



# A Declining Farm Workforce: Analysis of Panel Data from Rural Mexico

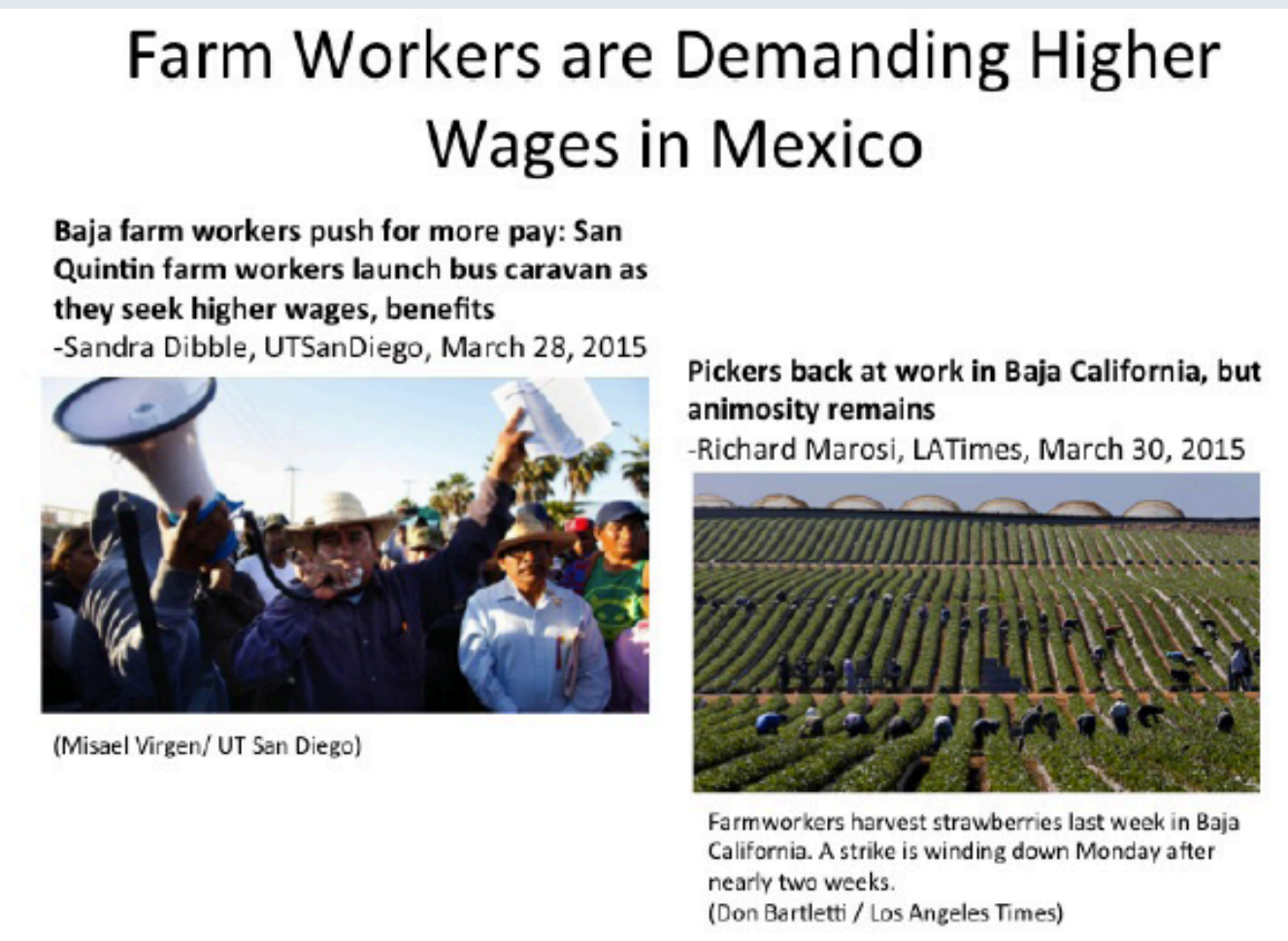
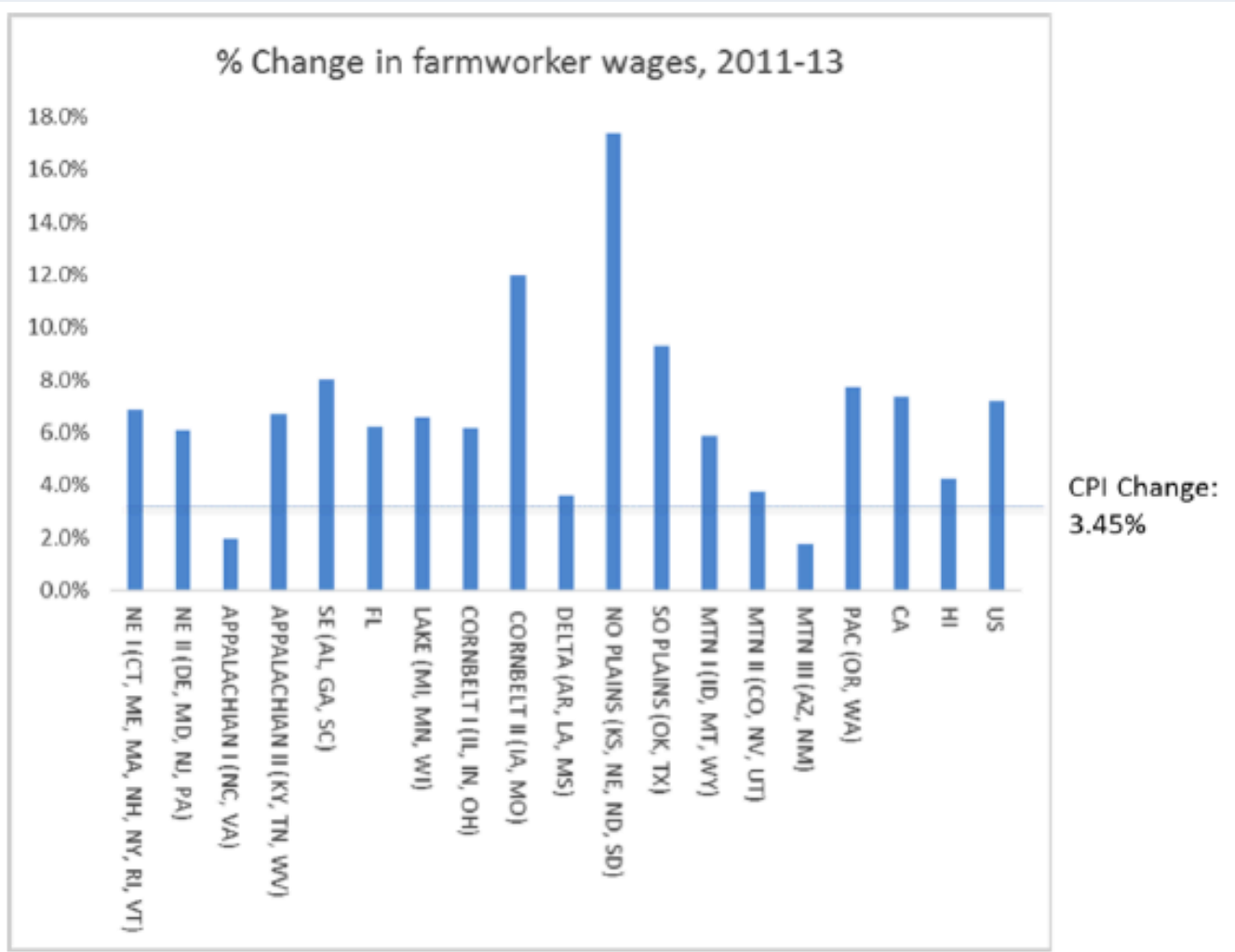
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## Background

- Rural Mexico is the primary source of hired labor for U.S. farms.
- Worldwide, as countries' per capita incomes rise, domestic workers shift out of agriculture in what is called the "agricultural transformation".
- Many potential factors explain this, including
  - Expanding education
  - Non-farm employment growth
  - Decreasing birth rates
- As Americans moved out of hired farm work in the 20<sup>th</sup> Century, rural Mexico filled the gap with an elastic supply of labor to U.S. farms
  - Enabling labor-intensive fruit, vegetable, and horticultural (FVH) production to expand (Martin, 2003)
  - Discouraging labor-saving technological change
  - Creating challenges to farm labor organizing
  - Contributing to the transmission of poverty from rural Mexico to rural America (Martin, Fix and Taylor, 2006; Martin and Taylor, 1998)
- Farm wages are rising in the U.S. and farm workers are demanding higher wages in Mexico, which leads to the questions: "Are rural Mexicans transitioning out of agriculture? And if so, what are the key causal factors?"

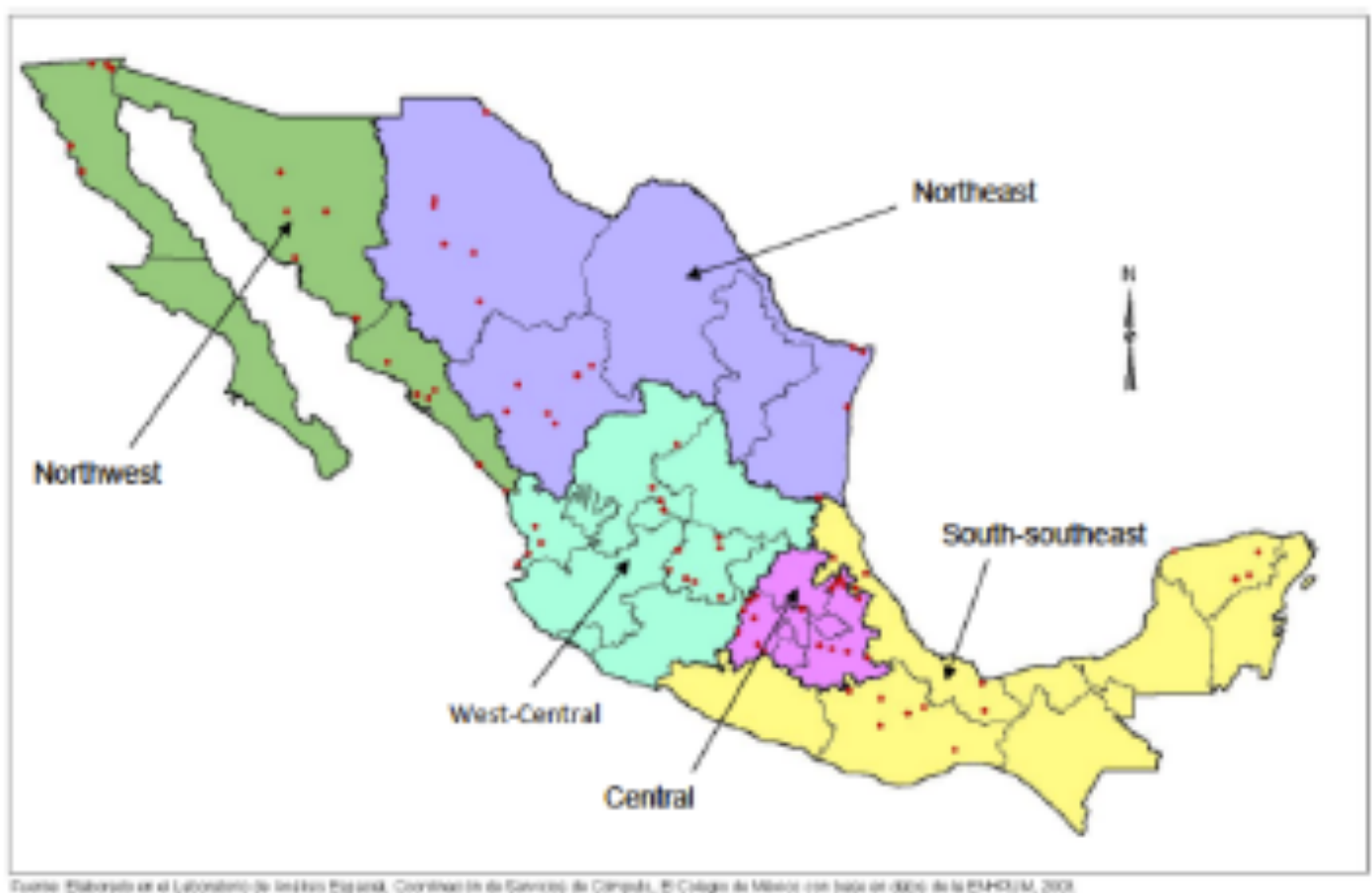


## Objectives

- We test whether there is a negative trend in the farm labor supply from rural Mexico using nationally representative household survey data, and we "unpack" the trend to identify factors explaining this agricultural transformation.
- We use unique 31-year panel data.
- We investigate how the agricultural transformation unfolds in a less-developed country linked with labor markets in a more developed country.
  - An inward shift in the farm labor supply from rural Mexico implies that U.S. and Mexican farmers must compete for workers at increasing wages.
  - A U.S. guest-worker program will not solve the U.S. farm labor shortage if migrants seek non-farm work in the U.S. or find better opportunities in Mexico.

## Data

- The UCD-COLMEX Mexico National Rural Household Survey (Spanish acronym ENHRUM)
  - 31 years of panel data (1980-2010)
  - 80 communities
  - Labor allocations of 9,837 rural Mexicans
  - 154,766 person-year observations
- Summary statistics show that the percentage of working-age individuals working in agriculture decreased by 23.8 percentage points between 1980 and 2010 while expected education rose for younger generations.



Sector of Work in 1980 and 2010					Years of Completed Schooling by Age in 2010					
Year	Sector	Percentage	sd	Obs	Age	Mean	sd	Min	Max	Obs
1980	Agriculture	46.5	49.9	2,230	20-29	8.94	3.42	0	17	1,320
	Non-agriculture	22.0	41.4		30-39	7.74	3.67	0	21	1,314
2010	Agriculture	22.7	41.9	5,215	40-49	6.58	3.96	0	18	996
	Non-agriculture	36.2	48.1		50-59	5.04	3.65	0	19	614

## Empirical Model

- Let  $Y_{i,t}$  equal 100 if individual  $i$  works in agriculture in year  $t$  and 0 otherwise.
- Regress  $Y_{i,t}$  on its lags and a yearly time trend. The lags control for persistence in an individual's labor choice decision from one year to the next. (Only the first 2 lags are significant.)

$$Y_{i,t} = \beta_0 + \beta_1 t + \gamma_1 Y_{i,t-1} + \gamma_2 Y_{i,t-2} + \epsilon_{i,t}$$

- Since individual work decisions are likely correlated across years,  $\epsilon_{i,t}$  is not independently and identically distributed.

$$\epsilon_{i,t} = \alpha_i + u_{i,t}$$

- $\alpha_i$  is correlated across years, but including individual FE in dynamic models leads to biased coefficient estimates (Nickell, 1981).
- Since the objective of this analysis is to identify the time trend, which is not correlated with  $\alpha_i$  by definition, OLS estimation gives consistent estimates of a linear trend.
- We additionally control for individual, household, and regional characteristics, denoted  $X_{i,t}$ , which include regional fixed effects, age, gender, education, and household size.
- Let  $Z_{i,t}$  be a vector of trending variables, including the ratio of Mexican industrial to agricultural GDP, intensity of U.S.-Mexico border patrol, real U.S. farm wages, and the number of reported homicides in the home municipality. We regress on both the lagged level effects  $Z_{i,t-1}$  and differences  $\Delta Z_{i,t}$ . This controls for short-term shocks, so that we can find long-term impacts without picking up correlations from cointegration.

$$Y_{i,t} = \beta_0 + \beta_1 t + \beta_2 X_{i,t} + \delta_1 Z_{i,t-1} + \delta_2 \Delta Z_{i,t} + \gamma_1 Y_{i,t-1} + \gamma_2 Y_{i,t-2} + \epsilon_{i,t}$$

- From this equation, we calculate the long-run impacts as follows:
  - Residual trend  $\frac{\beta_1}{1-\gamma_1-\gamma_2}$
  - Non-trending variables  $\frac{\beta_2}{1-\gamma_1-\gamma_2}$
  - And trending variables  $\frac{\delta_1}{1-\gamma_1-\gamma_2}$

## Findings

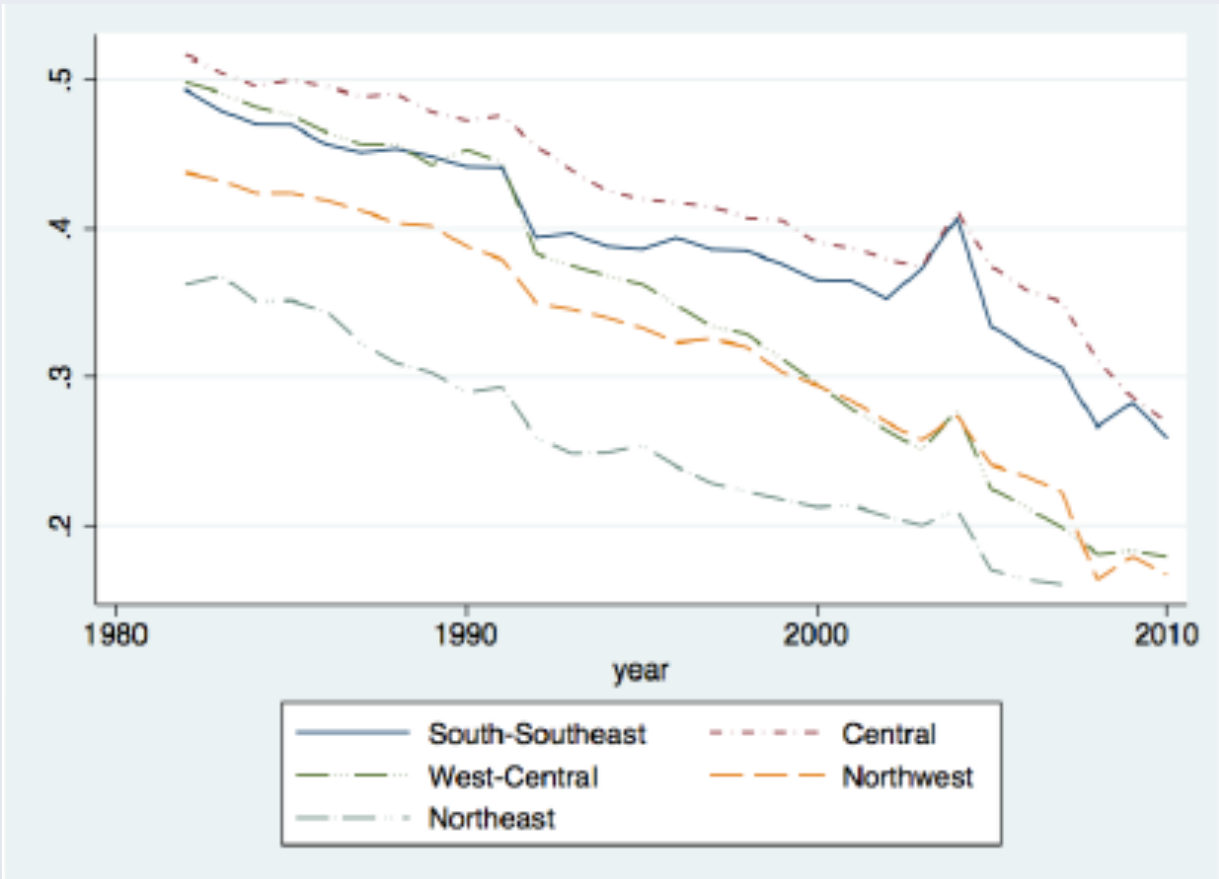
### Identifying the Trend (1982-2010)

- The probability of working in agriculture is decreasing by 0.97 percentage points each year on average.
- Scaling by the working-age population of rural Mexico in 2010, this implies a decrease in the farm labor supply by over 150 thousand people each year.
- The trend is negative and significant in all census regions.

Percentage Probability of Working in Agriculture, Adjusted Long Run Effects			
VARIABLES	(1) Baseline national trend	(2) Control for age	(3) Regional trends
t	-0.900 (0.081)***	-0.971 (0.080)***	
age in year t		0.507 (0.049)***	0.520 (0.048)***
Central region			5.843 (5.023)
West-Central region			-3.579 (4.858)
Northwest region			-4.845 (5.018)
Northeast region			-20.134 (5.317)***
South-Southeast regional trend			-0.726 (0.165)***
Central regional trend			-1.095 (0.176)***
West-Central regional trend			-1.279 (0.154)***
Northwest regional trend			-1.287 (0.179)***
Northeast regional trend			-0.676 (0.206)***
Observations	134,997	134,997	134,997
R-squared	0.834	0.834	0.834

Note: Robust standard errors in parentheses, clustered at the individual level  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

### Predicted Probability of Working in Agriculture by Region



### Unpacking the Trend (1991-2010)

Key factors driving the downward trend:

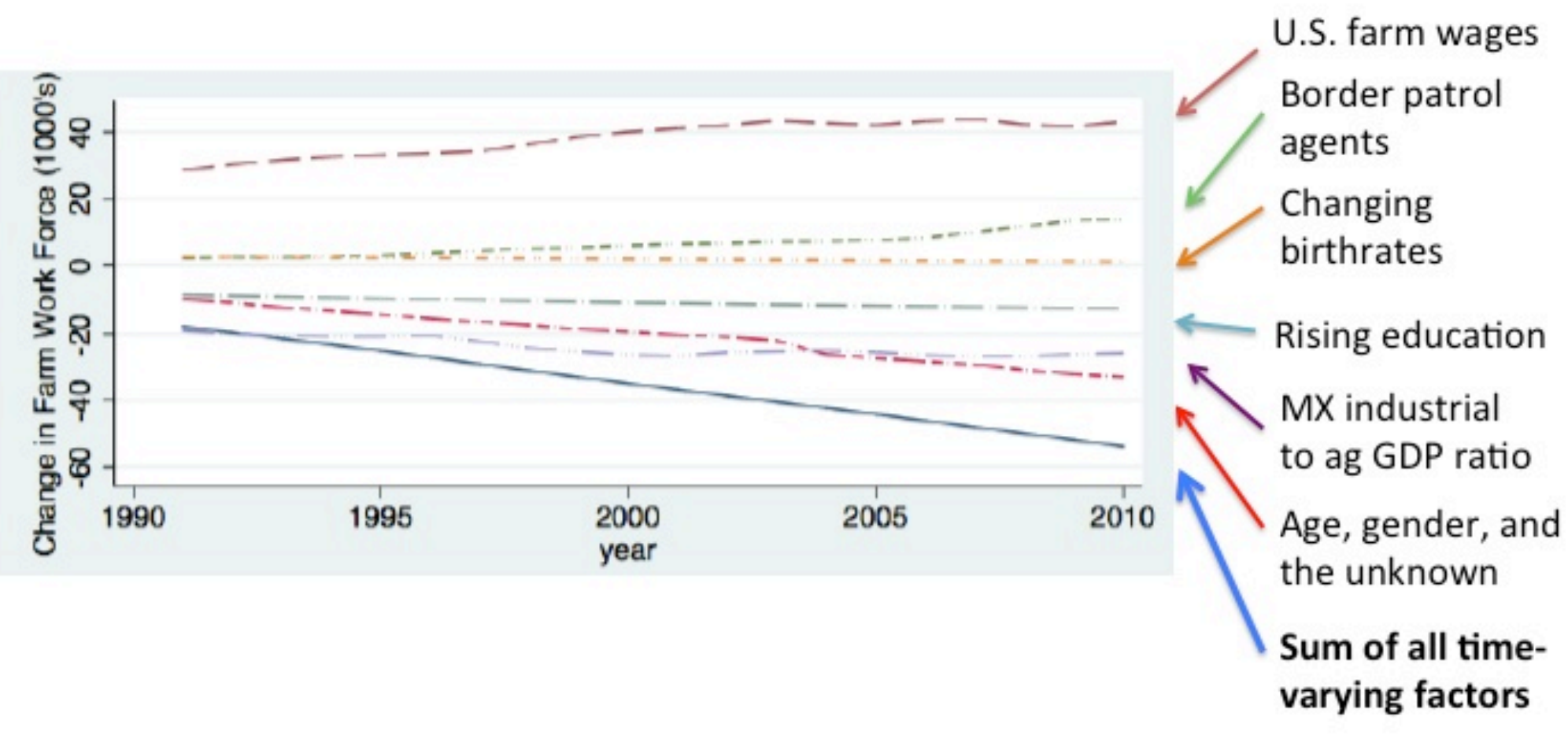
- Rising non-farm employment in Mexico
- Expanding rural education
- Decreasing birthrates

Percentage Probability of Working in Agriculture, Adjusted Long Run Effects			
VARIABLES	(1) No FE	(2) Village FE	(3) Household FE
t	-5.492 (1.114)***	-5.157 (1.021)***	-4.351 (0.823)***
age in year t	0.259 (0.056)***	0.272 (0.052)***	0.364 (0.052)***
female	-23.663 (1.179)***	-24.432 (1.083)***	-25.190 (0.913)***
MX industrial:ag GDP	-16.510 (4.260)***	-14.865 (3.925)***	-12.282 (3.210)***
ratio children:adults in hh	8.294 (1.058)***	7.630 (1.003)***	2.617 (1.319)**
years of education	-1.303 (0.150)***	-1.194 (0.153)***	-0.976 (0.165)***
border patrol	4.166 (0.743)***	3.756 (0.686)***	2.803 (0.553)***
US farm wage	22.033 (6.518)***	21.286 (6.005)***	17.485 (4.882)***
homicides (1000s)	-141.506 (11.633)***	19.802 (39.385)	22.843 (32.327)
Observations	80,623	80,623	80,623
R-squared	0.820	0.821	0.826

Note: Robust standard errors in parentheses, clustered at the individual level  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Predicted Impacts on the Farm Labor Supply

- The dashed lines represent the predicted change in farm labor supply attributable to each variable after controlling for household fixed effects.
- Rising U.S. farm wages and border patrol mitigate the downward slope of the trend, though their effect is quantitatively small.
- The solid blue line is the national trend, the sum of all factors that impact the farm labor supply, and it is quickly declining.



## Conclusions

- Rural Mexicans' probability of working in agriculture—whether in Mexico or the United States—declined by 0.97 percentage points annually between 1982 and 2010.
  - Increased education pushes workers out of agriculture.
  - Industrial growth in Mexico pulls workers out of agriculture.
  - U.S. farm wages and tighter border enforcement retain some workers in agriculture, but not enough to reverse the trend.
  - The residual trend remains significant and negative after controlling for all of these factors.
- This implies a decrease of over 150 thousand workers in the farm labor supply each year, after scaling by the size of the rural Mexican labor force in 2010 (16 million people).
- Mexico and the United States compete for this diminishing supply of farm workers.
- As the Mexican workforce shifts out of agriculture, immigration policy ceases to be a solution for the U.S. farm labor problem.
- U.S. farmers will have to switch to less labor-intensive crops, seek workers from other countries, or invest in labor-saving technologies.
  - The first two options appear less viable at the national level.
  - Greater mechanization in agriculture will raise the marginal productivity of workers and leads to higher wages.
  - This will likely benefit farm workers and the rural communities where farm workers live.

## References

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