The Selection of Return Migrants: Some Evidence and a Model-based Analysis

Joseph-Simon Görlach* and Filippo Palomba

September 30, 2019

Abstract

The relation between a migrant's productivity and his or her chosen migration duration is a priori unknown and potentially non-monotonic. We document a U-shaped relation between the intention of recent documented Mexican immigrants to stay permanently in the U.S. and their earnings. We estimate a simple dynamic life-cycle model that replicates this pattern. We carefully explain how the observed pattern of return intentions is used to identify the model's preference parameters. We use the estimated model to evaluate the effect of a change in the earnings level in Mexico, as well as of the purchasing power parity between the U.S. and Mexico on immigrants' return plans and their savings.

Keywords: Migration, Selection, Structural estimation

*Corresponding author: Department of Economics, Bocconi University, BIDSA and IGIER; e-mail: josephsimon.goerlach@unibocconi.it.

1 Introduction

In most contexts of international migration, some immigrants will later return to their country of origin, while others may stay for the rest of their life in the destination country. Return migration, however, is not a random event, but related to migrant's characteristics and economic outcomes. One dimension along which the selection of return migrants is of particular interest for host countries is their earnings. Understanding from which parts of the earnings distribution return migrants are drawn is important for multiple reasons. The fiscal contribution of immigrants to the host economy directly depends on their earnings, both via the taxes and social security contributions paid, and the public services from which individuals benefit. Kırdar (2012), for instance, shows that estimates of the contributions and costs of Turkish immigrants to the German social security system depend on whether the selection in return migration is accounted for. Immigrants who expect to return have also been shown to save a larger fraction of their incomes (Dustmann and Mestres, 2010), likely with the aim of enjoying a higher consumption level after a return to their home country, where assets accumulated abroad have a higher purchasing power. Again this is important from a host country perspective to the extent that the higher consumption of permanent migrants contributes to local demand for goods and services. Furthermore, the degree of competition with different parts of the non-migrant labor force will depend on the productivity of immigrants who stay in the country longer term. Labor market effects on non-migrants have been a major policy concern and continue being debated in economic research (see for instance Dustmann et al., 2016).

In this paper, we document and analyze the relation between earnings and migration duration for the case of Mexican migrants in the United States. The U.S. Department of Homeland Security estimates that about ten million Mexicans reside in the United States, corresponding to 40% of the total immigrant population (U.S. Department of Homeland

Security, 2017). We focus on the planned migration duration of documented Mexican immigrants. One advantage of using information on planned durations rather than ex-post realized durations is that the former do not suffer from the right-censoring problem inherent in observed actual migration durations. Stated return migration plans are likely a more precise predictor of actual return migration for the documented migrants covered by the dataset we use than for migrants residing in the U.S. without a legal permit.[1]

Previous papers have investigated the selection in outmigration, not least due to its importance for the estimation of immigrant earnings profiles, see Dustmann and Görlach (2015) for an overview. Most studies using North American data find a negative selection of outmigrants (Borjas, 1989; Hu, 2000; Lubotsky, 2007; Picot and Piraino, 2013). In our sample of documented Mexican migrants to the U.S., we find instead that the fraction of immigrants planning to the stay in the U.S. permanently in fact is a U-shaped function of earnings. We formulate a simple dynamic life-cycle model of asset accumulation and return migration that we use to pin down preference parameters that can rationalize this non-monotonicity. The model explains return migration (for some migrants) via a savings motive (as e.g. in Djajić and Milbourne, 1988, and many papers since). Diaspora savings are an important feature of international migration, estimated to exceed 2 percent of developing countries' GDP on average (Ratha and Mohapatra, 2011). The model's predictions are thus also important from the sending country's perspective.

We structurally estimate the model's parameters, and show that the curvature of utility with respect to consumption is central in explaining the observed pattern: within our model, a utility function with low concavity (large inter-temporal elasticity of substitution) generates an increasing relation between earnings and the tendency to stay

[1] According to Hanson (2006), 56 percent of Mexicans residing in the U.S. are undocumented, though more recent figures by the U.S. Department of Homeland Security (2017) suggest that this share has decreased during the last decade both in absolute number (-5.7 percent) and as a fraction of the whole population of undocumented immigrants in the U.S. (4 percentage points less).

permanently in the destination. A too concave utility function (low IES) generates a decreasing relation. The observed U-shaped pattern can thus be used to identify the curvature parameter in the utility function of our model. In fact, as the observed non-monotonicity requires that the inter-temporal elasticity of substitution changes across earning levels, it can be used to identify an additional preference parameter. We thus use hyperbolic absolute risk aversion preferences, where the additional parameter can be interpreted as a minimum required consumption level.

The model matches the data very well. In particular, we show that the model also replicates the level of assets, which we do not target in the estimation. Given the extensive use in the literature of consumption and savings data for identification of the intertemporal elasticity of substitution (Blundell et al., 1993; Beaudry and Van Wincoop, 1996), the model's ability to match the asset level is reassuring. We use the estimated model for an empirical evaluation of the effects of a change in Mexican earnings levels, as well as in the relative price level between Mexico and the U.S. on migration duration and on the saving behavior of immigrants. The model predicts that a rise in Mexican earnings or in the purchasing power of U.S. savings in Mexico both reduce migration duration and raise the savings ratio of migrants. As such, our analysis relates to a recent paper by Akay et al. (2018), who investigate the savings choices by immigrants from a large array of origin countries residing in Germany. Regressing log savings on log purchasing power parities between Germany and a migrant's country of origin, they find conditional coefficients in the range 0.76-2.64. For the sample of Mexican immigrants in the U.S., our model predicts a somewhat smaller (though economically still strong) elasticity of savings with respect to a change in relative price levels, with a slope of 0.53 of log savings relative to the log purchasing power parity for migrants planning to return.

By providing a detailed account of the estimation, identification and fit of a relatively simple dynamic life-cycle model of migration, this chapter may serve a starting point for

researchers seeking to contribute to the small but growing literature that structurally estimates models of temporary migration. Insofar, we build on Dustmann and Görlach (2016), who provide a detailed survey of this literature along a similar model, which however is not brought to the data. Rendon and Cuecuecha (2010), Thom (2010), Lessem (2018), Nakajima (2015), and Görlach (2018) estimate dynamic life-cycle models for international migrants, focusing on various aspects of Mexico-U.S. migration. In contrast to these papers, which mostly use data from the Mexican Migration Project (MMP), we focus on documented Mexican migrants to the U.S., sampled by the New Immigrant Survey (NIS). Besides the different target population, this under-utilized dataset has the advantage of interviewing migrants during their stay abroad. It thus also covers permanent migrants, while the MMP inquires about past migration experience of migrants who have returned to Mexico. Furthermore, the NIS is unique in that is provides information on migrants' *planned* duration of stay. This avoids censoring and attrition problems associated with measuring actual migration duration. Finally, interviewing migrants during their stay in the U.S. is likely to yield more reliable information on their U.S. earnings and other outcomes.

The next section provides some descriptives on the relation between immigrants' earnings and their planned length of stay, before introducing in Section 3 the model we use to rationalize the observed patterns. Section 4 explains identification and estimation of the model's parameters, while Section 5 presents the estimates together with a number of counterfactual simulations.

2 Data and Descriptives

This section presents the data and shows some descriptive statistics of the sample of Mexican migrants we analyze. The empirical analysis is based on the first full wave of the

New Immigrant Survey (NIS), which is a representative sample of legal immigrants to the U.S. who acquired legal permanent residents since the turn of the 21st century.[2] The data on immigrants include the country of origin, age, their year of arrival in the U.S., school career, as well as employment status, earnings and hours worked in 2003. Furthermore, it contains data on the intention to stay (permanently or not) in the United States. We focus on Mexican-born individuals with at most 12 years of schooling currently living in the U.S. and aged between 18 and 65.[3] This yields a final sample of 812 individuals. Table 1 gives a first, brief description of the sample at hand, listing mean and standard deviation of the main outcomes we use. In our main analysis, we include both female

	Mean	**St. Dev.**
Female	0.61	0.49
Age	37.66	12.16
Years of schooling	7.58	3.46
Hours worked per week	40.10	13.16
Annual earnings (USD)	8,592.95	13,156.78
Intention to stay	0.91	0.29
Number of Individuals	812	

Table 1: Descriptive statistics for the main variables in the NIS-2003-1.

and male migrants. As much of the literature restricts attention to male migrants, we show that estimates are similar when we repeat the estimation for men only. Given the restriction to non-tertiary educated immigrants, the average number of years of schooling is 7.6 years. Individuals work about 40 hours per week, earning on average 8,600 USD per year.

Our main interest is on the relation between earnings and migration duration, which

[2]The NIS is a longitudinal survey of randomly selected immigrants turned lawful permanent residents in 2003. The first interview was conducted between May and November 2003, the follow-up between June 2007 and December 2009. The NIS dataset is publicly available at `http://nis.princeton.edu/`.

[3]The restriction to non-tertiary educated migrants yields a more homogeneous sample, to which we apply the model in Section 3. Only 15.6 percent of Mexican immigrants in the NIS are tertiary educated given our other sample restrictions.

is determined by the selection of return migrants along the earnings distribution. Direct measures of actually realized migration duration are rarely available. Where this information is reported, it generally suffers from right censoring.[4] Instead, the NIS inquires about immigrants' *intention* to stay in the U.S. permanently. Specifically, the question asked in the NIS to immigrants is: "Do you intend to live in the United States for the rest of your life?". Given that we restrict attention to documented migrants, a relatively large share of 91% plans to stay in the U.S. permanently.[5] This fraction is 92,51% for men and 89,66% for women, with their difference not being statistically significant at any meaningful confidence level.

Return intentions are not uniform across the earnings distribution, however. Rather, we find a U-shaped relation between the two variables: in our sample, the intention to stay permanently is lowest in the middle of the earnings distribution, while higher at the lower and upper ends. Figure 1 illustrates this relation by displaying the mean intention to stay for different earnings terciles. The figure shows a clear convex relationship between the two variables of interest. On average, Mexican migrants with low or high earnings are significantly more likely to plan to permanently stay in the U.S. than those at intermediate earnings levels. The difference between the lower two earnings terciles is significant at the 5% level (t-statistic equal to 2.18, $p = 0.031$), while the difference between the upper two earnings tercile is significant at the 1% level (t-statistic of 2.65, $p = 0.009$). We will use these mean intended migration durations by earnings terciles as moments in the structural estimation detailed in Section 4. In the Appendix we report the same figure for different numbers of quantiles (Figure B.1), showing that the U-shaped relation is robust to finer partitions of the earnings distribution. We also show that the qualitative

[4]Note that our model in Section 3, by explicitly formulating the decision to return, would account for this censoring. The NIS, however, does not provide information on actual total migration duration.

[5]The fraction planning to stay decreases to 84 percent if immigrants who report that they do not know whether they intend to stay permanently or not are included. We do not consider the intentions of these respondents.

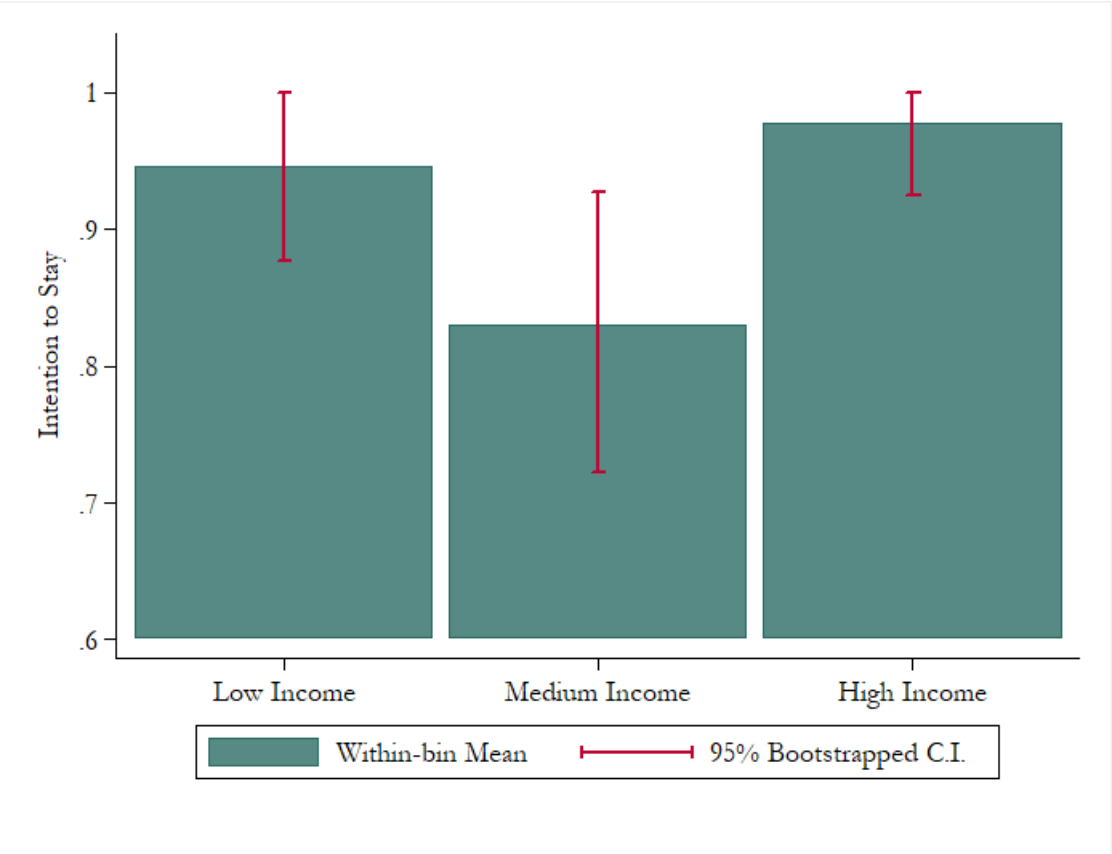

Figure 1: Intention to stay permanently in the U.S. across the earnings distribution. The figure shows the fraction planning to stay permanently within earnings terciles. Confidence intervals are bootstrapped.

pattern persists for earnings residuals after partitioning out different observed individual characteristics (Figure B.2). For further details on the variables we use, see Appendix A.

To account for different earnings and price levels across locations, we augment the NIS data with aggregate information. Specifically, we use the exchange rate and purchasing power parities for actual individual consumption from the OECD to compute that in 2003 assets accumulated in the U.S. have a 59 percent higher purchasing power in Mexico. Finally, we use OECD information on real earnings levels in Mexico and the U.S. to obtain an earnings ratio of 29 percent.

3 Model

The model is chosen to describe mechanisms determining the selection of returning migrants that can rationalize the pattern we observe in the data. The model begins at the time an immigrant arrives at the destination country and follows him or her through the remaining life-cycle, including time spent in the country of origin after a return. To analyze the mechanisms at work more clearly, the model is kept simple on purpose, and focuses on asset accumulation as a motive for return migration. Dustmann and Görlach (2016) provide a detailed discussion of extensions in various directions. This section describes the primitives of the model, including agents' information set and choices, state variable transitions, the timing of choices, and finally the dynamic specification of the model.

State variables. An immigrant i at time t makes decisions based on age $a_{i,t}$, current location $l_{i,t} \in \{o(rigin), d(estination)\}$, the accumulated stock of assets $A_{i,t}$, as well as his or her skill level, s_i which is assumed to be constant over time. The vector $\Omega_{i,t} \equiv (a_{i,t}, l_{i,t}, A_{i,t}, s_i)$ collects the state variables known by the agent at time t. In the estimation, a period is taken to be one year.

Timing. At the beginning of each period, individuals decide whether to stay for at least one more period in the destination country ($l_{i,t} = d$) or whether to return to the country of origin ($l_{i,t} = o$). After this decision has been made, consumption $c_{i,t}$ is chosen. Each of these choices is based on the individual's age $a_{i,t}$, assets $A_{i,t}$ and skill level s_i. It is assumed that return is an absorbing state.[6]

[6]While repeat migration cannot be ruled out, we do not observe it in our data. It likely also is less prevalent among the recent documented migrants we focus on, than among earlier cohorts of migrants sampled e.g. by the Mexican Migration Project.

Earnings. Log earnings are a function of skills and are given by

$$\log y_i^d = \mu + \sigma s_i \qquad \text{when in the destination country}$$
$$\log y_i^o = \log y_i^d + \log \omega \qquad \text{when in the origin country,}$$

where μ and σ can be interpreted as the rental rate of human capital and the returns to skill in the destination country, respectively. The relative earnings level in the country of origin is given by ω. Since skills are unobserved, a normalization is required. Individual skills are thus assumed to be drawn from a distribution with mean zero and standard deviation one. Whereas in the absence of selective return migration this implies a distribution of log earnings in the destination country with mean μ and standard deviation σ, the endogeneity of return decisions implies that the actually observed distribution can be different.

Budget constraint. The main motive for temporary migration in the model is financial wealth accumulation for an increase in future consumption in the country of origin. For a given location l, we assume a standard inter-temporal budget constraint to relate future assets $A_{i,t+1}$ to income y_i^l, the current stock of assets $A_{i,t}$, and consumption $c_{i,t}$,

$$A_{i,t+1} = (1+r)A_{i,t} + y_i^l - c_{i,t}, \tag{1}$$

where r denotes the real interest rate. To abstract from the decision of where to hold accumulated savings, real interest rates are assumed to be identical in the two locations. However, in order to take into account differences in currency purchasing power, the stock of assets is adjusted by real exchange rate x if a migrant returns. In this case, the budget

constraint becomes

$$A_{i,t_r+1} = x\left((1+r)A_{i,t_r} + y_i^d - c_{i,t_r}\right), \tag{2}$$

where t_r denotes the last period in the destination country prior to return. Immigrants are assumed to arrive without any savings in the destination country and to not have access to credit.

Preferences. Individuals derive utility from consumption and location-specific amenities. Per period utility is specified as

$$u_{i,t}(c_{i,t}, l_{i,t}) = \frac{(c_{i,t} - \tau)^{1-\varphi}}{1-\varphi} + \mathbb{1}[l_{i,t} = d]\pi.$$

That is, individuals' utility from consumption is characterized by hyperbolic absolute risk aversion (HARA) utility function. In our specification, φ is a curvature parameter and τ is the minimum consumption level. That is, for $c_{i,t} \leq \tau$, utility goes to minus infinity. The inter-temporal elasticity of substitution for this utility function is given by $\frac{c-\tau}{\varphi \cdot c}$. Finally π is an additional preference parameter that determines the preference for residing in the destination country, with $\pi < 0$, indicating a preference for the origin country. In the particular case in which agents in the U.S. are indifferent between staying for at least one more period and returning in Mexico, we assume they opt for the former[7].

Welfare. Consumption and the time of return are chosen to maximize life-time utility subject to the budget constraints (1)-(2). The dynamic problem for these choices is given

[7]Imposing the contrary, i.e. that agents decide to return in Mexico when indifferent, does not affect results qualitatively.

by the Bellman equation

$$V(\Omega_{i,t}) = \max_{c_{i,t},l_{i,t}} u_{i,t}(c_{i,t}, l_{i,t}) + \beta \, \mathrm{E}_t \left[V(\Omega_{i,t+1}) \right],$$

where β discounts future utility streams and $\mathrm{E}_t[\cdot]$ is the expectations operator given the information available at time t. Individuals live until age a^{end}, with $V(\Omega_{i,t}|a_{i,t} = a^{end}) = 0$.

Mechanisms. In this simple model, several forces determine the duration an immigrant chooses to stay in the destination country. In particular, there are two different mechanisms that may make a return the preferred outcome, despite persistently higher earnings in the destination country. Both these mechanisms are related to asset accumulation, though being fundamentally distinct. First, a high purchasing power of assets in the country of origin ($x > 1$) makes a return attractive, as a higher level of real consumption can be enjoyed in the origin country. Migrants hence need to weigh the benefit from a longer time of high earnings in the destination against that of a higher value of assets in the origin. Second, a preference for being in the country of origin ($\pi < 0$) may trigger a return if the decreasing marginal utility of consumption makes the benefit from further asset accumulation in the destination less valuable than the utility gain from return migration.

Note that despite the central role of asset accumulation for both mechanisms, they differ in a fundamental way: a high purchasing power of the host country currency in the origin country can rationalize an initial migration from the origin to the destination even if real earnings in the destination (evaluated at destinations prices) are not higher than in the origin country (i.e. if $\omega = 1$) and if migrants do not have a particular preference for either location ($\pi = 0$). The sole purpose of migration in this case is the anticipated return, and migrants will never stay abroad permanently. Consider, in contrast, a case

in which $x = 1$, but $\pi < 0$. In the absence of an earnings differential ($\omega = 1$), individuals would not be induced to leave their home country in the first place. If higher earnings can be achieved in the destination country ($\omega < 1$), individuals may emigrate, and depending on the size of the earnings differential and the strength of preferences towards the origin, migrants may find it optimal to return at some future point in time or to emigrate permanently. Such a corner solution of permanent emigration does not occur if migration is entirely driven by differences in purchasing power, because the sole purpose of migration is the anticipated higher level of consumption that can be enjoyed if and only if a return occurs.

4 Estimation and Identification

The model in Section 3 can be solved by backward induction. The choice functions obtained are used to simulate consumption and return migration decisions of a sample of individuals. The similarity of the moments of this simulated sample to those observed for Mexicans in U.S. New Immigrant Survey can then be used to identify the structural parameters of the model.[8]

We use five moments from the sample that are informative about the structural parameters in the model. The rental rate of human capital μ and the returns to skill σ that govern the mean and variance of immigrants' earnings in the U.S. have close counterparts in the empirical sample that we use for identification. Since the sample is collected several years after arrival, selective out-migration implies that only a non-random part of the full distribution will be observed. Hence, the mean and standard deviation of earnings of our immigrant sample do not directly correspond to the structural parameters μ

[8]The model features two macroeconomic parameters, the relative price level and earnings in Mexico, which we set to values taken directly from the OECD (see Section 2). We further set the discount factor and the real interest rate $\beta = \frac{1}{1+r} = \frac{1}{1.05}$. All other parameters are estimated.

and σ. Our model explicitly accounts for this selection. Thus, while μ and σ cannot be pre-estimated, these two parameters can be estimated within the model, jointly with the preference parameters.

The preference parameters φ, τ and π can be identified from different elements of of the distribution of the intentions of migrants to permanently stay in the United States. The difference in utility individuals derive from residing in the U.S. compared to Mexico is determined by π. Thus, a more negative value of π implies that fewer immigrants intend to stay in the U.S. permanently, and so the overall fraction of immigrants planning to stay can be used for identification of π.

The remaining two parameters φ and τ are identified from the variation of this fraction along the earnings distribution. To understand how, recall that there are opposing effects of earnings on the propensity to stay: on the one hand, higher earnings imply a higher opportunity cost of returning to Mexico, where earnings are lower. This substitution effect raises the desire to stay in the United States. On the other hand, the income effect raises demand for time to be spent in the country of origin, where individuals enjoy additional utility π. Whether the income or the substitution effect dominates depends on the curvature of the utility function and thus on the inter-temporal elasticity of substitution (IES): For a high IES, the substitution effect dominates, and individuals prefer the rise in consumption that can be achieved through spending additional time in the U.S. over the utility derived from residing in Mexico. For a low IES, the income effect dominates, and higher earnings raise the value of returning to the country of origin.

In our model, the IES is given by $\frac{c-\tau}{\varphi \cdot c}$. In the absence of a minimum consumption level ($\tau = 0$), the IES collapses to $1/\varphi$, thus being constant across consumption and earnings levels. In this case, either the income or the substitution effect dominates throughout, implying a monotonic relation between earnings and the desire to stay in the U.S. permanently. Specifically, for φ close to zero, the IES is large, and the substitution effect

dominates, implying a positive relation between earnings and permanency of migration. For large φ, in turn, the income effect dominates, leading to higher incomes being associated with a stronger tendency to return. Whether the fraction of immigrants planning to stay permanently decreases or increases with earnings thus identifies the curvature parameter φ.

As shown in Figure 1, this relation between migration duration and earnings is in fact non-monotonic. This non-monotonicity can be used identify the minimum consumption level τ. For a positive minimum consumption level $\tau > 0$, the IES $\frac{c-\tau}{\varphi \cdot c}$ varies with consumption and approaches $1/\varphi$ from below for $c \to \infty$. Starting from a low level of earnings and consumption (IES < 1), where the income effect dominates, an increase in consumption raises the IES and thus strengthens the substitution effect. This creates the U-shaped relation between earnings and the fraction of immigrants intending to stay permanently. The strength of this non-monotonicity pins down the parameter τ.

The estimation is based on the method of simulated moments developed by McFadden (1989) and Duffie and Singleton (1993). It estimates the structural parameters by minimizing the (squared and weighted) distance between a vector of moments predicted from the model and the same moments observed in the data. The estimation requires that the generation of the simulated sample mirrors that of the observed data. Our model starts at a migrant's arrival in the destination country. We thus draw the age at arrival for the simulated sample from the observed empirical distribution. Similarly, to select the simulated sample from which moments are to be constructed, we draw the age at the time of the survey from the empirical age distribution in the NIS.[9] The estimator then minimizes the objective function

$$crit = (\mathbf{m_d} - \mathbf{m_s}(\theta))' \mathbf{W} (\mathbf{m_d} - \mathbf{m_s}(\theta)),$$

[9]To be precise, we use the joint empirical distribution of age at arrival and age at interview to determine the simulated sample from which to construct moments.

where $\mathbf{m_d}$ is the vector of the targeted empirical moments, $\mathbf{m_s}(\theta)$ is the corresponding vector simulated from the model with parameter vector θ, and $\mathbf{W}$ is a weighting matrix. We weight moments by their inverse standard deviation. Our estimates are unchanged when the identity matrix or the efficient full inverse covariance matrix is used (see Table B.1). Table 2 lists these moments and shows that the model is able to replicate the observed moments very well. The table also reports the fit with respect to log savings, a moment that we do not need for identification, and that we do not target. The fact that the model's prediction nonetheless lies well within the empirical confidence interval is reassuring, and supports the model despite its parsimony.

To test over-identification more formally, we use a Sargan test for the null hypothesis that the minimized criterion equals zero. The test statistic is

$$S = (\tilde{\mathbf{m}}_\mathbf{d} - \tilde{\mathbf{m}}_\mathbf{s}(\theta))' \mathbf{Var}(\tilde{\mathbf{m}}_\mathbf{d})^{-1} (\tilde{\mathbf{m}}_\mathbf{d} - \tilde{\mathbf{m}}_\mathbf{s}(\theta))$$

where $\tilde{\mathbf{m}}_\mathbf{d}$ is the vector of targeted moments augmented with mean log savings as a sixth moment, and where $\mathbf{Var}(\tilde{\mathbf{m}}_\mathbf{d})$ is the variance-covariance matrix of $\tilde{\mathbf{m}}_\mathbf{d}$. The test statistic is Chi-square distributed with one degree of freedom. The realization of $S = 2.46$ for our sample implies that we cannot reject our model at the 10 percent level.

Targeted moment	**Data**	**(Standard error)**	**Model**
Mean Log Earnings	9.381	(0.06)	9.381
St. Dev. Log Earnings	1.188	(0.07)	1.185
Intention to Stay (Low Income)	0.945	(0.03)	0.938
Intention to Stay (Medium Income)	0.830	(0.05)	0.830
Intention to Stay (High Income)	0.978	(0.02)	0.979
Mean Log Savings	7.547	(0.20)	7.239

Table 2: Model fit.

To show the sensitivity of the moments we use to the parameters that we seek to identify, Figure 2 plots the (log) criterion against different values of the structural pa-

rameters. For each parameter, the criterion obtains a clear local minimum. In order to show local identification more formally, Table 3 shows the gradient matrix $\frac{\partial \mathbf{m_s}'}{\partial \theta}$. Identification requires that gradient vectors for all parameters are linearly independent. To ensure that this is the case, we compute the eigenvalues of $\frac{\partial \mathbf{m_s}'}{\partial \theta}$. These are, rounded to the second decimal figure, -1332.44, -110.80, 15.70, 9.04 and 0.88. Since we obtain as many different non-zero eigenvalues as there are parameters, our set of moments (locally) point identifies the structural parameters under the model.

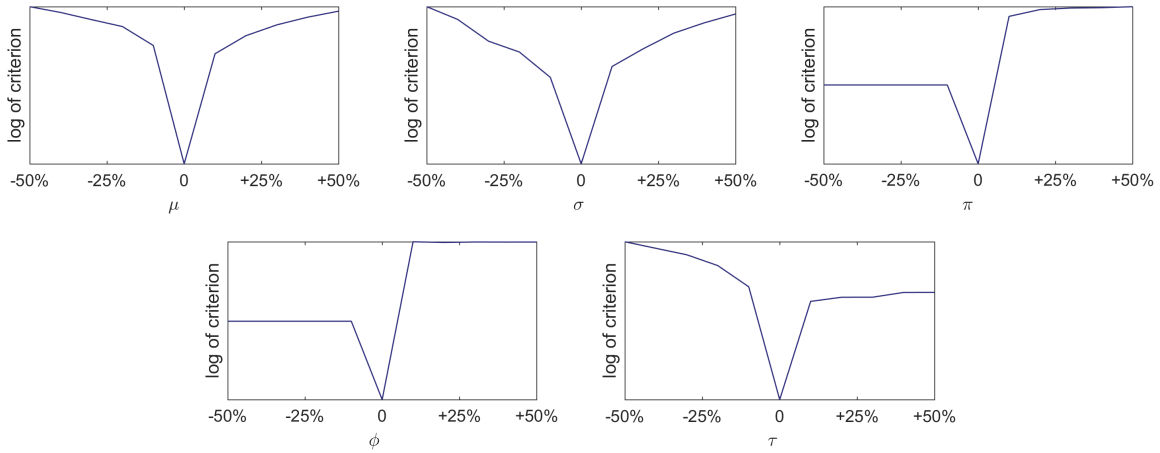

Figure 2: Local minima of the criterion with respect to values of structural parameters.

Parameters	**Moments**				
	earnings mean	earnings stdev	fraction staying (1st earn. tercile)	fraction staying (2nd earn. tercile)	fraction staying (3rd earn. tercile)
μ	15.612	0.087	-0.193	6.193	10.244
σ	0.046	13.455	-77.906	47.876	0.000
π	0.190	-0.334	0.000	441.948	283.354
ϕ	-32.730	21.224	-346.916	-1446.697	-3326.888
τ	0.000	0.000	-0.085	0.052	0.018

Table 3: Gradient matrix $\frac{\partial \mathbf{m_s}'}{\partial \theta}$.

5 Results

In this section, we discuss the estimated parameter values and how, within our model, they rationalize the observed patterns in the data. We further use the estimated model for a number of counterfactual evaluations of the effects of changes in macroeconomic differences between Mexico and the U.S. on migrants' consumption and migration behavior.

5.1 Estimates

Table 4 lists the estimated parameter values obtained through the method of simulated moments detailed in the previous section. In addition to our main estimates for the full sample, we also report estimates obtained when we focus on men only.[10] The results are almost identical to those for the full sample, with the exception that the higher earnings for men lead to a higher estimate of the mean earnings level μ. For the full sample, the mean and standard deviation of log annual earnings among documented Mexican migrants arriving in the U.S. are estimated to be $\mu = 9.37$ and $\sigma = 1.24$. Note that these do not coincide exactly with the mean and standard deviation of log annual earnings observed in the NIS, since immigrants may be surveyed several years after arrival, so that only a selected sub-sample of immigrants is observed. By modeling the return decision, our model explicitly accounts for this selection.

The estimate for the preference towards the destination country (π) is negative, implying that at any given level of consumption agents achieve a higher utility flow in Mexico than in the U.S. Notice that π captures various non-consumption amenities, such as the presence of family and friends, language or sense of belonging to a specific country or culture. Our estimate implies a negative combined effect of these different forces, which pull migrants towards a return migration.

[10] Estimation statistics corresponding to Figure 2, Table 2 and Table 3 are available upon request.

The estimate of $\phi = 0.89$ is in line with other estimates in the literature. Blundell et al. (1998), for instance, estimated this curvature parameter to be 0.93. The mean estimate in the literature reported by Chetty (2006) is 0.71. Finally, our estimate for the minimum consumption level is $\tau = 1,141$ (measured in PPP adjusted USD).

Parameters	μ	σ	π	ϕ	τ
All					
Estimate	9.37	1.24	-1.10	0.89	1140.80
Std. Err.	(0.00)	(0.01)	(0.00)	(0.00)	(4.92)
Males					
Estimate	9.57	1.24	-1.10	0.89	1140.80
Std. Err.	(0.01)	(0.01)	(0.01)	(0.00)	(65.35)

Table 4: Estimation results. Estimates are obtained by method of simulated moments, based on a simulation size of 10,000 individuals, and a diagonal weighting matrix with inverse variances on the diagonal. For the robustness of the estimates to other weighting matrices, see Appendix B. Standard errors in parentheses.

Taken together, these estimates imply that the IES equals one for a consumption level of $\tau/(1-\phi) = 10,371$ USD. This corresponds to the 46th percentile of annual consumption among immigrants in the U.S., as predicted by our model. Hence, while the relation between earnings (and thus consumption) and intention to stay permanently is flat at the center of the earnings distribution, it is negative at the lower end and positive at the upper end, explaining the U-shaped relation between earnings and planned permanence of migration observed in the data.

5.2 Counterfactual Analysis

With estimates for the structural parameters at hand, the model can be used for counterfactual analyses. In this section we focus on the effects of changes in macroeconomic conditions in the origin country on the migration and saving behavior of migrants. In

particular, we investigate how these outcomes respond to changes in the purchasing power of U.S. dollars in Mexico (x), and to changes in the relative earnings level (ω) between Mexico and the U.S.

The average saving ratio of immigrants in the U.S. is calculated as

$$\overline{sr} = \frac{1}{N} \sum_{i=1}^{N} \left(\sum_{t:l_{i,t}=d} \frac{y_i - c_{i,t}}{y_i} \right).$$

To focus on the role of savings for return migration, the model in Section 3 has abstracted from stochastic components and thus from a precautionary saving motive. Instead, agents in the model save only for the purpose of consumption after a return to the country of origin. The fraction of income agents put aside for this depends on the purchasing power of savings in Mexico.

Figure 3a shows how the saving ratio responds to changes in the real exchange rate. An increases in the purchasing power of U.S. dollars back in Mexico (x) raises the value of assets accumulated during the stay in the U.S., thus unambiguously raising the saving ratio while abroad. The higher value agents derive from spending assets in Mexico also raises the attractiveness of a return to the origin country. Figure 3b shows the stark decrease in the average time migrants spent in the U.S. as the purchasing power of U.S. dollars increases.[11] Note that this negative effect on migration duration is an empirical result: as the value of assets denoted in U.S. dollars rises, so does the benefit of staying and working in the U.S. This effect, however, turns out to be dominated by the benefit from returning, which is a pre-requisite for enjoying the higher consumption level agents can achieve when spending their savings in Mexico.

Apart from assessing the value of accumulated assets in terms of their purchasing power, migrants anticipate the drop in earnings suffered at a return to Mexico, where in-

[11] For migrants choosing to stay permanently, duration is truncated when they reach age 65.

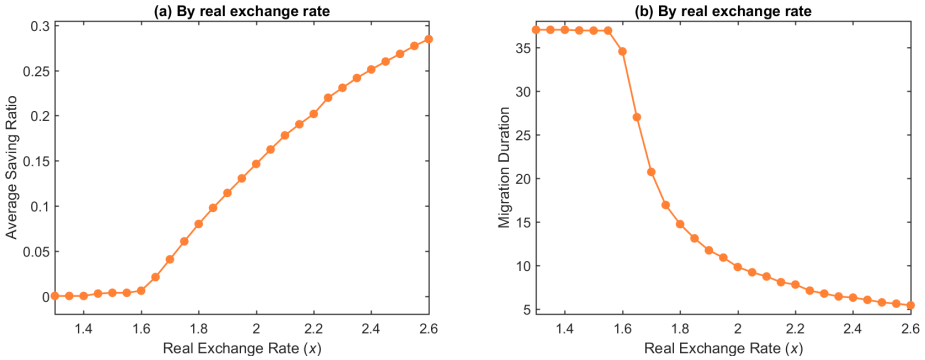

Figure 3: Effects of changes in the purchasing power of U.S. dollars in Mexico x on (a) immigrants' saving ratio, and (b) average time spent in the U.S.

come levels are generally lower. Taking a longer-run perspective, suppose Mexico catches up in terms of earnings levels relative to the U.S., amounting to an increase in ω in our model. This raises the value of residing in Mexico, and makes return migration a more desired option. The right panel of Figure 4 shows the reduction in the average time migrants spend in the U.S. The effect on savings, on the other hand, is ambiguous. On the one hand, fewer savings are required to achieve the same level of consumption after a return to Mexico, where individuals can now achieve a higher level of earnings. On the other hand, the shortened spell migrants choose to stay in the U.S. implies that a given level of desired assets needs to be accumulated within a shorter time period, requiring a higher saving rate. We find that the latter effect dominates for relative earnings levels in Mexico in the range of 30 to 85 percent of the U.S. earnings level (Figure 4a). For values of ω below this range, the model predicts that return migration is too unattractive, and migrants prefer to stay in the U.S. permanently, thus loosing the incentive to save. For values of ω above 85 percent, earnings in Mexico are sufficiently close to the those in the U.S. for the former effect to dominate, causing a decrease in the saving ratio. Note that even at $\omega = 1$ migrants continue to save, since we keep the real exchange rate at its actual level in this counterfactual simulation. Assets accumulated in the U.S. hence still have a higher consumption value back in Mexico, and migrants continue saving a positive

fraction of their income.

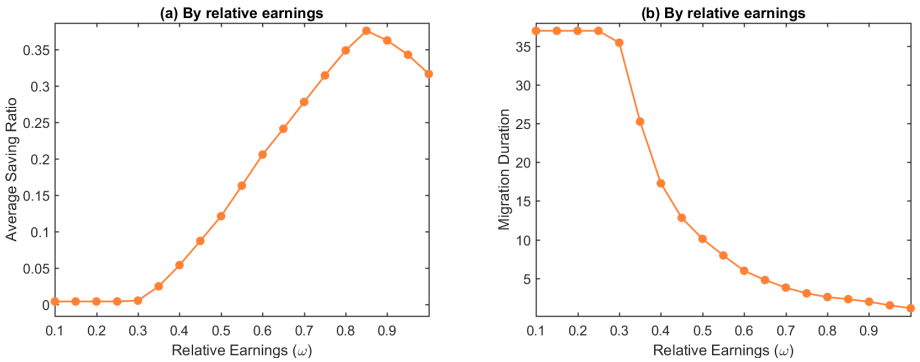

Figure 4: Effects of changes in relative earnings in Mexico ω on (a) immigrants' saving ratio, and (b) average time spent in the U.S.

The effect of a host country currency's purchasing power on migrants' saving is estimated in a recent paper by Akay et al. (2018) for immigrants in Germany from a large set of origin countries. The authors use a linear model to regress log savings on log purchasing power parities, and estimate an elasticity of 0.76 for their full sample, with larger estimates of up to 2.64 for migrants who report an intention to return. Figure 4a confirms the large elasticity. At the margin, however, the model predicts a somewhat smaller relation for our sample of Mexican immigrants in the U.S., with a slope of log savings over the log purchasing power of U.S. dollars in Mexico of 0.53.

6 Conclusions

Many immigrants in the U.S., as in other countries, do not intend to stay permanently. Instead, their optimal choice is to stay temporarily, often with the aim to accumulate a stock of assets that can be repatriated to the country of origin. A migrant's decision to return, however, is not taken randomly, but based available information and outcomes realized by the individual. In this paper we focus on the relation between anticipated return migration and earnings, and document a U-shaped relation in data for documented

Mexican surveyed by the U.S. New Immigrant Survey. Immigrants with intermediated earnings in this sample report a significantly lower desire to stay in the U.S. permanently. We relate this observation to the intertemporal elasticity of substitution in a simple dynamic life-cycle model of consumption and migration choices. We estimate the structural parameters of this model, with the novelty that we identify preference parameters that are typically identified using savings data by exploiting the pattern of planned migration durations along the earnings distribution. The estimated model is then used evaluate the sensitivity of migration duration and savings choices with respect to earnings and price ratios between the U.S. and Mexico. By carefully documenting the structural estimation of a dynamic migration model, we hope to support further research in this direction.

References

Akay, A., Brausmann, A., Djajić, S., and Kırdar, M. G. (2018). Purchasing-Power-Parity and the Saving Behavior of Temporary Migrants. Unpublished Manuscript.

Beaudry, P. and Van Wincoop, E. (1996). The Intertemporal Elasticity of Substitution: An Exploration Using a US Panel of State Data. *Economica*, pages 495–512.

Blundell, R., Duncan, A., and Meghir, C. (1998). Estimating Labor Supply Responses Using Tax Reforms. *Econometrica*, 66(4):827–861.

Blundell, R., Meghir, C., and Neves, P. (1993). Labour Supply and Intertemporal Substitution. *Journal of Econometrics*, 59(1-2):137–160.

Borjas, G. J. (1989). Immigrant and Emigrant Earnings: A Longitudinal Study. *Economic inquiry*, 27(1):21–37.

Chetty, R. (2006). A New Method of Estimating Risk Aversion. *American Economic Review*, 96(5):1821–1834.

Djajić, S. and Milbourne, R. (1988). A General Equilibrium Model of Guest-worker Migration: The Source-country Perspective. *Journal of International Economics*, 25(3-4):335–351.

Duffie, D. and Singleton, K. J. (1993). Simulated Moments Estimation of Markov Models of Asset Prices. *Econometrica*, 61(4):929–952.

Dustmann, C. and Görlach, J.-S. (2015). Selective Out-migration and the Estimation of Immigrant Earnings Profiles. In Chiswick, B. R. and Miller, P. W., editors, *Handbook of the Economics of International Migration 1A*, chapter 10, pages 489–533. North Holland.

Dustmann, C. and Görlach, J.-S. (2016). The Economics of Temporary Migrations. *Journal of Economic Literature*, 54(1):98–136.

Dustmann, C. and Mestres, J. (2010). Savings, Asset Holdings, and Temporary Migration. *Annals of Economics and Statistics/Annales d'Économie et de Statistique*, pages 289–306.

Dustmann, C., Schönberg, U., and Stuhler, J. (2016). The Impact of Immigration: Why Do Studies Reach Such Different Results? *Journal of Economic Perspectives*, 30(4):31–56.

Görlach, J.-S. (2018). Borrowing Constraints and the Dynamics of Return and Repeat Migration. Unpublished Manuscript.

Hanson, G. H. (2006). Illegal Migration from Mexico to the United States. *Journal of Economic Literature*, 44(4):869–924.

Hu, W.-Y. (2000). Immigrant Earnings Assimilation: Estimates from Longitudinal Data. *American Economic Review*, 90(2):368–372.

Kırdar, M. G. (2012). Estimating the Impact of Immigrants on the Host Country Social Security System when Return Migration is an Endogenous Choice. *International Economic Review*, 53(2):453–486.

Lessem, R. (2018). Mexico–U.S. Immigration: Effects of Wages and Border Enforcement. *Review of Economic Studies*, 85(4):2353–2388.

Lubotsky, D. (2007). Chutes or Ladders? A Longitudinal Analysis of Immigrant Earnings. *Journal of Political Economy*, 115(5):820–867.

McFadden, D. (1989). A Method of Simulated Moments for Estimation of Discrete Response Models Without Numerical Integration. *Econometrica*, 57(5):995–1026.

Nakajima, K. (2015). The Fiscal Impact of Border Tightening. Job Market Paper, University of Wisconsin-Madison.

Picot, G. and Piraino, P. (2013). Immigrant Earnings Growth: Selection Bias or Real Progress? *Canadian Journal of Economics/Revue canadienne d'économique*, 46(4):1510–1536.

Ratha, D. and Mohapatra, S. (2011). Preliminary Estimates of Diaspora Savings. *Migration and Development Brief*, 14.

Rendon, S. and Cuecuecha, A. (2010). International Job Search: Mexicans in and out of the US. *Review of Economics of the Household*, 8(1):53–82.

Thom, K. (2010). Repeated Circular Migration: Theory and Evidence from Undocumented Migrants. *Mimeo, New York University*.

U.S. Department of Homeland Security (2017). Population Estimates: July 2017.

A Data

The structural estimation of the model in Section 3 relies on two main variables provided by the New Immigrant Survey.

First, the questionnaire on which the NIS dataset is based contains the following question: "Do you intend to live in the United States for the rest of your life?".[12] Such a question reveals the intention to permanently stay in the U.S. at the time the migrant was interviewed. We compute the fractions planning to stay permanently within earnings terciles. This provides three out of the five desired moments.

Second, the data contains both the last yearly wage[13] and the hourly wage rate[14] for the two main jobs. This latter, multiplied by the number of hours worked per week and the number of weeks worked per year, allows us to construct a second measure for annual earnings. The two have similar distributions, with a difference in means that is statistically insignificant. To reduce the number of missing observations, we aggregate the two variables, treating the directly-reported wage as the dominant one, while the constructed wage is used only if the other one is missing. Our decision is based on two facts: the annual salary is more likely to be a good measurement of the true salary, while the probability of measurement errors in one of the three variables used to construct the alternative measure for wage is likely higher. From the constructed earnings measure we compute the mean and standard deviation as the remaining two moments required for identification.

We augment the analysis with macroeconomic data taken from the OECD database. In particular, we compute estimates for the relative earnings level in the country of origin

[12]Section J - Social Variables, question J196.

[13]Section G - Income Part 1, question G7A "Before taxes and other deductions, about how much wage and salary income did you receive in the last twelve months?".

[14]Section C - Employment, question C49 "What is your hourly wage rate for regular work not including extra for over time?".

(ω) and the real exchange rate Peso/USD (x).[15] The former is estimated taking the ratio between the average annual wage expressed in USD PPP for Mexico in 2003 and the same measure for U.S.. The latter is calculated as the ratio of the nominal and real exchange rates Peso/USD in 2003. The estimates we get are $x = 1.59$ and $\omega = 0.29$, respectively.

Finally, we use asset information from the NIS. As explained in Section 4, we do not use this information in the estimation directly, since we can identify the preference parameters in our model from stated return intentions. However, as a validity check, we show that our model is able to predict an additional moment on assets without explicitly targeting it. In particular, we estimate the moment for assets using data on savings from the NIS.[16]

B Robustness

B.1 Descriptive Patterns

In this section we perform several robustness checks. First, we show that the U-shape is robust to finer partitions of the earnings distribution (Figure B.1).

Second, the observed non-monotonic relation between permanence of migration and migrants' earnings may be driven by factors omitted from the analysis. To examine this, we condition on various individual characteristics observed in the sample. Figure B.2 shows that the U-shape relationship between intention to stay and earnings is preserved also conditional on these characteristics.

[15]The data for relative earnings has been downloaded from `http://stats.oecd.org/Index.aspx?DataSetCode=AV_AN_WAGE`, the data for the exchange rate from `https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm#indicator-chart`

[16]Section H - Assets and Income Part 2, question H116 "If you added up all [...] the accounts held in the United States about how much would they amount to right now?"

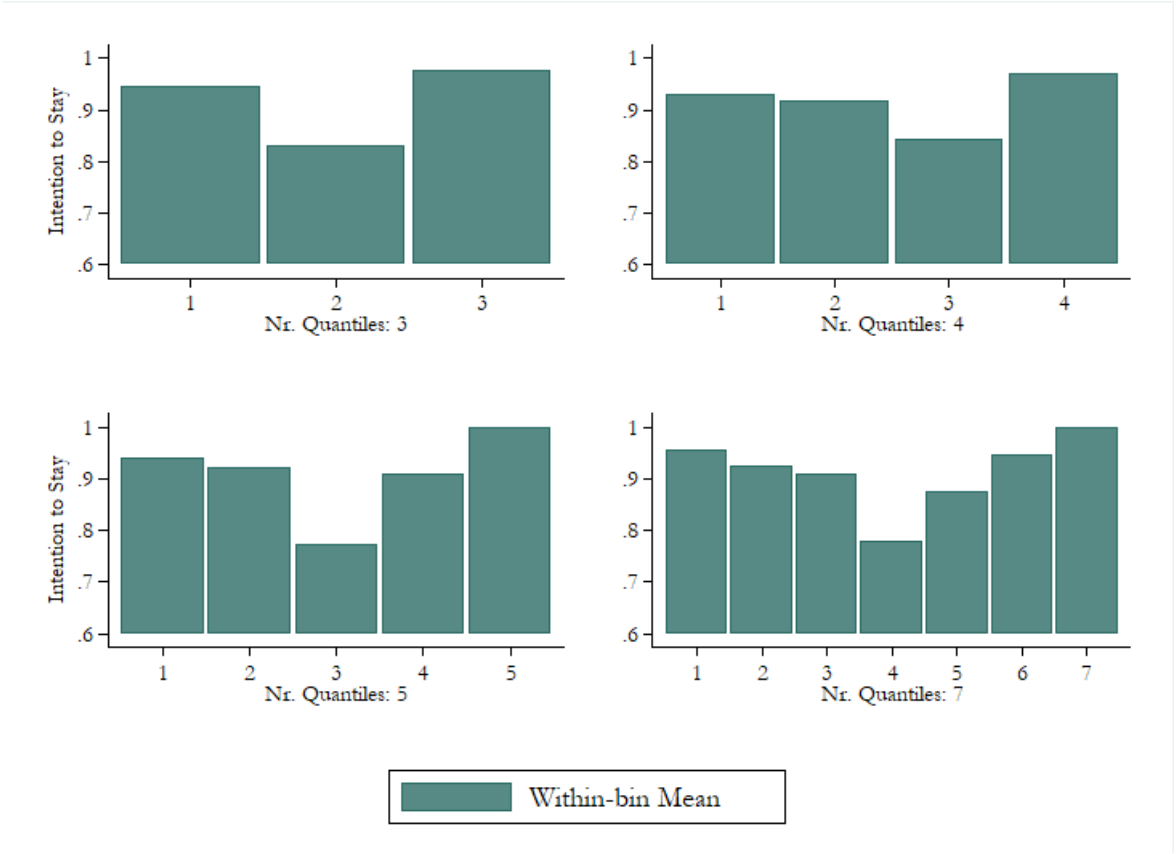

Figure B.1: Intention to stay permanently in the U.S. across the earnings distribution.

B.2 Structural Estimation

The method of simulated moments minimizes the squared difference between moments simulated from the model and their empirical counterparts in the data sample. These moment differences may be weighted, and we use a weighting matrix $\mathbf{W}$ (see Section 5) with the inverse empirical moment variances on the diagonal. For comparison, columns (2) and (3) of Table B.1 show estimates alternatively when either the identity or the full covariance matrix of the moments is used.

Parameter	**Weighting Matrix**		
	(1) **Diagonal with Stdev.**	(2) **Identity Matrix**	(3) **Full Cov. Matrix**
μ	9.37	9.38	9.37
σ	1.24	1.23	1.24
π	-1.10	-1.10	-1.10
ϕ	0.89	0.89	0.89
τ	1140.80	1139.27	1140.31

Table B.1: Estimated parameter values using different weighting matrices.

Figure B.2: Intention to stay permanently in the U.S. across the earnings distribution.