Immigrant Wage Assimilation, Selective Emigration, and the Welfare State

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Abstract

The main economic concerns on the welfare provision to immigrants center around the fiscal burden and the "welfare magnet." This paper analyzes the feasibility of income assistance policies for immigrants taking these two concerns into account. Since feasibility of welfare programs in the US is determined by immigrants' labor market performance in the US as well as potential impacts on their migration behavior, I build a structural model that incorporates a joint process of the wage assimilation of immigrants and their selective initial/return migration decisions. I estimate the parameters so as to replicate empirical evidence from various datasets that cover Mexican immigrants. Using estimated parameters, I conduct an experiment on the feasibility of income assistance policies for immigrants that does not rely on the tax revenue from the natives. I find that the welfare provision is possible when the enrollment is mandatory, because the large wage gap between the US and Mexico makes workers to optimally stay in the US despite the taxes.

Keywords: native-immigrant wage gap, learning about match quality, Mexican immigrants, welfare states

1 Introduction

Immigrants from less developed countries typically experience huge wage gains when they migrate to the US.[1] However, natives in the US do not necessarily welcome immigrants com-

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[1]A Mexican immigrant in the US earns on average 2.5 times more than Mexicans in Mexico with the same education and experience (Kennan (2013)). Although some of the observed wage difference may due

ing into their labor market. Existing research summarizes the two main economic concerns that seem to generate anti-immigration sentiments: competition in the labor market and fiscal burden on the welfare programs. While both concerns are important, I analyze the second issue in this paper.

While percentage below the federal poverty level is 12% for the US natives, the rates are much higher among non-citizens (19%), immigrants who stayed in the US for less than 8 years (22%), and Hispanic immigrants (20%) (U.S. Census Bureau 2007). Therefore, if immigrants are allowed access to the welfare programs in the host country on the same term as natives, they are on average likely to demand more than their tax contributions. Also, generous welfare programs act as a "welfare magnet" and attract low wage immigrants in the US. In order to decrease the welfare magnet effect and cut the cost, the welfare reform in 1996 denied eligibility of non-citizens who arrived after 1996 to all types of federal aid, although some states provided state-funded benefits to immigrants after 1996.[2] Did denying immigrants from the welfare programs solve all the problems? The existing empirical research on the effect of this welfare reform shows mixed evidence. In particular, the percentage of usage of welfare programs among immigrants remains high because immigrant households receive welfare on behalf of their US born children.[3] Also, it is unrealistic to exclude immigrants from using all types of welfare programs, including non-excludable public goods. Furthermore, even if the complete exclusion is possible, it is questionable whether this is idealistic in a long-run. For example, it is well studied that childhood poverty has a negative impact on his lifetime socioeconomic achievement. Therefore, excluding immigrants' children from welfare usage might serve as an obstacle for the assimilation of the future generation.

In this paper, I analyze the feasibility of constructing a welfare program for immigrants that is fully funded by the tax revenue from immigrants. If such program is feasible, then that program will overcome the current concern of using natives' tax revenue to provide welfare to immigrants. Also, this will provide a better childhood environment for the foreign-born children in the immigrant households. I consider a feasibility of simple welfare program: gives subsidy if one's wage is below a certain level and levies a proportional tax if otherwise. The welfare provision to immigrants is harder than provision to natives in two ways: 1) lower wage and 2) adverse selection. Since the available immigrant tax revenue is lower than natives, the subsidy-tax combination that is feasible for natives may not be feasible.

to unobserved characteristics, the wage difference is enormous.

[2]Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) in 1996 also limited the eligibility to those who are already in US. But once an immigrant obtains US citizenship, he is eligible for the welfare programs. California offered the most generous state-funded programs after 1996.

[3]For example, in 2009, 51.5% of US born children in immigrant-headed households participate in some welfare program (Borjas (2011), Camarota (2011)).

Second, there are adverse selection in both high-end and low-end. High tax will dismotivate high wage immigrants to be in the US. On the other hand, more low wage immigrants are attracted to the US because of subsidy. These channels make it harder to design a welfare program that runs using immigrants tax revenue.

In order to analyze sustainable income insurance policies for immigrants, it is crucial to understand immigrants' labor market performance. In particular, a typical immigrant starts off with wage lower than those of native with similar years of schooling and work experience. However, the native-immigrant wage gap narrows as immigrants accumulate work experience in the US. Therefore, long-term immigrants might be on the tax contributor side. Second, it is important to know how much heterogeneity exists among immigrants in terms of wage growth. After three decades of empirical research, a consensus among researchers on the nature of assimilation speed is elusive. For example, if one tracks the average wage of the same arrival year cohort using repeated cross-sectional data, one finds that the native-immigrant wage gap closes by 33.5% in 20 years. This number is more than double the estimates obtained using the panel data from the Social Security Administration (10-15%) (Lubotsky (2007)). This suggest that while some immigrants assimilate relatively quickly, other immigrants' assimilation stall after certain number of years and choose to return. Lastly, immigration policies affect immigrants' migration decisions. Ignoring this channel might give misleading predictions regarding the impact of immigration policies.

I focus on Mexican immigrants in the US for the following reasons. First, this group not only makes up a significant share of immigrants' labor force, but also shows fast growth within past 30 years (15.6% in 1980 to 30% in 2011). Second, the number of immigrants who make a return migration is large. Between 2005 to 2010, 1.4 million Mexicans and their children moved from the US to Mexico, and this size is about the same as the estimated inflow from Mexico to the US during this time (Pew Hispanic Center (PHC)). Third, they are more likely to be in disadvantaged economic status compared to immigrants from other countries. Therefore, they are more likely to be affected by welfare provision policies in the US.

This paper first documents Mexican immigrant's wage growth and migration patterns in the US using various datasets that have been used in the empirical literature on Mexican immigrants. The datasets cover Mexicans who never migrated to the US, Mexicans with US migration experience and have returned to Mexico, and Mexicans who have migrated to the US and surveyed in the US. By using various datasets, I can estimate the joint process of the wage assimilation and the migration decisions. This paper documents 1) the wage growth of immigrants at the aggregate and individual level, 2) selective initial migration depending on their observable demographics, 3) selective return migration, 4) correlation of wages of an individual in both countries, and 5) duration of stay in the US for those who chose to return to Mexico.

Next, I build a dynamic model of Mexican immigrants who make migration decisions given their expected wages in both countries. A worker initially migrates to the US expecting that he will earn an average wage according to his observable characteristics. A worker's wage in the US is determined by job-specific average wage of his observable characteristics, individual fixed effect, and a random shock. This individual fixed effect can be regarded as a worker's match quality with the US which is unknown to him. If he consistently draws bad wages (i.e. low signals), then he is inclined to believe that his true match quality is low valued. Since the match quality is persistent, he decides to return because the expected future wages are low as well. His wage grows through the accumulation of human capital which depends on his job type. The learning process is similar to Jovanovic (1979) which has been extended by Nagypal (2007) to incorporate both learning-by-doing and learning-about-match-quality channel of wage growth.

The rest of the paper is as follows. Section 2 summarizes the related literature. Section 3 explains the various datasets that I use to estimate the model. Section 4 documents immigrant's wage growth and migration patterns in the US using various data sets. Section 5 proposes the model. Estimation procedure is explained in Section 6. Section 7 shows the results. Conclusion and the future works are presented in Section 8.

2 Related Literature

This paper is related to the literature on wage assimilation of immigrants, the selectivity of Mexican immigrants and the welfare provision to immigrants. The structural model in this paper is related to papers that incorporate individual's migration decision. Also, the wage growth in my model is induced by both learning-by-doing and learning about match quality. Theoretical background of my model is related to papers that consider the relationship between worker's wage and the quality of match with the employer. Here I briefly summarize the existing consensus and my contribution to these fields.

First, the wage assimilation of immigrants has been documented using various cross-sectional and longitudinal datasets since 1970s (For example, Chiswick (1978), Borjas (1994), Hu (2000), and Reagan and Olsen (2000)). The wage assimilation speed estimated using the cross-sectional data is faster than the individual wage growth estimated from panel data (Lubostky (2007)). A hypothesis regarding why Latino immigrants' assimilation stalls is given by an occupational segregation (Mouw and Chavez (2012)). For example, Hispanic immigrants are stuck in the low-paid occupations where the share of Hispanics in this occupation is large. This type of occupation helps get a foodhold in the US when an immigrant cannot speak English well, but it eventually harms because it takes away the opportunity to learn English. I capture this setup by incorporating two types of jobs in the US.

Second, there are many studies using various datasets to understand the selection on initial migration of Mexicans. While Chiquiar and Hanson (2005) finds intermediate selection, Kaestner and Malamud (2013) find that immigrants are negatively selected. As shown in Kaestner and Malamud (2013), these negative selection can be partially explained by the observable characteristics: young, male, rural origin workers are more likely to migrate. In contrast to selective initial migration, there are not many studies on who returns to Mexico. Van Hook et al. (2006) conduct CPS Matching Method to consider how observable characteristics affect one't return migration decision from the US.

The contribution of this paper to these two fields is on the joint analysis of wage assimilation and the selective migration. Although labor market performance in the US and immigrants' migration decisions are tightly linked, the existing literature considers this two channels separately. The main reason is that there is no single data which covers both characteristics of immigrants. In this paper, I build a structural model that considers both wage growth in the US and the endogenous migration decision.

Third, regarding the welfare usage among immigrants, Borjas and Hilton (1996) found that immigrants are more likely to use welfare programs because they are on average poor than native households. Razin and Wahba (2011) find that generous welfare payments will make immigrants to be negatively selected.

In terms of theoretical understanding of the migration incentives, Sjaastad (1962) and Borjas (1987) set up a framework that an individual makes migration decision based on expected costs and benefits. Kennan and Walker (2011) estimates a structural model of internal migration that is driven by the expected income. In my model, an individual's wage grows as one resides in the US is through the accumulation of US experience (learning-by-doing). In addition, the productivity of an average worker increases over time through learning about persistent individual effect (learning about match quality). These two channels both contribute to an average wage growth observed in the data. Theoretical backgrounds of learning-by-doing and learning about match quality are related to Jovanovic (1979) and Nagypal (2004). Pessino (1991) builds a 2-period-2-location migration model where a worker makes a migration decision based on learning about the location-specific outcome.

3 Data

I use five datasets: the American Community Survey, the Mexican Migration Project Survey Data, the Mexican Family and Life Survey, the Survey of Income Program Participation, and the Mexican Census. The datasets cover Mexicans who never migrated to the US, Mexicans with US migration experience and have returned to Mexico, and Mexicans who have migrated to the US and surveyed in the US. These datasets have been used in the existing empirical studies on Mexican immigrants. Table 1 summarizes the available data and how each dataset covers various types of Mexicans. By using various datasets, I can estimate the joint process of the wage assimilation and the migration decisions.

Table 1: Data Coverage

Dataset	American Community Survey (ACS)	Mexican Migration Project (MMP)	Mexican Family and Life Survey (MxFLS)	Survey of Income Program Participation (SIPP)	Mexican Census (MX Census)
Survey Year	2004-2007	1987-2011	2002, 2006	96, 01, 04	2000,2010
Description	repeated cross-sectional	recall data on migration experience	2 waves panel of Mexicans	monthly panel of about 4 years	repeated cross-sectional
How I use	cross-sectional wage growth	duration of US stay conditional on returned	initial selection of immigrants	individual wage growth	wage in Mexico before and after migration

Data Coverage	Prior to Migration	While in the US	After returned to Mexico
Migrated and returned	MxFLS, (MMP)	MMP, (SIPP)	MxFLS, MX Census, (MMP)
Migrated and not returned	MxFLS, (MMP)	ACS, SIPP, (MMP)	
Never migrated	MX Census, MxFLS, (MMP)		

Parenthesis indicates that the sample size is small or the evidence is indirect.

3.1 Datasets

3.1.1 American Community Survey (ACS)

The ACS (2004-2011) is a repeated cross-sectional dataset of a random representative population in the US. I restrict to Mexican-born male and ages 25 to 55 at the time of survey. Ages 56 or older is eliminated because some natives retire early which makes hard to analyze the wage assimilation correctly.[4] I only consider those who entered to the US after age 19 so that most of them finished high-school education in Mexico.[5] Also, I restrict to those who stayed in the US for no more than 30 years, because I restrict to those who have entered age

[4]Employment rates fall faster among natives than immigrants among workers aged late 50s and 60s (Borjas (2011)).

[5]Only 1.1% pursue college education in the US.

25 or older. I assume that the reported year of entry is the year of entry of the current trip following Lubotsky (2007).

3.1.2 Mexican Migration Project (MMP)

The MMP contains people who currently live in Mexico as well as those who currently live in the US. To obtain its sample, the MMP starts with a list of regions in Mexico where emigration to the US is commonplace.[6] It next randomly selects a number of residents in those regions and interviews those who with US migration experience. At this time, interviewers ask their interviewees which city they lived in when they were in the US. The MMP then conducts a similar survey in those US cities that were identified as the most common destinations.

3.1.3 Mexican Family and Life Survey (MxFLS)

The first two waves of the MxFLS are used to analyze the observable characteristics and the likelihood of migration to the US. This dataset is a longitudinal dataset of nationally representative households in Mexico. The first wave conducted in 2002 consists of 8,440 households (or over 35,000 individuals) in 150 communities in Mexico. The follow-up interviews (the second wave) were conducted in 2006. In addition to basic demographic information, this dataset reports the past US migration experience, earnings, whether they have migrated to the US at the second wave. I used this data to compare the characteristics in Mexico between migrants and non-migrants. Also, I analyze the relationship between the US migration duration and Mexican wages after returned to Mexico.

3.1.4 Survey of Income Program Participation (SIPP)

I use the SIPP 1996-1999, 2001-03, and 2004-07 to obtain the wage growth of an individual immigrant. This survey collects monthly earnings of the same individual for about every 4 months for 9 to 12 times (i.e. over 3 to 4 years).[7] In each interview, a worker reports monthly earnings of four months prior to the survey. I use an average wage within these 4 months. In addition to basic demographics, the SIPP reports a workers year of US arrival, citizenship status, monthly level earnings, and occupations. I combine data from 1996, 2001, 2004 panels to increase the sample size.

[6] 134 communities in Mexico are surveyed.

[7] Surveys started in 1996 and 2004 have 12 interviews and the survey stared in 2001 has 9 interviews.

3.1.5 Mexican Census 2000, 2010

Mexican Census gives nationally representative household's demographics, earnings, and the country of residence 5 years prior to the survey.

4 Empirical Evidence

I focus on empirical evidence that is crucial for understanding the effects of welfare programs. In order to understand how the welfare program affects worker's migration decision, I explore the features on selective initial migration and emigration. Also, in order to understand how much tax can be collected and the potential demand on income transfer systems, I investigate immigrants' wage growth in the US.

4.1 Evidence on the Migration Decisions

4.1.1 Initial Migration Decision

The MxFLS gives the panel wage of randomly chosen Mexicans in Mexico. MxFLS reports whether an individual interviewed in the first wave migrated to the US during the second wave. Therefore, I can compare the characteristics reported in wave 1 between those who have migrated sometime during wave 1[8] and wave 2 and those who did not migrate. In general, migrants earnings are lower than non-migrants. The reason is that migrants tend to come from rural area, less educated and younger in age. Controlling for these variables, there is no other controls that explains the difference between migrants and non-migrants. Table 4 shows the regression results.

4.1.2 Selective Emigration

A lack of lifetime panel of immigrants prevents a researcher to directly observe the characteristics that induces one to return. However, the difference in cross-sectional wage growth and the panel wage growth indicates that the return is not a random phenomenon. As Lubotsky (2007) claims, a worker who is not performing well likely to have returned early. By comparing the deterministic observables across the the same arrival cohort in repeated cross-sectional data, I find that the proportion of those who came at younger ages increases as US stay increases (Figure 3). This means that workers who arrived at younger ages are more likely to stay.

[8] An individual is also asked whether he had migrated to the US in wave 2.

4.1.3 Likelihood of Stay in the US

The SIPP offers the panel data of an individuals for about every 4 months for about 3 to 4 years. If an interviewee moves between waves, the SIPP makes an attempt to locate the interviewee and conducts interview. [9] Thus, if an interviewee is missing in the later interviews, it is likely that he have emigrated from the US. I document the relationship between the characteristics of wages in the first interview and the likelihood of being present at the 9th interview.

First, the monthly earnings at the first interview is about 8% higher for those who stay until the 9th survey (Table 3). However, this relationship is no longer statistically significant when controlling for other education, age, length of US stay, and the age at the US entry. The reason is that a younger workers and those who have entered at younger ages are more likely to be sampled until the 9th survey, and these factors contribute to higher earnings.

4.1.4 Length of US stay conditional on returned

The MMP reports the duration of US stay for those who have migrated to the US and have returned to Mexico. I restrict to male workers who have migrated after 1986, and migrated at ages 19 to 30. Conditional on returned to Mexico, most workers return to Mexico within two years (Figure 4).

4.2 Wage Growth and Assimilation

4.2.1 Aggregate Wage Growth

In this section, I document the evidence of wage growth using ACS (2004-2007)[10] . The ACS reports the earnings of past twelve months. However, it could be that the earnings of newly arrived workers are lower simply because they were not employed for the most part of previous year. Therefore, I also compute the weekly earnings by dividing annual earnings by the number of weeks worked in pervious twelve months. Also, I homogenize the wage source by restricting to those who are employed at the private for-profit company or individuals.[11] I further eliminate those with zero wage and eliminate top 0.1% of wage observation. When

[9] I use SIPP instead of Current Population Survey Merged Outgoing Rotational Groups because CPS only conduct the second interview in the same location. Thus, missing at the second interview means that someone moved within US or emigrated from US. Van Hook et al (2006) and Van Hook and Zhang (2011) use CPS Matching Method to estimate the probability of emigration.

[10] I exclude 2008 or later because all cohorts experienced a decrease in wages due to the Great Recession.

[11] In order words, I eliminate 1) employee for a private not-for-profit, tax-exempt, or charitable organization, 2) government employee, 3) self-employed, 4) working without pay in family business or farm, and 5) unemployed for less than 5 years or never worked.

calculating the wage growth and assimilation process of immigrants, I divide immigrants into into 12 groups according to the 2 to 3-year-bin of US staying years. Length of US stay is calculated by

$$\text{US staying years} = \text{Reported Calendar Year of Entry} - \text{Calendar Year at the Survey.}$$

The groups are {0, 1, 2-3, 4-5, 6-7, 8-9, 10-11, 12-14,..., 27-30} which is denoted by $G \equiv \{1, \ldots, 12\}$. The wage growth of immigrants is captured by how the unobservable wage effects change as one reside in the US longer, controlling for education and experience. I consider the following OLS regression:

$$\log(wage) = a_0 + a_1 edu + a_2 age + a_3 age^2 + \sum_{y=2005}^{2007} a_{4y} \mathbf{1}_{year=y} + \sum_{g=1}^{12} a_{5g} \mathbf{1}_{group=g} + err.$$

Table 2 gives the result. Figure 1 shows the evolution of wage distribution for each years of US stay. Figure 2 shows the wage growth when tracking the same arrival cohort for the different experience levels and education levels.

4.2.2 Individual Wage Growth

Using the 3 to 4 year panel data from SIPP, I find that monthly earnings of a worker increases over the interviews. An immigrant shows faster wage growth during the early periods of US stay and the growth rate diminishes as he resides longer. Monthly earning grows 28% within the first 4 years among those who have been in the US for less than 4 years. The growth becomes 14% for those who have resided 4 to 10 years, and slows down to 10% for those who have resided more than 10 years (Table 6). Also, there is a persistency in an individual's wage. Table 7 shows the transition matrix between the monthly earnings in the first interview and the 9th interview (approximately 3 years later). The persistency is moderate compared to the native whites.

4.3 Relationship between Wage in the US and Mexico

4.3.1 Correlation between Individual's Wage in the US and Mexico

Using the MMP, I document the relationship between the wage in Mexico and in the US of an individual. In particular, I compare the wage of an individual in two locations and show that people who earn above average among migrants with the same observables tend to earn above average in Mexico among migrants with the same observables. The observables I control for includes years of education and age. In addition, I include age at US entry for the wage in the US, because this is a very strong predictor of the US wage. Also, I include an indicator of agricultural or non-agricultural occupation for the wage in Mexico, because agricultural workers earn significantly lower than the non-agirucltural workers in Mexico. The MMP offers the retrospective wage of migrants. I convert into 2012 USD using the average CPI across the years of US stay in the last trip. They also report the wage at the last job in Mexico. This dataset covers two types of people. First type is workers who have returned to Mexico. For these people, the wage at the last trip is the wage that they earned recently. I convert the wage into 2012 USD assuming the reported Mexican wage is earned at the survey year. The second type is those who are in the US and have not completed their trip at the time of survey. For these workers, the last job conducted in Mexico refers to the jobs that they have done prior to the current trip. Therefore, for these people, I convert the wage into 2012 USD assuming the reported Mexican wage is earned in the same year as the year they have most recently migrated to the US. To sum, I obtain year of education, wages in the two locations and the corresponding observables when this worker earned the reported wage. Using this information, I first regress the monthly wage in the US for the last (or current) trip to the US against average age during the last (or current) trip, years of education, and the age at the US entry of the last (or current) trip. Table 5 shows the OLS regression coefficient. Then I obtain the OLS residuals. This OLS residual is the discrepancy in the actual wage and the estimated wage using the OLS coefficient. This residual indicates a worker's ability to earn higher than the workers with the similar characteristics. Second, I run OLS regression of monthly earning in Mexico against age, years of education, and non-agricultural occupation dummy (Table 5). Similarly, I obtain the OLS residuals for the Mexican wage. Lastly, using the two OLS residuals in the 2 location, I show that a worker with higher OLS residual in the US has higher OLS residual in Mexico. If a worker earns 1% higher than those with the same observables in Mexico, then he is estimated to earn 0.08% higher in the US among the workers with the same observables. Given the fact that the monthly earnings in the US is about 4 times higher in Mexico, the 0.08% increase implies about $20 (USD) increase in the monthly wage.

4.3.2 Transferability of US Experience

According to the MxFLS, the longer the US stay, the higher the earnings at the time of survey. An extra year in the US makes annual earnings to increase by 6%, when controlling for education, rural/urban, and age (Table 8). This indicates that there is a positive gain from residing in the US.

5 Model

In words, a worker decides to migrate by comparing the expected gain from migrating to the US versus value of staying in Mexico. The financial gain from migration depends on wages in the US and Mexico, which are impacted by education, age, initial human capital, as well as unknown factors of how well he can perform in the US ("match quality"). An overall gain also depends on how much this worker prefers to live in Mexico ("locational preferences") and migration costs. Some stay in Mexico because of locational attachment to Mexico, despite the huge wage difference between Mexico and the US. Some in the worst socioeconomic circumstances prefer to stay in Mexico because he cannot afford the migration cost.

Once a worker decides to migrate to the US, there are two types of jobs in which he can potentially do. A worker can always choose to work at bad job. He can work at the good job after he has been offered a good job. A worker might not choose to take the good job in the beginning because he does not have enough human capital to take that job. A worker who is stuck in the bad job will experience slower wage growth than those who could switch to the good job.

Through the wage realizations, a worker gradually learns his match quality and updates his belief about the future wages. A worker decides to return or stay every period by comparing the expected future wages in the US and in Mexico. The heterogeneous wage growth process, heterogeneous locational preference, and a gradual learning process make the timing of return to Mexico to vary across workers. Based on locational preferences and realized wage, some return instantaneously, some return after accumulated US experiences, and some never return.

5.1 Model

There are two locations: the US (US) and Mexico (MX). A worker starts from being in Mexico and makes an initial migration decision to the US every period. Once migrated to the US, a worker makes a decision of stay in the US or return to Mexico at the end of each period. A worker decides to migrate based on locational preference to Mexico and observable characteristics X. Let $w_t^{US}(X)$ denote the wage in US at $t-$th year of US stay and $w_t^{MX}(X)$ denote the wage in Mexico at period t. A worker's per-period utility is given by

$$U_t(X) = \begin{cases} w_t^{US}(X) & \text{if} \quad \text{in } US \text{ at period } t \\ w_t^{MX}(X) + \eta_0 & \text{if} \quad \text{in } MX \text{ at period } t \end{cases}$$

where η_0 captures the locational preference of being at Mexico. A worker makes a return decision every period until $(T-1)$-th period. A worker's objective is to maximize the discounted sum of his utility in until period T (i.e. $\sum_{t=1}^{T}\beta^{t-1}U_t(X)$). A worker's wage is determined by match quality to the labor market and human capital accumulation. A priori, a worker only knows the distribution of the match quality, but not the realization of his match quality. He gradually learns through the wage realizations. This captures any components that affects worker's wage, but unknown to him. Let $\theta^l \sim N(0,\sigma^2_{\theta^l})$ denote the match quality in location l. A worker's wage increases as he resides in the US. Initial human capital upon migration depends on his observable characteristics $h_0(X)$.

Labor Market in the US

There are two types of job in the US: $\{G,B\}$. These jobs differ in the returns to a worker's human capital and the speed of human capital accumulation. Job B characterizes jobs that are always available and no English is required. These jobs offer lower returns to the human capital and slower human capital accumulation.

Job G offer arrives in period t with with probability λ if a worker did not do job G in period $t-1$.

The wage in the US at job $j \in \{G,B\}$ is given by

$$w_t^j(h_t,\theta^{US},\varepsilon_t) \;=\; \beta_{0j}+\beta_{1j}h_t+\beta_{2j}h_t^2+\theta^{US}+\varepsilon_t$$

where $\varepsilon_t \sim N(0,\sigma^2_\varepsilon)$ is i.i.d shock. Wage takes a second-order polynomial in order to replicate the concavity in the wage growth. The human capital accumulation at job $j \in \{G,B\}$ is given by $h_{t+1}=h_t+g_j \quad g_j \geq 0$.

Labor Market in Mexico

Wage in Mexico is determined by their observable characteristics, match quality in Mexico, and human capital accumulated in the US.

$$w_t^{MX}(h_t,X_t,\theta^{MX},\psi_t) \;=\; \mu_t^{MX}(X_t,h_t)+\theta^{MX}+\psi_t.$$

Timing

A worker is initially in Mexico and is just finished his education in Mexico. He realizes his locational preference to Mexico η_0.

- In MX at period $t \geq 1$: a worker draws a wage and a migration cost c. Based on the history of signals realized in MX, a worker Bayesian updates his belief about the true match quality and calculates the expected values of migration. A worker decides to migrate or not at the end of the period without knowing $w_{t+1}^{l} \quad l = US, MX$.

- In US at period $t > 1$:

  1. Wage(s) in period t is realized. If job H offer arrived, a worker makes an accept/reject decision. Through wage realizations, a worker backs out the noisy signal of his true match $z_s \equiv \theta^{US} + \varepsilon_t$.
  2. Based on the history of signals realized in US, a worker Bayesian updates his belief about the true match quality and calculates the expected values of stay. A worker makes a return decision at the end of period t (without knowing w_{t+1}^{US}.)

Let $\mathscr{I}_t$ denote information accumulated until t. The sufficient statistics for making a migration decision is the number of signals and the sample average of signals.

Bellman Equation

Let $V_t^{US,j}(h_t, \mathscr{I}_t)$ denote the value of being in US at t with job $j \in \{G, B\}$ and $V_t^{MX}(h_t, \mathscr{I}_t)$ the value of being in MX at t facing migration cost c.

At the terminal period T, there is no migration decision.

$$V_T^{US,j}(h_T, \mathscr{I}_T) \quad = \quad w_T^j, \quad V_T^{MX}(h_T, \mathscr{I}_T, c_t) = w_T^{MX} + \eta_0.$$

In US at period t, a worker

$$\begin{aligned}
&V_t^{US,G}(h_t, \mathscr{I}_t) \\
&= w_t^G + \beta \max_{\text{stay, return}} \{E[V_{t+1}^{US,G}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t], E[V_{t+1}^{MX}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t]\}. \\
&V_t^{US,B}(h_t, \mathscr{I}_t) \\
&= w_t^B \\
&+\beta \max_{\text{stay, return}} \{\lambda \max_{\text{acc,rej}} \{E[V_{t+1}^{US,G}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t], E[V_{t+1}^{US,B}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t]\} \\
&\qquad\qquad +(1-\lambda)E[V_{t+1}^{US,B}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t], \\
&\qquad\quad E[V_{t+1}^{MX}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t]\}.
\end{aligned}$$

I assume that the human capital stays constant in MX.

$$
\begin{aligned}
&V_t^{MX}(h_t, \mathscr{I}_t, c_t) \\
&= w_t^{MX} + \eta_0 + \\
&+\beta \max_{\text{migrate,stay}} \{[\lambda \max\{E[V_{t+1}^{US,G}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t], E[V_{t+1}^{US,B}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t] \\
&\qquad\qquad +(1-\lambda)E[V_{t+1}^{US,B}(h_{t+1}, \mathscr{I}_{t+1})|\mathscr{I}_t]] - c_t, \\
&\qquad \kappa E[V_{t+1}^{MX}(h_{t+1}, \mathscr{I}_{t+1}, c)|\mathscr{I}_t] + (1-\kappa)E[V_{t+1}^{MX}(h_{t+1}, \mathscr{I}_{t+1}, \infty)|\mathscr{I}_t]\}
\end{aligned}
.
$$

The functional form of w_t^{MX} is specified in Section 6.2. A worker must afford the migration cost prior to the migration. This is to be consistent with an empirical evidence that workers on the worst socioeconomic circumstances cannot afford the migration cost to migrate to the US (Angelucci (2012), Chiquiar and Hanson (2005)).

6 Estimation

6.1 Heterogeneous Workers

I consider 4 types of workers depending on their education (below or above 12 years of education) and residence in Mexico (rural/urban). The educational distribution and residence distribution is obtained by MxFLS.

		Distribution	(MxFLS)
	abbreviation	rural	urban
edu<12	HSD	0.675	0.088
edu>=12	COL	0.179	0.058

I consider a worker's decision starts right after he finished his education in Mexico. I set initial age to be 16 for the low educated worker and 19 for the high educated worker. I consider decision making of 30 years. One period equals to 6 months so that $T = 60$. I solve for an optimal strategy through the backward induction. The human capital level $h_t \in \{1, 1.5, 2, 2.5, \ldots, 24\}$ are approximated by 60 points. The signal values z_t are approximated by 31 points using Kennan (2006)'s method of approximating the continuous distribution. I assume that $\beta = 0.96$.

The locational preference distribution differs according to rural or urban. Worker from rural and urban area has high locational attachment with probability p^R, p^U ,respectively. Since this model does not consider the living cost difference in the rural and urban area, I catch this difference by allowing locational distribution to differ between rural and urban. Given the same amount of money, a worker prefers to live in rural area because living cost is low. However, the living condition in a rural area is not preferable. Therefore, a priori, proportion who prefers to live in Mexico may or may not be higher for rural workers.

6.2 Wage in Mexico

Per-period earnings in Mexico for a worker with and without US migration experience is given by

$$w_t^{MX}(X_t, h_t) = \begin{cases} \gamma_0 + \gamma_1 age + \gamma_2 age^2 + \alpha h_t + \theta^{MX} + \psi_t & \text{if never migrated to the US} \\ \rho_0 + \rho_1 age + \alpha h_t + \theta^{MX} + \psi_t & \text{if returned to Mexico} \end{cases}$$

I estimate the coefficients from the OLS regression of annual earnings against observables for each age groups using Mexican Census (2010). I restrict the samples to those who were not in the US 5 years prior to the survey to estimate those without migration experience. I estimate the coefficients ρ_0, ρ_1 by linear interpolating the pairs of (average age, average earnings) for 5 different age groups using Mexican Census (2010). I restrict the samples to those who have resided in the US 5 years ago with only primary education. Table 10 gives the values for Mexican wage.

6.3 Simulated Method of Moments Estimation

The 22 parameters to be estimated can be divided into 5 groups (Table 9). I consider heterogenous types of immigrants depending on their education and their origin (rural/urban) in Mexico. Below gives the list of 5 groups of parameters to be estimated and the brief description on the identification.

1. The locational preference in Mexico: I estimate the actual utility from residing in Mexico and proportion of workers with each locational preferences.

    - Identification: If locational attachment to Mexico is too high, than no body migrates. If it's too low, then nobody returns to Mexico.

2. Idiosyncratic shock to a worker's wage: There are persistent component (i.e. match quality) and i.i.d. component (i.e. random shock). A worker gradually learns the persistent part through the history of signals.

- Identification: If there is no heterogeneity in the persistent component, then the return is not driven by their wage being low. On the other hand, if there is no i.i.d. shock, then everyone learns perfectly after one wage realization so either 1) no one returns from the US or 2) only high earner returns (because their human capital is rewarded in Mexico.)

3. Wage growth in the US: Job offer arrival rate determines which portion of workers are in the high wage job. I estimate the speed of the human capital accumulation as well as the returns to the human capital for each jobs.

    - Identification: Idiosyncratic shocks (persistent, random) itself cannot replicate the increasing variance over the length of US stay. Heterogeneity in the human capital accumulation process is identified by the evolution of wage dispersion.

4. Difference between two locations: the returns to the accumulated human capital in Mexico. The correlation of match quality between two locations.

    - Identification: Returns from the accumulated human capital in Mexico is identified by the positive return for US experience on wage in Mexico.

5. Migration cost: I estimate the probability of getting a finite migration cost as well as the migration cost.

    - Identification: Per-period probability of getting a finite migration cost must be low enough to be consistent with that less than 1/3 ever migrates to the US. The migration cost should be low enough that some actually migrates.

The parameters are estimated through simulated method of moments (SMM). This method derives the best estimate of Θ in the sense that the distance between moments derived from simulated data and the actual data moments are minimized. Moments are chosen to capture the key features of wage growth, speed of learning, initial migration decision, and the migration gains. Let simulated worker i's $j-$th moment be denoted by $m_{ij}(\Theta)$ where Θ is the parameter that is used to simulate. Define $j-$th data moment be denoted by μ_j. [12] Define the difference between simulated and data moment by $\tilde{m}_{ij}(\Theta) = m_{ij}(\Theta) - \mu_j$. The SMM estimation is given by solving

[12] For example, when the moment is average trip times, $m_{ij}(\Theta)$ is the number of trips made by simulated sample i and μ_j is the average number of trips obtained from data.

$$\hat{\Theta} = \arg\min_{\Theta} \left(\frac{1}{I} \sum_i \tilde{m}_i(\Theta)' \right) W \left(\frac{1}{I} \sum_i \tilde{m}_i(\Theta) \right)$$

where $\tilde{m}_i$ is a (# of moments)-dimentional vector.

The estimation procedure for finding an optimal $\hat{\Theta}$ is as follows:

1. Given initial guess of parameter $\tilde{\Theta}$, for each type, solve for value functions and optimal migration decision for each t, each belief about match quality, each human capital h_t using backward induction.
2. Calculate simulated lifetime panel of 20000 workers. Moment is calculated using the weighted average of both types.
3. Calculate the objective value. Since the objective function is presumably not smooth in Θ due to discrete choices, I use the simulated annealing (p.299-301, Judd (98)).

7 Result

The estimated parameters are in Table 11. The simulated data replicates the wage growth and wage dispersion for each US staying years. Figure 5 compares the duration of US stay using simulated data and the actual data.

7.1 Experiment on the Welfare Provision

California provide temporary cash assistance for a needy family. This program offers about \$704 per month for the family with 3 kids for the maximum duration of 5 years. Legal immigrants who stayed in the US for 5 or more years is eligible for this program. I consider an experiment of providing the similar level (i.e. \$4200 for 6 months) of assistance using only immigrants' tax revenue. That is to say, a worker's net income is \$4200 is their income is below \$4200 and $(1-\tau)w_t^{US}$ is their income is above \$4200.[13] Figure 6 shows the simulated tax revenue and simulated subsidy expenditure for each proportional tax. Since immigrants' wage in the US is much higher than the wage in Mexico, workers migrate to the US despite the high taxes.

[13]Net income jumps around \$4200, however, this is not a problem because I do not consider intensive margin of labor supply.

8 Conclusion and Future Works

In this paper, I considered the feasibility of income assistance policy for immigrants taking their wage assimilation and migration decisions into account. It is important to consider these channels because empirical evidence shows that there are significant amount of heterogeneity in their wage growth process and their wage in the US affects their migration decision. As for the future work, I explore the feasibility and impact on the various welfare programs that reflects the current situation. For example, some state-funded welfare programs for immigrants restrict to those who have resided in the US for 5 years or longer. I will analyze whether such duration dependent criterion helps to sort out the welfare demanding immigrants.

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Figure 1: Wage Distribution of Immigrants (ACS)

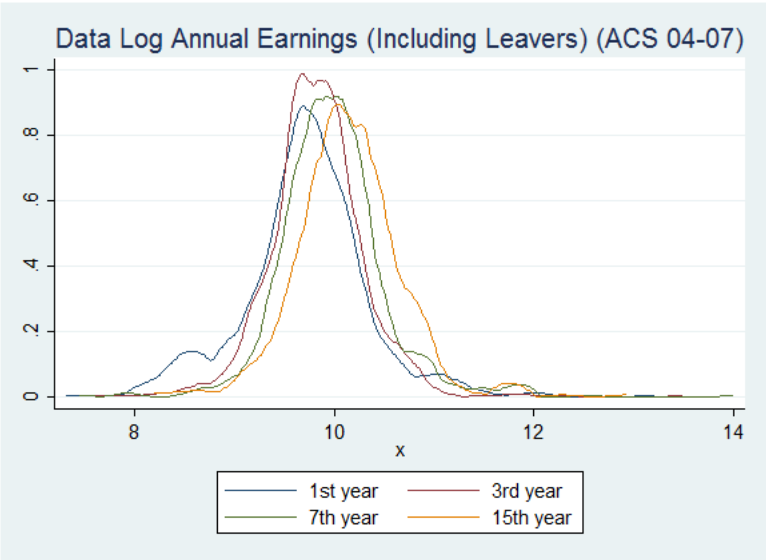


Table 2: Wage Growth of Immigrants (ACS)

	weekly	annual
Edu (years)	0.0288***	0.0336***
	(0.0007)	(0.0009)
Age (years)	0.0373***	0.0419***
	(0.0041)	(0.0048)
Age2/100	-.0505***	-.0582***
	(0.0052)	(0.0061)
year dummy=2005	-0.0376***	-0.0159
	(0.0103)	(0.0122)
year dummy=2006	0.1289***	0.1970***
	(0.0108)	(0.0127)
year dummy=2007	0.1164***	0.1779***
	(0.0108)	(0.0127)
0 (year of entry-survey year)	-0.6438***	-1.4399***
	(0.0262)	(0.0309)
1	-0.5920***	-0.8604***
	(0.0225)	(0.0264)
2 to 3	-0.5598***	-0.6449***
	(0.0195)	(0.0229)
4 to 5	-0.5259***	-0.5956***
	(0.0190)	(0.0224)
6 to 7	-0.4914***	-0.5275***
	(0.0188)	(0.0221)
8 to 9	-0.4479***	-0.4908***
	(0.0193)	(0.0228)
10 to 11	-0.3838***	-0.4164***
	(0.0191)	(0.0225)
12 to 14	-0.3515***	-0.3872***
	(0.0193)	(0.0227)
15 to 17	-0.3022***	-0.3157***
	(0.0184)	(0.0216)
18 to 20	-0.1646***	-0.1934***
	(0.0181)	(0.0213)
21 to 23	-0.1416***	-0.1763***
	(0.0197)	(0.0232)
24 to 26	-0.0611***	-0.0684
	(0.0195)	(0.0229)
Constant	5.7363***	9.4548***
	(0.0778)	(0.0916)
Observations	38358	38358
Adjusted R^2	0.1188	0.1551
*$p < 0.1$, ** $p < 0.05$,	*** $p < 0.01$	

Figure 2: Wage Growth of Immigrants (Tracking Arrival Cohorts) (ACS)

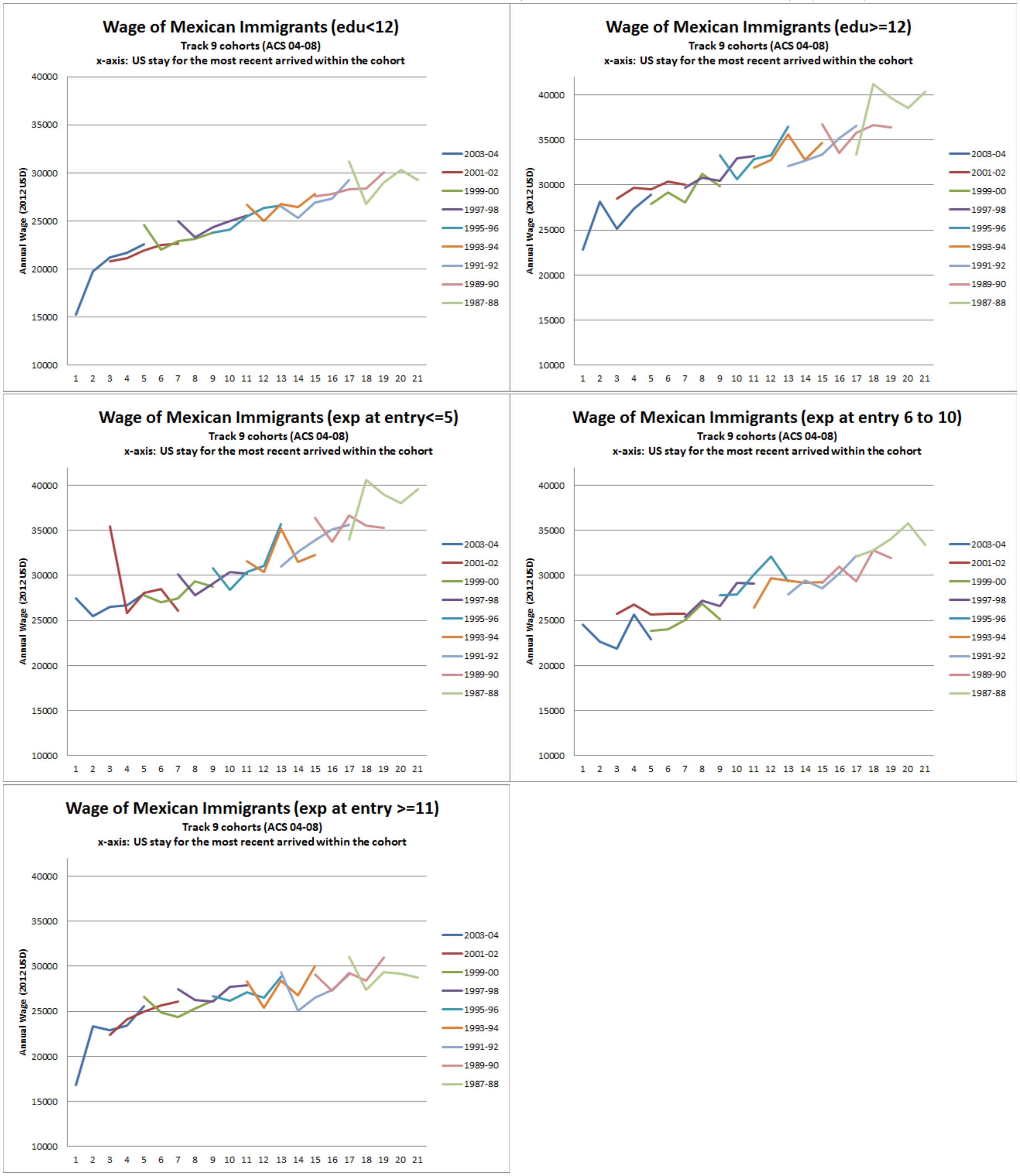


Figure 3: Age At Entry Distribution of tracking immigrants arrived in 2002-2003 (ACS)

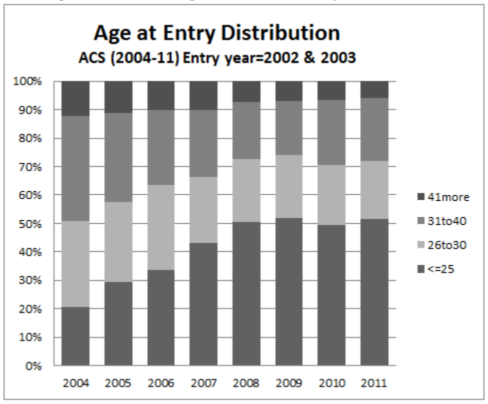


Table 3: Relationship between being surveyed at the 9th survey (SIPP)

	OLS	OLS	Probit	Probit
	log(monthly earnings at wave 1)	log(monthly earnings at wave 1)	Probability being sampled at 9th survey	Probability being sampled at 9th survey
sampled until 9th	0.0794**	-0.0098		
	(0.0311)	(0.0306)		
log(month wage at 1st survey)			0.1363**	-0.0199
			(0.0532)	(0.0579)
Edu (Years)		0.0174***		0.0047
		(0.0041)		(0.0092)
age at 1st survey		0.0711***		0.0946***
		(0.0106)		(0.0238)
(age at 1st survey)^2/100		-0.0706***		-0.0711**
		(0.0144)		(0.0325)
Length of US stay at 1st survey)		-0.00007***		-0.00009***
		(0.00001)		(0.00003)
Age at US entry		-0.0154***		-0.0406***
		(0.0027)		(0.0061)
Constant	7.4652***	6.185***	-0.8740**	-1.0948*
	(0.0232)	(0.1976)	(0.4006)	(0.5676)
samples	1520	1520	1520	1520

Data Restriction: male, aged 19 to 64 at the first survey, entered at ages 16 or older. Monthly wage at the first survey is $(0, 10000)$ 2012 USD.

Figure 4: Duration of US Stay (MMP)

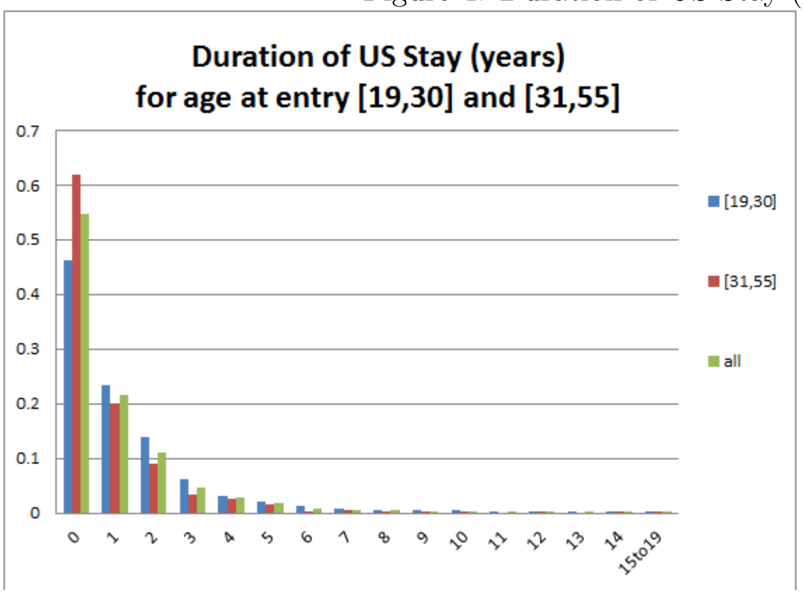
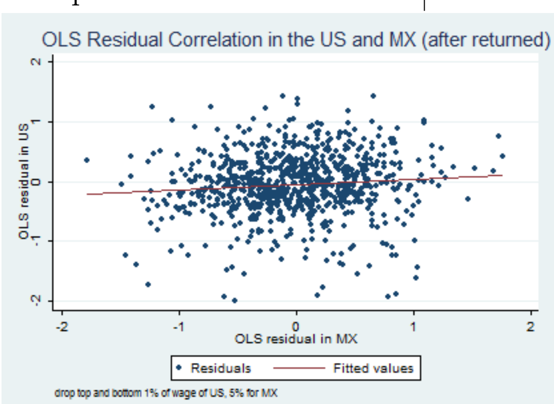


Table 4: Migration Decision and Characteristics at Wave 1 (MxFLS)

	probit	probit	OLS	OLS
	Probability of migrated after wave 1	Probability of migrated after wave 1	log(earnings at wave 1)	log(earnings at wave 1)
	never migrated before age [19,45]	after wave 1 age [19,45]	never migrated before age [19,50]	never migrated befo age [19,50]
migrated after wave 1			-0.3844***	-0.0634
			(0.0722)	(0.0651)
migrated before wave 1		0.7275***		
		(0.1174)		
rural	0.1636	0.1863*		-0.2735***
	(0.1005)	(0.0962)		(0.0386)
urban	-0.3914***	-0.3805***		0.2251***
	(0.1371)	(0.1325)		(0.0329)
No elementary	1.0234***	1.0307***		-1.1074***
	(0.2135)	(0.2074)		(0.0724)
Elementary	0.8598***	0.8967***		-0.8796***
	(0.1509)	(0.1503)		(0.0376)
Secondary	0.6667***	0.6661***		-0.5737***
	(0.1508)	(0.1504)		(0.0383)
High School	0.5511***	0.5855***		-0.3349***
	(0.1560)	(0.1552)		(0.0426)
age	-0.0606**	-0.0601**		0.1227***
	(0.0257)	(0.0251)		(0.0093)
age squared/100	0.0463	0.0436		-0.1528***
	(0.0444)	(0.0431)		(0.0138)
Constant	-1.0746***	-1.0918***	10.1129***	8.4203***
	(0.3772)	(0.3700)	(0.0132)	(0.1521)
samples	6610	6811	5218	5218
Control group is	college or more			

Table 5: Relationship between Wage in the US and in Mexico of an Individual (MMP)

	log(monthly earnings in the US)	log(monthly earnings in Mexico)
Age (years)	0.0077***	0.0038*
	(0.0017)	(0.0023)
Education (years)	0.0114***	0.0489***
	(0.0033)	(0.0066)
Age at Entry to the US	-0.0144***	
	(0.0019)	
Dummy for Non-agricultural		0.4924***
		(0.0508)
Constant	7.6175***	4.8989***
	(0.05802)	(0.1198)
samples	1940	1030



Samples are Mexican males who have entered to the US at ages 16 to 64.

For the left table, I delete top and bottom 1% of the wage observations. Only focus on Mexican wages after 1993. For the right table, I additionally delete top and bottom 5% of the Mexican wage observations.

Table 6: Panel Wage Growth for each year of US stay at the time of 1st interview (SIPP)

	Stayed ≤ 4 years	Stayed $(4, 10]$	Stayed $(10, 24]$
age	0.0502***	0.0386**	0.0451**
	(0.0127)	(0.0158)	(0.0187)
age squared/100	-0.0564***	-0.0561***	-0.0588***
	(0.0189)	(0.0204)	(0.0223)
edu 7 to 11	0.0234	0.0361	0.0509
	(0.0475)	(0.0459)	(0.0362)
edu 12	0.1595***	0.0817*	0.1716***
	(0.0536)	(0.0460)	(0.0378)
edu 13 more	0.0391	0.2524***	0.4445***
	(0.0588)	(0.0524)	(0.0464)
4months to 1 year later	0.1330**	0.0508	0.0181
	(0.0519)	(0.0460)	(0.0389)
1 to 2 years later	0.1725***	0.1305***	0.0650*
	(0.0522)	(0.0462)	(0.0391)
3 to 4 years later	0.2832***	0.1477***	0.0924**
	(0.0554)	(0.0499)	(0.0412)
constant	6.2993***	6.8432***	6.7579***
	(0.2056)	(0.2911)	(0.3867)
observations	982	1134	1809

Figure 5: Simulated Data and Actual Data of Duration of US Stay

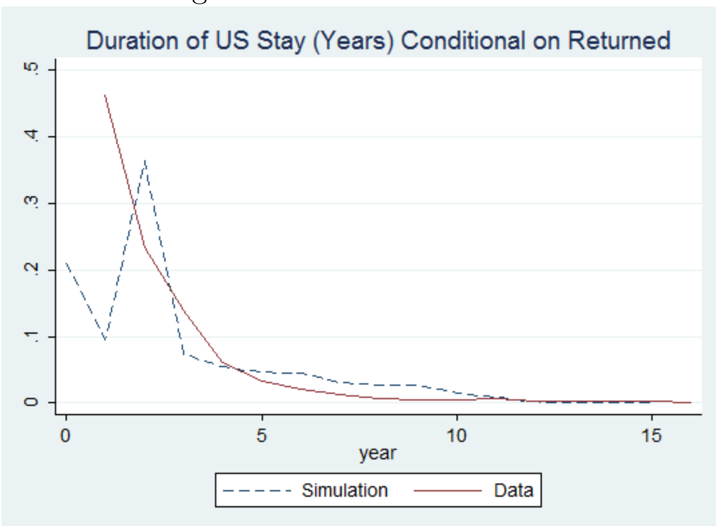


Figure 6: Simulated Tax Revenue and Expenditure

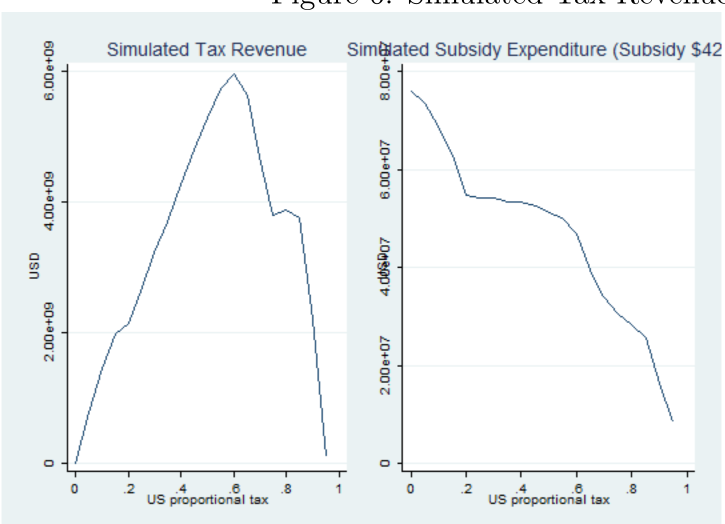


Table 7: Transition Matrix of Monthly Earnings (SIPP)

All workers who are sampled until 9th interview. Male, ages 19 to 64 at the first interview, entered to the US at ages 16 or older.

		9th survey	(about 3 years	later)
Mexicans	Edu≤11	lower 1/3	middle 1/3	upper 1/3
1st survey	lower 1/3	0.533	0.320	0.147
	middle 1/3	0.311	0.470	0.219
	upper 1/3	0.154	0.235	0.611

		9th survey	(about 3 years	later)
Mexicans	Edu≥12	lower 1/3	middle 1/3	upper 1/3
1st survey	lower 1/3	0.635	0.259	0.106
	middle 1/3	0.318	0.447	0.235
	upper 1/3	0.048	0.298	0.654

		9th survey	(about 3 years	later)
Native whites	All Edu	lower 1/3	middle 1/3	upper 1/3
1st survey	lower 1/3	0.678	0.239	0.084
	middle 1/3	0.241	0.562	0.197
	upper 1/3	0.081	0.201	0.718

Table 8: Duration of US stay and Mexican wage after returned (MxFLS)

Annual Income	
migrated after wave 1	-0.1265
	(0.1147)
US durations (years)	0.0608**
	(0.0271)
rural	-0.2965***
	(0.0378)
urban	0.2659***
	(0.0340)
No elementary	-1.0974***
	(0.0708)
Elementary	-0.8540***
	(0.0400)
Secondary	-0.5329***
	(0.0405)
High School	-0.3401***
	(0.0456)
age	0.1134***
	(0.0078)
age squared/100	-0.1401***
	(0.0111)
Constants	8.5332***
	(0.1355)
observations	5176
	ages [16, 55], migrated >=1986, delete top and bottom 1% of wage observations

Table 9: Parameter Estimates Θ

Description	Notation
locational preferences in Mexico	$\eta_0^M, \eta_0^L, p_M^{RUR}, p_M^{URB}, p_M^{COL}$
degree of uncertainty	$\sigma_\theta^2/\sigma_\varepsilon^2$
migration cost	c, κ
returns to human capital in the US	$\beta_{0H}, \beta_{0L}, \beta_{1H}, \beta_{1L}, \beta_{2H}, \beta_{2L}$
human capital accumulations in the US	h_0^{COL}, g_L, g_H
returns to human capital in Mexico	α
scaling parameter	η_1
job G arrival rate	$\lambda^{HSD}, \lambda^{COL}$

Table 10: Average Monthly Earnings in Mexico in 2012 USD (Mexican Census 2000, 2010)

	lived in Mexico		5 years ago		lived in the US		5 years ago	
	high-school dropouts		high-school graduates		high-school dropouts		high-school graduates	
age	earnings	samples	earnings	samples	earnings	samples	earnings	samples
20-24	305.47 (0.31)	488843	578.49 (3.38)	16950	347.57 (3.75)	6490	858.59 (144.13)	28
25-29	361.93 (0.42)	470545	801.25 (2.50)	54726	369.33 (2.74)	12017	1043.69 (67.48)	177
30-34	386.64 (0.48)	446976	962.22 (2.96)	55245	404.20 (3.43)	11191	1035.95 (55.00)	284
35-39	399.53 (0.53)	414550	1047.84 (3.18)	53513	407.68 (3.85)	8513	1186.67 (60.22)	252
40-50	401.88 (0.45)	665283	1127.61 (2.59)	88015	423.80 (4.19)	8624	900.04 (42.61)	283

eliminate top and bottom 1% of the observations. Standard errors are in parenthesis.
high school dropouts = reported less than high school, open high school, open basic
high school graduates = reported high school, college or higher

Table 11: Parameter Estimates $\hat{\Theta}$

Description	Notation	Value
locational preferences in Mexico	η_0^M	10948
	η_0^L	39
probability of getting η_0^M in rural, edu<12	p_M^{RUR}	0.58
probability of getting η_0^M in urban, edu<12	p_M^{URB}	0.50
probability of getting η_0^M for edu≥12	p_M^{COL}	0.25
degree of uncertainty	$\sigma_\theta^2/\sigma_\varepsilon^2$	13.3
migration cost	c	76.8
prob. of getting finite migration cost	κ	0.06
job B: returns to human capital (const)	β_{0B}	8.9
job B: coefficient on h_t	β_{1B}	0.009
job B: coefficient on h_t^2	β_{2B}	-0.0001
job G: returns to human capital (const)	β_{0G}	8.6
job G: coefficient on h_t	β_{1G}	0.027
job G: coefficient on h_t^2	β_{2G}	-0.00006
initial human capital for COL	h_0^{COL}	1
human capital accumulations	g_B	0
human capital accumulations	g_G	1
returns to human capital in Mexico	α	8.7
scaling parameter	η_1	4.03
Age penalty of getting Good job	ℓ	0.25
job G arrival rate for HSD	λ^{HSD}	0.15
job G arrival rate for COL	λ^{COL}	0.43