



IRLE WORKING PAPER  
#104-15  
March 2015

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Cite as: Maoyong Fan, Anita Alves Pena, and Jeffrey M. Perloff. (2015). "Effects of the Great Recession on the U.S. Agricultural Labor Market". IRLE Working Paper No. 104-15. <http://irle.berkeley.edu/workingpapers/104-15.pdf>

# Effects of the Great Recession on the U.S. Agricultural Labor Market

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March 10, 2015

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## Abstract

Recessions typically lead to excess supply in nonagricultural labor markets. However, a major recession, like the Great Recession, has different effects in the seasonal agriculture labor market. During such recession, hourly earnings of workers, the probability that workers receive bonuses, and employed workers' weekly hours rise. These results are consistent with a large reduction in immigrant labor supply during a major recession. Direct and indirect evidence on immigration supports this conclusion.

**Keywords:** agriculture, Great Recession, immigrants, recession, undocumented workers

**JEL Codes:** E32, G01, J43, J61

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\*Maoyong Fan thanks the UpJohn Institute for support (Mini-Grant No. 11-133-0111-133-01).

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## Abstract

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## Effects of the Great Recession on the U.S. Agricultural Labor Market

Although a large literature describes how recessions affect nonagricultural labor markets, few studies examine the effects of recessions in the seasonal agricultural labor market.<sup>1</sup> We examine how the last three recessions affected hourly earnings, the probability of receiving a bonus, and weekly hours in agricultural labor market. We compare those results to those in three nonagricultural labor markets that rely on immigrants. We empirically test five hypotheses.

First, we expect seasonal agricultural workers' earnings (hourly earnings and the probability of receiving a bonus) to rise during major recessions. Because the income elasticities of demand for seasonal agricultural products such as fruits and vegetables are relatively inelastic, recessions cause a small, possibly negligible leftward shift of the labor demand curve in seasonal agriculture. In contrast, a recession's may cause a significant leftward shift of the labor supply curve. Roughly half of hired, seasonal agricultural workers are undocumented.<sup>2</sup> The Great Recession significantly reduced the number of new, undocumented immigrants entering the United States (Papademetriou and Terrazas, 2009; Passel, Cohn and Gonzalez-Barrera, 2013), causing a substantial leftward shift of the agricultural labor supply curve.<sup>3</sup> Given a substantial leftward shift of the supply curve and only a minimal shift of the demand curve, agricultural workers' earnings rise.

Second, while we hypothesize that hourly earnings and the probability of receiving a bonus rose during the Great Recession, 2008–2009, we expect these earnings measures to rise by less or possibly fall in the earlier, relatively minor 1990–1991 and 2001 recessions. The Great Recession

caused much larger decreases in new immigrant labor supply than in these earlier recessions (Papademetriou and Terrazas, 2009; Passel, Cohn and Gonzalez-Barrera, 2013).

Third, we expect recessions to affect undocumented workers differently than documented workers (citizens and immigrants who may legally work in this country) because their labor markets are partially segmented. Evidence that these markets are partially segmented comes from earlier studies that show that, compared to documented workers, undocumented workers are more likely to be employed by farm labor contractors as opposed to farmers, and because their pay differs (Isé and Perloff, 1995; Pena, 2010; Taylor, 1992).

Fourth, we expect weekly hours of employed agricultural workers to increase to compensate for the reduced flow of new immigrants during major recessions.

Fifth, we expect recessions to have larger earnings effects in agricultural labor markets than in construction, hotel, and restaurant labor markets. These nonagricultural labor markets are more likely to have sticky wages due to union and other contracts and minimum wage laws.

The first section discusses how recessions affect the supply curve of agricultural labor. The next section describes our two data sets. The third section presents our empirical results. The final section discusses our results and draws conclusions.

## **Recessions, Agricultural Output, and Immigration**

We hypothesize that even major recessions have relatively little effect on agricultural output, but have substantial effects on the labor supply.

Given that fruits and vegetables' income elasticities are inelastic, we would not expect recessions to have a major impact on the demand for seasonal agricultural crops. Figure 1 shows that total agricultural output (in millions of 2008 dollars) did not obviously dip during the 1991–1992, 2001, or 2008–2009 recessions.

In contrast, during a major recession, fewer undocumented immigrants enter the United States from Mexico and other countries. Passel, Cohn and Gonzalez-Barrera (2013) reported a large drop in the number of undocumented immigrants during the Great Recession relative to the recovery years afterward and to preceding years, which include milder recessions. They estimated that the number of undocumented immigrants rose monotonically from only 3.5 million in 1990 until it peaked at 12.2 million in 2007. However, the number of immigrants fell to 11.3 million by 2009 during the Great Recession. In contrast, they found that the supply of immigrant labor rose during relatively mild 2001 recession.<sup>4</sup>

These results are consistent with U.S. border patrol reports from the Department of Homeland Security's Office of Immigration Statistics. Apprehensions by the U.S. border patrols dropped from 876,803 in 2007 to 556,032 in 2009.

Because immigrants often send money home, we can use remittances from the United States to Mexico to infer whether the number of immigrants changed substantially during a recession. Figure 2 shows quarterly remittances to Mexico in millions of U.S. dollars as reported by Banco de México (No data are available for the 1990–1991 recession). The figure shows that remittances increased during the relatively mild 2001 recession but decreased substantially during the 2008–2009 Great Recession. These data again support the view that the number of Mexican immigrants to the United States fell during the Great Recession but not during the previous, milder recession.

Moreover, Warren and Warren (2013) estimated that the net change of undocumented immigrants was negative during the Great Recession, which was related to a sharp decrease of new undocumented immigrants.

The United States Department of Agriculture, Economic Research Service (USDA-ERS) estimated number of full- and part-time agricultural workers fell from 1.032 million in 2007 to 1.003 million in 2008 and 1.020 million in 2009, before rising to 1.053 million in 2010.<sup>5</sup> That is, the

number of workers in 2008 was 3% to 5% lower than in the years before and after the Great Recession. Presumably the share of workers dropped by even more in seasonal agriculture, which employs most of the undocumented workers.

## **Data**

Our agricultural workers data comes from the National Agricultural Workers Survey (NAWS). The NAWS is a national, random sample of hired seasonal agricultural employees, who work primarily in seasonal crops.<sup>6</sup>

The NAWS is an employer-based survey. That is, it samples worksites rather than residences to overcome the difficulty of reaching migrant farm workers in unconventional living quarters. These employers are chosen randomly within the U.S. Department of Agriculture's 12 agricultural regions (California is one region).<sup>7</sup> Surveyors randomly select 2,500 employees of these growers to obtain a nationally representative sample of crop workers. Surveyors interview the more than 2,500 crop workers outside of work hours at their homes or at other locations selected by the respondent.

The NAWS has a long, visible history within farming communities, and the survey design incorporates questions aimed at data validation about legal status. Respondents receive a pledge of confidentiality and a nominal financial incentive for participation. As a result, only one to two percent of workers in the overall sample refuse to answer the legal status questions.

The NAWS contains extensive information about a worker's compensation, hours worked, and demographic characteristics such as legal status, education, family size and composition, and workers' migration decisions. We dropped workers from the sample who were missing any relevant variable, 23% of the original survey sample.

The NAWS is conducted in three cycles each year (spring, summer, and autumn) to match the seasonal fluctuations in the agricultural workforce. Unfortunately, the public-use data,

which we use, suppresses information about the cycle (season) and aggregates the 12 regions into 6 regions. As a result, our data set consists of repeated annual cross sections of workers from 1989 through 2012. Column 1 of Table 1 presents national summary statistics for the variables used in our empirical analysis. Columns 2 and 3 provide data for California and for the rest of the country, because 37% of the sample works in California. Compared to workers in the rest of the country, Californian workers tend to have less education; have more farm experience; are more likely to be non-native, Hispanics; and are more likely to work in fruit and nut crops and less likely to work in horticulture.

After analyzing the effects of recessions on agricultural workers, we replicate the analysis for workers in construction, hotels, and restaurants, which also employ many immigrants. The data for workers in these sectors come from the March Current Population Survey (CPS). In March of each year, workers in the basic CPS sample are administered a supplemental questionnaire in which they are asked to report their income such as hourly wage rate and additional labor force activity such as hours worked in the previous week.<sup>8</sup> Because information on immigration is available only since 1994, our sample period is 1994–2013. We include all workers who are 18 years and older.

## **Empirical Results**

Three recessions occurred during our 1989–2012 sample period (as determined by the National Bureau of Economic Research panel). The economy recovered quickly from the first of these recessions in 1990–1991. The second, 2001 recession was also relatively mild. However, the third recession, the 2008–2009 Great Recession, was much more severe and had longer-lasting economic and labor market effects than the first two.

We analyze the effects of recessions on hourly earnings, the probability of receiving a bonus, and weekly hours of work of employed workers. For workers paid by time, hourly earnings are a worker's hourly wage. For piece-rate workers, we use the workers' reported average hourly earnings.



The bonus dummy equals one for workers who receive a money bonus from an employer in addition to the wage, and zero otherwise. Weekly hours of work are the number of hours interviewees reported work at their current farm job in the previous week.

The explanatory variables in all these equations are the same. The explanatory variables include all the usual demographic variables: age, years of education, years of farm experience, job tenure (how long the worker has been with the current employer in years), gender, whether the workers is Hispanic, whether the worker was born in the United States, and whether the worker speaks English.<sup>9</sup> The specification uses a legal status variable to capture the bifurcated labor markets for documented and undocumented workers. It also includes crop and regional dummies.

We have seven main explanatory variables: dummies for each of the three recessions, the recession dummies interacted with the legal status dummy (undocumented = 1), and regional unemployment rates for workers in all sectors of the economy. We use separate dummies for each recession to allow for differential effects across the recession (cf., (Gardner, 1976; Goodman and Mance, 2011). The interaction terms capture whether employers treat undocumented workers differently than legal workers during a recession. We include the unemployment rate because it peaks after the end of each recession (the National Bureau of Economic Research defines recessions based on changes in output rather than in unemployment). We do not report the unemployment rate interacted with the undocumented dummy because we cannot reject that its coefficient is zero in any equation. We treat all these variables as exogenous to the compensation and weekly hours of individual agricultural workers.

### *Hourly Earnings*

We start by examining the effects of recessions on NAWS workers' hourly earnings. Column 1 of Table 2 presents regression estimates for the ln hourly earnings equation. The coefficients on the demographic variables have the expected signs and are generally statistically significantly different

from zero at the 5% level. Undocumented workers' hourly earnings are 2.1% less than those of documented workers. Females earn 6.4% less than males. Hispanics earn 4.9% less than non-Hispanics. Unlike most previous studies, we find a statistically significant effect of education. English speakers earn 3.9% more than non-English speakers.

The coefficients on the recession dummies reflect the effect of the recession on documented workers. Documented workers' hourly earnings rose 1.8% during the 1990–1991 recession, 4.2% during the 2001 recession, and 6.9% during the Great Recession.

We draw two conclusions about the effects of recessions on documented workers. First, the hourly earning effect of the Great Recession was larger than that of the relatively minor recessions, which is consistent with literature on business cycles and the farm labor market in the 1970s (Schuh, 1976). Second, in all recessions, documented workers' wages *rose*, which suggests that recessions cause the hired-agricultural-worker supply curve to shift leftward relatively more than did the demand curve.

The sum of the coefficients on the recession dummy and its interaction with the undocumented dummy (see the bottom of Table 2) captures the effect of a recession on undocumented workers. The 1990–1991 recession did not have a statistically significant effect on undocumented workers. Hourly earnings for undocumented workers rose by 3.4% during the 2001 recession and 1.9% during the Great Recession. In contrast to the pattern for documented workers, the undocumented workers' earnings rose by less during the Great Recession than during the 2001 recession.

Thus, not only do undocumented workers earn less than documented workers do in general, but their hourly earnings rise less during recession than do the earnings of documented workers. That is, the wage gap between documented and undocumented workers widens during recessions.

An increase in the unemployment rate by one percentage point, raises the hourly wage by 0.3%. Thus, although this effect is statistically significant, it is not large.

### *Bonus Payments*

In addition to hourly earnings, 28% of the workers in our sample receive bonus payments (Table 1), which supplement relatively low wage payments (Woodbury, 1983). These deferred payments play a similar function to that of efficiency wages in other sectors (Moretti and Perloff, 2002).

We use a binary indicator equal to one if a worker receives a money bonus. Column 2 of Table 2 shows the results of a regression using a linear probability model (the results are similar for a probit model). For documented workers, the probability of receiving a bonus did not rise during the two relatively minor recessions but increased by 5.8 percentage points (21% relative to the mean) during the Great Recession. Thus, the Great Recession not only raised documented workers' hourly earnings, but it raised the probability that they received a bonus substantially.

For undocumented workers, the probability of receiving a bonus fell by 2.9 percentage points (10% relative to the mean) during the 1990–1991 recession and rose by 9 percentage points (32% relative to the mean) during the Great Recession. Again, this result is consistent with the theory that the Great Recession caused a large supply side shock. Thus, for both documented and undocumented workers, the Great Recession had a larger, positive effect on the probability of receiving a bonus than did earlier recessions.

The unemployment rate has a statistically significant effect on the probability of receiving a bonus payment. A one percentage point increase in the unemployment rate raised the probability of receiving a bonus by 0.9 percentage points.

### *Weekly Hours*

Because our data set includes information about only employed workers, we cannot directly observe the effect of a recession on total employment. However, we can examine the effect on workers'

weekly hours. When employers have difficulty recruiting workers, they have employees work more hours per week to compensate for an unusually small workforce.

For documented workers, weekly hours fell by 2.2 hours during the 1990–1991 recession, but rose by 1.1 hours during the 2001 recession, and 2.3 hours during the Great Recession. For undocumented workers, weekly hours were not statistically significantly affected during the two relatively minor recessions, but rose by 2.6 hours during the Great Recession—more than for documented workers.

An increase in the overall unemployment rate by 1 percentage point lowered the weekly hours by 0.3 hours. Thus, an increase in the overall unemployment rate lowered weekly hours, but weekly hours rose during relatively large recessions.

### *Robustness Checks*

We conducted five robustness checks. First, we estimated all three equations separately for documented and undocumented workers. That is, we allowed all the coefficients to vary between these two groups instead of only the recession dummies. The coefficients on our seven key recession variables were virtually unchanged (see Appendix Table A1).

Second, we estimated all three regressions eliminating all newcomers (those who arrived in the United States this year), about 3,300 people or 7.5% of the sample, to see if compositional changes in the workforce during recessions are driving our results. However, the coefficients were virtually unchanged (see Appendix Table A2).

Third, we estimated all three regressions leaving out the unemployment rate. Doing so had negligible effects on the other recession variable coefficients (see Appendix Table A3).

Fourth, we excluded the crop dummies, in case they are endogenous. The recession variable coefficients were unaffected (see Appendix Table A4).

Fifth, to check for regional differences, we estimated separate regressions for California and for the rest of the United States (Table 3). With the exceptions of the coefficients on bonus pay for the 2001 recession ( $-0.043$  in California and  $0.062$  in the rest of the country) and the coefficients on log hourly wage for the regional unemployment rate ( $-0.004$  in California and  $0.009$  in the rest of the country), the seven key coefficients have the same sign in each pair of regressions.

### *Comparison with Other Sectors*

Do recessions have different effects in agriculture than in other sectors of the economy that employ many undocumented immigrants, such as construction, hotels, and restaurants? To answer this question, we constructed a comparable data set based on the March Current Population Survey (CPS) for 1994–2013. We can look at the effects from only two recessions, 2001 and the Great Recession, because the CPS does include certain key variables prior to 1994. It also lacks a variable on bonus payments.

In contrast to the NAWS, the CPS data does not record whether an immigrant is undocumented. Therefore, we focus on immigrants in general and form interaction terms between immigrant status and the recession dummies. Otherwise, we use as similar a set of demographic variables as possible.

Table 4 presents the regression results for the ln wage and weekly hours in the three sectors. In none of these three sectors did either recession affect the wages of non-immigrants or of immigrants. Presumably, wages are sticky in these sectors, partially due to union and other contracts and minimum wage laws. The unemployment rate had a statistically significant effect only in the construction sector, and that positive effect is small, as in the agricultural sector.

The 2001 recession did not affect the weekly hours in these sectors. The Great Recession reduced weekly hours by 1.3 hours in the hotel sector but not in the other sectors. Thus, for most employed workers in these three sectors, weekly hours remained constant during recessions. This

result contrasts with that in the agricultural sector where weekly hours rose substantially during recessions.

## **Conclusions**

We examine how three recent recession have affected earnings and weekly hours in agriculture and in construction, hotels, and restaurants, which also hire many immigrants. Our results were generally consistent with our expectations.

Our first hypothesis was that, during a major recession, agricultural hourly earnings and the probability of receiving a bonus payment would rise. Both rose during the Great Recession. These results are consistent with the labor supply curve shifting leftward by more than the labor demand curve.

Our second hypothesis was that during relatively minor recessions, wages would not rise or would rise by less than during the Great Recession. Consistent with that prediction, documented workers' hourly earnings roses by 1.8% during the 1990–1991 recession, 4.2% during the 2001 recession, and 6.9% during the Great Recession. The probability of receiving a bonus payment was unaffected by the two earlier recessions but rose by 5.8% for documented workers.

Our third hypothesis was that recessions would affect undocumented workers differently than documented workers because their labor markets are segmented. For undocumented workers, the hourly wage did not change statistically significantly during the 1990–1991 recession, rose 3.4% in 2001, and rose 1.9% in 2008–2009 (which is inconsistent with our second hypothesis). These effects were all smaller than for documented workers. For undocumented workers, the probability of receiving bonus payments fell by 2.9 percentage points during the 1990–1991 recession and rose by 9 percentage points during the Great Recession.

Our fourth hypothesis was that weekly hours of employed agricultural workers would increase to compensate for the reduced flow of new immigrants during major recessions. During the Great Recession, weekly hours rose by 2.3 hours for documented workers and by 2.6 hours for undocumented workers.

Our fifth hypothesis was that recessions would have larger hourly earnings effects in agriculture than in construction, hotel, and restaurant labor markets. Indeed, hourly wages were essentially unchanged during recessions in these latter three labor markets.

What are the implications of these results for farmers? Recessions raise farmers' labor costs and increase their risk. If farmers in seasonal agriculture cannot find workers when they need them, their crops may be ruined. One might think that finding workers would be easier during recessions because the supply of workers increases. While we lack the data to estimate a structural model of supply and demand, our reduced-form analysis strongly suggests that the labor supply curve shifts to the left during major recessions. This inference is consistent with other direct and indirect evidence about immigration during the Great Recession. Thus, the smaller supply forces farmers to pay more per hour during recessions, and the thinner labor market makes finding workers in a timely fashion even more difficult.

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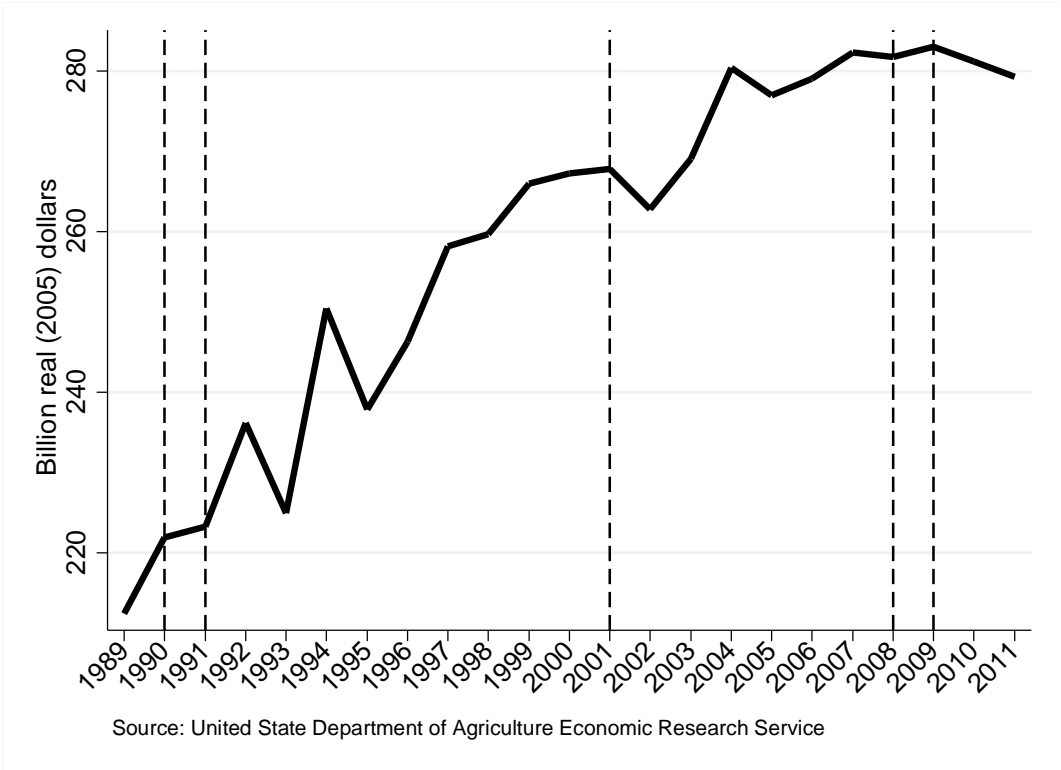
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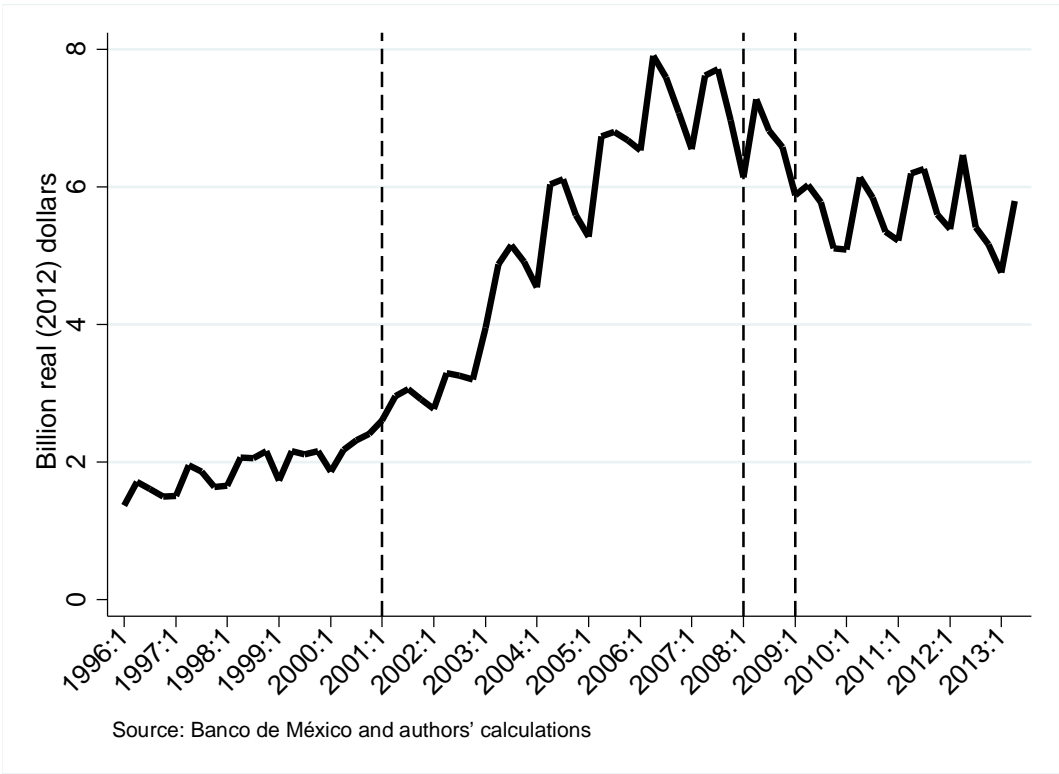
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**Figure 1. Total Agricultural Output over Time**



**Figure 2. Quarterly Remittances to Mexico, 1996–2013**



*Note:* We label only the first quarter of each year on the time axis.

**Table 1. Summary Statistics**

	Nation	California	Rest of the Country
<i>Continuous Variables</i>			
Ln Hourly Earnings (\$2012)	2.20 (0.26)	2.21 (0.22)	2.19 (0.28)
Weekly Hours	43.27 (13.30)	43.85 (11.49)	42.92 (14.25)
Age (Years)	34.93 (12.36)	35.20 (12.00)	34.78 (12.57)
Education (Years)	6.76 (3.74)	6.13 (3.36)	7.13 (3.90)
Farm Experience (Years)	11.20 (9.81)	12.23 (9.74)	10.58 (9.80)
Job Tenure (Years)	5.13 (5.72)	5.29 (5.55)	5.04 (5.82)
Regional Unemployment Rate	6.27 (1.86)	7.20 (2.08)	5.73 (1.47)
<i>Binary Variables</i>			
Bonus Pay (=1)	0.28	0.21	0.33
Undocumented Workers	0.47	0.46	0.48
Female	0.19	0.19	0.19
Hispanic	0.87	0.97	0.82
Born in the United States	0.15	0.03	0.22
Speaks English	0.26	0.14	0.33
Field Crop	0.15	0.06	0.20
Fruits and Nuts	0.37	0.61	0.23
Horticulture	0.18	0.09	0.23
Vegetable	0.25	0.22	0.26
Other Crops	0.06	0.02	0.08
California	0.37		
East	0.13		0.20
Southeast	0.17		0.27
Midwest	0.12		0.19
Southwest	0.08		0.13
Northwest	0.13		0.21
Number of Observations	43,677	16,215	27,462

*Source:* National Agricultural Workers Survey, 1989–2012.

**Table 2. Regressions for Seasonal Hired Agricultural Workers**

	Ln Hourly Earnings	Bonus Pay	Weekly Hours
1990–1991 Recession	0.018* (0.006)	-0.012 (0.009)	-2.238* (0.299)
2001 Recession	0.042* (0.007)	0.018 (0.013)	1.108* (0.342)
2008–2009 Recession	0.069* (0.007)	0.058* (0.012)	2.302* (0.302)
Undocumented × 1990–1991 Recession	-0.032* (0.012)	-0.017 (0.014)	1.516* (0.530)
Undocumented × 2001 Recession	-0.008 (0.010)	-0.012 (0.017)	-0.733 (0.488)
Undocumented × 2008–2009 Recession	-0.050* (0.008)	0.032* (0.016)	0.344 (0.411)
Regional Unemployment Rate	0.003* (0.001)	0.009* (0.001)	-0.301* (0.036)
Undocumented Workers	-0.021* (0.003)	-0.045* (0.006)	-0.123 (0.177)
Female	-0.064* (0.003)	-0.043* (0.005)	-4.807* (0.152)
Age	0.006* (0.001)	0.008* (0.001)	0.337* (0.034)
Age Squared /100	-0.009* (0.001)	-0.011* (0.001)	-0.461* (0.042)
Hispanic	-0.049* (0.006)	-0.037* (0.011)	1.036* (0.306)
Born in the United States	-0.017* (0.006)	-0.034* (0.011)	-2.119* (0.317)
Speaks English	0.039* (0.004)	0.071* (0.007)	0.078 (0.200)
Education	0.007* (0.000)	0.007* (0.001)	0.207* (0.021)
Farm Experience	0.008* (0.000)	0.011* (0.001)	0.205* (0.024)
Farm Experience Squared /100	-0.014* (0.001)	-0.019* (0.002)	-0.335* (0.059)
Tenure	0.008* (0.000)	0.016* (0.000)	0.255* (0.014)
Fruits and Nuts	0.051* (0.000)	-0.138* (0.000)	-6.998* (0.000)

	(0.004)	(0.007)	(0.234)
Horticulture	0.052*	-0.020*	-3.980*
	(0.004)	(0.008)	(0.232)
Vegetable	0.017*	-0.111*	-5.035*
	(0.004)	(0.007)	(0.246)
Other Crops	0.040*	0.016	-1.959*
	(0.006)	(0.011)	(0.331)
East	-0.018*	0.068*	-2.591*
	(0.004)	(0.007)	(0.236)
Southeast	-0.041*	0.105*	-3.690*
	(0.004)	(0.006)	(0.201)
Midwest	0.014*	0.117*	-2.741*
	(0.005)	(0.008)	(0.229)
Southwest	-0.094*	0.042*	-2.793*
	(0.005)	(0.008)	(0.257)
Northwest	0.050*	0.051*	-0.463*
	(0.004)	(0.007)	(0.200)
Constant	1.976*	-0.046	41.934*
	(0.014)	(0.025)	(0.771)
<hr/>			
Number of Observations	43,677	43,677	43,677
$\bar{R}^2$	0.160	0.166	0.100
<hr/>			

Sum of the Coefficients on the Recession and the Corresponding Interaction Dummies

	Ln Hourly Earnings	Bonus Pay	Weekly Hours
1990–1991 Recession	-0.014	-0.029*	-0.721
	(0.010)	(0.011)	(0.446)
2001 Recession	0.034*	0.006	0.375
	(0.007)	(0.010)	(0.353)
2008–2009 Recession	0.019*	0.090*	2.646*
	(0.005)	(0.011)	(0.295)

*Source:* National Agricultural Workers Survey, 1989–2012.

Notes: Robust standard errors in parentheses. Standard errors for the sum calculated using the delta method.

\*  $p < 0.05$

**Table 3. Regressions for Hired Agricultural Workers in California and the Rest of the Country**

	California			Rest of the Country		
	Ln Hourly Earnings	Bonus Pay	Weekly Hours	Ln Hourly Earnings	Bonus Pay	Weekly Hours
1990–1991 Recession	0.008 (0.008)	-0.002 (0.013)	-2.968* (0.432)	0.016 (0.010)	-0.034* (0.013)	-1.663* (0.414)
2001 Recession	0.023* (0.009)	-0.043* (0.017)	0.837* (0.398)	0.055* (0.010)	0.062* (0.018)	1.294* (0.505)
2008–2009 Recession	0.074* (0.010)	0.040 (0.021)	1.204* (0.488)	0.056* (0.008)	0.072* (0.015)	2.888* (0.384)
Undocumented × 1990–1991 Recession	-0.038* (0.019)	-0.003 (0.022)	1.196 (1.077)	-0.030* (0.015)	-0.002 (0.019)	1.453* (0.621)
Undocumented × 2001 Recession	-0.015 (0.011)	-0.028 (0.019)	-0.492 (0.589)	-0.005 (0.014)	-0.014 (0.024)	-0.912 (0.703)
Undocumented × 2008–2009 Recession	-0.040* (0.012)	0.045 (0.025)	0.325 (0.642)	-0.049* (0.011)	0.028 (0.021)	0.710 (0.532)
Regional Unemployment Rate	-0.004* (0.001)	0.009* (0.002)	-0.258* (0.046)	0.009* (0.001)	0.007* (0.002)	-0.370* (0.058)
Undocumented Workers	-0.009 (0.005)	-0.059* (0.008)	-0.418 (0.252)	-0.030* (0.004)	-0.038* (0.008)	0.039 (0.246)
Female	-0.033* (0.004)	-0.084* (0.007)	-4.209* (0.217)	-0.083* (0.004)	-0.018* (0.007)	-5.175* (0.207)
Age	0.004* (0.001)	0.011* (0.002)	0.231* (0.053)	0.007* (0.001)	0.007* (0.001)	0.382* (0.043)
Age Squared /100	-0.007* (0.001)	-0.015* (0.002)	-0.336* (0.066)	-0.009* (0.001)	-0.010* (0.002)	-0.512* (0.053)
Hispanic	-0.028* (0.012)	-0.187* (0.026)	2.470* (0.617)	-0.057* (0.007)	-0.010 (0.012)	0.509 (0.373)
Born in the United States	0.026* (0.011)	-0.028 (0.021)	-0.829 (0.540)	-0.038* (0.008)	-0.010 (0.013)	-2.573* (0.403)
Speaks English	0.028* (0.006)	0.077* (0.012)	0.309 (0.303)	0.047* (0.005)	0.060* (0.009)	-0.008 (0.261)
Education	0.005* (0.001)	0.007* (0.001)	0.158* (0.031)	0.009* (0.001)	0.007* (0.001)	0.232* (0.028)
Farm Experience (Years)	0.007* (0.001)	0.004* (0.001)	0.196* (0.036)	0.008* (0.001)	0.015* (0.001)	0.214* (0.032)
Farm Experience Squared /100	-0.010* (0.002)	-0.004 (0.003)	-0.374* (0.089)	-0.016* (0.001)	-0.028* (0.003)	-0.326* (0.077)
Tenure	0.009* (0.000)	0.021* (0.001)	0.287* (0.020)	0.007* (0.000)	0.014* (0.001)	0.238* (0.018)
Fruits and Nuts	0.032* (0.000)	-0.152* (0.000)	-7.362* (0.000)	0.074* (0.000)	-0.145* (0.000)	-6.841* (0.000)

	(0.007)	(0.015)	(0.485)	(0.005)	(0.008)	(0.285)
Horticulture	0.023*	-0.087*	-4.856*	0.059*	-0.009	-3.732*
	(0.008)	(0.019)	(0.525)	(0.004)	(0.009)	(0.260)
Vegetable	0.051*	-0.133*	-4.880*	0.002	-0.110*	-5.165*
	(0.008)	(0.016)	(0.520)	(0.005)	(0.008)	(0.284)
Other Crops	0.075*	0.025	-3.224*	0.035*	0.013	-1.673*
	(0.013)	(0.028)	(0.785)	(0.006)	(0.012)	(0.364)
East	-	-	-	0.076*	0.031*	0.132
				(0.006)	(0.010)	(0.315)
Southeast	-	-	-	0.051*	0.065*	-0.991*
				(0.005)	(0.009)	(0.290)
Midwest	-	-	-	0.110*	0.076*	0.014
				(0.006)	(0.010)	(0.304)
Constant	2.053*	0.134*	42.974*	1.834*	-0.022	38.906*
	(0.024)	(0.043)	(1.293)	(0.018)	(0.032)	(0.996)
Observations	16,215	16,215	16,215	27,462	27,462	27,462
$\bar{R}^2$	0.124	0.186	0.102	0.184	0.147	0.099

Sum of the Coefficients on the Recession and the Corresponding Interaction Dummies

	Ln					
	Ln Hourly Earnings	Bonus Pay	Weekly Hours	Hourly Earnings	Bonus Pay	Weekly Hours
1990–1991 Recession	-0.031	-0.005	-1.772	-0.014	-0.036*	-0.210
	(0.017)	(0.018)	(0.987)	(0.012)	(0.014)	(0.483)
2001 Recession	0.008	-0.070*	0.345	0.049*	0.048*	0.382
	(0.007)	(0.009)	(0.442)	(0.010)	(0.015)	(0.494)
2008–2009 Recession	0.034*	0.085*	1.529*	0.007	0.101*	3.599*
	(0.007)	(0.016)	(0.447)	(0.007)	(0.016)	(0.390)

Source: National Agricultural Workers Survey, 1989–2012.

Notes: Robust standard errors in parentheses. Standard errors for the sum calculated using the delta method.

\*  $p < 0.05$



Table 4. Regressions for Construction, Hotel, and Restaurant Workers

	Construction		Hotel		Restaurant	
	Ln Hourly Earnings	Weekly Hours	Ln Hourly Earnings	Weekly Hours	Ln Hourly Earnings	Weekly Hours
2001 Recession	0.017 (0.013)	-0.651 (0.362)	0.004 (0.029)	-1.265* (0.639)	0.034 (0.021)	0.171 (0.345)
2008/09 Recession	0.017 (0.013)	0.356 (0.347)	0.014 (0.029)	-0.302 (0.734)	-0.010 (0.017)	-0.340 (0.317)
Immigrant × 2001 Recession	-0.034 (0.035)	0.937 (0.695)	-0.036 (0.060)	-0.847 (1.017)	-0.067 (0.039)	-0.632 (0.800)
Immigrant × 2008/09 Recession	0.036 (0.030)	-0.904 (0.564)	-0.027 (0.049)	0.297 (1.186)	-0.007 (0.031)	0.013 (0.641)
Unemployment Rate	0.006* (0.002)	-0.086 (0.050)	0.000 (0.004)	-0.159 (0.095)	0.005 (0.003)	-0.149* (0.046)
Immigrant	-0.085* (0.015)	-0.595 (0.318)	-0.047* (0.022)	-0.609 (0.460)	0.031* (0.014)	0.471 (0.284)
Female	-0.249* (0.013)	-2.354* (0.306)	-0.087* (0.016)	-1.720* (0.334)	-0.154* (0.009)	-1.542* (0.177)
Age	0.045* (0.002)	0.138* (0.049)	0.017* (0.003)	0.400* (0.070)	0.006* (0.002)	0.452* (0.038)
Age Squared	-0.000* (0.000)	-0.002* (0.001)	-0.000* (0.000)	-0.005* (0.001)	-0.000 (0.000)	-0.005* (0.000)
African American	-0.184* (0.017)	-1.075* (0.392)	-0.011 (0.022)	-0.408 (0.470)	0.126* (0.013)	-0.092 (0.281)
Hispanic	-0.102* (0.015)	-0.809* (0.319)	0.013 (0.025)	0.668 (0.490)	0.001 (0.015)	0.882* (0.282)
Some School	0.047 (0.062)	-0.720 (1.087)	0.097 (0.056)	1.707 (1.024)	0.170* (0.058)	0.852 (2.261)
High School Graduate	0.200* (0.063)	0.439 (1.093)	0.159* (0.057)	2.237* (1.032)	0.182* (0.058)	2.524 (2.260)
Some College	0.249* (0.063)	0.669 (1.105)	0.180* (0.059)	1.829 (1.060)	0.142* (0.058)	1.664 (2.260)
College Graduate	0.318* (0.065)	1.143 (1.149)	0.285* (0.063)	2.394* (1.080)	0.150* (0.062)	2.487 (2.280)
Married	0.081* (0.008)	0.973* (0.194)	0.087* (0.017)	0.007 (0.332)	0.052* (0.011)	0.126 (0.213)
Employed Full Time	0.102* (0.010)	13.748* (0.292)	0.151* (0.017)	14.349* (0.402)	0.160* (0.009)	17.080* (0.180)
Firm Size	0.016* (0.001)	0.324* (0.032)	0.009* (0.002)	0.157* (0.058)	0.002 (0.001)	0.065* (0.025)

Constant	1.257*	23.909*	1.403*	16.802*	1.394*	13.949*
	(0.073)	(1.450)	(0.089)	(1.844)	(0.067)	(2.354)
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,535	10,535	2,786	2,786	10,579	10,579
$\bar{R}^2$	0.332	0.280	0.192	0.458	0.129	0.548

*Source:* March Current Population Survey 1994–2013.

Notes: Robust standard errors in parentheses.

\*  $p < 0.05$

Table A1. Regressions for Seasonal Hired Agricultural Workers: Documented vs. Non-documented

	Documented			Non-documented		
	Ln Hourly Earnings	Bonus Pay	Weekly Hours	Ln Hourly Wage	Bonus Pay	Weekly Hours
1990–1991 Recession	0.029* (0.007)	-0.018 (0.009)	-2.225* (0.304)	-0.025* (0.010)	-0.025* (0.011)	-0.739 (0.458)
2001 Recession	0.040* (0.007)	0.015 (0.013)	1.163* (0.344)	0.036* (0.007)	0.007 (0.010)	0.270 (0.351)
2008–2009 Recession	0.067* (0.007)	0.067* (0.013)	2.219* (0.307)	0.019* (0.005)	0.075* (0.011)	2.606* (0.304)
Regional Unemployment Rate	0.002 (0.001)	0.006* (0.002)	-0.248* (0.053)	0.004* (0.001)	0.010* (0.002)	-0.362* (0.050)
Female	-0.074* (0.004)	-0.062* (0.007)	-5.314* (0.206)	-0.053* (0.004)	-0.015* (0.007)	-3.863* (0.225)
Age	0.009* (0.001)	0.013* (0.002)	0.401* (0.049)	0.001 (0.001)	0.002 (0.002)	0.186* (0.054)
Age Squared (/100)	-0.012* (0.001)	-0.016* (0.002)	-0.533* (0.057)	-0.003* (0.001)	-0.002 (0.002)	-0.239* (0.075)
Hispanic	-0.043* (0.007)	-0.031* (0.012)	1.501* (0.336)	-0.014 (0.019)	-0.010 (0.029)	0.307 (0.885)
Born in the United States	-0.032* (0.007)	-0.037* (0.012)	-2.384* (0.342)	-	-	-
Speak English	0.041* (0.005)	0.069* (0.009)	0.325 (0.252)	0.028* (0.006)	0.064* (0.011)	-0.665* (0.335)
Education	0.010* (0.001)	0.007* (0.001)	0.233* (0.030)	0.005* (0.001)	0.007* (0.001)	0.181* (0.029)
Farm Experience (Years)	0.008* (0.001)	0.006* (0.001)	0.153* (0.034)	0.009* (0.001)	0.014* (0.001)	0.263* (0.044)
Farm Experience Squared (/100)	-0.013* (0.001)	-0.008* (0.003)	-0.212* (0.075)	-0.024* (0.003)	-0.038* (0.004)	-0.799* (0.150)
Tenure	0.007* (0.000)	0.015* (0.001)	0.224* (0.015)	0.008* (0.001)	0.026* (0.001)	0.384* (0.036)
Fruits and Nuts	0.036* (0.005)	-0.185* (0.010)	-8.873* (0.307)	0.065* (0.006)	-0.065* (0.009)	-4.181* (0.365)
Horticulture	0.064* (0.006)	-0.102* (0.011)	-6.643* (0.302)	0.038* (0.005)	0.083* (0.011)	-0.313 (0.364)
Vegetable	0.006 (0.006)	-0.171* (0.010)	-6.963* (0.328)	0.027* (0.006)	-0.026* (0.010)	-2.192* (0.374)
Other Crops	0.043* (0.008)	-0.050* (0.015)	-3.760* (0.433)	0.036* (0.008)	0.103* (0.016)	0.741 (0.517)
East	-0.018* (0.007)	0.073* (0.012)	-2.219* (0.364)	-0.014* (0.005)	0.089* (0.009)	-2.004* (0.310)
Southeast	-0.057* (0.006)	0.102* (0.010)	-3.360* (0.303)	-0.025* (0.005)	0.104* (0.008)	-4.093* (0.268)
Midwest	0.024* (0.006)	0.106* (0.010)	-2.906* (0.303)	0.003 (0.005)	0.139* (0.008)	-2.079* (0.268)

	(0.006)	(0.012)	(0.316)	(0.006)	(0.011)	(0.341)
Southwest	-0.096*	0.005	-3.702*	-0.083*	0.102*	-1.153*
	(0.006)	(0.010)	(0.320)	(0.008)	(0.014)	(0.446)
Northwest	0.065*	0.028*	-0.848*	0.039*	0.075*	0.073
	(0.006)	(0.011)	(0.290)	(0.005)	(0.008)	(0.280)
Constant	1.904*	-0.003	42.222*	1.990*	-0.134*	42.038*
	(0.021)	(0.038)	(1.120)	(0.025)	(0.041)	(1.329)
Observations	23,036	23,036	23,036	20,641	20,641	20,641
$\bar{R}$	0.161	0.138	0.136	0.093	0.144	0.066

Notes: Robust standard errors in parentheses. \* p<0.05

Table A2. Regressions for Seasonal Hired Agricultural Workers Excluding Newcomers

	Ln Hourly Earnings (1)	Bonus (=1) (2)	Weekly Hours (3)
Non-documented × 1990–1991 Recession	-0.035* (0.012)	-0.027 (0.016)	1.088* (0.550)
Non-documented × 2001 Recession	-0.007 (0.010)	-0.016 (0.018)	-0.612 (0.508)
Non-documented × 2008–2009 Recession	-0.053* (0.008)	0.026 (0.016)	0.124 (0.417)
1990–1991 Recession	0.018* (0.006)	-0.014 (0.009)	-2.282* (0.301)
2001 Recession	0.042* (0.007)	0.019 (0.013)	1.142* (0.342)
2008–2009 Recession	0.070* (0.007)	0.059* (0.012)	2.272* (0.301)
Non-documented Workers	-0.020* (0.003)	-0.042* (0.006)	-0.035 (0.178)
Regional Unemployment Rate	0.003* (0.001)	0.009* (0.001)	-0.280* (0.037)
Female	-0.067* (0.003)	-0.046* (0.005)	-4.886* (0.156)
Age	0.006* (0.001)	0.009* (0.001)	0.325* (0.036)
Age Squared (/100)	-0.009* (0.001)	-0.012* (0.001)	-0.449* (0.043)
Hispanic	-0.051* (0.006)	-0.033* (0.011)	1.008* (0.310)
Born in the United States	-0.020* (0.006)	-0.038* (0.011)	-2.266* (0.319)
Speak English	0.038* (0.004)	0.066* (0.007)	0.077 (0.202)
Education	0.008* (0.000)	0.007* (0.001)	0.202* (0.022)
Farm Experience (Years)	0.007* (0.000)	0.009* (0.001)	0.175* (0.026)
Farm Experience Squared (/100)	-0.013* (0.001)	-0.015* (0.002)	-0.278* (0.062)
Tenure	0.008* (0.000)	0.016* (0.001)	0.255* (0.026)

	(0.000)	(0.000)	(0.014)
Fruits and Nuts	0.049*	-0.155*	-7.558*
	(0.004)	(0.007)	(0.242)
Horticulture	0.053*	-0.033*	-4.721*
	(0.004)	(0.008)	(0.239)
Vegetable	0.015*	-0.127*	-5.633*
	(0.004)	(0.008)	(0.256)
Other Crops	0.041*	0.005	-2.560*
	(0.006)	(0.012)	(0.341)
East	-0.018*	0.077*	-2.389*
	(0.005)	(0.008)	(0.248)
Southeast	-0.043*	0.113*	-3.663*
	(0.004)	(0.007)	(0.211)
Midwest	0.013*	0.120*	-2.823*
	(0.005)	(0.009)	(0.236)
Southwest	-0.093*	0.042*	-2.787*
	(0.005)	(0.009)	(0.264)
Northwest	0.050*	0.052*	-0.774*
	(0.004)	(0.007)	(0.205)
Constant	1.972*	-0.036	42.970*
	(0.015)	(0.027)	(0.810)
Observations	40,307	40,307	40,307
$\bar{R}$	0.153	0.153	0.105

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Notes: Robust standard errors in parentheses. \* p<0.05

Table A3. Regressions for Seasonal Hired Agricultural Workers w/o Regional Unemployment Rate Control

	Ln Hourly Earnings (1)	Bonus (=1) (2)	Weekly Hours (3)
Non-documented × 1990–1991 Recession	-0.032* (0.012)	-0.014 (0.014)	1.437* (0.530)
Non-documented × 2001 Recession	-0.007 (0.010)	-0.011 (0.017)	-0.782 (0.487)
Non-documented × 2008–2009 Recession	-0.049* (0.008)	0.034* (0.016)	0.277 (0.411)
1990–1991 Recession	0.019* (0.006)	-0.009 (0.009)	-2.323* (0.298)
2001 Recession	0.038* (0.007)	0.007 (0.013)	1.485* (0.339)
2008–2009 Recession	0.074* (0.006)	0.073* (0.012)	1.796* (0.296)
Non-documented Workers	-0.020* (0.003)	-0.044* (0.006)	-0.171 (0.177)
Female	-0.065* (0.003)	-0.043* (0.005)	-4.797* (0.152)
Age	0.006* (0.001)	0.009* (0.001)	0.335* (0.034)
Age Squared (/100)	-0.009* (0.001)	-0.012* (0.001)	-0.460* (0.042)
Hispanic	-0.049* (0.006)	-0.038* (0.011)	1.050* (0.306)
Born in the United States	-0.017* (0.006)	-0.036* (0.011)	-2.073* (0.317)
Speak English	0.039* (0.004)	0.073* (0.007)	0.025 (0.200)
Education	0.008* (0.000)	0.007* (0.001)	0.200* (0.021)
Farm Experience (Years)	0.008* (0.000)	0.011* (0.001)	0.201* (0.024)
Farm Experience Squared (/100)	-0.015* (0.001)	-0.019* (0.002)	-0.327* (0.059)
Tenure	0.008* (0.000)	0.017* (0.000)	0.248* (0.014)

Fruits and Nuts	0.051* (0.004)	-0.137* (0.007)	-7.009* (0.234)
Horticulture	0.051* (0.004)	-0.020* (0.008)	-3.972* (0.232)
Vegetable	0.018* (0.004)	-0.110* (0.007)	-5.077* (0.246)
Other Crops	0.039* (0.006)	0.014 (0.011)	-1.881* (0.331)
East	-0.023* (0.004)	0.054* (0.007)	-2.111* (0.230)
Southeast	-0.045* (0.004)	0.093* (0.006)	-3.307* (0.199)
Midwest	0.009* (0.004)	0.101* (0.008)	-2.204* (0.224)
Southwest	-0.097* (0.005)	0.031* (0.008)	-2.422* (0.255)
Northwest	0.046* (0.004)	0.039* (0.006)	-0.051 (0.197)
Constant	1.993* (0.014)	0.012 (0.023)	40.008* (0.742)
Observations	43,677	43,677	43,677
$\bar{R}$	0.160	0.165	0.099

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Notes: Robust standard errors in parentheses. \* p<0.05



Table A4. Regressions for Seasonal Hired Agricultural Workers w/o Crop Controls

	Ln Hourly Earnings (1)	Bonus (=1) (2)	Weekly Hours (3)
Non-documented × 1990–1991 Recession	-0.031* (0.012)	-0.018 (0.014)	1.396* (0.539)
Non-documented × 2001 Recession	-0.007 (0.010)	-0.011 (0.017)	-0.740 (0.505)
Non-documented × 2008–2009 Recession	-0.049* (0.008)	0.031 (0.016)	0.241 (0.419)
1990–1991 Recession	0.019* (0.006)	-0.025* (0.009)	-2.678* (0.304)
2001 Recession	0.042* (0.007)	0.017 (0.013)	1.070* (0.357)
2008–2009 Recession	0.070* (0.007)	0.063* (0.012)	2.422* (0.311)
Non-documented Workers	-0.021* (0.003)	-0.042* (0.006)	-0.012 (0.179)
Regional Unemployment Rate	0.002* (0.001)	0.008* (0.001)	-0.330* (0.037)
Female	-0.059* (0.003)	-0.048* (0.005)	-5.313* (0.151)
Age	0.005* (0.001)	0.009* (0.001)	0.382* (0.034)
Age Squared (/100)	-0.008* (0.001)	-0.013* (0.001)	-0.516* (0.042)
Hispanic	-0.052* (0.006)	-0.050* (0.011)	0.776* (0.309)
Born in the United States	-0.023* (0.006)	-0.020 (0.011)	-1.330* (0.322)
Speak English	0.038* (0.004)	0.078* (0.007)	0.322 (0.202)
Education	0.007* (0.000)	0.008* (0.001)	0.216* (0.021)
Farm Experience (Years)	0.008* (0.000)	0.010* (0.001)	0.181* (0.025)
Farm Experience Squared (/100)	-0.015* (0.001)	-0.018* (0.002)	-0.264* (0.060)
Tenure	0.008* (0.000)	0.017* (0.001)	0.282* (0.025)

	(0.000)	(0.001)	(0.014)
East	-0.033*	0.112*	-0.525*
	(0.004)	(0.007)	(0.224)
Southeast	-0.049*	0.143*	-2.275*
	(0.004)	(0.006)	(0.192)
Midwest	0.007	0.161*	-1.261*
	(0.004)	(0.008)	(0.221)
Southwest	-0.107*	0.088*	-0.805*
	(0.005)	(0.008)	(0.259)
Northwest	0.046*	0.069*	0.240
	(0.004)	(0.007)	(0.205)
Constant	2.025*	-0.157*	35.759*
	(0.014)	(0.024)	(0.743)
Observations	43,679	43,679	43,679
$\bar{R}$	0.155	0.152	0.074

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Notes: Robust standard errors in parentheses. \* p<0.05

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<sup>1</sup> Most of this limited literature is descriptive and deals with recessions prior to the 1980s. Some of the best articles are Gardner (1976), Schuh (1976), and Gardner (1981). More recently, Martin (2009) discussed several reasons why the Great Recession might differ from earlier recessions and why the effects of recession might differ from those in other sectors.

<sup>2</sup> We base these calculations on the National Agricultural Workers Survey. See Table 1.

<sup>3</sup> Partially offsetting this supply effect, some workers from the service and other sectors who lost their jobs could look for agricultural jobs. However, this effect has probably been small in recent decades.

<sup>4</sup> Passel, Cohn and Gonzalez-Barrera (2013) estimated that the undocumented immigrant population was 8.6 million in 2000, 9.4 million in 2001, which was a recession year, and 9.7 million in 2002. Unfortunately, Passel, Cohn and Gonzalez-Barrera (2013)'s estimated data series for the size of the undocumented population over time is not detailed by year before 1995.

<sup>5</sup> These estimates are from a USDA-ERS analysis of the NASS Farm Labor Survey data, which are available at <http://www.ers.usda.gov/topics/farm-economy/farm-labor/background.aspx>.

<sup>6</sup> The U.S. Department of Labor is responsible for collecting these data. Details about the data are available at <http://www.doleta.gov/agworker/naws.cfm>.

<sup>7</sup> For a map of NAWS regions, see [http://www.doleta.gov/agworker/pdf/NAWS\\_Map.pdf](http://www.doleta.gov/agworker/pdf/NAWS_Map.pdf).

<sup>8</sup> The public-use CPS data are available at <https://www.ipums.org/cps/index.shtml>.

<sup>9</sup> Because less than 3% of the sample are African American, it is not always feasible to have a race dummy. Where it is, including it does not change our other results.