

Featured Article

Potential Impacts of a Pandemic on the US Farm Labor Market

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Abstract *An outbreak of COVID-19 among farmworkers could have significant impacts on the workers, agricultural producers, and the consumers. Farmers are implementing new labor management practices to slow the spread of the virus among workers. Since immigration is temporarily restricted, farmers may have difficulty securing a sufficient workforce. We test whether changes in the unemployment rate affected H-2A guest worker demand before the pandemic and find a statistically significant negative impact. Nevertheless, we expect that H-2A recruitment will be vital to sustaining agricultural production. We conclude by discussing potential long-term impacts of the pandemic on farm labor supply and demand.*

Key words: Coronavirus pandemic, Farm labor, H-2A guest workers.

JEL codes: J43, J23, J61.

On March 11, 2020 the World Health Organization (WHO) declared COVID-19 a pandemic. This highly contagious disease has impacted the lives of nearly everyone in the world, either directly through contact with the virus or indirectly by way of changes in government regulations and economic spillovers. Nearly all U.S. states ordered workers in non-essential industries to stay home for several weeks to help contain the spread of COVID-19. Nevertheless, work in the food supply chain was determined essential, and many employers and workers in the agricultural industry bore the risk of contracting and spreading COVID-19 at the workplace. In this paper, we discuss the potential impacts of the coronavirus pandemic on farm labor supply and demand with a particular focus on the demand for and availability of guest workers through the H-2A visa program.

Our first step is to discuss the challenges of keeping farm workers healthy and strategies to prevent the spread of COVID-19 at the workplace and within farm labor living quarters. There have been numerous COVID-19 outbreaks at farms and meat packing plants throughout the country, demonstrating that

workers at all stages of food production are highly susceptible to contracting the virus. Harvest of high-value fruits and vegetables is typically labor intensive and the window to harvest is fleeting. If workers must quarantine when fruit is ripe for harvest, the crop could be lost. There were at least ninety-five positive cases of coronavirus at a farm worker housing facility in Oxnard, California as of June 29, 2020; all of the residents had to be quarantined, and it is doubtful that a farmer could find one hundred or more replacement workers on short notice (ABC7.com 2020). Farm labor supply was tight prior to the pandemic, and an increasing number of producers have reported farm labor shortages in recent years (Charlton and Taylor 2016; Richards 2018; Zahniser et al. 2018). Learning to quickly contain the virus at the workplace and prevent its spread could be critical to national food security during the pandemic.

Second, we illustrate the potential short-run effects of the coronavirus pandemic on farm labor markets using basic principles of microeconomic theory. We consider the anticipated effects on farm labor demand of school and restaurant closures, disruptions to global trade, and government interventions intended to help farmers cope with COVID-related declines in revenue. We also consider how worker sickness and changes to immigration policy might affect the farm labor supply.

Third, we provide stylized facts regarding US farm labor markets and the farm labor supply in recent years. Real US farm wages have been increasing steadily over the past several years, there is evidence of increasing incidence of labor shortages, and H-2A guest worker demand grew more than threefold from 2011–2019 (Richards 2018; Zahniser et al. 2018; Castillo et al. 2020). It is estimated that H-2A constituted a little less than 10% of the crop workforce in 2019 (Costa and Martin 2020). Farmers can only hire H-2A workers for seasonal jobs if they can demonstrate that no domestic workers are willing or able to take the job and rising demand for H-2A workers suggests that the farm labor supply is tightening. We expect that increased restrictions on labor migration and risk of farm labor shortages due to worksite outbreaks of COVID-19 may increase agricultural producers' dependence on recruiting H-2A guest workers in 2020. Nevertheless, because of the severity of the economic downturn in response to the pandemic, the unemployment rate is the highest that it has been since the Great Depression. Some of the recently unemployed might consider taking a job in an essential industry, like agriculture. If so, farms may have very little risk of a labor shortage during the pandemic and there would be little need to hire additional H-2A workers. However, evidence shows that workers do not often switch from nonfarm to farm work (Richards and Patterson 1998; Martin, Fix, and Taylor 2006). This would suggest that even though a large share of the US workforce is unemployed, the agricultural sector will still need to recruit guest workers from abroad. Moreover, Congress temporarily increased unemployment benefits from March 20–July 31, 2020, which may have at least temporarily deterred unemployed nonfarm workers from seeking farm work.

Fourth, we examine the empirical relationship between changes in the local unemployment rate and H-2A guest worker demand. The local farm labor supply might rotate outwards as unemployment rates rise,¹ particularly if unauthorized workers who cannot access unemployment benefits are laid

¹See for example Taylor and Charlton (2018)'s discussion of "Equilibrium and Immigration in the Farm Labor Market" (graphical model on p. 82). Instead of workers migrating from another farm, in this case workers would be "migrating" from another sector of employment.

off and must seek a new job. Unauthorized immigrants represent an estimated 4.6% of the US workforce, including those who were unemployed and looking for jobs (Krogstad, Passel, and Cohn 2019).² Though a relatively small share of the US workforce, unemployed unauthorized workers may be the most likely source of additional farm workers from the local labor supply should farmers need to hire new workers during the pandemic. We leverage variation in the timing and magnitude of unemployment shocks across states between 2007–2019 to test their effects on state-level H-2A demand. We find that a 1% increase in the state unemployment rate is associated with a 5% decrease in H-2A demand.

Farm employers will still likely seek additional workers through the H-2A program during the pandemic since only a limited share of unemployed workers are expected to seek work in the farm sector. We examine H-2A visas issued each month from January through July of 2020 compared to previous years. Fewer visas were issued in April and May, shortly after the pandemic was declared; they rose to a similar number as 2019 in June, but in July they dropped to only 89.3% of what they were in 2019. Additional data are needed to observe how total agricultural employment compared to previous years and to what extent new workers entered the farm workforce. Nevertheless, the visa data indicate that H-2As remained an important labor source to US farms in 2020. We expect that H-2A consulting firms, growers' associations, and labor recruitment agencies play a critical role in connecting employers to guest workers while temporary restrictions on international travel apply.

Lastly, we conclude by discussing some of the potential long-term impacts of the coronavirus pandemic on farm labor demand. Although many of the associated shocks to US agricultural production are temporary, there may be some consequent long-lasting changes in food demand and agricultural production, with consequences for agricultural labor markets and technology adoption. Farm labor costs increased in 2020 as producers implemented new safety measures, possibly reducing the optimal farm labor demand and increasing the expected payoffs from adopting new technologies. Furthermore, Ridley and Devadoss (2020) predict that disruptions in the labor supply to fruit and vegetable farms will cause millions of dollars in lost production. In the long run, producers could try to hedge against risk of labor shortages and reduce labor costs by investing in labor-saving technologies.

Adoption of labor-saving technologies may not be feasible on all farms. The labor savings from technology adoption have to be relatively high to offset the upfront costs of increased capital investment. Consequently, large farms with economies of scale may have a competitive advantage unless rental and custom services markets develop concurrent to the new technologies (Kislev and Peterson 1982; Lu, Reardon, and Zilberman 2016). In any regard, the speed of developing new innovations and the rate of technology adoption often depend in large part on government policies, institutions, and university research (Sunding and Zilberman 2001).

Protecting the Health of Essential Workers

Due to their critical role in the US food supply chain, farm workers were deemed “essential” during the coronavirus pandemic by the US government.

²There were an estimated 7.6 million unauthorized immigrants in the US civilian workforce in 2017, and 10.5 million unauthorized immigrants total (Krogstad, Passel, and Cohn 2019).

Farm workers typically work in close proximity in the fields, share their living spaces, and commute to farms on crowded buses; these conditions increase the risk of exposure to COVID-19. Moreover, because farm workers earn relatively little, some may be inclined to report to work while sick so that they do not miss a paycheck, thus potentially exposing coworkers.

Government leaders have passed various legislation to help protect essential workers during the pandemic. For example, the Families First Coronavirus Response Act (FFCRA) requires employers with fewer than 500 employees to provide paid sick leave and paid family and medical leave for workers affected by COVID-19, but there is potential exemption for employers with fewer than fifty employees (Costa, 2020).³ If all farms with fewer than fifty employees were exempt, then only an estimated 36.2% of farm workers would be eligible for paid leave (Costa and Martin 2020).

To date, hundreds of asymptomatic farm workers have tested positive for COVID-19 (Dorning and Skerritt 2020; Wozniacka 2020). Rural Immokalee, Florida—known for having a large migrant worker community—recorded 900 cases of the novel coronavirus between April and June 2020 (Reiley 2020). Yakima County, Washington—a leading county in fruit and vegetable production—has the highest rate of COVID-19 infection on the West Coast (Dorning and Skerritt 2020). Particularly worrisome is that some of the workers infected in these communities are follow-the-crop workers who migrate from one harvest location to another, and thus may spread the virus more rapidly to rural communities throughout the country.

Many farms and farm labor contractors (FLCs) have taken proactive measures to protect their workforce. Some of these measures include assigning workers to the same crew everyday to limit the number of workers with whom each individual interacts, distancing crews in the field, increasing the number of handwash stands in the field, providing personal protective equipment, and taking workers' temperatures at the start of the day. Some farmers may need to schedule longer rest breaks so that workers can wash their hands and get water without crowding one another. Although implementing social distancing safety measures and providing protective gear may be costly to the employer in the short run, good health and safety policies could prove profitable to employers in the long run if these practices prevent a COVID-19 outbreak, which could force an employer to shut down.

Some employers are enacting safety measures that extend beyond labor management practices in the fields. Many FLCs and large farms provide housing for their workers, and arrange for transportation to and from the fields. To limit exposure while at home, some employers are reducing the number of workers living in a single housing unit. To limit trips on and off the farm, many farmers are either designating individuals to buy groceries for their entire workforce or having food delivered to the farm. Some farmers have designated quarantined housing for workers who show COVID-19 symptoms. To limit exposure during commute, some employers are using more buses than usual to transport their employees to the fields or making multiple trips with each bus (Beatty et al. 2020).

³“Small businesses with fewer than fifty employees may qualify for exemption from the requirement to provide leave due to school closings or child care unavailability if the leave requirements would jeopardize the viability of the business as a going concern.” U.S. Department of Labor Wage and Hour Division. “Families First Coronavirus Response Act: Employer Paid Leave Requirements.” <https://www.dol.gov/agencies/whd/pandemic/ffcra-employer-paid-leave>. Last accessed September 1, 2020.

Employers may need to additionally consider providing workers with health benefits and sick leave (even if not required to by law). Only 50% of crop workers in the National Agricultural Workers' Survey (NAWS), which excludes H-2A workers, said that they had health insurance in 2016.⁴ Some health clinics offer primary care services to farm workers on a sliding scale depending on individual ability to pay, but workers may not be aware of these services or how to access them.

Downstream Demand Shocks and Farm Labor Demand

Determining labor needs on farms is complex and shrouded in uncertainty even in a typical year. Unpredictable variation in weather, pests, trade, and commodity prices can lead to abrupt changes in input demands. Minor adjustments in labor demand throughout the agricultural season are not unusual. However, the large disruptions in the food supply chain due to COVID-19 forced many farmers to reverse some of their production decisions in 2020, some even tilling produce into the ground or planting a different crop.

Prior to the pandemic, about 54% of consumer food expenditures were for food away from home. In March and April 2020, while restaurants, cafeterias, and schools were closed, consumer food expenditures shifted primarily to grocery stores, and 75% of consumer food expenditures were for home consumption (Malone, Schaefer, and Lusk 2020). Processing facilities do not package food items and ingredients in the same quantities and designs for grocery shelves as they do for school cafeterias and restaurants, so some processing facilities sat idle while others operated at maximum capacity. Consumers stockpiled freezer foods and other nonperishable items, particularly in the weeks following the announcement of the pandemic, shifting the demand for fresh fruits and vegetables inward. Some fruit and vegetable farms were unable to sell their products fresh-to-market. Some farms managed to freeze or process their produce, thus receiving a lower price, some transported their crops to ranches to use as livestock feed, and others tilled their produce back into the soil (Jeffrey and Newburger 2020).

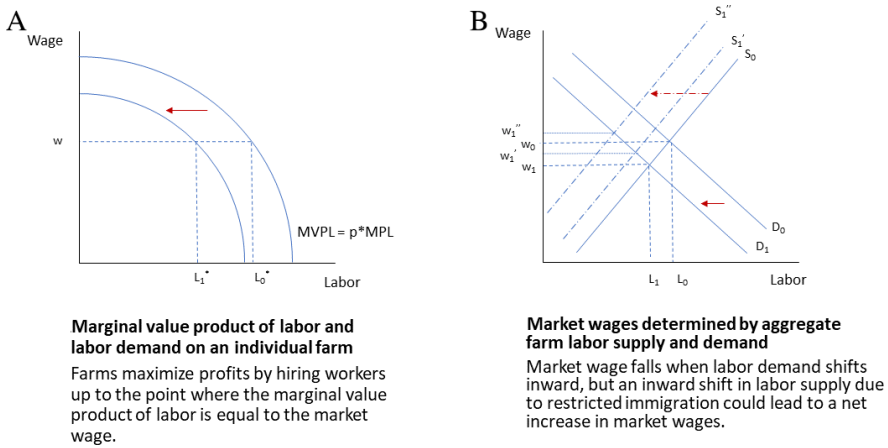
COVID-19 shocked agricultural export markets as well, but it appears that the largest negative price shocks from disruptions in international trade were to highly mechanized commodities. For example, US agricultural export forecasts of bulk commodities like soybeans, cotton, corn, and wheat were down \$3.0 billion on May 26, 2020 from their February forecasts, but livestock, poultry, dairy, and horticultural export forecasts were unchanged (Kenner and Jiang 2020).⁵ As a result, we expect that most of the changes in farm labor demand in the short run can be attributed to changes in domestic consumer behavior.

We illustrate the impacts of decreased demand for fresh fruits and vegetables in figure 1. Panel A shows the relationship between farm-level employment and the marginal value product of labor (MVPL). Under the standard assumptions, the marginal value product of labor falls as employment increases, illustrated by a downward-sloping MVPL curve. The MVPL is also concave to reflect diminishing marginal returns to labor.

⁴Authors' calculations based on the National Agricultural Workers Survey (NAWS), a nationally representative survey of crop farm workers that interviews farm workers, excluding H-2As, at their place of work. (United States Department of Labor, Employment and Training Administration 2017).

⁵Agricultural exports were forecast at \$136.5 billion for fiscal year 2020 on May 26, 2020.

Figure 1 Falling farm gate prices, labor demand, and wages [Color figure can be viewed at wileyonlinelibrary.com]



Let us suppose that the commodity is head lettuce, which is harvested by hand primarily from December through March in Arizona and April through November in California. Lettuce is consumed in greater quantities at school cafeterias and restaurants, so when schools and restaurants close, the demand for lettuce shifts inward and the price of lettuce falls. The farmer hires workers up to the point where the MVPL is equal to the cost of one unit of labor, the market farm wage. Panel A of figure 1 shows that as the price of lettuce falls, the MVPL curve shifts inward (MVPL is equal to the output price times the marginal product of labor). When the price of lettuce decreases, the optimal labor demand decreases from L_0^* to L_1^* , where the market wage intersects the new MVPL curve.

Now suppose that farmers spend an additional δ per worker above the wage in precautionary measures to prevent the spread of COVID-19 on the farm. This increases the farmer's per unit cost of labor to $w + \delta$ and decreases optimal quantity of farm labor employed to L_2^* . Farmers who have already planted lettuce and cultivated it in the field will till the lettuce back into the field if the cost of hiring workers to harvest the lettuce is greater than the expected revenues from harvest. Farmers who have not yet planted lettuce may plant a different crop with higher expected net profits.

Panel B of figure 1 shows the aggregate farm labor supply and demand. Although a single farmer cannot influence farm wages, industrywide changes in farm labor demand do affect farm wages. When many farms reduce hiring, the demand for farm workers shifts inward from D_0 to D_1 . Holding labor supply constant, the market wage falls.

Various government assistance programs can alter the marginal value product of labor or cost of labor on farms and in food processing businesses. The Farmers to Families Food Box Program supplies produce from farms to food banks and other nonprofits. This program is expected to help alleviate some of the gluts in the fresh produce supply chain by purchasing and distributing produce from farmers and is intended help prevent produce prices from falling. The Coronavirus Farm Assistance Program gives direct assistance to qualifying farms. This is expected to help some farms remain in operation, many of which might be on the brink of bankruptcy, potentially reducing the magnitude of the inward shift in aggregate farm labor demand. Some

farms may be eligible for the Paycheck Protection Program (PPP) administered by the Small Business Administration. Since PPP loans can be forgiven for businesses that retain workers, this program directly affects hiring decisions by reducing the effective cost per unit of labor.

Labor supply is affected by the pandemic as well. According to the National Agricultural Workers Survey in fiscal year 2016, 11% of the crop workforce, excluding H-2A, were international shuttle migrants, meaning that their home is in another country and they travel to the United States to work on farms, and about 2% were newcomers to US farm work.⁶ Immigration to the United States is temporarily restricted. The US-Mexican border is closed to nonessential travel from March 20, 2020 until at least September 21, 2020, and the United States is not issuing green cards. If some workers do not return to farms this year or if individuals in the workforce reduce their work hours due to sickness, the farm labor supply curve will shift inward. A relatively small inward shift in the farm labor supply causes farm wages to rise from w_1 to $w'_1 < w_0$, but a large inward shift in supply could raise farm wages higher than w_0 as the labor supply shifts to S''_1 illustrates in figure 1 panel B. However, rising unemployment rates resulting from the pandemic and temporary allowances intended to make it easier for farmers to obtain H-2A workers could ameliorate negative farm labor supply shocks. We discuss farm labor supply in more detail in the following section.

Background: Farm Labor Supply

Approximately 73% of the crop workforce in the United States, excluding H-2A workers, is foreign-born and an estimated 48% is unauthorized.⁷ Most farm workers in the United States are from rural Mexico, but rural Mexico is currently transitioning out of farm work and hence the US farm labor supply is expected to become increasingly tight (Charlton and Taylor 2016). The mean age of US farm workers has risen over the past several years, suggesting that fewer new workers are migrating from Mexico to US farms, and there are increasing reports of farm labor shortages (Richards 2018; Zahniser et al. 2018). Producers who are unable to find domestic workers willing and able to do seasonal farm work can hire workers through the H-2A program, and in fact, demand for H-2A workers rose dramatically from 2007–2019.

There is concern that temporary immigration restrictions in 2020 could reduce the farm labor supply. Total apprehensions of unauthorized immigrants on the southwestern US border declined by nearly 50% between March and April 2020, in contrast to increases in apprehensions between the same months in both 2019 and 2018.⁸ Absent a drastic change in border patrol in 2020, this suggests that fewer unauthorized immigrants attempted to enter the United States during the pandemic, and it will be more difficult for farmers to recruit new immigrant workers if workers from the previous

⁶Authors' calculations based on the National Agricultural Workers Survey (NAWS), a nationally representative survey of crop farm workers that interviews farm workers, excluding H-2As, at their place of work. (United States Department of Labor, Employment and Training Administration 2017).

⁷Authors' calculations based on the National Agricultural Workers Survey (NAWS), a nationally representative survey of crop farm workers that interviews farm workers, excluding H-2As, at their place of work. (United States Department of Labor, Employment and Training Administration 2017).

⁸Total apprehensions increased between March and April of 2019, 2018, and 2016. In 2017 apprehensions decreased, but only by 6%. Data source: U.S. Customs and Border Protection. "Southwest Border Migration FY 2020." <https://www.cbp.gov/newsroom/stats/sw-border-migration> Accessed May 26, 2020.

season do not return to the farm in 2020 or if farmers need to find replacements for workers who fall sick. Farm employers have two options to recruit additional workers: One is to hire workers locally, offering jobs to individuals who were laid off as a result of COVID-19, and the other is to contract additional guest workers with H-2A nonimmigrant visas.

Local Farm Labor Supply and Unemployment

The economic downturn resulting from COVID-19 has left many domestic workers without a job. The national unemployment rate is the highest it has been since the Great Depression, estimated at 14.7% in April 2020, up 10.3% from the previous month (U.S. Bureau of Labor Statistics 2020). With so many workers in nonessential sectors unemployed, including both native workers and immigrants, one might expect that some would take a job in the agricultural sector.

Nevertheless, if the Great Recession from 2007–2009 serves as a viable comparison, many domestic workers are unwilling to do farm work even when unemployment rates are high. There were 6,500 job openings for farm workers in North Carolina during the recession in 2008. Only 163 individuals showed up to take the jobs, and only 7 remained for the duration of the season (Corbett 2020).⁹ There may be even fewer incentives for workers in the United States to take up farm work in the current climate. For instance, the federal government provided an additional \$600 a week in unemployment benefits from March 27–July 31, 2020.

Despite high unemployment rates, it may be unlikely that unemployed workers will seek jobs in agriculture. Richards and Patterson (1998) find that once workers find jobs in the nonfarm sector, they are reticent to return to the farm sector, even if farm wages are relatively high. However, some immigrant workers, particularly unauthorized immigrants, who do not qualify for unemployment benefits, may be willing to do farm work. Theoretically, rising unemployment rates during the pandemic could reduce the agricultural sector's dependence on H-2A guest workers, but the relationship between unemployment and H-2A demand is hitherto unknown.

H-2A Guest Workers

If a producer advertises a seasonal farm job and no domestic workers are willing or able to take it, then the producer can apply to the H-2A program to fill the position with a foreign guest worker. Nonseasonal jobs, such as those in the dairy industry, do not qualify for H-2A, and employers who use the H-2A program must abide to strict regulations. Employers generally prefer to hire workers locally than to hire foreign guest workers because contracting H-2As is typically costlier. For example, employers must provide housing for H-2As, pay for transportation from and return to the worker's home country, and pay H-2As at least the Adverse Effect Wage Rate (AEWR) even if it is greater than the prevailing farm wage. Complying with the administrative regulations in the application process is also costly.

⁹A Colorado potato farmer who attempted to hire domestic workers in 2011, at a time when one in eleven US workers were unemployed, reported that nearly all of the new employees walked off the field before lunch on the first day. According to the employer records, several stated that the work was too hard. (Johnson 2011)

To qualify for H-2A certification, the proposed job must be temporary or seasonal; employers must demonstrate that there are insufficient US workers willing, able, and available to do the work; and employers must show that employment of H-2A workers will not adversely affect the wages and working conditions of similarly employed workers. If the employer can demonstrate that all of these criteria are met (usually by advertising the job in multiple states), he/she files a job offer with the State Workforce Agency (SWA) in the region of intended employment sixty to seventy-five days before the specified employment start date. If the job offer is accepted by the SWA, the employer must then file for a temporary labor certification for H-2A workers from the Office of Foreign Labor Certification (OFLC) in the U.S. Department of Labor (DOL). Next, the employer files an I-129 petition to the U.S. Citizenship and Immigration Services (USCIS) explaining in more detail the worker's qualifications and details of the job. Finally, once USCIS approves the I-129, the prospective worker may apply for an H-2A visa from the U.S. Department of State at an embassy or consulate in their own country (U.S. Citizenship and Immigration Services 2019).

The US government implemented temporary rules to ease some of the costs of hiring H-2A workers during the coronavirus pandemic. H-2A petitioners with a valid temporary labor certification can employ certain nonimmigrant workers who already have H-2A status as soon as the USCIS receives the petition. The DOL has published lists of H-2A positions that are near their expiration along with the addresses of their employers so that petitioners can locate eligible workers who have not yet left the United States. H-2A workers are also temporarily permitted to remain beyond their three-year maximum stay in the United States, and U.S. consulates are issuing H-2A visas to qualified new and returning H-2A workers without in-person interviews.¹⁰

To help farmers adjust to unexpected COVID-related changes in labor demand, the OFLC in the DOL is accepting requests for emergency H-2A applications that are processed more quickly than general applications. Farmers who have not previously used the H-2A program are more likely eligible for expedited application processing. Farmers who experience major disruptions to production for COVID-related reasons can also request permission from the OFLC to terminate H-2A work orders prior to the end date in the work contract.¹¹ These provisions may help provide flexibility to the H-2A program, which has often been criticized for its rigidity and complexity.

Despite the costs of the H-2A program, demand for H-2A workers increased rapidly from 2011–2019. Costa and Martin (2020) estimate that by 2019, H-2A workers had accounted for just under 10% of the total crop workforce. To help farm operators navigate the H-2A process, most states have active growers' associations or consulting firms that file for H-2A positions on behalf of farmers. These institutions typically help employers through multiple steps of applying for H-2A positions, inform employers of relevant regulations, and sometimes recruit foreign workers on behalf of employers (or refer the employers to reputable recruiters abroad). Growers' associations

¹⁰See USDA Farmers.gov. "H-2A Visa Program." <https://www.farmers.gov/manage/h2a>. Accessed June 30, 2020.

¹¹See U.S. Department of Labor, Employment and Training Administration, Office of Foreign Labor Certification. "COVID-19 Frequently Asked Questions, Round 1." March 20, 2020. https://www.foreignlaborcert.doleta.gov/pdf/DOL-OFLC_COVID-19_FAQs_Round%201_03.20.2020.pdf. Accessed July 7, 2020.

Figure 2 National total H-2A FTE applications and filer Type, 2007–2019 [Color figure can be viewed at wileyonlinelibrary.com]



and consultants filed 70% of the applications for H-2A positions between 2007–2018.

Figure 2 shows that growth in applications has been driven by filings from growers’ associations and H-2A consultants, with little or no growth in the number of applications generated by the smaller filing entities (law firms, agents, and self-filers).¹² Large filing intermediaries (growers’ associations and H-2A consultants) potentially reduce the cost of acquiring H-2As by reducing information costs, network-creation costs, and the risk of unintentional noncompliance with H-2A requirements, which can lead to fines. Presumably, these institutions reduce H-2A application costs by streamlining the application process and helping employers find qualified workers.

Source: Authors’ analysis of OFLC H-2A disclosure data.

Agents refer to individuals, who are not lawyers, who file H-2A applications behalf of the grower. Growers’ associations and consultants are the only examples of organizations that file H-2A applications on behalf of the grower.

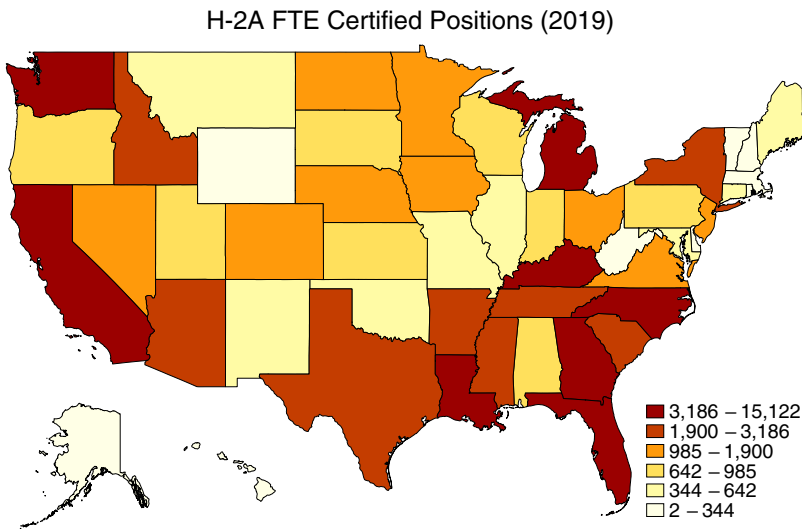
H-2A demand is most heavily concentrated in US regions where there is abundant production of labor-intensive fruits, vegetables, and horticultural (FVH) crops.¹³ Figure 3 illustrates the regional variation in H-2A demand in 2019. The six states with highest H-2A employment were Florida, Washington, California, North Carolina, Georgia, and Louisiana.

Given the current impediments to labor migration and the risk of farm labor shortages due to COVID-19 outbreaks, we expect that farmers may need to hire more H-2A workers in 2020. Nevertheless, employers have to demonstrate that no domestic workers are willing or able to take the job before they can receive H-2A certification, and unemployment rates soared to the highest they have been since the Great Depression. Whether changes in unemployment rates have any impact on H-2A demand is an empirical question. Workers may not switch from the farm to the nonfarm sector even when unemployment rates are high in the nonfarm sector, but farmers may be able

¹²There was no growth in the number of certified applications filed by a law firm if we drop applications filed on behalf of a Farm Labor Contractor (FLC). If we include the applications filed for FLCs, we find some growth in applications filed by law firms, but this is driven by few FLCs hiring large numbers of H-2As.

¹³A relatively small number of H-2A workers are hired to operate equipment for field crop production, to manage livestock, or to work in aquaculture (Castillo et al. 2020).

Figure 3 H-2A guest worker demand by state in 2019. Source: Authors' analysis of OFLC H-2A disclosure data [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]



to retain more farm workers when unemployment rates are high since there are fewer outside job options. Consequently, we would expect H-2A demand to be inversely related to changes in the unemployment rate.

Empirical Analysis

In this section, we analyze the relationship between annual changes in the unemployment rate and H-2A demand within states. If an increase in the non-farm unemployment rate either induces workers to move from the nonfarm sector to the farm sector or decreases the probability farm workers leave agriculture to work in another industry, then the massive layoffs occurring in 2020 could reduce H-2A demand and help ameliorate the risk of farm labor shortages. We analyze detailed data on the timing and worksite locations of H-2A certifications from 2007–2019. We use the lagged state unemployment rate as the explanatory variable.

Data

Data on the number of full-time equivalent (FTE) H-2A positions certified each year come from the U.S. Department of Labor, Employment and Training Administration, Office of Foreign Labor Certification. On average, 93% of H-2A requests were certified each year from 2007–2019.¹⁴ We use the number of full-time equivalent (FTE) H-2A certified positions each year as a proxy for H-2A demand since there is no cap on the number of H-2A visas issued each year.¹⁵ H-2A certified positions increased from 39,873 FTE in 2007 to 117,417 in 2019.

¹⁴We have data on the number of requests filed in 2007, 2011–2012, and 2015–2019 (eight years total). The share of requests that were certified each year ranged from 93.1 to 96.7%. Occasionally employers file the necessary paperwork and get an H-2A position certified but do not hire an H-2A worker, and occasionally one guest worker fills multiple certified positions on a single visa. Consequently, the number of certified H-2A workers exceeds the actual number of H-2A workers in the United States each year (Martin 2017).

¹⁵The overwhelming majority of H-2A visas are approved for less than a year, and thus certified positions in a year closely approximate annual total demand since there are very few certifications that continue from the previous year.

We obtain state unemployment rates each year from the Bureau of Labor Statistics. Unemployment rose dramatically during the Great Recession of 2008 and took several years to return to prerecession rates. State unemployment rates ranged from a low of 2.4% to a high of 13.6% from 2006–2018. The mean unemployment rate was 5.91%.

Empirical Model

Given the associated costs of hiring H-2A workers, we expect that employers would not contract H-2A workers if they could hire workers locally. An inverse relationship between the unemployment rate and H-2A certification within a state provides suggestive evidence that at least some of the workers in the local labor market seek farm jobs when employment in the nonfarm sector declines, or, alternatively, fewer local workers are pulled away from the farm sector when there are fewer job openings in the nonfarm sector.

Our baseline estimating equation is given by:

$$H2A_{s,t} = \beta_0 + \beta_1 UR_{s,t-1} + \alpha_s + \eta_t + \varepsilon_{s,t} \quad (1)$$

where $H2A_{s,t}$ is the number of full-time equivalent H-2A workers in state s and year t and $UR_{s,t-1}$ is the lagged state unemployment rate. State fixed effects α_s control for all time-invariant state characteristics, and year fixed effects η_t control for national shocks to H-2A demand. The error term is given by $\varepsilon_{s,t}$. We cluster standard errors at the state.

In order for our OLS estimate of β_1 to capture the causal effect of interest, the lagged state unemployment must be orthogonal to other factors that influence H-2A demand that are not absorbed in state or year fixed effects.

Our first concern is that states may pass immigration enforcement policies in response to local economic performance, and these policies might directly influence H-2A demand. Specifically, several states passed E-Verify mandates during the years of our analysis. E-Verify is a national system that matches social security numbers to national databases such as those kept by the Department of Homeland Security. Although E-Verify is nationally available, only a few states require that employers check new employees' status using the E-Verify system.¹⁶ As a robustness check, we drop all states that implemented an E-Verify mandate for private firms at any time prior to 2020.

A second concern is that there may be unobserved shocks to the local economy that simultaneously affect both agricultural labor demand (and, by extension, H-2A demand) and labor demand in other sectors of the local economy. For example, if a negative wealth shock decreases aggregate consumer demand, employment might decrease in all sectors of the local economy. However, agricultural products are traded and sold in national and international markets, and demand for food is highly inelastic, so local business cycles should have little impact on agricultural labor demand (Da-Rocha and Restuccia 2006). In fact, hired agricultural employment remained steady throughout the 2008 recession even though unemployment rose in nearly all other sectors of the economy (Hertz 2011).

¹⁶In the appendix, we summarize when states implemented E-Verify mandates that applied to private firms and the size of firms they applied to.

A third concern is that negative weather shocks may destroy crops leading to reduced farm labor demand and lower H-2A demand while also lowering overall economic activity and thus increasing the local unemployment rate. However, the effects of weather shocks on unemployment rates are likely temporary and small. Thus, weather shocks should not pose a significant threat to our analysis. Nevertheless, we run a third specification controlling for state-specific linear time trends.

Finally, we run a fourth specification using the natural log of H-2A FTE as the dependent variable to measure percentage impacts on H-2A demand.

Results

Table 1 column (1) shows the estimated coefficients from equation 1. Column (2) shows results dropping all states that implemented an E-Verify mandate applicable to private employers. Column (3) shows the results from additionally controlling for state trends, and column (4) exchanges the dependent variable in the specification in column (3) for the natural log of H-2A certified FTE positions.

We find a statistically significant negative association between the lagged unemployment rate and H-2A demand in all specifications. The magnitude of the coefficient decreases somewhat when we drop E-Verify states and decreases substantially when we control for state trends. The results in column (3) suggest that a 1% increase in the unemployment rate is associated with a decrease in H-2A demand of 165 FTE positions. That is a decrease of about 5% based on the findings in column (4). Given Costa and Martin (2020)'s estimates that H-2A made up nearly 10% of the FTE farm workforce in the United States in 2019, a back-of-the-envelope estimate suggests that a 1% increase in the unemployment rate would be associated with a predicted decline in H-2A workers amounting to a little less than a half of a percent of the 2019 agricultural workforce.

Table 1 Effect of Local Labor Market Conditions on H-2A FTE Certified Positions, 2007-2019

Variables	(1) Certified H-2A FTE	(2) Certified H-2A FTE	(3) Certified H-2A FTE	(4) Log H-2A
Lagged Unemployment Rate	-247.921** (92.539)	-224.298** (106.363)	-165.228* (91.294)	-0.051* (0.030)
Drop E-Verify States	N	Y	Y	Y
Control for State Trends	N	N	Y	Y
Observations	650	546	546	546
R-squared	0.229	0.195	0.874	0.805
State Clusters	50	42	42	42

Robust standard errors clustered at the state in parentheses.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

How 2020 H-2A Employment Compares to Previous Years

Our findings in the previous section suggest that H-2A demand declines somewhat as the unemployment rate rises. Nevertheless, the unemployed workforce in 2020 differed from that of previous years. Many highly skilled individuals unexpectedly found themselves without work and, as mentioned previously, unemployment benefits were temporarily expanded. Many factors that were unique to 2020 could have affected the demand for H-2A workers and the number of foreigners who sought and received an H-2A visa, including temporary immigration restrictions, increased difficulty of travel, shocks to the food supply chain, and changes in consumer demand for perishable fruits and vegetables, among others.

Examining H-2A visas issued in 2020, when unemployment rates hovered near record highs, we find that visas issued in April 2020 were much less than those in previous years. Visas issued in May and June 2020 were nearly identical to those in 2019. However, for July, the peak month for agricultural employment, visas issued in 2020 were only 89.3% of those in 2019.¹⁷

Table 2 shows H-2A visas issued each month in 2020 as a share of visas issued the same month in 2019 and 2018. H-2A demand appeared to be increasing in the months prior to the pandemic (January–March) relative to previous years, but relatively fewer visas were issued in April, immediately following the announcement of the pandemic. Difficulties processing visas while foreign consulates were closed, reduced farm labor demand due to disruptions in food supply chains, or reduced labor migration all could have been factors. This could have important consequences for agricultural production since April is typically the peak month for H-2A visas issued—though not necessarily the peak month for total H-2A employment since visas are typically valid for multiple months. Visa issuance appeared to recover in May and June but fell behind again in July. More data are needed to understand how total farm employment compared in 2020 to previous years and whether there were new entrants from the domestic workforce to the agricultural sector.

Many farmers were scrambling to secure a workforce in 2020 as there were numerous unanticipated disruptions to immigration and labor supply. Many farmers likely considered contracting H-2A workers for the first time. Immigrant networks play a vital role in connecting employers to new farm workers since most farm workers are foreign-born. Some former H-2A visa holders will return to work another season, and some may help friends, family, and neighbors obtain H-2A visas.

Nevertheless, some previous H-2A visa holders will not return in 2020, and migrant networks may shrink. A farmer in Maryland reported that only about a quarter of his previous H-2A crew returned to work on his farm in Maryland in March 2020. He was able to secure a few additional workers who had previously obtained H-2A visas to work on other farms, but he still had only a skeleton crew (Gonzalez and Aronczyk 2020).

Similar to workers applying for an H-2A visa for the first time, employers who are new to the H-2A program likely depend on employers with previous experience or consultants to help them learn how to use the program. We expect that growers' associations and H-2A consulting services were of

¹⁷We find that July is the peak month of agricultural employment based on analysis of multiple years of the Quarterly Census of Employment and Wages (QCEW).

Table 2 H-2A Visas Issued by Month in 2020 Compared to Previous Years

	Visas Issued 2018	Visas Issued 2019	Visas Issued 2020	2020 as a Share of 2019	2020 as a Share of 2018
January	9,984	11,395	13,083	1.148	1.310
February	13,250	14,737	17,279	1.172	1.304
March	20,353	22,374	26,957	1.205	1.324
April	35,167	35,215	31,303	0.889	0.890
May	28,479	26,430	26,342	0.997	0.925
June	20,208	19,151	20,565	1.074	1.018
July	12,860	15,689	14,016	0.893	1.010

Data source: U.S. Department of State. "Monthly Nonimmigrant Visa Issuance Statistics." <https://travel.state.gov/content/travel/en/legal/visa-law0/visa-statistics/nonimmigrant-visa-statistics/monthly-nonimmigrant-visa-issuances.html><https://travel.state.gov/content/travel/en/legal/visa-law0/visa-statistics/nonimmigrant-visa-statistics/monthly-nonimmigrant-visa-issuances.html>. Accessed September 1, 2020.

critical importance in connecting farmers to H-2A workers during the coronavirus pandemic. Given the numerous shocks to agricultural production, jobs and wages and unemployment benefits, and immigration it is no surprise that actual declines in H-2A demand in 2020 are much smaller than what our model would predict from a change in the unemployment rate alone. We expect that farm employers drew new workers both from the unemployed workforce and the H-2A program in 2020.

Conclusion with a Look to the Future

Many of the changes we see in agriculture in 2020 are temporary. Schools and restaurants will reopen, meat-processing facilities will gradually increase production, and agricultural supply chains disrupted by the pandemic will be repaired. Eventually, a vaccine will allow workers in all sectors to return to the workplace without fear of contracting and spreading the virus. Nevertheless, the pandemic has revealed tremendous vulnerabilities in the nation's food supply chains and drawn public attention to the essential role that unauthorized immigrants and H-2A guest workers play in our food production. There will likely be some long-lasting effects of the coronavirus pandemic on the agricultural industry, including farm labor management.

In the short run, producers at every stage of the food supply chain are attempting to adjust to rapidly changing consumer demands. Employers are attempting new practices to prevent the spread of COVID-19 at the workplace. Farm labor supply likely shifted inward as a result of workers getting sick and reduced labor migration. We find evidence that H-2A demand typically declines as local unemployment rates rise, providing suggestive evidence that either some workers seek jobs in the farm sector when laid off from a nonfarm job or fewer farm workers are pulled away from agriculture when fewer jobs are available in the nonfarm sector. We find that a 1% increase in the unemployment rate was associated with a 5% decrease in H-2A demand from 2007–2019, which was estimated equivalent to a little less than 0.5% of the total crop workforce in 2019.¹⁸ However, many of the

¹⁸Based on Costa and Martin (2020)'s estimate that H-2A constituted a little less than 10% of the farm workforce in 2019.

workers unemployed during the pandemic were receiving unemployment benefits, and unauthorized workers who do not qualify for unemployment benefits represented only an estimated 4.6% of the US workforce as of 2017 (Krogstad, Passel, and Cohn 2019).

COVID-19 outbreaks on farms and disruptions in the food supply resulting from the pandemic have drawn increased public attention to the agricultural industry's dependence on unauthorized immigrants.¹⁹ Some states, like California, have extended economic safety nets to unauthorized immigrants during the pandemic, though some potential recipients have said that they are fearful of exposing their immigration status by claiming benefits.²⁰ A recent survey of low-skilled domestic workers indicated that the coronavirus pandemic led many of them to empathize more with H-2A workers but did not change political views regarding immigration policy (Luckstead, Nayga Jr., and Snell 2020).

Policymakers have held repeated discussions intended to reform the H-2A program, which could foreseeably reduce the agricultural sector's dependence on an unauthorized workforce. Growers' organizations have advocated for changes to the H-2A program to make the hiring process more efficient and less costly, worker advocates voice concerns that guest workers need better legal protection, and domestic workers often fear that immigrants and guest workers could put downward pressure on domestic wages. There were numerous attempts to replace or reform the H-2A program, including the Agricultural Job Opportunities, Benefits and Security Act (AgJOBS) proposed under the George W. Bush administration in 2006 and the Legal Workforce Act proposed by U.S. House Judiciary Committee Chairman Bob Goodlatte in 2018. However, as of yet, no major reforms have taken place.

The Farm Workforce Modernization Act (FWMA) received bipartisan support and passed the House of Representatives in December 2019. The FWMA would streamline the H-2A application process by moving applications online, permit farmers to hire guest workers to perform year-round work as well as seasonal, and extend the maximum length of stay and provide a pathway to lawful permanent residence for agricultural guest workers, among other provisions. The Senate was still discussing proposed amendments to the bill when the COVID-19 pandemic was announced. Deficiencies in the current H-2A program may become more apparent as the pandemic tests the adequacy of the program to supply workers to US farms during a global crisis and protect guest workers' rights.

In the long run, we expect that increased labor costs to protect workers' health during the pandemic combined with increased risk of labor shortages will lead producers to invest in more labor-saving technologies. Koundouri, Nauges, and Tzouvelekas (2006) show that farmers often use technologies as a method of hedging against production risks. As long as the demand for domestically produced fruits and vegetables remains strong in the United States, producers are likely to invest in technologies rather than ceasing operation. There have been numerous strides in agricultural technologies in recent years, including prototypes for robotic strawberry harvesters and apple harvesters that use vacuum suction to pick apples from the trees. As of yet, these

¹⁹See for example, Jordan (2020) and Villa (2020).

²⁰"Governor Newsom Announces New Initiatives to Support California Workers Impacted by COVID-19." April 15, 2020. <https://www.gov.ca.gov/2020/04/15/governor-newsom-announces-new-initiatives-to-support-california-workers-impacted-by-covid-19/> Accessed May 27, 2020.

technologies have not been cost effective enough to adopt on commercial farms, but, as the S-shaped diffusion of mechanical raisin harvesters demonstrates, technology adoption can take place relatively quickly when labor becomes scarce or production risk rises (Charlton et al. 2019).

New labor-saving innovations will require a multidisciplinary approach, such as the combined efforts of plant breeder Jack Hanna and engineer Coby Lorenzen in the development of the tomato harvester in the 1950s. They will also require cooperation between universities, private, and government resources. The resources available for agricultural innovation may become scarce in the event of a global recession. Nevertheless, if farm labor becomes scarcer, costlier, or less reliable, the economic advantages of mechanization are expected to rise. Studies suggest that one outcome of the coronavirus pandemic is that people are increasingly concerned about national food security, which may increase consumer demand for domestically produced fruits and vegetables (Luckstead, Nayga Jr., and Snell 2020). Another likely outcome is increased innovations that make the food supply chain more resilient to global shocks, including new production methods that reduce seasonal farm labor demand but also create higher-skilled, higher-paying, safer farm jobs.

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References

- ABC7.com staff. 2020. Oxnard Housing Facility for Farmworkers Sees Coronavirus Outbreak. *ABC7*, June 29, 2020, <https://abc7.com/coronavirus-covid-19-ventura-county-oxnard-covid-19/6281997/>
- Beatty, Timothy, Alexandra Hill, Philip Martin, and Zachariah Rutledge. 2020. COVID-19 and Farm Workers: Challenges Facing California Agriculture. In *ARE Update*, Vol 23 (5) 2–4.
- Castillo, Marcello, Skyler Simnitt, Gregory Astill, and Travis Minor. 2020. Examining the Growth in Seasonal H-2A Labor. In *Working paper, United States Department of Agriculture*. Washington, DC: Economic Research Service.
- Charlton, Diane, and Edward J. Taylor. 2016. A Declining Farm Workforce: Analysis of Panel Data from Rural Mexico. *American Journal of Agricultural Economics* 98: 1158–1180.
- Charlton, Diane, Edward J. Taylor, Stavros Vougioukas, and Zachariah Rutledge. 2019. Innovations for a Shrinking Agricultural Workforce. *Choices* 34: 1–8.
- Corbett, Jack. 2020. What’s a Cooking Show Without Any Food? *NPR Planet Money*, July 1, 2020, <https://www.npr.org/2020/07/01/885700692/whats-a-cooking-show-without-any-food> (accessed October 8, 2020).
- Costa, Daniel. 2020. Nine in 10 Farmworkers Could be Covered by the Paid Leave Provisions of the Families First Coronavirus Response Act—But Not if Smaller Employers are Exempted. *Economic Policy Institute*, <https://www.epi.org/blog/9-in-10-farmworkers-could-be-covered-by-the-paid-leave-provisions-of-the-families-first-coronavirus-response-act-but-not-if-smaller-employers-are-exempted/>.

- Costa, Daniel, and Philip Martin. 2020. Farm employment, safety issues, and the H-2A guestworker program. *Economic Policy Institute*, March 24, 2020, <https://www.epi.org/publication/coronavirus-and-farmworkers-h-2a/>
- Da-Rocha, J.M., and D. Restuccia. 2006. The Role of Agriculture in Aggregate Business Cycles. *Review of Economic Dynamics* 9: 455–482.
- Dorning, Mike, and Jen Skerritt. 2020. Every Single Worker Has Covid at One U.S. Farm on Eve of Harvest. *Bloomberg*, May 29, 2020, <https://www.bloomberg.com/news/articles/2020-05-29/every-single-worker-has-covid-at-one-u-s-farm-on-eve-of-harvest> (accessed October 8, 2020).
- Gonzalez, Sarah, and Amanda Aronczyk. 2020. Food and Farmworkers. *NPR Planet Money*, March 25, 2020, <https://www.npr.org/2020/03/25/821593542/episode-984-food-and-farmworkers> (accessed October 8, 2020).
- Hertz, Thomas. 2011. Hired Farm Labor Held Steady in Great Recession. In *Amber Waves: The Economics of Food, Farming, Natural Resources, and Rural America*. Washington DC: U.S. Department of Agriculture, Economic Research Service.
- Jeffrey, Adam, and Emma Newburger. 2020. Wasted Milk, Euthanized Livestock: Photos Show How Coronavirus has Devastated US Agriculture. *CNBC.com*, May 2, 2020, <https://www.cnbc.com/2020/05/02/coronavirus-devastates-agriculture-dumped-milk-euthanized-livestock.html> (accessed October 8, 2020).
- Johnson, Kirk. 2011. Hiring Locally for Farm Work Is No Cure-All. *The New York Times*, October 5, 2011, <https://www.nytimes.com/2011/10/05/us/farmers-strain-to-hire-american-workers-in-place-of-migrant-labor.html> (accessed October 8, 2020).
- Jordan, Miriam. 2020. Farmworkers, Mostly Undocumented, Become “Essential” During Pandemic. *The New York Times*, April 2, 2020, <https://www.nytimes.com/2020/04/02/us/coronavirus-undocumented-immigrant-farmworkers-agriculture.html> (accessed October 8, 2020).
- Kenner, B., and H. Jiang. 2020. Outlook for U.S. Agricultural Trade: FY 2020 U.S. Agricultural Exports Forecast at \$136.5 Billion; Imports at \$130.2 Billion. Working paper, United States Department of Agriculture, Economic Research Service and Foreign Agricultural Service Situation and Outlook Report.
- Kislev, Yoav, and Willis Peterson. 1982. Prices, Technology, and Farm Size. *Journal of Political Economy* 90: 578–595.
- Koundouri, Phoebe, Celine Nauges, and Vangelis Tzouvelekas. 2006. Technology Adoption under Production Uncertainty: Theory and Application to Irrigation Technology. *American Journal of Agricultural Economics* 88: 657–670.
- Krogstad, Jens M., Jeffrey S. Passel, and D’vera Cohn. 2019. 5 Facts about Illegal Immigration in the U.S. Pew Research Center Fact Tank, June 12, 2019, <https://www.pewresearch.org/fact-tank/2019/06/12/5-facts-about-illegal-immigration-in-the-u-s/> (accessed October 8, 2020).
- Lu, Liang, Thomas Reardon, and David Zilberman. 2016. Supply Chain Design and Adoption of Indivisible Technology. *American Journal of Agricultural Economics* 98: 1419–1431.
- Luckstead, Jeff, Rodolfo M. Nayga, Jr., and Heather A. Snell. 2020. Labor Issues in the Food Supply Chain amid the COVID-19 Pandemic. *Applied Economics Perspectives & Policy*.
- Malone, Trey, Aleks K. Schaefer, and Jayson Lusk. 2020. Unscrambling COVID-19 Food Supply Chains. SSRN. Available at SSRN: <https://ssrn.com/abstract=3672018> or <https://doi.org/10.2139/ssrn.3672018>.
- Martin, Philip. 2017. *The H-2A Farm Guestworker Program is Expanding Rapidly: Here are the Numbers You Need to Know*. *Economic Policy Institute Working Economics Blog*, April 13, 2017, <http://www.epi.org/blog/h-2a-farm-guestworker-program-expanding-rapidly/> (accessed September 16, 2017).
- Martin, Philip L., Michael Fix, and Edward J. Taylor. 2006. *The New Rural Poverty: Agriculture and Immigration in California*. Washington DC: The Urban Institute.
- Reiley, Laura. 2020. Migrant Farmworkers, Many Coronavirus Positive, Move North from Florida to Other States. *Washington Post*, June 11, 2020, <https://www>.

- washingtonpost.com/business/2020/06/11/migrant-farmworkers-many-who-have-tested-positive-covid-19-move-north-florida-other-farm-states/ (accessed October 8, 2020).
- Richards, Timothy J. 2018. Immigration Reform and Farm Labor Markets. *American Journal of Agricultural Economics* 100: 1050–1071.
- Richards, Timothy, and Paul M. Patterson. 1998. Hysteresis and the Shortage of Agricultural Labor. *American Journal of Agricultural Economics* 80: 638–695.
- Ridley, W., and S. Devadoss. 2020. The Impacts of COVID-19 on Fruit and Vegetable Production. *Applied Economics Perspectives & Policy*.
- Sunding, David, and David Zilberman. 2001. The Agricultural Innovation Process: Research and Technology Adoption in a Changing Agricultural Sector. In *Handbook of Agricultural Economics, Vol. 1A*, ed. Bruce L. Gardener and Gordon C. Rausser, 207–261. Amsterdam: Elsevier Academic Press.
- Taylor, Edward J., and Diane Charlton. 2018. *The Farm Labor Problem: A Global Perspective*. Amsterdam: Elsevier Academic Press.
- U.S. Bureau of Labor Statistics. 2020. News Release. Working Paper No. USDL-20-0815, United States Department of Labor.
- U.S. Citizenship and Immigration Services. 2019. “H-2A Temporary Agricultural Workers.” <https://www.uscis.gov/working-united-states/temporary-workers/h-2a-temporary-agricultural-workers> (Last Checked November 18, 2019).
- United States Department of Labor, Employment and Training Administration. 2017. National Agricultural Workers Survey, Public Data, 1989–2012. <http://www.doleta.gov/agworker/naws.cfm> (accessed September 1, 2017).
- Villa, Lissandra. 2020. “We’re Ignored Completely.” Amid the Pandemic, Undocumented Immigrants are Essential But Exposed. *TIME Magazine*, April 17, 2020, <https://time.com/5823491/undocumented-immigrants-essential-coronavirus/> (accessed October 8, 2020).
- Wozniacka, Gosia. 2020. As Hundreds of Farmworkers Test Positive for COVID-19, Many Remain Unprotected. *Civil Eats*, May 13, 2020, <https://civileats.com/2020/05/13/as-hundreds-of-farmworkers-test-positive-for-covid-19-many-remain-unprotected/> (accessed June 16, 2020).
- Zahniser, Steven, Edward J. Taylor, Thomas Hertz, and Diane Charlton. 2018. Farm Labor Markets in the United States and Mexico Pose Challenges for U.S. Agriculture. Washington DC: U.S. Department of Agriculture, Economic Bulletin EIB-201.