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The Effect of Continuing Education Participation on Agricultural Worker Outcomes

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Introduction

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. Among these initiatives is the National Farmworker Jobs Program (NFJP), a job training and employment assistance program for migrant and seasonal farmworkers and their dependents.[1] 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 farmworker 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 is to fill this

[1] Complementary to this, the U.S. Department of Education offers vocational rehabilitation, defined to include evaluation, counseling, mental and physical rehabilitation, training, work adjustment, job placement, and postemployment services to disabled farmworkers through its Migrant and Seasonal Worker Program. The Department of Education also administers a Migrant Education Program, which offers support services aimed to facilitate primary and secondary education of migrant children. State and local government and privately-funded programs also exist in some areas.

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. Analysis here draws from a large nationally-representative survey of employed U.S. farmworkers. Results suggest that education participation is associated with higher wages all else equal, though variation of returns across individual programs is large. Program participation is found to be positively related to annual weeks worked in agricultural and nonagricultural occupations and negatively related to weeks spent outside of the U.S. and to poverty. 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 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.[2]

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)).

[2] In contrast, Chiswick (1988) finds that groups with higher education levels also have higher rates of return.

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.[3] Furthermore, 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, and official measures used 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.[4] 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 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

[3] In their survey of social returns to education, Lange and Topel (2006) argue that many empirical studies of education externalities have suffered from statistical imprecision. While evidence is generally consistent with the absence of externalities in the negative direction, the authors note that precise estimation of positive externality magnitudes is an area warranting continued research.

[4] 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.

area within agricultural labor economics, this paper 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 paper 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 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.[5]

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 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)

[5] Approximately one percent (416 workers) declined to answer legal status questions. Respondents are given a pledge of confidentiality and a nominal financial incentive. Furthermore, the NAWS has a long (and visible) history within farming communities. Still, illegal work status statistics should be considered lower bounds.

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.[6] Low participation rates overall across continuing education program categories are related to some extent to seasonality of work and participation in northward migrant streams as the agricultural season progresses. Only 16.3 percent of farmworkers who report following the crop also report participation in any U.S. education programs. This is in contrast to 31.9 percent of non-migrant agricultural workers.

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.

[6] U.S. education participation questions at the farmworker level are asked generically. It is possible that timing of participation varies over workers and that characteristics such as family structure are determined subsequent to participation for some workers. Participation rates based on household member participation in programs within the last two years, instead of individual participation at any time are correlated with farmworker participation and are presented in Appendix Table A-2.

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.
***$p< 0.01$, **$p< 0.05$, *$p< 0.1$

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. Survey data distinguish 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. farm work. 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.[7] Statistically significant differences are evident in most categories in Table 2.

Economic Outcome Variables in the NAWS

Worker outcomes of interest include differentials in wages, annual weeks worked and spent abroad, and annual incomes between those reporting participation and non-participation in the various U.S. educational program categories. 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

[7] Only six agricultural regions are identifiable in the public use data. The state of California stands alone as one of these six. Other regions are groupings of adjacent states with shared agricultural labor market characteristics.

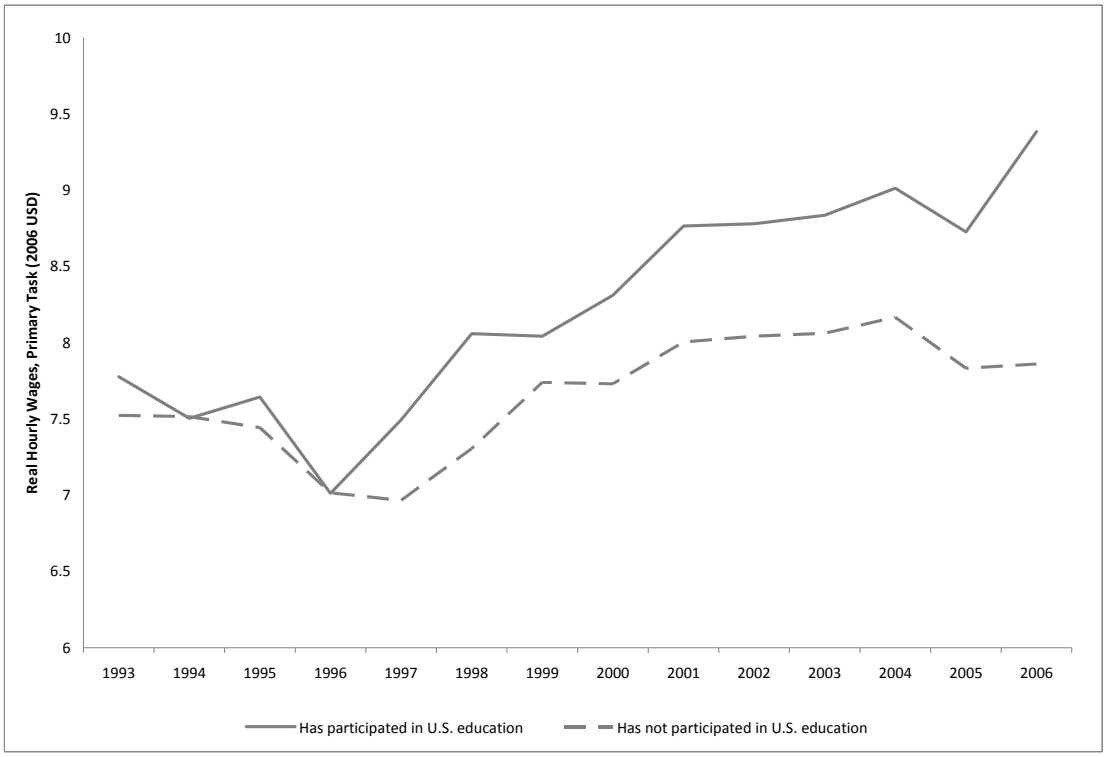
comparable with hourly rates reported by other workers.[8] Figure 1 depicts farmworker wages in treatment and control groups, which is based on whether or not the worker reports participation in U.S. education programs. A worker is classified as a participant if he or she reports any of the education programs described in Table 1.

Notably, real wages (adjusted to 2006 dollars) conditional on participation take a U-shaped pattern in this figure, decreasing in the early part of the series and increasing thereafter. In terms of wages, 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.

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. Following this reasoning, tenure is modeled in the conditional analysis as an explanatory instead of as a dependent variable.[9]

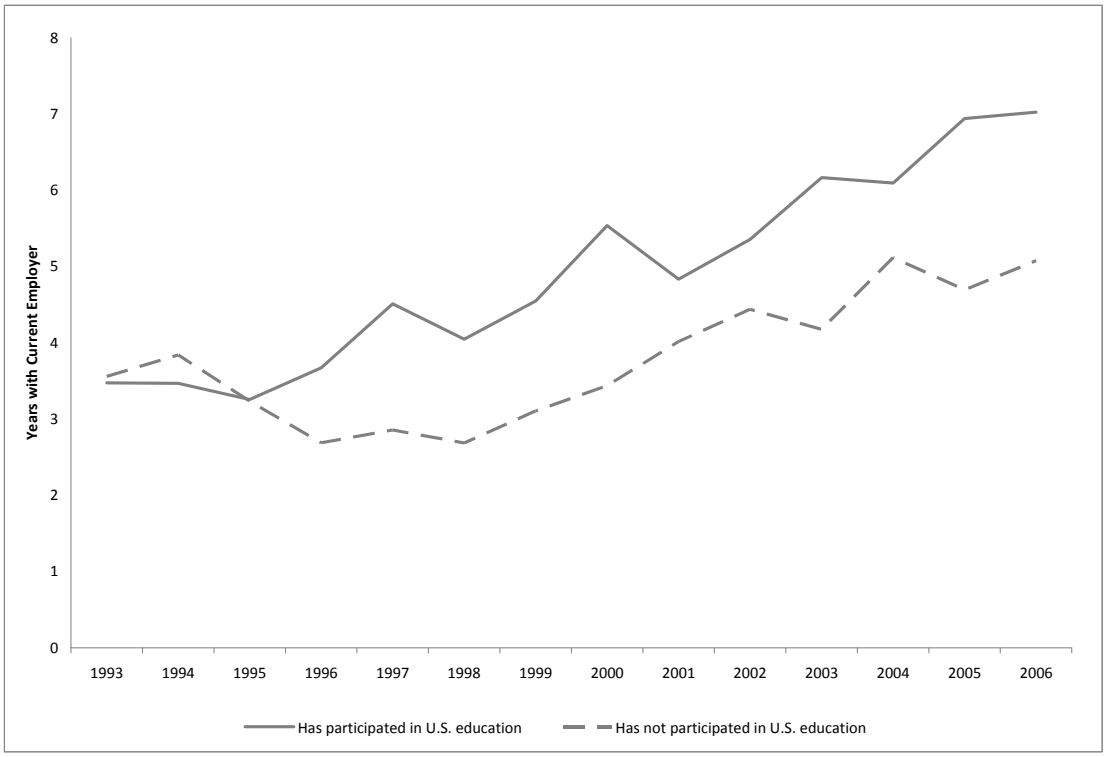
[8] The hourly-equivalent wage for piece rate workers used here is the same as that used for reporting purposes by the U.S. Department of Labor. It is not known if and to what extent this construction introduces measurement error.
[9] Note that the relationship can be thought to be somewhat bidirectional as higher wages may act to increase tenure.

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



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

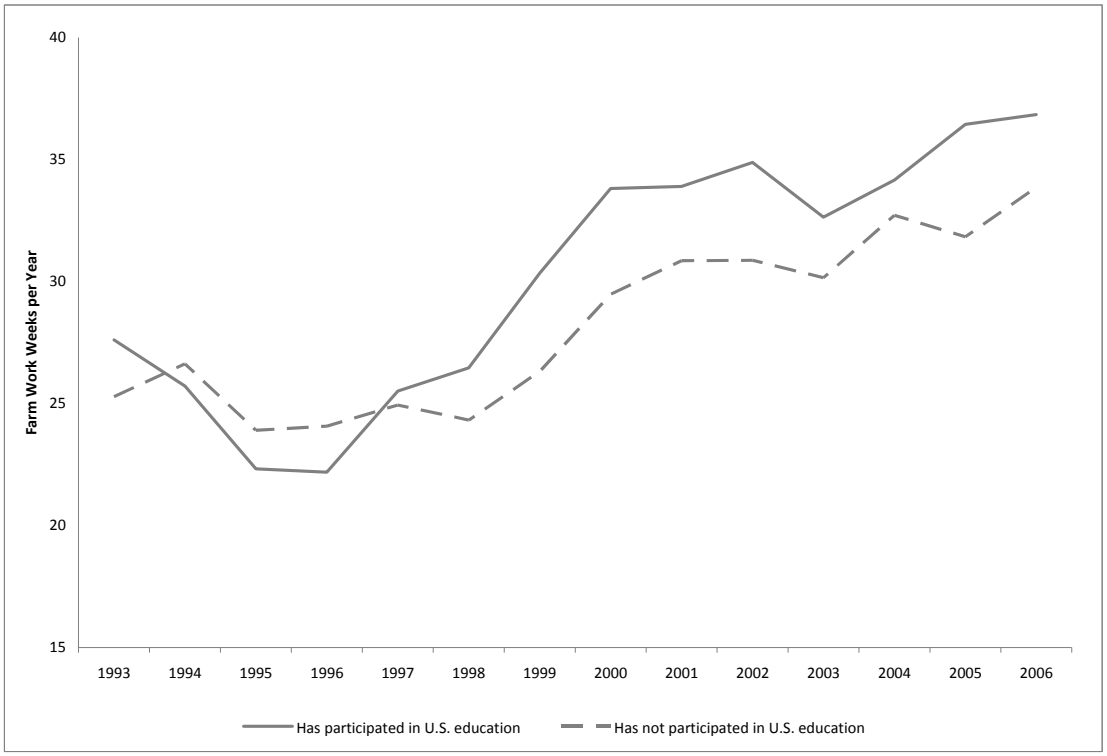
Figure 2. Average Tenure, by U.S. Education Participation



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.[10] 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 nonagricultural work weeks between participants and non-participants and negative differences in weeks abroad are evident over the entire survey period. Furthermore, while unconditional absolute differences in numbers of weeks worked across participation categories are generally small in magnitude, differences in weeks spent outside of the U.S. are larger.

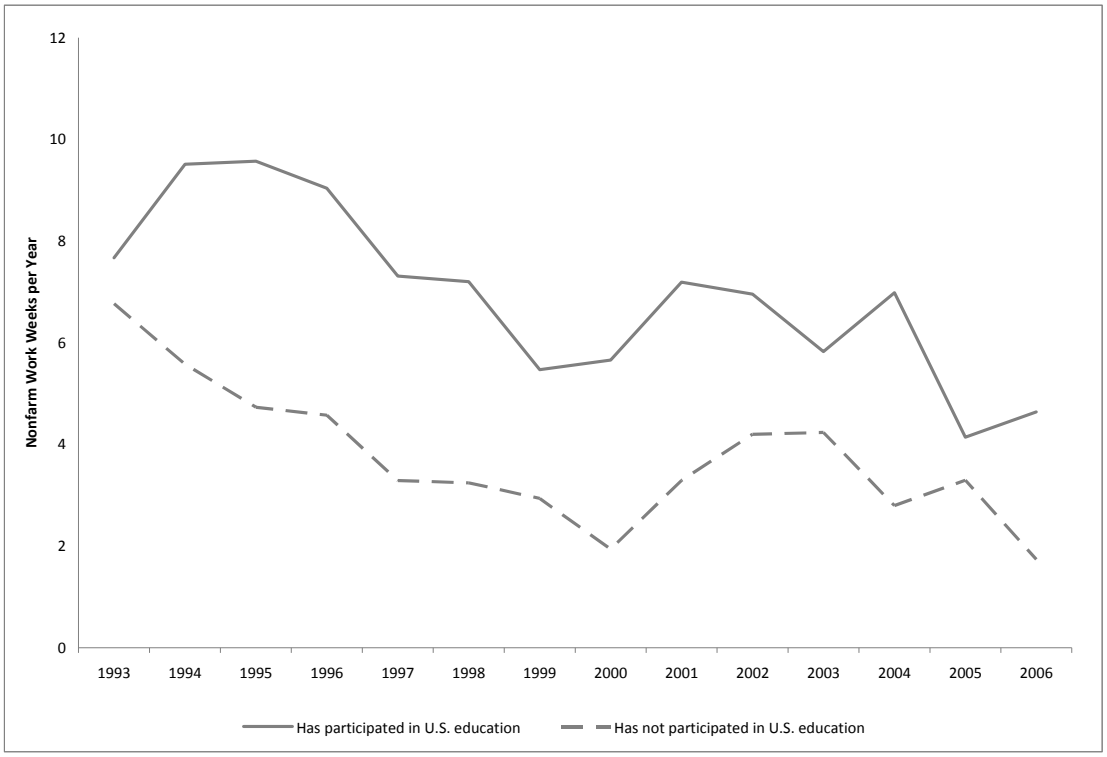
Figure 3. Average Annual Farm Work Weeks, by U.S. Education Participation



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

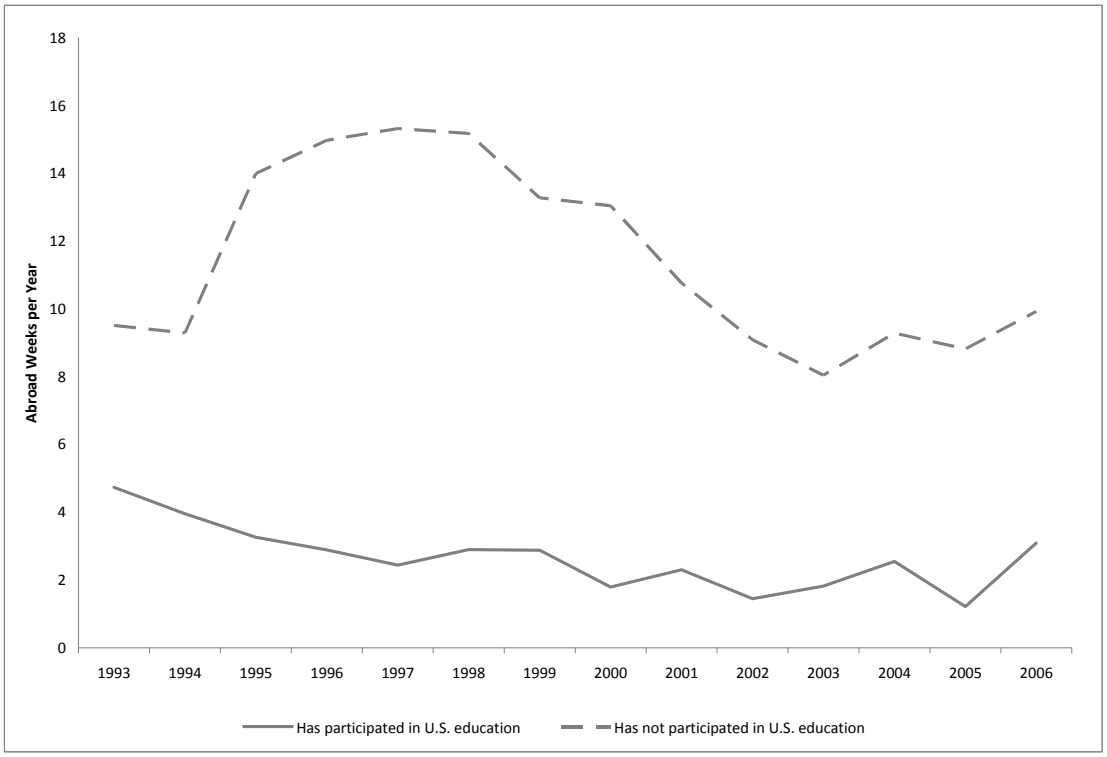
[10] The three weeks categories may or may not add to 52 as some workers may be unemployed for some weeks.

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



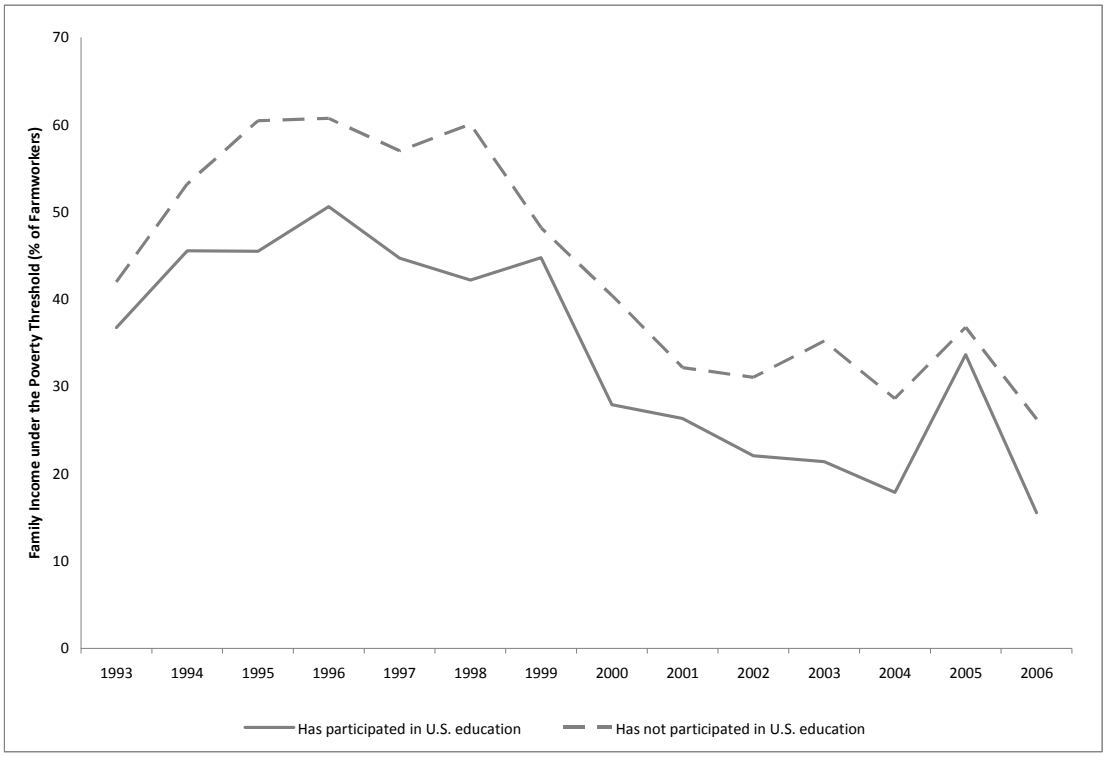
Source: National Agricultural Workers Survey, pooled cross sections 1993-2006.

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



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

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



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

As a final illustration, Figure 6 shows the percentages 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. Overall poverty incidence among families whose household head participated in continuing education programs is less than that for families whose household head did not participate. This is suggestive of positive returns of education on a poverty dimension as well. This pattern persists across survey years.

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. The basic econometric framework takes the general form:

$y_i = \alpha\ participate_i + X_i\beta + \varepsilon_i$ (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 and allow for the identification of heterogeneity across individual programs categories from Table 1.

Ordinary least squares estimates of the effects of continuing education program participation on hourly and hourly-equivalent farmworker wages are presented in Table 3. The effect of participation, broadly-defined to include any U.S. education program is found to be approximately two percent. Coefficients in the wage equations follow intuition. Female farmworkers earn less all else equal than do male farmworkers. Those with more education, experience, and tenure with employer accrue wage premiums. Relative to U.S.-born workers, immigrants receive lower wages controlling for demographic and job specific characteristics.

Regression results presented in columns (3) and (4) of Table 3 allow for heterogeneous correlations between specific program categories and wages. 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 these categories. College or

university courses are found to be associated with seven to eight percent higher wages, followed by citizenship classes (six to seven percent) and job training (three to five percent).

Results for the effects of continuing education program participation on weeks worked within and outside of agriculture and on weeks spent outside of the U.S. are presented in Table 4. Due to the seasonal nature of many agricultural tasks, there is a natural limit to increases in agricultural work weeks on an annual basis. Education program participation is found to be associated with approximately one more week in agricultural employment per year as well as an additional 1.6 weeks in non-farm work. These weeks are offset by the approximate three fewer weeks spent abroad among participants over nonparticipants. Variation, however, is notable across programs, and only English and ESL classes are consistent with this general pattern of statistical significance over all week allocation categories. Other program categories display results similar to the aggregate patterns though some results are not statistically significant.

The effect of participation on poverty status is modeled as a final outcome variable of interest. For poverty, continuing education participants are found approximately three percent less likely to be below their family size U.S. poverty thresholds all else equal. This effect is especially notable (order of five percent) for those who participate in English and ESL classes within the U.S. relative to non-participants.[11]

[11] A caveat is that results should be interpreted in light of the bi-national nature of much of the U.S. farm work 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 ongoing, related work (Pena (2010)).

Table 3. Farmworker Education Program Participation and Log(Wages)

	(1)	(2)	(3)	(4)
Participate (Any)	0.0207***	0.0187***		
	(0.00519)	(0.00509)		
English/ESL			0.0152**	0.0103
			(0.00651)	(0.00644)
Citizenship			0.0680***	0.0668***
			(0.0167)	(0.0165)
Job Training			0.0468***	0.0389**
			(0.0162)	(0.0157)
GED/H.S.			0.00868	0.0105
			(0.00859)	(0.00845)
College/University			0.0767***	0.0725***
			(0.0132)	(0.0128)
Other U.S. Classes			-0.0304***	-0.0235**
			(0.0105)	(0.0103)
Female	-0.0596***	-0.0616***	-0.0596***	-0.0615***
	(0.00532)	(0.00528)	(0.00532)	(0.00529)
Age	0.000386	0.00901***	0.000267	0.00867***
	(0.000255)	(0.00113)	(0.000256)	(0.00114)
Age Squared		-0.000116***		-0.000113***
		(1.39e-05)		(1.40e-05)
Education	0.00749***	0.00723***	0.00683***	0.00664***
	(0.000933)	(0.000918)	(0.000943)	(0.000927)
Farm Experience	0.00142***	0.00650***	0.00144***	0.00646***
	(0.000373)	(0.000841)	(0.000373)	(0.000842)
Experience Squared		-0.000130***		-0.000128***
		(1.83e-05)		(1.83e-05)
Tenure	0.00873***	0.00830***	0.00872***	0.00831***
	(0.000533)	(0.000523)	(0.000531)	(0.000522)
Naturalized Citizen	-0.0270**	-0.0360***	-0.0273**	-0.0354***
	(0.0124)	(0.0121)	(0.0128)	(0.0125)
Green Card	-0.0522***	-0.0657***	-0.0386***	-0.0515***
	(0.0144)	(0.0140)	(0.0146)	(0.0143)
Other Authorization	-0.101***	-0.109***	-0.0856***	-0.0937***
	(0.0185)	(0.0181)	(0.0187)	(0.0184)
Illegal	-0.0962***	-0.0853***	-0.0829***	-0.0718***
	(0.0159)	(0.0156)	(0.0161)	(0.0158)
Speaks English	0.0279**	0.0291**	0.0290**	0.0299**
	(0.0126)	(0.0123)	(0.0125)	(0.0122)
Reads English	-0.00198	-0.00264	-0.000814	-0.00194
	(0.0123)	(0.0119)	(0.0122)	(0.0118)
From Mexico	0.0871***	0.0743***	0.0769***	0.0650***
	(0.0129)	(0.0126)	(0.0131)	(0.0128)
From Central America	0.114***	0.103***	0.103***	0.0932***
	(0.0161)	(0.0159)	(0.0163)	(0.0161)
Observations	34,563	34,563	34,563	34,563
R-squared	0.329	0.341	0.332	0.343

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

Table 4. Farmworker Education Program Participation and Annual Week Allocations

	(1) Farm Weeks	(2) Farm Weeks	(3) Nonfarm	(4) Nonfarm	(5) Abroad	(6) Abroad
Participate (Any)	0.927***		1.625***		-2.977***	
	(0.338)		(0.326)		(0.251)	
English/ESL		2.181***		1.188***		-3.424***
		(0.442)		(0.402)		(0.370)
Citizenship		0.331		1.391*		-0.459
		(0.826)		(0.770)		(0.693)
Job Training		0.967		1.008		-0.721*
		(1.115)		(0.978)		(0.418)
GED/H.S.		0.797		0.418		-1.680***
		(0.565)		(0.628)		(0.307)
College/University		-0.313		2.098**		0.111
		(0.845)		(0.923)		(0.366)
Other U.S. Classes		-1.629**		0.673		-2.719***
		(0.736)		(0.887)		(0.538)
Female	-3.863***	-3.869***	-0.364	-0.344	-4.555***	-4.566***
	(0.341)	(0.341)	(0.311)	(0.312)	(0.306)	(0.306)
Age	0.288***	0.271***	0.447***	0.437***	0.154**	0.160**
	(0.0638)	(0.0641)	(0.0610)	(0.0609)	(0.0637)	(0.0640)
Age Squared	-0.00375***	-0.00355***	-0.00509***	-0.00499***	-0.00174**	-0.00182**
	(0.000801)	(0.000803)	(0.000744)	(0.000743)	(0.000767)	(0.000770)
Education	0.0841*	0.0815*	0.198***	0.193***	-0.112**	-0.135***
	(0.0466)	(0.0469)	(0.0416)	(0.0420)	(0.0476)	(0.0483)
Farm Experience	1.390***	1.385***	-0.282***	-0.281***	-1.084***	-1.084***
	(0.0517)	(0.0515)	(0.0505)	(0.0505)	(0.0459)	(0.0458)
Experience Squared	-0.0277***	-0.0277***	0.00495***	0.00493***	0.0223***	0.0224***
	(0.00121)	(0.00121)	(0.00102)	(0.00102)	(0.00107)	(0.00107)
Tenure	0.684***	0.681***	-0.361***	-0.362***	-0.128***	-0.125***
	(0.0322)	(0.0321)	(0.0235)	(0.0235)	(0.0218)	(0.0218)
Naturalized Citizen	-0.0859	-0.541	-2.604***	-2.693***	4.524***	5.114***
	(0.931)	(0.950)	(0.789)	(0.801)	(0.800)	(0.812)
Green Card	0.461	0.167	-0.714	-0.678	1.880**	2.583***
	(1.026)	(1.039)	(1.058)	(1.071)	(0.829)	(0.832)
Other Authorization	4.095***	3.735***	-2.523*	-2.459*	0.388	1.178
	(1.422)	(1.434)	(1.312)	(1.325)	(1.063)	(1.071)
Illegal	4.104***	3.793***	-2.829**	-2.848**	5.362***	6.094***
	(1.081)	(1.098)	(1.128)	(1.142)	(0.879)	(0.887)
Speaks English	0.437	0.407	1.503**	1.590**	-3.065***	-3.072***
	(0.710)	(0.717)	(0.641)	(0.642)	(0.666)	(0.676)
Reads English	-0.507	-0.466	0.777	0.878	-1.784***	-1.863***
	(0.748)	(0.754)	(0.674)	(0.682)	(0.669)	(0.668)
From Mexico	0.797	0.594	0.207	0.171	-0.179	-0.256
	(0.925)	(0.945)	(0.917)	(0.944)	(0.799)	(0.808)
From Central America	3.873***	3.586***	1.530	1.494	-4.562***	-4.626***
	(1.154)	(1.169)	(1.081)	(1.103)	(1.078)	(1.083)
Observations	35,534	35,534	35,540	35,540	35,540	35,540
R-squared	0.267	0.269	0.126	0.125	0.291	0.292

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

Table 5. Farmworker Education Program Participation and P(Poverty)

	(1)	(2)	(3)	(4)
Participate (Any)	-0.0337***	-0.0326***		
	(0.0120)	(0.0120)		
English/ESL			-0.0533***	-0.0503***
			(0.0149)	(0.0149)
Citizenship			-0.150***	-0.148***
			(0.0281)	(0.0284)
Job Training			0.0189	0.0289
			(0.0324)	(0.0326)
GED/H.S.			0.0104	0.00799
			(0.0210)	(0.0212)
College/University			-0.0539*	-0.0501
			(0.0317)	(0.0321)
Other U.S. Classes			0.0363	0.0296
			(0.0302)	(0.0302)
Female	0.0470***	0.0447***	0.0475***	0.0450***
	(0.0133)	(0.0133)	(0.0134)	(0.0134)
Age	-0.00190***	-0.00796***	-0.00172***	-0.00726***
	(0.000574)	(0.00255)	(0.000577)	(0.00257)
Age Squared		7.97e-05**		7.28e-05**
		(3.15e-05)		(3.17e-05)
Education	-0.00998***	-0.00987***	-0.00948***	-0.00946***
	(0.00175)	(0.00175)	(0.00177)	(0.00177)
Farm Experience	-0.00234***	-0.0119***	-0.00227***	-0.0118***
	(0.000808)	(0.00189)	(0.000809)	(0.00189)
Experience Squared		0.000252***		0.000253***
		(4.29e-05)		(4.29e-05)
Tenure	-0.0130***	-0.0121***	-0.0129***	-0.0121***
	(0.00127)	(0.00122)	(0.00127)	(0.00122)
Naturalized Citizen	0.142***	0.152***	0.162***	0.171***
	(0.0318)	(0.0317)	(0.0322)	(0.0321)
Green Card	0.0802**	0.0969***	0.0734*	0.0898**
	(0.0373)	(0.0373)	(0.0378)	(0.0379)
Other Authorization	0.0988*	0.106**	0.0938*	0.101*
	(0.0532)	(0.0530)	(0.0539)	(0.0538)
Illegal	0.160***	0.146***	0.153***	0.140***
	(0.0383)	(0.0385)	(0.0390)	(0.0392)
Speaks English	-0.0518**	-0.0548**	-0.0520**	-0.0547**
	(0.0244)	(0.0237)	(0.0247)	(0.0240)
Reads English	-0.0242	-0.0220	-0.0298	-0.0272
	(0.0261)	(0.0256)	(0.0263)	(0.0257)
From Mexico	-0.0939***	-0.0778**	-0.0722**	-0.0572*
	(0.0330)	(0.0330)	(0.0335)	(0.0335)
From Central America	-0.195***	-0.188***	-0.176***	-0.169***
	(0.0324)	(0.0330)	(0.0340)	(0.0347)
Observations	30,011	30,011	30,011	30,011

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

Selection Bias

If there are reasons to suspect selection bias, estimation by OLS alone may not 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 semi-parametric 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 and whether appropriate exclusion restrictions are available for identification. 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.

In literature pertaining to education and earnings in nonagricultural occupations, instrumental variable estimates of educational returns, which address endogeneity concerns, have been found to be significantly greater than OLS estimates. Consider the propensity to participate as an unobserved latent variable:

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

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

Table 6 presents estimates of probit marginal effects of various demographic and labor market characteristics on the probability that a worker participates in education program categories indicated by survey responses. Estimation results indicate that female gender, education, and years of previous farm work experience are positive, significant predictors of continuing education program participation. Age, on the other hand, is of significance in the negative direction.

Indicators of legal status also are of statistical and economic significance. Being U.S.-born is the excluded category in Table 6. In the full regressor version presented in column (5), marginal effects indicate that illegal workers are 21.0 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.

Table 6. Determinants of Farmworker Education Program Participation (Dependent variable: Participation in any U.S. classes or school)

	(1)	(2)	(3)	(4)	(5)
Female	0.0639***	0.0661***	0.0562***	0.0532***	0.0528***
	(0.00961)	(0.00969)	(0.00974)	(0.00998)	(0.00998)
Age	-0.00311***	-0.00796***	-0.00518***	-0.00516***	-0.00471***
	(0.000416)	(0.00175)	(0.00175)	(0.00177)	(0.00177)
Age Squared		6.56e-05***	4.13e-05*	3.78e-05*	3.28e-05
		(2.23e-05)	(2.25e-05)	(2.28e-05)	(2.27e-05)
Education	0.0263***	0.0265***	0.0198***	0.0191***	0.0198***
	(0.00117)	(0.00117)	(0.00123)	(0.00123)	(0.00124)
Farm Experience	0.00274***	0.0101***	0.00797***	0.00793***	0.00780***
	(0.000556)	(0.00126)	(0.00128)	(0.00128)	(0.00128)
Experience Squared		-0.000199***	-0.000167***	-0.000155***	-0.000144***
		(3.03e-05)	(3.08e-05)	(3.08e-05)	(3.02e-05)
Tenure	0.00136*	0.000885	0.000200	-5.42e-05	0.000169
	(0.000743)	(0.000747)	(0.000772)	(0.000774)	(0.000763)
Naturalized Citizen	0.0882***	0.0799***	0.0466*	0.0463*	0.0478*
	(0.0193)	(0.0193)	(0.0278)	(0.0280)	(0.0283)
Green Card	-0.0272**	-0.0388***	-0.102***	-0.102***	-0.0991***
	(0.0106)	(0.0109)	(0.0253)	(0.0252)	(0.0245)
Other Authorization	0.0411	0.0362	-0.0433	-0.0486	-0.0541*
	(0.0288)	(0.0288)	(0.0339)	(0.0328)	(0.0312)
Illegal	-0.180***	-0.172***	-0.216***	-0.214***	-0.210***
	(0.0109)	(0.0110)	(0.0317)	(0.0316)	(0.0310)
Speaks English			0.140***	0.137***	0.120***
			(0.0194)	(0.0189)	(0.0185)
Reads English			0.121***	0.121***	0.125***
			(0.0203)	(0.0199)	(0.0197)
From Mexico			0.178***	0.177***	0.169***
			(0.0208)	(0.0206)	(0.0204)
From Central America			0.359***	0.346***	0.347***
			(0.0504)	(0.0510)	(0.0498)
Crop controls?	no	no	no	yes	yes
Task controls?	no	no	no	yes	yes
Region controls?	no	no	no	no	yes
Survey year controls?	no	no	no	no	yes
Observations	36,250	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. ***$p<0.01$, **$p<0.05$, *$p<0.1$

Propensity Score Matching

A method to determine effects of participation is to match workers based on a measure of their observed characteristics (propensity score). [12] 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 general propensity score technique is to estimate an equation similar to (2). In this case, the propensity score is 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 performed based on both individual neighborhood (observations that can be ranked close together) or on smooth weighting (based on an assumed population distribution). The assumption imposed is unconfoundedness, or that

[12] Several strategies can be used for identifying the effect of participation using simultaneous estimation of equations (1) and (2). First, a maximum likelihood treatment effects 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). Exclusion restrictions, however, help with identification. 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 (wages) 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. Thirdly, a family structure variable, specifically the presence of children within the U.S. was considered as an instrument. Workers who have 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. Furthermore, correlations between the presence of children who are participating in education and their parents who also participate may be present, and family structure can be hypothesized to be unrelated to hourly wage rates. This identification method based on presence of U.S. 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 but included in the participation equation. Although results across these parametric estimations (available upon request) were somewhat sensitive to specification, the effect of participation broadly on log (wages) was generally positive, highly statistically significant, and of greater magnitude than the results from OLS and propensity score techniques.

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:

$E(y_{i1} - y_{i0}|participate_i=1) = E(y_{i1}|participate_i=1) - E(y_{i0}|participate_i=1)$ (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 7: Propensity Score Treatment Effects of Farmworker Education Program Participation on Worker Outcomes

	Log(wages)	Farm Weeks	Non-Farm Weeks	Weeks Abroad	P(Poverty)
Nearest-neighbor	0.052***	1.890***	0.799***	-3.380***	-0.072***
	(0.004)	(0.210)	(0.133)	(0.135)	(0.006)
Kernel	0.049***	1.528***	1.003***	-3.930***	-0.057***
	(0.004)	(0.203)	(0.153)	(0.101)	(0.005)

Notes: Author's calculations using survey weights, National Agricultural Workers Survey, 1993-2006. Analytical standard errors in parentheses for nearest-neighbor match method. Bootstrapped standard errors for kernel match method.

Propensity score treatment effect estimates for the five outcome variables of interest are presented in Table 7. Matching is based on covariates used in parametric estimations. 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.[13] Results follow general patterns identified by the OLS technique, though for four out of five outcomes, magnitudes of effects are greater. The treatment effect of participation on wages, for example, is found to be 5.2 percent by a random draw nearest-neighbor math technique and 4.9 percent by kernel matching respectively. The selection estimation method therefore leads to higher in magnitude estimates of the effect of continuing education on wages than does OLS. This pattern is consistent with literature demonstrating this

[13] 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.

pattern for other industries. Results in Table 7 for annual farm work weeks, non-farm work weeks, and weeks spent abroad also are consistent with OLS results with positive, significant differences in work week categories and negative significant differences for weeks spent abroad.

Discussion and Conclusions

The analysis overall presents evidence as to the effectiveness of U.S. continuing education programs for increasing farmworker wages and propensities to secure agricultural and nonagricultural work. Hourly wage gains are greatest when education participation is restricted to college and university, citizenship, and job training 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.

Semi-parametric propensity score matching results, which control for selection into participation, suggest that U.S. continuing education program participants earn approximately five percent higher wages all else equal and are six to seven percent less likely to fall below poverty thresholds than are non-participants. Participants also are found to work one to two more weeks per year than non-participants in both agricultural and nonagricultural labor markets and to spend these three to four fewer weeks per year outside of the U.S. Results of this paper therefore are consistent with farmworker educational opportunities increasing base wages and bettering employment options. Thus, this research provides evidence complementary to current program performance measures, which also note positive associations between continuing education program participation and worker outcomes.

Several caveats, however, remain. The data used in this paper, although nationally and regionally representative, are imperfect. First, data correspond solely to employed U.S.

farmworkers, meaning that workers who participate in continuing education programs and then exit agricultural labor markets are not included in the survey. The extent of substitution from agricultural to nonagricultural work therefore is muted in the empirical exercise here. By similar reasoning, effects of participation on wages and poverty propensities also are lower bounds. Furthermore, the effect of U.S. continuing education participation may vary from the intensive to extensive margin. Given the binary nature of survey questions pertaining to education programs, it is impossible given current survey data to examine effects of extent and duration of participation by individual workers (and likewise effects of milestones such as certificates and diplomas which may introduce nonlinearities). While continued data collection and research is warranted, this paper contributes a next step to the understudied area of continuing education participation among migrant and seasonal workers.

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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.