The Effect of Foreign Labor on Native Employment

A Job-Specific Approach and Application to North Carolina Farms

Michael Clemens

Abstract

Economists have measured the effects of immigration on native employment primarily with exogenous shifts in the foreign labor supply curve. I suggest an alternative, occupation-specific approach: directly describe, for one job, the native labor supply curve. I apply the method to seasonal farm work in North Carolina, and use two natural experiments to estimate native labor supply. The first natural experiment uses a legal requirement for farmers to demand native workers as perfect substitutes for foreign workers; this describes the level of native labor supply. The second natural experiment uses the spike in US unemployment during the 2007–8 economic crisis; this describes the local slope of native labor supply. The level and slope of native labor supply to this job, at both extensive and intensive margins, are nearly zero. This identifies two effects of foreign labor supply on native employment: a direct effect (close to zero) and indirect effect (positive) via consequent increases in sectoral output and its multiplier effects. I estimate that one U.S. job across all sectors of the North Carolina economy is created by each 1.5–2.3 foreign seasonal farm workers in the short run (Leontieff production), and by each 3.0–4.6 foreign seasonal farmworkers in the long run (Cobb-Douglas production).

JEL Codes: F22, J61, O15

Center for Global Development
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Working Paper 326
May 2013

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For data provision I thank the North Carolina Growers Association, the Division of Employment Security at the North Carolina Department of Commerce, and the Bureau of Economic Analysis at the US Department of Commerce. I thank Tejaswi Velayudhan and Marla Spivack for excellent research assistance. I received generous support from the John D. and Catherine T. MacArthur Foundation, the William and Flora Hewlett Foundation, and the Partnership for a New American Economy. I received help and ideas from Ann Bagchi, Gary Bullen, Stan Eury, Conor Hartman, Thomas Hertz, Jay Hill, David Nagel, Ben Powell, Lant Pritchett, Justin Sandefur, Peter Timmer, and Lee Wicker, plus seminar participants at the US Dept. of Labor, SMU, and Australian National University. I am solely responsible for any errors. Views expressed here are the author's only; they do not necessarily represent the views of the Center for Global Development, its board, or its funders.

CGD is grateful for contributions from the Partnership for a New American Economy, the William and Flora Hewlett Foundation, and the John D. and Catherine T. MacArthur Foundation in support of this work.

Michael Clemens . 2013. "The Effect of Foreign Labor on Native Employment: A Job-Specific Approach and Application to North Carolina Farms." CGD Working Paper 326. Washington, DC: Center for Global Development.
http://www.cgdev.org/publication/effect-foreign-labor

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1. Introduction

The literature uses two common methods to measure the effect of foreign labor on native employment, methods often called the "area" approach and the "factor proportions" approach. Both of these use shifts in the supply of foreign labor to measure subsequent changes in native unemployment. The "area" approach seeks exogenous changes of foreign labor supply within labor market segments delimited by geographic space, and measures changes in native employment in those spaces. The "factor proportions" approach seeks exogenous changes of foreign labor supply within labor market segments delimited by personal characteristics—especially age and education—and measures changes in native employment in those statistical cells, over larger geographic areas.

These approaches have been fruitful but have limitations. First, they face challenges in clarifying the mechanism of any employment effect: Is the degree of native-immigrant substitution within each labor submarket determined by labor demand (substitutability of native and foreign labor in the production function) or by labor supply (relative willingness of natives to accept certain jobs)? Second, in both approaches, adversely-affected native workers may go undetected if they self-select out of the submarket under examination—by moving out of immigration-intensive places, or investing in human capital to leave immigration-intensive statistical cells. Finally, both approaches rely on exogenous shifts in foreign labor supply, which is somewhat distant from real immigration policy. Much immigration policy regulates not just the supply of foreign labor but also the demand for foreign labor (not just *how many* foreign workers may enter, but *which* foreign workers employers may hire under what conditions).

In this paper, I propose a different, occupation-specific approach that has relative advantages and disadvantages. I build a simple model of the relationship between native labor supply for a job and effect of foreign labor supply to that job on native employment. I use two natural experiments affecting one occupation—seasonal farm work in the United States—to directly approximate the level and slope of native labor supply in that occupation. I apply the approach to a large group of farms in North Carolina.

This provides information about both the degree and the mechanism of foreign-native labor substitution in employment for this occupation.

The first of these natural experiments uses a provision of U.S. law that allows an unlimited supply of foreign seasonal farm labor but tightly restricts demand for that labor: Employers must hire native workers as if they were perfect substitutes for foreign workers, at fixed and equal wages. I use that provision to estimate the level of native labor supply for seasonal farm work at current terms of contract. I describe the universe of U.S. applicants to tens of thousands of seasonal farm jobs over a 15-year period (extensive margin labor supply) and describe how long they lasted before leaving the job (intensive margin labor supply).

The second experiment is a sudden, large, unexpected change in the demand for native labor in *other* occupations during the Great Recession. I use this to approximate the local slope of the native labor supply curve for seasonal farm work. I describe how unemployment shocks affect U.S. workers' applications to seasonal farm work (extensive margin) and their duration on the job (intensive margin). Theory and the labor literature suggest that a negative shock to expected reservation earnings should affect labor supply for a job analogously to a positive shock to that job's wage. This evidence suggests that both the level and the local elasticity of native labor supply to seasonal farm work are close to zero, which in turn suggests that the direct effect of foreign seasonal farm work on native employment is likewise close to zero.

This approach has advantages and disadvantages relative to other approaches. An advantage is that it elucidates the mechanism determining native-foreign employment substitution in this setting. Normally, imperfect substitution between native and foreign labor in the production function could give rise to different labor demand for native and foreign workers. But since employers are obliged to hire native workers as if they were perfect substitutes for foreign workers, any observed imperfect substitution must arise from differences in native and foreign labor supply. Another contribution is that the approach is a more direct measure of substitution, less prone to biases that can arise from other approaches when natives self-select out of immigration-intensive

geographic areas or skill groups. The first natural experiment used here requires each job to be first offered to all unemployed U.S. workers in the state and the relevant skill group. A third advantage is that this approach is more relevant to policy in some settings: the consequences of common restrictions on demand for foreign labor are not well-identified by natural experiments that shift only the supply of foreign labor. The occupation-specificity of the approach has advantages or disadvantages depending on the research question: It is less informative than typical research designs about the unemployment effects of regulations on the overall supply of foreign labor, but more informative about the effects of regulations on labor demand for particular types of foreign labor. Findings in the setting of seasonal farm work are certainly not externally valid to other settings, but the approach can be used in other settings.

The analysis finds that the level and local elasticity of native labor supply for seasonal, manual farm work in North Carolina—at both extensive and intensive margins—is well approximated by zero at current terms of contract. This suggests a near-zero direct effect of foreign labor supply to this occupation on native employment. This matches numerous findings in the literature across broader ranges of occupations. It furthermore offers evidence against a number of reasons for that near-zero effect. It is not because employers have a different demand for foreign workers, since they are required to demand native workers as perfect substitutes. It is not because native workers lack information about the jobs, since intensive-margin labor supply (among native workers aware of and experienced in this job) is likewise near zero. It is not because employers refuse modest increases in the wage; the local elasticity of native labor supply is barely distinguishable from zero across a substantial range.

Aside from these direct effects, this analysis implies an indirect effect of foreign seasonal farm labor on native employment—within and beyond the agriculture sector. If native labor supply to essential manual agricultural work is close to zero, foreign workers in agriculture heavily influence the output of the sector as well as its multiplier effects on other sectors' output. This effect is conditional on current technology, and would be altered by the full mechanization of the subsectors where most seasonal agricultural labor works. The multiplier effect generates native employment across all sec-

tors of the state economy. A conservative estimate is that, in the short run and without any adjustment by farmers, each 1.5–2.3 foreign seasonal farm workers create one native job in North Carolina. In the long run, following the greatest plausible adjustment by farmers, each 3.0–4.6 foreign seasonal farm workers create one native job in North Carolina.[1]

I begin by discussing previous related research and the predictions of a simple theory of immigration regulation via regulation on the demand for foreign labor. I then discuss details of the two natural experiments on which the analysis rests: legal restrictions on U.S. employers' demand for foreign seasonal farm work, and sharp changes in generalized U.S. demand for native workers in the Great Recession. Thereafter I discuss the empirical setting: a group of farms in North Carolina that is the largest user of the U.S. seasonal farm-work visa. I use those data to explore native labor supply for seasonal farm work at the extensive and intensive margins. I then sketch the effects of foreign seasonal farm labor supply on native employment across all sectors of the North Carolina economy, under assumptions about the agricultural production function and regional economic multipliers.

2. A new empirical approach

For over a century, the effect of foreign workers on native employment has shaped the economic research agenda (e.g. Hall 1913) and immigration policy (e.g. Goldin 1994) in the United States. The recent empirical literature takes two general approaches—the "area" approach and the "factor proportions" approach (Borjas et al. 1996).[2] The area

[1] These figures refer to the effects on the total stock of all jobs available to all North Carolinians seeking work. They do not refer to "displacement" effects on jobs held currently by North Carolinians, which could be replaced if lost. In other words, they do not mean that a decrease in the supply of seasonal farm labor would require currently employed North Carolinians to seek alternative jobs among an undiminished total number of jobs; rather, they imply that there would be a decline in the total number of jobs that could be sought by anyone.

[2] Bodvarsson and Van den Berg (2009, p. 133) call these two approaches the "spatial correlation method" and the "skill cell method", respectively. They also identify a third "production function method", starting with Grossman (1982), that first estimates demand elasticities for immigrant and native labor in production functions and uses those elasticities to compute the labor-market effects of immigrant supply. Because this subliterature estimates the production function using immigrant flows into delimited geographic areas, I follow Borjas et al. (1996) and include it within the "area" approach.

approach tests whether locals' unemployment rises after inflows of immigrants to limited geographic areas.[3] The factor proportions approach tests whether locals' unemployment rises after increases in immigrant share within age, experience, and/or occupation cells across a broader labor market.[4] Most of the studies using both approaches find that immigrants have quite small effects on overall unemployment among native workers.

The reason the effects are not larger is an area of active research with no consensus (Freeman 2006). Leading explanations for modest employment effects in geographic area studies include out-migration by local jobseekers (Borjas et al. 1997; Card 2001; Hatton and Tani 2005) and stimulation of local labor demand by immigrants' consumption (Bodvarsson et al. 2008). Leading explanations for modest effects in age/experience/occupation cell studies include capital adjustment and technological change (surveyed in Longhi et al. 2005). [5]

This study takes a new approach. It uses a natural experiment in which a large number of immigrant jobs were exogenously offered to native workers on identical terms. It measures native labor supply to those jobs initially and—in a second natural experiment—measures how native labor supply to those jobs changed following a large exogenous shock to native workers' alternative employment options. One advantage of this approach over the alternatives is that it allows identification of whether native-foreign labor substitution—in this setting only—is determined by the relative shapes of employers' demand functions for the two types of labor, or by the relative shapes of native and foreign workers' labor supply functions.

[3] These include Grossman (1982); Card (1990); Altonji and Card (1991); Hunt (1992); Carrington and de Lima (1996); Pischke and Velling (1997); Angrist and Kugler (2003); Dustmann et al. (2005); Cohen-Goldner and Paserman (2011); Jean and Jimenez (2011); González and Ortega (2011); Glitz (2012); Smith (2012). I omit studies that test effects on wages only and not employment.

[4] These include Borjas et al. (1997); Winter-Ebmer and Zweimüller (1999); Friedberg (2001); Borjas (2003); Carrasco et al. (2008); Ottaviano and Peri (2012); Facchini et al. (2013). Again I omit studies that test effects on wages only and not employment.

[5] A few studies find more substantial effects of immigration on native unemployment: Glitz (2012) finds that immigration cause substantial increases in unemployment in Germany and Angrist and Kugler (2003) find such displacement across the EU, to a lesser degree in countries with more flexible labor market institutions; Altonji and Card (1991) find that immigration causes substantial *declines* in unemployment in the United States.

A few prior studies have investigated the degree of native-immigrant substitution within occupations (including Card 2001; Peri and Sparber 2009). These research designs face challenges in specifying the mechanism that determines the degree of substitution. It could be determined by the labor demand function: Employers may get a different marginal revenue product from foreign labor, or employers have greater market power in hiring foreign workers and can pay them less—particularly on the black market. Alternatively, it could be determined by native workers' labor supply: Employers may have the same demand for both types of workers, but foreign labor supply may exceed native labor supply at given terms of contract. These questions are important to understanding and regulating the labor market impacts of particular types of immigration, and the answers are likely to vary greatly by occupation.

A second advantage of this approach is that the "area" approach and the "factor proportions" approach are vulnerable to native self-selection out of the labor market segment under investigation. Unemployment effects on natives within immigration-intensive geographic areas can be unobserved if natives move away from those areas (e.g. Hatton and Tani 2005). Likewise, unemployment effects on natives within statistical cells can be mitigated if natives self-select out of those cells. For instance, native high-school dropouts can mitigate the employment effects of immigration into high-school dropout skill cells by staying in high school or completing a General Equivalency Diploma (e.g. Hunt 2012). The alternative approach in this paper directly measures the willingness of native workers to take foreign workers' jobs, prior to the foreign workers' arrival. It therefore does not miss any impacts on natives caused by self-selection out of the sample resulting from the foreign workers' arrival.

A final advantage of this approach is that it tests the effects of immigration regulation via regulation of demand for foreign labor instead of via regulation of the supply of foreign labor. Much existing research, though it is motivated in part by an interest in immigration policy, tests only the effects of greater or lesser supply of immigrant labor. This is somewhat removed from policy, for two reasons.

First, most important migrant destination countries regulate not simply the number

of foreign workers who can enter, but also extensively regulate *which* foreign workers employers may hire, under what terms (see subsection 4.1.). The effects of labor supply regulations are not fully informative about the effects of labor demand regulations, for the same reason that an international trade literature about the effects of overall import flows on a country is not fully informative about the effects of trade barriers like local-content restrictions and local licensing requirements. Second, with large movements of unauthorized labor across some important borders, the ability of governments to regulate foreign labor supply has limits (e.g. Hanson and Spilimbergo 1999; Hanson et al. 2002). That is, studies of the effects of foreign labor supply are not even fully informative about the effects of supply-side restrictions because flows of labor across borders are only partly determined by those restrictions. The labor demand restrictions analyzed in this paper, in the setting examined, do not suffer from a large degree of extralegal activity; there is no evidence that substantial numbers of U.S. workers have been illegally turned away from the jobs examined here.

3. Native labor supply and the effects of foreign labor

I argue that there are advantages to a research design that allows separation of the effects of labor demand and labor supply on native-foreign labor substitution. Here I discuss these advantages in a simple model. Following LaLonde and Topel (1991) and Card (2001) as extended by Angrist and Kugler (2003), let the output y of a firm employing native and immigrant workers in some occupation be

$$\begin{aligned} y &= f\big(\theta g(N,M)\big), \\ \text{where} \quad g &= \big(N^{\rho} + \gamma M^{\rho}\big)^{\frac{1}{\rho}}, \end{aligned} \tag{1}$$

N and M are the demands for native and migrant labor in the occupation in question; θ is an exogenous shifter; $0 < \rho \leqslant 1$ determines the elasticity of substitution between native and migrant labor $\left(\frac{1}{1-\rho}\right)$; $\gamma > 0$ sets the relative marginal revenue product of native and migrant labor; and f is the production function such that $f'(\cdot) > 0$; and $f''(\cdot) < 0$. Normalizing the output price to unity, the employer sets demand to maximize profit $\Pi \equiv f(\theta g) - w^N N - w^M M$, where w^N and w^M are native and migrant wages. Here and

throughout, a subscript denotes the partial derivative. Demand for native labor N^d is set by the first-order condition

$$\ln f' + \ln g_N = \ln w^N - \ln \theta. \tag{2}$$

Now let natives have a different labor supply for the occupation than migrants, following Peri and Sparber (2009) and D'Amuri and Peri (2011). For a manual, routine occupation, this might be because natives dislike manual or routine work itself, because they dislike circumstances of the work (dirt, stench, exposure to the elements), or because they incur a social stigma for performing such work. Migrant labor supply M^s is fixed and inelastic, while native labor supply (shifted by a constant ξ) is

$$N^s = \xi \left(w^N\right)^{\varepsilon}, \tag{3}$$

where ε is the wage elasticity. To get the response of native labor to an increase in migrant labor, impose $N = N^d = N^s$ and $M = M^d = M^s$ by substituting (3) into (2), and totally differentiate with respect to M. Then,

$$N_M = \phi(\varepsilon, \cdot) \left(\frac{\theta f''}{f'} g_M + \frac{g_{NM}}{g_M} \right). \tag{4}$$

The first term in parentheses $\frac{\theta f''}{f'} g_M < 0$ represents the simple reduction in firms' use of native labor as the availability of migrant labor rises, provided that native and migrant labor are perfect substitutes.[6] If native and migrant labor are *imperfect* substitutes ($\rho < 1$), the term $\frac{g_{NM}}{g_M} > 0$ represents the countervailing increase in demand for native labor as the firm's production rises with greater use of migrant labor.[7] The overall effect of migrant labor on native labor is scaled by $\phi(\varepsilon, N, M, \rho, \theta) \equiv (1/N\varepsilon - g_{NN}/g_N - (\theta f''/f')g_N)^{-1} > 0$, where $\phi_\varepsilon > 0$.[8]

I highlight two implications of the effect of migrant labor on native labor (4). First, the effect has ambiguous sign, and the magnitude of any effect depends on three key

[6] The inequality holds because $g_M = \gamma \left(\frac{M}{g}\right)^{\rho-1} > 0$.

[7] The inequality holds because $\rho < 1 \iff \frac{g_{NM}}{g_M} = \gamma \frac{1-\rho}{M} \left(\frac{M}{g}\right)^{\rho} > 0$.

[8] Assuming imperfect substitution then $\phi > 0$, since $\frac{g_{NN}}{g_N} = N^{-1}(1-\rho)\left(\left(\frac{N}{g}\right)^{\rho} \frac{\rho}{N} - 1\right) \leqslant 0$.

forces. 1) It depends on the shape of f and thus the magnitude of $\theta f''/f'$. In different industries, therefore, the effect could differ. 2) It depends on the elasticity of substitution between native and migrant labor, $\frac{1}{1-\rho}$. The more imperfectly migrants substitute for natives in production, the smaller is any displacement effect. 3) The less willing native workers are to supply labor to this occupation (smaller ε), the smaller is any displacement effect.

Note that the effect of migrant labor depends both on the form of labor demand (via ρ) and, separately, on the form of labor supply (via ε). The most common approach in the literature is to estimate reduced-form equations capturing the overall effect N_M (Pischke and Velling 1997). These suit some purposes but do not allow separation of effects conditioned by firms' labor demand from effects conditioned by native and migrant labor supply. Such estimates also do not allow prediction of displacement by any given type of worker in a given industry.

Second, suppose a policymaker seeks to protect native employment, minimizing the average effect of migrant labor occasioned by the marginal effect. Equation (4) suggests two ways to accomplish this via migration policy: 1) The policymaker can regulate immigration by quotas, exogenously setting M^s to some low number, without changing the marginal effect N_M. 2) The policymaker can regulate a reduction in the marginal effect N_M: either the policymaker can regulate a lower bound on wages in immigrant-heavy industries (that is, force firms to behave as if $\frac{\theta f''}{f'} g_M$ were less negative), or can require firms to hire any native willing to do the work (that is, force firms to behave as if natives and migrants were perfect substitutes in production, thus $\rho = 1$ and $\frac{g_{NM}}{g_M} = 0$).

We observe governments doing each of these in different combinations: Governments sometimes regulate migration by quotas without wage/hiring restrictions (e.g. U.S. family-reunification residency visas); sometimes by wage/hiring restrictions without quotas (e.g. U.S. H-2A visa and Canada Seasonal Agricultural Workers Program); and sometimes have both quotas and wage/hiring restrictions (e.g. U.S. H-2B visa). A partial, explicit goal of all of these policies is to protect native employment. The effect of these interventions will be smaller to the extent that natives and migrants are im-

perfect substitutes in labor demand, and to the extent that labor supply to different occupations differs between natives and migrants.

Equation (4) is the key to interpreting the empirical results in this paper. It suggests that we can learn about the effect of foreign labor on native employment (N_M) by pinning down two parameters on the right-hand side: the degree to which foreign and native workers are complements in production (reflected by the term $\frac{g_{NM}}{g_M}$), and the elasticity of native labor supply (ε). Each of these, respectively, uses one of the two natural experiments described in the next section.

4. Two natural experiments

This paper uses two natural experiments to learn about the immigrant-native employment substitution relationship (4) in the setting of North Carolina seasonal farm labor. The first experiment is a legal restriction to hiring foreign seasonal farm workers that obliges employers to set demand for native labor as if native and foreign labor were perfect substitutes ($\rho = 1$, and thus $\frac{g_{NM}}{g_M} = 0$).

The second experiment uses an exogenous unexpected shock to the reserve employment options of natives, which is informative about the local slope of the native labor supply curve (ε). The lower this slope, the lower the effect of foreign labor demand restrictions on the displacement of native labor by foreign labor (since $\lim_{\varepsilon \to 0} N_M = \lim_{\varepsilon \to 0} \phi = 0$). Together, these two experiments imply that if ε is close to zero, then the effect of foreign labor on native employment N_M is negative but likewise close to zero.

4.1. First experiment: Native labor demand requirements for the H-2A visa

The first natural experiment used here is a legal restriction on the hiring of foreign labor under one major employment-based visa. This "H-2A" visa allows entry for low-skill, seasonal agricultural labor. The United States limits U.S. employers' foreign labor demand under the H-2A visa. But there is no numerical limit on foreign workers' labor

supply, no cap on the number of H-2A visas that can be given. Employers needing additional seasonal agricultural labor can sponsor foreign workers to enter the U.S. and remain for up to 10 months per year. In fiscal year 2011, the U.S. issued 55,384 H-2A visas. Of these, 51,927 (93.8%) went to workers of Mexican nationality.

Labor demand restrictions are common in immigration policy. Many countries regulate both the supply of and the demand for immigrant labor under employment-based visas. For example, the United States restricts labor supply through most employment-based resident visas via tightly-binding quotas. But it also regulates demand for workers through the same visas—such as by requiring employers to actively recruit any able and willing American worker before hiring a foreign worker.[9] Similar restrictions on labor demand apply to the U.S.'s largest temporary ("nonimmigrant") employment-based visas: H-1B for skilled immigrants with "specialized knowledge" and H-2A/B for low-skill seasonal workers. The United States is not exceptional in this regard. Most principal migrant destination countries, in addition to restricting the supply of migrant labor, likewise regulate demand for foreign workers.[10]

Prospective employers of H-2A workers must first receive a Foreign Labor Certification from the U.S. Dept. of Labor. To receive certification, employers must work with the State Workforce Agency to prepare a job order for intrastate and interstate recruitment of U.S. workers, advertise the positions in two local daily newspapers (and, in some

[9]The two largest categories of employment-based resident visas to the United States are the E2 category ("Professionals Holding Advanced Degrees and Persons of Exceptional Ability") and E3 category ("Skilled Workers, Professionals, and [Non-Seasonal] Unskilled Workers"). There are numerous limits on demand for immigrant labor through these visas. Employers may not sponsor a worker for these visas until the U.S. Dept. of Labor has certified that "there are not sufficient workers who are able, willing, qualified ... and available at the time of application ... and at the place where the alien is to perform such skilled or unskilled labor, and the employment of such alien will not adversely affect the wages and working conditions of workers in the United States similarly employed" (U.S. Immigration and Nationality Act, Section 212(a)(5)(A)). Employers must furthermore prove to the U.S. Dept. of Homeland Security that E2 workers have at least 10 years of work experience, that unskilled E3 workers are performing labor that is demanded in every month of the year, that skilled E3 workers have at least two years of work experience, and numerous other requirements. There are also limits on the supply of immigrant labor through these two visas: with minor exceptions, the number of entrants under each visa is currently restricted to a worldwide total of 40,040 per year, of which no more than 2,802 can go to nationals of any one country. (The number of workers is much smaller because spouses and children count against the quota.) These are tightly binding; the waiting list for most countries at the time of writing is 3 years for E2 and 6 years for E3. It is even longer for China and India.

[10]Examples from other migrant-destination countries are reviewed in Appendix section C.

states, on local radio stations), contact former U.S. workers to advise them of the opening, and prove to the Dept. of Labor National Processing Center (NPC) that they have done all of the above. This must occur at least 45 days before the job's start-date. Finally, "employers must submit a 'recruitment report' to the NPC at least 30 days before the start date that lays out the recruitment efforts made, identifies U.S. workers who applied for jobs, and explains 'lawful job-related reason(s)' for not hiring each U.S. worker who applied but was not hired; the number of jobs certified to be filled by H-2A workers is reduced for each U.S. worker wrongly rejected by the employer" (Martin 2008, p. 18). The requirement to hire any able and willing U.S. worker extends from the time of certification up to 50% of the way through the contract period.

Both native and foreign workers must be paid the same fixed wage set for each state called the Adverse Effect Wage Rate (AEWR), or the state or federal minimum wage if it is higher. Employers must also provide identical housing, laundry, and sanitation facilities for both types of workers, and international transportation for foreign workers.

The program is unpopular with U.S. farmers. Most foreign labor hired for seasonal farm work in the U.S. is hired on the unauthorized labor market rather than through the H-2A program (Carroll et al. 2005; Martin 2008). Less than five percent of all hired farmworkers are hired through the program, even though about three quarters of crop farmworkers have Mexican nationality (Kandel 2008, p. 14). Farmers complain that the H-2A program is "costly, unpredictable, and administratively flawed" (Wicker 2012), including the bureaucratic burden of advertising to, hiring, keeping records of, training, and replacing U.S. workers who show limited and short-lived interest in the positions (Martin and Taylor 2013).[11]

Employers hiring H-2A workers are required to make hiring decisions as if native and foreign workers were perfect substitutes. For this reason, any imperfect substitution in employment between these two groups is reliably attributable to the relative shape of

[11] I am not aware of scholarship on the effects of these burdens on use of the U.S. agricultural seasonal work visa program. Studying Australia, Gibson and McKenzie (2011) and Hay and Howes (2012) find that excessive red tape and bureaucratic requirements—including the requirement to prove that no Australian worker is interested in every position—prevented most employers from using Australia's Pacific Seasonal Worker Pilot Scheme.

the labor supply curves for native and foreign labor, at current terms of contract.

4.2. Second experiment: Unemployment in the Great Recession

The second experiment uses the sharp, exogenous, unexpected rise in U.S. unemployment in 2008 to provide information about the local slope of the native supply curve for seasonal farm work—away from current terms of contract. Figure 2 shows the large and sudden change in unemployment during the period under examination. The empirical problem is to measure the elasticity of labor supply by unemployed native workers for manual farm jobs. An ideal natural experiment would create exogenous changes of wage in job offers, or exogenous shifts in the labor demand curve, allowing the labor supply curve to be traced. An alternative method is to use exogenous shocks to labor demand in the unemployed worker's prospective alternatives.

How much labor will an unemployed native worker supply to a manual farm job? We now replace the assumed form of labor supply (3) with the richer, canonical model of labor supply in Cahuc and Zylberberg (2004, p. 33). Suppose an unemployed worker chooses labor supply to farm-work by solving $\max_{C,L} U = C^{1-\beta}L^{\beta}$ subject to $C + wL = w\bar{L} + R$, where C and L are consumption and leisure, w is the wage, β is the Cobb-Douglas elasticity, $\bar{L}$ is the total endowment of time available to be allocated between work and leisure, and R represents expected future income from prospective future wages outside of farmwork plus current nonwage income. For example, R could include prospective future income from white-collar employment (borrowed against), and current unemployment insurance payments.[12] Native labor supply N^s aggregates labor supply $n^{s,i}$ by each individual i:

$$N^s = \sum_i n^{s,i} \quad \text{where} \quad n^{s,i} = \begin{cases} 0 & \text{if } \frac{w}{R} < \frac{\beta}{1-\beta}\frac{1}{\bar{L}}; \\ (1-\beta)\bar{L} - \beta \cdot \frac{R}{w} & \text{if } \frac{w}{R} \geqslant \frac{\beta}{1-\beta}\frac{1}{\bar{L}}. \end{cases} \tag{5}$$

The first line shows labor supply at the extensive margin, the second line at the inten-

[12]The reservation wage $\bar{w}$ is the marginal rate of substitution between leisure and working at the farm job, evaluated at the point of maximum leisure $\bar{L}$: $\bar{w} = \frac{U_C}{U_L}\big|_{R,\bar{L}} = \frac{\beta}{1-\beta}\frac{R}{\bar{L}}$. The participation constraint $w \geqslant \bar{w}$ is therefore $\frac{w}{R} \geqslant \frac{\beta}{1-\beta}\frac{1}{\bar{L}}$.

sive margin.

In this simple model, two shocks have inverse and symmetric effects: an increase in the wage w, and a decrease in prospective alternative income R. This symmetry holds at the extensive margin of accepting any manual farm work, and at the intensive margin of choosing how many hours to work. Labor supply is elastic to a large negative shock in R if and only if it is elastic to a large positive shock in w.

This symmetry motivates the natural experiment used here. The Great Recession of 2007–2008 caused a large negative shock to prospective income from alternative jobs for unemployed workers in the short- to medium-term. A longstanding empirical labor literature provides support for the model in (5), showing that labor supply at a given wage rate responds positively to the duration of unemployment, corresponding to a reduction in expected R.[13] If the effect of a large shock to the unemployment rate on labor supply to any given occupation is very small, this suggests that β for this occupation is very small—which in turn suggests a near-vertical labor supply curve.

This does not mean that the response of native labor-supply to changes in the unemployment rate can offer straightforward numerical estimates of the labor supply slope β. The percentage change in perceived R for the average unemployed person could differ from the percentage-point change in the overall unemployment rate. This approach may nevertheless provide information about β. Assuming that changes in overall unemployment are well correlated with changes in R, any very large shock to the overall unemployment rate must cause a substantial percentage change in expected income from other employment options. If such shocks are not associated with substantial changes in labor supply, this is suggestive (but not conclusive) evidence that β is small.

I use both of these natural experiments to study labor market outcomes at a large network of farms in North Carolina that hires foreign seasonal manual agricultural labor exclusively through the H-2A program. North Carolina was subject to the large unem-

[13] This includes Kasper (1967); Barnes (1975); Kiefer and Neumann (1979); Fishe (1982); Lancaster and Chesher (1983); Feldstein and Poterba (1984); Addison and Portugal (1989). The average duration of unemployment and the expected probability of finding a new job within a give time are clearly correlated with the unemployment rate. The observed Beveridge curve in the U.S. is further evidence of this pattern.

ployment shock in 2008 experienced by the rest of the country.

Figure 1 sketches how these natural experiments provide new, occupation-specific information about mechanisms. The traditional "area" and "factor proportions" approaches (Figure 1a) trace the effects of a shift in foreign labor supply S_{foreign}, where L is quantity of labor and w/R is the ratio of wage to reserve option in equation (5). The effect on native employment and wages (point a) depends on both the shape of native labor supply S_{US} and the degree to which native and foreign labor are substitutes in the production function (the relationship between labor demand curves D_{US} and D_{foreign}). These approaches make it difficult to attribute observed effects to supply or demand. In this paper (Figure 1b), two natural experiments assist with isolating mechanisms. First, hiring restrictions force employers to have the same, infinitely elastic demand curve for both native and foreign labor (D). Second, natural shocks to the reserve option R exogeously shift D up and down in $\{L, \frac{w}{R}\}$ space. Observed native employment outcomes thus trace the local level and slope of S_{US}. This informs the mechanism for effects of foreign labor on native employment in this occupation.

5. Empirical setting: the North Carolina Growers Association

The data for this study come from the North Carolina Growers Association (NCGA), a network of approximately 700 farms across the state of North Carolina. In recent years the NCGA has hired about 6,500–7,000 foreign seasonal farm workers per year on H-2A visas (Table 1), making it the largest single user of the H-2A visa program. Its members grow cucumbers, sweet potatoes, tobacco, and Christmas trees, as well as smaller quantities of other crops including peppers, hay straw, beans, corn, and horticulture plants. Unlike most of the otherwise similar farms in the United States, the NCGA comprises farms whose sole source of foreign manual seasonal labor is the H-2A program.

The NCGA was founded in 1989 as a nonprofit business association to exploit group returns to scale in H-2A recruitment and regulatory compliance. It secures Foreign Labor Certifications for its member farms, processes foreign and domestic applicants for

H-2A jobs, trains and orients new workers, mediates in disputes between farmers and workers, and serves as the link between farmers and state and federal regulators. The NCGA hires the Mexican firm CSI Labor Services S.A. de C.V. of Monterrey, Nuevo León to recruit seasonal workers throughout Mexico. Most of these workers come from interior states of Mexico, not border states; the top five states of origin for NCGA workers in 2012 were, in decreasing order: Durango, Nayarit, San Luis Potosí, Guanajuato, and Hidalgo. Recruits are processed at the U.S. consulates in Monterrey and Nuevo Laredo, and brought by chartered bus to its headquarters at Vass, North Carolina before assignment to worksites across the state.

As described above, the NCGA is required to recruit unemployed U.S. workers for every H-2A job through the state workforce agency, the Division of Employment Security (DES) at the North Carolina Department of Commerce. Announcements of these jobs are mailed to any registered unemployed person who has expressed an interest in farm work, they are recommended by DES counselors monitoring unemployment benefits recipients, and they are listed at jobs terminals in DES offices statewide that are open to any member of the public. Upon request any DES office will refer an interested U.S. worker to the NCGA. The NCGA is furthermore required to purchase newspaper advertisements, in four newspapers across three states, for U.S. workers to fill every H-2A job.

Extremely few unemployed North Carolina residents processed by the DES show initial interest in NCGA jobs, and much fewer are willing to report for work and complete a harvest season. Table 2 summarizes these DES referrals to NCGA seasonal jobs over the last several years. The first three columns show the calendar year, the state unemployment rate in each year, and the annual average number of unemployed workers in the state. The next three columns show the number of new applications for jobs received by all DES offices statewide, and the number of referrals made to any employer in the state for non-agricultural and agricultural employment. The next column shows the number of these referrals that were sent to the NCGA. Almost all of these were hired by the NCGA, as shown in the next column. The following column shows how many of these reported for the first day of work. The penultimate column shows how many

of these worked until the end of the contract, without quitting or being fired. The final column shows the number of missing observations—workers whose outcome was not recorded.[14]

Why are so few unemployed workers willing to consider, accept, or complete these jobs? The pattern cannot be easily explained by geographic separation between NCGA jobs and DES offices, shown in Figure 3. While it is true that U.S. workers are less likely to show interest in NCGA jobs far from their residences, very large numbers of unemployed North Carolinians live close to NCGA worksites. Figure 3a shows the locations of NCGA H-2A jobs. Figure 3b shows the counties-of-residence of U.S. workers referred to the NCGA, and the locations of DES local offices. Figure 3c shows unemployment by county in 2011. The first two maps show that unemployed U.S. workers living close to NCGA worksites are more likely to show interest in the jobs.[15] But the unemployment map shows that every county that contains NCGA worksites either is or adjoins a county where unemployment was over 10% in 2011. Furthermore, access to DES offices is unlikely to be a major factor limiting native labor supply; in Figure 3b there is little correlation between U.S. referrals' residences and the presence of a nearby DES office.

6. Results

What is it, then, that so severely curtails native employment in these jobs? We can rule out one candidate explanation: There is no evidence that the North Carolina Growers Association is substantially out of compliance with the regulation to hire native workers as if they were perfect substitutes for foreign workers. The NCGA is closely watched by state and federal regulators; its members receive scores of inspections from the Dept. of Labor each year. Neither regulators nor advocacy groups currently allege that the NCGA systematically and illegally turns away substantial numbers of native workers willing and able to perform seasonal manual work.

[14] Due to a data fault, NCGA records on U.S. referrals for calendar year 2007 were not preserved.

[15] H-2A employers are required to provide basic, dormitory-style, state-inspected housing for workers who do not live nearby, so this pattern plausibly reflects a preference by U.S. workers to live at home during the work season and avoid employer-provided housing.

The analysis to follow explores alternative explanations. It could be that there is a special characteristic of the places with NCGA jobs that creates a spatial mismatch between unemployed U.S. workers and NCGA jobs. For example, the state workforce agency (Division of Employment Security) offices in places with NCGA jobs might not be the offices where large numbers of the unemployed go to seek work. It could be that unemployed U.S. workers, despite legal obligations for the NCGA to advertise through the DES and through local newspapers, do not learn of the jobs' existence. It could be that U.S. workers' access to unemployment insurance gives them a better option than manual farm labor. It could be that the NCGA pays too little to attract U.S. workers, but with modest increases in wages, native labor supply would rise. I test each of these in turn.

The interpretation of these results rests on equations (4) and (5). In this setting, employers are obliged to treat native and foreign workers as perfect substitutes ($g_{NM}/g_M = 0$), thus $N_M < 0$. But the magnitude of N_M depends on native labor supply elasticity ε, approximated by exogenous changes in R via equation (5), and $\varepsilon \approx 0 \implies N_M \approx 0$.

6.1. The elasticity of native labor supply: Extensive margin

The first step is to explore the effect of local unemployment on DES referrals to the NCGA and the outcomes of those referrals.[16] This analysis is conducted by DES office and month. Descriptive statistics are in Table 3.

Table 4 shows panel fixed-effects regressions with DES referrals and their outcomes as the dependent variable, local unemployment and office-level job-applications as the regressors, and DES office fixed effects. The first four columns show the relationship between the regressors and all referrals by each DES office to all jobs in the state, first non-agricultural jobs and then agricultural jobs. The final four columns show the same relationship for referrals by each DES office to the NCGA, and the outcomes of those referrals. To make all eight columns comparable, the NCGA referral data are restricted to the same months and years for which overal DES referral data are available: February

[16]'Local unemployment' means the unemployment rate at each DES office. This is calculated as the average unemployment rate in the counties served by that office, weighted by county labor force.

2005–May 2011.

Two features of Table 4 are notable. First, there is a positive association between local unemployment and referrals to the NCGA, as well as hiring by the NCGA—controlling for how many applications the DES office has received in the current month and in each of the preceding 10 months (columns 5 and 6). This relationship is significant at the 1% level. There is a much weaker, but still statistically significant positive relationship between unemployment and the number of those referrals who arrive to begin work at the NCGA (column 7). There is no detectable relationship between local unemployment and the number of U.S. referrals who complete their contracts with the NCGA (column 8).

Figure 4 represents these coefficients graphically as margins plots. The vertical axes are multiplied by the number of DES offices in the sample and the number of months in a year, so that they represent the expected number of total U.S. workers statewide per year. The horizontal axes show local unemployment. Those plots reveal that the magnitude of these relationships is extremely small. A 10 percentage-point rise in unemployment is associated with roughly 100 additional referrals to the NCGA each year, controlling for all time-invariant traits of the DES office in question as well as the number of applications it has received in the preceding 10 months. The same shock to unemployment is associated with about 50 additional U.S. workers statewide per year who actually arrive to begin work, and has no significant association at all with the number who complete work.

A second notable feature of Table 4 is that NCGA referrals are negatively correlated with lagged numbers of overall job applications at each DES office for the first five months of lags, but positively correlated for lags 6–10. One explanation for this pattern is the fact that, under the Employment Security Law of North Carolina, the maximum duration of state unemployment insurance benefits is 26 weeks. The coefficients are compatible with, but not conclusive evidence of, an effect of unemployment benefits that deters application to NCGA jobs: those who became unemployed during the coverage period are less likely to express interest in NCGA jobs (the negative coefficients in lags 0–5),

and those whose coverage expires are more likely to show interest.[17]

Any such deterrence effect from unemployment insurance is controlled away in the last column of Table 4, but the coefficient on unemployment is indistinguishable from zero. This suggests that unemployment insurance is not a substantial reason that we observe no relationship between local unemployment and native-worker completion of NCGA jobs.

6.2. The elasticity of native labor supply: Intensive margin

The analysis now shifts to the level of individual employment episodes. I start by measuring the attrition of U.S. referrals between the referral date and the first day of the work contract, and exploring the relationship between this attrition and local unemployment.

Figure 5a shows that for every two weeks that pass between an unemployed U.S. workers' referral to the NCGA and the start date of work, roughly an additional half of the referred workers fail to begin work. The figure displays a Kaplan-Meier survival curve for all workers referred to the NCGA between 1998 and 2012, from the date of referral until the date the work contract begins, with a 95% confidence interval around the curve. Censoring is defined as reporting for work as scheduled. Workers drop out if they either contact the NCGA to cancel the job, or simply do not appear for work. The solid vertical line shows the sample mean time from referral to start date, with dotted lines showing a 95% confidence interval for the mean.

Figure 5b shows that this survival curve has the property predicted by theory in (5). It shows the results of a Cox proportional hazards model where the regressor is local unemployment in the U.S. worker's county of residence in the month of referral. When unemployment is high, referred workers are substantially more likely to begin

[17] This pattern reflects a common finding in the labor literature: Close to the maximum duration of unemployment benefits, there are sharp declines in the reservation wage for labor supply (e.g. Fishe 1982) and sharp increases in escape rates from unemployment (e.g. Katz and Meyer 1990; Hunt 1995; Røed and Zhang 2003).

work. Table 5 shows the underlying semiparametric Cox regression, along with alternative parametric specifications. The hazard rate is roughly 9% lower for each additional percentage point of local unemployment. But Figure 5b shows that this effect is quite small; even a very large shock to unemployment tends to delay this attrition by around two weeks.

Similar patterns are seen in survival curves examining attrition from the start of work to the completion date of the work contract. Figure 6a shows these Kaplan-Meier survival curves for U.S. workers (solid black) and Mexican H-2A workers (dashed red), with 95% confidence intervals. Here, censoring is defined as completing the work contract. Workers drop out if they quit or are fired. The hazard rate for U.S. workers is roughly 35 times the rate for Mexican workers in the same jobs (Table 6).

There are two dimensions of missing data in the NCGA records, shown in Table 7. For some workers the outcome is unknown (for U.S. referrals, 111/1658 = 6.7%). In this case, I note that almost half of these missing values occur in a single year (2008, see Table 2), and the results are not materially sensitive to the omission of that year (results available on request). For other workers, the outcome is known but the duration is unknown (for U.S. referrals, 108/1658 = 6.5%). For these I impute survival times with a simple model.[18] The results of imputing U.S. worker survival times for observations with known outcome are shown with the dotted green line in Figure 6a and in the lower panel of Table 6. There is little change in the survival curve, and the U.S. worker day-to-day attrition rate from quitting or being fired remains above 32 times the Mexican rate.

Figure 6b shows the relationship between the U.S. worker survival curve (complete cases only) from start-of-work to contract completion, and local unemployment. Again it shows the result of a Cox proportional hazards model with local unemployment as the

[18]The imputation model assumes that unobserved survival times for U.S. workers are equal to the observed survival times of U.S. workers who are referred at the same local unemployment rate, who start after the same delay between referral and start-of-work, who finish work with the same outcome, in the same year and month. That is, survival time is predicted by an OLS regression of survival time on local unemployment in the month of referral, months between referral and start, a set of dummies for each outcome (completed, quit, fired), and a full set of interacted dummies for the year and month of application.

regressor. Table 5 shows the underlying Cox regression and fully parametric alternatives. Again the relationship corroborates the prediction about intensive-margin labor supply in (5): when unemployment is higher in a referred worker's county of residence, the worker lasts longer on the job. But the magnitude of this relationship is small, and only reaches conventional levels of statistical significance in the exponential survival model. These estimates suggest that with each additional percentage point of unemployment, U.S. workers' hazard rate following the start of work is around 3% lower, but this effect cannot be definitively distinguished from zero. A 10 percentage-point increase in unemployment makes U.S. workers stay roughly two weeks longer on jobs whose typical contract length is 4.5–5.5 months.

Together, these estimates suggest that the slope of the native labor supply curve in the neighborhood of the current wage is positive but very close to zero. Native labor supply at the intensive margin—willingness to begin work, and willingness to complete work once begun—is extremely low. It is affected by the reserve options available to these workers, but with an extremely small magnitude.

6.3. Indirect effects of foreign seasonal farm workers on native employment

The preceding results test and reject some alternative explanations for low labor supply by U.S. workers. Low labor supply is not likely to arise from spatial variation across DES offices; the analysis in Table 4 and Figure 4 includes DES office fixed-effects. It is unlikely to arise because U.S. workers do not know about the jobs: intensive-margin labor supply among U.S. workers referred for these jobs is similarly low to extensive-margin labor supply by all unemployed U.S. workers. It is unlikely to arise from deterrence by unemployment insurance; Table 4 captures and controls for at least some of any such deterrence. Finally, it is unlikely to arise from an unwillingness or inability of farmers to modestly raise wages; the evidence is compatible with near-zero local slopes for the extensive-margin and intensive-margin labor supply curves.

This suggests that there is close to zero employment substitution between native and foreign labor in these seasonal farm jobs, and that the mechanism for this lack of sub-

stitution is almost exclusively on the labor-supply side. This has a further implication for the effect of foreign seasonal farm work on native employment outside the farm sector. Conditional on North Carolina's continued production of crops that require manual harvest to be profitable, this implies that foreign seasonal laborers in North Carolina cause an increment to the economic product of the state. The following analysis conducts a rough estimate of that statewide economic effect and its consequences for native jobs in all sectors of the state economy.

Table 8a reports estimates of the marginal revenue product (MRP) of manual seasonal harvest and planting workers in North Carolina, for three of the principal crops produced by NCGA farms. They are based primarily on crop budgets produced by researchers at North Carolina State University and are specific to the state. The short-run estimates of workers' MRP assume a Leontieff production function, so that the MRP/hour/acre is simply equal to the MRP/acre/season divided by the hours of manual harvest and planting labor required per season. This clearly overestimates MRP, since farmers could be expected to adjust other inputs in response to a loss of manual labor. The long-run estimates assume a Cobb-Douglas production function, assuming that the production elasticity of manual labor equals its cost share.[19] This clearly underestimates MRP, since farmers of crops whose harvest has not been mechanized cannot infinitely substitute other inputs for manual labor at constant (unit) elasticity. Details of the method and data sources are given in Appendix subsection A.2.

These estimates suggest that the short-run MRP of seasonal manual labor in NCGA jobs is somewhere around 4–6 times the wage paid to manual seasonal workers, and the long-run MRP is somewhere around 2–3 times the wage.[20] The short-run MRP is conservatively less than 6, and the long-run MRP cannot go below 2—a value that would

[19] A basic implication of Cobb-Douglas production is that the output elasticity of an input is well approximated by its cost share. In the simplest version of the dual problem, $\min_{K,L}\left(wL+rK\right)$ s.t. $AK^{1-\alpha}L^{\alpha}=\bar{Q} \xrightarrow[FOC]{} \alpha=\frac{wL}{wL+rK}$. It is standard in the industrial organization literature to approximate firm-level output elasticities with industry-level input cost shares (e.g. Griliches 1963; Baily et al. 1992; Syverson 2004; Foster et al. 2008).

[20] These figures are corroborated by the only corresponding estimate of which I am aware in the agricultural economics literature. Assuming Cobb-Douglas production, Huffman (1976, Table 5) finds that for representative farms in North Carolina, the marginal revenue product of hired labor is 1.75 times the wage. The corresponding figures in Table 8a are 1.44–1.99 times the wage.

assume farmers can almost continuously substitute for any deficit in manual labor by adjusting other inputs.

Table 8b draws out the implications of these figures for the impact of foreign seasonal H-2A farmworkers for economic product and jobs in all sectors of the entire state of North Carolina. Details and sources for this calculation are given in Appendix subsection A.3. The MRP of 7000 foreign seasonal agricultural workers per year is between about $300 and 450 million in the short run and about $150 and 225 million in the long run. The U.S. Bureau of Economic Analysis RIMS II regional economic model predicts that an increment of this magnitude in the agricultural economy of North Carolina generates roughly 2800–4300 jobs in all sectors of the state economy in the short run, and roughly 1400–2100 jobs in the long run. In other words, each 1.5-2.3 foreign H-2A workers create one U.S. job in North Carolina in the short run, and each 3.0–4.6 foreign H-2A workers create one U.S. job in North Carolina in the long run. The RIMS II output multiplier furthermore suggests that if the labor of the 7000 H-2A workers employed by the NCGA were lost, the total economic output of North Carolina would decline by roughly $500–750 million in the short run (without any adjustment by farmers) and by at least $250–370 million in the long run (after the greatest plausible degree of adjustment by farmers).

These estimated impacts on U.S. workers' jobs do not represent the effect of H-2A workers on the current jobs of working North Carolinians, most of which could be replaced if lost. That is, they are not the common estimates of a "displacement" effect on U.S. workers' jobs if H-2A workers were lost. Rather, they reflect an increment to the total number of jobs that could be sought by any unemployed U.S. worker in North Carolina.

These estimates are conservative for four reasons. First, the particular RIMS II jobs multiplier used here is the 'Type I' multiplier, which omits all effects of local expenditure by workers. While H-2A workers at the NCGA remit to Mexico the majority of their earnings, they do spend roughly 10–15% of earnings in North Carolina. Second, the 'Type I' multiplier ignores the effects of spending by non-seasonal hired workers on the same farms, most of whom are U.S. workers who live and spend in the area. Third, it

ignores all effects of an expansion in the North Carolina economy on the economies of neighboring states and job creation in those states. Fourth, it ignores all effects on the U.S. economy from any eventual spending of dollars remitted to Mexico on U.S. exports.

7. Conclusion

These results suggest that the effect of foreign manual farm labor on U.S. native employment is almost zero in North Carolina. The reason is almost exclusively the shape of the native labor supply curve for these jobs—supply is close to zero at current terms of contract and at a range of nearby terms. I test and substantially rule out a range of possible explanations for low native labor supply, including geographic mismatch, illegal discriminatory hiring practices, asymmetric information, and moral hazard from unemployment insurance. It appears that almost all U.S. workers prefer almost any labor-market outcome—including long periods of unemployment—to carrying out manual harvest and planting labor. This remains true across a wide range of reserve options, suggesting that it remains true across a wide range of compensation as well.

This method has advantages over previous approaches in this setting. First, it identifies the mechanism: lack of native-foreign substitutability arises not from differences in employer demand for native and foreign labor but from differences in labor supply by native and foreign labor. Second, is it less prone to bias by native self-selection out of the labor market segment under examination; all of the jobs in question were first offered to natives within the relevant labor market segment before foreign hiring could occur. Third, this finding is more relevant to policy controls on foreign labor demand than other studies that use shifts in foreign labor supply. Such demand controls are frequently occupation-specific, and sometimes occur in the absence of supply constraints, as with the H-2A visa. The shape of native labor supply directly informs the effects of occupation-specific restrictions on foreign labor demand.

These results imply that if Americans continue to consume the crops in question at any-

where near current prices, only three outcomes are plausible. Either seasonal foreign labor will allow continued domestic production, domestic production will be replaced by imports, or technological change will reduce or eliminate the need for manual labor in production. Conditional on current technology, then, foreign seasonal labor causes an increase in GDP. This analysis suggests that if the roughly 7,000 Mexican seasonal workers employed by the North Carolina Growers Association in 2012 had not entered the country, in the short run the North Carolina economy would lose 2800–4300 jobs across all sectors and would shrink by $500–750 million. In the long run, after the greatest plausible degree of adjustment by farmers, this loss would be roughly 1400–2100 jobs and $250–370 million. In other words, each 1.5-2.3 foreign H-2A workers create one U.S. job in North Carolina in the short run, and each 3.0–4.6 foreign H-2A workers create one U.S. job in North Carolina in the long run.

Labor demand regulations in this industry have remarkable consequences. Regulators require the NCGA to advertise all of its H-2A jobs in four newspapers in three states. It spent $54,440 on these advertisements in 2011, and $35,906 in 2012, for a two-year total newspaper advertising expenditure of $90,346. During that two-year period, a total of five U.S. workers hired by the NCGA reported that they had first learned of the job through a newspaper advertisement (Table 9). Of those five, only one was willing to start the job, stay past the first few weeks, and complete the growing season—earning roughly $8,000 in four months. The newspaper advertising requirement appears equivalent to a large tax on farmers and subsidy for newspaper owners, with essentially no benefit to U.S. farm workers.

Beyond this, the NCGA reports that it spends roughly $46,000 per year in staff time exclusively related to required cooperation with the DES on recruiting, hiring, and tracking U.S. referrals. Combined with newspaper advertising costs, this means that the NCGA spent about $182,000 over the two-year period 2011–2012 to recruit U.S. workers. This exclusively comprises administrative costs at the NCGA headquarters office and does not include time spent by farmers to train or replace U.S. workers who leave. It also does not include government expenditures in the effort to recruit U.S. workers—the time of employees of DES, the U.S. Dept. of Labor, or the North Carolina Dept.

of Labor that was spent enforcing U.S. worker recruitment requirements. During that two-year period, 17 hired U.S. workers were willing to complete the season (Table 2). Each worked on average 5 months and earned about $9,700, for total earnings of about $165,000 across all 17 willing U.S. workers. This is less than the direct cost that the NCGA headquarters incurred to recruit the same workers. Given that this recruitment cost omits any costs to the farms themselves or to state or local government, this suggests that regulations on demand for foreign seasonal manual farm labor are a net destroyer of economic value in North Carolina.

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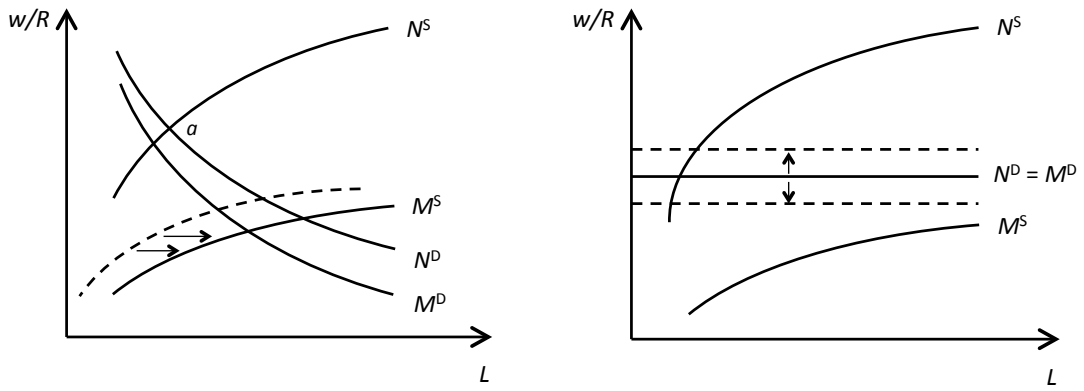
Figure 1: **How an alternative approach is informative about causal mechanism**

(a) *Standard approaches* (b) *An alternative approach*



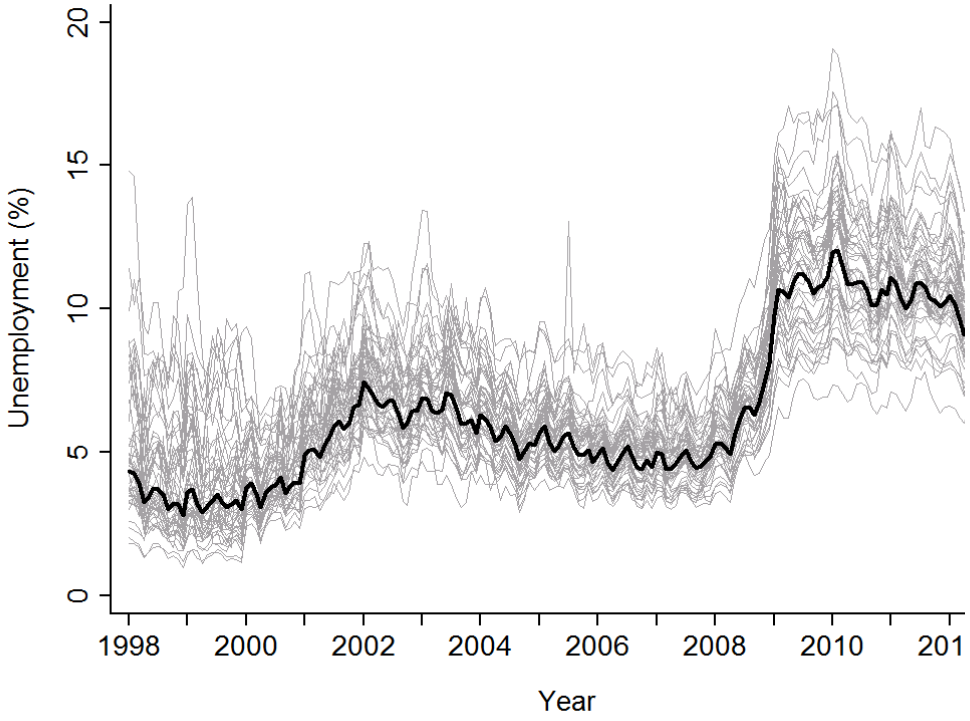
N and M represent native and migrant workers, respectively. Superscripts S and D represent supply and demand, respectively. L is the quantity of labor utilized, and $\frac{w}{R}$ is the ratio of wage to reserve option in equation (5).

Table 1: **Overview of Mexican H-2A Workers at NCGA**

Year	Number	Months/worker
2004	6799	4.454
2005	5602	4.527
2006	4786	4.571
2007	5410	4.797
2008	5969	5.233
2009	6237	5.084
2010	6201	5.613
2011	6474	5.496
2012	7008	5.506
Mean	6054	5.054

Number of workers shows number of unique individuals starting one or more H-2A employment events in each calendar year. Months/worker shows average months of work by each individual. 'Mean' row covers 2004–2012.

Figure 2: **North Carolina unemployment, at each DES office and statewide**



Black: North Carolina statewide average monthly unemployment rate (%). Gray: unemployment rate at each DES office—calculated as average unemployment rate in the counties served by that office, weighted by county labor force.

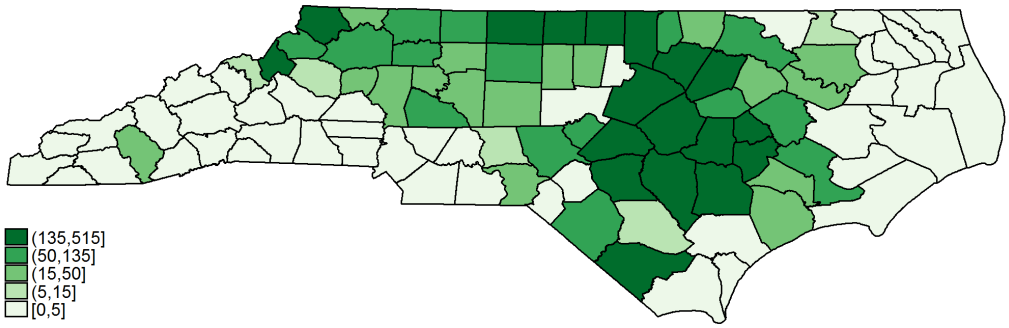
Table 2: **Overview of DES office referrals to all employers and to NCGA**

	Unemp.		DES to all employers			DES to NCGA				
	Rate	N	New	Referred		Referred	Hired	Started	Complete	Unknown
Year	(%)		apps	Non-ag.	Ag.					
1998	3.53	140782	–	–	–	112	98	14	0	25
1999	3.27	132707	–	–	–	41	39	6	0	3
2000	3.75	154577	–	–	–	35	34	4	0	1
2001	5.64	234934	–	–	–	46	44	13	0	0
2002	6.63	279281	–	–	–	99	91	43	2	2
2003	6.45	274193	–	–	–	244	242	83	3	0
2004	5.54	236328	–	–	–	134	134	37	2	3
2005	5.26	229030	–	–	–	57	57	22	6	2
2006	4.74	212099	236011	1642996	40880	88	88	22	10	15
2007	4.71	213276	238386	1586462	40924	–	–	–	–	–
2008	6.19	283048	256865	1498566	32958	170	167	58	11	50
2009	10.76	490010	276978	1396083	27168	108	105	48	6	0
2010	10.94	504885	267076	1604416	32245	74	73	30	10	10
2011	10.51	489095	–	–	–	268	245	163	7	0
2012	9.52	446469	–	–	–	253	213	143	10	0

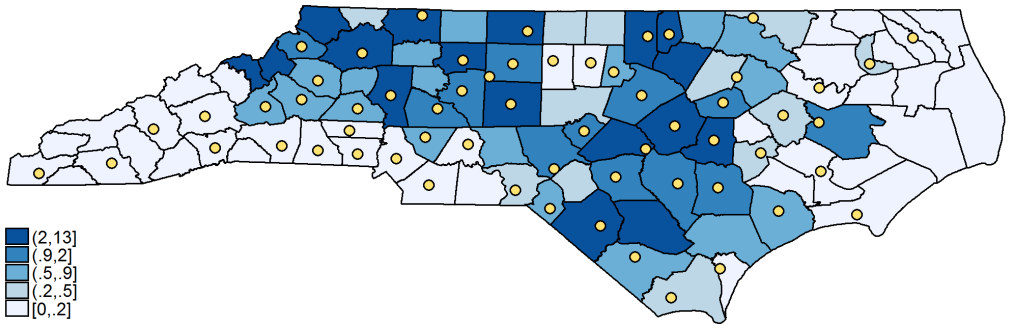
U.S. worker data for 2007 were not preserved by the NCGA. Unemployment (%) is average unemployment rate in the counties served by each DES office, weighted by size of labor force; Unemployed (N) is total number in those counties. The 2005 and 2011 DES totals are omitted from this table because published numbers only cover part of those two years: Feb.–Dec. 2005 and Jan.–May 2011.

Figure 3: **Locations of NCGA jobs, referred U.S. workers, and high unemployment**

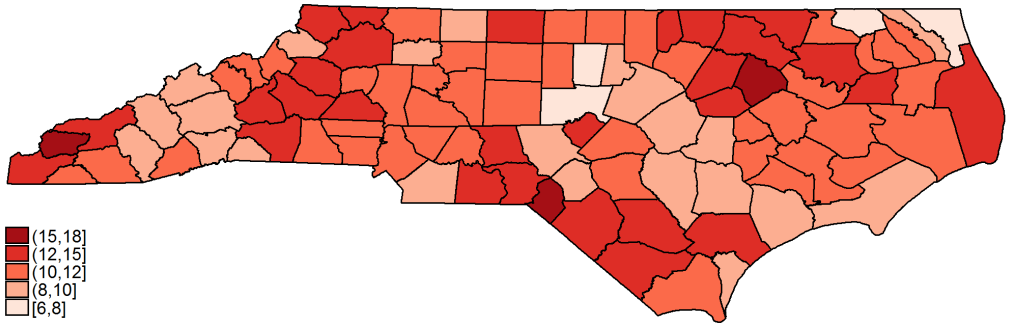
(a) *Average number of NCGA H-2A employment events per year (worksite)*



(b) *Average number of U.S. workers referred per year (residence), and DES offices (circles)*



(c) *Average unemployment rate in 2011 (%)*



All maps are divided into the 100 counties of North Carolina. In Figure 3b, shade of each county shows the average number of U.S. workers residing in that county referred by the DES to the NCGA each year, while yellow circles show locations of DES 'local' offices, excluding 'branch' offices (it omits the Warrenton local office because DES did not publish application/referral data for that office 2005–2011). North Carolina measures about 560 miles (901 km) from east to west; the average width of one county is 23.2 miles (37.3 km).

Table 3: **Descriptive statistics**

	N	Mean	S.D.	Min.	Max.
Data by DES office and month, Jan. 1998 to Dec. 2012					
Year	11086	2005.01	4.32	1998	2012
Month	11086	6.49	3.45	1	12
Unemployment (%)	10980	7.03	3.10	0.97	23.75
Unemployed (N)	10980	4722.09	5996.88	65	59994
Referrals to NCGA	11086	0.16	0.93	0	31
Hired by NCGA	11086	0.15	0.86	0	31
Began work at NCGA	11086	0.06	0.51	0	24
Completed work at NCGA	11086	0.01	0.09	0	4
Data by DES office and month, Feb. 2005 to May 2011					
Year	4484	2007.76	1.85	2005	2011
New job applications	4484	349.46	284.98	57	2411
Total non-agr. referrals	4484	2171.71	1352.99	0	13756
Total non-agr. placements	4484	87.27	73.09	0	751
Total agr. referrals	4482	46.28	115.39	0	2102
Total agr. placements	4484	24.15	92.11	0	1922
Data by employment episode: U.S. workers, Jan. 1998 to Dec. 2012					
Year of job start	1594	2006.35	4.41	1998	2012
Month of job start	1594	4.69	1.92	1	12
Unemployment (%)	1526	7.75	2.88	1.37	16.48
Time before work start (mo.)	1595	0.38	0.41	0.00	5.06
Time after work start (mo.)	586	1.06	1.46	0.00	8.54
Completed job, if referred?	1658	0.04	0.20	0	1
Completed job, if started?	805	0.08	0.28	0	1
Data by employment episode: Mexican workers, Jan. 2004 to Dec. 2012					
Year of job start	61439	2008.35	2.62	2004	2012
Month of job start	61439	5.40	1.92	1	12
Time after work start (mo.)	61254	4.50	2.28	0.00	11.27
Completed job, if started?	61255	0.92	0.27	0	1

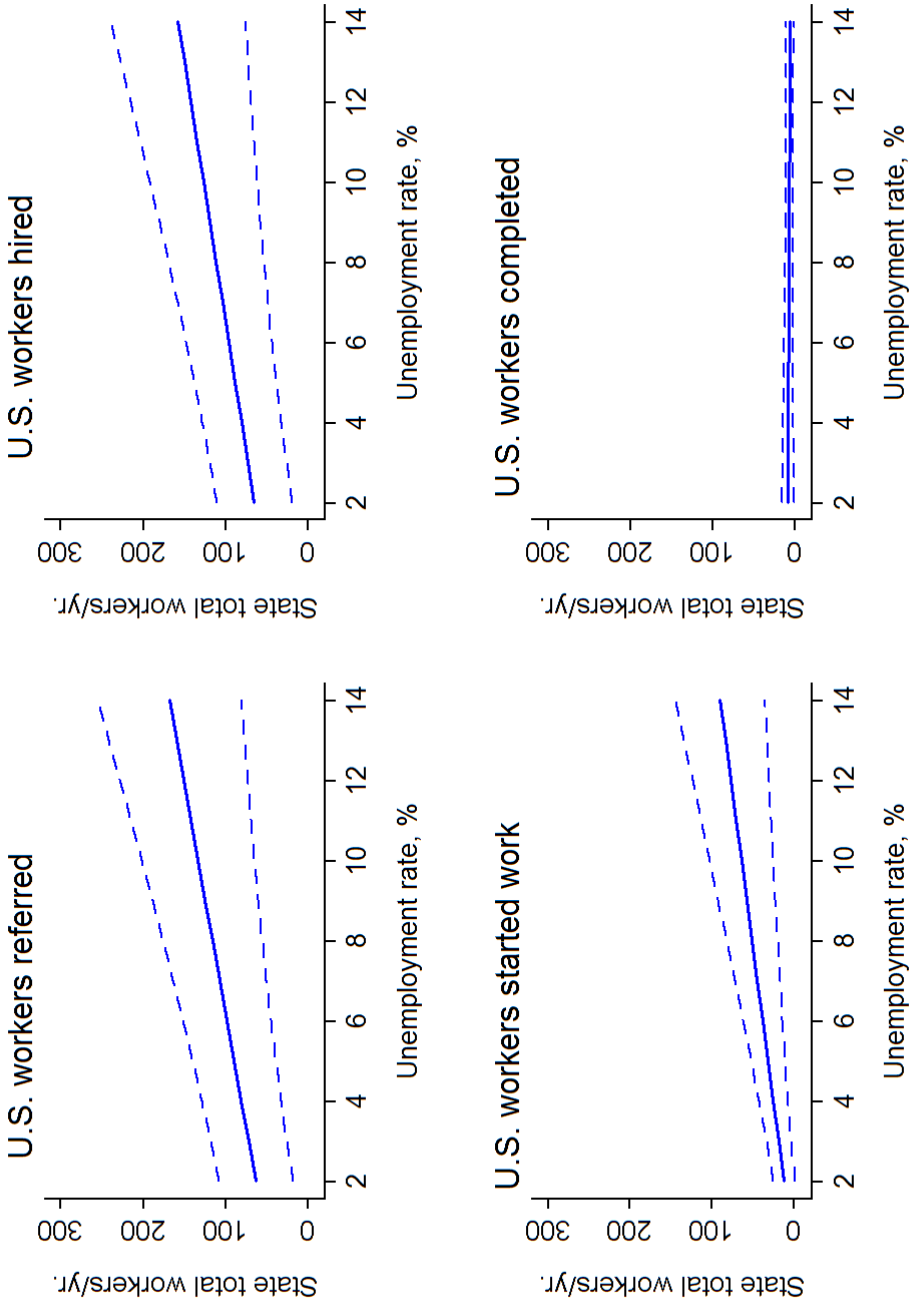
U.S. worker data for 2007 were not preserved by the NCGA. Unemployment (%) is average unemployment rate in the counties served by each DES office, weighted by size of labor force; Unemployed (N) is total number in those counties. All variables are shown unscaled; a scaled version of "new applications" (in thousands) is used in Table 4.

Table 4: **Effects of the recession on job referrals (Panel regressions with DES office fixed-effects), Feb. 2005–May 2011**

	All non-ag. jobs		All ag. jobs		NCGA jobs			
	Referred	Placed	Referred	Placed	Referred	Hired	Started	Completed
Unemployment (%)	−45.29***	−8.328***	−2.398*	−0.417	0.0122**	0.0108**	0.00909*	−0.000281
	(9.940)	(0.793)	(1.019)	(0.519)	(0.00410)	(0.00381)	(0.00289)	(0.000465)
New applications (000s), t	2092.0***	62.12***	345.7*	258.0	−0.260	−0.240	−0.208	−0.00985
	(441.0)	(11.90)	(168.3)	(146.1)	(0.168)	(0.155)	(0.120)	(0.0144)
" $t-1$	58.67	3.631	45.26	76.21	−0.343*	−0.323*	−0.189**	−0.0258
	(148.8)	(11.92)	(29.50)	(45.29)	(0.145)	(0.142)	(0.0731)	(0.0207)
" $t-2$	45.26	5.188	−33.14	−36.53	−0.376*	−0.349*	−0.173	−0.0251
	(85.31)	(13.74)	(30.14)	(27.29)	(0.176)	(0.172)	(0.0955)	(0.0195)
" $t-3$	−69.74	−25.04	−29.22	−53.81	−0.548**	−0.547**	−0.309**	−0.0298*
	(92.16)	(15.80)	(19.56)	(32.93)	(0.176)	(0.168)	(0.113)	(0.0146)
" $t-4$	−561.9***	36.18**	−29.11*	−26.57	−0.333*	−0.296*	−0.136*	−0.00699
	(97.15)	(13.61)	(12.89)	(15.20)	(0.133)	(0.127)	(0.0545)	(0.0167)
" $t-5$	−177.2	−16.81	−55.91**	−49.36*	−0.390*	−0.396*	−0.156	−0.0394*
	(95.69)	(15.68)	(21.43)	(20.50)	(0.169)	(0.167)	(0.0831)	(0.0185)
" $t-6$	−253.5	−25.67	−57.18**	−45.91**	0.375*	0.384*	0.161**	0.00613
	(159.0)	(13.54)	(19.32)	(16.93)	(0.171)	(0.171)	(0.0542)	(0.00929)
" $t-7$	227.8*	16.56	−50.86*	−52.23*	0.459	0.455	0.277*	0.108
	(109.3)	(23.75)	(23.17)	(22.66)	(0.266)	(0.271)	(0.137)	(0.0664)
" $t-8$	466.0***	7.336	−28.65	−48.62	0.769*	0.731*	0.492	0.0212*
	(135.3)	(11.43)	(15.82)	(25.34)	(0.326)	(0.321)	(0.253)	(0.0103)
" $t-9$	117.5	2.982	1.086	14.74	0.219	0.189	0.0361	−0.0340
	(94.49)	(9.190)	(12.44)	(10.51)	(0.288)	(0.266)	(0.234)	(0.0404)
" $t-10$	139.4	−27.88	−49.35	−22.89	0.385*	0.362*	0.163*	0.0296
	(96.84)	(15.07)	(43.45)	(35.70)	(0.161)	(0.150)	(0.0808)	(0.0327)
Constant	1772.3***	135.5***	41.86***	20.26**	0.0779	0.0781	0.0117	0.0141*
	(312.4)	(14.57)	(11.36)	(7.005)	(0.0412)	(0.0403)	(0.0168)	(0.00688)
N	3828	3828	3828	3828	3828	3828	3828	3828

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Observations are by DES office and month. All regressions use panel estimator with DES office fixed-effects. Standard errors in parentheses are clustered by DES office, given that $T > G$ ($T = 66$, $G = 58$). Data on NCGA referrals restricted to same period as the available data for DES referrals to all employers (Feb. 2005–May 2011). For this table only, new applications are measured in units of thousands (to make the coefficient estimates more compact). All dependent variables are in the original unscaled units: number of workers. NCGA jobs are linked by referral date: For example, "Completed" denotes the number of workers who completed an NCGA job for which they were referred in the month in question.

Figure 4: **Marginal effects of unemployment rate on U.S. labor supply to NCGA (state total/year)**



These figures represent the coefficients on the unemployment rate in columns 5–8 of Table 4. Those coefficients are in units of workers per office per month, so for this figure they are converted to statewide totals per year by multiplying by 720 (= 60 offices × 12 months). Dashed lines show 95% confidence interval.

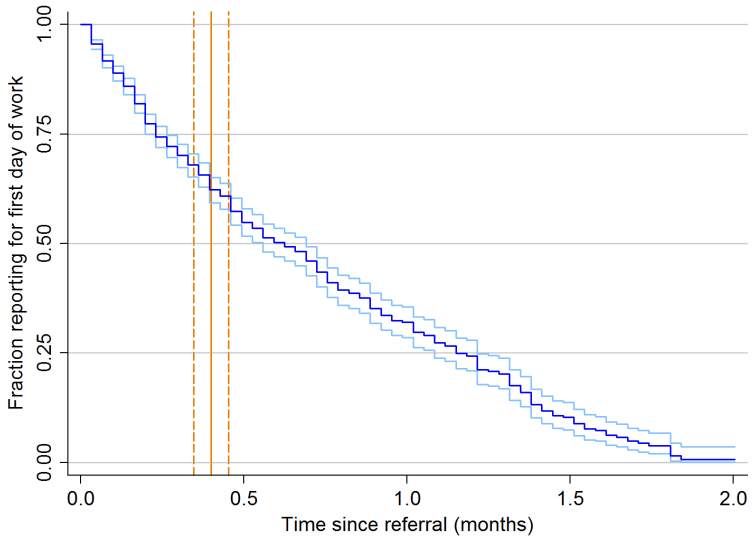
Table 5: **U.S. workers, by unemployment**

		Parametric survival estimation		
	Cox	*Exponential*	*Gompertz*	*Weibull*
From referral to start date:				
Unemployment (%)	0.913***	0.912***	0.912***	0.911***
	(0.0125)	(0.0125)	(0.0125)	(0.0125)
N	1384	1384	1384	1384
From start date to quitting/termination (Complete cases only):				
Unemployment (%)	0.972	0.946**	0.972	0.964
	(0.0184)	(0.0180)	(0.0183)	(0.0182)
N	503	503	503	503

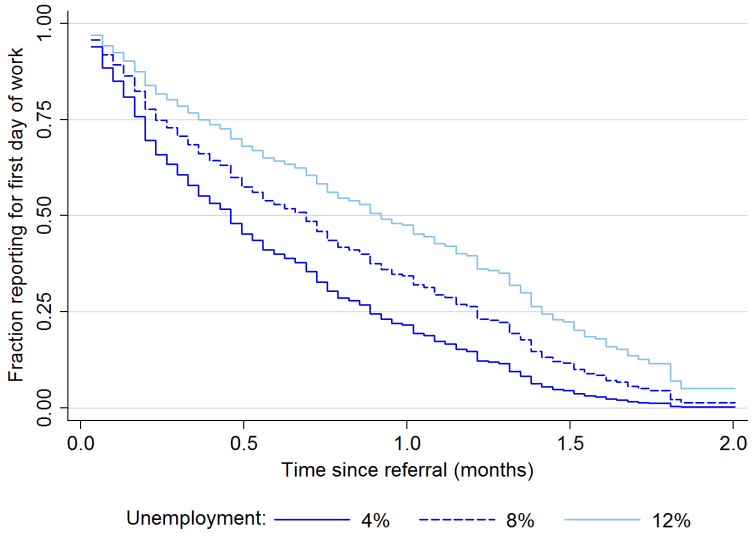
Exponentiated coefficients (log relative hazard form). Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. "Cox" is the semiparametric Cox proportional hazards model.

Figure 5: **U.S. workers, from referral to start date**

(a) *Kaplan-Meier survival curve*



(b) *Association with unemployment at referring office*



In Figure 5a, lines above and below survival curve show 95% confidence interval. Vertical orange line shows average duration to planned start date (with 95% confidence interval).

Table 6: **All workers, from start date to quitting/termination, by nationality**

		Parametric survival estimation		
	Cox	*Exponential*	*Gompertz*	*Weibull*
Complete cases				
U.S. worker	34.28***	42.22***	35.57***	35.49***
	(1.730)	(2.081)	(1.780)	(1.790)
N	61691	61691	61691	61691
Missing survival times imputed				
U.S. worker	31.89***	38.51***	32.60***	32.95***
	(1.393)	(1.639)	(1.416)	(1.437)
N	61865	61865	61865	61865

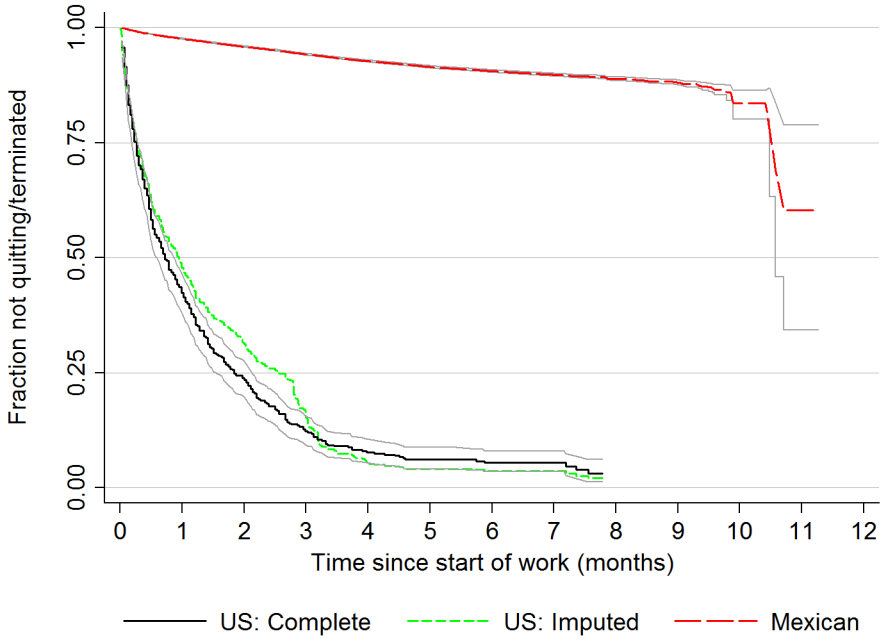
Base group is Mexican workers. Exponentiated coefficients (log relative hazard form). Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. "Cox" is the semiparametric Cox proportional hazards model. "Complete cases" are observations without missing survival time. "Imputed" means missing survival times modeled as a linear function of how the employment episode ended (completed, quit, fired); time from referral to start; unemployment rate at the referring DES office; and dummies for year, month, and year × month (for nonmissing survival times, model $R^2 = 0.4989$). "Extreme upper bound" means that each *U.S.* worker with a missing survival time is assigned the survival time of the average *Mexican* worker with the same job outcome (completed, quit, fired) who started work in the same month of the same year.

Table 7: **Missing observations on outcome and duration of work**

	U.S. worker duration		Mexican worker duration	
	Not missing	*Missing*	*Not missing*	*Missing*
Outcome:				
Completed	67	1	56505	0
Quit	488	100	2285	0
Fired	31	7	2464	1
Unknown	0	111	0	126

Figure 6: **U.S. & Mexican workers, from start of work to quitting/termination**

(a) *Kaplan-Meier survival curves*



(b) *Association with unemployment at referring office (U.S. complete cases)*

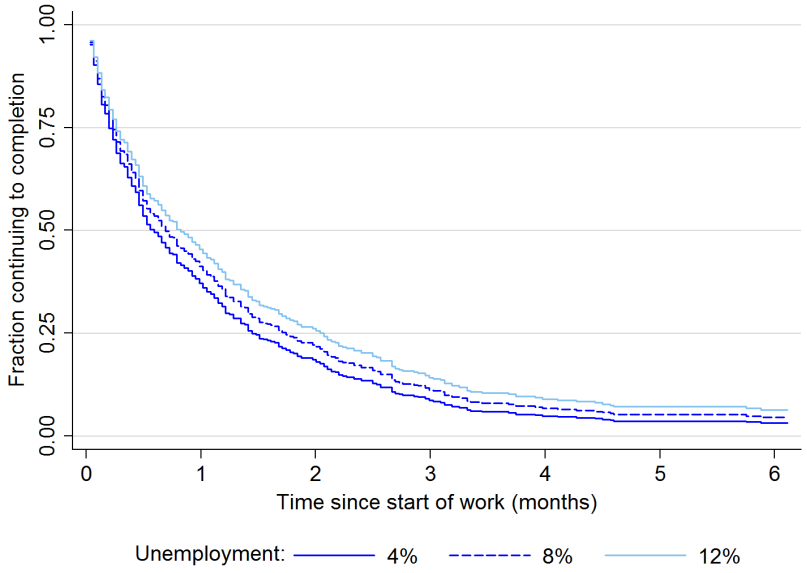


Table 8a: **Rough estimates of the marginal revenue product (MRP) of manual labor**

Crop	Cucumber		Sweet potato		Tobacco
Year	2002	2013	2002	2012	2009
Revenue/acre ($)	2040.00	2325.00	2637.50	3375.00	4050.00
Non-labor cost/acre ($)	806.17	1168.20	1485.82	1696.56	2627.95
Hours/acre	80	80	50	50	60
Revenue/acre/hr ($)	25.50	29.06	52.75	67.50	67.50
Non-labor cost/acre/hr ($)	10.08	14.60	29.72	33.93	43.80
Labor cost/acre/hr ($)	10.54	13.58	10.54	13.58	13.08
Cost fraction	0.51	0.48	0.26	0.29	0.23
NCGA wage/hour ($)	7.53	9.70	7.53	9.70	9.34
Short run, zero substitution (Leontief)					
MRP/hr/acre ($)	25.50	29.06	52.75	67.50	67.50
Multiple of wage	3.39	3.00	7.01	6.96	7.23
Long run, unit elasticity of substitution (Cobb-Douglas)					
MRP/hr/acre ($)	13.04	14.00	13.81	19.29	15.52
Multiple of wage	1.73	1.44	1.83	1.99	1.66

Seasonal crop budgets are representative for North Carolina; detailed method and sources given in Appendix subsection A.2. These crops are the most common on NCGA farms, often grown on the same farm. Numbers for cucumbers and tobacco are for pickling cucumbers and manual-harvest tobacco, respectively. 'Labor' here refers exclusively to unskilled manual labor for harvest and some planting, but not to packing or more skilled work such as machinery operation or supervision.

Table 8b: **Rough estimates of statewide US job creation by 7,000 H-2A workers**

	Short run		Long run	
	low	*high*	*low*	*high*
MRP multiplier	4	6	2	3
Total wage bill ($m)	74.7	74.7	74.7	74.7
Revenue product ($m)	298.8	448.1	149.4	224.1
Jobs multiplier	9.527	9.527	9.527	9.527
US jobs created in NC	2846	4269	1423	2135
H-2A workers per US job	2.3	1.5	4.6	3.0
Output multiplier	1.657	1.657	1.657	1.657
Effect on NC economic output ($m)	$495	$743	$248	$371

Figures are for 7,000 H-2A workers per year. Total wage bill for all NCGA H-2A workers assumes 5.5 months work for average H-2A worker, at approximately 50 hrs/wk: Thus $9.70/hr $\times$ 1100 hrs/yr $\times$ 7,000 workers = $74.7m. Statewide US jobs and output multipliers from US Bureau of Economic Analysis RIMS II model ('Type I', ignoring workers' expenditures); details in Appendix subsection A.3.

Table 9: **How U.S. applicants learned about job**

	Year		
	2011	2012	Total
Division of Employment Security	156	227	383
Friends or Family	24	40	64
Newspaper	4	1	5
Dept. of Social Services	0	4	4
Disaster Relief Fund	0	1	1
Division of Veterans Affairs	0	1	1
Employer	0	1	1
No answer	2	1	3
Total	186	276	462

In 2011 the survey comprises those workers who were initially hired and did not drop out of the hiring process before the survey was administered (245 were initially offered the job, 163 started work). In 2012 the survey covers all who were hired plus a number who were offered the job but did not accept (213 were hired, 143 started work).

Appendix: Data Sources and Background

A. U.S. job creation in North Carolina by value-added arising from H-2A manual farm labor

A.1. Production functions

In the estimates of Table 8a I use two different assumptions on the form of farms' production function. For the fixed-proportions production function, $MRP_{\text{Leontieff}} = Y$, where Y is revenue/hour/acre. For the constant (unit) elasticity of substitution production function, $MRP_{\text{Cobb-Douglas}} = \kappa Y$, where κ is the cost fraction of manual harvest labor.

A.2. Marginal revenue product (MRP) of North Carolina manual farm labor

Cucumbers (pickling): Data on revenue/season/acre and costs/season/acre (without manual harvesting & planting labor) for 2002 come from E. Estes, J. Schultheis, and H. Sampson (2002), "Cucumbers, Pickling: Est. Revenue, Operating Exp., Annual Ownership Exp., and Net Revenue Per Acre", Dept. of Agricultural and Resource Economics, North Carolina State Univ. (ARE/NCSU); and for 2013 come from G. Bullen and A. Thornton (2013), "Spring Cucumber for Pickles—Irrigated: Estimated costs per acre, 2013", ARE and Dept. of Horticultural Sciences, NCSU. Approximate worker-hours/season/acre for low-skill manual harvest labor is from Prof. David H. Nagel, Extension Professor in the Dept. of Plant and Soil Sciences, Mississippi State University, personal communication January 15, 2013. He is the author of D.H. Nagel (2000), *Commercial Production of Cucumbers in Mississippi*, Starkville, MS: Mississippi State University Extension Service.

Sweet potatoes: Data on revenue/season/acre and costs/season/acre (without manual harvesting & planting labor) for 2002 come from E. Estes, J. Schultheis, and H. Sampson (2002), "Sweetpotatoes: Estimated Rev., Operating Expenses, Annual Ownership Expenses, and Net Return Per Acre", ARE/NCSU; and for 2012 from G. Bullen (2012), Sweet Potato—2012: Estimated Costs per Acre, 2012, ARE/NCSU. Estimated worker-hours/season/acre for low-skill manual harvest and planting labor is from W. Ferreira, (2011), Sweet Potatoes—for fresh market, irrigated: Estimated Costs and Returns per Acre, Kingstree, SC: Clemson University Cooperative Extension Service; and from D. Parvin, C. Walden, and B. Graves (2000), *Estimated Costs and Returns for Sweetpotatoes in Mississippi*, Starkville, MS: Office of Agricultural Communications, Mississippi State Univ. Division of Agriculture, Forestry, and Veterinary Medicine.

Tobacco: To estimate typical revenue/season/acre I first take average yield/acre in North Carolina for the years 2009 (2,346 lb/acre) and 2010 (2,123 lb/acre), i.e. roughly 2,250 lb/acre (A.B. Brown et al. [2011], *Flue-Cured Tobacco Guide 2011*, Raleigh, NC: North Carolina State University, p. 7), and multiply by the average price received for all stalk positions (approximately \$1.80/lb in 2009, *ibid.* p. 8) to get approximate revenue/season/acre of \$4,050. Estimated costs/season/acre (without manual harvesting & planting labor) are from G. Bullen and L. Fisher (2012), "Flue-Cured Tobacco—Hand Harvest Piedmont 2012: Estimated Costs per Acre, 2012, ARE/NCSU. (Note that NCSU also publishes tobacco budgets for 2009 but they are for machine-harvested tobacco; the only current, recently published hand-harvest tobacco budget from NCSU is from 2012.)

Wages and manual labor costs: The 2012 and 2013 NCGA wage of \$9.70/hr is from the NCGA and

public records at the U.S. Dept. of Labor Foreign Labor Certification Center. The 2002 and 2009 wages are the North Carolina-specific "Adverse Effect Wage Rate" fixed for each year by the U.S. Dept. of Labor's Office of Foreign Labor Certification and published in the *Federal Register*. The employer's full cost of manual H-2A workers' labor is estimated at 1.4 $\times$ wage, in accordance with NCGA estimates. The additional costs are primarily for housing, transporting, equipping, and training workers.

A.3. U.S. jobs multiplier

The Bureau of Economic Analysis at the U.S. Dept. of Commerce built the Regional Input-Output Modeling System (RIMS II) to create estimates of how local demand shocks affect gross output, value added, earnings, and employment in regions of the United States. RIMS II estimates two types of employment multipliers for economic shocks in the "Crop and Animal Production" subsector of the "Agriculture, forestry, fishing, and hunting" sector. Type I multipliers omit the effects of household spending by all workers; Type II multipliers include these effects. With the relevant region limited to the state of North Carolina, the Type I multiplier for shocks to this subsector is 9.527 and the Type II multiplier is 13.815. This multiplier "represents the total change in number of jobs that occurs in all industries within the state for each additional million dollars of output delivered to final demand by the selected industry."

The jobs effect estimated in this way is very different from popular estimates of the number of jobs "supported by" manual laborers, which do not typically take into account the ability of workers to find other jobs if their current jobs were to be eliminated. Instead, the RIMS II jobs multiplier estimates the number of jobs in all sectors of the entire state that are caused to exist by a given change in the economic activity happening within one sector, *including* the ability of workers who lose their jobs to find other jobs. It estimates the effect of economic change on the total pool of all jobs available to any individuals, not the effect on the current jobs of particular individuals.

The RIMS II Type I multiplier for state output used in Table 8b is 1.657, and the corresponding Type II multiplier is 2.134. The output multiplier "represents the total dollar change in output that occurs in all industries within the state for each additional dollar of output delivered to final demand by the selected industry".

B. Other data sources

All data on U.S. workers referred to and hired by the North Carolina Growers Association (NCGA), and on Mexican workers hired by the NCGA, were provided by the NCGA.[21] Data on DES offices[22] were disseminated in the monthly editions of *Employment Services and Unemployment Insurance Operations* published by the Employment Security Commission of North Carolina, Labor Market Information Division, Employment Services and Unemployment In-

[21] 6 growers in the data are listed as being located in "Ashe/Allegheny" country. They are assigned to Ashe county, since the data contain far more growers that are only in Ashe than only in Allegheny. 64 U.S. workers in the original data were referred by an agency outside North Carolina; most of these (45) are from Puerto Rico. They are ignored in this analysis.

[22] The Division of Employment Security (DES) at the North Carolina Dept. of Commerce was known as the Employment Security Commission (ESC) until November 2011, and is still commonly referred to by this name.

surance Reporting Unit, from February 2005 to May 2011.[23] Estimates of the size of the labor force and number of unemployed persons in each North Carolina county are from the Local Area Unemployment Statistics (LAUS) database at the DES, which creates its estimates based on two sources of data from the U.S. Dept. of Labor Bureau of Labor Statistics: the Current Employment Statistics (CES) and the Quarterly Census of Employment and Wages (QCEW). Their method for creating county-level unemployment estimates is described in Bureau of Labor Statistics (2009), Local Area Unemployment Statistics: Estimation Methodology, U.S. Dept. of Labor, accessed Jan. 24, 2013.

For each month, county-level data were resolved to DES office-level data as follows.[24] First, only one county (Guilford) has more than one DES office (Greensboro and High Point). These two offices were treated as a single office, comprising the total applications, referrals, and placements for the two offices in each month. Second, 14 offices each serve more than one county.[25] In these cases, county-level data on number of people in the labor force and number of people unemployed were totaled across counties served by each DES office, then divided to achieve the office-level unemployment rate. Finally, the Warrenton DES office is ignored because the DES did not publish application, referral, and placement statistics for that office between February 2005 and May 2011.

C. Regulation of demand for immigrant labor in other countries

Canada's temporary work visas require a "labor market opinion" from Human Resources and Social Development Canada that "there is no Canadian or permanent resident available", while skilled-worker permanent visas are only allowed in certain occupations. **United Kingdom** employers recruiting foreign workers for some skilled occupations—those not on a list deemed in "shortage" by the government—must first actively recruit and hire any available UK workers under the Resident Labour Market Test requirement. **France** has a similar system: Unless a skilled occupation is in shortage ("*en tension*"), employers must first prove that they have been unable to recruit French workers, while in **Germany** various work visas require a similar test (*Vorrangprüfung*). In **Australia**, prospective employers of both skilled and seasonal unskilled foreign workers must offer the government "evidence of the efforts made to recruit from the local labour market".

[23] At the time of writing, no earlier or later editions were posted by the DES at www.ncesc.com.

[24] Here a DES "office" refers to a local office, not a branch office. DES publishes application, referral, and placement data by local office only, where the data for each local office include data for any branch office that may be linked to that local office.

[25] Asheville office serves Buncombe, Madison; Edenton office serves Chowan, Gates, Perquimans, Tyrrell, Washington; Elizabeth City office serves Camden, Currituck, Pasquotank; Forest City office serves Polk, Rutherford; Hendersonville office serves Henderson, Transylvania; Kinston office serves Greene, Lenoir; Murphy office serves Cherokee, Clay, Graham; New Bern office serves Craven, Jones, Pamlico; Reidsville office serves Caswell, Rockingham; Roanoke Rapids office serves Halifax, Northampton; Rocky Mount office serves Edgecombe, Nash; Washington office serves Beaufort, Hyde; Williamston office serves Bertie, Martin; Winston-Salem office serves Forsyth, Stokes.