The Effect of Continuing Education Participation on Agricultural Worker Outcomes

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Selected Paper for presentation at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

 This report has been funded, either wholly or in part, with Federal funds from the U.S. Department of Labor, Employment and Training Administration under Contract Number [DOLJ061A20380, Task Order 13]. The contents of this publication do not necessarily reflect the views or policies of the Department, nor does mention of trade names, commercial products, or organizations imply endorsement of same by the U.S. Government.

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May 3, 2010

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Abstract

Migrant farmworkers are among the poorest members of the working class served by the U.S. public workforce investment system. The National Farmworker Jobs Program (NFJP) provides job training and employment assistance to migrant and seasonal farmworkers and their dependents. While stated goals include assisting migrant farmworkers increase "economic stability" by steadying agricultural employment and developing job skills, little empirical evidence exists as to the effectiveness of these programs. This study investigates the effects of continuing education participation on wages, time worked in agriculture, and poverty in this population. Data come from the U.S. Department of Labor's National Agricultural Workers Survey (NAWS), a nationally and regionally representative survey of employed U.S. farmworkers. Multivariate regression analysis suggest that continuing education participation is associated with approximately 26 percent higher wages all else equal, though variation across programs is large and returns are greatest from job training and English language courses. Program participation is negatively related to annual weeks in agriculture overall, and positively related to nonagricultural work weeks and weeks spent abroad. Understanding the dynamics between continuing education participation and worker outcomes contributes to limited academic literature on migrant education programs and is important for strategic planning pertaining to future workforce investments.

Keywords: returns to education, adult education programs, agriculture, migrant education, migrant and seasonal farmworkers, NAWS

JEL codes: I21, I32, J43

The public workforce investment system is an intergovernmental network aimed at providing labor force-related business assistance. The system consists of state and local workforce investment boards, local One-Stop Career Centers that facilitate employer and employee matching and training programs, and activities targeting specific populations such as youth, Veterans, Native Americans, and farmworkers.

One of these initiatives, the National Farmworker Jobs Program (NFJP), is a job training and employment assistance program for migrant and seasonal farmworkers and their dependents. The Economic Opportunity Act of 1964 established the NFJP, and the Workforce Investment Act of 1998 currently authorizes it (U.S. Department of Labor). The stated goals of this program include assisting migrant farmworkers increase their "economic stability" by steadying agricultural employment and by helping in the development of skills that can be used in complementary occupations (for example, during off-seasons).

Migrant farmworkers have historically been among the poorest members of the working class in the U.S. In fact, the U.S. Department of Labor, in its Farm Labor Fact Book concluded that, "The migrant farm worker occupies the lowest level of any major group in the American economy" (1959, p. 110). Fifty years after this publication, descriptions of impoverished conditions for this largely immigrant population are still relevant. Few studies in agricultural labor economics, however, have focused on how educational programs targeting migrant and seasonal workers affect outcomes within this population. The aim of this research therefore is to fill this gap by quantifying to what extent farmworker participation in continuing adult education programs, such as in the types of programs facilitated by NFJP, results in measurable improvements in various

economic indicators. Results suggest that education participation is associated with approximately 26 percent higher wages all else equal, though variation of returns across programs is large, and greatest returns accrue from job training and English language skill categories. Program participation is found to be negatively related to annual weeks worked in agriculture overall and positively related to annual weeks in nonagricultural occupations as well as to weeks spent outside of the U.S. Family poverty rates, however, are higher for participants than non-participants after conditioning on demographic characteristics and controlling for self-selection bias. This, however, may relate to transitory periods between education and employment, or alternately, the inappropriateness of applying U.S. poverty measures to those who spend significant portions of the year in a source country as families may be better off overall once relevant cost of living levels are taken into account. Understanding links between continuing education participation and worker outcomes for both immigrant and U.S.-born workers contributes to the very limited academic literature on migrant education programs and is important for establishing benefits and costs for strategic planning exercises pertaining to future workforce investments.

The article proceeds as follows. Section 2 describes previous literature on the effects of education on earnings. Section 3 describes the agricultural worker data that are used in this study. Section 4 presents empirical strategies and results. Section 5 discusses policy implications and concludes.

The Effects of Education on Earnings

The existence of a positive, causal effect of education on earnings is well established in general labor economics. Card (1999) summarizes this literature starting with Mincer's

(1974) model in which earnings are decomposed into an additive function of schooling and work experience (and its quadratic). One relatively recent finding that Card stresses in his overview is that the marginal returns to schooling for certain "disadvantaged" subgroups (due, for example, to family background or abilities) are higher than average marginal returns to education in the overall population. This result suggests that larger effects of education program participation on earnings may be found for farmworkers than for other more advantaged groups.

Literature in public economics also has modeled education as developing human capital and future earnings ability. In addition, public finance has studied the role of education as a redistribution mechanism for increasing social equality (e.g., Fernandez and Rogerson (1996)). Education has been shown to generate a number of favorable externalities (in addition to private benefits), including increased economic growth rates and civic involvement, positive peer effects, and decreases in crime. This suggests that social returns to education may outweigh private ones. However, failures in financial markets may prevent current and potential students from borrowing fully against future earnings in order to obtain costly education. Together these findings support the role of government programs.

The extent to which farmworker assistance programs effectively achieve stated goals, however, is relatively unknown, because current measures used by the U.S. Department of Labor, Employment and Training Administration (ETA) for judging annual NFJP performance are limited. Specifically, measures used for annual reporting include percentages of farmworkers entering and retaining employment and average

earnings among participants.[1] While these performance measures are useful for summarizing participation and post-program employment rates and earnings, all three are unconditional statistics that do not control for changes in average worker characteristics and economic conditions, or for self-selection into NFJP participation. In contrast to the current measures, this project examines outcome differentials between adult education participants and non-participants (treatment and control groups) within agricultural labor markets using recent techniques from the econometrics of program evaluation (Imbens and Wooldridge (2009)) and comprehensive and nationally representative microeconomic data on farmworkers, their demographic characteristics, and education participation histories. Thus, in addition to contributing to an understudied academic research area within agricultural labor economics, this article has practical significance by providing complementary evidence to what is currently reported for policy purposes.

Data

Data for this study come from the U.S. Department of Labor's National Agricultural Workers Survey (NAWS), which is both a nationally and regionally representative survey of employed U.S. farmworkers (for 12 agricultural regions with survey weights). Survey respondents have been sampled from worksites in three seasons per year since 1989. The data are cross-sectional and are pooled for the analysis. This article uses these data restricted to the 1993-2006 period as some detailed education participation questions are not asked in the earliest waves of the survey. This restriction reduces the total sample size from 46,566 to 37,426 workers. Of this weighted sample, 73.0 percent reports

[1] Employment entry is calculated as the number of adult participants who are employed in the first quarter following exit (training completion or other departure from the program) divided by the number who exit during that quarter. Employment retention is the number employed in both the second and third quarters after exit divided by the number who exit during the quarter. Finally, average earnings are total earnings in the second and third quarters divided by the number who exit during the quarter.

Mexican origins. Of the overall sample (which includes U.S.-born workers), 49.4 percent indicates illegal U.S. work status. Of Mexican immigrant workers, 64.1 percent indicate illegal status.

Table 1. Farmworker U.S. Education Participation Rates, By Program (Percentage)

English/ESL	10.62
Citizenship	1.63
Literacy	0.10
Job Training	1.65
GED, High School Equivalency	6.46
College or University	3.54
Adult Basic Education	0.59
Even Start	0.04
Migrant Education	0.27
Other Education Program	2.37
Any Education Program	23.89
Observations	37,377

Source: Author's calculations, National Agricultural Workers Survey, 1993-2006. Statistics are survey weighted.

U.S. Education Participation in the NAWS

While participation in a NFJP-specific program is not identifiable in the data, NAWS includes data on whether workers have participated in English/ESL, citizenship, literacy, job training, GED/high school equivalency, college/university, adult basic education, Even Start, migrant education, or other classes while in the United States. Overall, 23.9 percent of farmworkers in the 1993-2006 sample report having participated in at least one U.S. education program. Table 1 shows participation rates by specific education program. More than 10 percent of farmworkers report participation in English or English as a Second Language (ESL) classes or school. The next most common education programs are high school equivalency (6.5 percent) and college or university classes (3.5 percent). Other education program participation rates are lower. Job training and

migrant education categories are closest to specific opportunities offered through the NFJP, though overlap is likely to some extent in all categories. Rates based on household member participation in programs within the last two years, instead of individual farmworker participation at any point of time, are presented in Appendix Table A-2 and are found to be similar.

Summary statistics of demographic and work-related characteristics of participants and non-participants are presented in Table 2. On average, participants are more likely to be female, to have greater years of education, work experience and tenure with current employer, to be married, and to have more children.

The NAWS is a rich source of data on illegal and legal agricultural immigrants and migrants (many of whom are Hispanic). Survey data distinguishes naturalized citizens, green card holders, those with other work authorization (e.g., temporary visas), those who are illegally working within the U.S., and those who are U.S.-born. Education program participants are more likely to be U.S.-born or legal immigrants and to be of higher English language proficiency, while non-participants are more likely undocumented and have lower levels of self-reported English ability. Further patterns are evident by crop, task, and region of U.S. farmwork. Specifically, participants are less likely than non-participants to be working fruit and vegetable crops, to be harvest workers, and to be surveyed in California.[2] Statistically significant differences are evident in most categories in Table 2.

[2] Only six agricultural regions are identifiable in the public use data. The state of California is one of these six.

Table 2. Mean Demographic Characteristics, by U.S. Education Participation Status

	Participants	Non-Participants	Difference
Female (%)	28.73	18.23	***
Age (years)	31.86	32.29	
Education (years)	9.21	6.48	***
Spouse (%)	43.22	32.30	***
Children (number)	0.89	0.65	***
U.S.-born (%)	40.41	13.58	***
Naturalized Citizen (%)	6.88	2.89	***
Green Card (%)	25.31	23.75	
Other Authorization (%)	2.33	1.44	***
Illegal (%)	25.08	58.35	***
Speaks English (%)	61.05	19.89	***
Reads English (%)	57.67	17.57	***
From Mexico (%)	55.14	80.55	***
From Central America (%)	2.24	3.30	***
From Puerto Rico (%)	0.95	1.61	***
Farm Experience (years)	10.50	8.76	***
Tenure (years)	4.76	3.67	***
Field Crop (%)	16.63	17.23	**
Fruit Crop (%)	27.38	34.59	***
Horticulture (%)	21.81	13.19	***
Vegetables (%)	24.27	28.96	***
Misc. (%)	9.71	5.96	***
Pre-harvest (%)	17.33	19.62	***
Harvest (%)	23.18	33.89	***
Post-harvest (%)	13.12	10.41	***
Semi-skill (%)	23.53	20.71	***
Supervisor (%)	0.27	0.11	***
Other Task (%)	22.57	15.26	***
California (%)	23.99	35.47	***
East (%)	14.30	17.37	***
Southeast (%)	11.97	13.76	***
Midwest (%)	24.26	16.55	***
Southwest (%)	8.32	7.36	
Northwest (%)	17.16	9.49	***
Observations	8,453	27,087	

Source: Author's calculations, National Agricultural Workers Survey, 1993-2006. Statistics are survey weighted. ***$p< 0.01$, **$p< 0.05$, *$p< 0.1$

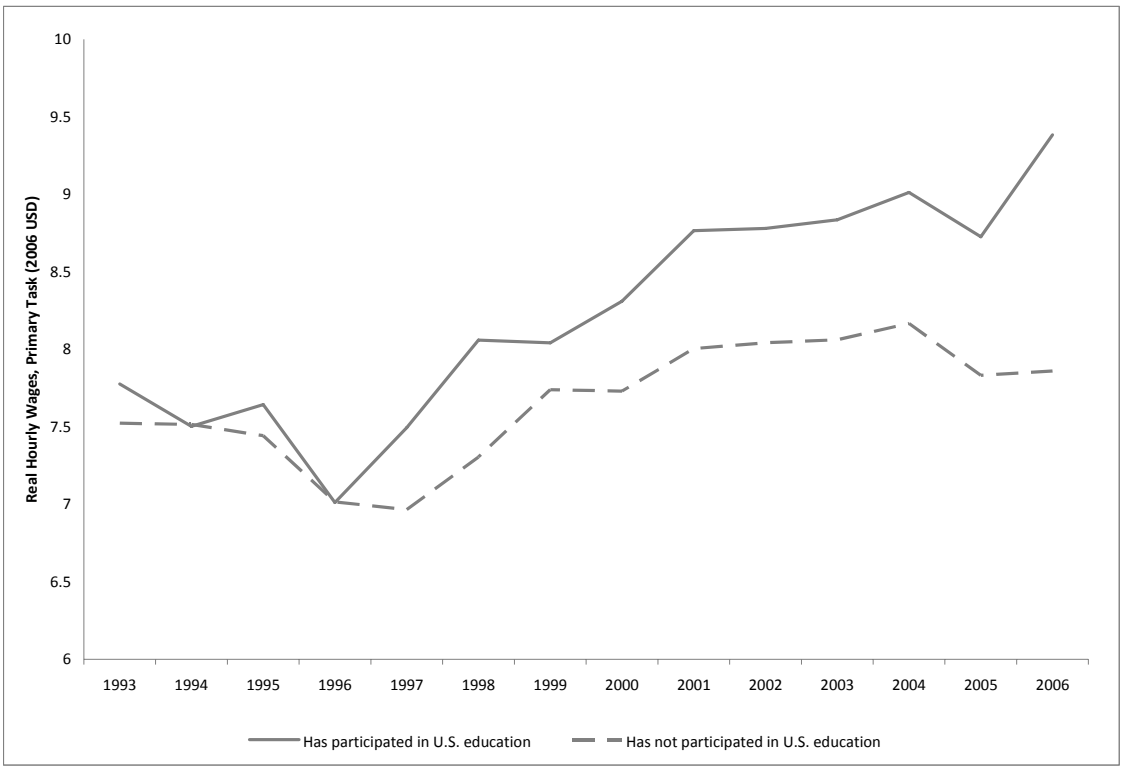
Economic Outcome Variables in the NAWS

The primary goal of this research is to quantify causal effects of participation on several worker outcomes. Differentials in wages, annual weeks worked, and annual incomes between those reporting participation and non-participation in the various U.S. educational program categories above are considered.

Because a large fraction of agricultural workers are paid piece rates (i.e. wages based on output) instead of time rates (i.e. wages based on time input), hourly-equivalent wages are constructed for piece rate workers based on survey questions indicating how much a worker (and his or her crew if applicable) was paid on average for each unit of output (e.g., box, bin, etc.) and how many units were produced in an average day, along with crew size information. These hourly-equivalent piece rate wages are then comparable with hourly rates reported by other workers. Figure 1 depicts farmworker wages in treatment and control groups, which is based on whether or not the worker reports participation in U.S. education programs. For this figure, a worker is classified as a participant if he or she participated in any of the education programs described in Table 1. Notably, these real wages (adjusted to 2006 dollars) conditional on participation take a U-shaped pattern which decreases in the early part of the series and increases thereafter. In terms of wages, participation relative to nonparticipation, there is a distinct breakpoint after which a wage gap between those participating and not participating in programs becomes evident. There are several exogenous explanations of this pattern in dynamics. This breakpoint occurs in the mid-1990s and corresponds to several public policy changes including fundamental welfare reform (the Personal Responsibility and Work Opportunity Reconciliation Act), increases to minimum wages, legislative initiatives such

as the Workforce Investment Act, and immigration-related reforms. This timeframe also corresponds to more positive macroeconomic conditions than in other parts of the series.

Figure 1. Average Farmworker Wages, by U.S. Education Participation

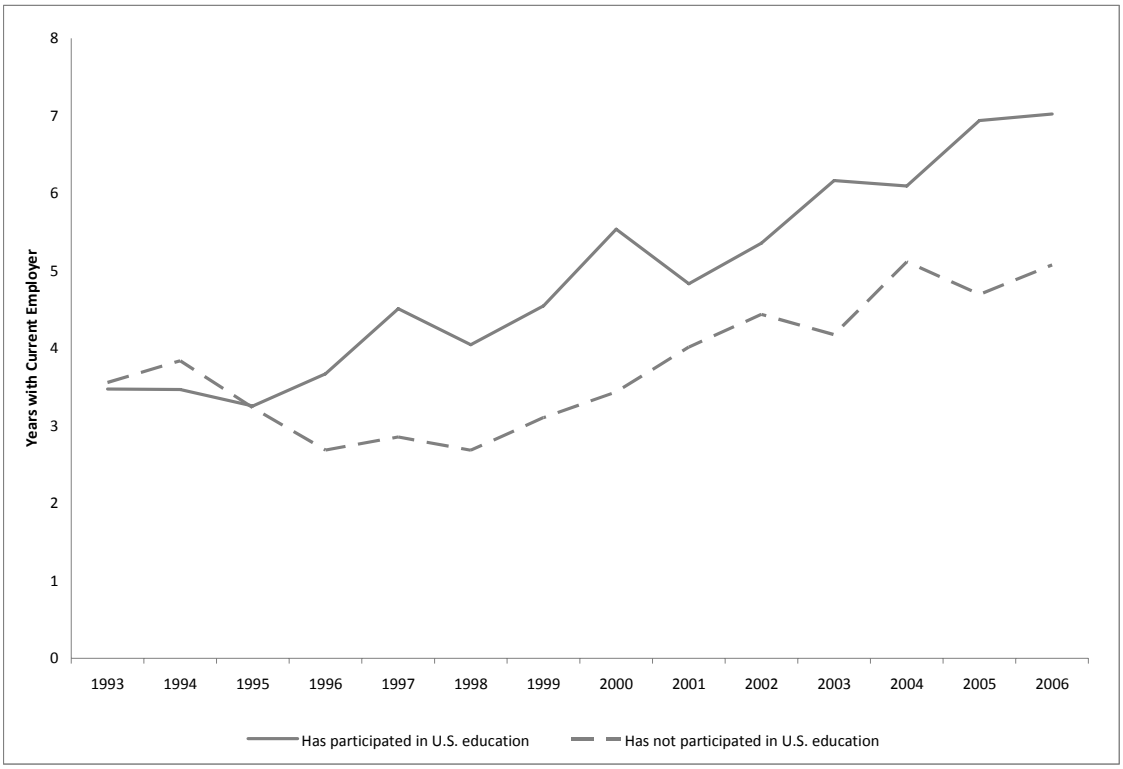


Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

Survey respondents were asked how many years they have worked with their current employer. Figure 2 plots this tenure with current employer. Again, a break point is observable after which tenure between the two groups diverges and becomes increasing for the treatment group. This point occurs slightly after what is observed in Figure 1. Since farmworker wages may be an increasing function of tenure, tenure may be a mechanism explaining the wage differences illustrated in Figure 1. Tenure, therefore, is modeled in the conditional analysis as an explanatory instead of as a dependent variable.[3]

[3] Note that the relationship can be thought to be somewhat bidirectional as higher wages may act to increase tenure.

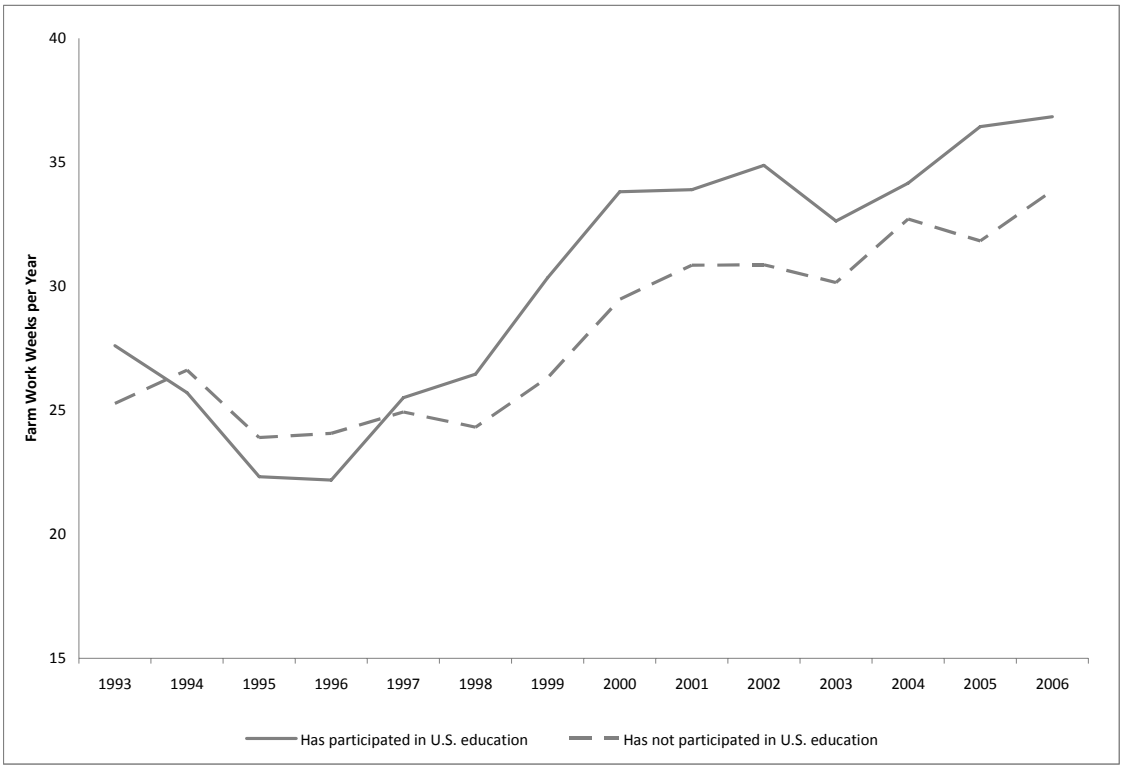
Figure 2. Average Tenure, by U.S. Education Participation



Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

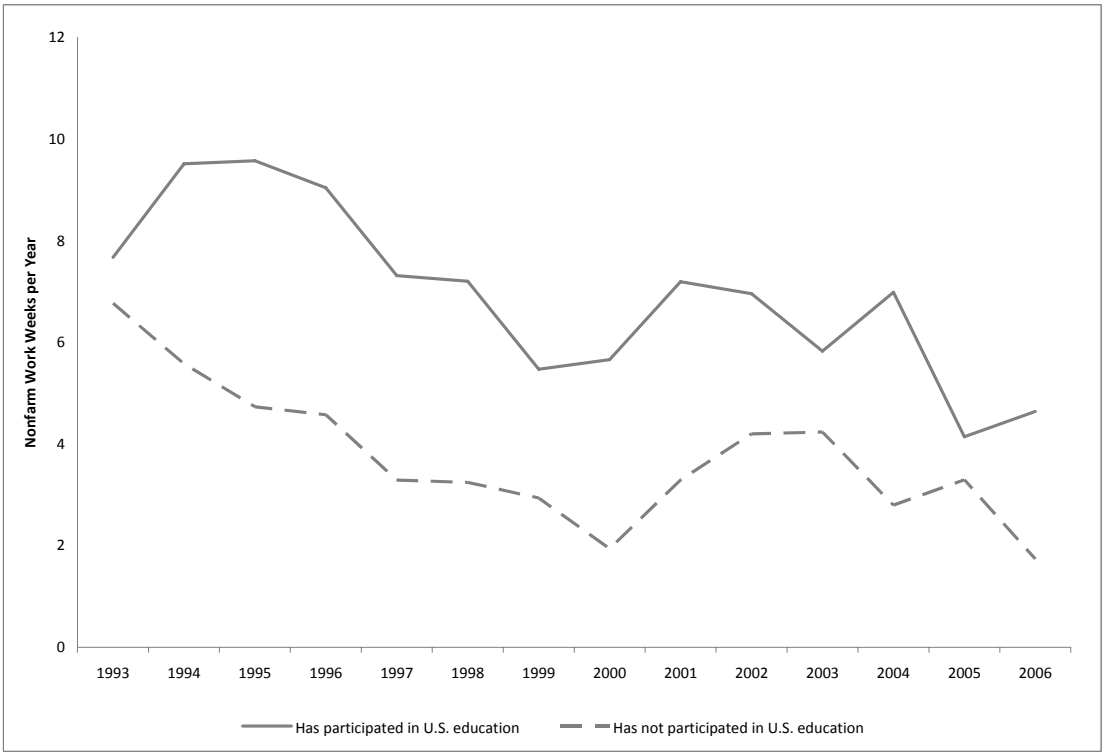
Answers to survey questions pertaining to tenure with current employer may represent either continuous or annual employment, and therefore increases in tenure may or may not correspond to increases in work time. Figures 3 through 5 illustrate weeks worked per year in agriculture, weeks worked outside of agriculture, and weeks spent abroad, respectively. Like the wage and tenure plots, positive differences in agricultural work weeks between program participants and non-participants are evident in the latter half of the period. Positive differences in non-agricultural work weeks between participants and non-participants and negative differences in weeks abroad are evident over the entire survey period. Furthermore, while these unconditional absolute differences in the numbers of weeks worked across participation categories are generally small in magnitude, differences in numbers of weeks spent outside of the U.S. are larger.

Figure 3. Average Annual Farm Work Weeks, by U.S. Education Participation



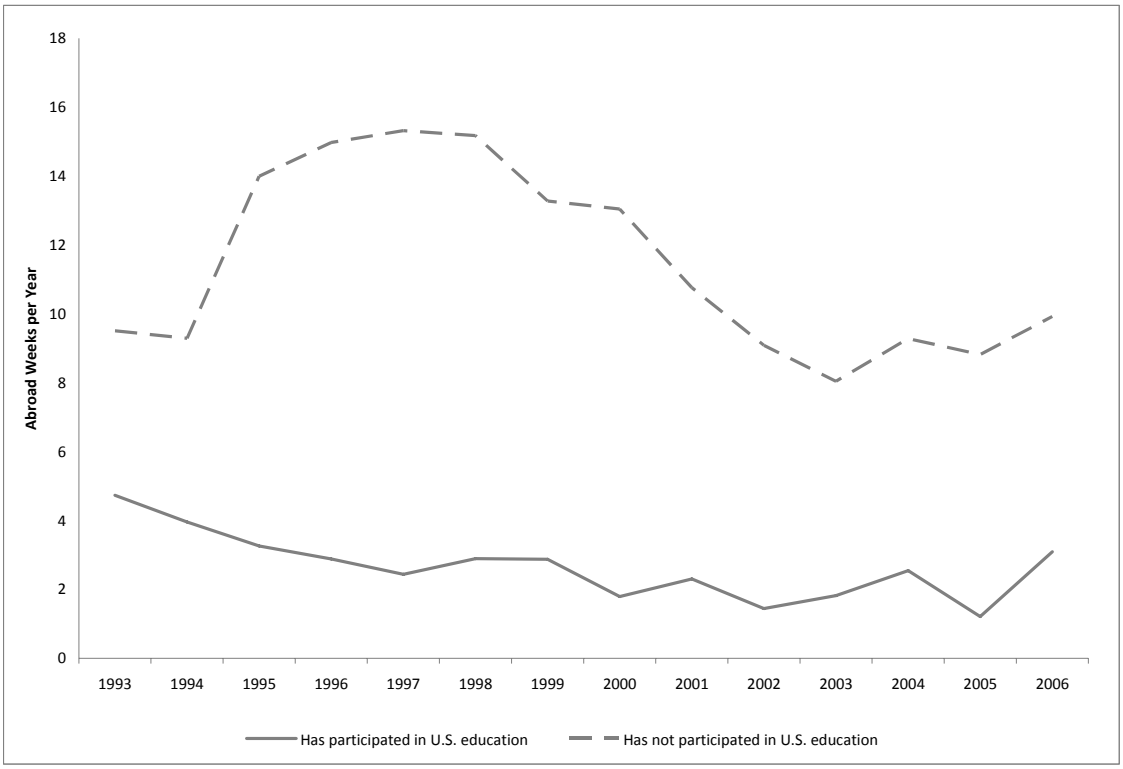
Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

Figure 4. Average Annual Non-farm Work Weeks, by U.S. Education Participation



Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

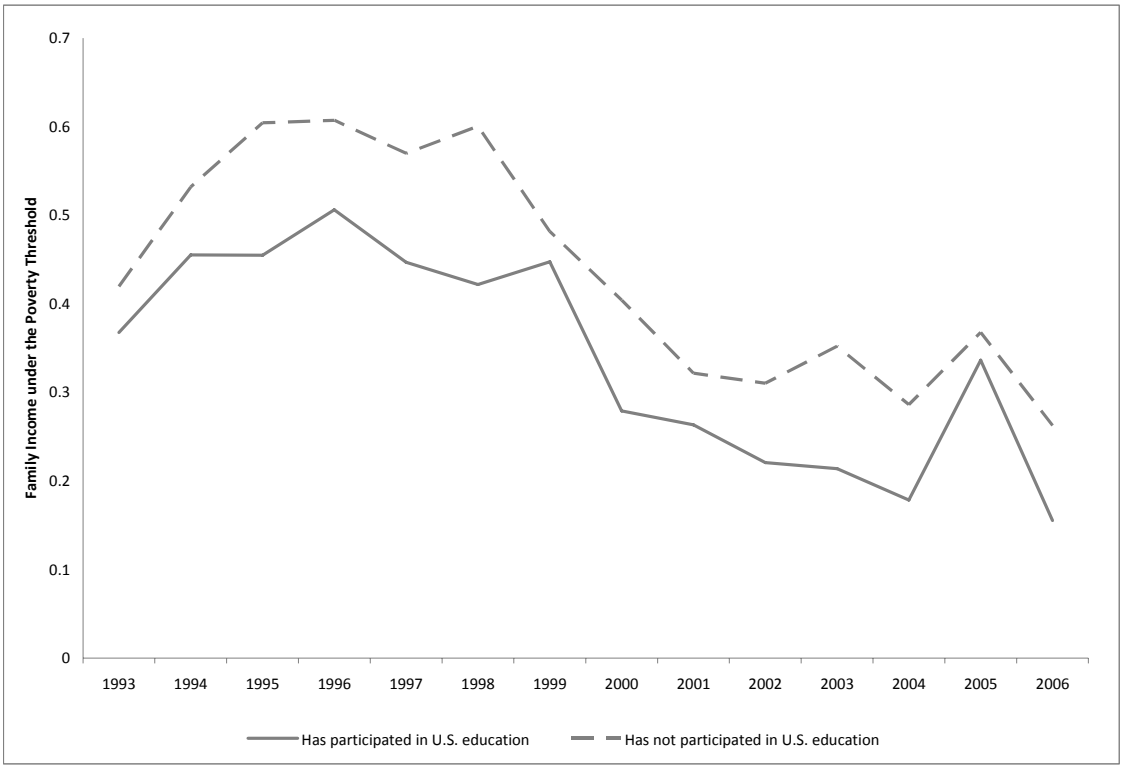
Figure 5. Average Annual Weeks Spent Abroad, by U.S. Education Participation



Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

As a final illustration, Figure 6 shows the fraction of farmworkers with annual family incomes below U.S. poverty thresholds. Workers are matched to relevant thresholds based on their reported family sizes and particular survey year. The proportion of families below the poverty threshold whose household head participated in continuing education programs is below that for families whose household head did not participate, suggesting positive returns of education on an overall poverty dimension as well. This pattern persists across all survey years.

Figure 6. Fraction with Family Incomes below Poverty Thresholds, by U.S. Education Participation



Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

Empirical Framework

The summary statistics presented in figures do not account for differences in observable or unobservable characteristics between workers who participate and those who do not. The effect of participation on outcomes, however, can be modeled in a multivariate framework.

Since there are several reasons to suspect selection bias, estimation by OLS alone is unlikely to be appropriate. Selectivity bias exists if, for example, higher ability people are more likely to participate in U.S. education programs than are lower ability workers, or alternately, if those with less ability are more likely both to attend classes and to earn lower wages. Other unobserved factors that may be correlated with U.S. education

participation and that may affect the outcome variables of interest include commitment to the U.S. workforce and employment instability. Selection on observable characteristics also is possible. Another finding that comes out of recent education and earnings literature is that educational returns vary across the population with observable factors such as parental education (Card (1999)). Therefore, while there are several reasons to suspect selection, the theoretical direction, source, and magnitude of bias is uncertain. Education participation can be modeled using both parametric multivariate regression analysis (e.g., maximum likelihood treatment effects) and nonparametric techniques (e.g., propensity score matching). The preferred method to deal with selectivity bias depends on whether selection occurs on the basis of unobserved or observed factors. Treatment effects models address bias due to correlation between regressors and omitted variables. Propensity score matching methods, on the other hand, are based on balancing observable characteristics in the data. The following subsections present these methods and results.

Maximum Likelihood Treatment Effects

For the parametric analysis, the basic econometric framework takes the general form:

$$y_i = \alpha\, participate_i + X_i\beta + \varepsilon_i \quad (1)$$

where the dependent variable y_i represents a series of outcome variables, including natural log of hourly-equivalent wage rates ($\ln w_i$), weeks worked in and outside of agriculture ($farm\_weeks_i$ and $nonfarm\_weeks_i$), weeks spent outside of the U.S. ($weeks\_abroad_i$) and the probability of falling below the poverty threshold (P($poverty_i$)). The variable $participate_i$ denotes whether a worker reports participation in the continuing education classes of interest. The vector X_i includes nativity, legal status, and general demographic and work-related characteristics such as gender, age, education, experience,

tenure, family structure, crop, task, geographic region of observation, and survey year. Of particular interest is the statistical and economic significance of the parameter α. While base line regressions define participation based on use of any U.S. education program, extensions relax these groupings to focus on certain individual programs from Table 1.

Because the decision to participate may be simultaneously determined with labor market outcomes, endogeneity corrections are used. In literature pertaining to education and earnings in non-agricultural occupations, instrumental variable estimates of educational returns, which address endogeneity concerns, have been found to be significantly greater than OLS estimates. As this also may be the case here, bivariate estimation is used. Outcome variables are modeled as function of participation where participation is an endogenous binary treatment. Specifically, propensity to participate is written as an unobserved latent variable:

$$participate_i^* = z_i\gamma + u_i \quad (2)$$

where the treatment decision rule is: $participate_i = \begin{cases} 1 \text{ if } participate_i^* > 0 \\ 0 \text{ otherwise} \end{cases}$.

The selection into treatment is estimated as a probit model with the error term assumed to follow a standard normal distribution. Table 3 presents estimates of probit marginal effects of various demographic and labor market characteristics on the probability that a worker participates in any of the 10 education program categories indicated by survey responses. Probit analysis serves as one stage of the estimation to determine the casual effects of education on worker outcomes, understanding which individual-level factors predict participation and is both of relevance to the empirical

modeling of the second stage and of policy interest by itself. Estimation results indicate that female gender, education, and years of previous farmwork experience are significant, positive predictors of continuing education program participation. Furthermore, family structure, particularly the presence of children, is a highly statistically significant predictor of participation. Age, on the other hand, is of significance in the negative direction.

Indicators of legal status are shown in the table to be of statistical and economic significance. Being U.S.-born is the excluded category in Table 3. In the full regressor version presented in column (6), marginal effects indicate that illegal workers are 21.5 percent less likely to participate in U.S. education programs all else equal. This is notable, but expected, since illegal workers are excluded from participation by some program rules. NFJP assistance, for example, is contingent on being a U.S. citizen, a lawfully admitted permanent resident, or a person with other employment authorization. English language ability and Mexican or Central American origin also are highly and positively correlated with adult education participation.

Notably, pre-harvest, harvest, and post-harvest task activities are all shown to be statistically and economically significant in the full regressor version (column (6)) in the table. Workers in these tasks are approximately three to four percent less likely to report participation than their counterparts in other agricultural activities. Field, fruit, and vegetable work are negatively correlated with participation.

Table 3. Determinants of Farmworker Education Program Participation (Dependent variable: Participation in any U.S. classes or school)

	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.0881***	0.0704***	0.0525***	0.0458***	0.0428***	0.0439***
	(0.0098)	(0.0099)	(0.0098)	(0.0099)	(0.010)	(0.010)
Age	-0.00238***	-0.00257***	-0.00317***	-0.00216***	-0.00238***	-0.00229***
	(0.00042)	(0.00042)	(0.00042)	(0.00043)	(0.00043)	(0.00043)
Education	0.0350***	0.0354***	0.0263***	0.0197***	0.0191***	0.0198***
	(0.0010)	(0.0010)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Farm Experience	0.00611***	0.00568***	0.00257***	0.00166***	0.00211***	0.00238***
	(0.00053)	(0.00054)	(0.00056)	(0.00058)	(0.00059)	(0.00058)
Tenure	0.00250***	0.00196**	0.00103	0.000308	0.0000583	0.000282
	(0.00077)	(0.00078)	(0.00075)	(0.00078)	(0.00078)	(0.00076)
Spouse		0.0130	0.00434	-0.000510	-0.00276	-0.00312
		(0.0100)	(0.0098)	(0.0095)	(0.0094)	(0.0093)
Children		0.0186***	0.0139***	0.0121***	0.0123***	0.0107***
		(0.0034)	(0.0035)	(0.0034)	(0.0033)	(0.0033)
Naturalized Citizen			0.0797***	0.0494*	0.0475*	0.0484*
			(0.019)	(0.028)	(0.028)	(0.028)
Green Card			-0.0371***	-0.0971***	-0.0993***	-0.0966***
			(0.011)	(0.025)	(0.025)	(0.025)
Other Authorization			0.0347	-0.0402	-0.0468	-0.0535*
			(0.029)	(0.034)	(0.033)	(0.031)
Illegal			-0.180***	-0.220***	-0.218***	-0.215***
			(0.011)	(0.032)	(0.032)	(0.031)
Speaks English				0.140***	0.137***	0.120***
				(0.020)	(0.019)	(0.019)
Reads English				0.122***	0.123***	0.126***
				(0.020)	(0.020)	(0.020)
From Mexico				0.177***	0.177***	0.169***
				(0.021)	(0.021)	(0.020)
From Central America				0.355***	0.344***	0.346***
				(0.050)	(0.051)	(0.050)
Field Crops					-0.0639***	-0.0495***
					(0.013)	(0.013)
Fruit Crops					-0.0235*	-0.0218
					(0.013)	(0.014)
Horticulture					-0.000155	0.0214
					(0.015)	(0.016)
Vegetables					-0.0326**	-0.0204
					(0.014)	(0.014)
Pre-harvest					-0.0328***	-0.0412***
					(0.012)	(0.012)
Harvest					-0.0277**	-0.0370***
					(0.012)	(0.012)
Post-harvest					-0.0235*	-0.0348***
					(0.013)	(0.013)
Semi-skill					0.00469	-0.00797
					(0.012)	(0.012)
Region controls?	no	no	No	no	no	Yes
Survey year controls?	no	no	No	no	no	Yes
Observations	36,651	36,651	36,250	35,563	35,540	35,540

Notes: Author's calculations using survey weights, National Agricultural Workers Survey, 1993-2006. Robust standard errors in parentheses. Probit marginal effects reported. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Effect of Farmworker Education Program Participation on Log (Wages)

Several strategies can be used for identifying the effect of participation using simultaneous estimation of equations (1) and (2). First, the model can be run without exclusion restrictions and the resulting identification is based on the nonlinearities of the probit functional form that is imposed for equation (2). Because exclusion restrictions help with identification, family structure variables are considered as instruments. The first two columns of Table 4 give results for equations (1) and (2) following an identification strategy based on excluding family structure characteristics from the wage equation.[4] Workers who have spouses and children present in the U.S. may be more likely to participate in continuing education programs if, for example, they are more likely to anticipate long-term residence and employment in the country.[5] Secondly, correlations between the presence of children who are participating in education and their parents who also participate may be present. Family structure, however, can be hypothesized to be unrelated to hourly wage rates. This identification method based on presence of U.S. family members (especially children) hypothesizes that parents, for example, are more likely to participate in education programs because the family also is doing so. Therefore, family structure characteristics are excluded from the wage regression reported in column 1 but included in the participation equation in column 2.

[4] A first strategy was based on harvest activity. Given its time intensive nature, harvest activity was hypothesized to be a significant negative predictor of education participation but not a predictor of all outcome variables. Harvest activity, however, is a statistically and economically significant predictor in the log (wage) equation during simultaneous estimation. Task-related variables such as participation in harvest activity are current, while U.S. education variables are retrospective. This suggests that causality may run in the opposite direction indicating that less educated people are less likely to be harvesting for other reasons (instead of harvest workers being less likely to participate). A second identification strategy could be based on state by state variation in program characteristics because available educational opportunities are set at state or local levels. Unfortunately, the public use version of the NAWS has only six identifiable agricultural regions. This restricts the use of state-level institutional characteristics as statistical instruments. Regional controls, however, are included as regions are based on known migrant streams.

[5] Variables used here are based on having a household spouse and children within the U.S. The full NAWS dataset also includes information on non-resident family.

Table 4. Treatment Effects of Farmworker Education Program Participation

	(1)		(2)		(2)		(4)	
	Log (Wage)	P(participate)	Farm Weeks	P(participate)	Non-farm Weeks	P(participate)	Weeks Abroad	P(participate)
Participate	0.257***		-7.318***		1.364***		18.99***	
	(0.024)		(1.54)		(0.43)		(0.30)	
Female	-0.0701***	0.111***	-4.994***	0.156***	-0.388	0.155***	-3.211***	0.189***
	(0.0061)	(0.034)	(0.37)	(0.035)	(0.33)	(0.034)	(0.35)	(0.031)
Age	0.000802***	-0.00746***	-0.0213	-0.00868***	0.0682***	-0.00840***	0.0852***	-0.00568***
	(0.00027)	(0.0015)	(0.016)	(0.0016)	(0.014)	(0.0016)	(0.016)	(0.0014)
Education	0.00344***	0.0683***	0.203***	0.0719***	0.219***	0.0724***	-0.455***	0.0498***
	(0.0010)	(0.0049)	(0.058)	(0.0047)	(0.042)	(0.0046)	(0.053)	(0.0050)
Farm Experience	0.00115***	0.00647***	0.331***	0.00927***	-0.111***	0.00875***	-0.247***	0.0140***
	(0.00040)	(0.0021)	(0.026)	(0.0022)	(0.022)	(0.0021)	(0.021)	(0.0018)
Tenure	0.00869***	-0.000443	0.698***	0.00203	-0.371***	0.00104	-0.100***	0.00428*
	(0.00056)	(0.0027)	(0.035)	(0.0029)	(0.024)	(0.0028)	(0.027)	(0.0022)
Spouse		0.100***	4.240***	-0.00585	0.1000	-0.0113	-4.839***	0.135***
		(0.032)	(0.37)	(0.034)	(0.33)	(0.034)	(0.32)	(0.029)
Children		0.0464***	0.573***	0.0389***	0.207	0.0391***	-1.397***	0.0529***
		(0.010)	(0.14)	(0.012)	(0.14)	(0.012)	(0.10)	(0.0095)
Naturalized Citizen	-0.0340**	0.163*	1.240	0.165*	-2.643***	0.167*	3.295***	0.0963
	(0.014)	(0.090)	(0.98)	(0.093)	(0.80)	(0.092)	(1.00)	(0.081)
Green Card	-0.0124	-0.400***	0.868	-0.372***	-0.863	-0.387***	4.400***	-0.121
	(0.017)	(0.11)	(1.11)	(0.11)	(1.08)	(0.11)	(1.08)	(0.094)
Other Authorization	-0.0726***	-0.219	4.111***	-0.199	-2.407*	-0.215	2.156	0.0172
	(0.021)	(0.14)	(1.46)	(0.14)	(1.34)	(0.14)	(1.38)	(0.12)
Illegal	-0.0318*	-0.757***	1.139	-0.789***	-2.583**	-0.790***	10.91***	-0.587***
	(0.019)	(0.12)	(1.22)	(0.12)	(1.15)	(0.11)	(1.13)	(0.097)
Speaks English	-0.00523	0.385***	1.214	0.405***	1.465**	0.411***	-5.565***	0.409***
	(0.014)	(0.063)	(0.76)	(0.061)	(0.64)	(0.060)	(0.67)	(0.065)
Reads English	-0.0381***	0.425***	1.250	0.435***	0.717	0.428***	-5.721***	0.361***
	(0.015)	(0.064)	(0.80)	(0.064)	(0.68)	(0.062)	(0.71)	(0.065)
From Mexico	0.0252	0.694***	3.301***	0.731***	0.189	0.735***	-4.986***	0.459***
	(0.016)	(0.11)	(1.06)	(0.11)	(0.94)	(0.11)	(1.04)	(0.093)
From Central America	0.0406**	0.944***	6.432***	0.971***	1.627	0.975***	-10.28***	0.703***
	(0.019)	(0.13)	(1.31)	(0.13)	(1.11)	(0.13)	(1.32)	(0.11)
Field Crops	-0.0211*	-0.176***	-3.569***	-0.209***	0.375	-0.192***	4.152***	-0.254***
	(0.011)	(0.056)	(0.59)	(0.056)	(0.60)	(0.056)	(0.57)	(0.049)
Fruit Crops	-0.0338***	-0.0518	-1.157**	-0.0890*	-1.329**	-0.0807	1.519***	-0.0982**
	(0.011)	(0.053)	(0.55)	(0.052)	(0.52)	(0.052)	(0.57)	(0.048)
Horticulture	0.00491	0.0881	4.286***	0.0627	-1.513**	0.0771	-0.531	0.0166

	(0.0096)	(0.054)	(0.65)	(0.056)	(0.61)	(0.055)	(0.60)	(0.049)
Vegetables	-0.0381***	-0.0644	-0.886	-0.0841	-1.420***	-0.0756	1.906***	-0.140***
	(0.0096)	(0.052)	(0.55)	(0.052)	(0.54)	(0.052)	(0.55)	(0.047)
Pre-harvest	-0.0432***	-0.150***	-2.091***	-0.153***	-0.609	-0.158***	1.796***	-0.153***
	(0.0070)	(0.045)	(0.52)	(0.047)	(0.41)	(0.046)	(0.52)	(0.045)
Harvest	0.0584***	-0.220***	-1.084**	-0.126***	-0.0925	-0.139***	0.555	-0.0916**
	(0.0078)	(0.045)	(0.51)	(0.045)	(0.39)	(0.045)	(0.52)	(0.044)
Post-harvest	0.00150	-0.167***	-1.332**	-0.119**	0.226	-0.133**	-1.223**	-0.0446
	(0.0087)	(0.051)	(0.60)	(0.053)	(0.50)	(0.052)	(0.59)	(0.049)
Semi-skill	-0.0169**	-0.0477	1.025**	-0.0206	-0.0196	-0.0294	-1.312***	0.00167
	(0.0080)	(0.042)	(0.51)	(0.044)	(0.41)	(0.043)	(0.50)	(0.041)
Constant	1.592***	-1.429***	20.23***	-1.218***	1.735	-1.517***	11.60***	-1.450***
	(0.021)	(0.12)	(1.22)	(0.11)	(1.09)	(0.12)	(1.34)	(0.14)
ath(ρ)	-0.608***		0.330***		0.0110		-1.488***	
	(0.073)		(0.060)		(0.012)		(0.030)	
ln(σ)	-1.378***		2.737***		2.374***		2.747***	
	(0.018)		(0.0085)		(0.014)		(0.0075)	
Observations	34,563		35,534		35,540		35,540	

Notes: Author's calculations using survey weights, National Agricultural Workers Survey, 1993-2006. Robust standard errors in parentheses. Region and survey year fixed effects included. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Statistically significant negative selection into U.S. continuing education programs is indicated by the auxiliary parameter ρ indicating improvement over simple OLS.[6] The regression estimates the treatment effect of continuing education participation on hourly wages at 25.7 percent.[7] OLS suggests that continuing education is associated with only a 2.0 percent increase in hourly wages (not shown). Therefore, the selection estimation leads to much higher estimates of the effect of continuing education on wages. This is consistent with literature demonstrating this pattern for other industries.

Coefficients in wage equations follow intuition. Female farmworkers earn less per hour all else equal than do male farmworkers. Those with higher years of education, experience, and tenure with employer accrue wage premiums as do those employed in time-sensitive harvest activity. Relative to U.S.-born workers, all immigrant groups receive lower hourly wages controlling for other observable demographic and job specific characteristics. Coefficients for regressors in the participation equation columns also follow the patterns identified in Table 3.

Effect of Farmworker Education Program Participation on Annual Allocation of Weeks

Alternative outcome variables of interest are examined in the subsequent columns of Table 4. Specifically, weeks spent working on farms, weeks spent working outside of agriculture, and total weeks abroad (which may or may not include work weeks) are

[6] Transformations of the auxiliary parameters, ρ and σ, are estimated and reported for computational reasons.

[7] A worry about the identification strategy might be that participation and family structure are jointly determined. To check for sensitivity to the guiding assumptions and for comparison, spouse and children regressors are excluded from both equations and therefore identification is from functional form alone. For this exercise, the treatment effect of participation on wages is 22.3 percent. Including family structure variables in both equations yields an estimate of 23.4 percent. Household spouse and children are jointly significant at the one percent level in the participation equation.

presented as dependent variables.[8] While family structure instruments may comprise a valid strategy for wage regressions, they are less likely to be appropriate for other outcome variables that are arguably more family structure dependent. Therefore, estimation is conducted without exclusion restrictions. Even without exclusion restrictions, the correlation between error terms across the two equations, ρ, is highly statistically significant for both farm work weeks and for weeks spent abroad. Controlling for selection via this technique, U.S. education participation is found to be associated with 7.3 fewer farm work weeks per year. This number is economically and statistically significant. Several mechanisms may explain this finding. First, fewer weeks may represent time spent in study as opposed to wage employment. Second, fewer weeks may represent turnover from agricultural work or be related to program goals such as to develop skills for non-farm jobs. To examine this further, non-farm work weeks and weeks spent abroad also are considered. U.S. education program participation is associated with 1.4 extra weeks of non-farm work per year. While this may be viewed as a positive effect of participation, it does not offset the fewer farm work weeks. Furthermore, after controlling for selection, participation is associated with approximately 19 more weeks per year abroad all else equal. Differences may relate to institutional details and comparative returns to U.S. education in domestic and international labor markets.

[8] Participation is found to have an insignificantly different from zero effect on total hours worked per week (not shown).

Table 5. Treatment Effects of Farmworker Education Program Participation, By Program

	Log (Wage)	Farm Weeks	Non-Farm Weeks	Weeks Abroad
English/ESL	0.284***	-11.12***	-1.872***	19.49***
	(0.021)	(1.79)	(0.69)	(0.36)
Citizenship	0.113**	-25.16***	18.98***	19.16***
	(0.055)	(0.88)	(0.75)	(1.24)
Job Training	0.363***	2.522	0.956	16.41***
	(0.027)	(3.08)	(1.15)	(1.37)
GED, High School Equivalency	-0.0466**	-0.628	0.437	-20.17***
	(0.018)	(2.23)	(0.75)	(0.33)
College or University	0.168***	3.423***	2.412**	11.43***
	(0.023)	(1.31)	(1.02)	(0.70)
Other Education Program	-0.103***	-11.07***	0.385	-23.74***
	(0.017)	(3.23)	(1.17)	(0.65)

Notes: Author's calculations using survey weights, National Agricultural Workers Survey, 1993-2006. Robust standard errors in parentheses. Demographic and employment related control variables and region and survey year fixed effects included. ***$p< 0.01$, **$p< 0.05$, *$p< 0.1$

Robustness: Effects of U.S. Education Participation, By Program

Individual programs with sufficient participation rates[9] are analyzed separately to allow for heterogeneous response across programs. Table 5 presents these results. Positive and significant wage effects of participation are concentrated among English language, citizenship, job training, and college and university level study with notable variation across categories. Job training participation, for example, is associated with 36.5 percent higher hourly wages, followed by English language classes with 28.4 percent and college level study is associated with 16.8 percent higher hourly wages over non-participants. Citizenship classes are associated with 11.3 percent higher wages even in the presence of legal status controls. GED and other education programs, however, are associated with lower wages.

For weeks, only college and university participation is associated with statistically significant increases in both farm and non-farm work weeks. This is notable given that

[9] The categories of adult basic education, Even Start, and migrant education have less that 1 percent participation rates (Table 1) and are excluded here.

college student status and full-time employment are often thought to have substitute characteristics. The results, however, may relate to a combination of the seasonal nature of farm work and the high cost of university attendance. Other program categories display results similar to the aggregate patterns with decreases in annual farm weeks and increases in non-farm weeks, though some results are not statistically significant. GED courses and the other education program category are associated with fewer annual weeks spent outside the U.S., while other program categories in the table are associated with more weeks abroad. This could be due to opportunity costs (and gains) of programs. Those who participate and earn higher wages, for example, may afford more weeks abroad with families remaining in source countries. Those who plan to stay in the U.S. longer, however, may sort into GED courses as part of a permanency plan.

Effect of Farmworker Education Program Participation on Probability that Family Income is Below Official Poverty Thresholds

As a final outcome variable of interest, the effect of participation on poverty status is modeled. Since the probability of being in poverty is binary by definition, bivariate probit estimation is used to estimate the effect of U.S. education program participation on the probability that a worker's family income is below the U.S. poverty threshold for his or her family size. Bivariate probit estimation accounts for a probit functional form in both equations of the estimation instead of just one as in the maximum likelihood treatment effects regressions. Using the same exclusion restrictions as in the hourly wage estimation, the marginal effect of continuing education participation on the probability that family income is below the appropriate U.S. poverty threshold based on a family's size is 8.6 percent, significant at the one percent level. Without family structure variables

in either equation, the effect is estimated at 4.4 percent, significant at the five percent level. With household spouse and children in both equations, the marginal effect is 4.9 percent, significant at the one percent level.[10] Therefore, participation is found to be associated with *increases*, not decreases, in family poverty after demographic factors and selection is taken into account.

The selection term is found to be negative, suggesting that those how participate are less likely to be in poverty (and therefore OLS would be biased in the negative direction). One possibility for these results is that this is a short-run phenomenon reflective of workers currently participating in (or currently transitioning out of) the education programs themselves, which may be time-intensive and therefore counterproductive in regards to current income. A second possibility is that results should be interpreted in light of the binational nature of much of the U.S. farmwork population. Border commuters and international shuttlers, for example, spend significant annual time both in source and receiving countries. U.S. poverty thresholds are based on U.S. cost of living scales and therefore may improperly reflect annual outcomes for many workers in this population. Thus, workers who spend significant time elsewhere may be more likely to report total annual income below U.S. thresholds yet may be less likely to be living in impoverished conditions given differences in exchange rates and living costs. If U.S. poverty thresholds are inappropriate for this population, then results may be incomplete even in the presence of selection corrections. Adjusting poverty measurement for border crossing populations is the topic of related work (Pena (2010)).

Propensity Score Matching

For comparison, a second method (in addition to maximum likelihood treatment effects)

[10] Full regression results are not shown.

to determine effects of participation on worker wage, weeks, and poverty outcomes is to match workers based on a measure of their observed characteristics, or propensity score. Propensity score matching has become increasing popular in recent empirical literature because it relies on fewer distributional assumptions than traditional parametric methods (Dehejia and Wahba (2002)).

The first step of the propensity score technique is to estimate an equation similar to equation (2). The propensity score is then the predicted value of the dependent variable. The second step is to examine the effect of U.S. adult education participation on outcomes by matching treatment and control variables based on their propensity scores and creating counterfactuals. To construct counterfactuals, matching is generally performed based on either individual neighborhood (observations that can be ranked close together) or on smooth weighting (based on an assumed population distribution). The primary assumption imposed by the technique in general is that of unconfoundedness, or that treatment and control observations with like propensity scores differ only in the error term from the propensity score equation. The average treatment on the treated is then:

$$E(y_{i1} - y_{i0} | participate_i=1) = E(y_{i1} | participate_i=1) - E(y_{i0} | participate_i=1) \quad (3)$$

where $E(y_{i1} | participate_i=1)$ and $E(y_{i0} | participate_i=1)$ are the actual and counterfactual average outcomes for the cases that participants did and did not receive treatment (i.e. did or did not participate).

Table 6. Propensity Score Treatment Effects of Farmworker Education Program Participation on Worker Outcomes

	Log (Wage)	Farm Weeks	Non-Farm Weeks	Weeks Abroad	P(Poverty)
Overall	0.052***	1.890***	0.799***	-3.380***	-0.072***
	(0.004)	(0.210)	(0.133)	(0.135)	(0.006)
English/ESL	0.064***	3.236***	0.742***	-4.324***	-0.102***
	(0.005)	(0.236)	(0.144)	(0.158)	(0.008)
Citizenship	0.140***	3.756***	0.315	-4.344***	-0.157***
	(0.012)	(0.469)	(0.284)	(0.237)	(0.016)
Job Training	0.049***	1.911***	1.498***	-2.029***	-0.012
	(0.014)	(0.664)	(0.519)	(0.219)	(0.019)
GED, High School Equivalency	-0.004	0.512	-0.555**	-2.057***	-0.030***
	(0.007)	(0.399)	(0.268)	(0.176)	(0.011)
College or University	0.137***	-0.222	1.495***	-0.722***	-0.100***
	(0.011)	(0.572)	(0.440)	(0.219)	(0.014)
Other Education Program	-0.066***	-0.511	0.643*	-2.871***	0.050***
	(0.010)	(0.605)	(0.379)	(0.276)	(0.017)

Notes: Author's calculations using survey weights, National Agricultural Workers Survey, 1993-2006. Analytical standard errors in parentheses. Nearest-neighbor matching method. Propensity score is based on regressors from maximum likelihood regressions as noted. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Results for a random draw nearest-neighbor match technique for each outcome variable of interest overall and by specific program are presented in Table 6. Matching is based on the same covariates used in the maximum likelihood specifications. Specifically, the balancing property is satisfied for 19 blocks based on gender, age, U.S.-born and other authorization legal status groups, and supervisor task responsibilities with the common support option selected.[11] Results are sensitive to this specification. The treatment effect of participation on wages, for example, is found to be only 5.2 percent overall, an intermediate between estimates from simple OLS and maximum likelihood.

Maximum likelihood treatment effects and propensity score matching differ in their primary assumption regarding the nature of self-selection. While parametric treatment effects assumes selection is based on unobservable characteristics present in the

[11] A disadvantage of balancing being only achievable based on a subset of observable characteristics is that it is possible that the remaining error in the propensity score equation is correlated with the error of interest. Propensity score and balancing results are not shown.

error term, propensity score matching assumes that observable characteristics are sufficient to create appropriate matches across treatment and control categories. The appropriateness of the parametric and nonparametric results depends on the nature of underlying selection. For the case of continuing education participation, maximum likelihood treatment effects regressions are hypothesized to be more reliable given likely unobservable characteristics. Classic arguments link innate ability and schooling. Furthermore, commitment to the U.S. workforce and employment instability are additional unobservables that are particularly relevant to immigrant workers.

Discussion and Conclusions

The analysis overall presents evidence as to the effectiveness of education programs for increasing wages, propensities to stay with (or return to) a given employer and to secure nonagricultural work during off-seasons. Hourly wage gains are greatest when education participation is restricted to job training and English language categories. This is notable given the presence of programs such as NFJP that aim to assist migrant farmworkers by steadying agricultural employment and by helping in the development of general skills that can be used in complementary occupations. The results of this article are consistent with farmworker educational opportunities both to increase base wages and to better outside employment options, thus allowing for substitution away from often strenuous and low-wage agricultural employment. Thus, this research provides evidence complementary to current ETA program performance measures, which also note positive associations between continuing education program participation and worker outcomes. Greater understanding of the dynamics identified in this article therefore is of value both to academic literature in agricultural labor economics and to practical policy discussions.

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Appendix

The sampling procedure of the National Agricultural Workers Survey (NAWS) is based on four levels: region, crop reporting district, county, and employer with probabilities proportional to size at each level. Specifically, NAWS uses 12 geographic regions based on USDA Quarterly Agricultural Labor Survey of farm employers. The 12 regions are defined in Table A-1 below. The public use NAWS sample used here is collapsed to six regions. USDA information also is used for cyclical allocation (based on the relative proportions of workers each cycle). There are 47 crop reporting districts (aggregates of counties with similar agricultural characteristics) from which sampling locations are selected. Within crop reporting district, counties are selected randomly without replacement with probabilities proportional to the county's farm labor expenses. Employer lists are from the Bureau of Labor Statistics Agricultural Soil and Conservation Service and are updated with information from county extension agencies, local employment agencies, grower organizations, and farmworker service programs. Employers are selected using probabilities proportional to the square root of the seasonal farm workforce. Once permission to interview is obtained, the maximum number of interviews per grower is determined with probabilities proportional to square root size. The number of interviews per site of a particular grower also is determined by a proportional distribution to total number of crop workers. Workers are selected and approached randomly when arriving for work, at lunch, or when leaving and interviews are scheduled for times away from worksite at locations chosen by the workers. Additional information and public access data are available from http://www.doleta.gov/agworker/naws.cfm.

Table A-1. NAWS Agricultural Regions

Region	States
California	CA
Southern Plains	TX, OK
Florida	FL
Mountain III	AZ, NM
Appalachia I, II	NC, VA, KY, TN, WV
Cornbelt Northern Plains	IL, IN, OH, IA, MO, KS, NE, ND, SD
Delta Southeast	AR, LA, MS, AL, GA, SC
Lake	MI, MN, WI
Mountain I, II	ID, MT, WY, CO, NV, UT
Northeast I	CT, ME, MA, NH, NY, RI, VT
Northeast II	DE, MD, NJ, PA
Pacific	OR, WA

Table A-2. Recent Household U.S. Education Participation Rates, By Program (Percentage)

English/ESL	3.92
Job Training	1.11
GED, High School Equivalency	4.74
Migrant Education	1.13
Head Start	3.13
Migrant Head Start	1.79
Other	1.94
Observations	27,028

Source: Author's calculations, National Agricultural Workers Survey, 1993-2006. Statistics are survey weighted and based on household member participation in programs within the last two years.