



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*



Housing Booms and H-2A Agricultural Guest Worker Employment

by Marcelo Castillo and Diane Charlton

Copyright 2021 by Marcelo Castillo and Diane Charlton. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

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

Marcelo Castillo[†]

Diane Charlton[‡]

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 the first paper, to our knowledge, that econometrically examines causal factors that contributed to the growth of H-2A demand. 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 shocks on local farm wages, consistent with an inward shift in the local farm labor supply. We find no evidence that housing demand has any effect on total fruit and vegetable acreage under production, suggestive that H-2A adoption, and possibly adoption of new agricultural technologies, facilitated steady agricultural production despite negative shocks to the local farmworker supply.

Keywords: H-2A guest workers, farm labor, immigration, housing demand.

JEL Codes: J43, J23, J61,Q18,R21,R31

*We would like to thank Thomas Hertz for helpful comments, and seminar participants at the 2018 AAEA Annual Meeting. Any remaining errors are our own. This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS. This research was supported in part by the U.S. Department of Agriculture, Economic Research Service and the National Institute of Food and Agriculture (NIFA). The findings and conclusions in this publication are those of the authors and should not be construed to represent any official USDA or U.S. Government determination policy.

[†]Economic Research Service, U.S. Department of Agriculture: marcelo.castillo@usda.gov.

[‡]Montana State University.

1 Introduction

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). 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). However, to our knowledge, there are no rigorous econometric studies examining the root causes of the recent rise in H-2A employment. In this paper, we focus on estimating the effects of housing demand shocks, which shift labor demand in nonfarm industries, on changes in H-2A demand within the local commuting zone.

We hypothesize that H-2A demand grew more rapidly in locations where positive housing demand shocks 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 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-skilled 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 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).

Increasing competition for workers in similarly skilled industries to agriculture could increase the risk of farm labor shortages, particularly if the farm labor supply tightens at the national level. 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). By providing access to a stable labor source, the H-2A program is intended to help mitigate the risk of farmworker shortages.

To estimate the effects of housing shocks on H-2A, we compare changes in outcomes across commuting zones during the housing boom from 2001-2006, the bust from 2006-2011, and the recovery from 2011-2017. 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). To address endogeneity concerns, we instrument for our housing demand proxy using instruments developed in the housing literature, including the magnitude of structural breaks in housing prices as in Charles, Hurst, and Notowidigdo (2018, 2019), and housing supply elasticities as in Guren et al. (2020). 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 roughly a 41-100 log point increase in H-2A employment. Our results are robust to the inclusion of controls for location-specific changes in immigration, shocks to agricultural production, and two-digit

NAICS industry employment trends.

We also find evidence in support of our proposed mechanism that local housing demand affects H-2A uptake by increasing labor demand in non-farm sectors and thus draws workers away from the local farmworker supply. [Charles, Hurst, and Notowidigdo \(2018, 2019\)](#) show that positive housing demand shocks led to higher MSA employment in construction and other low-skilled sectors during the boom of the 2000s. We show that these findings similarly hold in our sample of commuting zones from 2001-2017, including declines in employment during recessionary years. 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. We find no evidence of a housing effect on fruit and vegetable acreage under production, suggestive that H-2A adoption, and possibly adoption of other technologies that increase labor productivity on farms, help maintain agricultural production despite inward labor supply shocks.

This paper contributes to a recent literature that documents characteristics of the recent growth in H-2A and discusses its potential causes ([Martin 2017](#); [Devadoss and Luckstead 2018](#); [Charlton et al. 2019](#); [Luckstead and Devadoss 2019](#)). To our knowledge, the only econometric study investigating the drivers of H-2A demand is [Simmitt et al. \(2018\)](#), who examine the network effects of H-2A adoption within and across bordering counties. Our research contributes more broadly to the literature that examines the causes and consequences of a declining farm workforce ([Hertz and Zahniser 2013](#); [Kostandini, Mykerezi, and Escalante 2014](#); [Fan et al. 2015](#); [Charlton and Taylor 2016](#); [Ifft and Jodlowski 2016](#); [Richards 2018](#); [Charlton and Kostandini 2020](#)). We also contribute to the literature that examines factors affecting the farm labor supply, including wages in competing industries ([Barkley 1990](#); [Perloff 1991](#); [Duffield and Coltrane 1992](#); [Richards and Patterson 1998](#); [Kandilov and Kandilov 2010](#); [Buccola, Li, and Reimer 2012](#); [Richards 2020](#)). Lastly, our work contributes to the literature that considers the determinants of migration decisions of low-skill and undocumented workers from Mexico (e.g., [Card and Lewis 2007](#); [Cadena and Kovak 2016](#);

Hanson and Spilimbergo 1999; Orrenius and Zavodny 2005; Hanson and McIntosh 2010), and to the literature that examines how labor markets respond to housing shocks (Mian, Rao, and Sufi 2013; Mian and Sufi 2014; Charles, Hurst, and Notowidigdo 2018, 2019; Guren et al. 2020).

Understanding the underlying mechanisms that influence demand for H-2A workers is critical for anticipating future trends in farm labor demand and improving labor and immigration policy. There have been numerous attempts to reform, or even replace, the H-2A program, but there have been no significant changes since the program’s creation in 1986. This paper’s findings shed light on the interactions between agriculture and nonfarm sectors in low-skilled labor markets and help explain recent growth in the demand for H-2A guest workers. 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 for H-2A take-up in the presence of labor supply uncertainty, and Section 4 describes the data and variable construction. Section 5 describes the econometric model, Section 6 presents the main results, Section 7 presents robustness checks and relevant extensions to the main model, and Section 8 concludes.

2 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 Pro-

gram. 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.¹

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). Notably, partly in response to improving

¹ 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).

job prospects in the U.S. nonfarm sector, many workers legalized through the SAW program transitioned to other industries ([Martin 2002](#)).² 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. 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.³

Despite the complexity of obtaining H-2A certification, H-2A use increased substantially in the twenty-first century. This increase has often been attributed to a tightening of the farm labor supply caused by rural Mexicans becoming better educated and increasingly

² While the share of SAWs declined over the 1990s, [Tran and Perloff \(2002\)](#) find evidence that, in the short-run, IRCA did not incentivize SAWs to leave farm work.

³ Several government agencies play a role in the H-2A application process. If employers meet the eligibility criteria, they file a job order with the State Workforce Agency (SWA) in the region of intended employment sixty to seventy-five days before the job start date. If the job order is accepted by the SWA, the employer must then file for a temporary labor certification for H-2A workers from 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, if outside of the U.S. at the time of the application, the prospective worker applies for the visa with the Department of State at a U.S. consulate ([U.S. Citizenship and Immigration Services 2021](#)).

finding work in the growing nonfarm sector in Mexico and increased immigration enforcement (Zahniser et al. 2018; Devadoss, Zhao, and Luckstead 2020).⁴ 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 are often overlooked as a cause for the rise in H-2A employment.

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).⁵ 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.⁶

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

⁴ Other factors that may have led to a tightening of the U.S. farmworker supply are the decline in the Mexico-US migration rate, falling fertility rates in Mexico, the passage of stricter local immigration enforcement laws, 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.

⁵ A representative for the United Farm Workers of America estimated that 15% of farmworkers leave agriculture each year in California (Preston 2006).

⁶ 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).

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).⁷ 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).⁸

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 the incidence (or perceived risk) of farmworker shortages. 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). In the next section, we show that farm employers might employ H-2A workers as a strategy to mitigate the increased risk of a farm labor shortage caused by the decline in the local

⁷ In many areas construction is commonly considered to be the greatest competitor for agricultural labor (Richards and Patterson 1998; Buccola, Li, and Reimer 2012).

⁸ Richards (2018) shows econometric evidence of chronic shortages in parts of the California labor market and argues that stricter immigration policies that reduce farmworker supply would make shortages more severe.

farm labor supply.

3 Theoretical Model

We use a simple model to illustrate how increases in the perceived risk of farm labor shortages, caused by increases in labor demand in the nonfarm sector, could lead to higher demand for H-2A. This model shows that even if H-2A and local farm workers have the same marginal product and even if it is more expensive to hire H-2As, some farmers may employ H-2As to avoid the possibility of encountering a labor shortage. We model the decision to hire H-2As using a model similar to that developed by [Koundouri, Nauges, and Tzouvelekas \(2006\)](#) to illustrate technology adoption under production uncertainty. In our model, a farmer's choice to participate in the H-2A program is similar to adopting a new technology that reduces the risk of a labor shortage.

Suppose that farmers use a vector of inputs \mathbf{x} and labor L to produce an agricultural good q according to the production function $q = f(L, \mathbf{x})$, where f is continuous and twice differentiable, increasing in labor and other inputs with diminishing marginal returns. Labor and other inputs are complements in production. Farmers are price-takers in output and input markets, so that output price p , wages w , and the vector of input prices \mathbf{r}' are nonrandom. Farmers encounter labor shortages with probability $\theta > 0$, and θ is exogenous to farmers' decisions. Farm labor shortages are the only source of risk in this model. For simplicity, we assume that when there is a labor shortage, farmers hire no one ($L = 0$) and lose their entire crop ($q = 0$) but still incur the costs of inputs $\mathbf{r}'\mathbf{x}$.

Farmers can either hire workers in the local labor market or hire H-2A workers. They must make hiring decisions before the planting and harvesting season. When the farmer hires H-2As, there is no risk of a labor shortage since workers are under a contract with their employer and cannot move to the nonfarm sector. H-2A and local workers are paid the same wage, but there is a fixed cost C for contracting H-2A, which accounts for the cost of filing

for H-2A certification, recruiting and transporting workers, and learning to comply with the H-2A regulations.⁹ H-2A and local workers have the same skills and productivity, so that the two labor types are perfect substitutes. The farmer hires either local workers or H-2A, but not both.

Consider the case in which farmers are risk neutral, and thus they maximize expected profits. Let $H2A = 1$ be an indicator variable that denotes whether the farmer hires H-2A workers, and the corresponding expected profit be $E[\pi|H2A = 1]$. Let $(q^1 = f(\mathbf{x}^1, L^1), \mathbf{x}^1, L^1)$ be the optimal output and input choices if the farmer hires H-2A workers, and $(q^0 = f(\mathbf{x}^0, L^0), \mathbf{x}^0, L^0)$ if the farmer hires locally.

The risk neutral farmer hires H-2A if

$$\begin{aligned}
& E[\pi|H2A = 1] > E[\pi|H2A = 0] \\
& pq^1 - wL^1 - \mathbf{r}'\mathbf{x}^1 - C > (1 - \theta) (pq^0 - wL^0 - \mathbf{r}'\mathbf{x}^0) + \theta (-\mathbf{r}'\mathbf{x}^0) \\
& p(q^1 - (1 - \theta)q^0) - w(L^1 - (1 - \theta)L^0) - \mathbf{r}'(\mathbf{x}^1 - \mathbf{x}^0) - C > 0 \\
& \{p(q^1 - q^0) - w(L^1 - L^0) - \mathbf{r}'(\mathbf{x}^1 - \mathbf{x}^0)\} - C > \theta(wL^0 - pq^0)
\end{aligned}$$

The left-hand side of the inequality is the difference in the profit from hiring H-2As and that from hiring local workers in the event the shortage does not materialize. Optimal use of all inputs, and thus optimal production, decreases in the probability of a labor shortage θ when the farmer hires locally.¹⁰ Given that the wage w is the same for local and H-2A workers, and $\theta > 0$, the optimal labor input will be higher when the farmer hires H-2A than when she hires locally. Thus, the first term of the inequality (in braces) is greater than zero. The right-hand side of the inequality is the probability of a labor shortage multiplied by the net change in profits when a shortage occurs, which is always negative. Thus, the choice to hire

⁹ Since the AEWR paid to H-2As is supposed to reflect the wages in the local labor market, in theory, the AEWR should be about the same as the local market wage. In practice, the AEWR may be higher or lower than the local wage. We could adjust the model so that the H-2A wage is different than the domestic wage without altering the models main predictions.

¹⁰See the appendix for a proof.

H-2A workers depends on whether the probability of a farm labor shortage θ is sufficiently high and the fixed H-2A costs C are sufficiently low.

Now, consider the case in which farmers are risk averse, and they maximize expected utility, which is an increasing function of profits. Each farmer i has von Neumann-Morgenstern preferences, which can be expressed by the utility function $U_i(\pi_i)$. In this case, a farmer hires H-2A if $E[U_i(\pi_i) | H2A = 1] > E[U_i(\pi_i) | H2A = 0]$. A risk averse farmer will hire H-2A workers even if the expected profit from doing so is less than that of hiring locally. Thus, the risk averse farmer chooses to hire H-2A workers for smaller values of θ than the risk neutral farmer (or higher costs C). In a labor market where risk preferences vary across farmers, some farmers hire H-2A workers while others do not even if θ and H-2A costs are the same for all farms.

When there is a positive shock to housing demand, labor demand in nonfarm sectors shifts outward. Some local farmworkers move from agriculture to the nonfarm sector, thus shifting the local supply of farmworkers inward and increasing the risk of a local farm labor shortage θ . Positive housing demand shocks are therefore expected to increase the demand for H-2A workers.¹¹

4 Data and Measurement

We approximate H-2A employment counts by commuting zone (CZ) using two data sources. The first source is the U.S. Department of Labor (DOL) H-2A case disclosure files, which contain all H-2A applications for temporary labor certification by fiscal year starting in fiscal year (FY) 2006. We complement the DOL data with the United States Citizenship and Immigration Services (USCIS) I-129 application records from FY 2001-2017. We obtained

¹¹ Equilibrium farm wages are expected to rise in response to an inward shift in the labor supply. Since H-2A wages are determined by the AEWR set by the Department of Labor, H-2A wages are supposed to be roughly equivalent to the market wage for farm workers and workers in similar employment. It is often presumed that the AEWR is set somewhat higher than the equivalent market farm wage. However, if a local labor market shock due to increased housing demand causes market wages to rise, the market wage might exceed the AEWR until the DOL updates the AEWR. This wage differential would simultaneously increase the demand for H-2A.

these records under a Freedom of Information Act 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 H-2A demand, and we map locations to their corresponding CZ.¹² 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 FY2010. 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 worksite location is not available.

For the housing boom period, we proxy for the change in CZ H-2A demand 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.¹³ Thus, from 2001-2006, we drop CZs in states with a large presence of growers associations, including

¹² 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.

¹³ In the DOL data, if associations file jointly with multiple employers the location of each employer is recorded separately.

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 1 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.

Similarities between aggregate trends in H-2A and construction employment are merely suggestive of a causal relationship between housing and H-2A demand. Many confounding macroeconomic factors could be driving this relation. 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 commuting zones (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 ΔH_{it} can be expressed as

$$\Delta H_{it} = \eta_i^D \Delta P_{it} + \Delta Q_{it} \tag{1}$$

where η_i^D is the price elasticity of housing demand, ΔP_{it} is the log change in local housing prices and ΔQ_{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 2000.¹⁴ 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 shocks 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 BLS 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.

5 Econometric Model

To begin our analysis, we estimate the effects of local housing demand shocks on H-2A demand by exploiting differences in outcomes across CZs and over time. We estimate the following equation:

$$\Delta y_{it} = \beta \Delta \widehat{H}_{it} + \gamma_t + \varepsilon_{it} \quad (2)$$

where Δy_{it} is the change in the inverse hyperbolic sine (*asinh*) of H-2A employment in CZ i for the following three subperiods: 2001-2006, 2006-2011, and 2011-2017.¹⁵ By expressing

¹⁴ We map counties to CZs using David Dorn’s concordance which can be accessed from <https://www.ddorn.net/data.htm>.

¹⁵ 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 . They suggest that applied researchers interpret the coefficients of the *asinh* models as they would specifications with variables in logs if y and x

the specification in first differences, we eliminate time-invariant characteristics potentially unique to each commuting zone. The explanatory variable of interest $\Delta \widehat{H}_{it}$ is our proxy for the change in housing demand. Period fixed effects γ_t account for nation-wide shocks. The error term is given by ε_{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 our coefficient of interest β using ordinary least squares (OLS). We repeat our analysis using 2-stage least squares (2SLS) with instruments described below.

5.1 Instrumental Variables

One might be concerned that housing prices and construction are correlated with other determinants of farm employment and H-2A demand, thus preventing a causal interpretation of the OLS estimate of β . 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.

Our first instrument for housing demand shocks is constructed by detecting sharp structural breaks in a CZ’s housing price trend each period (Ferreira and Gyourko 2011; Charles, Hurst, and Notowidigdo 2018, 2019). The magnitude of these structural breaks is a strong predictor of housing price changes during our sample, as we show below. Much of the variation in housing prices and production during the housing boom and bust of the 2000s stemmed from speculative activity and not from changes in fundamental factors such as productivity, income, or population (Shiller 2009; Mayer 2011; Glaeser and Nathanson 2015). Charles, Hurst, and Notowidigdo (2018) assume that changes in fundamentals are incorporated smoothly into prices, and breaks from trends reflect exogenous speculative activity, are greater than 10. Because housing prices and permits are always positive, and take relatively large values, $(\text{asinh}(P_{it}) + \text{asinh}(Q_{it}))$ and $(\ln(P_{it}) + \ln(Q_{it}))$ are nearly indistinguishable. 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)).

and thus these breaks are orthogonal to potentially confounding factors. As evidence of this assumption’s validity, they show that the magnitude of the structural breaks is not correlated with lags or pre-trends in housing prices, along with other validity tests. In table 7 in the appendix, we show that our estimated magnitude of the break is not correlated with pre-trends in agricultural wages, employment, or acreage.

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

$$\ln(P_{it}) = \alpha_i + \tau_i t + \lambda_i (t - t_i^*) \pi_{it} + \varepsilon_{it} \quad (3)$$

where t_i^* is the time at which the break occurs, τ_i is a linear time trend, $\pi_{it} = 1$ if $t > t_i^*$ and zero otherwise, and λ_i is the magnitude of the break. We estimate (3) for each t in a period and select t_i^* and λ_i based on the specification that returns the largest R-squared. We use our estimates of λ_i to instrument for the change in the housing demand shock. For simplicity, we use the opposite sign of the λ_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](#)).

We first estimate (3) 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 (3) using annual data, which are available for more geographic locations. We use the λ_i estimated using quarterly price data when possible and annual price data when not.

A second instrument for changes in housing demand is an estimate of the price elasticity of local housing supply interacted with regional changes in housing prices, which are presumably exogenous to local economic shocks. The intuition is that given that two areas experience a similar housing demand shock, the area with the more inelastic housing supply will experience larger price changes ([Mian and Sufi 2011](#)). Our preferred estimate comes from [Guren et al.](#)

(2020), who infer a city’s housing supply elasticity based on its historical responsiveness to changes in regional housing prices. For example, when housing prices appreciate in the Northeast, after accounting for differences in local economic conditions, prices in Providence tend to grow more rapidly than in Rochester, and thus the estimated housing supply elasticity is smaller in Rochester than in Providence (Guren et al. 2020).

To estimate the housing supply elasticities, Guren et al. (2020) use the following specification:

$$\Delta \ln (P_{irt}) = \tau_i + \psi_i \Delta \ln (P_{rt}) + \omega' \mathbf{X}_{irt} + \varepsilon_{it} \quad (4)$$

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 ψ_i . Their instrument, which they refer to as a “sensitivity instrument,” is given by $\hat{\psi}_i \Delta \ln (P_{irt})$, where $\hat{\psi}_i$ is the OLS estimate of ψ_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 commuting zones when we use this instrument than when we use the structural break instrument.¹⁶¹⁷

¹⁶ A second estimate of the housing supply elasticity at our disposal is that of Saiz(2010), which has been used in recent work to identify the effects of housing wealth shocks, which are a function of housing prices, on retail employment and other outcomes (e.g., Mian, Rao, and Sufi 2013; Mian and Sufi 2014). The Saiz elasticity is partly based on geographic barriers to construction, such as oceans and steep topography. Davidoff (2016) contends that the same geographic features that constraint land development are also desirable amenities for buying a home and are correlated with other drivers of wealth (e.g., productivity growth). Guren et al. (2020) address Davidoff’s concerns by controlling for long-run growth trends in prices, and other endogenous variables. Importantly, the sensitivity instrument is a better predictor of house prices than the Saiz instrument, especially outside the boom and bust periods. Nonetheless, in unreported regressions we find similar results when instrumenting housing demand shocks using the Saiz elasticity instrument.

¹⁷ We compute the $\hat{\psi}_i$ using the data and code provided in the supplementary material in Guren et al. (2020). For simplicity, we compute the $\hat{\psi}_i$ using all years in their sample.

6 Main Results

In table 1, we present our baseline OLS and 2SLS results. In column (1), we report estimates of β from estimating equation (1) using OLS. We find a positive relationship between housing demand shocks 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 shocks on H-2A demand 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 demand. 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 74-87 log point increase in H-2A demand. Thus, H-2A demand appears highly sensitive to changes in local housing demand.

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). However, the coefficient on changes in housing demand is highly statistically significant in all three periods using OLS. The 2SLS results in columns (2) and (3) show larger effects of housing demand booms from 2001-2006 on H-2A (panel 1) 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%, although 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).

7 Robustness and Extensions

While we believe our instruments address endogeneity issues with our proxy for changes in housing demand, one might still be concerned that certain omitted factors potentially correlate with housing price breaks or the housing supply elasticity instrument and simultaneously affect H-2A demand. For example, one might worry that national changes in agricultural commodity demand or immigration could affect farm labor demand differentially across regions and correlate with housing demand shocks. In this section, we address these concerns by repeating our analysis including controls for shocks to farm labor demand and immigrant labor supply.

Furthermore, we investigate plausible mechanisms by which housing demand shocks might affect H-2A demand. We first investigate whether Charles, Hurst, and Notowidigdo (2018, 2019)'s findings that housing demand shocks led to increased MSA employment in construction and other low-skilled sectors during the boom of the 2000s holds in our sample of CZs from 2001-2017. Second, we seek evidence that increasing housing demand leads to an inward shift in the local farm labor supply. We estimate the effects of housing demand shocks on farm wages, which should increase when there is an inward shift in local farm labor supply barring changes in technology or crop acreage (Clemens, Lewis, and Postel 2018). Lastly, we test the effects of housing demand shocks on acreage of labor-intensive fruit and vegetable commodities. One would expect an inward labor supply shift to cause labor-intensive agricultural production to decrease. Nevertheless, our model predicts that reduced production risk associated with contracting H-2A workers could mitigate output

losses stemming from negative labor supply shocks, and thus the effects of housing demand shocks on crop acreage is theoretically ambiguous.

7.1 Farm Employment and Immigration Controls

One potential concern in our main analysis is that unobserved shocks that directly affect food demand, and thus H-2A labor demand, may simultaneously affect the local demand for housing. For example, one may worry that positive wealth shocks attributed to rising home values might increase local food expenditures and increase the demand for workers on local farms. However, since agricultural products are traded and sold in national and international markets, and demand for food is highly inelastic (Fan, Pena, and Perloff 2016; Richards 2018), local wealth shocks are unlikely to affect local agricultural demand and H-2A demand.

Nevertheless, 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).¹⁸ Our Bartik control for agriculture is intended to capture local shocks that stem from changes to aggregate agricultural product demand. The idea is to predict the change in CZ farm labor demand for a given agricultural industry if the industry grew at the same rate as its national counterpart.¹⁹

Second, we also control for two-digit NAICS employment shares, including the share in

¹⁸ These variables are commonly referred to as “Bartik instruments” since they tend to be used as instrumental variables, though they are also used in the reduced form. In the immigration literature, see Kerr and Lincoln (2010), Peri, Shih, and Sparber (2015), and Kerr, Kerr, and Lincoln (2015), for examples of Bartik-type variables used as explanatory variables or controls.

¹⁹ We construct our agriculture Bartik control as follows:

agriculture, interacted with time fixed effects as in [Mian and Sufi \(2014\)](#) and [Guren et al. \(2020\)](#) Mian and Sufi (2014) and Guren et al. (2020). Thus, we control for industry-specific shocks that may affect local housing demand and labor availability within a commuting zone.²⁰

Another concern is that shocks to the local supply of immigrants from Mexico, driven by changes in national migration trends (e.g., declining fertility rates in Mexico), 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.²¹

We account for this possibility using 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 (e.g., [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 the pooled 2005-2010 American Community Survey (ACS) estimated population shares in the last subperiod. Second, we control for the CZ’s distance to the Mexican Border interacted with time fixed effects since

$$BA_{it} = \sum_m s_{im,2001} * \frac{\Delta E_{mt}}{E_{mt}}$$

where $s_{im,2001}$ is the 2001 share of total agricultural employment in CZ i in industry m , and $\frac{\Delta E_{mt}}{E_{mt}}$ is the national growth rate of employment in that industry (excluding the contribution of CZ i). In computing the measure, we use six-digit NAICS industries that are highly exposed to the H-2A program (e.g., fruits, vegetables, tobacco, and FLCs).

²⁰ 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. Acreage data are taken from the U.S. Census of Agriculture.

²¹ By increasing employment demand in low-skilled sectors, housing demand shocks could attract new immigrants to the local labor market. If for some reason some of these new immigrants take jobs in the farm sector, then housing shocks may increase the local farm labor supply, decreasing H-2A demand. While we do not believe this channel to be important in our setting, this type of migration does not pose problems to our identification approach since it occurs in response to housing shocks, as opposed to causing them. In this case, migration is just another mechanism by which housing shocks could affect H-2A demand.

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 \(2012\)](#).

In table 3, we show that our findings are robust to accounting 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 shocks (column 2). Controlling for changes in other industry employment and Mexico-U.S. migration decreases the estimated coefficient on housing demand from 0.42 (in column 1) to 0.40 (in column 3). In column 4, we control for 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 a given period, and regional trends. Including the rest of the controls increases the OLS estimate back to the benchmark of 0.42, without altering the estimate's precision by much.

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 including additional controls indicate that a 1% increase in housing demand causes a 0.62-0.97% increase in H-2A demand.

7.2 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. 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 housing effects 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 can 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.²² 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.

One challenge to estimating how opportunities in nonfarm sectors affect agriculture is that it is not completely clear which sectors compete with agriculture for similarly skilled workers ([Richards and Patterson 1998](#)). To construct our “low-skilled” sector employment measure, we use employment in construction, manufacturing, retail, administrative and support services, and hospitality (NAICS 23, 31-33, 44-45, 56, and 72).²³ We use mean weekly

²² According to the [Rural Migration News \(2020\)](#), employers in California and Washington must report H-2A workers in Unemployment Insurance, and thus include them in their QCEW data while Florida does not. Authors’ conversations with unemployment offices in North Carolina indicate that H-2A are not included in North Carolina’s QCEW data, and the office in Georgia was unable to provide an answer. Due to increased phone traffic to unemployment insurance offices during the recession in 2020, the authors did not continue gathering these data.

²³ It is worth noting that we could attempt to estimate the effects of local labor market competition on

wages in crops, livestock, and support services (NAICS 111,112, and 115).

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 breaks instrument, and column 3 from 2SLS using the sensitivity instrument. All specifications include time FE and cluster standard errors at the CZ level. We find statistically significant positive effects of housing demand shocks on construction and other low-skilled employment and farm wages in all specifications. We find no discernible effect of housing demand shocks on fruit and vegetable acreage.

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 39 log points, low-skilled employment by 13 log points, and weekly farm wages by 4.6 log points. 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.

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

H-2A employment by examining how H-2A uptake across CZs varies with changes in low-skilled employment outcomes. However, in addition to being unclear which sectors compete with agriculture, we do not have valid instruments for low-skilled employment. Nonetheless, in the Appendix (table 8) we show that H-2A uptake is strongly correlated with increases in employment in construction and in the low-skilled sector.

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 21st century. Adoption of new labor-saving technologies, like the automated tomato harvester, and reduced production of other labor-intentensive crops prevented farm wages from rising after Bracero exclusion (Clemens, Lewis, and Postel 2018; Taylor and Charlton 2018).

In contrast, labor-augmenting technologies that raise both worker productivity and labor demand were more commonly available for various fruits and vegetables in the early 21st century. Examples of such technologies include hydraulic platforms that replace ladders in orchards and reduce time spent moving from tree to tree and mobile conveyor belts that reduce time and burden carrying heavy loads of fruit. The adoption of these technologies have been shown to increase farm wages in part by raising labor productivity (Hamilton et al. 2020). Thus to the extent that inward shifts in the farm labor supply caused by housing demand shocks increased adoption of labor-augmenting technologies, we might expect farm wages to rise even more, and perhaps without observing any significant losses in output.²⁴ And to the extent that contracting H-2A workers reduces production risk, by hiring H-2A, agricultural production may remain steady when farmers face inward shifts in the supply of local farm workers. ²⁵

²⁴Notably, in response to negative labor supply shocks, producers that adopt labor augmenting technologies may increase their demand for labor. Thus, even if producers do not adopt H-2A, it is theoretically unclear whether the decline in labor supply would lead to a noticeable decline in total employment. In unreported regressions, we find little evidence that housing shocks affect QCEW total farm employment (i.e., taking no account for state-to-state differences in H-2A inclusion).

²⁵Since farmers can only obtain H-2A certification if they can provide substantial evidence that H-2A workers will not adversely affect the employment and wages of similarly skilled workers, we would expect domestic farm wages to rise as local farm labor supply shifts inward, even if employers simultaneously hire additional H-2A workers to compensate for the loss of local workers. However, decreased production risk could mitigate output losses associated with the increased labor cost.

8 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. Fears of farm labor shortages were not realized in the years directly following IRCA, and there was little demand for H-2A workers for over a decade and a half. However, H-2A employment increased by more than 450% between 2001 and 2019, even in spite of farm industry complaints that the program is costly and confusing to navigate.

Agricultural economists have generally attributed the 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). However, there is little econometric work examining the causes of the recent rise in H-2A employment. 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 Kostandini 2020; 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. To our knowledge, this is the first paper that econometrically estimates the H-2A employment effects of local economic factors that shift the local farm labor supply.

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 41-100 log point 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 39 log points, low-skilled employment by 13 log points, and weekly farm wages by 4.6 log points. 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.

We believe our findings to be of interest to agricultural leaders, rural planners, and policymakers. There have been many attempts to reform the H-2A program to make the application process more streamlined and more accessible to a wider variety of farmers. To date, there have been no significant changes to the H-2A program since its inception in 1986. Increased take-up of the program in recent years has inspired new interest in legislation to update the 34-year-old guest worker program. The Farm Workforce Modernization Act passed the House in December 2019 and received bipartisan support, and it currently awaits Senate approval. This study, along with other rigorous analyses of H-2A demand and farm labor supply, could help inform lawmakers, worker advocates, and agricultural industry leaders to make provisions that benefit farm employers, workers, and rural economies alike.

References

- Bahar, D., and H. Rapoport. 2018. "Migration, Knowledge Diffusion and the Comparative Advantage of Nations." *The Economic Journal* 128:F273–F305.
- Barham, B.L., A.P. Melo, and T. Hertz. 2020. "Earnings, Wages, and Poverty Outcomes of U.S. Farm and Low-Skill Workers." *Applied Economic Perspectives and Policy* 42:307–334.
- Barkley, A.P. 1990. "The Determinants of the Migration of Labor out of Agriculture in the United States, 1940-85." *American Journal of Agricultural Economics* 72:567–573.
- Bartik, T.J. 1991. *Who Benefits From State and Local Economic Development Policies?*. WE Upjohn Institute for Employment Research.
- Bellemare, M.F., and C.J. Wichman. 2019. "Elasticities and the Inverse Hyperbolic Sine Transformation." *Oxford Bulletin of Economics and Statistics* 82:50–61.
- Buccola, S., C. Li, and J. Reimer. 2012. "Minimum Wages, Immigration control, and Agricultural Labor Supply." *American Journal of Agricultural Economics* 94:464–470.
- Cadena, B.C., and B.K. Kovak. 2016. "Immigrants Equilibrate Local Labor Markets: Evidence from the Great Recession." *American Economic Journal: Applied Economics* 8:257–90.
- Card, D. 2001. "Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration." *Journal of Labor Economics* 19:22–64.
- Card, D., S. DellaVigna, P. Funk, and N. Iriberry. 2020. "Are Referees and Editors in Economics Gender Neutral?" *The Quarterly Journal of Economics* 135:269–327.
- Card, D., and E.G. Lewis. 2007. "The Diffusion of Mexican Immigrants during the 1990s: Explanations and Impacts." In *Mexican Immigration to the United States*. University of Chicago Press, pp. 193–228.

- Charles, K.K., E. Hurst, and M.J. Notowidigdo. 2018. “Housing Booms and Busts, Labor Market Opportunities, and College Attendance.” *American Economic Review* 108:2947–2994.
- . 2019. “Housing Booms, Manufacturing Decline and Labour Market Outcomes.” *The Economic Journal* 129:209–248.
- Charlton, D., and G. Kostandini. 2020. “Can Technology Compensate for a Labor Shortage? Effects of 287 (g) Immigration Policies on the U.S. Dairy Industry.” *American Journal of Agricultural Economics* 103:70–89.
- Charlton, D., and J.E. Taylor. 2016. “A Declining Farm Workforce: Analysis of Panel Data from Rural Mexico.” *American Journal of Agricultural Economics* 98:1158–1180.
- Charlton, D., J.E. Taylor, S. Vougioukas, and Z. Rutledge. 2019. “Can Wages Rise Quickly Enough to Keep Workers in the Fields?” *Choices* 34:1–7.
- Clemens, M.A., E.G. Lewis, and H.M. Postel. 2018. “Immigration Restrictions as Active Labor Market Policy: Evidence from the Mexican Bracero Exclusion.” *American Economic Review* 108:1468–87.
- Clemens, M.A., and E.R. Tiongson. 2017. “Split Decisions: Household Finance When a Policy Discontinuity Allocates Overseas Work.” *Review of Economics and Statistics* 99:531–543.
- Cortes, P. 2008. “The Effect of Low-Skilled Immigration on US prices: Evidence from CPI Data.” *Journal of political Economy* 116:381–422.
- Costa, D., and P. Martin. 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.” Working paper, 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/, March 31.

Davidoff, T. 2016. "Supply Constraints Are Not Valid Instrumental Variables for Home Prices Because They Are Correlated With Many Demand Factors." *Critical Finance Review* 5:177–206.

Devadoss, S., and J. Luckstead. 2018. "U.S. Immigration Policies and Dynamics of Cross-Border Workforce in Agriculture." *The World Economy* 41:2389–2413.

Devadoss, S., X. Zhao, and J. Luckstead. 2020. "Implications of U.S. Immigration Policies for North American Economies." *Journal of Agricultural and Resource Economics* 45:161–178.

Doran, K., A. Gelber, and A. Isen. 2020. "The Effects of High-Skilled Immigration Policy on Firms: Evidence from H-1B Visa Lotteries." Working paper, National Bureau of Economic Research.

Duffield, J.A., and R. Coltrane. 1992. "Testing for Disequilibrium in the Hired Farm Labor Market." *American Journal of Agricultural Economics* 74:412–420.

Fan, M., S. Gabbard, A. Alves Pena, and J.M. Perloff. 2015. "Why Do Fewer Agricultural Workers Migrate Now?" *American Journal of Agricultural Economics* 97:665–679.

Fan, M., A.A. Pena, and J.M. Perloff. 2016. "Effects of the Great Recession on the U.S. Agricultural Labor Market." *American Journal of Agricultural Economics* 98:1146–1157.

Ferreira, F., and J. Gyourko. 2011. "Anatomy of the Beginning of the Housing boom: U.S. Neighborhoods and Metropolitan Areas, 1993-2009." Report No. 0898-2937, National Bureau of Economic Research.

Fisher, D.U., and R.D. Knutson. 2013. "Uniqueness of Agricultural Labor Markets." *American Journal of Agricultural Economics* 95:463–469.

- Glaeser, E.L., and C.G. Nathanson. 2015. "Housing bubbles." In *Handbook of Regional and Urban Economics*. Elsevier, vol. 5, pp. 701–751.
- Guren, A.M., A. McKay, E. Nakamura, and J. Steinsson. 2020. "Housing Wealth Effects: The Long View." *The Review of Economic Studies*, 04, pp. 1–39, rdaa018.
- Hagan, J., N. Lowe, and C. Quingla. 2011. "Skills on the Move: Rethinking the Relationship Between Human Capital and Immigrant Economic Mobility." *Work and occupations* 38:149–178.
- Hamilton, S.F., T.J. Richards, A. Shafran, and K.N. Vasilaky. 2020. "Farm Labor Productivity and the Effect of Mechanization." Working paper, Available at SSRN 3743620.
- Hanson, G., C. Liu, and C. McIntosh. 2017. "The Rise and Fall of US Low-Skilled Immigration." *Brookings Papers on Economic Activity* 2017:83–168.
- Hanson, G.H., and C. McIntosh. 2010. "The Great Mexican Emigration." *The Review of Economics and Statistics* 92:798–810.
- Hanson, G.H., and A. Spilimbergo. 1999. "Illegal Immigration, Border Enforcement, and Relative Wages: Evidence from Apprehensions at the US-Mexico Border." *American economic review* 89:1337–1357.
- Hertz, T., and S. Zahniser. 2013. "Is There a Farm Labor Shortage?" *American Journal of Agricultural Economics* 95:476–481.
- Ifft, J., and M. Jodlowski. 2016. "Is ICE Freezing US Agriculture? Impacts of Local Immigration Enforcement on U.S. Farm Profitability and Structure." *Selected paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2* Working Paper.
- Kandel, W., and J. Cromartie. 2004. "New Patterns of Hispanic Settlement in Rural America." *USDA ERS, Economic Bulletin* EIB.

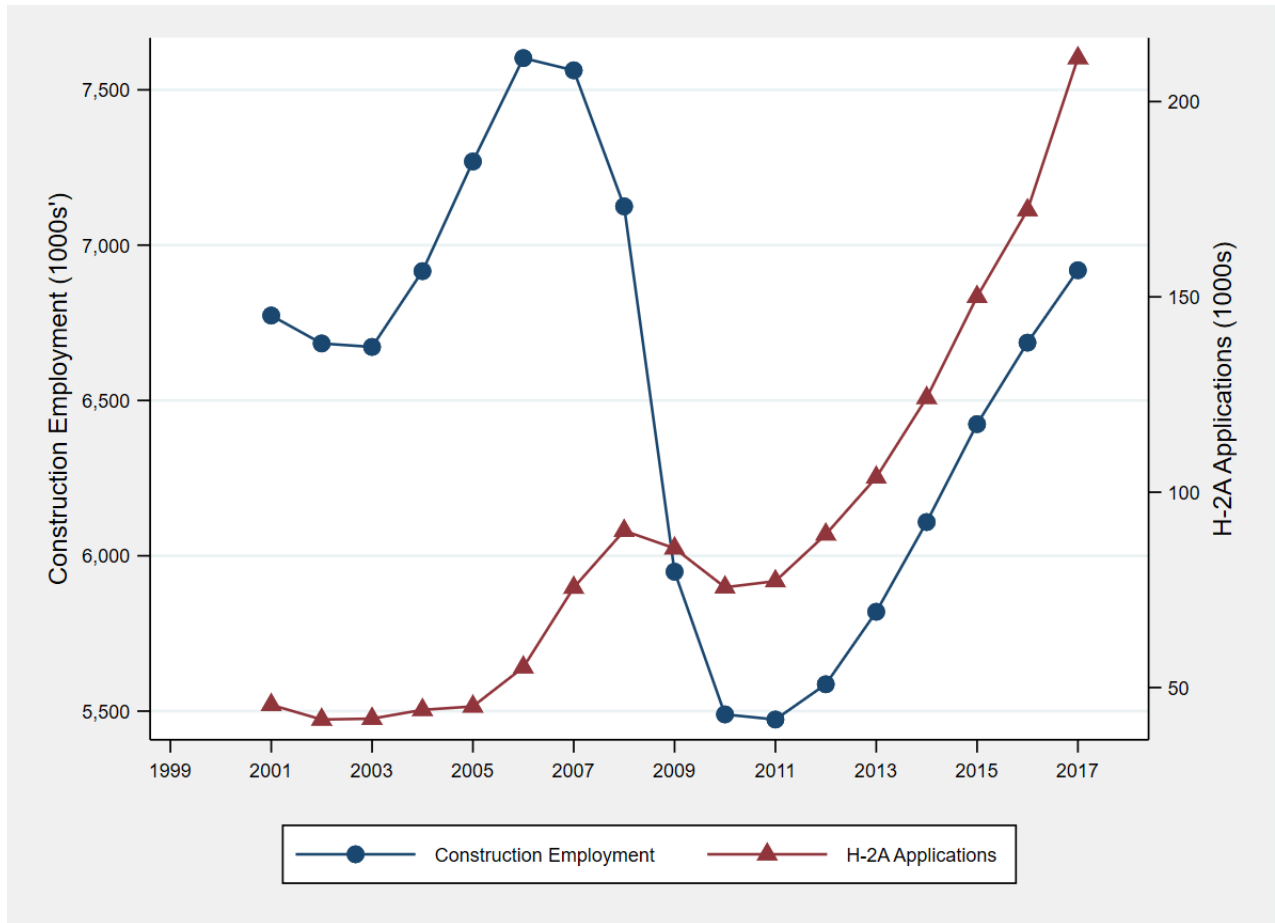
- Kandilov, A.M.G., and I.T. Kandilov. 2010. "Job Displacement from Agriculture." *American Journal of Agricultural Economics* 92:591–607.
- Kerr, S.P., W.R. Kerr, and W.F. Lincoln. 2015. "Skilled Immigration and the Employment Structures of US Firms." *Journal of Labor Economics* 33:S147–S186.
- Kerr, W.R., and W.F. Lincoln. 2010. "The Supply Side of Innovation: H-1B Visa Reforms and U.S. Ethnic Invention." *Journal of Labor Economics* 28:473–508.
- Kossoudji, S.A., and D.A. Cobb-Clark. 1996. "Finding Good Opportunities within Unauthorized Markets: U.S. Occupational Mobility for Male Latino Workers." *International Migration Review* 30:901–924.
- . 2000. "IRCA's Impact on the Occupational Concentration and Mobility of Newly-Legalized Mexican Men." *Journal of Population Economics* 13:81–98.
- Kostandini, G., E. Mykerezzi, and C. Escalante. 2014. "The Impact of Immigration Enforcement on the U.S. Farming Sector." *American Journal of Agricultural Economics* 96:172–192.
- Koundouri, P., C. Nauges, and V. Tzouvelekas. 2006. "Technology Adoption under Production Uncertainty: Theory and Application to Irrigation Technology." *American Journal of Agricultural Economics* 88:657–670.
- Luckstead, J., and S. Devadoss. 2019. "The Importance of H-2A Guest Workers in Agriculture." *Choices* 34:1–8.
- Martin, P. 2017. "The H-2A Farm Guestworker Program is Expanding Rapidly: Here are the Numbers You Need to Know." Economic Policy Institute. <http://www.epi.org/blog/h-2a-farm-guestworker-program-expanding-rapidly/>. Last checked September 16, 2017.
- . 2012. "Hired Farm Workers." *Choices* Quarter 2.

- . 2002. “Mexican Workers and US agriculture: The Revolving Door.” *International Migration Review* 36:1124–1142.
- Martin, P., and J.E. Taylor. 2013. “Ripe with Change: Evolving Farm Labor Markets in the United States, Mexico, and Central America.” Migration Policy Institute, <http://www.migrationpolicy.org/pubs/RMSG-Agriculture.pdf>.
- Martin, P.L., M. Fix, and J.E. Taylor. 2006. *The New Rural Poverty: Agriculture and Immigration in California*. The Urban Institute.
- Mayer, C. 2011. “Housing Bubbles: A Survey.” *Annual Review of Economics* 3:559–577.
- Mian, A., K. Rao, and A. Sufi. 2013. “Household Balance Sheets, Consumption, and the Economic Slump.” *The Quarterly Journal of Economics* 128:1687–1726.
- Mian, A., and A. Sufi. 2011. “House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis.” *American Economic Review* 101:2132–56.
- . 2014. “What Explains the 2007-2009 Drop in Employment?” *Econometrica* 82:2197–2223.
- Munshi, K. 2003. “Networks in the Modern Economy: Mexican Migrants in the U.S. Labor Market.” *The Quarterly Journal of Economics* 118:549–599.
- Orrenius, P.M., and M. Zavodny. 2003. “Do Amnesty Programs Reduce Undocumented Immigration? Evidence from IRCA.” *Demography* 40:437–450.
- . 2005. “Self-Selection Among Undocumented Immigrants from Mexico.” *Journal of Development Economics* 78:215–240.
- Passel, J.S., and D. Cohn. 2019. “Mexicans Decline to Less than Half the U.S. Unauthorized Immigrant Population for the First Time.”

- Peri, G. 2012. “The Effect of Immigration on Productivity: Evidence from U.S. States.” *Review of Economics and Statistics* 94:348–358.
- Peri, G., K. Shih, and C. Sparber. 2015. “STEM Workers, H-1B visas, and Productivity in US Cities.” *Journal of Labor Economics* 33:S225–S255.
- Perloff, J.M. 1991. “The Impact of Wage Differentials on Choosing to Work in Agriculture.” *American Journal of Agricultural Economics* 73:671–680.
- Preston, J. 2006. “Pickers Are Few, and Growers Blame Congress.” *The New York Times* September 22.
- Richards, T.J. 2018. “Immigration Reform and Farm Labor Markets.” *American Journal of Agricultural Economics* 100:1050–1071.
- . 2020. “Income Targeting and Farm Labor Supply.” *American Journal of Agricultural Economics* 102:419–438.
- Richards, T.J., and P.M. Patterson. 1998. “Hysteresis and the Shortage of Agricultural Labor.” *American Journal of Agricultural Economics* 80:683–695.
- Rural Migration News. 2020. “A Tale of Two States: Farm Labor in CA and FL.”
- Rytina, N. 2002. *IRCA Legalization Effects: Lawful Permanent Residence and Naturalization through 2001*. Office of Policy and Planning, Statistics Division, US Immigration and Naturalization Service.
- Saiz, A. 2007. “Immigration and Housing Rents in American Cities.” *Journal of urban Economics* 61:345–371.
- Sánchez-Soto, G., and J. Singelmann. 2017. “The Occupational Mobility of Mexican Migrants in the United States.” *Revista Latinoamericana de Población* 11:55–78.
- Shiller, R.J. 2009. “Unlearned Lessons from the Housing Bubble.” *The Economists Voice* 6.

- Simmitt, S., D. Farnsworth, G. Onel, and F. Roka. 2018. “The Diffusion of the H-2A Temporary Agricultural Workers Program: A Spatial Econometric Approach.” *Selected Paper prepared for presentation at the 2018 Agricultural & Applied Economics Association Annual Meeting, Washington, D.C.* Working Paper.
- Smith, C.L. 2012. “The Impact of Low-Skilled Immigration on the Youth Labor Market.” *Journal of Labor Economics* 30:55–89.
- Taylor, J.E. 1992. “Earnings and Mobility of Legal and Illegal Immigrant Workers in Agriculture.” *American Journal of Agricultural Economics* 74:889–896.
- Taylor, J.E., and D. Charlton. 2018. *The Farm Labor Problem: A Global Perspective*. Academic Press.
- Tran, L.H., and J.M. Perloff. 2002. “Turnover in U.S. Agricultural Labor Markets.” *American Journal of Agricultural Economics* 84:427–437.
- U.S. Citizenship and Immigration Services. 2021. “H-2A Temporary Agricultural Workers.” <https://www.uscis.gov/working-in-the-united-states/temporary-workers/h-2a-temporary-agricultural-workers> (Accessed February 3, 2021).
- Velarde, L. 2020. “Essential Workers: The Visa Program Keeping Americans Fed.” *Washington Post* June 18.
- Zahniser, S., J.E. Taylor, T. Hertz, and D. Charlton. 2018. “Farm Labor Markets in the United States and Mexico Pose Challenges for U.S. Agriculture.” *USDA ERS, Economic Bulletin* EIB-201.

Figure 1 – 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*** (0.10)	0.72*** (0.25)	0.84*** (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*** (0.38)	2.42*** (0.16)
R-squared		0.670	0.780

Notes: 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*** (0.18)	1.42*** (0.53)	2.09** (0.84)
N	312	312	216
First Stage F-Statistic		98.3	53.9
II. Period 2006-2011			
Housing Demand Change	0.37*** (0.12)	0.22 (0.36)	0.30 (0.23)
N	364	364	246
First Stage F-Statistic		47.1	199.5
III. Period 2011-2017			
Housing Demand Change	0.43*** (0.16)	0.56** (0.28)	0.84** (0.41)
N	364	364	246
First Stage F-Statistic		104.9	123.2

Notes: 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. : $\Delta \ln h(H-2A)$, 2001-2017	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Housing Demand Shock	0.42*** (0.10)	0.40*** (0.10)	0.40*** (0.10)	0.40*** (0.10)	0.42*** (0.10)	0.98*** (0.33)	0.62* (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*** (0.43)	2.39*** (0.22)
R-squared						0.734	0.835

Notes: 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 CZs 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) OLS	(2) 2SLS Struct. Break IV	(3) 2SLS Sensitivity IV
I. Dep Var: Construction Employment			
Change in Housing Demand	0.15*** (0.01)	0.38*** (0.03)	0.30*** (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*** (0.01)	0.13*** (0.01)	0.10*** (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*** (0.006)	0.045*** (0.014)	0.032** (0.014)
First Stage F-Statistic		92.3	104.5
N	1028	1028	699
IV. Dep Var: F&V Acreage			
Change in Housing Demand	-0.03 0.04	-0.07 0.13	-0.15 0.12
First Stage F-Statistic		80.7	103.2
N	1013	1013	702

Notes: 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.

9 Appendix

9.1 Data

We obtain H-2A data from two data sources: the Department of Labor (DOL) disclosure data, which are publicly available, and the U.S. Citizenship and Immigration Services (USCIS) I-129 individual records, which we obtained through a Freedom of Information Act (FOIA) request. The primary advantage of the USCIS data is that they include information on H-2A certified applications from 2001 and the DOL data only from 2006. Below, we describe differences across data sources and how we combined the datasets.

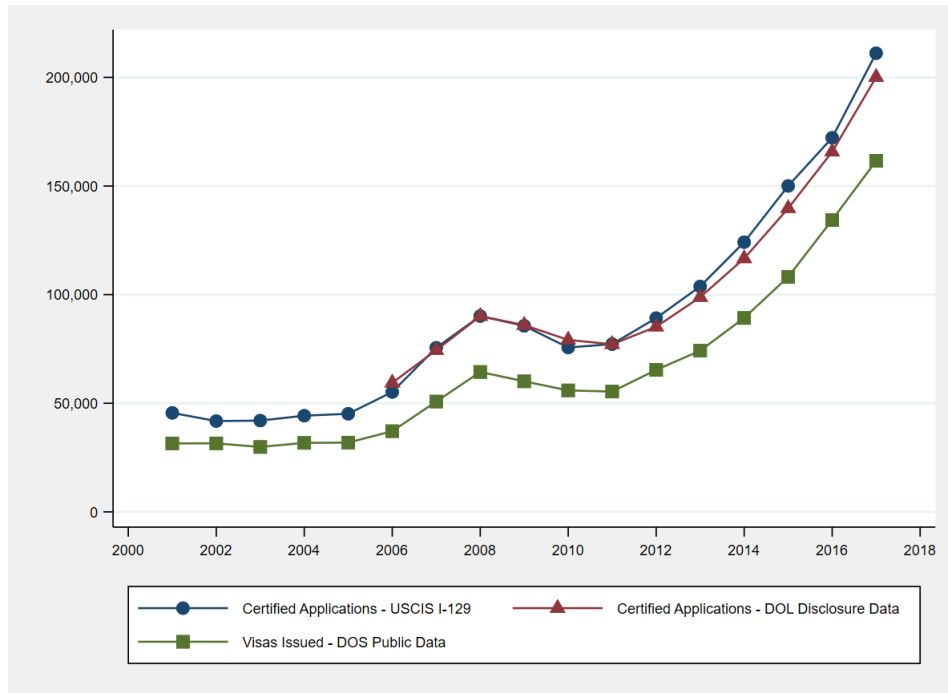
9.1.1 Comparing Totals among H-2A Data Sources (DOL, USCIS, DOS)

Three federal agencies play a role in the H-2A application process: the DOL, the USCIS, and the U.S. Department of State (DOS). The employer first files a labor certification application with the DOL and then an I-129 with the USCIS. If outside of the United States at the time of application, the worker submits the I-129 alongside the rest of the application documents to the DOS at a US consulate. The DOS ultimately issues the visa.

Figure 2 shows the national totals for certified DOL labor certifications, USCIS I-129 applications, and the DOS number of H-2A visas granted. USCIS and DOL totals are very close to each other, which lends some support to our approach to combine datasets in our analysis. While the three series follow the same trend, DOL and USCIS applications are always higher than DOL visas granted primarily because the same worker may obtain multiple labor certifications and I-129s because of job extensions, employer changes, etc.²⁶ Job extensions and employer changes require filing a new I-129, and generally, a new labor certification, but DOS is not involved in this process. It is worth noting that the DOS only releases national summaries on H-2A, and thus, visa data are not suitable for our analysis.

²⁶ There are other reasons for this discrepancy including that, after the USCIS approves an applicants petition, (1) DOS may deny the visa request if the applicant fails the screening process, (2) the applicant may decide not to apply for the visa.

Figure 2 – H-2A certified applications and visas granted, 2001-2017



Notes: Data on H-2A certified applications are from I-129 records obtained from the USCIS, and from the DOL Disclosure data. Data on visas granted are from the DOS.

9.1.2 Data issues

In many instances, the employer's location recorded in the I-129 files is that of the firm that filed the I-129 application on behalf of the employer (e.g., a law firm), which may be located in a different commuting zone (CZ). To deal with this issue, we identify the likely workplace by matching the DOL and USCIS data by employer name and mapping employer location in the DOL to the USCIS data. We use standard fuzzy matching techniques available in Stata (`relink2` and associated programs) to match employer names that are misspelled in one dataset or the other.

After matching, there are at least two remaining issues to address. The first is that the USCIS data only records the primary employer's name when an H-2A employee is contracted

to work for multiple employers (termed “joint employment”). Joint employment is a common practice of growers associations such as the North Carolina Growers Association, the New England Apple Council, and the Western Range Association. Hence, from 2001-2006, we exclude all CZs in North Carolina, all New England States, and mountain states (ID, WY, MT, CO, and UT), where joint employment through a growers association is common. Nevertheless, our estimated results are qualitatively unchanged even when we include CZs in these states.

The second issue is that the USCIS reports only the employer location and not the worksite location, and these two locations could differ. For 2008-2017, the DOL reports both the worksite and employer locations, so we can compare the locations in the DOL data during this time. In most cases, the employer county location matches the worksite location when individual farms apply for the H-2A position.²⁷ Discrepancies primarily arise when farm labor contractors (FLCs) apply for H-2A positions and contract workers to work on another firm’s farm. Since the FLC share of H-2A employment is very small before 2010, we expect few discrepancies in employer and worksite locations when using the USCIS data from 2001-2006. Thus, we assign H-2A positions to CZs in the USCIS data using the reported employer location in the DOL disclosure data from 2006-2017.

9.1.3 QCEW

We use nearly completely unsuppressed Quarterly Census of Employment and Wages (QCEW) data from the Bureau of Labor Statistics (BLS). Unlike the publicly available QCEW data, our data do not suppress employment in industries with few firms in a single county. We accessed data from 1996-2017.²⁸ These data are fully unsuppressed in 38 states. For 11 states (CT, FL, KY, MI, MS, NH, NY, NC, RI, VT, WY), the data are suppressed in some

²⁷ To be precise, the DOL data contain the employer’s address, including the zip code. We use zip codes to assign employer counties to applications. For worksite location, the data report the worksite state starting in FY 2007 and the worksite city starting in FY 2008. We use the city and state to assign a worksite county to applications.

²⁸ The 1996-2000 data use the SIC industry classification. Data for 2001-2017 use the NAICS classification.

years but not in others. For MA, the data are always suppressed, and thus we do not include MA in our regressions.

For consistency, for CZs in states with some suppression, we construct time-varying CZ employment variables by including only counties that are always unsuppressed from 2001-2017 and are thus in the public data. Because we have unpressed data for nearly all states at some point in time, we can check whether employment in a CZ can be closely approximated with the public data. In states with some suppression, we keep only CZs for which the share of disclosed employment is above 75% of total employment.

9.2 Summary Statistics

Tables 5 and 6 present summary statistics of the main variables in this study.

9.3 Pre-Trends Tests

Table 7 shows the results from regressing pre-trends in QCEW farm employment and weekly wages (1996-2000) and Census of Agriculture acres (1997-2002) on our instruments and the housing demand shock for the 2001-2006 period. We find no evidence of significant pre-trends in agricultural employment, wages, or acreage correlated with exposure to housing demand shocks from 2001-2006.

9.4 H-2A and Construction and Low-Skilled Employment

In table 8, we show OLS estimates from regressing H-2A on construction and low-skilled employment. We find a statistically significant positive association between construction and low-skilled employment and H-2A demand, even after controlling for immigration and farm production shocks. Because we do not have valid instruments for low-skilled employment, these coefficients may be biased estimates of a causal effect of local labor market competition on H-2A employment. However, we find it comforting that the estimated relationship is

statistically significant and of the correct sign.

9.5 Theoretical proof

We want to show that optimal inputs (and thus output) are decreasing in the risk of a farm labor shortage θ . We consider the two-input case. Let f_z and f_{zz} be the first and second derivatives of f w.r.t to Z . We assume that $f_L, f_X > 0$, $f_{LL}, f_{XX} < 0$, and $f_{LX} = f_{XL} > 0$.

The risk neutral farmer solves the following optimization problem:

$$\max_{L, X} (1 - \theta) [pf(L, X) - wL - rX] + \theta(-rX)$$

The First Order Conditions (FOCs) are given by

$$pf_L - w = 0$$

$$pf_X - \frac{r}{(1 - \theta)} = 0$$

Note that $J = \begin{bmatrix} pf_{LL} & pf_{LX} \\ pf_{LX} & pf_{XX} \end{bmatrix}$ is the Jacobian matrix, and its determinant $|J| = pf_{LL}pf_{XX} - pf_{XL}pf_{LX} > 0$ given strict concavity of the production function. Totally differentiating the FOCs and rearranging we obtain:

$$\begin{bmatrix} \frac{dL}{d\theta} \\ \frac{dX}{d\theta} \end{bmatrix} = -\frac{1}{|J|} \begin{bmatrix} pf_{XX} & -pf_{LX} \\ -pf_{XL} & pf_{LL} \end{bmatrix} \begin{bmatrix} 0 \\ -\frac{r}{(1-\theta)^2} \end{bmatrix}$$

where $\begin{bmatrix} 0 \\ -\frac{1}{1-\theta} \end{bmatrix}$ is the partial derivatives of the FOC with respect to θ and $\frac{1}{|J|} \begin{bmatrix} pf_{XX} & -pf_{LX} \\ -pf_{XL} & pf_{LL} \end{bmatrix}$ is the inverse of the Jacobian matrix. Thus,

$$\frac{dL}{d\theta} = -\frac{1}{|J|} \left(\frac{prf_{LX}}{(1 - \theta)^2} \right) < 0$$

since $\frac{1}{|J|} > 0$ and $\left(\frac{prf_{LX}}{(1-\theta)^2}\right) > 0$.

And

$$\frac{dX}{d\theta} = \frac{1}{|J|} \left(\frac{prf_{LL}}{(1-\theta)^2} \right) < 0$$

since $\frac{1}{|J|} > 0$ and $\frac{prf_{LL}}{(1-\theta)^2} < 0$. Thus, optimal labor and other inputs, and hence total output, are decreasing in the risk of a farm labor shortage.

Table 5
Means and Standard Deviations of Main Variables

	2001-2006	2006-2011	2011-2017	2001-2017	01-06 & 11-17
	(1)	(2)	(3)	(4)	(5)
$\Delta asinh(H-2A)$	2.00 (2.24)	-0.27 (1.63)	1.68 (2.12)	1.09 (2.24)	1.83 (2.18)
Housing Demand Change	0.42 (0.63)	-1.09 (0.73)	0.65 (0.65)	-0.03 (1.03)	0.54 (0.65)
$\Delta \ln(\text{Low-Skill Emp})$	0.02 (0.09)	-0.10 (0.09)	0.10 (0.08)	0.01 (0.12)	0.06 (0.10)
$\Delta \ln(\text{Construction})$	0.11 (0.18)	-0.28 (0.24)	0.15 (0.19)	-0.01 (0.28)	0.13 (0.19)
$\Delta \ln(\text{Weekly Farm Wage})$	0.17 (0.12)	0.14 (0.11)	0.20 (0.10)	0.17 (0.11)	0.18 (0.11)
N	312	364	364	1040	676

Notes: This table reports summary statistics for the main variables used in this study. The proxy for changes in housing demand defined as the change in the sum of log housing prices and building permits. Standard deviations are reported in parenthesis.

Table 6
Means and Standard Deviation of H-2A Employment (levels)

	2001 (1)	2006 (2)	2011 (3)	2017 (4)
H-2A Workers	70.21 (587.55)	183.68 (400.70)	176.44 (458.96)	544.60 (1295.78)
$asinh(H-2A)$	1.69 (2.26)	3.91 (2.45)	3.63 (2.53)	5.31 (2.20)
N	364	364	364	364

Notes: This table reports means and standard deviations for the level of H-2A employment for the CZs in our sample. Standard deviations are reported in parenthesis.

Table 7
H-2A Employment, Housing Demand Shocks and Filer Exposure, 2011-2017

Dep.Var.: $\Delta asinh(H-2A)$	(1) OLS	(2) 2SLS Struct. Break IV	(3) 2SLS Sensitivity IV
I.			
Change in Housing Demand (2011-2017)	0.47*** (0.17)	1.20*** (0.35)	1.77*** (0.56)
Intermediary Exposure (CZ Level)	1.23*** (0.30)	1.27*** (0.31)	1.01*** (0.39)
First Stage F-Statistic		57.8	62.3
II.			
Change in Housing Demand (2011-2017)	0.42** (0.17)	1.17*** (0.37)	1.77*** (0.58)
Intermediary Exposure (State Level)	1.46*** (0.36)	1.39*** (0.37)	0.63 (0.53)
First Stage F-Statistic		57.3	60.6
N	364	364	246
Controls	X	X	X

Notes: In panel I, the intermediary exposure variable is the share of CZ H-2A certifications where the application was filed by a consulting agency, a law firm, or a growers association in the presample. In panel II, the intermediary exposure variable is the share of state H-2A certifications where the application was filed by a consulting agency, a law firm, or a growers association. For CZs located in more than one state, we use the state with the largest fraction of the population of the CZ. The proxy for changes in housing demand is 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. All specifications include the controls described in table 3 and cluster robust standard errors at the CZ level. All models are unweighted. ***, **, * denotes significance at 1%, 5%, and 10% level respectively.

Table 8
Pre-period Checks

	$\Delta \ln(\text{Emp})$ (1996-2000)	$\Delta \ln(\text{Wages})$ (1996-2000)	$\Delta \ln(\text{Acre})$ (1997-2002)	$\Delta \ln(\text{Acre F\&V})$ (1997-2002)	$\Delta \ln(\text{Land Value})$ (1997-2002)
	(1)	(2)	(3)	(4)	(5)
I.					
Struct. Break IV	0.16 (0.30)	-0.13 (0.12)	-1.69 (1.11)	-1.32* (0.72)	-0.14 (0.20)
N	298	298	298	298	298
R-squared	0.146	0.123	0.424	0.114	0.225
II.					
Sensitivity IV	0.07 (0.24)	0.06 (0.06)	-0.34 (0.40)	0.06 (0.28)	0.06 0.17
N	207	207	207	207	207
R-squared	0.112	0.232	0.450	0.119	0.241
III.					
$\Delta \hat{H}$	-0.02 (0.02)	0.01 (0.01)	-0.01 (0.07)	0.08 (0.15)	-0.02 (0.01)
N	298	298	298	298	298
R-squared	0.146	0.124	0.419	0.113	0.227

Notes: In panels I,II, and III, the explanatory variables are the (2001-2006) magnitude of the structural break, the sensitivity instrument, and the proxy for the change in housing demand, respectively. The proxy for changes in housing demand is defined as the change in the sum of log housing prices and building permits. In columns 1-5, the dependent variables are the change in the log of average employment and weekly wages in agriculture for 1996-2000, and of total acres, acres in fruits and vegetables, and land values, as described in the column headings. Employment and wage data come from the QCEW confidential dataset, and acreage and land values data from the 1997 and 2002 Agriculture Censuses. All specifications include the controls described in table 3, and cluster robust standard errors at the CZ level. All models are unweighted. ***,**,* denotes significance at 1%, 5%, and 10% level respectively.

Table 9
H-2A and Employment Outcomes, OLS Regressions

Dep.Var.: $\Delta \ln(H-2A)$	(1)	(2)
I. Construction Employment		
$\Delta \ln(\text{Construction Emp})$	1.11*** (0.34)	1.01*** (0.35)
R-squared	0.210	0.327
II. Low-Skilled Employment		
$\Delta \ln(\text{Low-Skill Emp})$	1.64** (0.82)	1.71** (0.79)
R-squared	0.204	0.324
Time FE	Yes	Yes
Specification	OLS	OLS
Controls		X
N	1040	1040

Notes: In panels I, and II, the explanatory variables are the change in log employment in the construction sector, and employment in low-skilled sectors, 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). In column 1 we only control for time fixed effects. In columns 2 we include all controls described in table 3. All models are unweighted. ***, **, * denotes significance at 1%, 5%, and 10% level respectively.

Table 10
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	0.32*** (0.10) OLS	0.31*** (0.10) OLS X	0.31*** (0.12) OLS X X	0.31*** (0.12) OLS X X X	0.33*** (0.12) OLS X X X X	1.07*** (0.37) 2SLS X X X X	0.83* (0.47) 2SLS X X X X
Specification							
Ag. Emp. Controls							
Industry Emp. Shares							
Immigration Controls							
Other Controls							
N	1040	1040	1040	1040	1040	1040	708
First Stage F-Statistic						83.5	67.0
II. First Stage							
Instrument						3.88*** (0.41)	1.82*** (0.21)
R-squared						0.693	0.780

Notes: This table repeats the analysis in table 3 now using the 2001-2007, 2007-2011, and 2011-2017 subperiods instead of the 2001-2006, 2006-2011, and 2011-2017 subperiods.