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Why Do Fewer Agricultural Workers Migrate Now?

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Abstract

The share of agricultural workers who migrate within the United States has fallen by approximately 60% since the late 1990s. To explain this decline in the migration rate, we estimate annual migration-choice models using data from the National Agricultural Workers Survey for 1989–2009. On average over the last decade of the sample, one-third of the fall in the migration rate was due to changes in the demographic composition of the workforce, while two-thirds was due to changes in coefficients ("structural" change). In some years, demographic changes were responsible for half of the overall change.

JEL: J43, J61, J82, Q19

Key Words: Migration, agricultural workers, demographics

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Why Do Fewer Agricultural Workers Migrate Now?

The share of hired agricultural workers who migrate within the United States plummeted by almost 60% since the late 1990s. This paper is the first to document and systematically analyze this drop in the migration rate. We estimate annual models of crop workers' migration decisions for 1989 through 2009. Based on these estimates, we decompose the change in the migration rate into two causes: shifts in the demographic composition of the workforce and changes in coefficients ("structural" change).

During the same period as the migration rate decreased, the total number of farm workers fell.[1] The combination of these two effects has substantially reduced the ability of farmers to adjust to seasonal shifts in labor demand throughout the year, leading to crises in which farmers report not being able to hire workers at the prevailing wage during seasonal peaks (Hertz and Zahniser, 2013).[2] As the academic literature shows, labor migration can temper the effects of macroeconomic shocks that vary geographically (Blanchard et al., 1992; Partridge and Rickman,

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[1] According to estimates from the Economic Research Service (ERS) of the United States Department of Agriculture (USDA) indicate that 891,000 hired farmworkers (full- and part-year combined) worked in 2000 but that number dropped 13% to 775,000 by 2012. Full-year workers alone also showed decreases (from 640,000 to 576,000 or a 10% drop). ERS, **www.ers.usda.gov/topics/farm-economy/farm-labor/background.aspx#Numbers,** also reports that there were an average of 1,142,000 farmworkers and agricultural service workers combined in 1990, 1,133,000 in 2000, 1,020,000 in 2009, and 1,027,000 in 2011. Thus, the number of these workers also has fallen by this alternate definition of workers.

[2] For example, a front-page story in the *San Francisco Chronicle*, "Jobs Go Begging," August 11, 2013, bemoans the lack of labor in California to pick berries that were ripe on the vines. Similarly, Mark Koba, "The Shortage of Farm Workers and Your Grocery Bill," **www.cnbc.com** quotes agricultural economists and farmers talking about long-run shortages of labor.

2006) and the effects of industry restructuring such as those arising from the decline of manufacturing (Dennis and İşcan, 2007).

The demographic composition of the agricultural work force has changed substantially since 1998. For example, the average worker today is older, more likely to be female, and more likely to be living with a spouse and children in the United States. We hypothesized that such workers might be less likely to migrate. We test various hypotheses and find that demographic changes played an important role in reducing the migration rate alongside underlying structural changes.

The first section discusses U.S. and Mexican institutional, governmental, and economic changes during our sample period that affected the demographic composition of the agricultural workforce and the migration of workers. The next section describes our data set, provides summary statistics, and plots trends in migration rates over time. The third section presents the estimates of the migration choice model for various years. The fourth section decomposes the drop in the migration rate into (1) changes due to shifts in the means of demographic variables, holding the model's structure constant, and (2) changes in the estimated coefficients, holding the means of the demographics constant. The fifth section shows how changes in the mean of individual demographic characteristics contributed to the decline in the migration rate. The last section summarizes our results.

Institutional, Governmental, and Economic Shocks

A number of institutional, governmental, and economic changes contributed to the reduction in the migration rate within the United States directly or through their effects on the demographic composition of the workforce. These shocks affected the supply and demand for labor in both Mexico and the United States.

At about the time that the migration rate started to fall in the late 1990s, many institutional changes occurred in the United States and Mexico that affected the ease of crossing the U.S.-Mexican border and the desire of Mexican nationals to cross. Several new U.S. laws and additional funding for border enforcement made crossing more difficult: the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, the Homeland Security Act of 2002, the USA Patriot Act of 2002, the Enhanced Border Security and Visa Entry Reform Act of 2002, the Intelligence Reform and Terrorism Prevention Act of 2004, the REAL ID Act of 2005, and the Secure Fence Act of 2006.

According to a survey of migrants, the cost of crossing the border with the help of smugglers, or "coyotes," rose substantially since mid-1990s (e.g. Cornelius, 2001; Gathmann, 2008). Cornelius (2001) notes that increasing coyote costs are associated with decreases in the probability of returning to a country of origin and with increases in deaths along the border. Pena (2009) shows that border enforcement is negatively associated with agricultural worker migration specifically. Newspaper articles indicate that the U.S. government substantially increased U.S.-Mexican border enforcement since the mid-2000s.

In addition, changes in U.S.-Mexican foreign relations and in Mexican public policy reduced incentives for its citizens to move to the United States in the second half of our sample period (1999–2009). Mexican farm laborers were less like to migrate to the United States because of increased economic growth in Mexico, rising productivity, and decreased birth rates (Boucher et al., 2007; Taylor, Charlton and Yúnez-Naude, 2012). The 1997 anti-poverty *Programa de Educación, Salud y Alimentación* (later renamed *Oportunidades*) in Mexico increased welfare in Mexico through education, health, and conditional cash transfer initiatives, which decreased the incentive for workers to cross the border (e.g. Angelucci, Attanasio and Di

Maro, 2012). *Oportunidades* also increased agricultural production in Mexico (Todd, Winters and Hertz, 2009).

Changes in the legal status of farm workers also affected the U.S. farm labor force. For example, the 1986 Immigration Reform and Control Act (IRCA) conferred legal status on many previously unauthorized workers, which provided a path to a legal permanent residence status and citizenship. By so doing, IRCA reduced the share of unauthorized workers during the 1990s. Over time, many of these workers left agriculture.

Together, these factors reduced the number of undocumented workers from Mexico in the United States. Martin (2013) reviews the history of immigration legislation and domestic enforcement and concludes that the e-verify program (which allows a firm to check a worker's legal status) had little impact during the period immediately after IRCA went into effect. In contrast, Kostandini, Mykerezi and Escalante (2014) show that after 2002, counties participating in the Department of Homeland Security's 287(g) enforcement program had fewer foreign-born workers, reduced labor usage, and experienced changes in cropping patterns among producers. In our empirical analysis, we investigate whether the willingness of a worker to migrate within the United States depends crucially on legal status.

A variety of other structural factors also affected the supply and demand for U.S. farm labor. In recent years, increased consumer demand for fresh fruits and vegetables and expanded exports of agricultural commodities led to greater production of labor-intensive crops (Martin, 2011). Agricultural producers have responded to higher labor costs by improving productivity through increased mechanization and more efficient cultivation practices (Martin, 2011; Martin and Calvin, 2010). These changes, by altering the value of the marginal products of labor across areas, affected the incentives to migrate within the United States.

Ideally, we would like to model and test the effects of each of these various shocks. However, the number of institutional and policy changes are large relative to the number of years in our data set, 1989 to 2009. Thus, it is not feasible to test and model these shocks individually. Rather, we estimate a migration model for each of the large, annual cross sections, and allow the coefficients in each year to change, so as to reflect the structural change over time stemming from all these individual shocks.

Data

We use data from the National Agricultural Worker Survey (NAWS), which is a nationally representative cross-sectional dataset of workers employed in seasonal crops. The NAWS collects basic demographic characteristics, legal status, education, family size and composition, wage, and working conditions in farm jobs from a sample of farmworkers in several cycles each year.

The NAWS samples by worksites rather than residences to overcome the difficulty of reaching migrant and seasonal farm workers. In contrast, the other major data source, the Current Population Survey, samples by standard residences and hence under samples agricultural workers and particularly migrants, who often live in nonstandard residences (Gabbard, Mines and Perloff, 1991). To have a representative sample, the NAWS varies the number of interviews conducted in a season in proportion to the level of agricultural activity at that time of the year. Spring, summer, and autumn survey cycles begin in February, June, and October and last approximately 12 weeks each.[3]

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[3] The NAWS uses a multi-stage sampling procedure, which relies on probabilities proportional to size to obtain a nationally representative random sample of crop workers annually, **www.doleta.gov/agworker/pdf/1205_0453_Supporting_Statement_PartB32210.pdf**.

We use the most recently available public use version of the NAWS, which provides

annual cross-sections of agricultural workers for the fiscal years 1989 through 2009. We use

NAWS's sampling weights constructed by the disseminators of the survey to maintain the

representativeness of the data in summary statistics, figures, and estimations. After dropping

individuals who are missing data on key variables, we have 37,075 observations of agricultural

workers.

We study whether these agricultural workers migrated to their current job. By the nature

of our data, we can tell if the worker entered agriculture from a non-agricultural sector, but we

cannot examine whether a current worker will "migrate" in the future by exiting agriculture (cf,

Barkley, 1990; Perloff, 1991).

Summary Statistics

Table 1 presents summary statistics for the variables used in our empirical analysis for the entire

sample and for the migrants and non-migrant subsamples separately. Approximately 39% of the

hired farm workers in our full sample from 1989 through 2009 were migrants.

Migrants (column 2) and non-migrants (column 3) have substantially different

demographic characteristics. Compared to non-migrants, migrants are more likely to be male,

Hispanic, unauthorized to work in the United States, and to work for a third-party farm labor

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Approximately 90 county clusters are selected using probabilities proportional to the size (PPS) of the seasonal agricultural payroll. The number of interviews within each season, region, and county are proportional to the amounts of agricultural activity at that time and location. Within each county cluster, the NAWS selects counties using the PPS of the seasonal agricultural payroll. Next, the NAWS randomly samples farm sites from a list of all farm employers located in the counties. The NAWS contacts the selected farm employers to obtain permission to interview the farm workers. Interviewers randomly sample workers employed by those farm employers and interview them outside of work hours at a location chosen by the worker (e.g., at the place of work, the worker's home, or another location).

contractor rather than directly for a grower. They earned less income the previous year, are younger, have less farm experience. They are less likely to speak English, live with a spouse or children in the United States, and own (or be in the process of buying) a house or motor vehicle in the United States.

Table 1 also divides the sample into two subperiods. The migration rate was relatively stable during the first half of the sample, 1989 through 1998, and then fell rapidly in the subsequent years. Workers in the stable migration period, 1989–1998, had substantially different demographics than those in the period of rapid decline, 1999–2009 (compare columns 4–6 to columns 7–9). Compared to the stable period, workers in the declining period are older and more educated, have higher income, have more farm experience, are more likely to live with their spouse and children in the United States, and have more assets.[4]

Migration Trends

During the relatively stable first half of the sample, 1989 through 1998, the share of migrants within the United States fluctuated by a moderate amount, but a trend line for this period is relatively flat, with only a slight downward slope (Figure 1). Thereafter, the share of migrants plummeted, as the steeply declining trend line in the later period shows. The share of seasonal agricultural workers in the NAWS dataset who migrate plummeted from roughly half in the 1990s to less than one-quarter by 2009.

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[4] Workers in the declining period are also more likely to be unauthorized, but they are less likely to be Hispanic and are less likely to have other work authorizations in comparison with their counterparts in the stable period. This change may be partially the result of the large-scale legalization of agricultural workers that accompanied IRCA in the years immediately before the beginning of our sample period.

These trends hold for various subsamples. Figure 2 plots the proportion of migrant farm workers from 1989 through 2009 by legal status, region, and age. The solid line in each subpanel indicates the proportion of migrants in the full sample.

Subpanel 2A shows how the proportion varies by legal status over time: citizens, legal permanent residents, and unauthorized workers. On average over the entire period, 18% of citizens migrate compared to 39% for legal permanent residents, 60% for those with other work authorization, and 48% for those who are unauthorized.[5] Thus, a higher share of unauthorized and other authorized workers migrated than did citizens and legal permanent residents in the sample overall.[6] The figure illustrates how the migration rates for authorized (inclusive of citizens, legal permanent residents, and those with other work authorization) versus unauthorized workers both fall over the last decade of our sample.

Subpanel 2B presents the proportion of migrants by geographic migration patterns. Traditional networks of migrants follow typical U.S. harvest patterns by starting in the south and moving north as the season progresses.[7] The NAWS classifies workers into three north-south streams based on their work location at the time of interview and therefore includes both workers who follow-the-crop and those who work in a single location. As the figure shows, migration

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[5] The share of other-authorized workers is smaller than the shares of workers in other legal status categories and shrank during the 2000s.

[6] A large proportion of the unauthorized workers who cross the U.S.-Mexican border work in U.S. agriculture for only part of the year and return to Mexico for the rest. During our data period, the share of unauthorized workers rose from 14% in 1989 to 42% in 1998 and further to 48% in 2009.

[7] Pena (2009), for example, documents how migration decisions of U.S. agricultural workers respond to locational attributes including the existence of networks at personal and community levels.

rates were generally higher for Eastern and Midwestern stream workers than for Western stream workers. The migration rate declines over time for all streams.

Subpanel 2C shows that workers younger than 35 are slightly more likely to migrate than are older workers. Again, both groups show a decline in the rate of migration in the recent period. These results also hold for other demographic variables that are correlated with age, such as education and experience levels.

Our definition of a migrant includes both of the NAWS's sub-categories of migrants: follow-the-crop migrants and shuttle migrants. Follow-the-crop migrants are workers who move between U.S. farms as the agricultural season progresses. Shuttle migrants move between their homes (either in the United States or abroad) and a single distant work site.[8] Figure 3 shows how the share of farmworkers who follow-the-crop or are shuttle migrants varies over time. The migration rate for both groups fell over our sample period. After the first year of the sample, the share of shuttle migrants exceeds that of follow-the-crop migrants. Analyzing these types of migrants separately produces results similar to those reported for the combined group in the following sections.

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[8]The NAWS defines a follow the crop migrant as a worker having two U.S. farm jobs greater than 75 miles apart. A shuttle migrant travels at least 75 miles from a home base to a single agricultural worksite. Shuttle migrants include domestic migrants as well as international migrants who are not border commuters. Foreign-born newcomers are classified as migrants because they migrated across a border to obtain farm work in the United States even though they have not worked in U.S. agriculture long enough to present a cyclical pattern. Careful examination does not reveal any changes in the construction of the migrant variable over this period or the administration of the survey.

Migration Model

To estimate a migration model, we can use any of the standard binary choice models: logit, probit, and the linear probability model. Because the share of workers who migrate lies between a quarter and a half in most years, all three methods produce nearly identical results in terms of the marginal effects of individual variables, their ability to predict, and our other analyses. For presentational simplicity, we use the linear probability model.[9]

We estimate separate migration models for each year of the sample. We did so because the coefficients are not constant over time.[10] We tested and rejected that the intercept and slope coefficients are constant across various time-period aggregations such as the two halves of the sample and each pair of successive years.

We examine how the probability of migrating varies with three groups of demographic variables: individual characteristics, family attributes and assets, and employment experiences.[11] Our individual demographic variables include age; years of school; a dummy for female; dummies for Hispanic, African American, and American Indian (the base group is white non-Hispanic); dummies for legal permanent resident, unauthorized worker, and other authorized worker (the base group is citizen worker); and a dummy for whether the individual speaks at least some English.

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[9] For comparison purposes, Table A1 in the Appendix shows the corresponding logit estimates for 1998, which are very close to those of the corresponding linear probability model in Table 2.

[10] It is not feasible to test for cointegration given our short time series.

[11] This migration choice model is similar to that of previous empirical studies of migration (Emerson, 1989; Perloff, Lynch and Gabbard, 1998; Stark and Taylor, 1989; Stark and Taylor, 1991; Taylor, 1987; Taylor, 1992).

Family characteristics include whether the worker is married, lives with a spouse in the United States, and lives with at least one child under 18 years of age. Family wealth and income variables include whether the individual owns or is buying a house in the United States; whether the individual owns or is buying a car or truck in the United States; and the worker's self-reported real personal income in the previous year (in 2011 dollars based on the Consumer Price Index). We used lagged personal income to avoid endogeneity.

Our employment variables include years of farm experience; a dummy if the employee performs semi-skilled or skilled work or supervises others; and a dummy if the worker was hired by a farm labor contractor (rather than a grower).[12] Our dependent variable equals one if the worker is a migrant and zero otherwise.

Table 2 shows estimates of our model using data from 1989, the first year of our sample (column 1); for 1998, the end of our stable period (column 2); and for 2009, the last year of the data (column 3). The table reports robust standard errors in parentheses.

Based on hypotheses tests, we can reject the hypothesis that all the slope coefficients are identical in any two years. We can similarly reject any of the other aggregations over time.

The following discussion focuses on the estimates from the 1998 model (column 2). Nine out of the 19 slope variables are statistically significantly different from zero. A female is 15 percentage points less likely to migrate than a male, which is a large difference given that the sample average probability of migrating is 53% in 1998. Hispanics are 15 percentage points more likely to migrate than are non-Hispanics. Skilled workers are 7% percentage points less

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[12] Our results are similar if we include dummies for the type of crop and region. We exclude those variables in our tables because they may be endogenous to the migration decision.

likely to migrate than unskilled workers. Surprisingly, age and farm experience have negligible effects.

Married workers who do not live with their spouse in the United States are 19 percentage points more likely to migrate (the coefficient on "married"). However, married workers who live with their spouse in the United States are 10 percentage points less likely to migrate (the sum of the "married" and the "spouse in household" coefficients). Similarly, workers are 11 percentage points less likely to migrate if they live with their children. Presumably, these family-oriented workers see themselves as having a higher opportunity cost of migrating.

The probability of migrating falls with lagged personal income. We expected this result because the main purpose of migrating for these workers is to earn a higher income. Workers hired by farm labor contractors are 15 percentage points more likely to migrate than are those who are directly hired by farmers. Farm labor contractors provide labor to many farms and may provide transportation to distant jobs. In contrast, a worker hired by a farmer is likely to work at a single location.

We had expected that legal status of workers would play an important role; however, no clear pattern emerged. In the 1989 and 1998 regressions, we cannot reject the hypothesis that the coefficients on unauthorized workers are zero (the base group is citizens in the regressions). The coefficient is negative and statistically significant in the 2009 regression. We see the same pattern for other-authorized workers. In contrast, legal permanent residents were 14 percentage points more likely to migrate in 1998, but the difference was not statistically significant in the other two years.

Migration Change Decomposition

The change in the annual average migration rate over time is due to (1) changes in the estimated coefficients, such as from institutional, governmental, and economic shocks, and (2) changes in the means of the demographic variables. We decompose the change in the migration rate into these two effects, which we call the *coefficient* and *demographic* effects. In the following, we compare the change in the migration rate between 1998 (the last year of the stable period) and each year thereafter. (We get similar results if we compare the migration rate in any given year before 1998 or 2001 to these later years.)

Our approach, which uses separate regression equations for each year, differs from the traditional Oaxaca-Blinder decomposition method, which typically uses a single regression (Oaxaca, 1973; Blinder, 1973; Elder, Goddeeris and Haider, 2010). We use the regression equation for each year t to calculate the fitted migration rate

$$\hat{y}_t = \hat{a}_t + \hat{b}_t \overline{X}_t,$$

where $\overline{X}_t$ is a vector of mean values of the explanatory variables over the N survey respondents in year t, and $\hat{a}_t$ and $\hat{b}_t$ are estimated intercept and coefficients of the explanatory variables.

To examine the change in the migration rate from year t to the following year, $t+1$, we subtract $\hat{y}_t = \hat{a}_t + \hat{b}_t \overline{X}_t$ from $\hat{y}_{t+1} = \hat{a}_{t+1} + \hat{b}_{t+1}\overline{X}_{t+1}$ and rearrange the terms:

$$\hat{y}_{t+1} - \hat{y}_t = \hat{a}_{t+1} - \hat{a}_t + \hat{b}_t(\overline{X}_{t+1} - \overline{X}_t) + (\hat{b}_{t+1} - \hat{b}_t)\overline{X}_{t+1}.$$

Similarly, for changes between a pair of successive years $t+n–1$ to $t+n$, we have

$$\hat{y}_{t+n} - \hat{y}_{t+n-1} = \hat{a}_{t+n} - \hat{a}_{t+n-1} + \hat{b}_{t+n-1}(\overline{X}_{t+n} - \overline{X}_{t+n-1}) + (\hat{b}_{t+n} - \hat{b}_{t+n-1})\overline{X}_{t+n}.$$

Consequently, the total change from year t to $t+n$ is

$$\hat{y}_{t+n} - \hat{y}_t = (\hat{y}_{t+1} - \hat{y}_t) + (\hat{y}_{t+2} - \hat{y}_{t+1}) + \cdots + (\hat{y}_{t+n} - \hat{y}_{t+n-1})$$

$$= \sum_{j=0}^{n-1} \left(\hat{a}_{t+j+1} - \hat{a}_{t+j} + \hat{b}_{t+j} (\overline{X}_{t+j+1} - \overline{X}_{t+j}) + (\hat{b}_{t+j+1} - \hat{b}_{t+j}) \overline{X}_{t+j+1} \right)$$

$$= \underbrace{\sum_{j=0}^{n-1} \left(\hat{a}_{t+j+1} - \hat{a}_{t+j} \right) + \sum_{j=0}^{n-1} \left(\hat{b}_{t+j+1} - \hat{b}_{t+j} \right) \overline{X}_{t+j+1}}_{Coefficient\ Effect} + \underbrace{\sum_{j=0}^{n-1} \hat{b}_{t+j} \left(\overline{X}_{t+j+1} - \overline{X}_{t+j} \right)}_{Demographic\ Effect}$$

Thus, the total change in the migration rate is the sum of the coefficient effect—which allows the coefficients to change while holding the means of the demographic variables constant—and the demographic effect—which allows the demographic means to change while holding the coefficients constant.[13]

Table 3 shows that the total change in the migration rate from 1998 to a given later year, $\hat{y}_{t+n} - \hat{y}_t$, equals the sum of the changes due to coefficients alone and due to demographics alone. The first column of Table 3 shows the decrease in the actual migration rate between 1998 and a given later year. For example, the 2009 results (the next to last row) show that the actual migration rate dropped by 33 percentage points from 1998 to 2009.

Columns 2 and 3 in Table 3 show the total change can be decomposed into the demographic and coefficient effects respectively. For example, as the 2009 row shows, from 1998 to 2009, the migration rate fell by 18.2 percentage points due to the changes in coefficients (second column) and 14.8 percentage points due to changes in the demographics. By the properties of a linear regression, the total percentage change between 1998 and 2009 equals the

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[13] An alternative decomposition is

$$\hat{y}_{t+n} - \hat{y}_t = \underbrace{\sum_{j=0}^{n-1} \left(\hat{a}_{t+j+1} - \hat{a}_{t+j} \right) + \sum_{j=0}^{n-1} \left(\hat{b}_{t+j+1} - \hat{b}_{t+j} \right) \overline{X}_{t+j}}_{Coefficient\ Effect} + \underbrace{\sum_{j=0}^{n-1} \hat{b}_{t+j+1} \left(\overline{X}_{t+j+1} - \overline{X}_{t+j} \right)}_{Demogrpahic\ Effect}$$

We do not separately report these results because they are qualitatively the same and fairly close quantitatively.

sum of these two effects: 33 = 18.2 + 14.8. For this example, 44.9% (= 14.8/33) of the total

change is attributable to changes in demographics and 55.1% to changes in coefficients.

On average across the years, a little more than one third of the drop in the migration rate

since 1998 was due to changes in the demographic composition of the work force. The remaining

roughly two-thirds of the drop in the migration rate was due to changes in coefficients, such as

from institutional, governmental, and economic shocks.

Effects of Individual Demographic Variables

We can also calculate the contribution of each demographic variable to the decline in the

migration rate from 1998 to 2009. The migration rate for the average worker in 1998 was 52.8%.

Column 1 of Table 4 shows the change in the average value of a given demographic

variable between 1998 and 2009. Column 2 shows the resulting effect of each demographic

variable on the migration rate. The contribution of kth demographic attribute is calculated as

$\sum_{j=0}^{n-1} \hat{b}_{t+j}^{k}(\bar{X}_{t+j+1}^{k} - \bar{X}_{t+j}^{k})$. If the relevant coefficient is statistically significantly different from

zero, the term in Column 2 is bold.

Changes in the shares of legal permanent residents, Hispanics, married workers, workers

living with a spouse, workers living with children, workers employed by a farm labor contractor,

and personal income were associated with particularly large changes in the probability of

migrating.

The last two rows of the first column in Table 4 show that the combined effect of all the

demographic variables caused the probability of migrating to fall by nearly 15 percentage points.

Because the total decrease in the migration rate from 1998 to 2009 is 33 percentage points, 45%

of the total is due to demographic changes, as the 2009 row in Table 3 also shows.

Based on statistically significant coefficients, our main findings are that workers who had higher income last year and who are settled in the United States—living with a spouse and children—are less likely to migrate. In contrast, married worker who are not living with their families are more likely to migrate. The drop in the share of Hispanic workers also reduced the migration rate.

Conclusions

According to the National Agricultural Workers Survey, the migration rate of hired agricultural workers within the United States was relatively constant from 1989 to 1998, but then plummeted 30 percentage points from 53% in 1998 to 23% in 2009. Explaining this drop in the migration rate is crucial because U.S. farmers in seasonal agriculture depend on the availability of short-term workers to meet their peak labor demands during planting and harvesting seasons.

To explain this drop, we estimate a migration choice model for each year from 1989 through 2009. In general, the specification of our migration equation is similar to those in the previous literature on agricultural workers migration. We find that workers who have higher incomes and who live with a spouse and children in the United States are less likely to migrate. In contrast, married workers who are not living with their families are more likely to migrate—perhaps so that they can send more money home to their families in Mexico or other countries of origin. All else the same, Hispanic workers are more likely to migrate.

Using those estimates, we decompose the drop in the migration rate into two effects. First, on average, roughly two-thirds of the decline in the migration is due to changes in the coefficients ("structural" changes), holding the demographic composition of the labor force constant. These changes reflect a variety of institutional, governmental, and economic changes in the United States and Mexico.

Second, on average, the remaining one third of the decline in the migration rate is due to a shift in the demographic composition of the U.S. hired agricultural labor force holding the structural model constant. In some years, the demographic changes were responsible for roughly half the total change.

New immigration laws and more vigorous enforcement in recent years—especially after 9/11— as well as changes to the incentives to migrate from Mexico due to international policy and economic changes presumably were largely responsible for most of the changes in the demographic composition of the workforce. These shocks reduced the influx of new migrants, who are predominantly young and single, into the agricultural labor force.

As a result, between 1998 and 2009, the agricultural workforce became older, more experienced in farm work, less likely to be employed by a farm labor contractor, and less likely to be Hispanic. Workers also were more likely to be married and living with immediate family members such as a spouse and children in the United States, and more likely to have a home or a car in the United States.

Because migrants play a crucial role in many labor-intensive, seasonal, agricultural crops, the dramatic decrease in migration rates and the total number of migrants significantly reduced the ability of agricultural labor market to respond to seasonal shifts in demand during the year. If the current downward trend of migration continues and no alternative supply (such as from a revised H-2A program or earned legalization program) becomes available, farmers will probably experience much greater difficulty finding workers during planting and harvesting seasons and may have to substantially raise wages. Indeed, according U.S. Department of Agriculture, between 1990 and 2009, the real wage of nonsupervisory hired farmworkers increased 20%.

Thus, lawmakers should pay particular attention to the adverse effect of immigration laws on agriculture.

Our results also directly address a major concern that granting legal status to unauthorized agricultural workers will reduce their willingness to migrate. We find that U.S. citizens and legal permanent residents were more likely to migrate than unauthorized workers during the 1999–2008 period. Apparently, stricter border enforcement during this period made unauthorized workers less willing to migrate within the United States because they feared such a migration would raise the odds of being caught.

Nonetheless, one-time legalization programs—such as the 1986 Immigration Reform and Control Act's Seasonal Agricultural Workers (SAWs) program—will not allow the United States to close its Mexican border and at the same time avoid a farm labor problem. Because agricultural work is physically demanding, it is difficult to remain in agriculture over one's working life. Moreover, as agricultural workers put down roots in the United States, living here with their families and amassing assets, they become less willing to migrate. The experience of seasonal agricultural workers who gained documentation under IRCA shows that, while they continued to migrate for years after they obtained legal status, eventually, they began to migrate less and leave the farm labor force. A SAW who was 22 in 1986 would be 45 in 2009. By 2009, the farm labor force had few SAWS (and few farmworkers over age 45). Thus, to maintain a large and flexible agricultural worker force, a steady stream of new, young workers is required— whether it be from a porous border, temporary work permits, or a perpetual program of earned legalization through farm work.

References

Angelucci, M., O. Attanasio, and V. Di Maro. 2012. "The impact of oportunidades on consumption, savings and transfers." *Fiscal Studies* 33(3):305-334.

Barkley, A.P. 1990. "The determinants of the migration of labor out of agriculture in the united states, 1940–85." *American Journal of Agricultural Economics* 72(3):567-573.

Blanchard, O.J., L.F. Katz, R.E. Hall, and B. Eichengreen. 1992. "Regional evolutions." *Brookings Papers on Economic Activity* 1992(1):1-75.

Blinder, A.S. 1973. "Wage discrimination: Reduced form and structural estimates." *The Journal of Human Resources* 8(4):436-455.

Boucher, S.R., A. Smith, J.E. Taylor, and A. Yúnez-Naude. 2007. "Impacts of policy reforms on the supply of mexican labor to U.S. Farms: New evidence from Mexico." *Applied Economic Perspectives and Policy* 29(1):4-16.

Cornelius, W.A. 2001. "Death at the border: Efficacy and unintended consequences of us immigration control policy." *Population and Development Review* 27(4):661-685.

Dennis, B.N., and T.B. İşcan. 2007. "Productivity growth and agricultural out-migration in the united states." *Structural Change and Economic Dynamics* 18(1):52-74.

Elder, T.E., J.H. Goddeeris, and S.J. Haider. 2010. "Unexplained gaps and oaxaca–blinder decompositions." *Labour Economics* 17(1):284-290.

Emerson, R.D. 1989. "Migratory labor and agriculture." *American Journal of Agricultural Economics* 71(3):617-629.

Gabbard, S.M., R. Mines, and J.M. Perloff (1991) A comparison of the CPS and NAWS surveys of agricultural workers. University of California, Berkeley.

Gathmann, C. 2008. "Effects of enforcement on illegal markets: Evidence from migrant

    smuggling along the southwestern border." *Journal of Public Economics* 92(10–

    11):1926-1941.

Hertz, T., and S. Zahniser. 2013. "Is there a farm labor shortage?" *American Journal of*

    Agricultural Economics 95(2):476-481.

Kostandini, G., E. Mykerezi, and C. Escalante. 2014. "The impact of immigration enforcement

    on the U.S. Farming sector." *American Journal of Agricultural Economics* 96(1):172-192.

Martin, P. 2011. "Farm exports and farm labor: Would a raise for fruit and vegetable workers

    diminish the competitiveness of U.S. agriculture." Economic Policy Institute.

Martin, P. 2013. "Immigration and farm labor: Policy options and consequences." *American*

    Journal of Agricultural Economics 95(2):470-475.

Martin, P., and L. Calvin. 2010. "Immigration reform: What does it mean for agriculture and

    rural America?" *Applied Economic Perspectives and Policy* 32(2):232-253.

Oaxaca, R. 1973. "Male-female wage differentials in urban labor markets." *International*

    Economic Review 14(3):693-709.

Partridge, M.D., and D.S. Rickman. 2006. "An svar model of fluctuations in us migration flows

    and state labor market dynamics." *Southern Economic Journal* 72(4):958-980.

Perloff, J.M. 1991. "The impact of wage differentials on choosing to work in agriculture."

    American Journal of Agricultural Economics 73(3):671-680.

Perloff, J.M., L. Lynch, and S.M. Gabbard. 1998. "Migration of seasonal agricultural workers."

    American Journal of Agricultural Economics 80(1):154-164.

Stark, O., and J.E. Taylor. 1989. "Relative deprivation and international migration."

    Demography 26(1):1-14.

Stark, O., and J.E. Taylor. 1991. "Migration incentives, migration types: The role of relative deprivation." *The Economic Journal* 101(408):1163-1178.

Taylor, J.E. 1987. "Undocumented Mexico-US migration and the returns to households in rural Mexico." *American Journal of Agricultural Economics* 69(3):626-638.

Taylor, J.E. 1992. "Earnings and mobility of legal and illegal immigrant workers in agriculture." *American Journal of Agricultural Economics* 74(4):889-896.

Taylor, J.E., D. Charlton, and A. Yúnez-Naude. 2012. "The end of farm labor abundance." *Applied Economic Perspectives and Policy* 34(4):587-598.

Todd, J.E., P.C. Winters, and T. Hertz. 2009. "Conditional cash transfers and agricultural production: Lessons from the oportunidades experience in Mexico." *The Journal of Development Studies* 46(1):39-67.

Table 1. Summary Statistics: Mean (Standard Deviation)

	Full (1)	Migrants (2)	Non-migrants (3)	Stable Period (1989-1998) Full (4)	Migrants (5)	Non-migrants (6)	Declining Period (1999-2009) Full (7)	Migrants (8)	Non-migrants (9)
Continuous Variable:									
Age	34.47	32.78	35.54	32.85	31.63	34.13	35.92	34.68	36.39
	(12.22)	(11.74)	(12.39)	(11.79)	(11.25)	(12.21)	(12.41)	(12.27)	(12.43)
Years of Education	7.17	6.38	7.66	6.72	6.19	7.28	7.56	6.68	7.89
	(3.84)	(3.54)	(3.94)	(3.8)	(3.5)	(4)	(3.84)	(3.59)	(3.88)
Income, Last Year (1000's)[a]	14.71	11.26	16.87	11.92	10.11	13.79	17.19	13.16	18.73
	(9.83)	(7.65)	(10.41)	(8.62)	(7.03)	(9.67)	(10.16)	(8.24)	(10.4)
Years of Farm Experience	10.66	9.00	11.70	9.27	8.25	10.33	11.90	10.22	12.53
	(9.4)	(8.36)	(9.87)	(8.4)	(7.77)	(8.88)	(10.06)	(9.11)	(10.32)
Binary Variable:									
Migrant	0.39			0.51			0.28		
Female	0.23	0.14	0.28	0.21	0.13	0.30	0.24	0.15	0.27
Hispanic	0.84	0.96	0.76	0.86	0.96	0.77	0.81	0.95	0.76
African American	0.03	0.01	0.04	0.02	0.01	0.03	0.04	0.02	0.04
Native American	0.06	0.07	0.05	0.04	0.04	0.03	0.07	0.11	0.06
Legal Permanent Resident	0.28	0.28	0.28	0.29	0.26	0.33	0.27	0.33	0.25
Other Authorized Worker	0.07	0.11	0.05	0.14	0.17	0.10	0.01	0.01	0.01
Unauthorized Worker	0.40	0.49	0.34	0.36	0.46	0.25	0.44	0.55	0.40
English Speaker	0.32	0.19	0.40	0.30	0.19	0.42	0.34	0.20	0.39
Married	0.61	0.60	0.62	0.60	0.59	0.61	0.62	0.62	0.62
Spouse in Household	0.43	0.25	0.54	0.37	0.24	0.51	0.48	0.27	0.56
Children in Household	0.38	0.22	0.48	0.35	0.22	0.48	0.41	0.21	0.48
Own or Buying a U.S. House	0.18	0.09	0.24	0.14	0.07	0.21	0.22	0.11	0.26
Own or Buying a U.S. Car/Truck	0.54	0.38	0.64	0.46	0.34	0.58	0.60	0.43	0.67

Skilled Worker	0.23	0.19	0.25	0.24	0.21	0.27	0.21	0.16	0.23
Employed by a Farm Labor Contractor	0.19	0.25	0.16	0.21	0.26	0.16	0.18	0.23	0.16
Number of Observations	37,075	12,509	24,566	14,811	6,907	7,904	22,264	5,602	16,662

These summary statistics are calculated using sampling weight for data from the National Agricultural Workers Surveys (NAWS) for 1989–2009, where observations with missing variables were dropped.
[a] NAWS income information is categorical: it equals 1 if income < $500, 2 if $500 < income < $999, and so forth. We set income equal to the midpoint of the relevant interval.

Table 2. Linear probability migration model

	1989 (1)	1998 (2)	2009 (3)
Female	-0.201**	-0.149**	-0.112**
	(0.053)	(0.034)	(0.021)
Age	0.000	-0.002	0.001
	(0.002)	(0.001)	(0.001)
Hispanic	0.074	0.149**	0.142**
	(0.108)	(0.046)	(0.036)
African American	-0.257	-0.092	-0.073*
	(0.207)	(0.060)	(0.034)
American Indian	0.150	-0.004	0.038
	(0.133)	(0.043)	(0.043)
Legal Permanent Resident	0.100	0.137**	-0.026
	(0.086)	(0.041)	(0.035)
Other Authorized Worker	0.051	0.049	-0.120*
	(0.085)	(0.083)	(0.058)
Unauthorized Worker	-0.028	0.055	-0.118**
	(0.090)	(0.045)	(0.036)
Education (Years)	0.010	-0.002	0.010**
	(0.006)	(0.004)	(0.003)
English Speaker	-0.083	-0.065	-0.088**
	(0.062)	(0.037)	(0.025)
Married	0.113*	0.188**	0.157**
	(0.056)	(0.030)	(0.031)
Spouse in Household	-0.132*	-0.286**	-0.198**
	(0.059)	(0.041)	(0.033)
Children in Household	-0.119*	-0.111**	-0.043*
	(0.057)	(0.036)	(0.020)
Have or Buying a U.S. House	0.107	-0.026	-0.021
	(0.114)	(0.036)	(0.021)
Have or Buying a U.S. Car/Truck	-0.010	-0.045	-0.052**
	(0.048)	(0.028)	(0.020)
Personal Income Last Year (Log)	-0.127**	-0.085**	-0.105**
	(0.026)	(0.015)	(0.019)
Farm Experience (Years)	-0.005	0.001	0.000
	(0.004)	(0.002)	(0.001)
Skilled Worker	-0.014	-0.068**	-0.023
	(0.053)	(0.026)	(0.018)
Employed by a Farm Labor Contractor	0.227**	0.148**	0.015
	(0.052)	(0.027)	(0.030)
Constant	1.588**	1.229**	1.158**
	(0.288)	(0.152)	(0.188)
Number of Observations	474	1,473	1,765

R^2	0.243	0.278	0.139

The dependent variable equals one if the worker migrated and zero otherwise.
Heteroskedastic-consistent standard errors are reported in the parentheses.
* indicates statistical significance at the 5% level.
** indicates statistical significance at the 1% level.

Table 3. Decomposition of demographic and structural contributions: 1998 vs. post-1998 years

	$\hat{y}_{t+n} - \hat{y}_{1998}$ (1)	Coefficient Effect (2)	Demographic Effect (3)	Contribution of Demographic Effect (4)
1999	-0.135	-0.112	-0.023	16.9%
2000	-0.133	-0.098	-0.036	26.8%
2001	-0.192	-0.125	-0.067	35.1%
2002	-0.268	-0.182	-0.086	32.1%
2003	-0.237	-0.149	-0.088	37.0%
2004	-0.292	-0.164	-0.128	43.8%
2005	-0.296	-0.174	-0.123	41.4%
2006	-0.352	-0.209	-0.142	40.5%
2007	-0.365	-0.227	-0.138	37.7%
2008	-0.359	-0.209	-0.150	41.7%
2009	-0.330	-0.182	-0.148	44.9%

Forecasting equation: $\hat{y}_t = \hat{a}_t + \hat{b}_t \overline{X}_t$

Decomposition:

$$\hat{y}_{t+n} - \hat{y}_t = \sum_{j=0}^{n-1} \left(\hat{a}_{t+j+1} - \hat{a}_{t+j} + \hat{b}_{t+j}\left(\overline{X}_{t+j+1} - \overline{X}_{t+j}\right) + \left(\hat{b}_{t+j+1} - \hat{b}_{t+j}\right)\overline{X}_{t+j+1} \right)$$

$$= \underbrace{\sum_{j=0}^{n-1} \left(\hat{a}_{t+j+1} - \hat{a}_{t+j}\right) + \left(\hat{b}_{t+j+1} - \hat{b}_{t+j}\right)\overline{X}_{t+j+1}}_{Coefficient\ Effect} + \underbrace{\sum_{j=0}^{n-1} \hat{b}_{t+j}\left(\overline{X}_{t+j+1} - \overline{X}_{t+j}\right)}_{Demographic\ Effect}$$

Table 4. Contribution of individual demographic variable: 1998 vs. 2009

|	Change in Characteristic (%), 1998 to 2009	Migration Effect
	(1)	(2)
Female	4.9%	**-0.001**
Age	11.2%	-0.001
Hispanic	-7.2%	**-0.014**
African American	55.4%	-0.0003
American Indian	-41.1%	0.002
Legal Permanent Resident	-43.0%	**-0.010**
Other Authorized Worker	4.3%	0.0005
Unauthorized Worker	21.8%	0.005
Education (Years)	17.1%	-0.002
English Speaker	33.8%	0.003
Married	8.0%	**0.011**
Spouse in Household	40.7%	**-0.047**
Children in Household	36.5%	**-0.010**
Have or Buying a U.S. House	54.1%	-0.002
Have or Buying a U.S. Car/Truck	19.3%	-0.004
Personal Income Last Year (Log)	6.6%	**-0.068**
Farm Experience (Years)	38.0%	-0.0005
Skilled Worker	11.5%	**0.0001**
Employed by Farm Labor Contractor	-50.8%	**-0.010**
Sum, All Significant Variables		-0.149
Sum, All Variables		-0.148

Calculations based on statistically significant coefficients are in bold.

The contribution of the k_{th} demographic variable is $\sum_{j=0}^{n-1} \hat{b}_{t+j}^{k} \left(\bar{X}_{t+j+1}^{k} - \bar{X}_{t+j}^{k} \right)$.
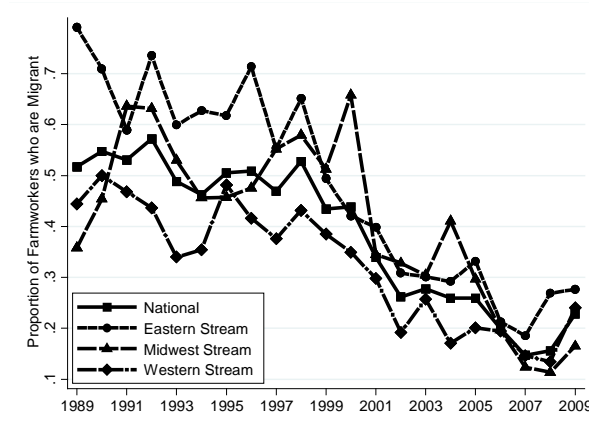
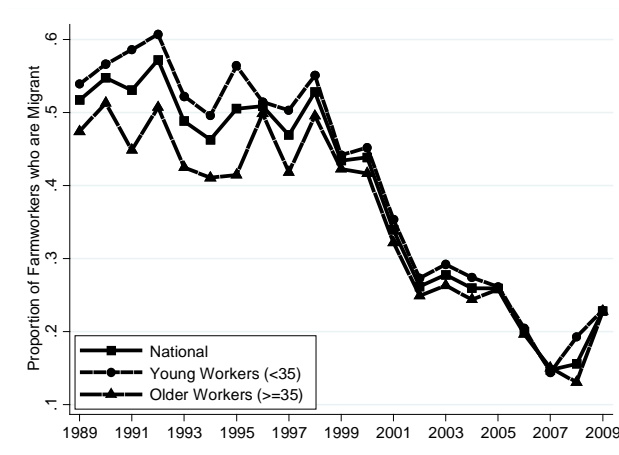**Figure 1. Migration Rate over Time**
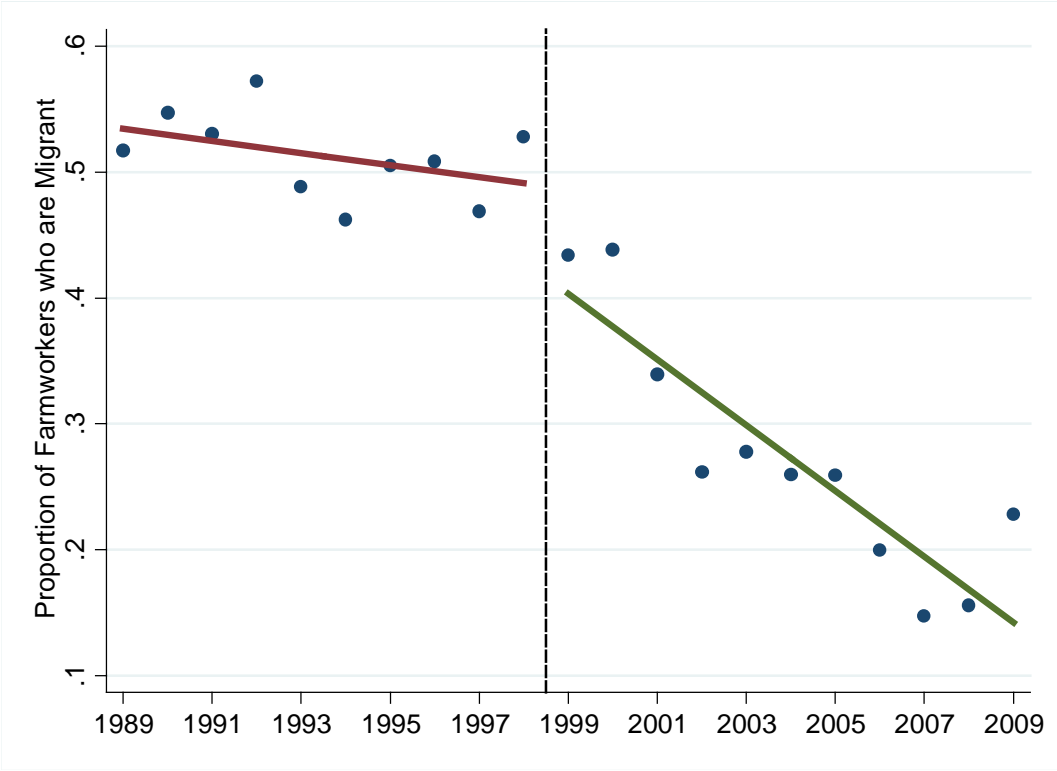
Figure 2. Actual Weighted Proportion of Migrants, by Legal Status, Geography, and Age
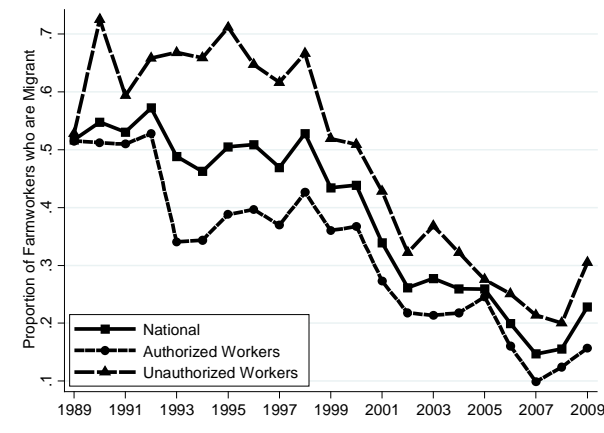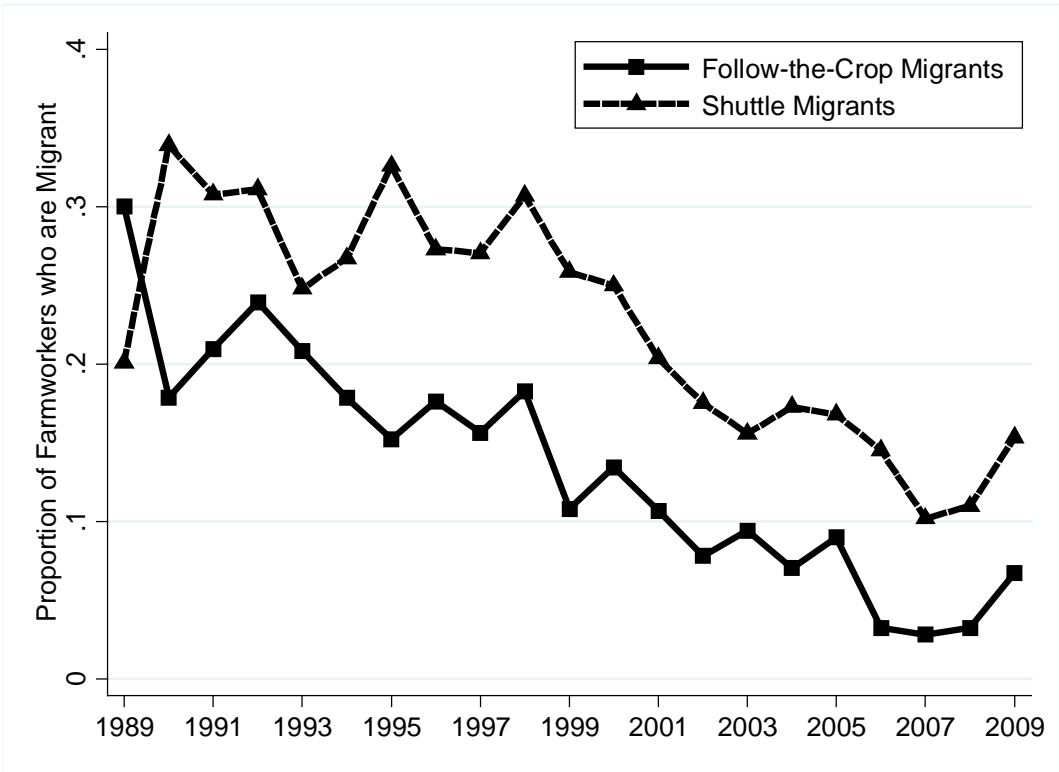

(A) Migrants by Legal Status

(B) Migrants by Migrant Stream

(C) Migrants by Age Group

Figure 3. Composition of the Migrant Definition

Appendix

Table A1. Logit migration model for 1998

	Coefficients	Marginal Effects
	(1)	(2)
Female	-0.845**	-0.204**
	(0.192)	(0.043)
Age	-0.011	-0.003
	(0.008)	(0.002)
Hispanic	1.338**	0.300**
	(0.353)	(0.063)
African American	-0.310	-0.077
	(0.395)	(0.096)
American Indian	-0.065	-0.016
	(0.230)	(0.058)
Legal Permanent Resident	0.833**	0.205**
	(0.232)	(0.055)
Other Authorized Worker	0.357	0.089
	(0.486)	(0.118)
Unauthorized Worker	0.288	0.072
	(0.246)	(0.061)
Education (Years)	-0.014	-0.004
	(0.022)	(0.006)
English Speaker	-0.309	-0.077
	(0.192)	(0.047)
Married	0.931**	0.228**
	(0.178)	(0.042)
Spouse in Household	-1.442**	-0.342**
	(0.226)	(0.049)
Children in Household	-0.528**	-0.131**
	(0.197)	(0.048)
Have or Buying a U.S. House	-0.235	-0.059
	(0.218)	(0.054)
Have or Buying a U.S. Car/Truck	-0.190	-0.047
	(0.142)	(0.035)
Personal Income Last Year (Log)	-0.519**	-0.130**
	(0.096)	(0.024)
Farm Experience (Years)	0.008	0.002
	(0.011)	(0.003)
Skilled Worker	-0.311*	-0.077*
	(0.141)	(0.035)
Employed by a Farm Labor Contractor	0.770**	0.189**
	(0.152)	(0.036)
Constant	3.876**	
	(0.944)	

Number of Observations	1,473	1,473

The dependent variable equals one if the worker migrated and zero otherwise.
* indicates statistical significance at the 5% level.
** indicates statistical significance at the 1% level.