potential endogeneity problem on our results. Our first strategy is to adopt an instrumental variables approach using instruments constructed from lagged AEWRs. This approach rests on the assumption that current shocks are less correlated with shocks two periods ago than with those from the previous period. For example, weather shocks in period $t-2$ that influence the AEWR change in period $t-1$ are less likely to influence the change in the demand for labor in period t than weather shocks in period $t-1$ that influence the AEWR change in period t.

Our first instrument for the (log) AEWR in state s at time t, $\ln A_{st}$, is its lagged value, $\ln A_{st-1}$. Our preferred instrument is a leave-one-out version of this lagged AEWR instrument, which is defined as:[24]

$$\ln(\overline{A_{st-1}}) = \ln\left(\frac{1}{|E_s|}\sum_{k\in E_s} A_{kt-1}\right), \tag{10}$$

where $E_s = \{k : R_k \neq R_s\}$ is the set of states not in the same FLS region where state s is located, and $|E_s|$ denotes the number of states that belong to E_s.

Our second attempt to address our endogeneity problem is to include individual-level covariates in our analysis. Specifically, we include age, schooling, marital status, gender, English-speaking ability, and undocumented status. These covariates should help control for important regional differences that could potentially confound our estimates. For instance, undocumented immigrants may be more attracted to immigrant enclaves. Regions with large enclaves may experience larger undocumented labor supply shocks relative to those with smaller enclaves, and these shocks may be serially correlated. However, even after controlling

[24] See Acemoglu et al. (2019) and Fruehwirth, Iyer, and Zhang (2019) for recent empirical work using leave-one-out instruments.

for these covariates, there is still a possibility that labor market shocks in other parts of the country during period $t-2$ are correlated with local labor market shocks in period t. This situation can cause our preferred instrument to fail to satisfy the exclusion restriction. Even though our IV methodology arguably produces estimates that are closer to the population parameter than our OLS estimates, we prefer to err on the side of caution. Therefore, we interpret our instrumental variables estimates as upper bounds for the parameters of interest given that there is a potential for the presence of unmitigated sources of omitted variables bias.

3.2 Data

To conduct our analysis, we use data from three sources. Our domestic farmworker wage data consists of individual-level data from the 1991-2022 samples of the restricted-access National Agricultural Workers Survey (NAWS).[25] We restrict our sample to individuals aged 18 to 64, which retains about 95% of the sample. We adjust nominal wages to real 2022 dollar values using the consumer price index. The NAWS also contains a host of individual-level variables that we use as controls, including age, years of education, marital status, gender, English language ability, and undocumented status.

Regional AEWR data were obtained from the USDA's Farm Labor Survey (FLS) (NASS, 2021). These AEWRs represent the average regional wages for hired crop and animal workers from the previous year, which we assign to the states that belong to each FLS region.

A selection of summary statistics can be found in Table 1, and details about the data sources and variable construction can be found in Appendix D. Across our sample period, AEWRs averaged \$13.30 (in \$2022) while the real wage of domestic crop employees averaged \$12.55 (in \$2022). The mean age of workers was 36 years, and 80% of the workforce was male. Sixty-one percent of employees were married, 46% were undocumented, and only 22%

[25] Wage data in the NAWS are available as far back as FY 1989, but AEWR data are only available from 1990. As a result, when we use our lagged instrument, we lose an additional year of data. So, our sample period begins in 1991.

of employees spoke English well. The average education of workers in our sample was 7 years.

[Table 1 about here.]

4 Empirical Results

4.1 Main Analysis

Our main results from the wage analysis are presented in Table 2. The table has two panels, a top panel analyzing data on all 50 states, and a bottom panel that focuses solely on the top five H-2A employment states.[26] Within each panel, columns (1) to (4) show our OLS estimates. Moving from column (1) to (4), the models include progressively more comprehensive sets of control variables. In all of our OLS results, we find a positive relationship between AEWRs and domestic farm wages. As we add additional controls to the models, the estimates become smaller, which we interpret as our controls helping mitigate upward bias resulting from unobserved labor supply and demand shocks. The estimate in column (4) of the top panel implies that a 10% increase in the AEWR leads to at most a 4% increase in domestic wages.

[Table 2 about here.]

In columns (5) and (6) we present estimates of AEWR marginal effects obtained using two-stage least squares (2SLS), including the same set of controls as in column (4). Estimates in column (5) use the lagged AEWR instrument, and those in column (6) use our preferred lagged leave-one-out AEWR instrument. In all cases, the 2SLS estimates are smaller than the OLS estimates, suggesting that our instrumental variables strategy further helps mitigate upward bias from unobserved labor market shocks. Consider, for example, the coefficient

[26] The top five H-2A employment states in FY 2023 include Florida, California, Georgia, Washington, and North Carolina.

associated with our preferred specification in column (6) of the top panel. The IV estimate of 0.28 is smaller than the OLS estimate of 0.40 in column (4). It is important to note that our instruments pass the weak instrument test with the smallest first stage partial F-statistic being greater than 450.

Our preferred specification in column (6) reveals that a 10% increase in the AEWR causes at most a 2.8% increase in domestic farm wages when considering the whole nation and at most a 4.8% when we focus only on the top five H-2A employment states. To put this in context, the AEWR has grown at a rate of 4.7% per year over the past decade, and the average real wage of domestic farmworkers between 2020 and 2022 was $15.59.[27] When considering a $15.59 wage value, a 4.7% increase in the AEWR would cause the average wage of domestic farm employees to rise by as much as 1.32%, or $0.21 per hour to $15.80.[28]

In 2022, establishments within crop production (NAICS 111) and crop support services (NAICS 1151) reported a total wage bill of approximately $36 billion to their state's unemployment insurance (UI) authorities, as recorded in the Quarterly Census of Employment and Wages (QCEW) (US Bureau of Labor Statistics, 2024). As such, our estimates imply that a 4.7% AEWR increase in the AEWR would have resulted in UI-bound farmers paying an additional $475 million in wages to domestic farmworkers during that year.[29]

Conversely, our estimates imply that a one-year AEWR freeze, as proposed by legislative measures such as the Farmworkforce Modernization Act (FWMA), would have reduced the growth of domestic farmworker crop wages by at most $475 million had the AEWR been frozen in 2022.[30] These wage savings for employers would be in addition to the savings from limiting wage increases for H-2A workers and for domestic workers employed by H-2A employers in similar roles. Castillo, Martin, and Rutledge (2022) estimated a $140 million in reduced wage growth for H-2A workers and $29 million for domestic workers employed by

[27] The NAWS recommends using more than one year of data when calculating averages.

[28] Note that $0.28 \times 4.7\% = 1.32\% \implies 1.32\% \times \$15.59 = \$0.21$.

[29] $1.32\% \times \$36$ billion $\approx \$475$ million.

[30] Moreover, a 3.25% per year AEWR cap, as proposed by the FWMA for the nine years after the first year of its enactment, would have reduced the total wage growth of domestic farm employees by as much as $150 million per year ($\$36\text{B} \times (4.7\% - 3.25\%) \times 0.28 \approx \$150$ million) had the AEWR been capped in 2022.

H-2A employers in similar roles had AEWRs been frozen in 2020. Considering the increases in AEWRs and the H-2A program from 2020 to 2022, these figures likely understate these reductions in wage growth that would have occurred had AEWRs been frozen in 2022.

4.2 Heterogeneity Analysis

In this section, we explore whether there are differences in the magnitude of AEWR marginal effects across different groups of workers within the U.S. domestic farm workforce. We focus on three dimensions of human capital: English-speaking ability, education, and work experience. Specifically, we compare estimates of AEWR effects between individuals who do and do not speak English proficiently, those who with at least six years of schooling versus those with fewer, and workers with at least 10 years of farm work experience compared to those with less.

For simplicity, Table 3 shows results from analyses using data only on the top five H-2A employment states. As in Table 2, OLS results can be found in columns (1) to (4), results using the lagged AEWR instrument in column (5), and those from the lagged leave-one-out AEWR instrument in column (6).

All of our instruments have strong first stages with the smallest first stage F-statistic being greater than 200. Estimates from our preferred model indicate that individuals with greater human capital tend to have larger domestic wage-AEWR elasticities, perhaps suggesting that those with higher skills or education tend to have greater bargaining power, enabling them to negotiate higher wages when the AEWR increases. For example, our preferred 2SLS specification produces an upper bound elasticity estimate of 0.56 for individuals who speak English well, compared to 0.41 for those who do not. Similarly, those with at least six years of schooling (the average is 7 years) have a statistically significant upper bound estimate of 0.50, while those with less education have an upper bound of 0.28, which is not statistically significant. Moreover, individuals with extensive work experience have an elasticity of at most 0.53, while those with less experience have an elasticity of at most 0.42. These results are perhaps suggestive that workers who have more human capital may be better positioned to leverage the AEWR to their advantage when negotiating wages with their employers or might have more inelastic labor supply curves.

[Table 3 about here.]

5 Conclusion

The H-2A visa program expanded rapidly over the past decade, sparking new interest in the rules and regulations that govern the program, especially those concerning Adverse Effect Wage Rates (AEWRs), which set the minimum wages for H-2A workers. In FY 2023, more than 370,000 H-2A jobs were certified to work in the United States, and this number is expected to rise. Recent legislation, such as the Farm Workforce Modernization Act, has been proposed that would make a number of changes to the H-2A program, including provisions that would freeze the AEWR and place a limit on its year-to-year growth. To date, these proposals have not received full bi-partisan support in the U.S. Congress. Further, DOL has implemented regulatory changes that have faced legal challenges from both employee and employer groups (Florida Growers v. DOL, 2023; Columbia Legal Services, 2023).

Employers and farmworker advocates have long disputed issues regarding AEWRs. For example, farmers grappling with labor scarcity often express concern about the impacts of rising AEWRs on their farming operations, while farmworker advocacy groups argue that AEWRs prevent wages from rising as much as they should. In this paper, we provide both a theoretical and empirical examination of the role of the AEWR on U.S. farm labor markets, addressing some of the most pressing questions in the ongoing public debate. Our theoretical model provides insights into how the AEWR may create spillovers into the U.S. domestic farm labor market, helping to determine whether the level at which the AEWR is set has unintended consequences for domestic workers. We also provide empirical estimates of these spillover effects.

Our simple theoretical model suggests that an increase in the AEWR will lower the demand for H-2A labor and create a substitution effect that increases the demand for domestic farmworkers. This increase in domestic farm labor demand causes domestic farm wages to rise. An alternative model presented in Appendix C provides an additional mechanism through which raising AEWRs from their current levels might lead to higher domestic wages: by serving as a bargaining chip for domestic farmworkers. This effect, sometimes referred to as "a lighthouse effect," might create negative labor supply pressures that cause non-H-2A farm employers to raise wages as AEWRs rise.

Our empirical analysis provides evidence that is consistent with our theory, substantiating the notion that the level at which AEWRs are set affects the labor market outcomes of domestic farmworkers. The estimates from our preferred specifications indicate that a 10% increase in the AEWR causes the average wage of domestic farm employees to increase by at most 2.8% when focusing on the nation as a whole and at most 4.8% when focusing solely on the top five H-2A employment states. A closer look at farmworker subpopulations indicates that workers who have higher human capital benefit more from increases in the AEWR, perhaps suggesting that workers who bring greater value to the farm have higher bargaining power.

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Table 1: Summary Statistics

	Mean	SD	Obs
Real AEWR ($2022)	13.30	1.64	883
Real domestic farm wage ($2022)	12.55	3.99	61,802
Age (years)	35.79	11.94	61,802
Male	0.80	0.40	61,802
Married	0.61	0.49	61,802
Undocumented	0.46	0.50	61,802
Speaks good English	0.22	0.41	61,802
Number of years of education	7.27	3.84	61,802

Note: AEWR data were obtained from the Farm Labor Survey and denote the average real AEWRs (in $2022) for each state-year over our sample period. The remainder of the summaries were calculated using NAWS data.

Table 2: Domestic Farmworker Wage-AEWR Elasticity Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	All H-2A States					
ln A	0.936	0.680	0.474	0.399	0.305	0.279
	(0.029)	(0.053)	(0.098)	(0.090)	(0.117)	(0.151)
N	61,802	61,802	61,802	61,802	61,802	61,802
First Stage F-Statistic	–	–	–	–	2,977.38	843.94
	Top Five H-2A States					
ln A	1.072	0.910	0.581	0.563	0.451	0.477
	(0.040)	(0.088)	(0.164)	(0.151)	(0.205)	(0.179)
N	37,443	37,443	37,443	37,443	37,443	37,443
First Stage F-Statistic	–	–	–	–	1,316.24	460.54
Controls						
Year Fixed Effects	–	X	X	X	X	X
State Fixed Effects	–	–	X	X	X	X
Demographic Controls	–	–	–	X	X	X
Specification						
OLS	X	X	X	X	–	–
Lagged AEWR IV	–	–	–	–	X	–
Lagged Leave-One-Out AEWR IV	–	–	–	–	–	X

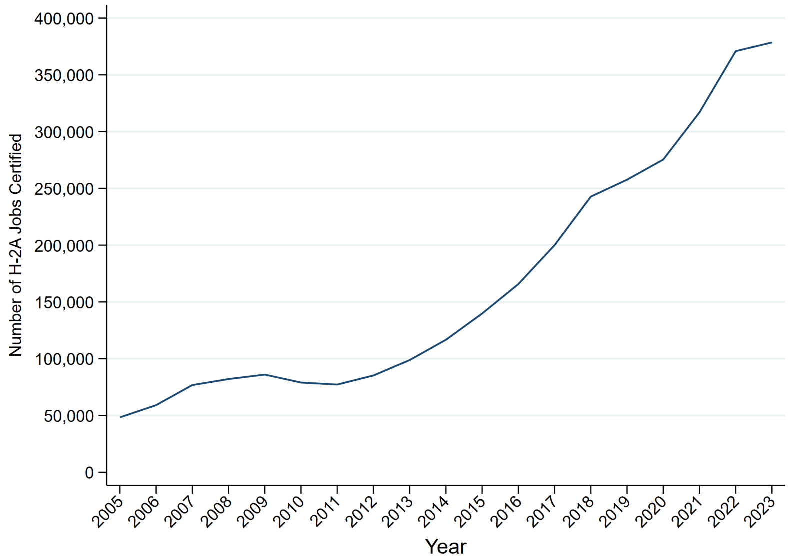
Notes: Table 2 reports the OLS (columns 1 - 4) and 2SLS (columns 5 - 6) results. The explanatory variable is the natural logarithm of the real state-level AEWR (in $2022), and the outcome variable is the natural logarithm of the real individual-level domestic crop farmworker wage (in $2022). Column (1) presents results from models that do not have any controls. Column (2) includes year fixed effects, and column (3) state fixed effects. Columns (4), (5), and (6) include the following individual-level demographic controls: age, schooling, marital status, gender, English-speaking ability, and undocumented status. The top panel reports the results from all states, and the bottom panel reports the results from the top five H-2A states, which include Florida, California, Georgia, Washington, and North Carolina. Standard errors are design-corrected according to DOL guidelines. The p-values are denoted by
* $p < .1$, ** $p < .05$, *** $p < .01$.

Table 3: Domestic Farmworker Wage-AEWR Elasticity Estimates in Top Five H-2A States

	(1)	(2)	(3)	(4)	(5)	(6)
	Proficient in English					
ln A	1.011	1.094	0.700	0.760	0.482	0.563
	(0.079)	(0.082)	(0.181)	(0.173)	(0.161)	(0.255)
N	4,627	4,627	4,627	4,627	4,627	4,627
First Stage F-Statistic	–	–	–	–	886.22	236.68
	Not Proficient in English					
ln A	1.116	0.899	0.531	0.498	0.507	0.413
	(0.054)	(0.105)	(0.188)	(0.181)	(0.173)	(0.202)
N	32,912	32,912	32,912	32,912	32,912	32,912
First Stage F-Statistic	–	–	–	–	3,838.01	1,384.97
	Sixth Grade or More					
ln A	1.095	0.927	0.637	0.604	0.553	0.507
	(0.050)	(0.068)	(0.150)	(0.138)	(0.126)	(0.185)
N	25,629	25,629	25,629	25,629	25,629	25,629
First Stage F-Statistic	–	–	–	–	1,076.52	343.82
	Less Than Sixth Grade					
ln A	1.115	0.862	0.458	0.431	0.457	0.276
	(0.079)	(0.182)	(0.287)	(0.279)	(0.277)	(0.254)
N	11,910	11,910	11,910	11,910	11,910	11,910
First Stage F-Statistic	–	–	–	–	1,602.10	409.94
	High Experience					
ln A	0.990	1.039	0.803	0.799	0.760	0.534
	(0.068)	(0.087)	(0.198)	(0.181)	(0.155)	(0.251)
N	19,560	19,560	19,560	19,560	19,560	19,560
First Stage F-Statistic	–	–	–	–	1,542.54	368.18
	Low Experience					
ln A	1.057	0.709	0.403	0.361	0.340	0.416
	(0.056)	(0.112)	(0.195)	(0.193)	(0.204)	(0.205)
N	17,762	17,762	17,762	17,762	17,762	17,762
First Stage F-Statistic	–	–	–	–	1,255.64	354.89
Controls						
Year Fixed Effects	–	X	X	X	X	X
State Fixed Effects	–	–	X	X	X	X
Demographic Controls	–	–	–	X	X	X
Model Specification						
OLS	X	X	X	X	–	–
Leave-One-Out IV	–	–	–	–	X	–
Lagged Leave-One-Out IV	–	–	–	–	–	X

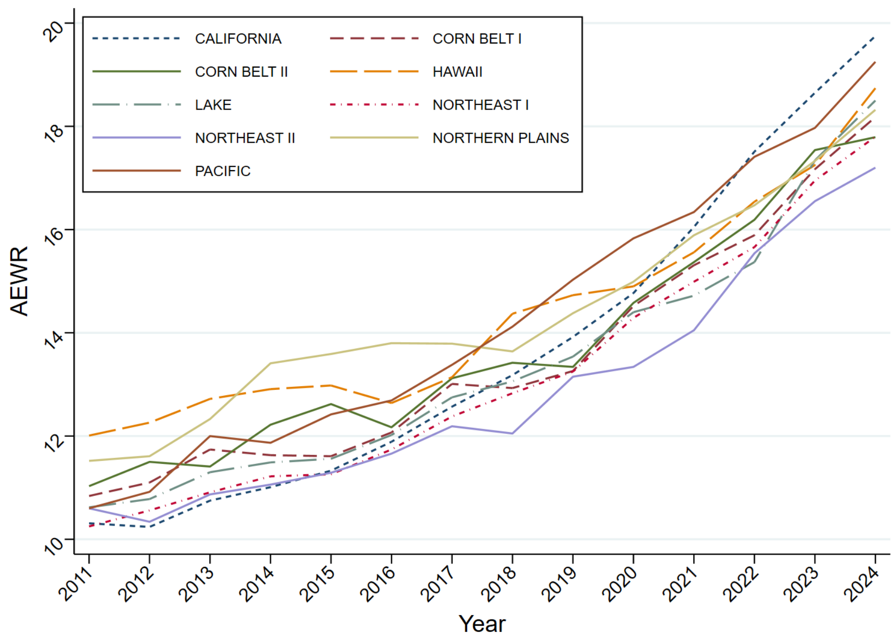
Notes: Table 3 reports the OLS (columns 1 - 4) and 2SLS (columns 5 - 6) results. The explanatory variable is the natural logarithm of the real state-level AEWR (in $2022), and the outcome variable is the natural logarithm of the real individual-level domestic crop farmworker wage (in $2022). Column (1) presents results from models that do not have any controls. Column (2) includes year fixed effects, and column (3) state fixed effects. Columns (4), (5), and (6) include the following individual-level demographic controls: age, schooling, marital status, gender, English-speaking ability, and undocumented status. The top panel reports the results from all states, and the bottom panel reports the results from the top five H-2A states, which include Florida, California, Georgia, Washington, and North Carolina. Standard errors are design-corrected according to DOL guidelines. The p-values are denoted by
* p < .1, ** p < .05, *** p < .01.

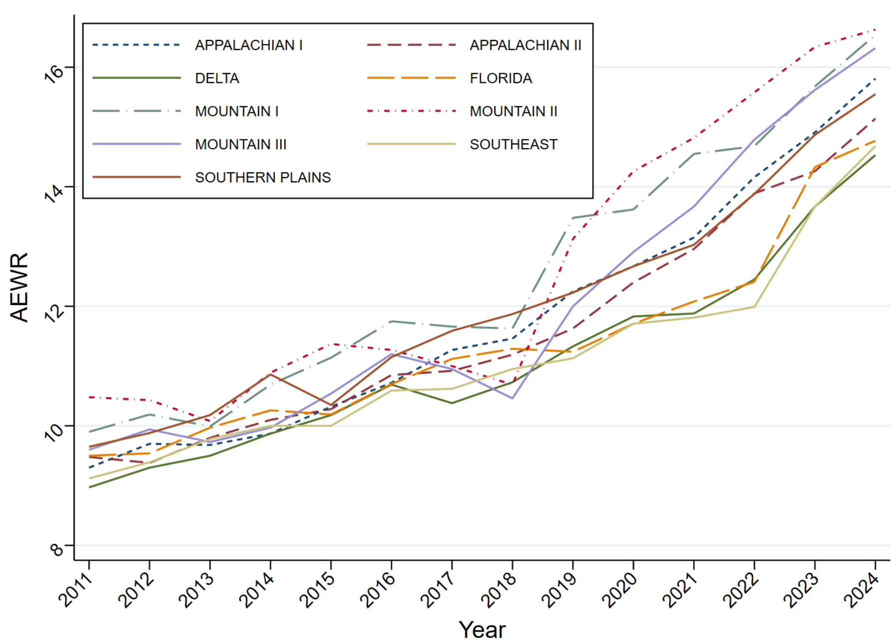
Figure 1: Number of H-2A Jobs Certified, Fiscal Years 2005 – 2023



Notes: H-2A job certification data were obtained from the U.S. Department of Labor's disclosure data website (`https://www.dol.gov/agencies/eta/foreign-labor/performance`).

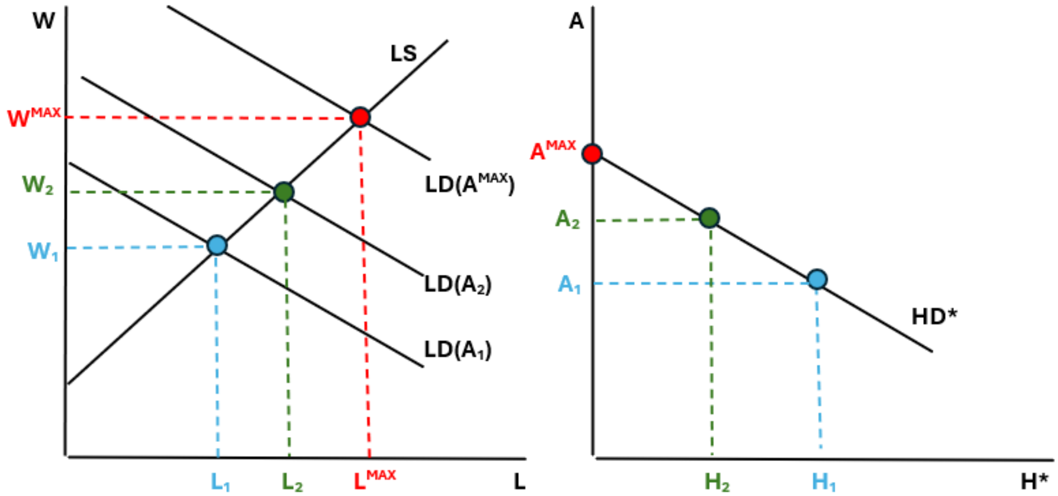
Figure 2: Adverse Effect Wage Rates, 2011 – 2024





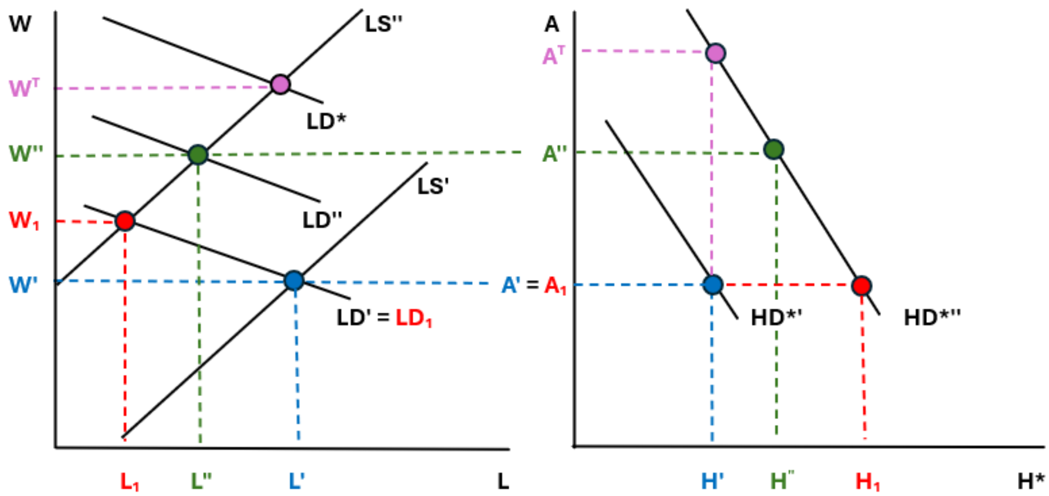
Notes: Regional AEWRs between calendar years 2011 and 2024. AEWR data were obtained from the Farm Labor Survey and are expressed in nominal values. AEWR values have generally increased over time, and their values have increased at a higher rate in recent years.

Figure 3: Short-Run Equilibrium in the Domestic and H-2A Labor Markets



Notes: The left panel of the figure shows short-run equilibrium domestic wages and employment, and the right panel equilibrium H-2A employment for different values of the AEWR, holding Ω constant. For clarity, we draw linear domestic labor supply and demand curves, along with the H-2A equilibrium employment response function. When $A < A^{MAX}$, increases in the AEWR increase domestic labor demand leading to higher equilibrium domestic wages and employment. As such, when $A < A^{MAX}$, the AEWR marginal effect on domestic wages is positive. The adverse effect on domestic wages of setting the AEWR at A_1 is $-(W^{MAX} - W_1)$. An AEWR increase from A_1 to A_2 leads to a decline in the adverse effect of the AEWR on domestic wages, which falls by a magnitude of $|W_1 - W_2|$. However, after the increase to A_2, the adverse effect is still negative (i.e., $-(W^{MAX} - W_2) < 0$.)

Figure 4: Labor Market Adjustments to Steady State



Notes: Before the year 1 labor supply shock, the equilibrium is $W^{0} = A^{0}$ with domestic employment of L^{0} and H-2A employment of $H^{*^{0}}$. After the shock, the domestic labor supply curve shifts from LS^{0} to LS^{00}, resulting in a wage increase to W_1 while the AEWR remains at $A^{0} = A_1$ for the period. As domestic wages increase, the H-2A equilibrium response curve shifts from $HD^{*^{0}}$ to $HD^{*^{00}}$, leading to an increase in H-2A employment from H^{0} to H_1. AEWRs are updated based on lagged wages in year 2 so that $A_2 = W_1 > A_1$. As AEWRs increase, farmers substitute H-2A labor for domestic labor, causing an upward shift in the domestic labor demand curve. To avoid cluttering the figure, we omit the short-run equilibrium in year 2. This process repeats, with AEWRs and domestic wages continuing to rise in subsequent periods until the new steady state is reached at $W^{00} = A^{00}$. If the AEWR were set at a level that maintained H-2A employment at its initial level H^{0}), the domestic wage would be higher than at the new steady state (i.e., $W^T > W^{00}$). As such, access to H-2A labor prevents wages from rising as much as they would have otherwise, as farmers are able to substitute some domestic labor for H-2A workers.

Appendix

A Comparative Statics

A.1 AEWR Comparative Statics

We want to show that $\frac{dL}{dA}$, $\frac{dW}{dA} = \frac{dg_t(A)}{dA} > 0$ and $\frac{dH}{dA} < 0$. For clarity, during these exercises, we omit the time indices. The equilibrium is characterized by the H-2A and domestic labor demand equations (equations (A.1) and (A.2), respectively), and the expression for domestic labor supply (A.3):

$$H = \frac{W - (A + c_1)}{2c_2} \tag{A.1}$$

$$L = \frac{p}{W}^{\frac{1}{1}} - \frac{W - (A + c_1)}{2c_2} \tag{A.2}$$

$$L = \frac{W}{w_C}. \tag{A.3}$$

From equating (A.2) to (A.3) and rearranging, we see that the equilibrium wage, $W(A) \equiv W = W$, satisfies the following condition:

$$\frac{p}{W}^{\frac{1}{1}} - \frac{W - (A + c_1)}{2c_2} - \frac{W}{w_C} = 0.$$

Let

$$F(W, A) = \frac{p}{W}^{\frac{1}{1}} - \frac{W - (A + c_1)}{2c_2} - \frac{W}{w_C}.$$

By the implicit function theorem, we know that $\frac{dW}{dA} = -\frac{\partial F/\partial A}{\partial F/\partial W}$. Note that the numerator is positive because $\frac{\partial F}{\partial A} = \frac{}{2c_2}$, and $\frac{}{2c_2} > 0$ since $, c_2 > 0$. Moreover,

$$-\frac{\partial F}{\partial W} = \frac{p}{W^2} \cdot \frac{1}{1 -} \frac{p}{W}^{\frac{}{1}} + \frac{2}{2c_2} + \frac{W}{w_C}^{1} > 0,$$

which is positive since all the terms in parenthesis are positive by assumption. It follows that $\frac{dW}{dA} > 0$.

From equation (A.3) above, we see that $\frac{dL}{dA} = \frac{1}{w_C}\frac{dW}{dA} = \frac{W}{w_C}^{1}\frac{dW}{dA} > 0$. Lastly, using (A.2), the domestic labor demand function, we know that

$$\frac{dL}{dA} = \left(\frac{d\left(\frac{p}{W}\right)}{dA}\right)^{\frac{1}{1}} - \frac{dH}{dA} > 0.$$

Note that $\frac{d\left(\frac{p}{W}\right)}{dA}^{\frac{1}{1}} = -\frac{1}{1}(p)^{\frac{1}{1}} \cdot W^{\frac{1}{1}\ 1}\frac{dW}{dA}$, which is negative since the term in parenthesis and $\frac{dW}{dA}$ are both positive. Then, $-\frac{dH}{dA} > 0$ because we have just shown that $\frac{dL}{dA} > 0$. As such, since > 0, it must be the case that $\frac{dH}{dA} < 0$.

A.2 Other Parameter Comparative Statics

Besides examining how AEWR changes affect domestic wages and employment, we can also show how changes in other parameters of the model impact farm labor markets. Moreover, we can use the model to explain differences in wages and employment across regions by setting its parameters to vary across them (e.g., labor supply as modeled by the outside employment option of domestic workers w_C, crop mix as governed by technology , output demand as governed by output prices p, and H-2A profitability differences as governed by the productivity gap term , and all H-2A costs inclusive of the AEWR (i.e., $c_1; c_2; A$).

The following table summarizes the predicted effects of positive changes in the exogenous variables on the endogenous variables in our model:

	H	L	W	Type
$p;$	+	+	+	(1) All three move in the same direction
Supply Shifters, w_C	+	-	+	(2) H and W move in the same direction
$A; c_i;$ H-2A-specific costs	-	+	+	(3) L and W move in the same direction
- relative productivity	+	-	-	(3) L and W move in the same direction

A.3 Convergence to Steady State in Response to Shocks

Suppose that the model is at the steady associated with Ω', $\{A'; W'; H'; L'; Y'; \Omega'\}$. Now, suppose there is a negative domestic labor supply shock between year $t-1$ and year t, so that Ω' changes to Ω''. Using the implicit function theorem, we can show that $\frac{dW'}{dw_C} > 0$ for all w_C, so that in the new steady state, $\{A''; W''; H''; L''; Y''; \Omega''\}$, AEWRs and domestic wages are higher than before. To see this, note that steady-state domestic wages solve the following equation:

$$F_0 = \left(\frac{p}{W'}\right)^{\frac{1}{1-}} - \left(\frac{W' - (W' + c_1)}{2c_2}\right) - \frac{W'}{w_C} = 0.$$

By the implicit function theorem, we know that $\frac{dW'}{dw_C} = -\frac{\partial F_0 / \partial w_C}{\partial F_0 / \partial W'} > 0$ because $\frac{\partial F_0}{\partial w_C} = \frac{W'}{w_C^{+1}} >$ 0, and

$$-\frac{\partial F_0}{\partial W'} = \left(\frac{p}{W^2} \cdot \frac{1}{1-} \left(\frac{p}{W}\right)^{\frac{}{1-}}\right) + \left(\frac{W}{w_C}\right)^{-1} + \frac{(2-)}{2c_2} > 0$$

since all the terms in parentheses are positive.

However, in the short run, AEWRs are fixed at the original steady-state level, and this leads to a short-run equilibrium domestic wage that is lower than the new steady state. To see this, note that the change in the original steady state wage given the labor supply shock, holding the AEWR fixed at A', we can show that $\frac{dW'(A = A')}{dw_C} = -\frac{\partial F_1 / \partial w_C}{\partial F_1 / \partial W'} > 0$, where

$$F_1 = \left(\frac{p}{W'}\right)^{\frac{1}{1-}} - \left(\frac{W' - (A' + c_1)}{2c_2}\right) - \frac{W'}{w_C} = 0.$$

This result emerges because $\frac{\partial F_1}{\partial w_C} = \frac{W'}{w_C^{+1}} > 0$, and

$$-\frac{\partial F_1}{\partial W'} = \left(\frac{p}{W^2} \cdot \frac{1}{1-} \left(\frac{p}{W}\right)^{\frac{}{1-}}\right) + \left(\frac{W}{w_C}\right)^{-1} + \frac{2}{2c_2} > 0.$$

Clearly, $0 < -\frac{\partial F_0}{\partial W'} < -\frac{\partial F_1}{\partial W'}$ since $\frac{2}{2c_2} < \frac{2}{2c_2}$, and the two expressions are otherwise identical.

As such, since $\frac{\partial F_1}{\partial w_C} = \frac{\partial F_0}{\partial w_C}$ and $0 < -\frac{\partial F_1/\partial w_C}{\partial F_1/\partial W'} < -\frac{\partial F_0/\partial w_C}{\partial F_0/\partial W'}$, the marginal wage response to the shock is lower when AEWRs are fixed. To see that the new domestic wage steady state is larger than the short-run equilibrium wage, i.e., $W'' > W_t > W' = A' = A_t$, we can use the Fundamental Theorem of Calculus. Suppose w_C increases from w_{C1} to w_{C2}. Then

$$W'' - W' = \int_{w_{C1}}^{w_{C2}} -\frac{\partial F_0/\partial w_C}{\partial F_0/\partial W'} dw_C > \int_{w_{C1}}^{w_{C2}} -\frac{\partial F_1/\partial w_C}{\partial F_1/\partial W'} dw_C = W_t - W'.$$

Because $W_t > A_t = W_{t-1}$, in period $t+1$, farmers face a higher AEWR than they did in period t since $W_t = A_{t+1} > A_t = W_{t-1}$, and thus AEWRs increase from period t to period $t+1$. After the original labor supply shock, the parameters in Ω'' are fixed, and thus the only parameter changing from t to $t+1$ is the AEWR. We know that $\frac{dW(A;\,'')}{dA} > 0$ for all A. As such, $A_{t+1} > A_t$ implies $W_{t+1} > W_t$. Thus, wages grow in response to AEWR growth, which leads to further AEWR growth and so on. This feedback process leads to wages and AEWRs increasing monotonically over time.

Proposition: Wages and AEWRs increase monotonically over time and converge to the new steady state.

Proof: Because domestic labor demand is strictly downward-sloping, whether short or long run, and domestic labor supply is strictly upward-sloping, we know that our short and long-run equilibria are unique. Uniqueness also implies that $W(A'') = W(W'') = W''$.

In the path to the steady state, the sequence of wages are bounded above by the steady state. Since $A'' = W'' > W_t > W' = A'$, it follows that $A'' > W_t = A_{t+1} > A'$. Recall that $W(A)$ is strictly increasing in A for all A. Thus, because $A'' > A_{t+1}$, it must be the case that $W'' = W(A'') > W_{t+1}(A_{t+1})$, and thus $W_{t+1} \in (W_t, W'')$. A similar argument shows that $W_{t+2} \in (W_{t+1}, W'')$ and so forth. Now, since steady states are unique, we know that there does not exist another steady state such that $W''' < W''$. As such, the sequence of wages converges to the steady state W''.

B AEWR Measurent Issues and The Ratcheting Effect

For nearly all states and occupations, employers must pay H-2A workers no less than the AEWR, which is set at the region's average hourly wage for crop and livestock workers in the previous year as measured in the FLS. As such, the AEWR at time t, A_t, is given by

$$A_t = (\widehat{W}_{t-1})(1 - {}_{t-1}) + (\widehat{A}_{t-1}) {}_{t-1}$$

$\widehat{W}_{t-1}$ are domestic wages as measured in the FLS, and $\widehat{A}_{t-1}$ are H-2A wages as measured in the FLS.[1] ${}_{t-1}$ is the H-2A share of agricultural employment as measured in the FLS. Note that ${}_{t-1}$ will tend to be very small for many reasons, including the fact that (1) close to half of all H-2A workers are hired by farm labor contractors (FLCs), which are not sampled in the FLS and (2) the FLS includes many farm jobs not eligible for H-2A employment.

Because FLS wages might be measured with error, we use the following simple measurement error (ME) framework to help us answer some issues of policy interest. Let true but unobserved (lagged) mean hourly wages for temporary and seasonal agricultural jobs for domestic workers be W_{t-1}, and A_{t-1} denote the true hourly H-2A wage, which is just the AEWR. We can then write A_t as:

$$\begin{aligned} A_t &= (W_{t-1} + u_{t-1})(1 - {}_{t-1}) + (A_{t-1} + u_{t-1}) {}_{t-1} \\ &= W_{t-1}(1 - {}_{t-1}) + A_{t-1} {}_{t-1} + u_{t-1}; \end{aligned}$$

where u_{t-1} denotes ME, which for simplicity of exposition, we assume is the same for both domestic and H-2A wages. Here, ME stems from any of the following reasons:

- Incentive pay. The FLS only captures gross wages and thus includes bonuses and piece rates paid to the most productive workers: $u_{t-1} > 0$.

[1] For simplicity, we focus on H-2A wages only though we could include in these wages the wages of workers in corresponding employment without changing any of the analysis.

- Sampling issues. The FLS samples direct hires but not FLCs; direct hires tend to receive higher wages. The FLS also includes jobs ineligible for H-2A employment (year-round jobs): $u_{t-1} > 0$. Also, as noted in the literature, only a potentially endogenous subset of sampled farms responds to the FLS. Measurement error is of an indeterminate sign.

Using this simple expression for the AEWR, we can discuss two issues of policy interest. The first is whether AEWRs are too high or not, at least in the sense that $A_t > W_t$. Even if we have measurement error such that $u_{t-1} > 0$, AEWRs are not necessarily higher. Why? The condition $A_t > W_t$ is equivalent to

$$W_{t-1}(1 - \alpha_{t-1}) + A_{t-1}\alpha_{t-1} + u_{t-1} > W_t \iff$$
$$W_{t-1} + \alpha_{t-1}(A_{t-1} - W_{t-1}) + u_{t-1} > W_t. \tag{B.4}$$

Rearranging (B.4) reveals that

$$u_{t-1} > (W_t - W_{t-1}) + \alpha_{t-1}(W_{t-1} - A_{t-1}).$$

The first term on the right captures the fact that the AEWR is measured using lagged domestic wages. The second accounts for any pre-existing gap between domestic wages and AEWRs, scaled by α_{t-1}, which, as mentioned above, is likely very small. One takeaway for this expression is that if wages are growing rapidly, because AEWRs are measured with a lag, even when measurement error is such that $u_{t-1} > 0$, so that AEWRs are higher than last year's domestic wage, AEWRs may still be lower than the current domestic wage.[2]

While some focus on the impact of ME on the *level* of the AEWR, some worry that ME also distorts *changes* in the AEWR. More specifically, some worry that ME contributes to a "ratcheting effect" on the AEWR. A few versions of this type of "ratcheting effects" exist in

[2] Suppose $u_{t-1} = kW_{t-1}$ so that the gap between wages and the error is constant over time, then $A_t > W_t \iff k > \frac{(W_t - W_{t-1})}{W_{t-1}} + \frac{\alpha_{t-1}(W_{t-1} - A_{t-1})}{W_{t-1}}$.

the context of the AEWR, but all of them seem to be based on the idea that the AEWR's updating process results in mechanical increases in AEWRs year after year.

One popular version suggests that since FLS-measured H-2A wages include incentive pay, the FLS average H-2A wage should consistently be higher than the AEWR. The idea is to first abstract away from the fact that the level of the AEWR could affect the domestic wage (i.e., that is, assume that H-2A and domestic labor operate in fully segmented labor markets). Consequently, updating the AEWR based on the FLS average leads to a continuous increase in AEWRs.

Some employers blame this ratchet effect for the rapid increases in the AEWR we have seen in the past 10-20 years. While ME and an AEWR updating rule can generate ratcheting, the fact that the H-2A share measured in the FLS is likely much smaller than the overall H-2A share of farm employment makes the measurement error ratcheting effect explanation for rapidly rising wages quite unappealing. Moreover, even if this share were larger, this type of ratcheting could not possibly generate never-ending wage increases (i.e., the effects will necessarily die off as time goes on).

To see this, first, assume that the AEWR has no causal effect on the domestic wages of workers not in corresponding employment so that $W_{t\ 1}$ is not a function of $A_{t\ 1}$. To highlight the role of measurement error in this ratcheting effect, let's assume no shocks to wages or ME, so that $W_{t\ 1} = W_0$, $u_{t\ 1} = u$ for all t, and $\ _t = \ $. Assume that $u > 0$ so that both domestic and H-2A hourly wages are smaller than measured FLS wages. Then, AEWRs are updated using the rule $A_t = W_0(1 - \ ) + \ A_{t\ 1} + u$.

Using backward substitution, one can show that:

$$A_t = A_0 \ ^t + W_0(1 - \ ^t) + (u + u \sum_{i=1}^{t\ 1} \ ^i):$$

This expression shows that the impact of u on A_t is not only the current value u but also all its previous values. It turns out that the initial year's measurement error plays a significant role, but the subsequent years' measurement error contribution to current values of A are fairly small when is very small (since $\ ^t$ is very small from the outset).

Moreover, note that the effect of u on $A_{t+1} - A_t$, is $u\ \ ^t$:

$$A_{t+1} - A_t = A_0(\ \ ^{t+1} - \ \ ^{t}) + W_0(\ \ ^{t} - \ \ ^{t+1}) + u\ \ ^{t}$$

As such, even if we have no shocks to domestic wages $W_{t\ \ 1}$ or to ME in these wages u, A_t could trend up since it depends on lagged H-2A wages and a positive term u. However, if $\ _t$ is very small, the change in A_t induced by u would also tend to be really small. Thus, while u could lead to potentially much higher H-2A wages than domestic wages, its effects on *changes* in A are likely minor.

We provide a numerical example below. Suppose that $\ = :05$, and we start at $A_0 = W_0 = 15$. To make our point, assume that the measurement error is very large, say, $u = 7$.

$$A_1 = (:95) \cdot 15 + (:05) \cdot 15 + 7 = 22$$

$$A_2 = (:95) \cdot 15 + (:05) \cdot 22 + 7 = 22:35$$

$$A_3 = (:95) \cdot 15 + (:05) \cdot 22:35 + 7 = 22:367$$

So that at first, wages increase \$7.00 but then they only increase by .35 cents in period 2 and less than 2 cents in period 3. While the measurement error causes the AEWRs to be substantially higher than domestic wages in this example, it does not lead to substantial increases in AEWRs over time. This example may help provide a different perspective on this version of the ratcheting effect argument, where the ME ratcheting effect is considered the primary driver behind the recent rapid growth in AEWRs.

This is not to say that measurement error cannot contribute to AEWR growth. If we assume no causal effect of the AEWR on domestic wages, AEWR growth stems primarily from growth in domestic wages, W_t, and growth in measurement error, u_t. As such, if u_t increases over time, so will A_t. Growth in measurement error has been proposed as a potential explanation for AEWRs "ratcheting up." However, we argue that this is not what one would consider a "ratcheting effect" since there is no feedback between A and u. As such, after the initial measurement error, if the shocks to u_t stop, so do mechanical increases in A_t when   is small.

C Marginal Effects Under Alternative Theory

To gain additional insight into the marginal effects of the AEWR on domestic wages, we develop a second model using a simple cost minimization framework. Markets are perfectly competitive. A representative farmer produces a homogeneous labor-intensive crop output using three inputs, domestic farm labor (L), H-2A labor (H), and capital (K). The farmer seeks to minimize her total production costs subject to a fixed amount of contracted production during the growing season, which is generated by a constant returns to scale Cobb-Douglas production technology.

To make ideas clear, we define the domestic wage (respectively, the AEWR) as W (respectively, A). To accommodate "lighthouse effects," which occur when domestic farm workers view the AEWR as a market signal and demand higher wages to supply their labor to the market (Fan and Pena, 2019; Boeri, Garibaldi, and Ribiero, 2011), we let the domestic labor supply function depend on the AEWR:[3]

$$L = e^{[\ \ + \ \ \ln W]} \iff \ln L = \ \ + \ \ \ln W; \tag{C.1}$$

where the elasticity of domestic farm labor supply is given by $\ \geq 0$, and $\ \equiv - \ \ \ln(A + C)$. Non-wage H-2A costs, C, are expressed on a per-hour basis. The (log) marginal effect of the AEWR on domestic labor supply is given by $\frac{\partial \ln L}{\partial \ln A} = -\ \ $, which is the elasticity of the domestic farm labor supply with respect to the AEWR. The parameter $\ > 0$ captures the

[3] Industry sources claim that when H-2A labor is employed in a local labor market, employers of domestic workers must raise their wages to match or exceed the AEWR so that their employees do not quit and seek work in corresponding employment at the H-2A employer's place of work where all employees are guaranteed the AEWR. Such a scenario is consistent with a lighthouse effect.

magnitude of the elasticity of labor supply with respect to the total cost of H-2A labor, and $\equiv \frac{A}{A+C} \in (0; 1)$ is the AEWR's share of total H-2A labor costs at the equilibrium before an AEWR shock takes place.

As in the text, we assume the supply of H-2A labor is perfectly elastic at the level of the AEWR. The parameter r denotes the rental rate of capital. We assume that all markets clear. For a given level of output Y, the farmer's optimal input decision-making process is as follows:

$$\min_{L;H;K} \; WL + (A + C)H + rK$$

subject to

$$Y = \Pi L \;\; H \;\; K \; : \tag{C.2}$$

We assume that the input cost shares are positive (i.e., $\{ \; ; \; ; \; \} \in (0; 1)$), and constant returns to scale in production such that $\; + \; + \; = 1$. Using this framework, the representative farmer's optimal (log) demand for domestic labor can be expressed as:[4]

$$\ln L = \frac{-(\; + \;)}{\; + \; + \;} \ln W + \frac{\;}{\; + \; + \;} \ln(A + C) + Z \tag{C.3}$$

where

$$Z = \ln \frac{Y}{\Pi} + \; \ln \; - \; + \; \ln \; \frac{r}{\;} \; :$$

C.1 The E ect of the AEWR on Domestic Farm Employee Wages

Since markets clear, we use equations (C.1) and (C.3) to set the (log) domestic farm labor supply equal to the (log) domestic farm labor demand and solve for the equilibrium (log) domestic farm wage, which is given by:

$$\ln W \; = \Gamma + \frac{\; + \;}{\; + \; + \;} \ln(A + C) + \frac{1}{\; + \; + \;} \ln Y + \frac{\;}{\; + \; + \;} \ln r; \tag{C.4}$$

[4] See Appendix C.2 for proof.

where

$$\Gamma = \frac{1}{\ + \ +} \quad \ln \ - \ + \ \ln \ - \ - \ln \Pi \ ;$$

How does the equilibrium wage change as the AEWR increases? We can derive the marginal effect of the AEWR on the equilibrium domestic farm wage, denoted , by taking the partial derivative of (C.4) with respect to $\ln A$. Doing so, we can show that this marginal effect, as in the text, is positive, and is given by:

$$\equiv \frac{\partial \ln W}{\partial \ln A} = \frac{(\ + \ )}{\ + \ +} = \underbrace{\frac{}{\ + \ +}}_{} + \underbrace{\frac{}{\ + \ +}}_{} > 0; \tag{C.5}$$

where represents an AEWR-driven substitution effect, and represents a domestic labor supply driven lighthouse effect. The following two sections provide insights into the underlying structural mechanisms driving these effects and an explanation about why > 0 and > 0 such that the total effect of the AEWR results in higher domestic farm wages (i.e., > 0).

C.1.1 AEWR-Driven Substitution E ect

In our model, AEWR-driven domestic labor demand shocks induce a substitution effect, denoted $\in (0; 1)$ in equation (C.5), that shifts the domestic farm labor demand curve outward. This substitution effect results from the fact that, for a given production technology, rental rate, and output level, an increase in the AEWR causes the quantity of H-2A labor demanded to fall, requiring an increase in domestic farm employment to maintain the contracted level of production. In Figure C.1(a), the H-2A labor market equilibrium prior to an increase in the AEWR is characterized by the initial AEWR, A_0, and H-2A employment level, H^0. If a given level of production is to be maintained, when the quantity of H-2A labor demanded falls, the demand for domestic farm labor must increase, causing the equilibrium wage in the domestic farm labor market to rise.

Figure C.1 depicts the farm labor market equilibrium at a fixed level of capital in the $L-H$ space.[5] Similarly, the initial equilibrium in the domestic farm labor market is characterized by W_0 and D^0 in Figure C.1(b). Figure C.1(c) depicts the initial equilibrium in the $L - H$ space with the isoquant Y implied by equation (C.2).

[Figure C.1 about here.]

As shown in Figure C.1(a), when the AEWR increases from A_0 to A_1, the quantity of H-2A labor demanded decreases from H^0 to H^1 (a movement along the initial H-2A demand curve H_d^0). Figure C.1(c) reveals that this AEWR increase changes the relative wage ratio from (-A_0=W_0) to (-A_1=W_1), which causes the slope of the isocost line in the $L - H$ space to decrease (become steeper). Thus, the farmer must increase the amount of domestic labor she employs to meet her contracted production level, so her demand for domestic farm labor rises.[6]

Figure C.1(b) displays an increase in domestic farm labor demand and a corresponding increase in domestic farm employment from L^0 to L^1. Thus, the equilibrium wage in the domestic farm labor market increases from W_0 to W_1.[7] While an increase in the domestic farm wage will also induce substitution back into H-2A labor, there is net substitution out of H-2A labor into domestic farm labor because $< 1 \iff (-A_1$=$W_1) < (-A_0$=$W_0)$, so the slope of isocost line ultimately decreases (becomes steeper).

If the domestic farm labor supply is fixed, and is thus perfectly inelastic (i.e., $= 0$), the AEWR-driven increase in domestic farm labor supply will push up the domestic wage without a corresponding increase in domestic employment. In such a case, the domestic farm

[5]While we acknowledge that capital-labor substitution occurs (Win, Rutledge, and Maredia, 2024; Rutledge and Taylor, 2019), existing technologies are generally unable to replace labor for most labor-intensive crop production tasks such that the first-order adjustments likely occur in the labor markets. Therefore, our discussion focuses on substitution between the domestic and H-2A labor inputs.

[6]In some cases, farmers who employ only domestic workers will have to match or exceed the AEWR so they can retain their domestic employees and refrain from having to rely on the H-2A visa program, which is typically more expensive due to the AEWR and the non-wage costs of using the program. Such a scenario may also explain increased demand for domestic labor (i.e., increase wages at the initial level of employment).

[7]Note that the cost minimizing solution in Figure C.1(c) is characterized by increases in the AEWR and the domestic farm wage.

wage must rise to a level that returns the slope of the isocost line to its initial value. In other words, when $\;= 0$, the following condition must hold:[8]

$$\frac{A_1}{W_1} = \frac{A_0}{W_0} \iff \quad = 1.$$

However, such a case is implausible because $\; > 0$ implies that capital is a productive input, so a higher AEWR will also induce substitution into capital, which attenuates the magnitude of , so it must be the case that $\; < 1$.[9] The magnitude of is also influenced by the magnitudes of the domestic farm labor supply elasticity, , the H-2A labor cost share, , and the AEWR's initial share of H-2A labor costs, . In the limiting case where the supply of domestic farm labor is perfectly inelastic (i.e., $\; = 0$), one can infer an upper bound for by substituting in values for the cost shares $\approx .08$ and ≈ 0.60 and ≈ 0.75 such that the AEWR-driven substitution effect is likely at most (i.e., $\approx \frac{0.08 \quad 0.75}{0.08+0.60} \approx 0.09$).[10]

C.1.2 AEWR-Driven Lighthouse Effect

Section C.1.1 reveals that higher AEWRs put upward pressure on the demand for domestic farm labor, which will lead to higher domestic employment. However, such a scenario is inconsistent with the current state of affairs. In fact, H-2A expansion is driven by a decline in the supply of domestic farm labor. It is well documented that the decline in the supply of farm labor has resulted from a confluence of factors (e.g., Taylor, Charlton, and Yúnez-Naude, 2012; Fan et al., 2015; Zahniser et al., 2012; Charlton and Taylor, 2016), but the literature has yet to investigate the extent to which the AEWR is one of them. Equation (C.5) reveals that the AEWR induces a lighthouse effect because it causes domestic farm

[8] See Appendix C.3 for proof.

[9] The attenuation of ψ by σ can also be seen by looking at the denominator of ψ in equation (C.5).

[10] Estimates suggest that the non-wage per-hour costs of employing H-2A labor is about \$5.00 per hour. The average state AEWR in 2023 was \$16.13 so that $\eta \approx 0.75 \approx \frac{\$16.13}{\$16.13+\$5.00}$. Our estimate of 0.08 for β comes from the fact that total labor costs comprise about 40% of the cost of specialty crop production (i.e., $\alpha+\beta \approx 0.40$), and the H-2A wage bill in the U.S. is about 20% of all labor costs so that $\beta \approx 0.08 \approx 0.20\times 0.40$. Similarly, labor costs account for roughly 40% of production costs, so the cost share of capital is about 0.60 (i.e., $\sigma \approx 0.60 \approx 1-0.40 \approx 1-\alpha-\beta$).

employees to demand higher wages to supply their labor to the market. The lighthouse effect is denoted $\; > 0$ in equation (C.5).

A graphical depiction of the lighthouse effect can be found in Figure C.2. As can be seen in Figure C.2(a), when the AEWR increases, domestic workers view it as a market signal and demand higher wages, causing the domestic farm labor supply curve to shift from L_s^0 to L_s^1. This shift causes the domestic farm wage to increase from W_1 to W_2 and the domestic employment level to drop from L^1 to L^2. As shown in Figure C.2(c), the increase in the domestic farm wage is accompanied by an increase in the slope of the isocost line (it becomes flatter) from $(-A_1/W_1)$ to $(-A_1/W_2)$. As shown in Figure C.2(b), the farmer's demand for H-2A labor must increase from H_d^0 to H_d^1 to maintain the contracted level of production so that H^2 units of H-2A labor are employed.

[Figure C.2 about here.]

Given our empirical setting, it is not feasible to identify the AEWR-driven substitution and lighthouse effects separately because our outcome variable of interest is an equilibrium value that reflects changes in the supply of and demand for domestic farm labor. The substitution effect arises from AEWR-driven shocks to the demand for domestic farm labor, and the lighthouse effect is a result of AEWR-driven labor supply shocks. Therefore, our empirical estimates reflect the total effect, i.e., the sum of the substitution and lighthouse effects.

C.1.3 Non-AEWR H-2A Labor Cost Spillover Effects

Interestingly, a similar result emerges when the non-wage cost (e.g., housing, transportation, etc.) of employing H-2A workers increases. By taking the partial derivative of equation (C.4) with respect to $\ln C$, we derive the following formula for the elasticity of domestic farm wages with respect to the non-wage H-2A costs, denoted :

$$\equiv \frac{\partial \ln W}{\partial \ln C} = \frac{\quad}{+ \quad +} + \frac{\quad}{+ \quad +} > 0, \tag{C.6}$$

where $\;\equiv 1 - \; = \frac{C}{A+C} \in (0,1)$ is the non-wage cost share of employing H-2A workers at the initial equilibrium. Equation (C.6) reveals that, ceteris paribus, an increase in C will also increase the equilibrium wage in the domestic farm labor market. This result occurs because any increase in the cost of employing H-2A workers, whether through the AEWR or through non-wage channels, induces domestic farm labor supply and demand shocks that mimic the effects of the AEWR. In fact, the magnitude of   only differs from   to the extent that the non-wage H-2A labor costs differs from the AEWR.

C.2 Optimal Domestic Farm Labor Demand Derivations

The farmer's optimal input decision making process in the current growing season is characterized by the following cost minimization problem:

$$\min_{L,H,K} \; WL + (A+C)H + rK$$

subject to

$$Y = \Pi L \;\; H \;\; K \;. \tag{C.7}$$

The Lagrangean function can be expressed as follows:

$$\mathscr{L} = WL + (A+C)H + rK + \;\; (Y - \Pi L \;\; H \;\; K \;).$$

The first order conditions imply that

$$H = \frac{W}{(A+C)} L \tag{C.8}$$

and

$$K = \frac{W}{r} L. \tag{C.9}$$

Substituting (C.8) and (C.9) into (C.7), taking logs, and solving for $\ln D$ allows us to derive the optimal (log) demand for domestic labor:

$$\ln D = \frac{-(\quad + \quad)}{\quad + \quad + \quad} \ln W + \frac{\quad}{\quad + \quad + \quad} \ln(A + C) + \underbrace{\ln \frac{Q}{\Pi} \; + \; \ln \; \frac{}{} \; + \; \ln \frac{r}{}}_{z} :$$

C.3 Proof that $\frac{A_1}{W_1} = \frac{A_0}{W_0} \iff \quad = 1$

Assume the following condition holds such that the relative wages are the same before and after an increase in the AEWR:

$$\frac{A_1}{W_1} = \frac{A_0}{W_0}: \tag{C.10}$$

By using the following algebraic process, one can see that equation (C.10) is equivalent to $\quad = 1$:[11]

$$\frac{A_1}{W_1} = \frac{A_0}{W_0} \iff \frac{A_1}{A_0} = \frac{W_1}{W_0} \iff \frac{A_1}{A_0} - 1 = \frac{W_1}{W_0} - 1 \iff$$
$$\frac{(A_1 - A_0)=A_0}{(W_1 - W_0)=W_0} = \frac{1}{\quad} = 1 \iff \quad = 1:$$

D Data and Variable Construction

D.1 NAWS

The NAWS data come from the restricted-access dataset obtained from JBS International via a request to U.S. Department of Labor. This dataset contains state identifiers, which allows us to merge the FLS data into the NAWS at the state level. We use the variable WAGET1 to identify hourly wages, A09 to identify years of schooling, L01 to identify undocumented status, GENDER to identify males, B11 to identify years of farm work experience, MARRIED

[11] Note that $\lambda = \frac{\frac{W_1 \quad W_0}{W_0}}{\frac{A_1 \quad A_0}{A_0}}$.

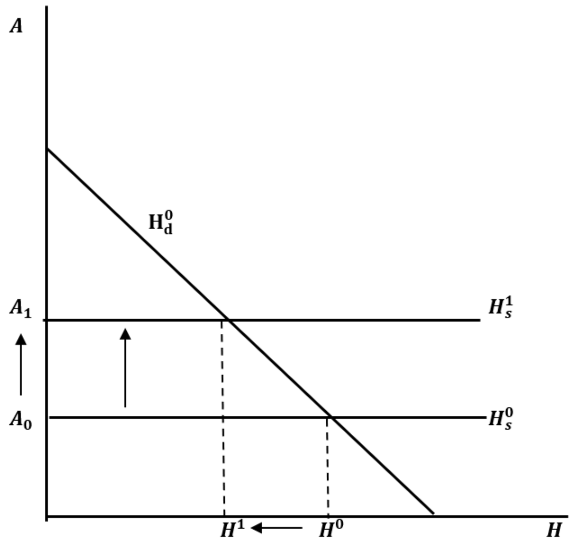
to identify marital status, and AGE to identify age.

All the NAWS regressions use a survey design correction for the standard errors to account for the stratified random sampling methodology, and regressions are weighted using the probability weighting variable PWTYCRD. Specifically, the regressions account for two strata that are defined by the variables CYCLE and REGION12. Primary sample units are defined by the variable CLUSTER. The regressions are estimated in Stata using the "svy: regress" or "svy: ivregress 2sls" commands.

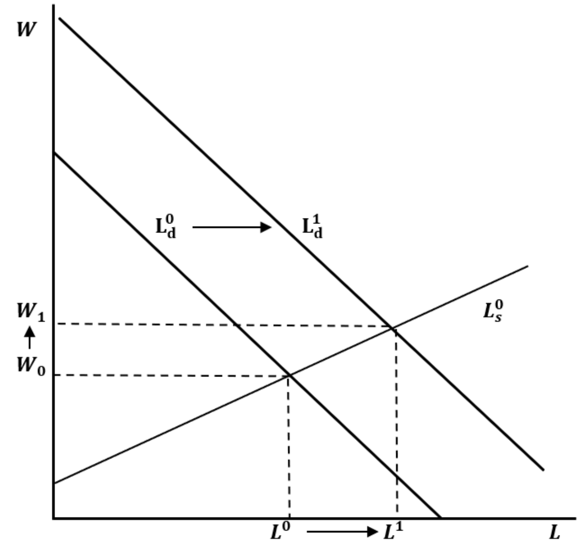
D.2 AEWR

AEWR data were obtained from the USDA NASS Quickstats website. AEWRs are available at 18 region levels, which we manually code to match to each of the 50 U.S. states. The AEWR data were calculated by taking the previous year's FLS wage value and assigning it to the current year. State level AEWR data are merged into the NAWS andACS datasets.

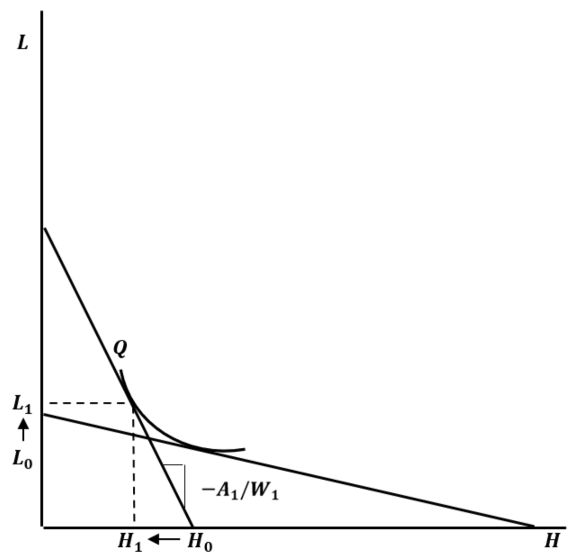
Figure C.1: AEWR-Driven Substitution Effect



(a) H-2A Labor Market



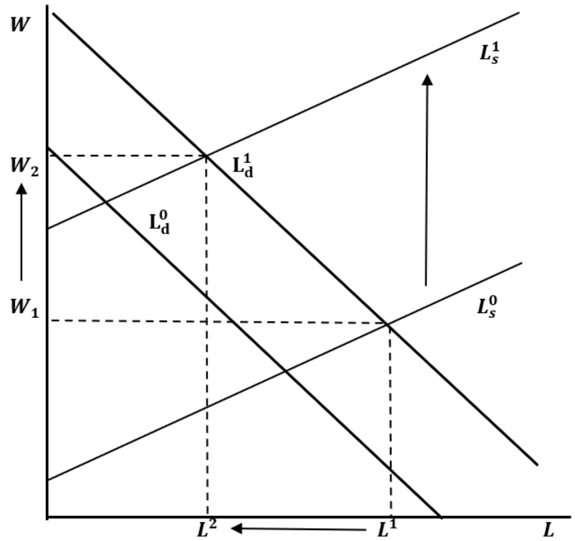
(b) Domestic Labor Market



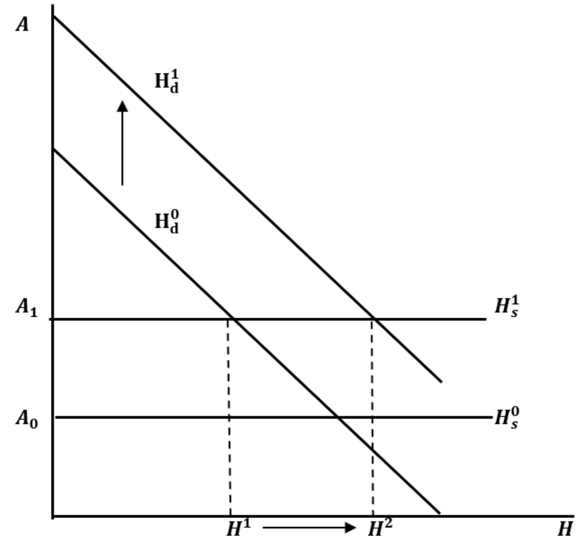
(c) Substitution Effect

Note: The initial wages, changes in wages, and slopes of the the lines depicted in this figure are not necessarily drawn to scale and do not necessarily depict specific values. Figure C.1(a) depicts the H-2A labor market before and after an increase in the AEWR. The increase in the AEWR causes the quantity of H-2A labor demanded to fall and a corresponding increase in domestic labor demand as shown in Figure C.1(b). This substitution effect is depicted in figure C.1(c) for an arbitrary isoquant and fixed capital.

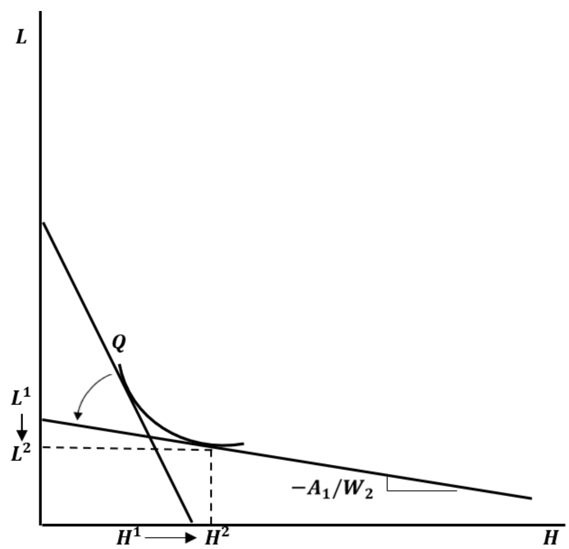
Figure C.2: AEWR-Driven Lighthouse Effect



(a) Domestic Labor Market



(b) H-2A Labor Market



(c) Lighthouse Effect

Note: The initial wages, changes in wages, and slopes of the the lines depicted in this figure are not necessarily drawn to scale and do not necessarily depict specific values. The domestic labor market is depicted in Figure C.2(a) before and after the lighthouse effect. The lighthouse effect shifts the domestic labor supply curve up causing a decrease in the amount of domestic labor employed and a corresponding increase in the demand for H-2A labor as shown in Figure C.2(b). This substitution into H-2A labor is shown in figure C.2(c) for an arbitrary isoquant and fixed capital.