LEGAL STATUS AND U.S. FARM WAGES

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Abstract
Using National Agricultural Workers Survey data, we estimate U.S. farm worker wage differentials by legal status. In order to adequately correct sample selection bias, we develop a Heckman-type two-stage method with an ordered probit model in the first stage and a wage equation model in the second stage.

Keywords: Legal status, wage rates, sample selection bias.

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Introduction

The U.S. agricultural labor market is heavily dependent on foreign-born workers. According to the National Agricultural Workers Survey (NAWS) data, 79% of agricultural workers were foreign born in 2002. This figure, although increasing slightly, has been rather stable during the 1990s. However, the composition of legal status of farm workers has varied dramatically in the same period. For the years 1989-92 only 16% of farm workers are unauthorized. The portion of unauthorized workers rose to 36% for the years 1993-95, and 50% for the years 1998-2000 and 48% for the years 2001-2004. This dramatic change in legal status composition of farm workers might have had a significant impact on the cost structure for U.S. agriculture over the above period. The purpose of this study is to investigate whether, holding worker characteristics constant, there are wage differentials by legal status for farm workers in the U.S. For that purpose, we estimate wage equations for each legal status worker and implement simulations to forecast how the wage of current unauthorized farm workers will change if they are given a legal status.

Limited empirical work has been done on the relationship between legal status and farm worker wage (Taylor 1992, Ise and Perloff 1995, Moretti 2000). In general, these studies conclude that estimated wages for authorized, in contrast to unauthorized, workers are significantly higher. A problem to be dealt with when studying the relationship between legal status and farm worker wages is sample selection bias. The wage for a worker with a particular legal status is observed only if the worker is in that legal status; the worker's earnings in an

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alternative legal status are not observed. Each foreign-born worker chooses his/her legal status, considering conditions such as his/her individual demographic characteristics, cost of application, and benefit of the status. This selection of legal status may be related to the wage of the worker. If this is the case, the wage equation without correcting for this selection process will yield biased and inconsistent estimates. Correction of selection bias is particularly important for the estimation of the change in mean wage, should she/he attain an alternative legal status.[1] This simulation study is essential to forecast the effects of immigration policy change which could result in a change in status from unauthorized to authorized for a large number of workers.

Ise and Perloff (1995) correct the selection bias by using Lee's extension of Heckman's two-stage sample selection method (Lee 1983, Heckman 1979).[2] In the first stage, the multinomial logit model is run to estimate the legal status equation assuming the error term has a Gumbel distribution. However, the second-stage wage equation with the correction term, which is calculated from the first stage result, does not generally yield consistent estimates with the normal distribution assumption of error term in the wage equation (Schmertmann 1992, Bourguignon et al. 2004). We develop an alternative Heckman-type two-stage method with the ordered probit model in the first stage. We use the ordered probit model in the first stage for two reasons: (1) this method, with the appropriate correction term, yields consistent estimates in the second stage wage equation, and (2) it maintains the ordinal nature of legal status which the multinomial logit does not. Considering the advantages in the labor market, the alternatives can be ordered as "unauthorized, authorized, permanent resident, and citizen workers."

[1] Maddala (1983) emphasizes importance of this by showing following examples: the evaluation of the benefits of social programs, and profession choice problems.
[2] Taylor (1992) corrects selection bias by the standard Heckman two-stage method using selection of primary (skilled) or secondary (unskilled) farm jobs instead of legal statuses. But, the correction terms are not statistically significant in either wage equation.

Methodology

Our Heckman-type two-stage method is specified with the ordered probit model for the first stage and the wage model for the second stage. The ordered probit model is used to explain the legal status of worker *i* as a function of the individual's socioeconomic and policy variables (denoted as vector x_i). A foreign-born worker's legal status (J_i) takes on four values: 0=unauthorized, 1=authorized, 2= permanent resident (green card holder), and 3=citizen. With the familiar argument of latent regression (Greene 2003), we can assume that an unobserved variable J_i^* is censored as follows: $J_i = 0$ if $J_i^* \le \mu_0$, $J_i = 1$ if $\mu_0 < J_i^* \le \mu_1$, $J_i = 2$ if $\mu_1 < J_i^* \le \mu_2$, $J_i = 3$ if $\mu_2 < J_i^*$, where $J_i^* = x_i^{'}\alpha + \varepsilon_i$; x_i is a vector of exogenous characteristics of individual *i*; and ε_i is a disturbance term. The characteristics include gender, marital status, English speaking ability, race (black, white, and other), ethnicity (Hispanic and other), age, age squared, education, education squared, US farm experience, US farm experience squared, and the year of interview (before 1993, after 2001, and in-between). We assume that ε_i is normally distributed with a mean of zero and a standard deviation of σ_ε which is normalized to be one. Then the likelihood function can be expressed as

$$L(\alpha, \sigma_\varepsilon, \mu_j \mid data) = \left\{ \begin{array}{l} \prod_{J_i=0}\left[\Phi\left(\frac{\mu_0 - x_i^{'}\alpha}{\sigma_\varepsilon}\right)\right]\prod_{J_i=1}\left[\Phi\left(\frac{\mu_1 - x_i^{'}\alpha}{\sigma_\varepsilon}\right) - \Phi\left(\frac{\mu_0 - x_i^{'}\alpha}{\sigma_\varepsilon}\right)\right] \\ \prod_{J_i=2}\left[\Phi\left(\frac{\mu_2 - x_i^{'}\alpha}{\sigma_\varepsilon}\right) - \Phi\left(\frac{\mu_1 - x_i^{'}\alpha}{\sigma_\varepsilon}\right)\right]\prod_{J_i=3}\left[1 - \Phi\left(\frac{\mu_2 - x_i^{'}\alpha}{\sigma_\varepsilon}\right)\right] \end{array} \right\}, \quad (1)$$

where $\Phi(\cdot)$ indicates the cumulative distribution for the standard normal.

The wage equation may be expressed as $\ln w_{ij} = z_i^{'}\beta_j + u_{ij}$ where $u_{ij} \sim N(0, \sigma_j)$. Further, we assume that the mean of log of wage for a worker *i* with legal status *j* ($\ln w_{ij}$) depends on independent variables z_i (dummy variable for seasonal worker, dummy variable for worker paid by piece rate, dummy variable for skilled task, race (white or not), gender, marital status, age, age squared, education, education squared, US farm experience, US farm experience squared, English speaking ability, availability of free housing, region (California, Florida, and other), the year of the interview (before 1993 or after 2001 or in-between).

However, wage w_{ij} is observed only if person *i* has legal status *j*. This is a typical case for selection bias. Assuming ε_i and u_{ij} are bivariately normally distributed with correlation coefficient ρ_j, the mean of the log of the wage conditioned on the legal status of person *i* is

$$E\left[\ln w_{ij} \mid J_{\mathrm{i}} = j; x_i, z_i\right] = z_i^{'}\beta_j + \rho_j \sigma_j \lambda_{ij},$$

where λ_{ij} is the correction term for the selection bias which is given as

$$\lambda_{ij} = -\frac{\phi(\gamma_{ij}) - \phi(\gamma_{ij-1})}{\Phi(\gamma_{ij}) - \Phi(\gamma_{ij-1})},$$

where $\gamma_{ij} = \dfrac{\mu_j - x_i^{'}\alpha}{\sigma_\varepsilon}, \gamma_{ij-1} = \dfrac{\mu_{j-1} - x_i^{'}\alpha}{\sigma_\varepsilon}$. Note that we can use the result of the ordered probit model in the first stage for estimates of γ_{ij} and γ_{ij-1}. Also note that $\mu_{-1} = -\infty, \mu_3 = \infty$ from the assumption of normal distribution. In the second stage we estimate the wage equation (equation (2)) by OLS with the correction term, λ_{ij}, included, which is calculated from the first stage.

$$\left[\ln w_{ij} \mid J_{\mathrm{i}} = j; x_i, z_i\right] = z_i^{'}\beta_j + \rho_j \sigma_j \lambda_{ij} + v_{ij} = z_i^{'}\beta_j + \beta_{\lambda_j}\lambda_{ij} + v_{ij}. \tag{2}$$

Note that v_{ij} is heteroschedastic. Its conditional variance depends on *i* as

$$\mathrm{var}\left[v_{ij} \mid J_{\mathrm{i}} = j; x_i, z_i\right] = \sigma_j^2\left[1 - \rho^2 \delta_{ij}\right],$$

where

$$\delta_{ij} = \frac{\gamma_{ij}\cdot\phi(\gamma_{ij}) - \gamma_{ij-1}\cdot\phi(\gamma_{ij-1})}{\Phi(\gamma_{ij}) - \Phi(\gamma_{ij-1})} + \left[\frac{\phi(\gamma_{ij}) - \phi(\gamma_{ij-1})}{\Phi(\gamma_{ij}) - \Phi(\gamma_{ij-1})}\right]^2.$$

Then a consistent estimator of σ_j^2 is given by $\hat{\sigma}_j^2 = \sum_{i=1}^{N_j}\left[\hat{v}_{ij}^2 + \hat{\beta}_{\lambda_j}^2 \hat{\delta}_{ij}\right] / N_j$ where N_j is the number of observations for legal status j and $\hat{v}_{ij}^2$ is estimated from the least squares residuals from (2). We also use a consistent estimator of the asymptotic covariance matrix for $\hat{\beta}_j$ and $\hat{\beta}_{\lambda_j}$.[3]

Data

The data used in this study are obtained from the National Agricultural Workers Survey (NAWS) (Office of Assistant Secretary for Policy 2005). We used the study period from 1989, when the NAWS was first available, to the most recent year available, 2004. This section will describe the definitions of each variable used in the model.

Legal status is a discrete variable ranging from 0 to 3. Status 0 = "unauthorized" workers means that the worker is undocumented (did not apply to any legal status or application was denied) and also includes those who had no work authorization even if they were documented. Status 1 = "authorized" workers or documented workers; these workers must have a work authorization and may fall into any of the following status: having border crossing card/commuter card, with pending status, or temporary residents holding a non-immigrant visa. Status 2 = "permanent residents or green card holders" who have the right to reside and work in the U.S., and status 3 = "citizens" who are citizens by birth or naturalization.

Wage is average earnings per hour for a worker regardless of the method of payment. If a worker is paid by piece rate, his/her *wage* is calculated by (piece rate)×(average pieces per hour). We also deflated the *wage* by U.S. Consumer Price Index (Bureau of Labor Statistics, U.S. Department of Labor 2005).[4]

The variable *English* measures the capability to speak English. The variable is a discrete variable ranging from 1 to 4, where 1= not speaking English at all, 2 = speak a little English, 3 =

[3] Jimenez and Kugler (1987) also use ordered probit in the first stage to correct the selection bias, but their method does not deal with heteroschedasticity for the disturbance term nor does it use a consistent estimator for the asymptotic covariance matrix for $\hat{\beta}_j$ and $\hat{\beta}_{\lambda_j}$.

[4] We use the standard CPI: monthly CPI for all items for all U.S. urban consumers.

somewhat able to speak English, and 4 = speaking good English. *Hispanic* is a dummy variable for Hispanic which includes Mexican-American, Mexican, Chicano, Puerto Rican, and other Hispanic ethnic groups. *Black* (or African American) and *White* are also dummy variables derived from a question regarding their race which may also be American Indian/Alaka Native, Indigenous, Asian, Native Hawaiian or Pacific Islander, or others. *Age* was calculated from the difference between the date of interview and the date of birth, except in the earlier years of the survey when age was asked directly. *Education* is the highest grade level for education, and it ranges from 0 to 20. *Experience* is the number of years of doing farm work in the U.S. (not including farm work experience abroad). *Skilled Task* is a dummy for workers who engage in semi-skilled or supervisory tasks. Although the original questions have over 100 task codes, tasks are grouped into six categories as follows: 1 = pre-harvest, 2 = harvest, 3 = post-harvest, 4 = semi-skilled, 5 = supervisor, and 6 = other.

Seasonal Worker is a dummy for workers who were working on a seasonal basis for the employer at the time of interview. *Piece rate* is a dummy for workers who are paid by piece rate instead of being paid by the hour or a salary. *Labor contractor* is a dummy variable for workers who are employed by labor contractors rather than the grower. *Free housing* is a dummy variable for workers (or workers and their family) who receive free housing from their current employer. It does not include those who own their house or live for free with friends or relatives. It also excludes those who pay for housing provided by employers or by the government or charity.

The dummies for *Florida* and *California* are the location at the time of interview. *Before 1993* dummy variable is for all the years prior to 1993 when the majority of IRCA legalization was granted, and *After 2001* is the years post-September 11, 2001 event.

Ordered Probit Model for Legal Status

Here we estimate the ordered probit model for legal status for foreign-born farm workers using NAWS data. Table 1 shows estimates for parameters and asymptotic standard errors (given in the parentheses) using 30,610 observations of foreign-born farm workers. Using a 0.05 significance criterion, we find that all coefficients except education squared are statistically significant. The third column of Table 1 shows the marginal effect of each variable on the probability of a worker becoming legal. The probability of worker *i* being legal is given by $\Pr ob(J_i^* > \mu_0) = 1 - \Phi(\mu_0 - x_i'\alpha)$. Then the marginal effect of variable *k* evaluated at the mean $\bar{x}$ is $\phi(\mu_0 - \bar{x}'\alpha)\alpha_k$ for the continuous variables and $\Phi(\mu_0 - \bar{x}'_{-k}\,\alpha_{-k}) - \Phi(\mu_0 - \bar{x}'_{-k}\,\alpha_{-k} - \alpha_k)$ for the dummy variables, where $\bar{x}'_{-k}$ and α_{-k} are variables and coefficients excluding *k*. Females, married, workers with higher English speaking ability, non-black, white, non-hispanic are statistically significantly more likely to have more advantageous legal status all else being the same. We also find that both age and US farm experience have a significant nonlinear effect on legal status. US farm experience has a positive effect on legal status up to 38 years. Age has a positive effect on legal status up to 78 years. Education has a significantly positive linear effect on legal status. We find that the greatest positive marginal effect is from the female dummy followed by English speaking ability and the before 1993 dummy. The greatest negative marginal effect is from the Hispanic dummy followed by the after 2001 dummy and the Black dummy. Note that, holding all other characteristics the same, the workers interviewed before 1993 are 12% more likely and those interviewed after 2001 are 13% less likely to be legal compared to those interviewed between these periods.

Finally, Table 2 shows the actual-predicted legal status table. A worker is predicted to be status 0 (unauthorized) if $x_i'\hat{\alpha} < \hat{\mu}_0$, and is predicted to be status 1 (authorized) worker if $\hat{\mu}_0 < x_i'\hat{\alpha} < \hat{\mu}_1$ and so on. Table 2 shows that 84% of unauthorized workers are correctly predicted to be unauthorized. In the same way, 19% of authorized workers, 67% of permanent residents and 18% of citizens are correctly predicted in their legal status. Our ordered probit model does a very good job in distinguishing unauthorized workers from legal workers, but many of authorized workers and citizen workers are mistakenly predicted to be permanent residents.

Wage Equation Model with Selection Bias Correction

Here we estimate the wage equation model with selection bias correction using the results from the ordered probit legal status model in the first stage. Table 3 shows estimates for parameters and asymptotic standard errors (given in the parentheses) for farm workers with each legal status. Status 0 (unauthorized) workers have 16,195 observations, status 1 (authorized) workers have 2,688 observations, status 2 (permanent resident) workers have 9,739 observations, and status 3 (citizen) workers have 9,166 observations. Based on asymptotic standard errors using a 0.05 significance criterion, the coefficients on the selectivity variables, λ_j, are all highly significant except for authorized (status 1) workers. That is, using ordinary least squares without correcting for selectivity would lead to bias in all equations except for authorized workers. Actually, observations for status 1 workers are much fewer than other three categories, and they are concentrated in early 1990's. For the years 1989-93 about 26% of all workers had this legal status (status 1), but that portion has declined to only 1.3% for the years 2001-04. Besides, many workers were given this legal status under IRCA, which might weaken the explanatory power of the legal status selection model for this legal status category. Henceforth, the selection bias correction term calculated from this result does not have as much effect on the authorized worker wage as it does on wages for other worker categories.

Many variables have a statistically significant effect on worker wage in a common direction for all equations. Regardless of the legal status, workers in skilled task, non-seasonal workers, workers employed by growers, workers paid by piece rate, male workers, workers in California, and workers interviewed after 2001 are statistically significantly more likely to have a higher wage. Free housing has significantly negative effect on wage for all legal statuses except for authorized workers for whom it does not have a significant effect. Marital status has a significantly positive effect on wage for permanent resident and citizen workers, but does not have a significant effect for the other two worker status groups. We also find that age has a significant nonlinear effect on wage for all legal statuses except for the authorized worker for which it does not have a significant effect.[5]

All of the signs of these coefficients are reasonable, but an interesting result is for the after 2001 dummy. It increases the wage rate for unauthorized workers by only 4% all else being the same, while it increases the wages for authorized workers by 13%, for permanent residents by 11%, and citizen workers by 9%. As for the magnitude of influence, the piece rate payment dummy and skilled task dummy dominate. The former increases wage more than 20% and the latter increases wage more than 15%, regardless of legal status.

Other variables tend to have various directions of influence on farm work wage for each legal status. US farm experience has a significantly positive nonlinear effect on wage for unauthorized and citizen workers, but a significantly negative nonlinear effect for permanent resident workers.[6] Education has a significantly positive nonlinear effect on wage for unauthorized workers, but a significantly negative nonlinear effect for citizen workers.[7] The white dummy has a significantly positive impact on wage for citizen workers, but has a significantly negative effect for authorized workers. The before 1993 dummy has a significantly positive impact on wage for authorized and permanent resident workers, but has a significantly negative effect for citizen workers. The Florida dummy has a significantly negative effect on wage for unauthorized workers, but does not have a significant effect on other legal statuses.

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[5] The age effect is positive up to an age of 28 years for unauthorized, up to 25 years for permanent resident workers, and up to 41 years for citizen workers.

[6] The US farm experience effect is positive up to an experience of 19 years for unauthorized, and up to 34 years for citizen workers. On the other hand, the effect is negative through 25 years for permanent resident workers

[7] The education effect is positive up to an education of 13 years for unauthorized, but the effect is negative up to 4 years for citizen workers. Considering the mean length of education for each (6 years for unauthorized, 10 years for citizen workers), we can consider that the education effect is positive for both.

Next, using estimates of each equation, we calculate the predicted farm worker wage by legal status by averaging the predictions over all observations for each equation (Table 4). The results indicate that the average predicted wage for unauthorized workers is the lowest with \$6.85, followed by authorized workers (\$7.51) and citizen workers (\$7.78). Permanent resident workers have the highest average predicted wage of \$8.08. That is, average predicted wages for authorized, permanent resident and citizen workers are 10%, 18% and 14% higher than for unauthorized workers. This is comparable to the result from Ise and Perloff (1995) who conclude that the earnings of legal workers in 1991 averaged 15% more than for unauthorized workers.

Simulation Study

Finally, we implement a set of simulations to examine how farm work wage of a typical unauthorized worker would be expected to change with a change in legal status. This approach isolates the effect of legal status of the worker from differing observable characteristics of workers by holding the characteristics constant across varying legal status. In addition, we vary the time period (before or after 2001[8]), the location (California or other states of the U.S.[9]), the task (skilled or non-skilled), the type of employer (grower or labor contractor), and the type of payment (piece rate payment or others). We fix each continuous variable at the mean of unauthorized worker observations, and fix each remaining discrete variable at the category with the maximum number of observations of unauthorized workers. The profile of the "typical" unauthorized worker is illustrated in Table 5.

As before, the conditional expected wage for the unauthorized worker *i* with observable characteristics of x_i and z_i is given by

$$E\left[\ln w_{i0} \mid \varepsilon_i \le \mu_0 - x_i'\alpha; x_i, z_i\right] = z_i'\beta_0 + \rho_0\sigma_0\lambda_{i0} = z_i'\beta_0 + \beta_{\lambda_0}\lambda_{i0}, \qquad (3)$$

When legal status of unauthorized worker *i* is converted to status *j* (*j*=1, 2 and 3), the conditional

[8] Before 2001 means years from 1993 to 2001.

expected wage would be

$$E\left[\ln w_{ij} \mid \varepsilon_i \le \mu_0 - x_i'\alpha; x_i, z_i\right] = z_i'\beta_j + \rho_j \sigma_j \lambda_{i0} = z_i'\beta_j + \beta_{\lambda_j}\lambda_{i0}, \ \ j = 1,2,3 \qquad (4)$$

Note that the condition in the square bracket is retained, since it formulates the unobservable characteristics for legal status selection of the worker *i*.[10] We calculate these conditional expected wages by using estimates ($\hat{\beta}_0, \hat{\beta}_{\lambda_0}, \hat{\lambda}_{i0}, \hat{\beta}_j, \hat{\beta}_{\lambda_j}$) from previous section.

The expected wages for this "typical" unauthorized worker, calculated from equations (3) and (4), are shown in Table 6. For 31 out of 32 cases,[11] unauthorized workers working as "legal" workers would have a higher expected wage than when working as unauthorized workers.[12] For specific legal statuses, 77 out of 96 simulations have higher expected wages than as an unauthorized worker. The largest effects were for unauthorized workers working under the permanent resident status – all 32 cases were positive, varying from 19 to 46 percent. On the other hand, for 15 out of 32 cases, unauthorized workers working under a citizen status would have *lower* expected wages. Interestingly, these converted citizen workers who engage in unskilled tasks would have *lower* expected wages in 14 out of 16 cases, while those who engage in skilled tasks would have a *higher* expected wage in 15 out of 16 cases.

Simulation results for authorized workers are not as large in magnitude as for permanent resident workers, but the directions are almost equally stable. Focusing on after 2001, for all 16 cases, unauthorized workers working under authorized worker status would have *higher* expected wages, ranging from 6 to 31 percent. Even before 2001, for 12 out of 16 cases, the effects are positive. Interestingly, all negative cases happen for non-piece-rate-payment workers in non-California region.

[9] Other states of the U.S. does not include Florida.
[10] See p.259 in Maddala (1983) for the detailed argument.
[11] Only exception is the following case: an unskilled worker paid by non-piece rate by labor contractor in non-California state before 2001.
[12] "Legal" worker wage is the average wage weighted by composition of three legal statuses.

We find a very clear tendency for three employment categories. Comparing skilled and unskilled tasks, the former has a higher expected wage increase for legal status in 47 out of 48 cases. [13] Comparing workers employed by growers and those employed by labor contractors, the former have higher expected wage increases for legal status in 47 out of 48 cases. [14] Comparing piece rate payment and other payment contract, the former has higher expected wage increase for legal status in 47 out of 48 cases. [15]

Also, the wage increase for legal status tends to be higher after 2001 than before. The after 2001 period has higher expected wage increase for legal status than before in 47 out of 48 cases. [16] California tends to have higher expected wage increase for legal status than rest of U.S. California has higher expected change in wage than rest of U.S. in 32 out of 48 cases. [17]

We compare our simulation results with those done by Ise and Peroff (1995). Here we focus on the period before 2001 because Ise and Perloff use 3,989 observations for the years 1989 to 1991. Since Ise and Perloff do not include dummy variables for employment category (dummy variables for skilled task, labor contractor employment, piece rate payment, and seasonal contract) in independent variables, directly comparable cases are only the following two: Mean of unauthorized worker case (first row in table 6) and California case (ninth row in table 6). For the former case, Ise and Perloff predict that wages of authorized, permanent resident and citizen workers are expected to be 12%, 10% and -0.2% higher than unauthorized worker wage respectively, while our simulation has -2%, 8% and -11% respectively. For the California case,

[13] Only exception is the following case: an unskilled worker paid by non-piece rate by labor contractor in California before 2001 has 13 % wage increase from converting to a citizen, while a skilled worker has 0.3 wage increase in the same situation.

[14] Only exception is the following case: an unskilled worker paid by non-piece rate by labor contractor in California before 2001 has 13 % wage increase from converting to a citizen, while a worker employed by grower has 9 % wage decrease in the same situation.

[15] Only exception is the following case: an unskilled worker paid by non-piece rate by labor contractor in California before 2001 has 13 % wage increase from converting to a citizen, while a worker paid by piece rate has 10 % wage decrease in the same situation.

[16] Only exception is the following case: an unskilled worker paid by non-piece rate by labor contractor in California before 2001 has 13 % wage increase from converting to a citizen, while the same kind of worker has 8 % wage decrease in the same situation after 2001.

Ise and Perloff predict that wages of authorized, permanent resident and citizen workers are expected to be 7%, 17% and -3% higher than unauthorized worker wage respectively, while our simulation has 5%, 20% and -9% respectively. In general, our result is higher for permanent resident workers, but lower for authorized and citizen workers than the result from Ise and Perloff.

Taylor (1992) predicts that weekly earnings of legal workers are expected to be 33% and 5% higher than unauthorized workers for primary (skilled) jobs and secondary (unskilled) jobs respectively.[18] Corresponding results from our simulation show that wages of legal workers are expected to be 10% and 8% higher than unauthorized workers for skilled tasks and unskilled tasks respectively. [19]

Conclusion

Using National Agricultural Workers Survey data, we estimate U.S. farm worker wage differentials by legal status. In order to adequately correct sample selection bias, we develop a Heckman-type two-stage method with an ordered probit model in the first stage and a wage equation model in the second stage. We also implement simulations to examine how farm work wage of a typical unauthorized worker would be expected to change with a change in legal status.

In the ordered probit legal status model, all coefficients except education squared are statistically significant, and 84% of unauthorized workers are correctly predicted to be unauthorized. We find that the greatest positive marginal effect on the probability of a worker being legal is from the female dummy followed by English speaking ability and the before 1993 dummy. The greatest negative marginal effect is from the Hispanic dummy followed by the after

[17] 16 exception cases are as follows: wage increase for workers in California resulted from converting to a permanent resident is lower than that for workers in rest of US.

[18] Taylor does not separate working hours differentials from weekly earnings differentials. Hence, this large earnings differentials may be partially explained by working hours differentials.

[19] We use the average of column "legal" in row 9 to 12 in table 6 for unskilled task, and the average of column "legal" in row 13 to 16 in table 6 for skilled task.

2001 dummy and the Black dummy. The workers interviewed before 1993 are 12% more likely and those interviewed after 2001 are 13% less likely to be legal compared to those interviewed between these periods, given all else being the same.

In the second stage wage equation model, workers in skilled task, non-seasonal workers, workers employed by growers, workers paid by piece rate, male workers, workers in California, and workers interviewed after 2001 are statistically significantly more likely to have a higher wage, regardless of the legal status,. The after 2001 dummy increases the wage for unauthorized workers by only 4% all else being the same, while it increases the wages for authorized workers by 13%, for permanent resident by 11% , and for citizen worker by 9%. As for the magnitude of influence, the piece rate payment dummy and skilled task dummy are outstanding. The former increases wage more than 20% and the latter increases wage more than 15% for all legal status workers. Average predicted wages for authorized, permanent resident, and citizen worker are 10%, 18% and 14% higher than that for unauthorized workers respectively.

We implement a set of simulations to examine how farm work wage of a typical unauthorized worker would be expected to change with a change in legal status. For 77 out of 96 cases, unauthorized workers working as "legal" workers would have expected a higher wage than working as unauthorized workers. The largest effects were for unauthorized workers working under the permanent resident status – all 32 cases were positive, varying from 19 to 46 %. The results are similar for the cases of unauthorized workers working under authorized worker status, although the magnitude of wage increases is smaller. On the other hand, for 15 out of 32 cases, unauthorized workers working under a citizen status would have *lower* expected wages. In general, our result has a higher expected wage increase for permanent resident worker, but lower wage increase for authorized and citizen worker than the result from Ise and Perloff (1995).

The simulation study also shows very clear tendency for three employment categories. Skilled workers, workers employed by growers, and workers paid by piece rate have higher expected wage increase for legal status than those unskilled, employed by labor contractors, and paid by other methods respectively. Also, legal status tends to have a higher expected wage increase after 2001 than before.

It seems that rather clear tendencies from wage equations enable us to forecast the wage for a worker with specific demographics, employment type and legal status. The important information for farmers is how much cost will increase as the legal status and demographic composition of labor force changes, given the current technology. Suppose 50% of current employees are unauthorized for a farmer, but all of them are converted to authorized workers. The farmer may need to raise their wages by about 10% on average, so that the total labor cost may increase by about 5%. Assuming labor cost is approximately one third of total cost, the labor cost increase will result in approximately 1.7% increase in total cost. However, the actual increase in total cost may be lower than this since a farmer may absorb the wage increase by using other factors more intensively. The next issue is to combine this wage forecast with production function of farms.

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Table 1. Ordered Probit Model for Legal Status for Foreign-Born Farm Workers

	Parameter Estimate	Marginal Effect		Parameter Estimate	Marginal Effect
Female	0.461*	0.177	Education^2	-0.0006	
	(0.020)			(0.0005)	
Married	0.213*	0.084	Experience	0.164*	0.044
	(0.018)			(0.003)	
English Speaking	0.356*	0.141	Experience^2	-0.002*	
	(0.010)			(0.00007)	
Black	-0.220*	-0.088	Before 1993	0.310*	0.121
	(0.080)			(0.019)	
White	0.146*	0.058	After 2001	-0.332*	-0.132
	(0.016)			(0.020)	
Hispanic	-0.524*	-0.199	μ_0	2.808*	
	(0.051)			(0.096)	
Age	0.036*	0.008	μ_1	3.198*	
	(0.004)			(0.097)	
Age^2	-0.0002*		μ_2	5.299*	
	(0.00005)			(0.099)	
Education	0.048*	0.016			
	(0.007)				

* indicates that the estimated coefficient is statistically significant at 5 percent level of significance.

The probability of worker *i* being legal is given by $\Pr ob(J_i^* > \mu_0) = 1 - \Phi(\mu_0 - x_i'\alpha)$. Then the marginal effect on becoming authorized of variable *k* evaluated at the mean $\bar{x}$ is $\phi(\mu_0 - \bar{x}'\alpha)\alpha_k$ for the continuous variables and $\Phi(\mu_0 - \bar{x}'_{-k}\,\alpha_{-k}) - \Phi(\mu_0 - \bar{x}'_{-k}\,\alpha_{-k} - \alpha_k)$ for the dummy variables, where $\bar{x}'_{-k}$ and α_{-k} are variables and coefficients excluding *k*.

Table 2. Actual-Predicted Legal Status Table

	Predicted Legal Status				Total
Actual Legal Status	0	1	2	3	
0	14,085	1,180	1,466	5	16,736
1	1,345	528	953	2	2,828
2	1,824	1,439	6,653	57	9,973
3	987	709	4,531	1,397	7,624
Total	18,241	3,856	13,603	1,461	37,161

Table 3. Wage Equation Model for Farm Workers with Each Legal Status

	Unauthorized	Authorized	Permanent Resident	Citizen
λ	-0.045*	-0.029	-0.102*	0.031*
	(0.011)	(0.020)	(0.010)	(0.005)
Skilled Task	0.165*	0.188*	0.260*	0.311*
	(0.057)	(0.072)	(0.028)	(0.037)
Seasonal Worker	-0.040*	-0.045*	-0.065*	-0.079*
	(0.003)	(0.010)	(0.005)	(0.006)
Labor Contractor	-0.062*	-0.072*	-0.083*	-0.115*
	(0.004)	(0.013)	(0.006)	(0.011)
Piece Rate	0.225*	0.326*	0.261*	0.258*
	(0.004)	(0.011)	(0.006)	(0.011)
Female	-0.059*	-0.058*	-0.074*	-0.087*
	(0.005)	(0.017)	(0.007)	(0.007)
Married	-0.001	0.008	0.013*	0.069*
	(0.004)	(0.012)	(0.006)	(0.006)
White	0.0009	-0.070*	0.002	0.082*
	(0.004)	(0.011)	(0.005)	(0.006)
Age	0.002*	-0.006	0.005*	0.008*
	(0.001)	(0.003)	(0.001)	(0.001)
Age^2	-0.00004*	-0.00003	-0.0001*	-0.0001*
	(0.00001)	(0.00004)	(0.00002)	(0.00002)
Education	0.009*	0.001	0.004	-0.013*
	(0.002)	(0.005)	(0.002)	(0.003)
$Education^2$	-0.0004*	0.0001	-0.0002	0.002*
	(0.0001)	(0.0003)	(0.0002)	(0.0002)
Farm Experience	0.009*	0.0008	-0.006*	0.008*
	(0.001)	(0.004)	(0.002)	(0.0008)
Farm $Experience^2$	-0.0002*	-0.00001	0.0001*	-0.0001*
	(0.00003)	(0.00007)	(0.00003)	(0.00002)
Free Housing	-0.038*	-0.017	-0.013*	-0.070*
	(0.005)	(0.014)	(0.007)	(0.008)

Table 3 (continued). Wage Equation Model for Farm Workers with Each Legal Status

	Unauthorized	Authorized	Permanent Resident	Citizen
California	0.027*	0.100*	0.024*	0.057*
	(0.004)	(0.013)	(0.005)	(0.008)
Florida	-0.049*	-0.011	-0.011	0.017
	(0.005)	(0.015)	(0.009)	(0.011)
Before 1993	0.012	0.058*	0.017*	-0.035*
	(0.006)	(0.016)	(0.007)	(0.011)
After 2001	0.041*	0.134*	0.114*	0.092*
	(0.004)	(0.032)	(0.006)	(0.006)
Constant	1.810*	2.025*	2.058*	1.680*
	(0.017)	(0.078)	(0.040)	(0.028)

* indicates that the estimated coefficient is statistically significant at 5 percent level of significance.

Table 4. Average Predicted Wage for Each Legal Status ($)

Legal Status	**Wage**
Unauthorized	6.85
Authorized	7.52 (9.69%)
Permanent Resident	8.08 (17.85%)
Citizen	7.78 (13.51%)

Values inside the parenthesis are % changes from unauthorized worker wage.

Table 5. Profile of the "Typical" Unauthorized Worker

Constant	1
Female	0
Married	0
Hispanic	1
White	0
Black	0
Age	28.201
English Speaking	1.470
Education	6.073
Experience	5.075
Seasonal Worker	1
Free Housing	0

Table 6. Simulated Changes in Farm Wage by Legal Status[a]

After 2001	California	Skilled Task	Labor Contractor	Piece Rate Payment	Unauthorized	Legal Status: Legal[b]: Authorized	Permanent Resident	Citizen	Legal[c]
No	No	No	No	No	6.64	6.47 (-2.44)	7.96 (19.97)	5.89 (-11.28)	6.81 (2.68)
No	No	No	No	Yes	8.31	8.97 (7.90)	10.33 (24.26)	7.62 (-8.32)	8.92 (7.30)
No	No	No	Yes	No	6.24	6.03 (-3.37)	7.32 (17.43)	5.25 (-15.88)	6.20 (-0.63)
No	No	No	Yes	Yes	7.81	8.35 (6.87)	9.50 (21.63)	6.79 (-13.07)	8.11 (3.84)
No	No	Yes	No	No	7.83	7.82 (-0.15)	10.32 (31.85)	8.03 (2.65)	8.93 (14.04)
No	No	Yes	No	Yes	9.81	10.83 (10.43)	13.39 (36.56)	10.40 (6.08)	11.69 (19.17)
No	No	Yes	Yes	No	7.36	7.28 (-1.10)	9.49 (29.05)	7.16 (-2.67)	8.12 (10.36)
No	No	Yes	Yes	Yes	9.22	10.08 (9.38)	12.32 (33.67)	9.27 (0.58)	10.63 (15.33)
No	Yes	No	No	No	6.82	7.15 (4.90)	8.15 (19.56)	6.23 (-8.60)	7.15 (4.93)
No	Yes	No	No	Yes	8.54	9.91 (16.02)	10.58 (23.83)	8.07 (-5.55)	9.37 (9.65)
No	Yes	No	Yes	No	6.41	6.66 (3.90)	7.50 (17.02)	5.55 (13.33)	6.51 (1.55)
No	Yes	No	Yes	Yes	8.03	9.23 (14.91)	9.73 (21.21)	7.19 (-10.44)	8.52 (6.12)
No	Yes	Yes	No	No	8.04	8.64 (7.37)	10.57 (31.39)	8.51 (5.76)	9.37 (16.54)
No	Yes	Yes	No	Yes	10.08	11.97 (18.74)	13.71 (36.09)	11.01 (9.29)	12.27 (21.79)
No	Yes	Yes	Yes	No	7.56	8.04 (6.34)	9.72 (28.61)	7.58 (0.28)	8.53 (12.78)
No	Yes	Yes	Yes	Yes	9.47	11.14 (17.61)	12.62 (33.20)	9.81 (3.62)	11.16 (17.86)

Table 6 (continued). Simulated Changes in Farm Wage by Legal Status[a]

After 2001	California	Skilled Task	Labor Contractor	Piece Rate Payment	Legal Status				
						Legal[b]			
					Unauthorized	Authorized	Permanent Resident	Citizen	Legal[c]
Yes	No	No	No	No	6.87	7.37 (7.28)	8.82 (28.34)	6.47 (-5.82)	7.56 (9.94)
Yes	No	No	No	Yes	8.61	10.22 (18.64)	11.45 (32.93)	8.38 (-2.68)	9.90 (14.89)
Yes	No	No	Yes	No	6.46	6.87 (6.25)	8.12 (25.61)	5.77 (-10.71)	6.87 (6.40)
Yes	No	No	Yes	Yes	8.10	9.51 (17.51)	10.53 (30.11)	7.47 (-7.73)	9.00 (11.19)
Yes	No	Yes	No	No	8.11	8.90 (9.80)	11.44 (41.04)	8.84 (8.97)	9.90 (22.11)
Yes	No	Yes	No	Yes	10.16	12.34 (21.43)	14.84 (46.08)	11.44 (12.60)	12.97 (27.60)
Yes	No	Yes	Yes	No	7.62	8.29 (8.75)	10.52 (38.05)	7.88 (3.32)	9.01 (18.17)
Yes	No	Yes	Yes	Yes	9.55	11.49 (20.27)	13.66 (42.99)	10.20 (6.77)	11.79 (23.49)
Yes	Yes	No	No	No	7.06	8.15 (15.35)	9.03 (27.89)	6.85 (-2.97)	7.94 (12.35)
Yes	Yes	No	No	Yes	8.85	11.29 (27.57)	11.72 (32.47)	8.87 (0.26)	10.39 (17.41)
Yes	Yes	No	Yes	No	6.64	7.59 (14.25)	8.31 (25.18)	6.11 (-8.00)	7.22 (8.73)
Yes	Yes	No	Yes	Yes	8.32	10.51 (26.35)	10.79 (29.66)	7.91 (-4.93)	9.45 (13.63)
Yes	Yes	Yes	No	No	8.33	9.84 (18.06)	11.71 (40.55)	9.36 (12.27)	10.40 (24.79)
Yes	Yes	Yes	No	Yes	10.44	13.63 (30.57)	15.20 (45.58)	12.11 (16.01)	13.61 (30.40)
Yes	Yes	Yes	Yes	No	7.83	9.16 (16.93)	10.77 (37.57)	8.34 (6.45)	9.46 (20.76)
Yes	Yes	Yes	Yes	Yes	9.81	12.69 (29.32)	13.98 (42.49)	10.79 (10.00)	12.38 (26.20)

Notes:
[a] All other worker characteristics are as in Table 5.
[b] Numbers in parentheses are percentage changes from expected wage in an unauthorized status.
[c] The *legal* category combines the three previous categories – authorized, permanent resident, and citizen. The calculation is:

$$\frac{E[\ln(w_{i1}) \mid J_i = 1]\Pr[J_i = 1] + E[\ln(w_{i2}) \mid J_i = 2]\Pr[J_i = 2] + E[\ln(w_{i3}) \mid J_i = 3]\Pr[J_i = 3]}{1 - \Pr[J_i = 0]}$$