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## Can Wages Rise Quickly Enough to Keep Workers in the Fields?

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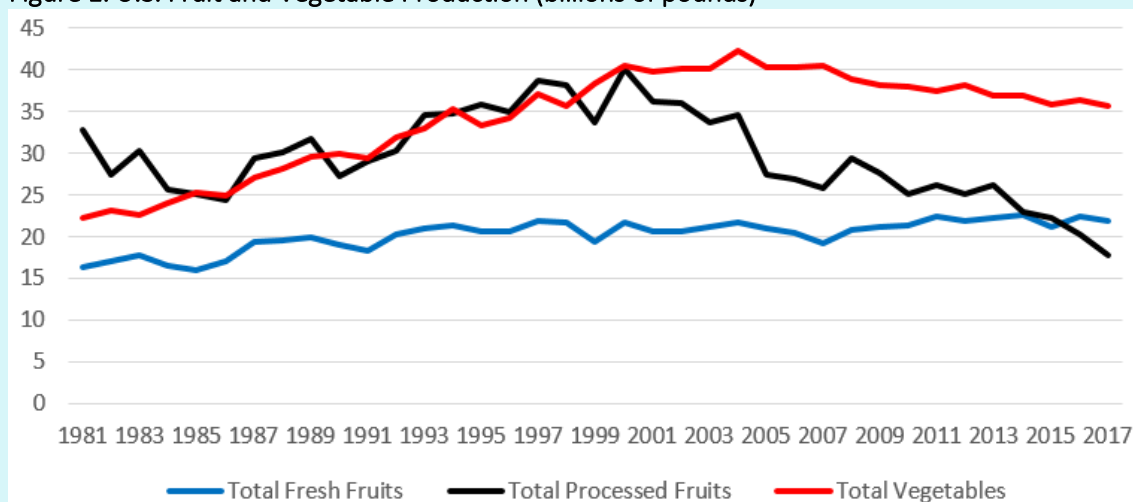
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Agricultural producers across the United States are raising concerns about the reduced availability of hired farm workers. The agricultural workforce is aging, wages are rising, and producers are finding it more difficult to find sufficient workers during peak season. Recent work by Charlton and Taylor (2016) shows that people in rural Mexico, the primary source of labor to U.S. farms, are transitioning out of farm work. What does this imply for U.S. agriculture? In this article, we use household survey data from rural Mexico to measure the trend in the probability of working in U.S. agriculture and to calculate the percentage rise in real U.S. farm wages that would be necessary to retain a constant farm workforce by attracting more Mexican workers. We find that real U.S. farm wages would have to rise by more than 10% over 10 years to keep the farm labor supply constant. U.S. agricultural research and development in labor-saving practices and mechanization will have to rise to keep U.S. agricultural production competitive at a global scale and reduce dependence on an elastic foreign labor supply.

Fresh fruit and vegetable production grew in the latter half of the twentieth and early twenty-first centuries, in part because the industry had access to a large, low-cost labor force from rural Mexico. While processed fruit production has fallen slightly, fresh fruit and vegetable production has grown since 1980 (Figure 1). These numbers mask large increases for some fruits and vegetables and differences across regions.

Figure 1. U.S. Fruit and Vegetable Production (billions of pounds)



*Notes:* Fruit production numbers include non-citrus, grapefruit, lemons, and oranges.

Processed fruit excludes wine and the “other” fruit category.

*Source:* U.S. Department of Agriculture (2018b,c).

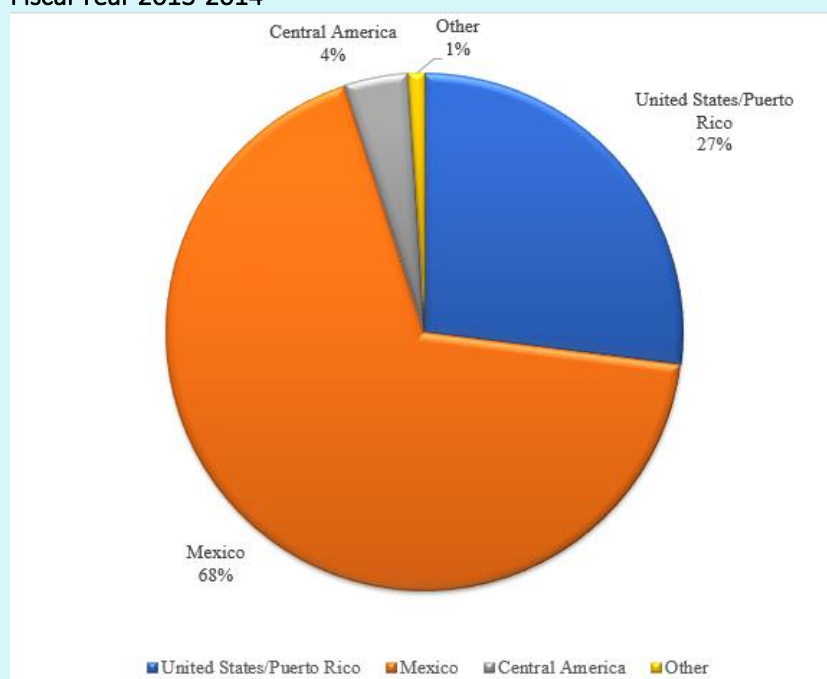
As labor becomes costlier, we expect to see a shift toward more highly mechanized production processes and more efficient labor management practices throughout the United States. The shift toward more mechanization is already occurring for many crops. The raisin harvest was once the most labor-intensive seasonal activity in North America, but innovations in horticultural practices, grape varieties, and mechanical harvesters have greatly reduced the seasonal labor demands associated with raisin production (Martin and Calvin, 2010). Labor-saving innovations also have transformed the production of wine grapes and nuts.

Adoption of technologies to reduce labor needs has been relatively slow for many other crops. As long as U.S. producers had access to an abundance of low-wage, seasonal workers, primarily from rural Mexico, there was little incentive to invest in mechanization. Nevertheless, the conditions under which U.S. agriculture prospered in the twentieth century are changing, and the agricultural industry will have to change as well in order to remain competitive.

## The Changing Farm Workforce in the United States

Mexico is the primary supplier of labor to the U.S. hired farm workforce. The National Agricultural Worker Survey (NAWS), an employment-based, random-sample survey of U.S. crop workers that interviews workers face-to-face, found that in 2013–2014 the shares of hired U.S. farm workers born abroad and in Mexico were 73% and 68%, respectively (Figure 2). In the 2013–2014 NAWS, when foreign-born farm workers were asked what sector they worked in before coming to the United States, 55.5% of those that responded reported that they had done farm work at least part time, 20.9% reported that they had done nonfarm work, and 17.4% reported that they had never worked. This suggests that the majority of foreign-born farm workers migrated from rural regions. In California, only 9% of hired farm workers were U.S.-born, and 89% were from Mexico (U.S. Department of Labor, 2017b).

Figure 2. Share of Hired Farm Workforce by Country or Region of Origin Fiscal Year 2013-2014



Source: U.S. Department of Labor (2017b).

Because rural Mexico is the dominant source of new hired crop workers, economic, demographic, and social changes in Mexico will affect U.S. farm labor supply. Charlton and Taylor (2016) find three major trends related to economic development in rural Mexico that are highly significant in explaining the rural Mexicans' shift out of farm work. First, Mexican families are getting smaller. In the 1960s, Mexican women had nearly seven children each. Today they have just over two—about the same as women in the United States. Second, education of younger generations is rising. The mean years of education of an individual in his/her 50s in 2010 was 5 years (one year shy of completing primary school), while the mean education of an individual in his/her 20s was almost 9 years (the completion of lower secondary school or junior high). Third, Mexico's workforce is shifting out of agriculture and into a service-based economy, just as the U.S. workforce did several decades ago. Demographic changes such as shrinking family size and rising education suggest that workers are not only shifting out of farm work but they are also becoming less willing to work in agriculture as the characteristics of the workforce change. This suggests that the farm labor supply is becoming more inelastic while shifting inward.

A critical component of economic development is the transition of labor out of agricultural work. U.S. workers shifted out of hired farm work in the mid-twentieth century. Today, domestic workers constitute less than 0.5% of America's hired farm workforce. As domestic workers moved out of farm work, Mexican immigrant workers filled most of the void. Now rural Mexico is transitioning out of farm work. The probability that working-age adults (age 15–65) from rural Mexico work in agriculture, whether in Mexico or the United States, decreased by 0.97 percentage points per year between 1980 and 2010 (Charlton and Taylor, 2016). Multiplying the change in the probability of working in agriculture by size of the rural working-age population in 2010, that scales to more than 150,000 individuals leaving agricultural work each year.

## The Farm Labor Market and Diminishing Labor Supply in the United States

Given that the vast majority of U.S. farm workers are from rural Mexico, the U.S. farm industry is vulnerable to economic and demographic changes there. Historically, hired farm workers in the United States have been young, single men, and most worked in agriculture for only a few years, transitioning to nonfarm jobs in manufacturing, construction, or the service sector. That, combined with the physical demands of farm work, explains the low average age of farm workers. However, the average age of workers is rising, as young replacement workers become scarcer.

Real wages rose steadily throughout the 1990s and into the 2000s, suggesting that the hired farm labor supply is becoming more inelastic. That is, people are demanding higher wages to perform hired farm work.

Can rising farm wages avert farm labor shortages in the future? The answer depends on the elasticity of the farm labor supply with respect to wages. Inasmuch as rural Mexico is the principal source of hired labor to farms in the United States, understanding how the supply of Mexican workers to U.S. agriculture changes when U.S. farm wages rise goes a long way toward answering this question.

We estimated the effect of U.S. farm wages on Mexico's farm labor supply to the United States, building on Charlton and Taylor (2016), with a matched panel of household survey data that is nationally representative of rural Mexico. The National Rural Mexican Household Survey (Spanish acronym ENHRUM) collected work histories for all members of the household and children of the household head and his/her spouse from 1980 through 2010. The survey asked whether individuals worked locally, elsewhere in Mexico, or in the United States each year and whether they worked primarily in the farm or nonfarm sector. We analyze work history data since 1989, inasmuch as these are the years in which we also observe mean U.S. farm wages.

We measure the effects of a time trend and U.S. farm wages on the percentage probability that rural Mexicans work in U.S. agriculture using a linear probability model. (The logit model produces similar results.) Our methodology mirrors that of Charlton and Taylor (2016), changing the outcome to a binary variable for working in U.S. agriculture.

The outcome variable of interest,  $Y_{i,t}$ , is equal to 100 if individual  $i$  worked in agriculture in the United States in year  $t$  and zero otherwise to measure the marginal effects of explanatory variables on the *percentage* probability of working in U.S. agriculture. We then estimate the following equation:

$$Y_{i,t} = \beta_0 + \beta_1 t + \theta age_{i,t} + \delta_1 wage_{t-1} + \delta_2 \Delta wage_t + \gamma_1 Y_{i,t-1} + \gamma_2 Y_{i,t-2} + \varepsilon_{i,t}$$

where  $t$  is a linear trend,  $age_{i,t}$  is the age of individual  $i$  in year  $t$ ,  $wage_{t-1}$  is the mean U.S. crop worker wage in year  $t - 1$ ,  $\Delta wage_t$  is the farm wage in year  $t$  minus the farm wage in year  $t - 1$ ,  $Y_{i,t-1}$  and  $Y_{i,t-2}$  are lagged percentage probabilities that individual  $i$  worked in U.S. agriculture the previous two years, and  $\varepsilon_{i,t}$  is the error term. We control for age since the average age of the sample increases over time by design of retrospective data. We control for autocorrelation by including lagged dependent variables.

The coefficient on the differenced U.S. farm wage,  $\delta_2$ , indicates the short-run effect of U.S. farm wages on the percentage probability of working in U.S. agriculture. The coefficient on the lagged U.S. farm wage,  $\delta_1$ , indicates how quickly the dependent variable returns to its equilibrium level after a shock in U.S. farm wages.

The results are reported in Table 1. Column 1 presents the estimated regression coefficients, and Column 2 adjusts the coefficients for the long run marginal effects.<sup>1</sup>

What do these results mean for U.S. farms? Suppose real farm wages remain constant over the next 10 years. The long-term trend indicates that the labor supply from rural Mexico to U.S. farms would decrease by 5.6%, or approximately 892,800 workers over 10 years. However, permitting real wages to rise would counteract the downward trend. Suppose real wages rose by \$0.55 over ten years (or by 5% of the national average farm wage in 2010). Then the labor supply from rural Mexico would decrease by only 2.8 percentage points. Table 2 indicates how much the labor supply from rural Mexico to U.S. farms would change over 10 years for varying assumptions about changes in real wages. The results show that real wages would have to rise by about 10% over 10 years to retain a constant farm labor supply. At the current inflation rate of 1.9%, this implies an increase in nominal farm wages of just over 30%.

We can test how well our model performs by examining changes in real U.S. farm wages between 2010 and 2016. The model predicts that farm wages would have to rise 6% over six years to maintain a constant farm labor supply from rural Mexico. In reality, real U.S. farm wages rose 7.7% by 2016. Accurate counts of farm workers are not available, but estimates from the Bureau of Economic Analysis (BEA) suggest that farm employment grew only modestly from 2010 to 2016, from 754,000 full- and part-time jobs to 820,000 (U.S. Department of Agriculture, 2018a). We cannot account for other supply- and demand-side factors that impact agricultural wages. The model predictions in Table 2 estimate wage changes necessary to counteract supply-side trends from rural Mexico, but other supply-side factors may simultaneously impact U.S. farm wages. For example, farm labor mobility within the United States has been decreasing over time due to demographic and structural changes (Fan et al., 2015). This is expected to decrease the availability of workers at a given time and location, putting upward pressure on wages. Demand-side factors may also impact agricultural wages. For example, an increase in the production of labor-intensive crops would put

**Table 1. Impacts of U.S. Farm Wages on Rural Mexicans' Percentage Probability of Working on U.S. Farms, 1990-2010**

Variables	(1) Regression Coefficients	(2) Long—Run Marginal Effects
T	-0.078*** (0.019)	-0.558*** (0.133)
Age	-0.010*** (0.002)	-0.071*** (0.012)
Lagged real U.S. farm wage	0.706*** (0.185)	5.062*** (1.315)
Differenced real U.S. farm wage	0.525*** (0.158)	
Lagged probability	0.773*** (0.017)	
Twice lagged probability	0.087*** (0.016)	
Constant	-5.586*** (1.665)	-40.051*** (11.813)
No. of obs.	114,376	
R <sup>2</sup>	0.696	

*Notes:* Single, double, and triple asterisks (\*, \*\*, \*\*\*) indicate significance at the 10%, 5%, and 1% level, respectively. Robust standard errors are in parentheses.

*Source:* Authors' analysis of the Mexico Rural Household Survey (ENHRUM) (El Colegio de México and University of California, Davis).

<sup>1</sup> Long-run marginal effects of wages are calculated  $\frac{\delta_1}{1-\gamma_1-\gamma_2}$ . Similarly, the long-run residual trend in the probability of working in U.S. agriculture is calculated  $\frac{\beta_1}{1-\gamma_1-\gamma_2}$ . More detailed description of these calculations are available in Charlton and Taylor (2016).

upward pressure on wages while the adoption of labor-saving technologies and mechanization would put downward pressure on farm wages. Changes in the demand for farm labor and changes in the farm labor supply within the United States that occur simultaneous to the trend in the farm labor supply from rural Mexico are beyond the scope of this analysis. The observed increase in U.S. farm wages suggests the predicted downward trend in the farm labor supply, holding wages constant, has continued since 2010, the last year for which we have Mexican household survey data.

**Table 2. Projected Change in U.S. Farm Labor Supply from Mexico**

Percentage Rise in Real U.S. Farm Wages	Percentage Change in Labor Supply from Rural Mexico to U.S. Farms in 10 Years	Change in U.S. Farm Labor Supply from Rural Mexico (thousands of workers)
0	-5.58	-892.8
1	-5.03	-804.11
5	-2.81	-449.37
10	-0.04	-5.94
10.07	0	0

*Notes:* Calculated changes in U.S. farm labor supply are based on the working-age population of rural Mexico in 2010, the final year of the ENHRUM survey.

*Source:* Authors' analysis of the Mexico Rural Household Survey (ENHRUM) (El Colegio de México and University of California, Davis).

## Responses to a Shrinking Farm Labor Supply

The end of farm labor abundance has far-reaching implications for U.S. and Mexican farmers, who can no longer count on a steady supply of low-wage workers. Immigration will not be a sufficient answer to meet U.S. farm labor demand since Mexico is transitioning out of farm work altogether and Mexican farms compete with U.S. farms for a limited supply of workers. Rising wages already have stimulated a search for alternative production methods on U.S. farms to reduce dependence on an elastic seasonal labor supply, including increased use of the H-2A agricultural guest worker program to contract seasonal guest workers, changes in crop mix, and the development and adoption of new technologies.

Agricultural producers are adopting more efficient labor management practices, such as hiring foreign guest workers through labor and growers' associations that streamline the hiring process and educate employers regarding legal and best practices. One such association is WAFLA (formerly known as the Washington Farm Labor Association; <https://www.wafla.org/>), which offers services to help farm employers file for H-2A visas, recruit workers, and comply with lodging, transportation, and other provisions of the H-2A program. It initially served large farms but increasingly recruits workers for small farms as well. Producer organizations like the North Carolina Growers Association and Virginia Agricultural Growers Association, unlike WAFLA, serve as joint employers with growers instead of merely hiring agents, so that workers can move among member farms where workers are most needed during their visa term. Efficient labor management practices, along with maintaining strong connections with a shrinking foreign workforce, become more vital as the agricultural transition unfolds in Mexico and other labor-source countries.

The H-2A program expanded 250% between 2007 and 2018 (U.S. Department of Labor, 2017). Guest worker programs are only a short-term option, at best. Although farms can hire guest workers from numerous countries, 91% of H-2A guest workers employed in 2017 came from Mexico, and 97% came from North America, including Central America and the Caribbean. This implies that guest worker programs recruit primarily from an ever-smaller pool of available farm workers in Mexico and Central America. There is little hope of recruiting enough farm workers from other nations to take the place of Mexican workers. In fact, Mexico has a program to import farm workers from Guatemala, but the Central American farm workforce is far too small to meet the labor demands of the United States, Mexico, and Central America. The total rural population of Central America was 6.9 million persons smaller than the rural population of Mexico in 2016 (World Bank, 2017).



The rural populations of Asia and Africa are relatively large, but contracting hundreds of thousands of farm workers from more distant countries is costly, and gaining political support for this appears infeasible. Furthermore, the factors pushing and pulling Mexicans out of farm work, such as rising education and a growing nonfarm economy, are also at play in other developing countries.

U.S. farmers could respond to farm labor shortages by growing fewer of the fresh fruits and vegetables that require large amounts of labor. To a certain extent, we observe this occurring. Acreage of handpicked fruits like apples, peaches, and citrus has decreased in the United States since 2002, while acreage of mechanically harvested almonds has increased. We would expect to see increased imports of handpicked fruits and vegetables from countries with more abundant farm labor and lower wages. However, these imports would have to come from more distant countries as farms in the Americas compete for workers from the same diminishing pool. Furthermore, niche markets for locally grown produce have expanded in many communities of the United States. As long as consumer demand for domestically grown fresh fruits and vegetables persists, we will continue to see these commodities grown in the United States.

A more viable option for many producers is to invest in the development and adoption of labor-saving technologies to meet the demands of consumers in the midst of a declining farm labor supply. The big question for farmers, researchers, and policy makers is whether new labor-saving technologies keep pace with the shrinking farm labor supply, and what the implications will be for farm workers and the communities in which they live.

There are already many mechanization success stories. However, these do not happen overnight, and they typically involve combined advances in engineering, agricultural practices, and/or plant varieties. U.S. agricultural production can remain competitive in the global economy only if academic research and industry leaders continue to push the technological frontier forward, reducing agriculture's dependence on a large, seasonal labor force. Unlike previous advances in technologies that were blamed for taking jobs from farm workers, workers today do not want to work in agriculture—at least not in the currently available jobs. Mechanization and technological innovations hold the potential to improve workers' productivity, raising wages, and ease some of the physical risks and discomforts traditionally associated with farm work.

## For More Information

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