Increasing minimum wage and farmers' hiring decisions

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Introduction

Labor shortages and raising farm labor cost are among major challenges facing the U.S. agricultural industry (Hanson et al., 2008; Hertz & Zahniser, 2013; Zahniser et al., 2018). Shortages of farm workers are reported by the farmers across the country (Richards, 2018). From 2016 to 2018, approximately 87 percent of the farm employers who recruited seasonal agricultural workers from foreign countries indicated that they requested for the U.S. workers but received zero application (DOL, 2019). Workers who can legally work in the U.S. without restrictions tend not to consider agricultural jobs, due to the physically demanding nature and challenging working environments (Escalante & Luo, 2017). Relocating, training, and other transition costs also prevent the non-agricultural workers to enter the agricultural sector (Richards & Patterson, 1998). For these reasons, the U.S. farmers indicated that there have not been enough consistent and reliable domestic labor force to sustain their farm operations (Hertz & Zahniser, 2013; Kostandini et al., 2014). The situation is especially challenging for the sectors that are facing strong foreign competitions such as tomato and strawberry (Guan, Suh, et al., 2018; Guan, Wu, & Whidden, 2018; Li et al., 2021; Wu et al., 2018). Hence, more growers started to bring labor forces from outside the United States under foreign worker programs.

The H-2A program, which authorizes growers to hire seasonal temporary agricultural workers from foreign countries, has become an important solution to growers' labor constraints (Guan et al., 2015; Luckstead & Devadoss, 2019; Williams & Escalante, 2019). In the recent decade (2011-2020), the number of certified H-2A workers tripled from 90,420 to 275,430 (DOL OFLC, 2021). Although the use of foreign workers can relieve labor shortages facing the U.S.

growers, the government also needs to ensure that the domestic labor market is not adversely affected by the foreign hires (Roka & Guan, 2018). Hence, every year, the Department of Labor (DOL) publish an Adverse Effect Wage Rate (AEWR) for each state which is the minimum hourly wage required for hiring H-2A workers in that specific state. The results of the Farm Labor Survey (FLS) conducted by the USDA's National Agricultural Statistics Service (NASS) and the DOL provides the references for the AEWR calculations, and a state's AEWR is always set to be significantly higher than its domestic minimum wage (state or federal; whichever is higher) to prevent the adverse effects. By surveying U.S. farms with $1,000 or more in annual sales (excluding the ones in Alaska), the FLS reports provide the basis for wage estimates for workers hired directly by the farms. For this reason, AEWRs are usually strongly correlated with the domestic minimum wages unless there is a policy shock (e.g., 2020-2021 H-2A wage freeze implemented by the Trump's administration).

In 2022, many states began the year with higher minimum wages, and some of them are agriculture-producing states, including California and Florida where two states combined accounts for over half of the fruit and vegetable acreages in the United States (USDA NASS, 2019). In California, the state minimum wage is scheduled to gradually increase from $10 per hour in 2017 to $15 per hour by 2023. Following California, Florida passed the law in 2020 that will increase the state minimum wage rate by 75% within 5 years, from $8.65 per hour in 2020 to $15 per hour in 2026. Among other top agriculture-producing states, Illinois is set to increase the state minimum hourly wage from $11 in 2021 to $15 in 2025, and Minnesota has increased the state minimum wage from $8.21 in 2021 to $8.42 in 2022 ($10.08 in 2021 to $10.33 in 2022 for large employers). Since the AEWR is designed to be significantly higher than the domestic minimum wage, the spike in minimum wage will affect the wage rates of both domestic and foreign workers. For this reason, regardless of the labor source (domestic or H-2A) of a farm, its hiring decisions and business profit will be affected by a raise in minimum wage. Since labor is a key component and major cost item in crop production (Beal Cohen et al., 2020), raising minimum wage will not only strike the agricultural sectors that are more labor intensive (e.g., fruit and vegetables) but will also become a serious issue for other sectors in the near future.

Given the U.S. food system's reliance on domestic agricultural industry, the industry's high dependency on labor, coupled with the rising minimum wage in the years to come, makes the question of how to maintain the industry sustainability of the U.S. agriculture one of the most challenging and critical issues that need to be addressed by both the industry stakeholders and policymakers. In response to the need for growers, we present an optimization model which demonstrates the effects of the rising minimum wage on business performance and inform farm labor decision makings. In response to the need for policymakers, the findings of this study will answer how the raising minimum wage, coupled with labor shortage, will affect the industry performance over time.

The rest of the paper is organized as follows. Section 2 presents the theoretical framework of the labor decision models and the constraints associated with domestic and H-2A hires. In section 3, the simulation results of the farms' business performances under different domestic and AEWR movement scenarios are presented and discussed. The final section provides policy implications and concludes this study.

Labor Decision Model

The effects of the minimum wage on the U.S. agricultural sector in various perspectives such as farm employment (Kandilov & Kandilov, 2020), working hours and hourly wage of farm employees (Fan & Pena, 2019), employment growth (Even & Macpherson, 2019), and output quantities and prices (Keller et al., 2022) were studied in recent years. These studies analyze the aggregate impact of minimum wage on either the entire U.S. agricultural industry (Even & Macpherson, 2019; Fan & Pena, 2019; Kandilov & Kandilov, 2020) or a specific sector (Keller et al., 2022). However, there is a lack of studies that investigate how the rising minimum wage will change growers' hiring decisions and business performance from the perspective of individual farms. In this study, following Wu and Guan (2016) who used the profit maximization methodology to determine preferred farm labor sources, we extend the farm decision model and conduct simulations to demonstrate how an individual farm will adjust its labor hiring decisions to maximize profit in the face of the rising minimum wage.

Specifically, the model is developed to determine the optimal labor decisions of the two labor sources, domestic and H-2A, and associated business performance under 1) different levels of labor shortages, and 2) wage movement scenarios, representing symmetric/asymmetric effects of the increasing minimum wage on domestic rate and AEWR. The results will identify optimal grower hiring decisions in the face of the domestic labor shortages and the rising minimum wages and will inform policymakers of the potential impacts of the increasing minimum wage on farm business performances. The empirical application is employed through the case of the Florida tomato growers in the face of the state's gradually minimum wage increase ($15 per hour by 2026).

Objective function

We consider a profit maximization problem for a representative farm's labor hiring decisions. As suggested in Wu and Guan (2016), the representative farm is assumed to make hiring decisions to maximize the expected "harvesting profit" of the season. Harvesting profit is defined as revenue minus harvesting costs. In this study, we categorize the farm labors into two main categories: domestic and H-2A. For each of the two labor sources, we solve for the optimal number of workers and their working hours. The objective function of the profit maximization problem is as follows:

$$max_{N_{jt},H_{jt}}\left\{E\sum_{t=1}^{T}\{(p_t-w_{jt})\theta_{jt}N_{jt}H_{jt}\}-[(C_1N_{h1}+C_2N_{ht})\cdot I(1\ if\ j=h;0\ otherwise)]\right\}$$

where *j* = *h or d* to represent the use of H-2A worker or domestic workers; p_t is the crop price at period *t*; w_{jt} is the wage rate (piece rate); θ_{jt} is the harvesting efficiency (pieces harvested per hour); N_{jt} is the number of workers; H_{jt} is the number of working hours for each worker. C_1 is the H-2A hire's one-time costs including the application and the inbound and outbound costs, and C_2 denotes the monthly H-2A variable costs such as housing and local transportation expenses. *I* is a binary indicator which equals to 1 when *j* = *h*; 0 otherwise.

The maximization problem is subject to two general constraints. First, for both domestic and H-2A workers, their working hours cannot exceed the maximum available hours ($\overline{H}$) due to the workers' physical limit,

$$H_{jt}\leq\overline{H}\ \ \forall j\ \ \forall t$$

Second, the amount harvested ($\theta_{jt}N_{jt}h_{jt}$) at each period cannot exceed each period's yield bound (y_tA) where A is the total acreage of the crop and y_t denotes the yield,

$$\theta_{jt}N_{jt}H_{jt}\leq y_tA\ \ \forall j\ \ \forall t$$

Regardless of which types of farm workers (domestic or H-2A) the representative farm is hiring, these two constraints hold. However, the domestic and H-2A hires subject to different additional constraints, representing the difficulties in domestic hires and program rules for H-2A hires, and these constraints are illustrated below.

Constraints for domestic hires

First, domestic labor shortage is one of the largest issues in the face of U.S. agriculture. Most growers report that they have hard time recruiting enough domestic labor. To represent domestic labor shortages in the models, the following constraint indicates that, for the domestic hires, the number of workers a grower can hire is bounded by the available domestic labor, L_t,

$$N_{dt} \leq L_t \quad \forall\, t$$

This constraint holds for every week throughout the entire harvesting season (*t = 1,…,T).*

Constraints for H-2A hires

First, due to the administratively cumbersome, the H-2A employers rarely terminate the H-2A workers before the contract period ends. So, we assume that the H-2A employers keep all H-2A workers for the entire season, and the number of H-2A workers remains the same since the first week (*t* = *1*).

$$N_{ht} = N_{h1} \; \forall\, t$$

Second, H-2A employers are required to comply with the three-quarter rule. They need to offer H-2A workers employments for at least 75% ($k = 0.75$) of the total offered hours in the contract term, represented by the product of the offered weekly hours (H_0) and the contract duration (T).

$$\sum_{t=1}^{T} H_t \geq 0.75TH_0$$

If the three-quarter of the guaranteed hours are met, the H-2A workers' pay depends solely on their working hours, so the farmer's labor use costs are $\sum_{t=1}^{T}(w_{ht}\theta_{ht}N_{ht}H_{ht})$.

If a worker's actual number of working hours is less than 75% of his offered hours, the farmers need to pay for the working hours plus the gap between the working hours and 75% of the offered hours. In this case, the labor use costs are $\sum_{t=1}^{T}(w_h\theta_{ht}N_{ht}H_{ht}) + N_h(0.75TH_0 - \sum_{t=1}^{T}H_{ht})w_h$.

Incorporating the two cases into the cost function, the H-2A labor total cost can be written as:

$$\sum_{t=1}^{T}C(N_{ht}, H_{ht}, w_{ht}, \theta_{ht}) = c_0 + c_1N_{ht} + c_2N_{ht}T + \sum_{t=1}^{T}(w_{ht}\theta_{ht}N_{ht}H_{ht}) \cdot \Omega(\sum_{t=1}^{T}H_{ht} \geq 0.75TH_0) + \left[\sum_{t=1}^{T}w_{ht}\theta_{ht}N_hH_{ht} + N_{ht}(0.75TH_0 - \sum_{t=1}^{T}H_{ht})w_{ht}\,\theta_{ht}\ \right] \cdot (1 - \Omega(\sum_{t=1}^{T}H_{ht} \geq 0.75TH_0)$$

where c_0, c_1, and c_2 denote different types of costs associate with H-2A hires, and $\Omega(\cdot)$ is the indicator function, which takes a value of 1 when the argument follows is true and 0 otherwise.

To illustrate how rising minimum wage will affect domestic and H-2A employers' farm labor decisions and business performance using the presented profit maximization framework, a representative tomato farm in Florida is used for the numerical simulations in the section follows.

Simulations

When conducting a numerical simulation, assumptions are made to reduce the complexity of the decision models. One of the strongest assumptions is that the presented profit maximization problem models a deterministic process even though farm labor planning is inherently stochastic because of the uncertainties and randomness of the yield waves. To relax this strong assumption, following earlier studies (e.g., Wishon et al., 2015), we define the necessary coefficients and apply the Monte-Carlo Method to establish the stochastic process of the yield waves and price movements, and we solve the model to maximize expected harvesting profit.

Yield and price simulations

The fruit development features growth waves that the yield continues to increase until it reaches the peak and subsequently decline (Wu et al., 2015). This wave pattern of yield of tomatoes can be formalized with a quadratic specification. Weekly field trial data of Florida tomatoes in Fall from 2011 to 2017 are used. These experimental trials used standard commercial production practices (e.g., cultivars, fertilization, pest management, etc.). We estimate the coefficients and standard errors using the trail data, and these parameters are used to simulate tomato yield from harvest 1 to harvest *t*. In this study, we follow the most common practice of Florida tomato farms where each tomato plant is usually harvested three times and set t = 3. Figure 1 shows the average three-harvest yield per acre from 1000 simulations.

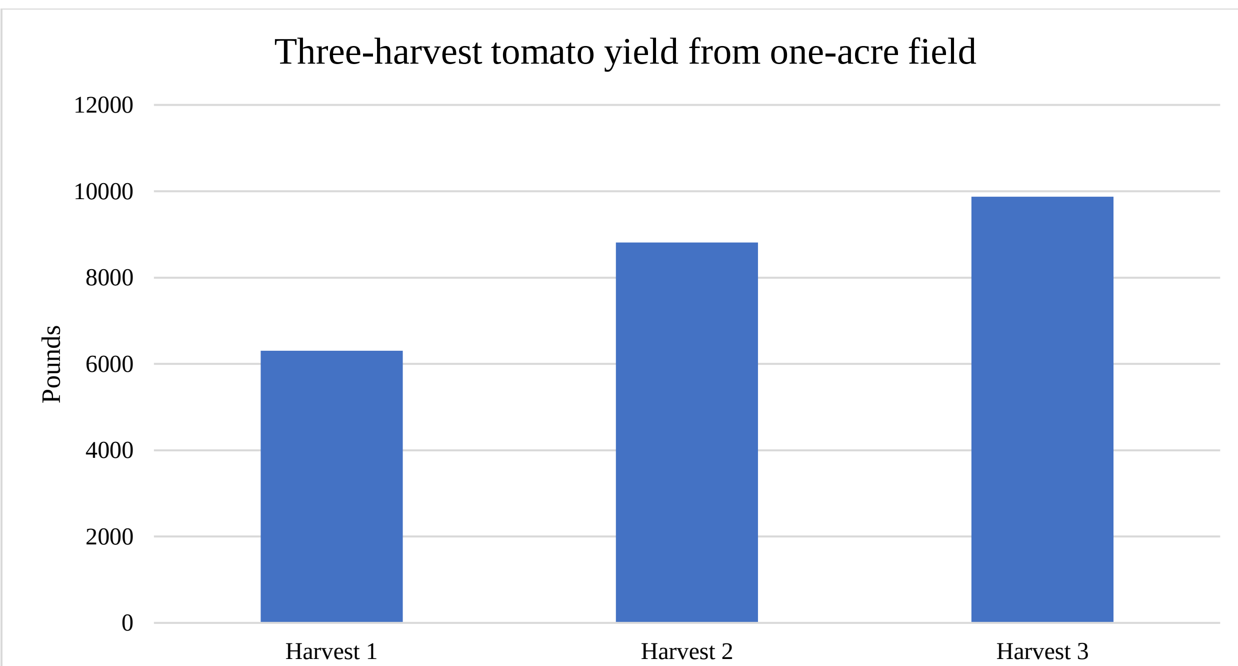

Figure 1. Three-harvest tomato yield from one acre field

To guarantee stable weekly tomato yield, growers usually divide an entire farmland to multiple fields and plant only one field each week in a staggered planting schedule. Using a Florida tomato farm with a 10-week long planting season and a 12-week long harvest season as an example, its entire farmland is divided into ten fields, and one field is planted one week apart throughout a 10-week planting season. Since each field will be harvested three times, there will be one field available for harvest in the first week, two fields available for harvest in the second week, three fields available for harvest starting from the third to the tenth week, two fields available for harvest in the 11th week, and one field available for harvest in the 12th week. By stacking three-harvest yields one week apart for ten times, a 12-week yield curve that represents the yield pattern of commercial farms can be derived. The yield of the 11th and 12th week in the 12-week yield curve is the yield of the second and third harvest of the 10th three-harvest yield wave. Figure 2 presents the average weekly tomato 12-week yield from 1000 simulations.

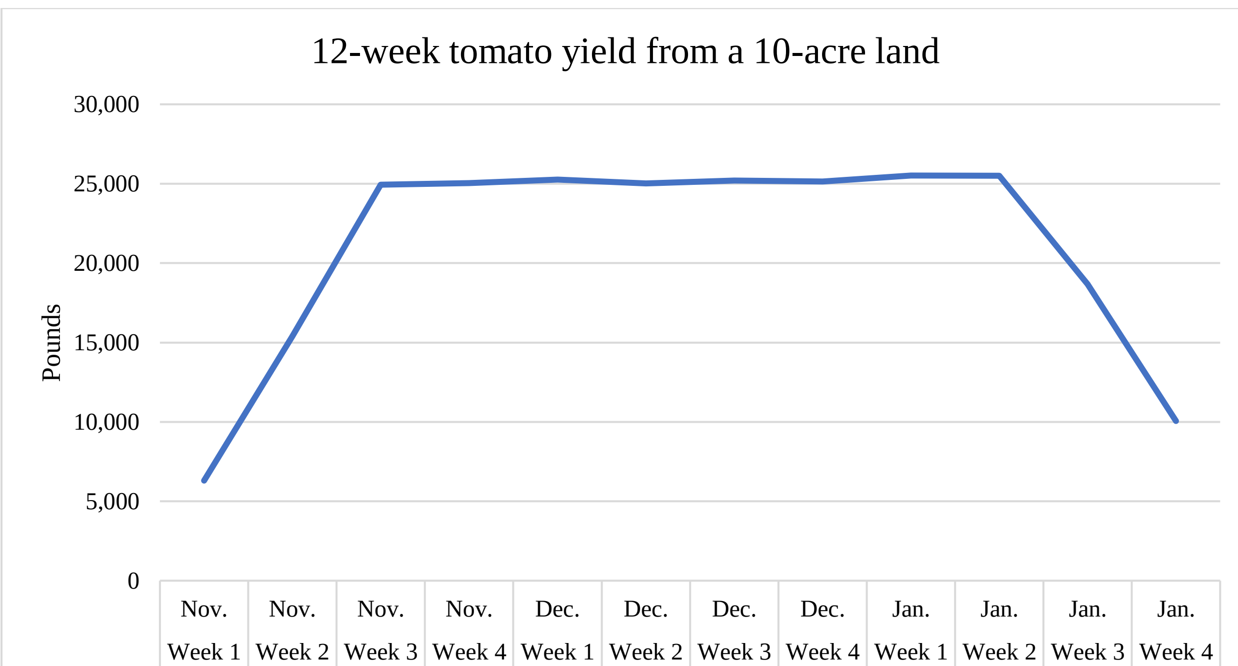

Figure 2. 12-week tomato yield from a 10-acre land

An adaptive approach is used to characterize the random tomato price. The adaptive formulation for determining price dynamics has been employed and suggested by the previous studies (e.g., Chavas & Holt, 1996). The 2010 to 2017 weekly average shipping point tomato prices in Florida are modeled using the adaptive formulation. The regressions results, coefficient estimates and standard errors, are then used as the parameters in the price simulations. Since the harvest season of Florida tomatoes in Fall is 12 weeks from November to January, tomato prices of 12 weeks (t=12) are simulated. The average 12-week price curve from 1000 simulations are presented in Figure 3.

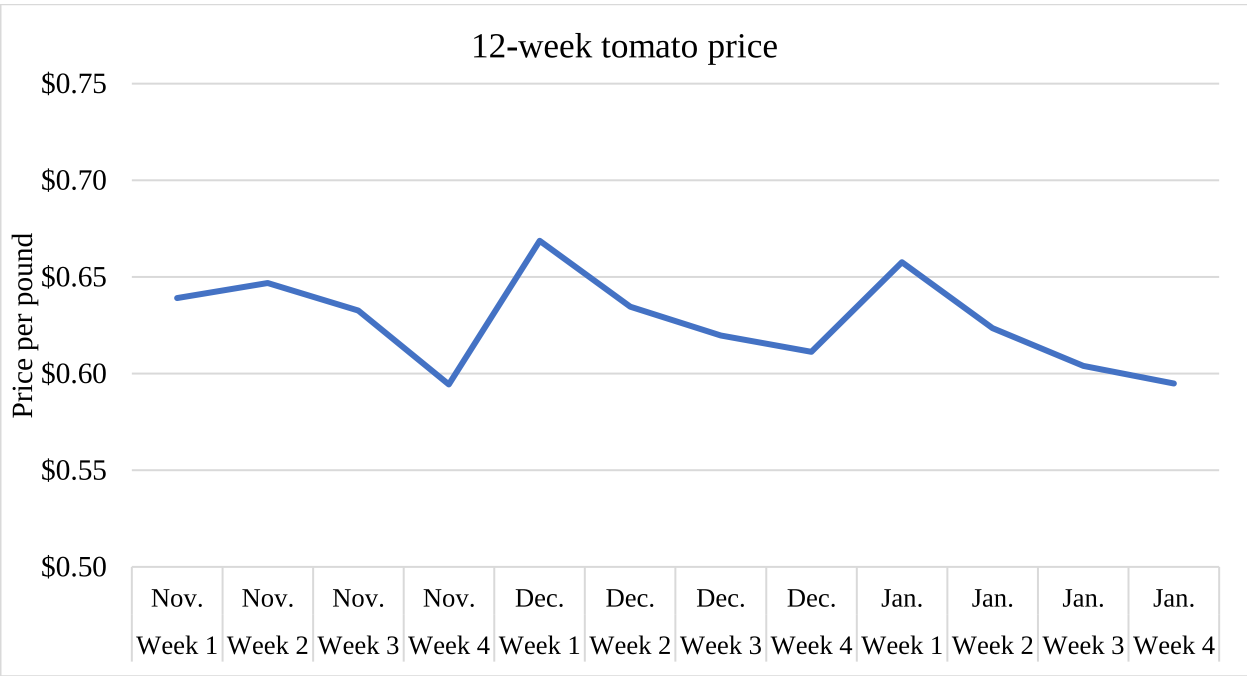

Figure 3. 12-week tomato price

Key parameters: efficiency, wage, hours, and hiring and other costs

In the tomato industry, field workers are usually paid by a piece rate of each bucket they picked, and each bucket holds approximately 30 pounds of tomatoes. Hence, a worker's hourly wage is the product of the piece rate (per bucket) and the picking efficiency (the number of buckets of tomatoes harvested in an hour). A harvest timing study for conventional tomato harvest in southwest Florida was conducted by Guan, Wu and Sargent (2018). The average efficiency and piece rate reported in the study is adopted in our simulations for the main discussion, specifically, the picking efficiency of 25 buckets (750 pounds) per hour and the average piece rate of 67.5 cents per bucket are used in the baseline model. Different piece rates will be employed in the scenarios analysis to demonstrate how the rising minimum wage will affect farm labor decisions and business performances under different wage movement and labor market scenarios. Since picking efficiencies vary by person, yield, farm, and other factors in practice, simulations employing different picking efficiencies are also conducted and reported as sensitivity analysis.

Following the commercial practice of Florida tomato farms, we assume that each tomato harvest crew of 24 pickers needs two dumpers, and one flatbed truck driver. After pickers filled buckets with tomatoes and brought them to the dumpers, the dumpers empty the tomatoes into large field bins and hand the pickers one token for each filled bucket. When crew members start picking, the truck driver needs to constantly move the truck along with the crew to minimize the walking distance of pickers. After all the field bins on the truck are filled, the truck driver needs to transport them to the packinghouse. Unlike the pickers who are paid by a piece rate, the dumpers and truck drivers are paid by daily rates of $100 and $120, respectively (Guan, Wu, & Sargent, 2018).

Since most domestic agricultural workers are at-will workers, we do not set minimum weekly hour requirements for domestic hires. For foreign hires, the H-2A employers tend to offer only the minimum required weekly working hours ($H_0 = 35$ hours) in the contracts to relax the three-quarter guaranteed hours constraint. Since there is a physical limit for intensive agricultural field work, we assume that a worker (either domestic or H-2A) cannot work for more than 48 hours a week (8 hours per day and up to 6 days a week).

There are hiring and indirect costs associated with H-2A hires. Roka et al. (2017) surveyed Florida citrus growers to retrieve H-2A hiring and indirect cost information, and they suggested that the costs would be similar for other crops. Following their study, we assume that the average H-2A pre-employment cost (excluding housing) was approximately $805 per worker. The cost covers application fees, advertising expenses, agent filing and recruiting fees, Visa, and travel costs that cover round-trip travels from the workers' hometown to the worksite. In addition to the pre-employment costs, the employers also need to pay for the H-2A workers' housing and transportation (between the employee housing location and the worksites). Roka et al. (2017) reported that the average 8-month housing and transportation cost for one H-2A worker was approximately $1,165. We consider such costs as monthly variable costs because the amount varies by the durations of the employments. By dividing the $1,165 by eight months, the monthly variable cost is $145.6 per month per worker. Hence, to employ one H-2A worker, an employer needs to spend a one-time hiring cost of $805 and an indirect monthly cost of $145.6. Since domestic hiring does not require the costs mentioned above, we assume there are no hiring and indirect costs associated with domestic hires.

Baseline result: domestic labor shortage

This section presents the simulation results of the optimal labor use and farm profit from the optimization model solved using the numerical method. Each of the 1000 sets of the simulated yields and prices over the 12-week Florida tomato harvest season is used in the computation of optimal solutions. The average labor use and corresponding profits from the 1000 optimal solutions are presented.

In the baseline model, growers who employ either domestic workers or H-2A workers do not face labor shortages. Following the piece rate indicated in Guan, Wu and Sargent (2018), the piece rate for all workers are set as 67.5 cent per bucket in the model. The AEWR in the baseline model follows the 2022 Florida AEWR, $12.42 per hour. The rate determines the penalty that a grower needs to pay when the actual working hours of the H-2A workers cannot reach 75% of total offered hours. Under the baseline assumptions, the growers who use domestic workers can adjust the number of workers every week, but the growers who use H-2A workers keep the same number of workers throughout the entire season due to the administratively cumbersome of the H-2A program. The simulation results show that farms employing domestic workers would start the season with only nine pickers, subsequently increase the number to 35 at the third week, reduce the number to 26 at the eleventh week, and finish the season with 14 workers. In contrast, the farms employing H-2A workers would keep 50 workers throughout the 12 weeks. The presented numbers of employments may seem small, but it is worth noting that since the tomato growers follow the staggered planting schedule, for a 500-acre farm, the acreage available to harvest each week is only 50 (first and 12th week), 100 (second and 11th week), or 150 acres (from the third to the tenth week). The corresponding 12-week “harvesting” profits of the two types of representative 500-acre farms (using domestic labor or H-2A workers) are approximately $7.27 million and $5.17 million, respectively. Harvesting profit is defined as sales revenue minus costs associated with harvesting labor. It is worth noting that when calculating the actual net farm profit, other production and operations costs need to be further deducted from the harvesting profit. The results show that the employment of domestic labor is more profitable than H-2A workers in the absence of labor shortages.

However, in practice, the shrinking domestic labor pool has been a serious problem for growers. Since the severity of labor shortage vary by sector, state, and farm, we illustrate how different levels of domestic labor shortage affect the profit of farms that use domestic labor force in Figure 4. The domestic labor supply is represented by the percentage of the optimal number of domestic workers available to the farm. The interaction of the two lines in Figure 4 shows that using domestic labor becomes less profitable (compared to H-2A workers) when the domestic labor shortage reaches 32.57% (domestic labor supply gets below 67.43%). The harvesting profit of using domestic labor continues to decline and deviate from that of using H-2A workers as domestic labor supply decreases.

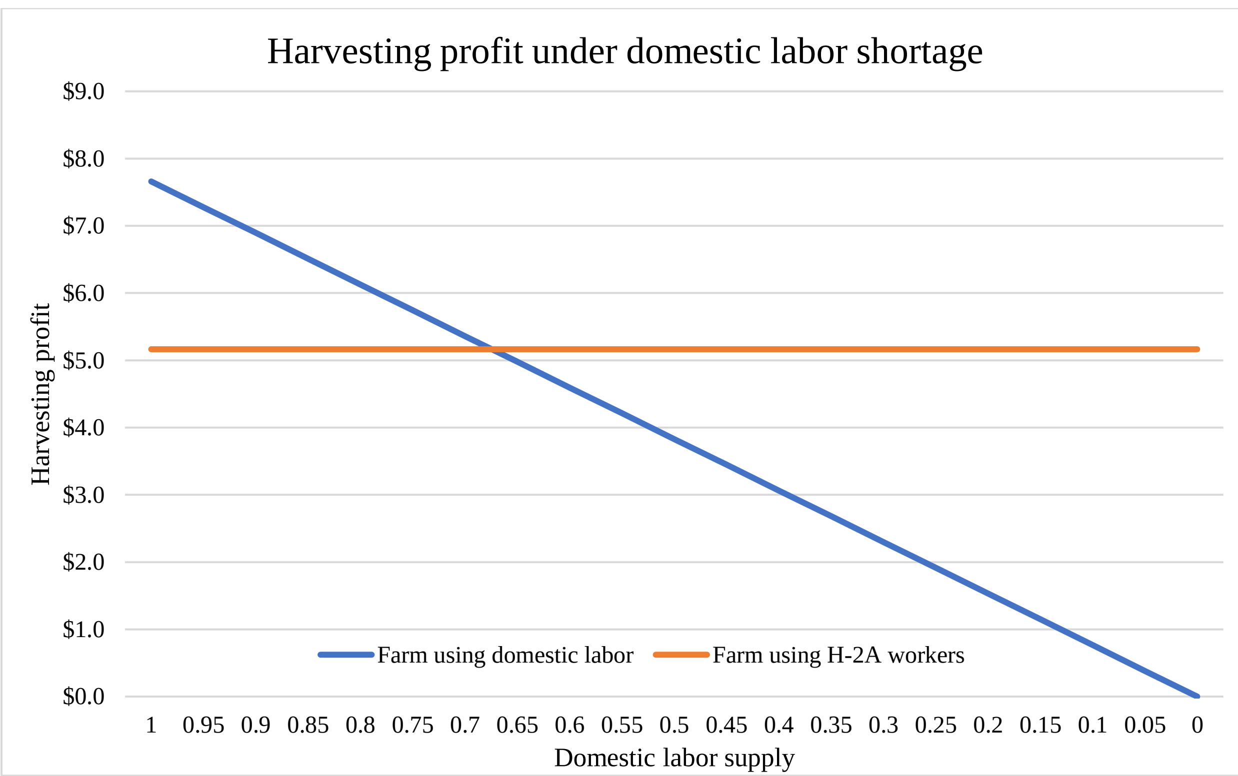

Figure 4. Harvesting profit under domestic labor shortage

Scenario analysis

In addition to the domestic labor shortage, the rising minimum wage also affects the farm labor decisions and corresponding profit. Unlike the domestic labor shortage that affects only the farms employing domestic labor, the rising minimum wage could affect both types of farms due to its impacts on piece rate and AEWR. In this section, we present the simulation results of the representative farms' farm profit and labor decisions under different scenarios. The scenarios represent the symmetric/asymmetric impacts of Florida minimum wage increase schedule on the piece rate and AEWR. The harvesting profits of both types of farms (employing domestic or H-2A workers) will be presented and compared.

Scenario 1: Piece rate and AEWR increase symmetrically and simultaneously

The domestic labor shortage of 32.57% where both types of farms would yield the same amount of harvesting profit is used as the reference point to start the profit comparisons between two types of farms. In Figure 5, we present the harvesting profits of the two farms under scenario 1 which indicates an increase in minimum wage affect both the piece rate and AEWR simultaneously. The results show that when both the piece rate and AEWR increase at the same rate (percentage) with domestic labor supply being fixed, the harvesting profit of employing either type of workers decreases but at a different degree. For instance, when both the piece rate and AEWR increase by 10%, the harvesting profit of the farm using H-2A workers is $9,300 lower than that of the one using domestic labor. The difference in harvesting profits expands to $18,500 if both the piece rate and AEWR increase by 20%, and the gap continues to widen as the percentage change becomes greater.

In 2022, the minimum hourly wage and AEWR at Florida are $11 and $12.41, respectively. The hourly wage is scheduled to gradually increase by $1 every year until it reaches

$15 at 2026. Using the $11 in 2022 as the baseline, the minimum hourly wage of 2023, 2024, 2025, and 2026 is equivalent to an increase of 9%, 18%, 27%, and 36%, respectively. Assuming both the piece rate and AEWR follow an identical increasing trend, the harvesting profit of the farm using domestic labor would decrease from $5.17 million in 2022 to $5.15 million (-0.4%) in 2023, $5.13 million (-0.7%) in 2024, $5.11 million (-0.9%) in 2025, and $5.10 million (-1.3%) in 2026. For the farm using H-2A workers, its harvesting profit would decrease from $5.17 million in 2022 to $5.14 million (-0.5%) in 2023, $5.11 million (-1.1%) in 2024, $5.09 million (-1.4%) in 2025, and $5.06 million (-1.9%) in 2026. The results of this scenario analysis show that regardless of which type of workforce a farm is using, the harvesting profit would decrease in the years to come. Most importantly, for farms that are operating near the breakeven point, the decreasing harvesting profit may be the last straw that could break the camel's back.

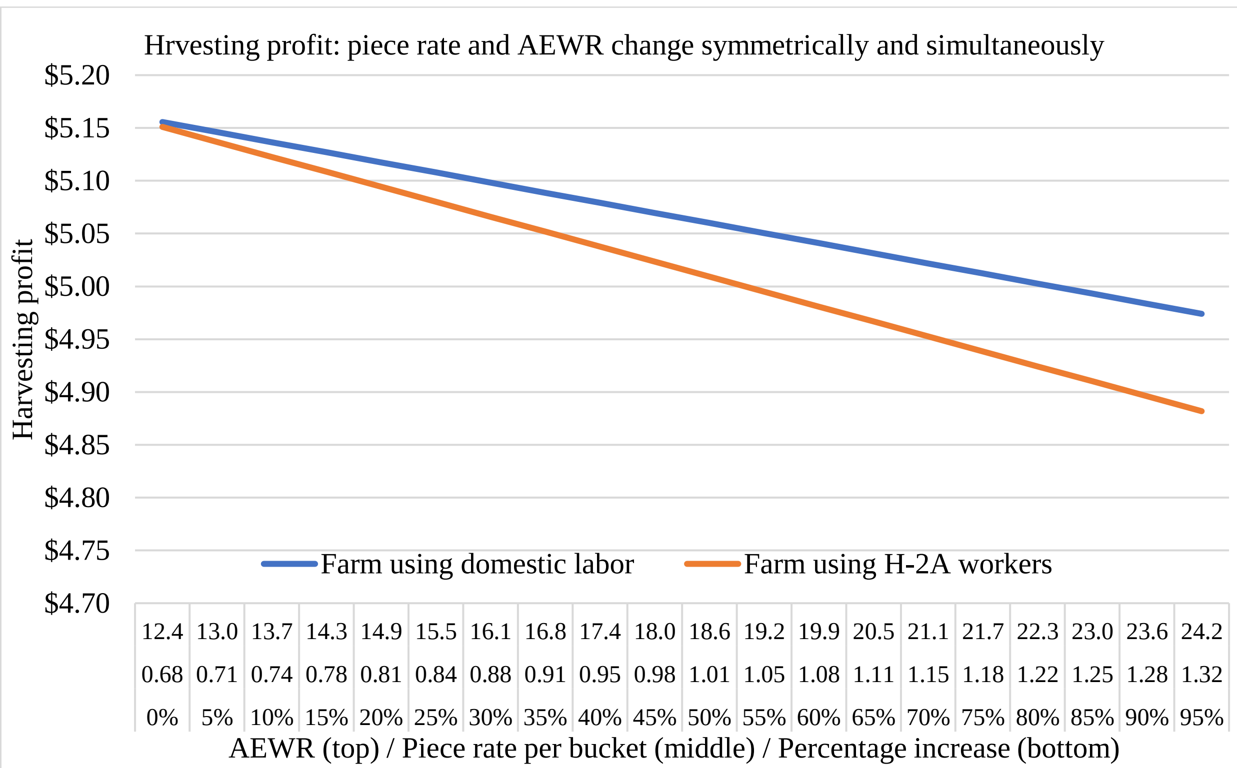

Figure 5. Harvesting profit: piece rate and AEWR change symmetrically and simultaneously

Scenario 2: Piece rate and AEWR increase asymmetrically

It is uncertain that both the piece rate and AEWR will grow symmetrically and simultaneously as the minimum wage increase. In the second scenario, we assume that the AEWR will be affected by the increasing minimum wage, but the piece rate will remain constant when the AEWR is below the actual hourly pay pickers receive. The intuition of this scenario is that the growers are not legally obligated to increase the piece rate because the current actual hourly wage, $17, calculated as the product of average piece rate of 68 cents per bucket and average picking efficiency of 25 buckets per hour, is in fact greater than the $15 minimum hourly wage requirement of 2026. In contrast, the AEWR, which is set at a rate significantly higher than the minimum wage rate to prevent adverse effects on domestic labor market, follows the increasing trend of the minimum wage closely when there is no H-2A wage freeze or other policy shocks. It is reasonable to expect that the AEWR will surpass $17, the current actual hourly pay, as the minimum wage gradually increases because the AEWR is approximately 39% higher than the minimum wage in the most recent three years (2019-2021) at Florida. In the case of the AEWR surpasses $17, the growers will need to increase the piece rate accordingly to ensure the rate (translating from piece rate to hourly rate) exceeds the AEWR. The harvesting profit will be affected not only by the increasing AEWR but also the raising piece rate.

In this scenario analysis, the piece rate remains at 68 cents per bucket when the AEWR is below $17, and the piece rate and AEWR increase at the same rate when the AEWR is above $17. As presented in Figure 6, the results show that the impacts of AEWR are relatively small before it reaches the $17 threshold. A 10% increase in AEWR creates only $400 loss in harvesting profit of the farms employing H-2A workers. The reason is that the AEWR will affect the harvesting profit only when there is not enough yield that the H-2A workers can work/pick for at least 75% of their offered hours (the three-quarter rule). To prevent the penalties, the growers optimize their hiring decisions by hiring just enough number of workers to harvest the crop. For this reason, only in rare cases where simulated yield is extremely low, the three-quarter rule will be activated and further affect the harvesting profit. However, once the AEWR surpasses $17, the piece rate needs to be raised accordingly, and the harvesting profit starts to decline more significantly; every 5% increase in the AEWR results an $11,500 loss in the harvesting profit of the farms employing H-2A workers. Since employing domestic labor is not subject to the three-quarter rule, the harvesting profits of these farms are not affected by the AEWR and remain at $5.17 million before the AEWR reaches the $17 threshold. However, since both the domestic and H-2A pickers receive the same piece rate, the harvesting profit of the farms employing domestic labor also starts to decline as soon as the AEWR reaches $17, and the piece rate starts to increase. Every 5% increase in AEWR creates an average loss of $7,650 in the harvesting profit for the farms using domestic labor.

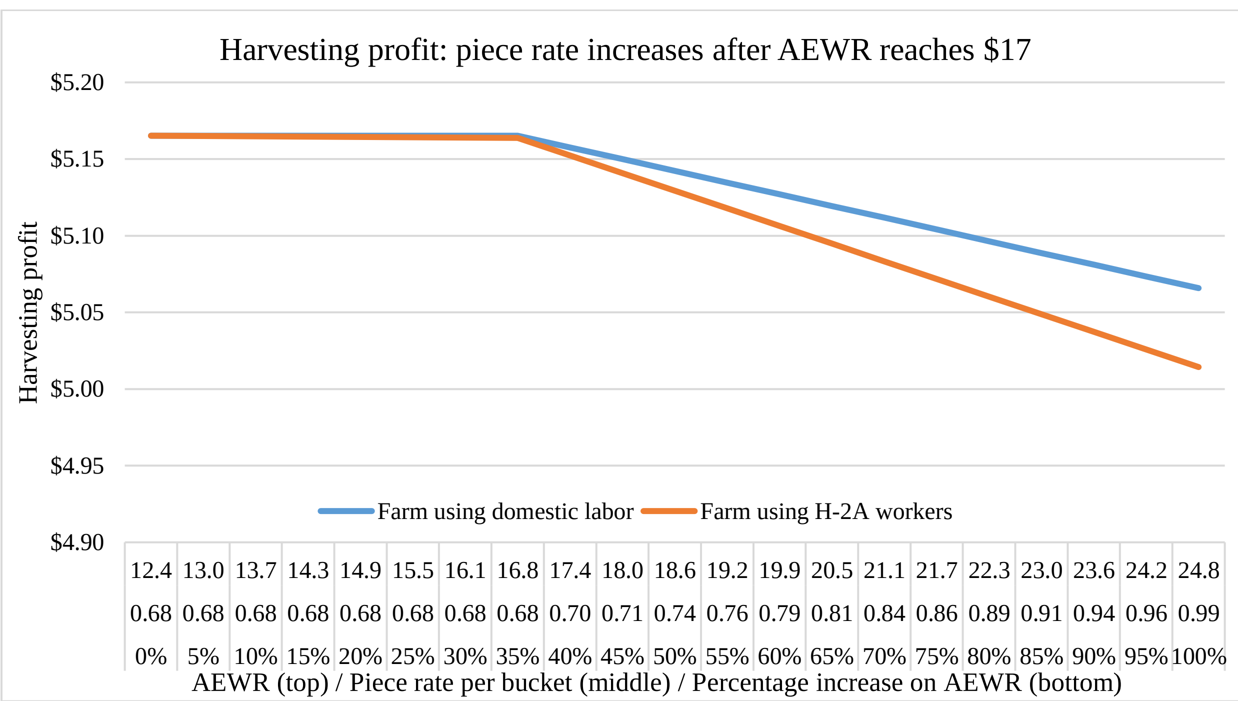

Figure 6. Harvesting profit: piece rate increases after AEWR reaches $17

In the first scenario, we assume that the increasing minimum wage leads to symmetric and simultaneous impacts on both the piece rate and AEWR. When the minimum wage increases, the wages offered by non-agricultural labor-intensive industries may also increase. The symmetric and simultaneous increases in the piece rate and AEWR stated in the first scenario reflect the workers' increased opportunity costs (income from other jobs that they are qualified to). Assuming the wages of agricultural and its comparable sectors all follow the increasing minimum wage trend is a reasonable but strong assumption that may lead to overestimating the negative impacts of increasing minimum wage on harvesting profit. Hence, the results of this scenario can be viewed as the upper bound of the harvesting profit reduction due to the minimum wage increase.

In the second scenario, we assume that the increasing minimum wage affects the piece rate only if the AEWR surpasses the $17 threshold. In this scenario, only the legal obligation that the growers face is considered. We assume that the growers will not have problems recruiting workers by paying the minimum piece rates required by the laws. However, as discussed in the previous paragraph, since the wages offered by other comparable sectors may increase as the minimum wage increases, the growers may have a hard time recruiting people by paying the minimum required piece rate. Hence, the results of this scenario can be viewed as the lower bound of the negative impact of the increasing minimum wage on harvesting profit.

Concluding remarks

The agricultural industry's high dependency on labor, coupled with the rising minimum wages in the years to come, makes the question of how to maintain the industry sustainability of the U.S. agriculture one of the most critical issues that need to be addressed by both the industry stakeholders and policymakers. In response to the needs for both parties, we present an optimization model which demonstrates the effects of the rising minimum wage on business performance to inform farm labor decision and policy making.

The empirical application is employed through the case of the Florida tomato growers in the face of the state's gradually minimum wage increase ($15 per hour by 2026). The weekly field trail and price data of Florida tomatoes from 2011 to 2017 are used to define the necessary coefficients for the Monte-Carlo Simulation that establishes the stochastic process of the yield waves and price movements. Using the simulated yields and prices, the optimization models demonstrate the business performances of a 500-acre representative tomato farm under different levels of labor shortages, and wage movement scenarios, representing symmetric/asymmetric effects of the increasing minimum wage on domestic rate and AEWR. The results of the baseline model show that when the domestic labor shortage is 32.57%, farms employing either domestic labor or H-2A workers yields equal harvesting profits, and the harvesting profit of the farms employing domestic work continues to decrease as the domestic labor shortage rises.

The results from scenario 1, which assumes both the piece rate and AEWR increase symmetrically and simultaneously, show that the farms employing H-2A workers decrease at a faster pace in harvesting profit than the ones using domestic workers. Furthermore, if both the piece rate and AEWR increase by 36% (the percentage difference between the current ($11) and 2026 ($15) minimum wages), the harvesting profit of each type of farms decreases by 1.3% (employing domestic workers) and 1.9% (H-2A workers), respectively. The symmetric and simultaneous increases in the piece rate and AEWR reflect not only the growers' increased legal obligations but also the workers' increased opportunity costs (income from other jobs that they are qualified for). Expecting the wages of agricultural and its comparable sectors all follow the increasing minimum wage trend is a reasonable but strong assumption. Hence, the results of this scenario can be viewed as the upper bound of the harvesting profit reduction due to the minimum wage increase.

In scenario 2, we assume that the piece rate only increases when the AEWR surpasses the $17 threshold, the actual hourly pay pickers are currently receiving. The results show that 1) before the AEWR reaches $17, a 5% increase in AEWR creates only $200 loss in harvesting profit of the farms employing H-2A workers, and 2) after the AEWR surpasses $17, a 5% increase in AEWR reduces the harvesting profits of the farms employing domestic labor and the farms using H-2A workers by $7,650 and $11,500, respectively. In this scenario, only the legal obligations that the growers face are considered. We assume that the growers will not have problems recruiting workers by paying the minimum piece rates required by law. However, since the wages offered by other comparable sectors may increase as the minimum wage increases, the growers may have a hard time recruiting people by paying only the minimum required piece rate. Hence, the results of this scenario can be viewed as the lower bound of the negative impacts of the increasing minimum wage on harvesting profit.

Our study shows that the Florida tomato farms, regardless of their labor sources, will experience severe loss of profit as the minimum wage gradually increases. This study focuses on the harvest side of the story, so only the increased direct harvest labor cost and harvesting profit are evaluated and considered in the presented models. In practice, increasing minimum wage will also cause other production and operation costs to go up, so the actual effects of the increasing minimum wage on farms' net profit (harvesting profit minus all other production and operation costs) should be greater. More importantly, for farms that are operating near the breakeven point, the decreasing harvesting profit could potentially throw them out of business. The industry sustainability will be facing increasing challenges in the years to come. It is essential that the policymakers start developing solutions that can help growers to mitigate the negative effects of increasing labor costs such as accelerating the development and deployment of the labor-saving harvesting technologies. The presented framework can also be applied to other crops to identify the effects of the increasing minimum wage and assess sustainability of the sectors.

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