Mexican Migrant Labor and Southern Plains Labor: Compatible or Exclusive

Syed H. Jafri[1], Edward Osei[2], Seth Gaston[3], and Huang Ningyang[4]

[1]Professor, Economics, Tarleton State University, jafri@tarleton.edu
[2]Associate professor and senior research economist, Texas Institute for Applied Environmental Research, Tarleton State University, osei@tiaer.tarleton.edu
[3]Senior, Economics, Tarleton State University, seth.gaston@go.tarleton.edu
[4]Professor, Economics, Huazhong Agricultural University, hny0519@gmail.com

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A. Introduction

In 2008, there were 11.4 million Mexican immigrants in the United States, accounting for 30.1 percent of all US immigrants and 10 percent of the Mexican population. Over half of all Mexican immigrants reside in the United States illegally, of which the number is increased 42 percent between 2000 and 2009, rising from 4.7 million to 6.7 million since 2000. The Mexican-born share of all unauthorized immigrants rose from 55 percent in 2000 to 62 percent in 2009. The Office of Immigration Statistics (OIS) estimates that the unauthorized immigrant population from Mexico increased on average by about 220,000 people per year between 2000 and 2009. Over three-quarters of Mexican immigrants in 2008 were adults of working age. More than half of Mexican foreign-born adults did not have a high school education. Almost 40 percent of employed Mexican-born men work in construction, extraction, and transportation (Michefer and Baker, 2010).

With the increasing of immigration population, some questions are asked. Are Mexican migrant workers substituting for the job opportunities of the U.S. workforce or not? Does the increase of Mexican migrant workers obviously aggravate domestic unemployment? In order to give answers to these questions, our study has evolved over time; initially, we approached addressing these questions using a heterogeneous productive factors model and had concentrated primarily in the Southern Plains region of Texas & Oklahoma. However, the model was limited in testing for statistical significance of the results besides being too narrow in scope for any generalizations on a larger scale. Subsequently, we expanded the scope of the study to include other border states (Arizona, California and New Mexico) and

using a national database (National Agricultural Workers Survey) applied the translog model to calculate elasticities and were able to test for statistical significance.

B. Rationale and Significance

The issue of undocumented immigration encompasses social, political, and, obviously, national and economic factors. Politically and socially, there is often a great void of reliable, unbiased information, which can help spur on erroneous beliefs in people of varying political affiliations and cause the problem to continue. The end of the Bracero Program in 1964 made legal entry to the U.S. significantly more difficult for workers from Mexico; it is unsurprising that illegal immigration has seen a significant rise and has been a more prevalent issue ever since. The pull factors for undocumented immigrants have always been tremendous; the increase in wages alone for immigrants from Mexico is often enough to cause workers to risk taking jobs in the U.S. without authorization. While it is not difficult to understand the reasons for undocumented immigration to the U.S., it is clear that discussion surrounding the issue is often polluted by a lack of reliable, empirical information. This study seeks to provide that information, to help further the conversation toward more suitable social and political climates, and to attempt to answer the glaring economic question that is the focus of this research.

C. Research Objectives

The overarching goal of the proposed study is to determine the implications of Mexican migrant labor in the U.S. workforce on the nature and kinds of employment opportunities for American citizens. To this end, we will pursue the following specific objectives. (1) Determine the relationship between Mexican immigrant labor and the domestic workforce by

estimating the heterogeneous factors model, and (2) Use the translog model to estimate the elasticities of substitution for documented and undocumented workers. Based on these results, we will analyze whether the relationship between undocumented Mexican immigrant workers and domestic workers is compatible or exclusive.

D. Literature Review

Research shows that Mexican workers are integral to U.S. economic growth. The portion of Mexican workers in the U.S. workforce has doubled during the past decade, as they become more integral to the nation's economic growth. The supply of Mexican workers has been critical to the expansion of U.S. industry in the last decade. In the 1990s alone, the number of Mexican immigrant workers in the U.S. grew by 2.9 million persons. Gordon H. Hanson found that 31% of all undocumented immigrants in the U.S. came from Mexico (2006). Nearly 43 percent of all job openings by 2010 required only a minimal education. The owners and managers of factories, restaurants, hotels, and construction sites, hospitals, orchards, and innumerable other places of employment have been clear about their need for continued access to immigrant workers, a large portion of whom come from Mexico (Donahue, 2001). As citizens of a developing nation, many Mexican immigrants may have relatively low levels of formal education, but they have the necessary skills that are compatible with numerous jobs being created in the U.S. (Suro and Singer, 2002). Hanson continues to assert the conclusion that undocumented workers are necessary and beneficial in later research (2009).

While the trend, especially in recent years, has been for undocumented workers to shift out of the agricultural field, their presence is still felt strongly in this sector. The Pew

Hispanic Center estimates that 25% of all agricultural employees are undocumented. The undocumented male population also tends to be more fully employed than the native or documented immigrant population. Undocumented males have an employment rate around 94%, compared to documented and native males with employment rates of 85% and 83%, respectively. Undocumented women tend to be employed at a rate around 58%, as compared to 66% and 73% of documented immigrant and U.S.-born women, respectively (Passel and D'Vera, 2009). While undocumented women have lower employment rates than native and documented women, the Pew Hispanic Center notes that the number of undocumented men and women is split roughly half and half. So it is logical to assume that overall, due to the much higher percentage of male undocumented workers being hired, undocumented immigrants enjoy a higher employment rate than documented or native residents. They are being more fully employed in the fields in which they are able to find work. These figures, when taken into account along with previously discussed research, continue to support the notion that undocumented workers in agriculture (and other industries in which they find work) cannot always be taking jobs from native workers; they are present in these fields in too large a volume and are employed too completely for there to exist a genuine desire by native workers to attain the jobs worked by the undocumented population, at least under normal conditions.

In terms of wages and the labor market, it is economically feasible that if enough undocumented workers entered the nation, and were willing to accept substantially lower wages than the native workforce, the wage rates of the sectors in which they found work could be driven down – enough so that native workers might reduce the amount of time they

worked, or even leave the labor force altogether. The main issue is that it is very difficult to accurately track the effects the undocumented population has on a nation or region's wage and employment rates, generally due to the movement of goods or people (Friedberg and Hunt, 1995). This difficulty alone will make many uneasy. If it is nearly impossible to track the effects of the undocumented population on the nation, many may feel that they are doing considerable harm, unbeknownst to the native population. While this is not the general attitude of Friedberg and Hunt's research, the issues are still mentioned, and warrant discussion.

It is also noteworthy that the undocumented population may contribute, though indirectly, to a wedge that is being driven between the interest of the employers and the employees. The issue is explained by elementary economic theory. Naturally, employers want to keep expenses low. Since undocumented workers earn substantially lower wages than their documented or native counterparts, employers will be more inclined to hire them; native workers will want this external competition removed (Gerking and Mutti, 1980). The issue Gerking and Mutti bring to light here is that the undocumented population may be legitimately causing a social rift which cannot and will not be easily resolved. Both the employer and the employee must be attended to; however, the presence of the undocumented population may be creating tremendous social stress according to the research done here.

E. Research Methods and Data

This study utilized multiple government data sources to tabulate Gross Domestic Product data, number of workers in the Southern Plains agricultural labor force, and to aid in

the estimation of the population of undocumented Mexican workers in Southern Plains agriculture.

Initially, the intention was to gather census figures for the number of hired farm workers the Southern Plains region from the National Agricultural Statistics Service (NASS), as well as those from the Bureau of Labor Statistics (BLS). The approximation of undocumented workers would be estimated by subtracting the BLS figure for hired farm workers from the NASS figure for all relevant years. The NASS figures represent the "total" figure for hired farm labor – including those who are undocumented – and the BLS figures represent the documented labor force; so a reasonable estimate of the total undocumented labor force could be determined via this method.

In order to provide a sufficient number of data points for the analyses, data were collected for the period starting in 1990 and including the most recent data available. However, the farm labor data were only readily available in the BLS databases from 2001 forward. After contacting the BLS, the team was able to obtain the pertinent figures for all desired years.

The NASS census data presented an issue as well: For the pertinent years, only 1992, 1997, 2002, and 2007 censuses were available. Four data points is clearly not sufficient to create viable analysis, and so the other figures were interpolated. Annual total employment was not available for the Southern Plains region; however, seasonal data was available through NASS, and this data was summed and percentage change was used to estimate the annual employment based on the four available censuses. Once these figures had all been gathered or calculated, the BLS figures were subtracted from them to create the current

estimates of the undocumented worker population for the Southern Plains region.

State-level Gross State Product (GSP) figures were obtained from the Bureau of Economic Analysis (BEA). The data were available either in the Standard Industrial Classification (SIC) database (for data up to and including 1997) or in the North American Industrial Classification System (NAICS) format for data from 1997 onward. The SIC data were reported in chained 1997 dollars, while the NAICS data were reported in chained 2005 dollars. This created a break in the data starting in the year 1997. The NAICS figures were used for the year 1997. Adjustments were needed for the pre-1997 figures in order to account for inflation.

Once the necessity for further flexibility and accuracy became apparent, we decided to further refine our results using the translog model, and so new data were needed. To this end, we used data from the U.S. Department of Labor's "National Agricultural Worker's Survey (NAWS)" as our main data source for collecting information on wages, income, family status, etc. Loan Rates were obtained from the Federal Reserve Bank of Chicago (Chicago Fed, 2013). The NAWS data base is derived from a national random sample of seasonal agricultural workers who are working in field crops, vegetable crops, nurseries and cash grains. NAWS divides the country into different regions and the focus of our study includes the border states in the southwest region and includes states such as California, Arizona, New Mexico, Oklahoma and Texas. We were able to collect data from 1989 to 2009.

Data gathered from the National Agricultural Workers Survey (NAWS) show some definite trends which provide insight into the issue as well as providing a scientific basis for answering academic, political, and social questions. Yearly data were gathered for 1989

through 2009. The data was categorized by region, then by residency status (i.e., documented or undocumented), and the minimum, maximum, and average wage rate, personal income and total family income were pulled from the data set.

As expected, the average wage rate for undocumented workers was lower than that of documented workers for all years included in the study. Furthermore, for virtually all years, the California region had a significantly higher wage rate than that of the Southwest region (1994 being the only exception) for both documented and undocumented workers. This can be expected since the higher cost of living in California will translate into higher wages.

Quite surprisingly, the minimum total family income tends to be somewhat higher in the Southwest region than in California. This suggests that those making the least in the Southwest region, regardless of documentation status, may actually have a higher quality of life than the workers in California as well. While the minimum total family incomes did in fact trend higher in the Southwest region, for many years the minimums were quite similar or the same.

Heterogeneous Factors Model

The model of heterogeneous production factors concerns migrant workers and domestic labor. The model assumes that: first, there were only two types of heterogeneous factors of production-migrant workers and domestically labor; Second, there was no system obstacles or other costs for migrant labor working in cities and towns ; third, assuming the form of production function is:

(1) $F = f(L_1, L_2, K)$

F is the output level in domestic areas and the function of the domestic labor, the migrant workers and capital. L_1 is domestic labor; L_2 is the migrant workers; K is the capital. The impact of the increasing migrant workers depends on whether the relationship between the productive factors L_2 and L_1 is alternative or complementary. As shown in Fig.1, the initial demand curve of the domestic labor is D_0D_0 line, the supply curve is S_0S_0 line. At the equilibrium point A in the labor market, the wage is W_0 and the number of employment is N_0. Increasing of the migrant workers will influence its employment by changing the location of the domestic labor demand curve.

If the relationship between L_2 and L_1 is complementary, an increase of undocumented migrant workers will shift the demand curve for migrants workers rightward to D_1D_1, the labor market reaches equilibrium at point C, the wages and the employment will separately increase to W_1 and N_1, and the increase in employment is N_0N_1; however, if the relationship between L_2 and L_1 is alternative, then the increase of the migrant workers in urban companies will make the demand curve of the undocumented workforce shift leftward to D_2D_2. Under the assumption that labor wages in urban areas are flexible, the labor market reaches equilibrium at point B. The wages and the employment number will separately decrease to W_2 and N_2, and the number of unemployment is N_2N_0. If there exists downward rigidity of urban workers' wages, the labor market reaches equilibrium at point D. The employment number reduces to N_3 with more unemployed workers, and the number of unemployed increases from N_2 N_0 to N_3N_0.

How can it be determined whether the relationship between L_2 and L_1 is alternative or complementary? This paper solves the problem by using second-order elastic cross partial

derivative F_{12} in Hicks's complementary formula. After the first-order partial derivatives of domestic labor with the production function F, which shows the output level, by using the partial derivative of the migrant workers, F_{12} is acquired. The specific formula is as follows:

$$F_{12} = \frac{\partial^2 F}{\partial L_1 \partial L_2} = \frac{\partial(\frac{\partial F}{\partial L_1})}{\partial L_2} = \frac{\partial(\frac{\partial F / \partial T}{\partial L_1 / \partial T})}{\frac{\partial L_2}{\partial T}} \quad (2)$$

Among them, the output F is denoted by the sum GDP of the domestic state, L_1 refers to the domestic workforce, L_2 denotes migrant workers, and T the time (years). When time T Changes with Δ T = 1, the above formula can be simplified to the following formula:

$$F_{ij} = \frac{\Delta(\frac{\Delta F}{\Delta L_1})}{\Delta L_2} \quad (3)$$

When F_{12} is greater than zero, the relationship between F_2 and F_1 is complementary; when F_{12} is less than zero, the relationship between F_2 and F_1 is alternative.

Mexican immigrant workers and Texas workforces are heterogeneous productive factors. According to the model of heterogeneous productive factors, what impacts will appear when Mexican immigrant workers transfer to Texas areas depends on whether the relationship between them is alternative or complementary. According to the above-mentioned formula (3) of Hicks's complementary flexibility formula, we calculated second-order cross-partial derivatives F_{12} for the Southern Plains region for 1992-2010. Data calculated show that at times they are compatible and at times exclusive. Of 19 calculated elasticity values, 6 returned negative values, and the other 13 returned positive values (about 68% of calculated elasticity values). Therefore, it can be stated that, as a general rule, the undocumented

workforce in Southern Plains agriculture tends to fill a gap in the agricultural labor market (a complementary relationship). See Table 1 for the relevant data and calculation method.

Elasticities of Substitution

A more rigorous assessment of the relationship between undocumented immigrant labor and domestic or documented labor can be performed through an empirical estimation. Specifically, the question of whether undocumented Mexican labor serves a complementary or substitute role in the domestic labor market can be answered by deriving the elasticity of substitution between domestic labor and undocumented Mexican labor. This paper adopts a methodology similar to the one used by Jajri and Ismail (2006). For simplicity, suppose that there are only three factors in the domestic agricultural production function, namely, domestic labor (L_1), undocumented Mexican labor (L_2), and capital (K). Then the agricultural production function can be expressed as in (1) above, where F is agricultural production. Let W_1, W_2, and R be the factor prices corresponding respectively to L_1, L_2, and K. Then the translog functional form of the cost function can be expressed as:

$$\begin{aligned} \ln C = {} & \ln \beta_0 + \beta_1 \ln W_1 + \beta_2 \ln W_2 + \beta_3 \ln K + \frac{1}{2}\beta_{11}(\ln W_1)^2 \\ & + \frac{1}{2}\beta_{12}(\ln W_1)(\ln W_2) + \frac{1}{2}\beta_{13}(\ln W_1)(\ln R) + \frac{1}{2}\beta_{22}(\ln W_2)^2 \\ & + \frac{1}{2}\beta_{23}(\ln W_2)(\ln r) + \frac{1}{2}\beta_{33}(\ln R)^2 \end{aligned} \tag{4}$$

assuming symmetry so that $\beta_{ij} = \beta_{ji} \ \forall i, j$

By Shephard's lemma, cost minimization under perfect competition requires that the partial derivative of the cost function with respect to the price of a factor equals the Hicksian demand for that factor. Hence, given the translog functional form,

(5) $$s_{L_1} = \frac{\partial \ln C}{\partial \ln W_1} = \beta_1 + \beta_{11} \ln W_1 + \beta_{12} \ln W_2 + \beta_{13} \ln R$$

(6) $$s_{L_2} = \frac{\partial \ln C}{\partial \ln W_2} = \beta_2 + \beta_{12} \ln W_1 + \beta_{22} \ln W_2 + \beta_{23} \ln R$$

(7) $$s_R = \frac{\partial \ln C}{\partial \ln R} = \beta_3 + \beta_{13} \ln W_1 + \beta_{23} \ln W_2 + \beta_{33} \ln R$$

where s_{L_1}, s_{L_2}, and s_K are the shares of L_1, L_2, and K in the total production cost.

By assumption, the cost shares sum up to 1, so the third cost share can be estimated as 1 minus the sum of the other two. Assuming homogeneity in prices, we also have that

(8) $\beta_{13} = -(\beta_{11} + \beta_{12})$ and

(9) $\beta_{23} = -(\beta_{12} + \beta_{22})$

Thus any two of equations (3) through (5) can be estimated to generate the Allen elasticities of substitution between pairs of factors:

(10) $\sigma_{L_1 L_2} = (\beta_{12} + s_{L_1} s_{L_2}) / s_{L_1} s_{L_2}$

(11) $\sigma_{L_1 R} = (\beta_{13} + s_{L_1} s_R) / s_{L_1} s_R$, and

(12) $\sigma_{L_2 R} = (\beta_{23} + s_{L_2} s_R) / s_{L_2} s_R$

Any pair of factors i, j are complements (substitutes) if $\sigma_{ij} < 0$ (> 0).

In this study, equations (5) and (6) were estimated as Seemingly Unrelated Regressions (SUR) equations. The SUR option of the SYSLIN procedure in Statistical Analysis System (SAS®) was used.

F: Results and Discussion:

Results of regression estimations using the SYSLIN procedure in SAS are presented in Table 2. First order parameters for L_1 and L_2 (β_1 and β_2) are obtained from the regression results,

while the first order parameter for capital was obtained as the difference based on the underlying assumptions of the model. Similarly, second order parameter estimates were obtained from the regression procedures or estimated using equations (8) and (9) above.

Given the above estimates, the Allen elasticities of substitution are presented in Table 3. The results indicate that there is a substitutionary relationship between all production factors. Most significantly, preliminary results from the SUR estimations suggest that undocumented immigrant labor from Mexico serves as a substitute for documented labor in the domestic labor market. Furthermore, the magnitude of the elasticity presented in Table 3 between documented and undocumented Mexican labor is greater than the elasticities between capital and either documented or undocumented labor.

G: Conclusions and suggestions for further research:

This paper presents results of analyses conducted to determine the relationship between undocumented Mexican labor and documented or domestic labor in the agricultural sector of the States that border Mexico. The study was thus confined to the Southwest region – including Texas, Oklahoma, New Mexico and Arizona – and California.

The results presented above suggest that undocumented Mexican immigrant labor acts as a substitute in the agricultural labor market of these states. While in some years the productivity of domestic labor is enhanced by increased participation of undocumented Mexican labor, as indicated by the year to year computations presented under the heterogeneous factors model, the overall empirical estimations and the resulting Allen

elasticities of substitution suggest that undocumented Mexican labor is a substitute to domestic labor in the agricultural sector.

The results of this study may be limited by the fact that the entire southwestern and California regions were lumped together in the analysis. Future work on this theme will explore the potential for differences in elasticity between California, where significant agricultural labor is hired for vegetable production, as compared to Texas and other states in the Southwest where most of the hired farm labor works in less labor intensive operations.

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Table 1: Income and labor derivatives for Southern Plains and Mexican workers

Year	Southern Plains AG. GSP	Change in Southern Plains Ag GSP ΔF	Southern Plains (SP) documented workers (thousands) L_1 BLS	Change in SP documented workers ΔL_1 ΔBLS	$\frac{\Delta F}{\Delta L_1}$	$\Delta(\frac{\Delta F}{\Delta L_1})$	Undocumented workers in SP (thousands) L_2	Change in undocumented workers in SP ΔL_2	$\frac{\Delta(\frac{\Delta F}{\Delta L_1})}{\Delta L_2}$
1990	5,483		66,796				172.335		
1991	5,790	307	69,932	3136	0.098		176.233	3.898	
1992	6,454	664	68,604	-1328	-0.500	-0.5979	188.613	12.38	-0.048
1993	6,625	171	73,042	4438	0.039	0.5385	190.204	1.591	0.339
1994	7,095	470	74,967	1925	0.244	0.2056	169.188	-21.016	-0.010
1995	5,691	-1404	76,290	1323	-1.061	-1.3054	162.841	-6.347	0.206
1996	4,947	-744	74,995	-1295	0.575	1.6357	170.165	7.324	0.223
1997	5,753	806	75,272	277	2.910	2.3352	173.763	3.598	0.649
1998	5,334	-419	74,498	-774	0.541	-2.3684	150.63	-23.133	0.102
1999	6,955	1621	91,263	16765	0.097	-0.4447	118.923	-31.707	0.014
2000	7,364	409	75,129	-16134	-0.025	-0.1220	168.925	50.002	-0.002
2001	6,668	-696	73,138	-1991	0.350	0.3749	220.723	51.798	0.007
2002	8,233	1565	72,767	-371	-4.218	-4.5679	143.484	-77.239	0.059
2003	8,711	478	71,104	-1663	-0.287	3.9309	111.812	-31.672	-0.124
2004	8,941	230	70,607	-497	-0.463	-0.1753	115.728	3.916	-0.045
2005	9,222	281	72,134	1527	0.184	0.6468	126.167	10.439	0.062
2006	7,718	-1504	70,159	-1975	0.762	0.5775	100.79	-25.377	-0.023
2007	6,936	-782	69,752	-407	1.921	1.1599	133.685	32.895	0.035
2008	6,284	-652	68,610	-1142	0.571	-1.3504	128.581	-5.104	0.265
2009	6,020	-264	68,500	-110	2.400	1.8291	149.213	20.632	0.089
2010	9,306	3286	68,308	-192	-17.115	-19.5146	123.53	-25.683	0.760
2011			67,453	-855			113.231	-10.299	

Data source: GDP data from Bureau of Economic Analysis. Labor force data from Bureau of Labor Statistics, U.S. Census Bureau.

Table 2: SUR parameter estimates

	Documented	Undocumented	Capital
First order parameter estimates			
	-0.0481	-0.0773	0.1254
Second order parameter estimates			
Documented	0.0192*	0.0406***	0.0183***
Undocumented	0.0406***	-0.0209	0.0019
Capital	0.0183***	0.0019	-0.0202

*Significant at 5%

***Significant at 1%

Table 3: Allen elasticities of substitution

	Elasticity
Documented, Undocumented	5.35
Documented, capital	1.19
Undocumented, capital	1.03

Figure 1

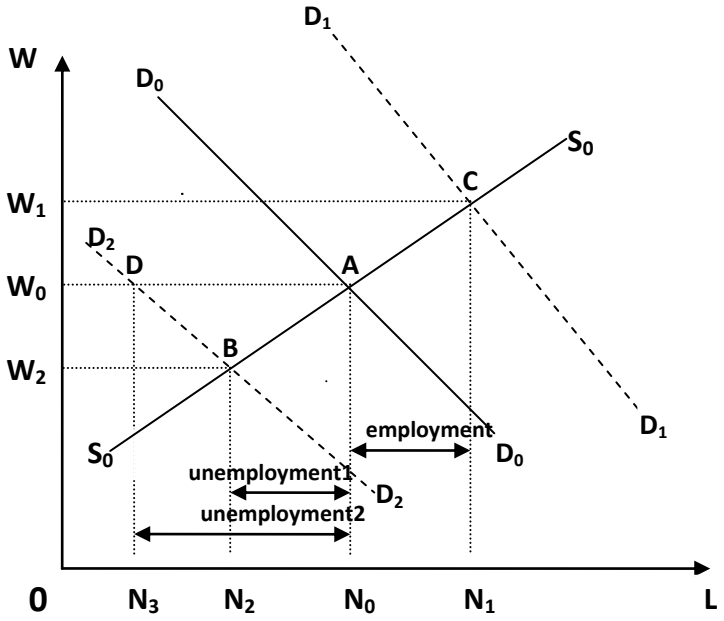

Figure 1 the impact of increasing migrant workers on domestic workers