# Housing Booms and H-2A Agricultural Guest Worker Employment*

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**Abstract**

This paper examines the effects of changes in housing demand on H-2A employment within commuting zones from 2001-2017. Agricultural employers who demonstrate that no workers in the domestic labor market are willing or able to perform a seasonal or temporary farm job can apply for certification to hire guest workers through the H-2A visa program. H-2A employment grew more than 450% between 2001 and 2019 from 45,000 to 258,000. This is one of the first papers to econometrically examine causal factors that contributed to the growth of H-2A employment. We find that a 1% increase in housing demand leads to a 0.40-0.97% increase in H-2A employment. We also show suggestive evidence that changes in housing demand affect H-2A employment through shifts in the demand for workers in non-farm industries that pull workers from the agricultural sector. Consistent with previous literature, we show that positive housing demand shocks lead to increased employment in construction and other nontradable sectors that traditionally hire immigrant workers. We also find positive effects of housing demand on local farm wages, consistent with an inward shift in the local farm labor supply during housing booms.

**Keywords:** farm labor, H-2A guest workers, housing demand, immigration.
**JEL Codes:** J43, J23, J61,Q18,R21,R31

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Following a decade and a half of negligible growth, H-2A agricultural guest worker applications increased by more than 450% between 2001 and 2019. By 2019, H-2A workers constituted an estimated 10% of the U.S. full-time equivalent farm workforce (Costa and Martin 2020). The *Washington Post* even claimed during the COVID-19 pandemic that H-2As "carry the responsibility to feed America," accentuating the U.S. agricultural industry's dependence on foreign guest workers (Velarde 2020). Agricultural economists have often attributed the recent rise in H-2A demand to a falling farm labor supply at the national level (Zahniser et al. 2018; Luckstead and Devadoss 2019). However, to our knowledge, there are few econometric studies examining the root causes of the recent rise in H-2A employment. In this paper, we estimate the effects of changes in housing demand, which positively affect employment in construction, services, and other non-farm industries, on H-2A employment within local commuting zones. In an era of tightening farm labor supply, hiring foreign guest workers through the H-2A program could be a critical strategy to help farm employers mitigate losses stemming from increases in labor competition from other local non-farm industries.

Rural Mexicans, the primary source of labor to U.S. farms, are transitioning out of farm work at an estimated rate of about 1 percent per year (Charlton and Taylor 2016), and the Mexico-US migration rate is simultaneously declining (Hanson, Liu, and McIntosh 2017; Passel and Cohn 2019). Throughout the United States, real farm wages are rising, as is the incidence of local farm labor shortages (Richards 2018; Hertz and Zahniser 2013). Given the sensitive timing of agricultural production, farm labor shortages can be catastrophic. If workers are unavailable during a critical stage of production, farmers can lose their entire crop. An article on the front page of the *New York Times* in 2006 showed a photo of a farmer watching several tons of ripe pears rot on the ground because there were insufficient workers to come pick before the pears fell (Preston 2006). In April 2021, Shay Myers, a farmer on the Oregon-Idaho border gave away 350,000 pounds of asparagus, worth an estimated $180,000, to anyone who was willing to come pick. Myers said that he could not hire enough workers, and he preferred to give the crop away than to destroy it (Laudato 2021).

We hypothesize that H-2A demand grew more rapidly in locations where increased demand for housing drew workers away from agriculture and into the nonfarm sector, thus leading farm employers to seek out foreign guest workers as an alternative labor source. Positive housing demand shocks have been shown to increase labor demand in the industries that employ most Mexican immigrants in the United States. For example, Charles, Hurst, and Notowidigdo (2018, 2019) find that increases in housing demand during the boom of the 2000s significantly increased employment in many low and semiskilled industries, particularly in construction. Notably, they find that these employment effects were stronger for immigrants, who make up the majority share of U.S. farm workers, than for native workers. Related literature finds that by relaxing liquidity constraints and increasing housing wealth, higher housing prices boost expenditures in the local economy and thus increase employment in nontradeable sectors such as retail, landscaping, personal services, and hospitality (Mian, Rao, and Sufi 2013; Mian and Sufi 2014; Guren et al. 2020).

To estimate the effects of changes in housing demand on H-2A, we compare changes in H-2A employment across commuting zones during the housing boom from 2001-2006, the bust from 2006-2011, and the recovery from 2011-2017.[1] We measure H-2A employment using publicly available data on H-2A certified positions from the Department of Labor and novel data obtained from the U.S. Citizenship and Immigration Services through a Freedom of Information Act (FOIA) request. Our proxy for local housing shocks is a function of local housing prices and new building permits as in Charles, Hurst, and Notowidigdo (2018, 2019).[2] To address endogeneity concerns, we instrument for our housing demand proxy using two instruments developed in the housing literature and show that our results are robust to the inclusion of controls for location-specific changes in immigration and agricultural production, among others.

Our first instrumental variable comes from Charles, Hurst, and Notowidigdo (2018, 2019), who use exogenous shocks to housing demand that stem from speculative investment in housing-related assets (e.g., Shiller 2009; Mayer 2011; Glaeser and Nathanson 2015) to estimate how the housing boom and bust of the 2000s affected U.S. college enrollment and labor market outcomes.[3] Following their strategy, we proxy for speculative activity in the housing market using the magnitude of "structural breaks" in each commuting zone's price trend during 2001-2006, 2006-2011, and 2011-2017. The main identifying assumption is that changes in factors that affect the housing market, which might be endogenous to H-2A employment, and for which we cannot control directly, are incorporated smoothly into price trends. Thus, structural breaks in the price trends are likely driven exclusively by speculation, which affects H-2A only through its effect on housing demand.

Our second instrumental variable was developed by Guren et al. (2020) and leverages geographic variation in local housing supply elasticities within a common region interacted with changes in regional prices. All else equal, if two commuting zones within a single region experience a similar change in housing demand, housing prices will change by a greater magnitude in the commuting zone with more inelastic housing supply. The main identification assumption is that, conditional on a set of controls, there are no unobserved regional confounding variables that (1) are correlated with regional prices and (2) tend to have a stronger effect on H-2A demand in the same commuting zones whose local housing supply elasticities make their house prices most sensitive to regional price changes.

We find that a 1% increase in a commuting zone's housing demand from 2001-2017 led to a 0.40-0.97% increase in H-2A employment. A one standard deviation increase in housing demand across commuting zones during 2011-2017 caused a 50-172% increase in H-2A employment. Our results are robust to the inclusion of controls for location-specific immigration and agricultural employment shocks, and two-digit NAICS industry employment trends. We also find suggestive evidence that local housing demand affects H-2A uptake by shifting inward the local farmworker supply. We replicate Charles, Hurst, and Notowidigdo (2018, 2019)'s findings in our sample of commuting zones to show that positive housing demand shocks increase employment in construction and other low-skilled sectors within commuting zones from 2001-2017. We further show that increases in housing demand led to higher farm wages, suggestive that farm workers migrate from the farm to nonfarm sectors during housing booms.

This paper contributes to the descriptive literature documenting recent unprecedented growth in H-2A, likely resulting, at least in part, from diminishing farm labor supply at the national level (Castillo et al. 2021; Martin 2017; Devadoss and Luckstead 2018; Charlton et al. 2019; Luckstead and Devadoss 2019). To our knowledge, the only econometric papers examining the causal drivers of the recent growth in H-2A are Simnitt et al. (2018), Orrenius and Zavodny (2020), and Charlton and Castillo (2021). Simnitt et al. (2018) find evidence that similar to the dispersion and adoption of other agricultural technologies, knowledge spillovers between farmers play an important role in increasing adoption of the H-2A program. Orrenius and Zavodny (2020) and Charlton and Castillo (2021) show that state-level unemployment rates and H-2A employment were inversely related in the 2000s. In this paper, we investigate more rigorously the effects of local labor market conditions on H-2A employment.

More broadly, our research contributes to the literature that examines factors affecting the U.S. farm labor supply. For example, Fan et al. (2015) show that the share of farm workers who migrate to farms within the United States fell by about 60% between the late 1990s and 2009. Reduced labor migration within the United States likely causes the U.S. farm labor supply to be more inelastic, potentially contributing to an increased incidence of farm labor shortages. Structural changes in the farm labor supply in Mexico are also at least partly responsible for the tightening labor supply. Using household survey data nationally representative of rural Mexico, Charlton and Taylor (2016) show that rural Mexicans are transitioning out of farm work just as U.S. workers did in the mid-20$^{\text{th}}$ century. As a result of these phenomena, farm wages are expected to rise and labor shortages could become more frequent (Charlton et al. 2019).

Consistent with this notion, Richards (2018) finds evidence of persistent farm labor shortages in certain sub-sectors of the California farm labor market from 1989-2014, and Hertz and Zahniser (2013) show evidence suggestive of local labor shortages during 2010-2011 in support activities including farm labor contractors. Several studies show that producers adjust to declines in the supply of farm labor by adopting labor-saving technologies and changing their crop-mix. Charlton and Kostandini (2020), Ifft and Jodlowski (2016), and Kostandini, Mykerezi, and Escalante (2014) show that implementation of county- or statewide immigration enforcement policies from 2005-2012 led to reduced production of labor-intensive crops and increased capital-labor substitution on farms.

The H-2A program provides another alternative for producers to adjust to a tightening farm labor supply by providing means for employers to legally recruit guest workers from abroad. Unlike other types of farm workers, who readily migrate out of agriculture as economic conditions improve in non-farm sectors (Barkley 1990; Perloff 1991; Duffield and Coltrane 1992; Buccola, Li, and Reimer 2012) but generally hesitate to return to farm work even as relative farm wages rise (Richards and Patterson 1998), H-2A workers cannot switch sectors since they are eligible only to work in agriculture. Employment of H-2A workers might thus mitigate the risk of local farm labor shortages, particularly as employment expands in other low-skilled labor sectors.

The paper proceeds as follows. Section 2 describes some of the history of the H-2A program and discusses the relevant literature on the job mobility of agricultural workers. Section 3 presents a simple theoretical model that illustrates how changes in housing demand might affect H-2A employment, Section 4 describes the data and variable construction, Section 5 describes the econometric model, Section 6 presents the main results, Section 7 shows robustness checks and relevant extensions to the main econometric model, and Section 8 concludes.

# Background

The H-2A program was implemented in 1986 to provide an alternative source of labor to agricultural producers after the Immigration Reform and Control Act (IRCA) made it illegal to knowingly hire unauthorized workers. Nevertheless, by some estimates, unauthorized workers have constituted at least half of the crop workforce in the United States since the mid-1990s (Martin 2012). Thus, despite access to a guest worker program, agricultural production in the United States has remained highly dependent on unauthorized workers.

Many years before the creation of the H-2A program, U.S. farmers hired Mexican guest workers through a series of bilateral agreements with Mexico referred to as the Bracero Program. The Bracero Program was terminated in 1964, but one of the program's primary legacies was an expansive migration network between Mexico and the United States (Taylor and Charlton 2018). As early as the 1970s, the ease of Mexico-U.S. immigration facilitated by the Bracero network and weak immigration enforcement, combined with strong U.S. economic performance and high fertility rates in Mexico, led to large-scale Mexican immigration (Munshi 2003; Orrenius and Zavodny 2005; Hanson and McIntosh 2010). Most of the immigrants arrived undocumented and many found jobs on U.S. farms (Taylor and Charlton 2018).

The H-2A program was formed in 1986 as part of a compromise, known as the Schumer compromise, between Western crop farmers, who had come to rely on an undocumented workforce, and lawmakers, who were attempting to reform immigration policy through IRCA. IRCA had three primary components: 1) It made it illegal to knowingly employ unauthorized workers, 2) It provided a path to legalization for unauthorized aliens who had lived in the United States continuously since January 1, 1982, and 3) It increased funding for Border Patrol. The Schumer compromise added two major features to IRCA. The first part was the Special Agricultural Worker (SAW) program, which legalized unauthorized immigrants who had worked in agriculture for at least 90 days between May 1984 and May 1985 (Taylor and

Charlton 2018). The second part created two guest worker programs reserved exclusively for agriculture: The Replenishment Agricultural Worker (RAW) program and the H-2A agricultural guest worker program.[4]

Despite increased border enforcement and penalties for hiring unauthorized workers, Mexican workers continued to come to the United States in large numbers during the 1990s, and within the decade, the Mexican population increased by an estimated five million (Orrenius and Zavodny 2003; Card and Lewis 2007). Partly in response to improving job prospects in the U.S. nonfarm sector, many workers legalized through the SAW program transitioned to other industries (Martin 2002).[5] Moreover, Mexican immigrants began to settle in places outside of historical enclaves in California and Texas, and new arrivals started to take jobs in construction and retail in increasing numbers rather than in agriculture (Kandel and Cromartie 2004; Card and Lewis 2007). Although new migrants increasingly chose nonfarm work as their first job, many found work on farms, which led to a substantial increase in the share of unauthorized Mexican workers in U.S. agriculture. During this period, the incidence of farm labor shortages was relatively low, the RAW program was allowed to expire, and few workers were hired through the H-2A program.

Historically, agricultural employers have cited the high costs associated with H-2A employment as the primary barrier to using the program. Hiring H-2As is generally costlier than hiring locally because employers must provide housing for H-2As, pay for transportation from the worker's home country and return, and pay H-2As at least the Adverse Effect Wage Rate (AEWR), which is typically greater than the minimum wage and many contend is often also greater than the prevailing farm wage.[6] Complying with the administrative regulations in the application process can also be costly. To qualify for H-2A certification, employers must show that the proposed job is temporary or seasonal, insufficient U.S. workers are willing, able, and available to do the work, and the employment of H-2A workers will not adversely affect the wages and working conditions of similarly employed workers.

Despite the complexity of obtaining H-2A certification, H-2A use increased substantially in the 21st century. This increase has often been attributed to a tightening of the farm labor supply. Rural Mexicans are becoming better educated and increasingly find work in Mexico's growing nonfarm sector, and U.S. immigration enforcement is increasing its intensity (Zahniser et al. 2018; Devadoss, Zhao, and Luckstead 2020).[7] A salient feature of the U.S. agricultural labor market is that workers change jobs relatively often (Tran and Perloff 2002; Kandilov and Kandilov 2010). Thus, improving job opportunities in nonfarm sectors are likely to contribute to the decline in farmworker supply but there is, as of yet, little research investigating the potential connection between nonfarm employment and H-2A growth.

While high turnover is partly a result of workers temporarily moving out of agriculture in the off-season, many workers move out of farm work and never return. Farm jobs are physically demanding and often dangerous, and there is little opportunity for upward mobility, especially for undocumented immigrants (Perloff 1991; Taylor 1992).[8] Many new immigrants view agriculture as a springboard to more desirable jobs (Martin 2002; Martin and Taylor 2013). Although undocumented immigrants, who often have limited English proficiency, face barriers to job mobility, they switch sectors relatively frequently (Kossoudji and Cobb-Clark 1996). Kossoudji and Cobb-Clark (2000) document that unauthorized Mexican men were highly mobile both before and after receiving amnesty under IRCA, and the likelihood of working in agriculture decreased with time spent in the United States.[9]

Differences in wages between agriculture and nonfarm industries are an important determinant in how quickly workers, whether documented or not, move out of agriculture (Barkley 1990; Perloff 1991; Duffield and Coltrane 1992; Buccola, Li, and Reimer 2012). Of particular interest is the construction industry because wages in construction tend to be higher and undocumented immigrants can more easily move up the occupational ladder in construction than in many other industries (Hagan, Lowe, and Quingla 2011; Barham, Melo, and Hertz 2020).[10] Once workers leave agriculture, many do not return, even when they become unemployed or farm wages rise (Richards and Patterson 1998; Martin, Fix, and Taylor 2006). This reluctance to move back into farm work partly explains why minor labor market frictions can cause labor shortages in agriculture and why shortages can persist even when unemployment rates are relatively high (Richards and Patterson 1998). Farm labor shortages tend to be local, as opposed to regional or national, likely because farm labor markets are highly specialized and farmworkers are increasingly unwilling to travel long distances to harvest crops (Fisher and Knutson 2013; Fan et al. 2015).

Given these features of U.S. farm labor markets, we would expect housing booms, which have been shown to increase labor demand in the sectors that employ most Mexican immigrants, to pull workers from agriculture and increase both the incidence of farmworker shortages and H-2A demand. Positive shocks to housing demand increase new housing production, thus increase employment in construction and related sectors such as finance, insurance, and real estate (Charles, Hurst, and Notowidigdo 2018, 2019). These positive shocks also increase local housing prices, leading to higher household wealth and liquidity, which boost local consumer expenditures (Mian, Rao, and Sufi 2013; Mian and Sufi 2014; Guren et al. 2020). Increased local spending leads to a rise in labor demand in non-tradable sectors, including service and retail industries, landscaping, and housekeeping. Employment demand in tradable sectors, such as agriculture, is unaffected by increased local consumption since prices of these goods are determined in national and global markets (Mian and Sufi 2014).

# Theoretical Model

To motivate our empirical approach, we use a Roy-type general equilibrium model of sectoral choice, closely related to models developed by Charles, Hurst, and Notowidigdo (2019) and Autor, Levy, and Murnane (2003). We show that positive shocks to labor demand in the construction sector cause domestic workers to move from the farm to the construction sector, farm wages to rise, and, if the costs of hiring H-2A are sufficiently low, H-2A employment to increase.

For simplicity, we consider only two sectors of employment, the farm sector (subscript $F$) and the construction sector (subscript $C$). There are two types of workers: domestic workers, who can migrate to either sector of employment, and H-2A workers, who can work only in the farm sector. A large number of domestic workers inelastically supply labor to either sector. Domestic workers can move between sectors and have heterogeneous productivity endowments in each sector. Formally, a worker is endowed with skills in each sector giving him or her a vector of labor efficiency $E_i = [e_{iF}, e_{iC}]$. Individual $i$ supplies $e_{is} \in (0,1]$ efficiency units to sector $s$ when employed in that sector, and workers are paid wage $w_s$ per efficiency unit for working in sector $s$.

Domestic workers choose which sector to work in so as to maximize their income. Individual $i$ chooses to work in construction if his or her income in the construction sector ($w_C e_{iC}$) is greater than the income he or she would obtain from working in the farm sector ($w_F e_{iF}$). Let $\eta_i = \frac{e_{iF}}{e_{iC}}$ be worker $i$'s relative efficiency in farm versus construction work. Worker $i$ works in the construction sector if the relative wage in construction is greater than her relative efficiency at performing farm versus construction work (i.e., if $\frac{w_C}{w_F} > \frac{e_{iF}}{e_{iC}}$). In equilibrium, the marginal worker has $\eta_i^*$ relative efficiency units and is indifferent between working in either sector. In this setting, construction labor supply can be expressed by a function $g\left(\frac{w_C}{w_F}\right) = \sum_i e_{iC} I[\eta_i < \frac{w_C}{w_F}]$ and domestic farm labor supply by a function $h\left(\frac{w_C}{w_F}\right) = \sum_i e_{iF} I[\eta_i \geq \frac{w_C}{w_F}]$, where $I$ is the indicator function. Assume that both $g$ and $h$ are continuous and differentiable for $\frac{w_C}{w_F} > 0$. Note that $g$ is increasing in $\frac{w_C}{w_F}$ and $h$ is decreasing in $\frac{w_C}{w_F}$. Thus the domestic relative supply function of construction labor to farm labor is $m\left(\frac{w_C}{w_F}\right) = \frac{g\left(\frac{w_C}{w_F}\right)}{h\left(\frac{w_C}{w_F}\right)}$ and is increasing in $\frac{w_C}{w_F}$.

Unlike domestic workers, H-2A workers can only work in the farm sector, and for simplicity, we assume that they have homogenous skills.[11] H-2A workers are paid the market farm wage. We assume that the supply of H-2As is perfectly elastic at this wage since U.S. farm wages are much higher than farm wages in Mexico and other migrant-sending countries, and there are limited opportunities to obtain legal work visas in the United States. Thus, there are more workers in migrant-sending countries who would be willing to work on an H-2A visa than there are available H-2A positions. There are additional costs to hiring H-2As, including housing, transport, and costs of filing for an H-2A position, and there are also recruitment costs, which we assume are increasing in the number of H-2A hired.[12] Specifically, H-2A total cost is given by $(w_F + b_1)H + b_2H^2$. Convexity of recruitment costs ensures that producers never fully replace domestic farm workers with H-2A workers even though H-2A and domestic farm workers are paid the same wage.

Aggregate output $Y$ is sold at a price of one ($p_Y = 1$), and is produced using a Constant Elasticity of Substitution (CES) production function given by:

$$Y = \left((L + \gamma H)^{\frac{\sigma-1}{\sigma}} + (A_C C)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where $L$ is domestic farm labor input, $H$ is H-2A labor input, and $C$ is labor input in the construction sector, all measured in efficiency units. While $L$ and $H$ are perfect substitutes in production, we assume that H-2A efficiency units of labor translate to higher output ($\gamma > 1$), on account of the fact that H-2A workers cannot switch sectors and are certain to have legal work status, thus having no risk of deportation or other immigration-related concerns. $A_C$ is a construction-augmenting technology term. We assume that the elasticity of substitution between farm and housing production is $\sigma > 1$, such that farm and housing inputs are gross substitutes in production. As such, an increase in $A_C$ will increase housing demand by more than it increases farm labor demand.

Labor inputs are paid their marginal value product so that[13]

$$w_C = \frac{\partial Y}{\partial C} = Y^{\frac{1}{\sigma}} A_C^{\frac{\sigma-1}{\sigma}} C^{-\frac{1}{\sigma}} \tag{2}$$

$$w_F + b_1 + 2b_2 H = \frac{\partial Y}{\partial H} = Y^{\frac{1}{\sigma}} (L + \gamma H)^{-\frac{1}{\sigma}} \gamma \tag{3}$$

$$w_F = \frac{\partial Y}{\partial L} = Y^{\frac{1}{\sigma}} (L + \gamma H)^{-\frac{1}{\sigma}} \tag{4}$$

Combining (3) and (4) and solving for $H$ yields

$$H = \frac{w_F(\gamma - 1) - (b_1)}{2b_2} \tag{5}$$

The equation above shows that H-2A demand depends solely on the farm wage and parameters determining the relative efficiency of H-2A workers and H-2A costs.

In equilibrium, wages are set such that labor supply equals labor demand in both sectors, and the output market clears. We examine the effects of a shock to the construction sector on H-2A employment and the sectoral allocation of employment and wages of domestic workers. From the FOCs, we can see that the relative labor demand for construction labor inputs is given by

$$\frac{C}{L + \gamma H} = \left(\frac{w_F}{w_C}\right)^{\sigma} A_C^{\sigma-1} \tag{6}$$

which is increasing in $A_C$ since construction and agriculture are gross substitutes ($\sigma > 1$). Because relative construction labor supply is upward sloping in relative construction wages, an increase in $A_C$ leads to a higher equilibrium relative construction wage. As a result, domestic workers reallocate from the farm to the construction sector. As workers move to the construction sector, domestic labor supply in agriculture falls, leading to higher wages in the farm sector. As farm wages rise, so does the demand for H-2A workers.[14]

In figure 1 we show the initial equilibrium and comparative statics assuming linear labor supply curves.[15] Panel A shows the construction labor market. An increase in $A_C$ leads to higher construction demand, and higher equilibrium wages and employment in the construction sector. Panel B shows the agricultural labor market. To show equilibrium H-2A employment in the figure, we express farm labor supply (in efficiency units) as the sum of domestic labor supply ($S_F$) and $\gamma H$, which is increasing in the farm wage since $H = \frac{w_F(\gamma-1)-(b_1)}{2b_2}$. As such, the demand curve represents overall farm labor demand. In equilibrium, farm wages clear the farm labor market. The shock to $A_C$ shifts domestic labor supply to the left, and thus $S_F + \gamma H$ also shifts. In the new equilibrium, wages and H-2A employment are both higher.

[Figure 1 about here.]

# Data and Measurement

Three federal agencies play a role in the H-2A application process: the U.S. Department of Labor (DOL), the U.S. Citizenship and Immigration Services (USCIS), and the U.S. Department of State (DOS). The employer first files for a temporary labor certification for H-2A workers from the DOL. Next, the employer files an I-129 petition to the USCIS explaining the worker's qualifications and details of the job in more detail. Once USCIS approves the I-129, if outside of the United States at the time of the application, the prospective worker applies for the visa with the DOS at a U.S. consulate (U.S. Citizenship and Immigration Services 2021).

We approximate H-2A employment counts by commuting zone (CZ) using two data sources. The first source is the DOL H-2A case disclosure files, which contain all H-2A applications for temporary labor certification by fiscal year (FY) starting in FY 2006. We complement the DOL data with the USCIS I-129 application records from FY 2001-2017. We obtained these records under a Freedom of Information Act (FOIA) request. To our knowledge, we are the first to analyze the USCIS data.

Both datasets include the employer name and address, the number of workers requested, and the number of workers certified, among other variables. We use the number of workers certified to create proxies for changes in CZ H-2A labor demand.[16] Since fiscal years begin in October of the previous calendar year and employers contract H-2A workers in advance, likely determining their H-2A needs based on the economic conditions during the previous year, we use the change in certified H-2A workers from FY 2002-2007, 2007-2012, and 2012-2018 to proxy for the change in H-2A demand corresponding to the housing boom from 2001-2006, the housing bust from 2006-2011, and the housing recovery from 2011-2017. The DOL specifies the worksite location beginning in FY 2008, which matches the employer location in most cases, except for when the employer is a farm labor contractor (FLC). Since few of the employers before 2010 are FLCs, there is little discrepancy between worksite and employer locations in the DOL data before FY 2010. To construct our proxy for the change in CZ H-2A employment from 2006-2011 and 2011-2017, we use the DOL location of the worksite when available and the employer location when the worksite location is not available.

For the housing boom period, we proxy for the change in CZ H-2A employment using the USCIS data. Because the employer address recorded by the USCIS is in many cases that of the firm that filed the I-129 application on behalf of the employer, we match employer names across datasets and transfer the location of employment from the DOL to the USCIS data. Unfortunately, unlike the DOL, if the employer is a growers association requesting workers on behalf of multiple farmers, the USCIS combines all employer applications into a single record. In these cases, we cannot reliably ascertain the worksite locations.[17] Thus, from 2001-2006, we drop CZs in states with a large presence of growers associations, including North Carolina, Montana, and Idaho, and we have a somewhat smaller sample size in these years. In the appendix, we provide a more detailed description of the datasets.

Figure 2 shows that national trends in H-2A and construction employment evolved similarly from 2001-2017. Construction employment data come from the Quarterly Census of Employment and Wages (QCEW), administered by the U.S. Bureau of Labor Statistics (BLS). Changes in H-2A and construction employment mirror one another during the housing boom of the early 2000s and during the economic recovery from 2011-2017. If construction pulls workers from the agricultural sector when housing construction is on the rise, employers might turn to the H-2A program for additional workers. H-2A demand drops somewhat during the housing crash from 2008-2010 while construction employment falls precipitously. The smaller relative decline in H-2A during the Great Recession might result from workers' reluctance to return to farm work (Richards and Patterson 1998). Thus, we expect the effect on H-2A of an increase in housing demand to differ from that of a decrease.

[Figure 2 about here.]

Similarities between aggregate trends in H-2A and construction employment are merely suggestive of a causal link between housing and H-2A demand. Many confounding macroeconomic factors could drive this relationship. To account for confounding variables at the national level, we estimate the effects of housing demand on H-2A by comparing changes in outcomes across CZs. To measure CZ changes in housing demand, we follow the work of Charles, Hurst, and Notowidigdo (2019). Using a simple log-linear housing supply and demand model, Charles, Hurst, and Notowidigdo (2019) note that housing demand shocks $\Delta H_{it}$ lead to changes in house prices and the quantity of housing supplied and can be expressed as

$$\Delta H_{it} = \eta_i^D \Delta P_{it} + \Delta Q_{it} \tag{7}$$

where $\eta_i^D$ is the price elasticity of housing demand, $\Delta P_{it}$ is the log change in local housing prices and $\Delta Q_{it}$ is the log change in new housing. We assume that $\eta_i^D \approx 1$, as indicated in the literature (see Charles, Hurst, and Notowidigdo (2019)). Thus, our proxy for housing demand shocks $\Delta \widehat{H}_{it}$ is simply the sum of the change in log prices and log of new housing produced. We obtain annual county-level housing prices from the Federal Housing Finance Agency. We create CZ-level housing prices by matching counties to CZs and weighting county-level prices by population in 2000.[18] To proxy for new housing, we use annual county-level data on new housing unit permits from the Census Building Permits Survey.

As robustness checks, we control for trends in industry employment, and as an extension to our main analysis, we examine the effects of housing demand on employment in low-skilled sectors and farm wages. We obtain data on employment and weekly wages by industry from the QCEW. Employment data are available for two to six-digit NAICS industries and at the county level. For confidentiality reasons, the publicly available QCEW data are suppressed for county-industry pairs with few employers. We access confidential QCEW data that are nearly entirely unsuppressed from 1996-2017 regardless of the number of employers located in a county. We describe these data in more detail in the appendix.

## Econometric Model

To begin our analysis, we estimate the following equation:

$$\Delta y_{it} = \beta \Delta \widehat{H_{it}} + \gamma_t + \varepsilon_{it} \tag{8}$$

where $\Delta y_{it}$ is the change in the inverse hyperbolic sine ($asinh$) of H-2A employment in commuting zone (CZ) $i$ for the following three subperiods: 2001-2006, 2006-2011, and 2011-2017.[19][20] Our main explanatory variable is the proxy for the change in housing demand $\Delta \widehat{H_{it}}$. Period fixed effects $\gamma_t$ account for nation-wide shocks. The error term is given by $\varepsilon_{it}$. We cluster standard errors at the CZ level. We restrict the analysis to CZs with at least 50 workers employed in both agriculture and construction in our preferred specifications, though our results are not sensitive to this restriction. We first estimate $\beta$ using ordinary least squares (OLS). We repeat our analysis using 2-stage least squares (2SLS) with instruments described in the following subsection.

### *Instrumental Variables*

One might be concerned that changes in housing demand are correlated with other determinants of farm employment and H-2A demand, thus preventing a causal interpretation of the OLS estimate of $\beta$. Moreover, classical measurement error in the proxy for housing demand shocks would lead the OLS estimate to be biased downwards. We attempt to address these issues by using two instrumental variables from the real estate economics literature.

#### *Structural break instrument*

Following the work of Charles, Hurst, and Notowidigdo (2018, 2019), our first instrument for housing demand is constructed by detecting sharp changes in a CZ's housing price trend in each relevant period.[21] Charles, Hurst, and Notowidigdo (2018, 2019) study how the housing boom and bust of the 2000s affected college enrollment and labor market outcomes in the United States.[22] Since traditional fundamental drivers of housing demand, such as productivity, income, or population, could independently affect labor market outcomes and college enrollment, they used structural breaks in housing price trends attributed to speculative activity to instrument for changes in housing demand. There is strong evidence that changes in housing prices and production during the housing boom and bust of the 2000s stemmed almost exclusively from speculative activity and other exogenous housing-specific shocks, and not from changes in market fundamentals (e.g., Shiller 2009; Mayer 2011; Glaeser and Nathanson 2015). Speculative activity in the housing market should have no direct bearing on agricultural labor demand and supply, except through the channel of changes in housing demand and consequent restructuring of the labor market.

Charles, Hurst, and Notowidigdo (2018, 2019) estimate the timing and size of "structural breaks" in housing prices using standard techniques from the time series econometrics literature (Bai 1997; Bai and Perron 1998) and use the magnitude of these breaks as instrumental variables. Their main identification assumption is that fundamentals do not change abruptly but rather incorporate smoothly into prices (i.e., they do not lead to kinks in a city's housing price trend), and breaks from housing price trends reflect exogenous speculative activity or other housing shocks presumed orthogonal to any potentially confounding factors related to fundamentals. As evidence of the validity of their identification strategy, they show that the magnitude of these structural breaks in housing prices is not correlated with lags or pre-trends in housing prices, along with many other validity tests. Similarly, in table 8 of the appendix, we show that the structural break instrument is not correlated with pre-trends in agricultural wages, employment, acreage, or farm rental rates.

For each CZ from 2001-2006 and 2011-2017, we estimate a single structural break using the regression:

$$\ln\left(P_{it}\right) = \alpha_i + \tau_i t + \lambda_i\left(t - t_i^*\right)\pi_{it} + \varepsilon_{it} \tag{9}$$

where $t_i^*$ is the time at which the break occurs, $\tau_i$ is a CZ-specific linear time trend, $\pi_{it} = 1$ if $t > t_i^*$ and zero otherwise, and $\lambda_i$ is the magnitude of the break. We estimate (9) for each $t$ in a period and select $t_i^*$ and $\lambda_i$ based on the specification that returns the largest R-squared. We use our estimates of $\lambda_i$ to instrument for the change in housing demand. For simplicity, we use the opposite sign of the $\lambda_i$ that we estimate from 2001-2006 ($-\lambda_i$) to instrument for price changes from 2006-2011 since the magnitude of the price break during the housing boom is highly predictive of the magnitude of the bust (Charles, Hurst, and Notowidigdo 2018).[23]

### *Sensitivity instrument*

Following the work of Guren et al. (2020), our second instrument for changes in local housing demand is an estimate of the price elasticity of local housing supply interacted with regional changes in housing prices. Guren et al. (2020) study how the housing wealth effect, or the effect of house prices on economic activity, has changed over time. Similar to Charles, Hurst, and Notowidigdo (2018), the identification problem in Guren et al. (2020) is that housing prices and economic activity (as proxied by retail employment in their study) are caused by endogenous factors such as shocks to sectoral labor demand or population growth. To address this issue, they instrument for housing demand by leveraging differences in housing supply elasticities across locations within a region. The intuition is that given that two cities within a region experience a similar increase in housing demand, all else equal, the city with the more inelastic housing supply will experience larger price changes. For example, because housing supply is more inelastic in Providence than in Rochester, when housing prices appreciate in the Northeast, prices in Providence tend to grow more rapidly than in Rochester (Guren et al. 2020).

To generate proxies for local housing supply elasticities Guren et al. (2020) estimate the following specification:

$$\Delta \ln (P_{irt}) = \psi_i \Delta \ln (P_{rt}) + \mathbf{X}_{irt}^{'} \Omega + \varepsilon_{it} \tag{10}$$

where $\Delta \ln (P_{irt})$ is the annual log change in price in city $i$ in Census region $r$, $\Delta \ln (P_{rt})$ in the regional house price (excluding city $i$'s price from the computation). $\mathbf{X}_{irt}$ is a vector of controls that are meant to capture other determinants of local prices that may be correlated with $\psi_i \Delta \ln (P_{rt})$ such as the industrial composition of a city. The inverse of the city-specific housing supply elasticity is $\psi_i$. Their instrument, which they refer to as a "sensitivity instrument," is given by $\widehat{\psi}_i \Delta \ln (P_{irt})$, where $\widehat{\psi}_i$ is the OLS estimate of $\psi_i$. We map the Guren et al. (2020) elasticities to the CZ level. Because the sensitivity instrument is only available for MSAs, we use a smaller set of CZs when we use this instrument than when we use the structural break instrument.[24]

The main identification assumption in this IV approach is that, after we account for the vector of controls $\mathbf{X}_{irt}$, there are no other regional confounders that affect variation in local consumption and employment across cities within a region in a similar way as regional prices affect local prices as governed by the supply elasticity $\hat{\psi}_i$. In other words, there are no unobserved confounders that take the form $\mu_i \omega_{rt}$, where the regional component $\omega_{rt}$ is correlated with $\Delta \ln (P_{rt})$ and the city-specific component $\mu_i$ is correlated with $\hat{\psi}_i$. Our controls include aggregate factors such as national shocks to product demand and immigration from Mexico that could potentially lead to confounding local variation in housing prices. We also include a similar set of control variables to those in Guren et al. (2020). Lastly, we show that our second instrument is uncorrelated with pre-trends in farm wages and employment.

# Main Results

In table 1, we present our baseline OLS and two-stage least squares (2SLS) results. In column (1), we report estimates of $\beta$ from estimating equation (8) using OLS. We find a positive relationship between changes in housing demand and H-2A employment, and the point estimates are strongly statistically significant (t-stat = 4.2). This estimate implies that a 1% increase in CZ housing demand caused a 0.42% increase in H-2A employment. In columns (2) and (3) we estimate the effects of housing demand on H-2A employment using 2SLS. We instrument for housing demand using structural breaks in housing prices in column (2) and the housing supply elasticity in column (3). We report the first stage results in panel II of table 1. Both instruments are highly predictive of changes in housing demand and produce large F-statistics. We find that the estimated magnitude of the coefficient on housing demand is larger when we use 2SLS. The 2SLS results indicate that a 1% increase in CZ housing demand caused a 0.72-0.84% increase in H-2A employment. Given that from 2001-2017 a one standard deviation change in housing demand across CZs was 1.03, our results imply that a one standard deviation increase in housing demand led to a 110-139% increase in H-2A employment. Thus, H-2A demand appears highly sensitive to changes in local housing demand.

[Table 1 about here.]

Table 2 shows that our results are not driven by any particular time period and that housing shocks have larger marginal effects on H-2A demand when housing demand is increasing than when it is decreasing. The OLS results in column (1) show positive marginal effects in all three sub-periods. The marginal effects are somewhat smaller during the housing bust from 2006-2011 (panel II) but are highly statistically significant in all three periods. The 2SLS results in columns (2) and (3) show larger effects of housing demand booms from 2001-2006 on H-2A (panel I) than in either of the periods that follow. These results indicate that a 1% increase in housing demand within a CZ led to a 1.4-2.1% increase in H-2A employment from 2001-2006 and an estimated 0.56-0.84% increase in H-2A from 2011-2017. The effect of a 1% change in housing demand on H-2A during the housing bust from 2006-2011 in the 2SLS models is only 0.22-0.30%, and these effects are not statistically significant. The smaller effect we find during the housing bust is perhaps unsurprising since previous literature finds that workers are hesitant to move back to agriculture from the nonfarm sector even when relative wages in the farm sector rise (Richards and Patterson 1998).

[Table 2 about here.]

# Robustness and Extensions

In this section, we first repeat our main analysis including controls for changes in agricultural product demand and immigration, among others, to address concerns that our instrumental variables may yet be correlated with confounding variables that directly affect H-2A employment. We then explore potential causal mechanisms by which housing demand affects H-2A.

## *Farm Employment, Immigration, and Other Controls*

Our first set of controls include proxies for changes in agricultural employment within CZs. Since agricultural goods are sold in national and international markets, local market dynamics should have no bearing on agricultural prices. However, one might be concerned that national or international shocks to the demand for specific agricultural goods may increase agricultural wealth in the geographic locations where they are produced and simultaneously increase the demand for farm workers and housing demand. For example, a positive shock to the national demand for strawberries could increase farm income and labor demand in regions that specialize in strawberry production, thus leading to a local increase in housing demand.

To account for this possibility, we construct two controls for local changes in agricultural employment. First, we control for a variable similar to that developed by Bartik (1991). Our Bartik control for agriculture is intended to capture local shocks that stem from changes to national agricultural product demand. The Bartik control interacts the CZ share of national agricultural employment in a base year with the contemporary national growth rate in agricultural employment.[25] It thus predicts the change in CZ farm labor demand for a given agricultural industry as though the industry grew at the same rate as its national counterpart. Second, we also control for two-digit NAICS employment shares, including the share in agriculture, interacted with time fixed effects as in Mian and Sufi (2014) and Guren et al. (2020). These variables control for industry-specific shocks that may affect local housing demand and labor availability within a commuting zone (CZ).[26]

Our second set of controls address concerns regarding potentially correlated shocks to the local supply of immigrants from Mexico driven by changes in national migration trends (e.g., declining fertility rates in Mexico), which may affect housing demand and employment in low-skilled sectors, including agriculture (Saiz 2007; Cortes 2008). A negative immigration shock would presumably lead to lower local housing demand and agricultural supply but higher H-2A demand. Thus, these negative shocks could bias our estimated coefficient towards zero.

We use two variables commonly used in the immigration literature to account for changes in the local supply of immigrant workers that stem from changes in supply-push factors abroad (Card 2001; Peri 2012). First, we control for the Mexican-born share of the population interacted with time fixed effects, as in Card and Lewis (2007) and Cadena and Kovak (2016). We use the 2000 Census to construct the Mexican-born population shares in the first two subperiods and use the pooled 2005-2010 American Community Survey (ACS) to construct the shares in the last subperiod. Second, we control for the CZ's distance to the Mexican Border interacted with time fixed effects since the distance to Mexico is likely inversely related to the size of U.S.-Mexico migration flows. The CZ distance to the Mexican border variable comes from Smith (2012).

Our third set of controls addresses geographic variation in the ease of accessibility to H-2A workers that could potentially correlate with the magnitude of changes in housing demand. Much political attention has focused on efforts to reform the H-2A program in order to make it easier and less costly to employers, and some suggest that streamlining the H-2A application process would raise demand (Martin 2017). In recent years, many third-party intermediaries have emerged throughout the United States to help file for H-2A positions on behalf of the employer. They also frequently help farm employers navigate the many steps involved in obtaining H-2A visas and provide additional services to aid employers in hiring H-2As, such as helping employers understand how to comply with the relevant regulations, recruiting workers and matching them to employers, or referring employers to reputable recruiters in other countries. These intermediaries include growers associations, H-2A agents and consulting firms, and law firms. Presumably, the creation of these third-party institutions has reduced the costs of participating in the program and thus played a role in the recent growth in H-2A take-up.

The presence of third-party intermediaries only poses a threat to our identification strategy if they cause housing booms (or busts) or if they are correlated with factors that cause changes in housing demand, both of which are highly improbable. However, given the likely importance of these intermediaries in H-2A growth during the 21$^{st}$ century, we test the robustness of our results to controlling for a CZ's exposure to third-party intermediaries in a base year. We control for a dummy for the 2011-2017 period interacted with the share H-2A certifications in a CZ that were filed using a third-party intermediary during 2008-2010.[27][28]

Lastly, we control for the change in the share of the CZ population that is rural and a dummy variable for whether the CZ is located in a state where an E-Verify mandate was put into effect for any part of the time period. E-Verify policies require employers to verify the immigration status of new employees using a nationally available electronic identification system. If employees cannot prove that they are authorized to work in the United States their employment must be terminated. Given the large share of crop workers who are unauthorized immigrants, E-Verify implementation could increase the demand for H-2As. However, this is only a concern if the timing and location of E-Verify implementation are correlated with the magnitude of changes in housing demand.

In table 3, we show that our findings are robust to the inclusion of controls for farm employment and immigration shocks. Column 1 shows our benchmark OLS estimate from the first column of table 1, where we include only controls for time fixed effects. In the following columns, we sequentially add control variables, and the estimated coefficients remain qualitatively similar from one column to the next. We find little change in the estimated coefficient after controlling for agricultural employment and other industry employment shocks (columns 2 and 3). Controlling for Mexico-U.S. migration decreases the estimated coefficient on housing demand from 0.42 (in column 1) to 0.40 (in column 4). In column 5, we control for third party intermediary exposure, the share of the CZ population that is rural, a dummy variable set to one if an E-verify mandate was active in the state during the given period, and regional trends.

[Table 3 about here.]

In columns 6 and 7, we present our 2SLS estimates using as instruments the magnitude of the structural break and the sensitivity instruments in each column, respectively. In panel II we report the first stage estimates associated with the results in panel I. After including our controls, both instruments remain very strong predictors of housing demand changes with large first stage F-statistics. Our 2SLS results are a bit larger than the corresponding OLS estimates in column 4. While the standard errors are larger, when using instruments, the results are statistically significant in all specifications. The 2SLS results indicate that a 1% increase in housing demand causes a 0.62-0.97% increase in H-2A demand.

### *Housing demand shocks, farm wages, fruit and vegetable acreage, and employment in construction and other low-skilled sectors*

We suggest that housing demand shocks affect H-2A demand through their effects on employment demand in nonfarm industries that likely compete with agriculture for low-skilled workers.[29] We look for evidence to support this hypothesis by corroborating Charles, Hurst, and Notowidigdo (2018, 2019)'s findings on the positive effects of housing demand on construction and low-skilled employment using our sample of CZs from 2001-2017. If higher housing demand increases construction and other low-skilled sector labor demand and pulls workers from agriculture, we should find positive effects of housing demand on construction and low-skilled employment.

In the absence of labor-saving technology adoption or adjustments towards less labor-intensive crops, we would also expect to see agricultural wages rise and domestic farm employment to fall in response to an inward shift in the farm labor supply as workers migrate to the nonfarm sector. We obtain mean weekly farm wages by county from the QCEW. The QCEW also records employment by sector, but it does not indicate which states include H-2A workers and which do not. Thus, we investigate the effects of housing demand on farm wages only. Finally, we test whether housing demand shocks have any effect on total fruit and vegetable acreage in production since fruits and vegetables have large seasonal fluctuations in labor demand and are thus vulnerable to labor supply shocks.[30]

In table 4, we show that consistent with the literature, housing demand shocks have substantial impacts on construction employment and low-skilled employment. In the table, we also show that increases in housing demand raise farm wages but do not affect fruit and vegetable production. Panel I of table 4 shows the estimated effects of housing demand shocks on construction employment, panel II on low-skilled employment, panel III on mean weekly farm wages, and panel IV on fruit and vegetable acreage. Column 1 shows the results from the OLS specification, column 2 from the 2SLS specification using the structural break instrument, and column 3 from 2SLS using the sensitivity instrument. All specifications include time FE and cluster standard errors at the CZ level.

[Table 4 about here.]

Our 2SLS results in column 2 show that from 2001-2017, a 1% increase in housing demand caused a 0.38% increase in construction employment, 0.13% increase in low-skilled employment, and a 0.045% increase in weekly wages. A one standard deviation (1.03) increase in housing demand increased construction employment by 48%, low-skilled employment by 14%, and weekly farm wages by 4.7%. The estimated housing effect on total acreage is negative but not significantly different from zero. These findings are consistent with the notion that housing shocks pull workers from the agricultural sector into construction and other low-skilled labor sectors, leading to a tightening of the farm labor supply. Moreover, in response to the shock, our results are consistent with producers adjusting in part by hiring H-2A, which could prevent meaningful declines in output and fruit and vegetable acreage.[31]

Our findings differ from those of Clemens, Lewis, and Postel (2018), who find no detectable effect on local wages stemming from the inward shift in the farm labor supply attributed to the termination of the Bracero Program in 1964. We suspect that this is due, at least in part, to a lack of newly available labor-saving technologies for agricultural production in the early 21$^{st}$ century. Adoption of new labor-saving technologies, like the automated tomato harvester, and reduced production of labor-intensive crops prevented farm wages from rising after Bracero exclusion (Clemens, Lewis, and Postel 2018; Taylor and Charlton 2018).

Potentially attenuating the overall effect of housing demand changes on H-2A employment is that housing booms might increase agricultural land values by increasing the returns to converting farmland into housing. Because land (and structures) is a significant component of farmer wealth (over 82% of farm-sector assets in 2016), land values could strongly affect production outcomes and thus hired farmworker demand (Burns et al. 2018). For example, one would expect an increase in land values to reduce labor demand, and thus presumably H-2A demand, as the price of land, a complementary input, has increased. Similarly, higher agricultural land values could make it more expensive to rent or build new housing for H-2A workers in rural areas, decreasing H-2A demand since employers incur the costs of H-2A housing. However, housing booms are likely to increase development pressures primarily in areas close to urban areas (Burns et al. 2018). Nickerson et al. (2012) estimated that only a quarter of all U.S. farmland was subject to some degree of urban exposure, only 7% was deemed to be highly exposed. Moreover, they find that most U.S. farmland values did not decline during the housing bust (measured from 2006 to 2009). Thus, we expect the effect of housing demand on H-2A that operates through land prices to be negligible and to operate in the opposite direction as the sectoral mobility channel, which, if anything, would attenuate our results.[32]

# Conclusion

The H-2A guest worker program was created with the passage of IRCA in 1986 as a concession to agricultural advocates who maintained that domestic workers would not perform seasonal farm work. Agricultural advocates feared that unauthorized immigrants who received amnesty through IRCA would migrate to nonfarm jobs and that increased immigration enforcement would discourage new immigrants from coming to U.S. farms. Even though immigrant workers legalized through IRCA generally migrated to the non-farm sector within a few years of receiving amnesty (Martin 2002), farm labor shortages were not realized in the short run (Tran and Perloff 2002). Few employers utilized the H-2A program in the years directly following IRCA's implementation likely because unauthorized immigration from Mexico to the United States persisted at a high rate following IRCA and continued throughout the 1990s (Hanson and McIntosh 2010), counterbalancing any declines in the farmworker supply that stemmed from sectoral mobility.

Farm labor markets experienced some distinct changes in the 21st century. H-2A employment increased by more than 450% between 2001 and 2019, and agricultural economists have generally attributed this rising demand for H-2A workers to a declining U.S. farm labor supply (Devadoss, Zhao, and Luckstead 2020; Luckstead and Devadoss 2019; Zahniser et al. 2018). Many factors may have contributed to a tightening of the U.S. farm labor supply. The agricultural transformation is currently underway in rural Mexico (Charlton and Taylor 2016). Mexican immigration is on the decline (Hanson, Liu, and McIntosh 2017). Farm workers are more settled and less willing to migrate for farm work (Fan et al. 2015). Immigration enforcement has exacerbated the incidence of farm labor shortages and led some farmers to invest in agricultural technologies or transition away from labor-intensive crop or livestock production altogether (Charlton and Castillo 2021; Devadoss, Zhao, and Luckstead 2020; Ifft and Jodlowski 2016; Kostandini, Mykerezi, and Escalante 2014; Richards 2018). These factors likely play a key role in the recent increase in H-2A take-up and provide the backdrop for our analysis. It is in this context of a tightening national farm labor supply that we examine how changes in housing demand affect H-2A employment. To our knowledge, this is one of the first papers to econometrically estimate the H-2A employment effects of local economic factors that shift the local farm labor supply, and the first to exploit exogenous variation in these factors across geographic areas for identification.

We find that increases in housing demand in a commuting zone during 2001-2017 led to higher H-2A employment. A 1% increase in housing demand leads to a 0.40-0.97% increase in H-2A employment. Equivalently, a one standard deviation change in housing demand across CZs during 2001-2017 led to a 50-172% increase in H-2A employment. Our results are robust to the inclusion of controls for shocks to agricultural labor demand and immigration. We also find some evidence to support our hypothesis that positive housing demand shocks increase H-2A demand by pulling local workers from the agricultural to non-agricultural sectors. Specifically, we find that, from 2001 to 2017, a one standard deviation increase in housing demand increased construction employment by 48%, low-skilled employment by 14%, and weekly farm wages by 4.7%. These findings are consistent with the housing literature (e.g., Charles, Hurst, and Notowidigdo 2018, 2019; Mian and Sufi 2014), showing that housing demand shocks had strong impacts on employment in construction and other low-skill nontradable sectors during the boom and bust of the 2000s. Taken together, our findings demonstrate that the farm labor market is highly sensitive to changes in the local nonfarm economy, and H-2A can help farmers adjust to inward shocks in the local farm labor supply.

# Notes

[1] Commuting zones were developed by USDA's Economic Research Service to serve as a spatial measure of local labor markets. Commuting zones are collections of counties with strong commuting ties with one another but with weak commuting ties with counties in other commuting zones (Tolbert and Sizer 1996; Autor and Dorn 2013). Essential to our analysis, commuting zones cover the entire United States and thus include both metro and nonmetro areas.

[2] Our choice of periods follows that of Charles, Hurst, and Notowidigdo (2018, 2019). Although the Great Recession did not begin until December 2007, at the national level, housing prices peaked in 2006 and new building permits peaked even earlier. For this reason, we use 2006 as the final year of the housing boom and the start of the bust. Nevertheless, we show in the online supplementary appendix that our main findings are not sensitive to the selection of 2006 rather than 2007 as the transition year.

[3]One notable example of speculative investment in housing is the act of buying houses for their investment value (Shiller 2009).

[4] There was one primary difference between the H-2A and RAW programs. To hire H-2A, farmers had to recruit under the Department of Labor's supervision and had to pay for housing, but workers were contractually obligated to stay with the employer for the duration of the contract. The RAW program admitted a fixed number of farmworkers to the US each year, but these workers were allowed to move from farm to farm and employers did not have to provide housing (Taylor and Charlton 2018).

[5] While the share of SAWs in agriculture declined over the 1990s, Tran and Perloff (2002) find evidence that, in the short-run, IRCA did not incentivize SAWs to leave farm work.

[6] For example, Bier (2020) contends that the AEWR is unfairly high for farm employers to pay.

[7] Other factors that may have led to a tightening of the U.S. farmworker supply are the passage of stricter local immigration enforcement laws, falling fertility rates in Mexico, and declining migration rates of farmworkers within the United States (Passel and Cohn 2019; Hanson, Liu, and McIntosh 2017; Charlton and Kostandini 2020; Ifft and Jodlowski 2016; Kostandini, Mykerezi, and Escalante 2014; Fan et al. 2015). While all of these factors may have contributed to the recent growth in H-2A, identifying their effects is beyond the scope of our analysis.

[8] A representative for the United Farm Workers of America estimated that 15% of farmworkers leave agriculture each year in California (Preston 2006).

[9] In their first job, 17% of Kossoudji and Cobb-Clark's sample worked in agriculture. By the time they applied for amnesty, however, only 5.3 % remained in agriculture, and only 2.7% a few years later. Using

other data sources, Rytina (2002) and Sánchez-Soto and Singelmann (2017) also document immigrants' tendency to move away from agriculture with time spent in the United States. For example, by the time SAWs applied to become US citizens in the 1990s, only 3% remained in agriculture (Rytina 2002).

[10] In many areas construction is commonly considered to be the greatest competitor for agricultural labor (Richards and Patterson 1998; Buccola, Li, and Reimer 2012).

[11] We can relax this assumption on skill homogeneity without any change to our main findings.

[12] This set of assumptions follow those of Bound et al. (2015) closely. To model the demand for U.S. computer scientists, they make a similar argument for the elasticity of supply of H-1B workers and increasing marginal recruitment costs.

[13] For simplicity, we focus on an interior solution (i.e., $L > 0$ and $H > 0$).

[14] See the appendix for a formal proof.

[15] For clarity, we hold the demand for agricultural inputs fixed during the comparative statics exercise. In this model, agricultural demand also increases in response to an increase in $A_C$. However, because $\sigma > 1$, the increase in construction demand is larger so that relative demand for construction increases.

[16] In the DOL and USCIS datasets, the overwhelming majority of petitions requested are certified. In the Appendix, we document that the total number of certifications is nearly identical between the two datasets.

[17] In the DOL data, if associations file jointly with multiple employers the location of each employer is recorded separately.

[18] We map counties to CZs using David Dorn's concordance which can be accessed from https://www.ddorn.net/data.htm.

[19] The inverse hyperbolic sine transformation is closely related to the log transformation but can also be calculated for zero values, which are common in our first period due to low H-2A use in the early 2000s. Bellemare and Wichman (2019) show that in a regression of $asinh(y)$ on $asinh(x)$, the coefficient on $x$ closely approximates the elasticity of $y$ with respect to $x$. Our results are robust to expressing H-2A employment in logs though our standard errors are larger given that we lose the many CZs that do not hire H-2As in 2001. For recent empirical work using the $asinh$ transformation see Card et al. (2020), Doran, Gelber, and Isen (2020), Bahar and Rapoport (2018),and Clemens and Tiongson (2017)).

[20]By expressing our models in "long differences", we eliminate time invariant characteristics potentially unique to each CZ. Importantly, this methodological choice allows us to use the instrumental variables in Charles, Hurst, and Notowidigdo (2018, 2019) to help us identify our causal effect of interest $\beta$.

[21] Their strategy builds on the work of Ferreira and Gyourko (2011).

[22]They find that that housing booms improve labor market conditions for young adults, increasing the opportunity cost of attending college, and thus reducing college enrollment.

[23]We first estimate (9) using price data by year and quarter which is only available at the MSA level. We

annualize the magnitude of the breaks and map these to the CZ level. We then estimate (9) using annual data, which are available for more geographic locations. We use the $\lambda_i$ estimated using quarterly price data when possible and annual price data when not.

[24] We compute the $\widehat{\psi}_i$ using the data and code provided in the supplementary material in Guren et al. (2020). For simplicity, we compute the $\widehat{\psi}_i$ using all years in their sample.

[25]See the appendix for details on how to construct this variable.

[26] In unreported regressions, we directly control for agricultural employment and fruit and vegetable acreage. While endogenous to housing shocks, and thus not proper controls, our results are robust to accounting for these variables.

[27] We do not account for exposure during the boom of the 2000s because we cannot construct third-party exposure measures using the USCIS data. However, given the limitations of the USCIS data noted above, for the 2001-2006 boom period, our analysis excludes CZs in states with a strong presence of growers associations, which was likely the dominant intermediary type in the 1990s.

[28]In the appendix, we document in more detail the construction of this variable.

[29]We use the term "low-skilled" employment to include jobs requiring low levels of education, but not to imply that the jobs require low skills.

[30] See the appendix for details on how to construct these variables.

[31] It is worth noting that our measure of fruit and vegetable acres may poorly reflect labor use, and thus our acreage results should be interpreted with some caution.

[32] Worth noting is that housing booms affecting land values are only problematic for our identification strategy if our instruments cause land values to increase by channels other than increases in housing demand, which would violate the exclusion restriction. This seems unlikely in our setting. For example, our structural break instrument captures speculative activity targeted primarily at residential housing and thus presumably would only affect rental values through its effects on housing demand. Relatedly, national farmland values nearly doubled during our study period, and some of the increase may have stemmed from increased investor interest in farmland (Burns et al. 2018), which is often seen as a safe investment. However, we wouldn't expect investor interest in farmland across CZs to be strongly related to speculative activity in urban housing markets.

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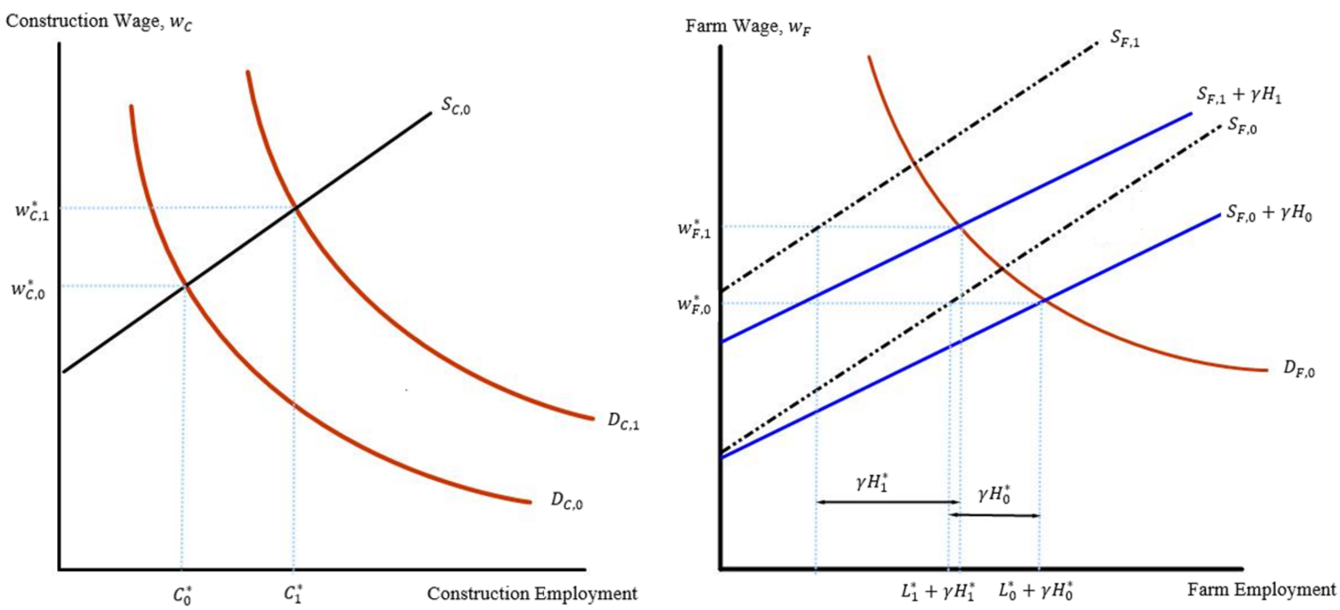
Figure 1 – Equilibrium in the construction and agricultural labor markets

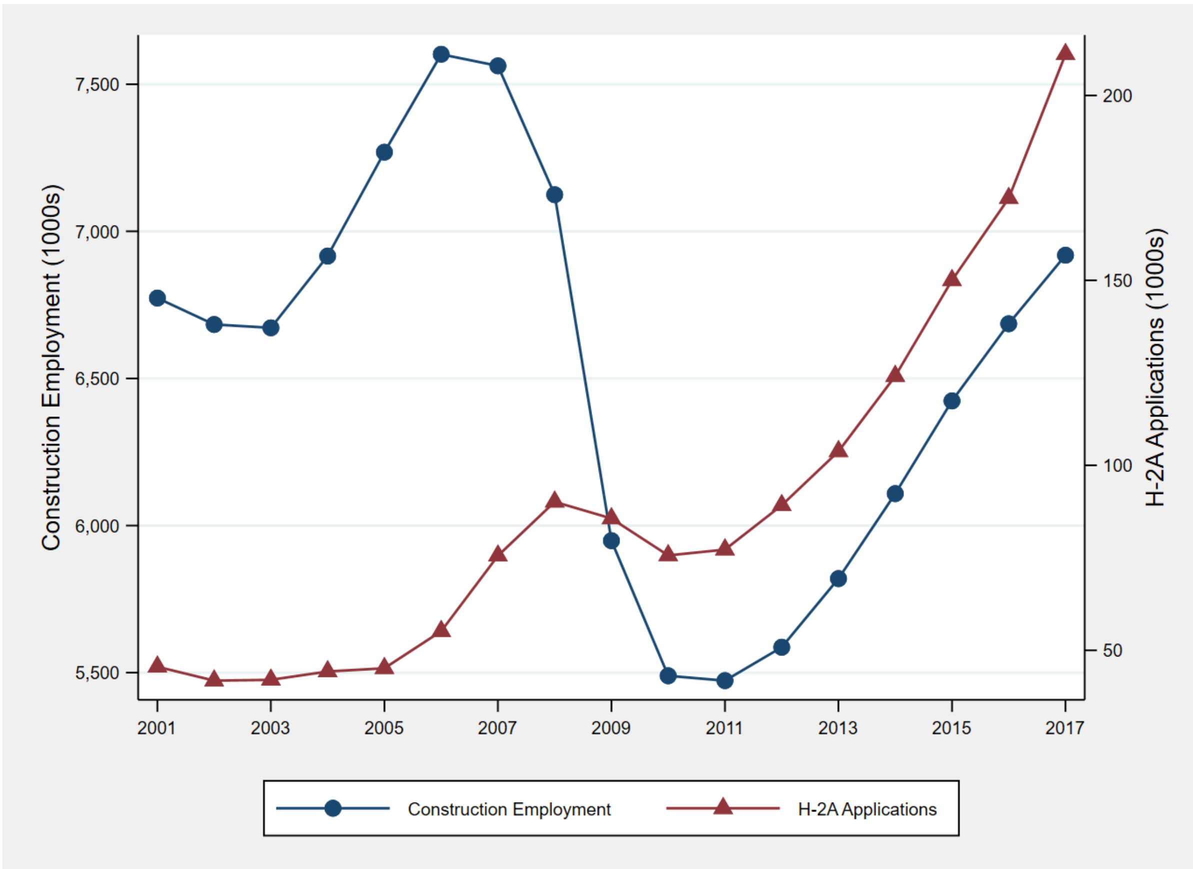
Panel A. Construction labor Market

Panel B. Farm labor market




Notes: This figure shows the initial equilibrium wages and employment in the construction (panel A) and agricultural labor markets (panel B) and the new equilibrium after an increase in $A_C$. Construction employment demand increases from $D_{C,0}$ to $D_{C,1}$, and as a result, construction wages and employment are higher in the new equilibrium. To show graphically how an increase in $A_C$ affects H-2A employment, we express farm labor supply (in efficiency units) as the sum of domestic farm labor supply ($S_F$) and $\gamma H$. The agricultural demand curve ($D_{F,0}$) represents total labor demand for agricultural labor, which we hold fixed during the comparative statics exercise for clarity purposes. Farm wages and H-2A employment increase in the new equilibrium, and domestic farm employment decreases as domestic workers move to the construction sector.

Figure 2 – Growth in H-2A and construction employment, 2001-2017




Notes: Data on construction employment (calendar year) come from the Quarterly Census of Employment and Wages, U.S. Bureau of Labor Statistics. Data on H-2A certified applications (fiscal year) are taken from I-129 records obtained from the U.S. Citizenship and Immigration Services.

**Table 1**
**H-2A Employment and Housing Demand Shocks, Baseline Estimates**

| | (1) OLS | (2) 2SLS Struct. Break IV | (3) 2SLS Sensitivity IV |
|---|---|---|---|
| I. Dep.Var.: $\Delta asinh$(H-2A), 2001-2017 | | | |
| Housing Demand Change | 0.42*** | 0.72*** | 0.84*** |
| | (0.10) | (0.25) | (0.27) |
| Time Fixed Effects | Yes | Yes | Yes |
| N | 1040 | 1040 | 708 |
| First Stage F-Statistic | | 200.0 | 240.3 |
| II. First Stage | | | |
| Instrument | | 5.33*** | 2.42*** |
| | | (0.38) | (0.16) |
| R-squared | | 0.670 | 0.780 |

Note: Table 1 reports the baseline OLS (column 1) and 2SLS results (columns 2-3). The explanatory variable is the proxy for changes in housing demand defined as the change in the sum of log housing prices and new building permits. In column 2, we instrument housing demand changes using the magnitude of the structural break, and the sensitivity instrument in column 3. We include only CZs with at least 50 workers employed in both agriculture and construction. For 2001-2006, we exclude CZs in states for which we do not have reliable H-2A counts in the USCIS data. All specifications include time fixed effects, and cluster robust standard errors at the CZ level. All models are unweighted. ***,**,* denotes significance at 1%, 5%, and 10% level respectively.

**Table 2**
**H-2A Employment and Housing Demand Shocks, Separately by Period**

| Dep.Var.: $\Delta asinh$(H-2A) | (1) OLS | (2) 2SLS Struct. Break IV | (3) 2SLS Sensitivity IV |
|---|---|---|---|
| I. Period 2001-2006 | | | |
| Housing Demand Change | 0.49*** | 1.42*** | 2.09** |
| | (0.18) | (0.53) | (0.84) |
| N | 312 | 312 | 216 |
| First Stage F-Statistic | | 98.3 | 53.9 |
| II. Period 2006-2011 | | | |
| Housing Demand Change | 0.37*** | 0.22 | 0.30 |
| | (0.12) | (0.36) | (0.23) |
| N | 364 | 364 | 246 |
| First Stage F-Statistic | | 47.1 | 199.5 |
| III. Period 2011-2017 | | | |
| Housing Demand Change | 0.43*** | 0.56** | 0.84** |
| | (0.16) | (0.28) | (0.41) |
| N | 364 | 364 | 246 |
| First Stage F-Statistic | | 104.9 | 123.2 |

Note: Table 2 reports the baseline OLS (column 1) and 2SLS results (columns 2-3) separately by period. The explanatory variable is the proxy for changes in housing demand defined as the change in the sum of log housing prices and new building permits. In column 2, we instrument housing demand changes using the magnitude of the structural break, and the sensitivity instrument in column 3. We include only CZs with at least 50 workers employed in both agriculture and construction. For 2001-2006, we exclude CZs in states for which we do not have reliable H-2A counts in the USCIS data. All specifications include time fixed effects, and cluster robust standard errors at the CZ level. All models are unweighted. ***,**,* denotes significance at 1%, 5%, and 10% level respectively.

**Table 3**
**H-2A Employment and Housing Demand Shocks, OLS with Controls and 2SLS Estimates**

| I. Dep. Var. : $\Delta asinh$(H-2A), 2001-2017 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Housing Demand Shock | 0.42*** | 0.40*** | 0.40*** | 0.40*** | 0.42*** | 0.98*** | 0.62* |
| | (0.10) | (0.10) | (0.10) | (0.10) | (0.10) | (0.33) | (0.34) |
| Specification | OLS | OLS | OLS | OLS | OLS | 2SLS | 2SLS |
| Ag. Emp. Controls | | X | X | X | X | X | X |
| Industry Emp. Shares | | | X | X | X | X | X |
| Immigration Controls | | | | X | X | X | X |
| Other Controls | | | | | X | X | X |
| N | 1040 | 1040 | 1040 | 1040 | 1040 | 1040 | 708 |
| First Stage F-Statistic | | | | | | 87.9 | 105.8 |
| II. First Stage | | | | | | | |
| Instrument | | | | | | 4.23*** | 2.39*** |
| | | | | | | (0.43) | (0.22) |
| R-squared | | | | | | 0.734 | 0.835 |

Note: In Table 3 we report OLS estimates for different sets of control variables in columns 1-5, and 2SLS in columns 6-7. The explanatory variable is the proxy for changes in housing demand defined as the change in the sum of log housing prices and building permits. In columns 2-7, we control for the predicted growth in farm employment and the employment share in agriculture, and in columns 3-7 we include the industry employment shares in 23 two-digit sectors, interacted with time dummies. In columns 4-7 we control for the share of the CZ's population born in Mexico, and the distance to the Mexican border, interacted with time dummies. In columns 5-7 we control for E-verify with a dummy variable that turns to 1 for 2011-2017 and for states that implemented an E-Verify policy for private employers, and for exposure to third-party filers with a dummy that turns to 1 for 2011-2017 interacted with the share of certifications in a CZ where the application was filed by a third party. In column 6, we instrument for housing demand changes using the magnitude of the structural break, and the sensitivity instrument in column 7. We include only CZs with at least 50 workers employed in both agriculture and construction. For 2001-2006, we exclude CZs in states for which we do not have reliable H-2A counts in the USCIS data. All specifications include time fixed effects, and cluster robust standard errors at the CZ level. All models are unweighted. ***,**,* denotes significance at 1%, 5%, and 10% level respectively.

**Table 4**
**Housing Demand Change, Employment in Construction and other Low-skill Sectors, Farm Wages, and Fruit and Vegetable Acreage**

| | (1)<br>OLS | (2)<br>2SLS<br>Struct. Break IV | (3)<br>2SLS<br>Sensitivity IV |
|---|---|---|---|
| I. Dep Var: Construction Employment | | | |
| Change in Housing Demand | 0.15*** | 0.38*** | 0.30*** |
| | (0.01) | (0.03) | (0.03) |
| First Stage F-Statistic | | 87.9 | 105.8 |
| N | 1040 | 1040 | 708 |
| II. Dep Var: Low-Skilled Employment | | | |
| Change in Housing Demand | 0.05*** | 0.13*** | 0.10*** |
| | (0.01) | (0.01) | (0.01) |
| First Stage F-Statistic | | 87.9 | 105.8 |
| N | 1040 | 1040 | 708 |
| III. Dep Var: Farm Weekly Wages | | | |
| Change in Housing Demand | 0.022*** | 0.045*** | 0.032** |
| | (0.006) | (0.014) | (0.014) |
| First Stage F-Statistic | | 92.3 | 104.5 |
| N | 1028 | 1028 | 699 |
| IV. Dep Var: F&V Acreage | | | |
| Change in Housing Demand | -.03 | -0.07 | -0.15 |
| | 0.04 | 0.13 | 0.12 |
| First Stage F-Statistic | | 80.7 | 103.2 |
| N | 1013 | 1013 | 702 |

Note: In panels I,II, III, and IV the dependent variables are the change in log employment in the construction sector, employment in “low-skilled” sectors, weekly farm wages, and fruit and vegetable acreage, respectively. Low-skilled employment is defined as employment in construction, manufacturing, retail, administrative and support services, and hospitality (NAICS 23, 31-33, 44-45, 56, and 72). We use the log change in acreage from 2002-2007, 2007-2012, and 2012-2017 to proxy for the changes corresponding to the housing boom from 2001-2006, the housing bust from 2006-2011, and the housing recovery from 2011-2017. The explanatory variable is the proxy for changes in housing demand defined as the change in the sum of log housing prices and building permits. In column 2, we instrument housing demand changes using the magnitude of the structural break, and the sensitivity instrument in column 3. We include only CZs with at least 50 workers employed in both agriculture and construction. For 2001-2006, we exclude CZs in states for which we do not have reliable H-2A counts in the USCIS data. All specifications include time fixed effects and the rest of the controls described in table 3, and cluster robust standard errors at the CZ level. All models are unweighted. ***,** denotes significance at 1%, and 5% level respectively.