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Heterogeneous Human Capital and Migration: Who Migrates from Mexico to the US?

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This paper first provides evidence of a U-shaped relationship between education and migration among Mexicans. That is, by comparing cohorts of Mexicans who migrated to the US with the same cohorts residing in Mexico it is shown that the highest and lowest educated tend to migrate more than the middle educated. A model is presented that is capable of reproducing this relationship. The model assumes that individuals are endowed with heterogeneous levels of human capital. These levels are determined partly by an intergenerational transmission from their parents and partly by an investment on education also made by their parents. Migration decisions are driven mainly by two forces. On the one hand, there is a progressive loss of human capital faced by immigrants, due to its imperfect transferability. On the other hand, the altruism towards future generations together with the transmission of human capital drives the positive relationship. Finally, the model is calibrated to match relevant moments from the Mexican and US, Censuses and used for policy evaluation. First, the long run effect of the Mexican government run *Oportunidades* program on the average human capital accumulation among Mexican migrants and non-migrants is evaluated. Second, a US government run restrictive policy, intended to make immigration more difficult, is also evaluated. Overall, the evaluation suggests that the *Oportunidades* program has effects that are more desirable on the migrants selection and the education distribution of Mexicans than restrictive policies.*

I. Introduction

By comparing data collected from the 2000 Mexican and US censuses, in this paper I show that the relationship between education and migration among Mexicans is U-shaped: the highest and lowest educated tend to migrate more than the middle educated[1, 2]. Standard theories of self-selection applied to migration fail to explain this puzzle.[3]. The first objective of this paper is to provide an

1. The term U-shape is a simplification or stylization of the relationship between education and migration. Considering five education groups, in Section 2 I show that the migration rate is high for the first group of zero educated people, than goes significantly down for primary and lower secondary education and back up for high school education. After high school the migration rate drops again. However, it remains at levels substantially higher than for primary and lower secondary education and not far from high school.
2. Suggestive evidence of this fact is also provided by CHIQUIAR and HANSON [2005] (TABLES 2a and 2b) They show that people with zero years and with 13 to 15 years of formal education are more likely to reside in the US than those with low, but positive, levels of schooling.
3. See BORJAS [1987] for an application of the Roy model to migration.

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alternative model capable of explaining this particular characteristic of Mexican emigration. The second objective, given the particular relationship between migration and education, is to evaluate the long run implications of policies set to favor education in source countries or to control immigration flows. I look in particular at the *Oportunidades* program implemented by the Mexican government aimed at increasing the education attainment of the Mexican population, and I compare its outcomes with restrictive policies aimed at reducing the immigration flow.

With respect to the policy experiments my findings are that the Mexican government policy, by giving financial subsidies to poor families with children conditional on children's school attendance from grade three to twelve, improves the education attainment and the human capital distribution of future generations of Mexicans[4]. This in turn affects migration by increasing the quality and reducing the quantity of immigrants to the US.

Conversely, policies set to reduce the flow of immigrants may have less desired effects[5]. This stems from the fact that the utility function is concave. At lower levels of education earnings and consumption are lower, therefore an increase in earnings has a greater impact. This is why the incentive to migrate for the lower-educated is higher and, as long as there are no borrowing constraints, more difficult to reduce by restrictive policies. Overall, the effect of a restrictive migration policy is a worsening of the education distribution of immigrants in the US, with no significant impact on the education distribution in Mexico.

In order to understand what factors contribute to determining the relationship between education and migration I construct a theory that can explain the U-shaped emigration pattern. Building on BORJAS [1993], I propose an application of the intergenerational altruistic model of migration. I assume that potential immigrants are different because of different levels of human capital, which is composed of an observable part, education, and an unobservable part inherited from parents. Therefore, in the model the U-shape is generated by the interaction of two forces. On the one hand, there is a loss of human capital faced by emigrants, due to imperfect transferability, that increases with education. This results in a negative relationship between education and migration. On the other hand, altruism toward future generations and the transmission of human capital from one generation to the next results in a positive relationship. At lower levels of education the negative relationship dominates, while at higher levels it becomes positive. The result is the observed U-shape with respect to human capital and, given the strict relationship between human capital and education, with education as well.

I consider human capital to be a country-specific investment. Therefore, not all of the human capital accumulated in the source country can be used by immigrants to generate earnings in the destination country. I label the amount of human capital accumulated in the country of birth as intrinsic, and the amount used to generate earnings as marketable. The difference between the two represents the loss of human capital caused by imperfect transferability. By comparing the performance of Mexicans working in Mexico with those working in the US, I find evidence that the return to education is higher for residents in Mexico than for immigrants in the US. This suggests

4. This finding is consistent with the literature that recently evaluated the effect of *Oportunidades* in Mexico. See BEHRMAN, SENGUPTA and TODD [2001] and SCHULTZ [2004] for more details on the program and its evaluation.

5. I simulate two types of policies. First I simulate a policy that increases the utility cost of migrating by making it harder and longer to obtain visas or by increasing the probability of being caught in case of illegal attempts at migration. Then I simulate a policy that introduces a fixed, monetary cost that immigrants have to pay. The latter simulates policies aimed at discriminating aginst lower-educated individuals.

that immigrants face a loss of human capital and that the loss is more than proportional to human capital. That is, very low skilled workers may have the same employment opportunities in the two countries, but higher skilled workers do not. Language and social barriers in the work environment, for instance, may prevent immigrants from using, in the destination country, all of the human capital accumulated in their native country. Thus, in my model I assume that immigrants face a loss of human capital when they move from the home to the destination country.

Human capital, however, is not only used to procure earnings, but is also an input in the production function of children's human capital. The distinction between intrinsic and marketable human capital is important to describe the process of the intergenerational transmission of human capital. Although there is a consensus that the transmission of skills from parents to children is an important factor that contributes to the formation of children's human capital, a consensus about what exactly drives this transmission has not yet been reached. If genetics is the major determinant, then the portion of human capital transmitted by this channel is not reduced by migration. Indeed, it is reasonable to believe that is the intrinsic human capital, rather than the marketable one, which is transmitted to future generations. Other channels though, could be affected by migration. Cultural traits, for example, may also be transmitted. Among them there could be traits responsible for the loss faced by immigrants, as with language. But the cultural channel of transmission is one that, unlike genetics, can be modified by parents. Parents can, to some extent, choose what to transmit to their children and avoid those traits that may constitute an obstacle for their assimilation. For these reasons I assume that intrinsic human capital enters the production function of children's human capital. That is, immigration does not diminish the ability of parents to transmit human capital to their children[6].

Given the above assumptions, the model predicts, similarly to BORJAS [1993], that if individuals are selfish then they are negatively selected in the destination country. Because at lower levels of education the loss of human capital is contained, and because in terms of utility the cost of migration is the same for all potential migrants, the individuals with lower levels of education have a higher incentive to migrate than those with higher levels of education. Conversely, if individuals only care about their offspring, then the model has the opposite prediction from BORJAS [1993]. In this case the loss of human capital is not important because it will be experienced only by the first generation. The benefit to second generation migrants of being born in the destination country is an increasing function of parents' education. This causes a positive relationship between human capital and emigration.

If individuals care both about themselves and their children, then at increasing levels of education, potential migrants face a trade-off between their own decreasing current gain from migration, and the increasing future gain of their offspring. With the two forces at work the U-shaped emigration rate is, therefore, one possible outcome of the theory, in which at lower levels of education the first effect prevails and at higher levels, the second effect dominates the first.

One contribution of my paper is to the literature on the selection mechanism of immigrants in a destination country. BORJAS [1987, 2000] found that recent cohorts of immigrants in the US are negatively selected. Among them are Mexicans, which represent about 30% of the whole foreign-born population in the US. CHIQUIAR and HANSON [2005], on the contrary, suggest that the selection of Mexican immigrants is positive or intermediate. Using 1990 and 2000 census micro-data from

6. CAPONI [2011] provides evidence supporting this assumption based on a model of intergenerational transfers of abilities estimated on data on three different generations of Mexican immigrants in the US.

both the US and Mexican censuses they found that, on average, Mexicans living and working in the US are more educated than Mexicans remaining in Mexico. As further evidence that Mexicans' selection pattern into the US has remained a puzzle so far, there is a more recent series of papers that addresses this issue. MCKENZIE and RAPOPORT [2010] for example explore the role of immigrant networks in determining negative selection among Mexicans. They find that Mexican immigrants belonging to communities with high migrant networks are likely to be negatively selected, while immigrants coming from communities with no or low migrant networks axe positively selected. This paper, like MCKENZIE and RAPOPORT [2010], also provides a possible explanation for the coexistence of two alternative selection mechanisms at work. Unlike MCKENZIE and RAPOPORT [2010] however, these alternative mechanisms are at work at different levels of the education distribution. Contrary to CHIQUIAR and HANSON [2005], FERNANDEZ-HUERTAS MORAGA [2010] finds evidence of negative selection of Mexicans migrating to the US. He uses a new source of data collected in Mexico, the Encuesta Nacional de Empleo Trimestral (ENET), which, sampling households, collects information on the personal characteristics and wages of its members every three months for five times. Most importantly, the survey records the migration behavior of individuals if from one period to the next some members have left the household. FERNANDEZ-HUERTAS MORAGA [2010] finds that those individuals who left for the US between 2000 and 2004 are on average less educated and earned less than those who remained in Mexico. A proposed explanation for the different results obtained with respect to CHIQUIAR and HANSON [2005] is that the US census heavily under-counts Mexican immigrants, especially at lower levels of education.

In this paper I follow the idea in CHIQUIAR and HANSON [2005] of evaluating the selection mechanism by comparing Mexican migrants with Mexican stayers. To do so I use the micro data from the US census and from the Mexican census collected in 2000. However, rather than limiting the comparison to the average of the education attainment of the two groups I extend it to the entire education distribution. In this way I show that the selection mechanism is more complex than hypothesized by BORJAS [1987, 2000] or by CHIQUIAR and HANSON [2005]. Indeed both selection mechanisms are at work at different levels of the education distribution, and this may also explain why there are conflicting results in the literature.

My explanation in terms of intergenerational altruism and transmission of human capital also has another important implication. Since BORJAS [1993] does not distinguish between intrinsic and marketable human capital, he implicitly assumes that the loss of human capital faced by the first generation of immigrants is transmitted to the next generations. This, together with negative selection, leads to the conclusion that the assimilation of recent cohorts will be slower than the assimilation of past cohorts. My model, instead, suggests that future generations of recent immigrants from Mexico should be expected to assimilate as fast as descendants of previous cohorts. This is because selection at higher levels of human capital is positive and immigrants transmit more human capital to their children than that used by the labor market. Thus, second generation immigrants are expected to perform better than first generation immigrants, overcoming the disadvantage their parents faced in relation to the native population[7].

7. Evidence that second generation Mexicans outperform the first generation can be found in CAPONI [2011]. In the same paper it is also shown that the second generation performs better in terms of education and earnings than the third, suggesting that the second generation inherits the positive selection of the first one while the third reverses back to the average human capital in the population.

In the next Section I briefly discuss the data and show the relevant evidence that motivates this paper. In Section 3, I introduce the theory and then, in Section 4 I present the calibration strategy of the model. In Section 5, I evaluate alternative policy experiments. Section 6 concludes.

II. Mexican Emigration

Although the theoretical model I present in the next section aims at being general in explaining the reasons and consequences of migration for origin and destination countries, the empirical part of the model and the evidence I produce to support the model are taken from the Mexican migration experience. Mexico offers a unique opportunity for researchers to understand the causes of emigration, because the vast majority of Mexican migrants emigrate to the United States, where their performance in the labor market can be observed and compared with individuals remaining in Mexico.

The most recent Mexican census was designed to gather some information on the international migration experience of Mexicans[8]. The questionnaire asked families to indicate if they had any relatives who had emigrated abroad during the previous five years. If they did, they were asked to provide some basic information about those emigrants, including sex, age at the time of last emigration, where the had emigrated to, and their place of residence at the time of the census. The findings are not surprising: 97.05% of people reported as having migrated abroad between 1995 and 2000 had gone to the United States. The second country of destination was Canada with 0.6%. The census also revealed that, in the timespan considered, some emigrants had returned to Mexico or left for some other country by the time of the census. The percentage of Mexican emigrants living in the US in 2000 was only 76.64%, while 16.69% were reported as having returned to Mexico.

The census does not cover the whole experience of Mexican migration. Since it was based on information provided by relatives, it could catch only emigrants who had left family members behind in Mexico. Emigrants who left with their whole (possibly extended) family are not included. Moreover, if we assume that migrants who left their families back home are more likely to return, then return migration is likely to be overestimated. Therefore, the conclusion we can safely draw from these figures is that the vast majority of Mexican emigrants emigrate to only one place: the US. This fact allows us to compare Mexican migrants with those who stayed in Mexico by simply comparing Mexicans in the US with those in Mexico.

To compare the educational attainment of emigrants and stayers I use data taken from the censuses of both Mexico and the US[9]. The Mexican schooling system up to high school is divided into three levels of education. The first six years of schooling lead to an elementary degree. Three more years lead to a lower secondary degree. With another three years, students can obtain a high school degree. After high school there are various options, but the most common is for students to continue their education by attending university. Each of these levels grants a degree, and this is the main reason why the majority of the population has six, nine, or twelve years of schooling or

8. The most recent Mexican Census is the: "XII Censo General de Población y Vivienda, 2000" by the National Institute of Statistics (Instituto Nacional de Estadística y Geografía INEGI), available on their web site.
9. For the US I use the public-use microdata samples at 5% (PUMS5) from the US Census Bureau. For Mexico I use the mentioned 2000 census.

post secondary education. A vast portion of the Mexican population is below the elementary school degree level having zero or only a few years of education (mostly three years). TABLE II shows the distribution of education in Mexico by sex. It clearly shows that the lowest level of education, which corresponds to zero years of education, and the highest, both high school and college, have a higher share among US immigrants than residents in Mexico. The large difference between immigrants and Mexican residents in the less than elementary group could be the result of questions differently posed or interpreted in the US and Mexican censuses. For this reason in the remainder of the paper I group together the less than elementary and elementary school groups.

TABLE I. — Mexican Immigrants in the us Compared With Residents in Mexico

	Men		Women	
	Non-migrants	Migrants	Non-migrants	Migrants
No School	5.77	11.95	8.08	12.68
Less Than Elementary	17.18	7.58	17.92	8.12
Elementary	23.14	23.00	25.53	23.50
Lower Secondary	30.86	24.49	27.33	23.38
High School	13.38	22.24	14.47	21.54
College	9.68	10.73	6.67	10.77

Source: US Census, Public Use Micro Sample 5%, 2000, Bureau of Census USA; XII Censo General de Población y Vivienda, 2000, (Institute Nacional de Estadística y Geografía INEGI). Men and Women aged between 18 to 65, who were at least 18 when they migrated to the US.

TABLE II shows that for both women and men the population of Mexican immigrants in the US is more disperse with respect to education than the population living in Mexico. In particular the zero schooling education group in the US is two times that in Mexico. This is also the case with the high school group. The table clearly indicates that the emigration rate across education groups is not flat, but follows a U-shape pattern.

However, TABLE II cannot be used to derive a measure of the migration rate by education from Mexico to the US. The reason is that by comparing the two populations we likely compare two very heterogeneous groups of Mexicans in terms of age, and age is likely to be correlated with education[10]. For this reason, I compute the migration rate for each cohort of Mexicans by looking at the ratio of Mexicans in the US over the whole population of Mexicans for cohort aged between 18 and 65. Moreover, in order to have a better understanding of the more recent migration I include among the Mexicans in the US only those who migrated on and after 1995, and who were at least 18 years old when they migrated. Finally I only look at males. The details of this computation are in TABLE A.I. The last column of the table shows the weights I use to finally calculate the overall migration rate. These weights are obtained looking at the frequency of each cohort among the overall population of Mexican residents either in the US or in Mexico. The weighted sum of the migration rates by cohort is reported in FIGURE 1.

10. Older Mexicans are much more likely to be less educated than younger Mexicans. The recent years before 2000 saw a large influx of Mexican immigrants. Immigrants are typically younger than the rest of the population and, as such, it is likely that the population of Mexicans resident in the US is generally younger than the population in Mexico. Only comparing these two groups would therefore bias the estimation of the propensity to migrate of a randomly chosen Mexican with education upward.

The points in the graph represent the probability that a person of this group immigrated to the US, conditional on the level of education. Clearly having zero years of formal education or a high school and college degree increases the probability of migration. This does not appear to be the case with respect to an elementary or lower secondary degree. Further, post secondary education decreases the probability of migrating, although it is still higher with respect to the middle educated[11].

Another piece of evidence to add to this puzzling pattern of emigration is the returns to education of Mexican residents in Mexico compared to Mexicans who emigrated to the US and the rest of the US non-Mexican residents. TABLE II shows the regression of log hourly earnings on years of schooling, experience, experience squared, a dummy that indicates if the person is an immigrant in the US, plus one that indicates if the observation comes from the US census, an interaction variable for immigrants' years of schooling, and one for non-Mexicans years of schooling[12]. The sample consists of people aged 18 to 65, who migrated at the age of at least 18 if an immigrant, in full-time work over a year, where full time is at least 30 hours per week and less than 100.

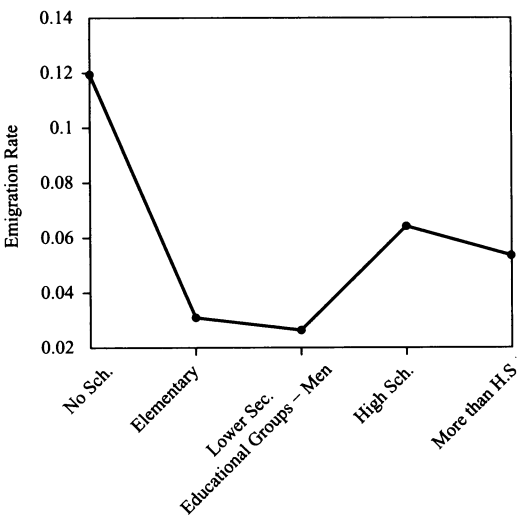

FIGURE 1. — Emigration Rate by Education Group – Men

The intercept in the regression measures the log wage for a man with zero education working in Mexico. The coefficient on the immigrant dummy measures the difference between the log wage in

11. This fact is not entirely surprising, if students who self-select into university are also likely to be those that already have high expectations about their future in Mexico. We must also take into account that the skills acquired at this level of education may be, at least for some disciplines, highly specific to the country: Law, political science, literature, to some extent medicine and other disciplines are chosen with a clear intent to remain in Mexico.

12. Other regressors not reported are the experience accumulated in the US market by immigrants given by age minus age at migration and dummy variables for states in the US and Mexico.

Mexico and the log wage in the US at zero years of education[13]. If we assume that earnings are given by a wage rate common to every person working in the same country multiplied by human capital, and that at zero years of schooling there is no loss of human capital, then this difference measures the wage gap between Mexico and the US. The table indicates that the wage in Mexico is about 15% that in the US. The coefficient on years of schooling measures the Mincerian returns to education in Mexico, while the coefficient on the interaction dummy, which gives the years of education for immigrants, measures the difference between the returns to schooling of a Mexican working in Mexico and a Mexican working in the US. We can sec that this coefficient is negative and significant, suggesting that every extra year of schooling is worth about 4.12% less for those working in the US than for those working in Mexico. As education is acquired in Mexico by both immigrants and non-migrants, we can interpret these lower returns as a loss of human capital due to imperfect transferability. Moreover, in row five is measured the difference between the returns to years of school in Mexico and in the US for non-Mexican individuals and this term is positive although very small. This implies that the difference between Mexican migrants and non-migrants cannot be attributed to lower return to schooling in the US in general, rather to lower returns only for Mexican immigrants. It is further evident that this loss is more than proportional to the level of human capital[14]. The next sections build on these facts to construct a theoretical model that is capable of explaining the U-shape pattern of emigration.

TABLE II. — Returns to Education – Mexicans

	Men	Women
Intercept	-0.3546 (0.0200)	-0.5520 (0.0300)
US Wages Dummy	1.8966 (0.0212)	1.7237 (0.0312)
Years of education	0.1031 (0.0007)	0.1101 (0.0009)
Years of educ. * Immigrant	-0.0412 (0.0015)	-0.0425 (0.0023)
Years of educ. * non-Mexican	0.0058 (0.0008)	0.0068 (0.0011)
Experience	0.0173 (0.0001)	0.0104 (0.0001)
Experience squared	-0.0593 (0.0007)	-0.0491 (0.0008)
R^2	0.6551	0.5896
N. Obs	380,017	221,429

III. The Model Economy

The model economy analyzed below consists of two countries that are characterized by different total factor productivity, education distributions, and human capital production functions. In each

13. The state dummies exclude the Sate of California and the Distrito Federal, therefore the intercept measures the log wage of a person with zero years of education resident in Mexico City, while the immigration dummy measures the gain for a Mexican with zero years of education in California.

14. Since the dependent variable in the regression is measured in log, the analysis suggests that the loss of human capital is more than proportional with education. I.e., the percentage difference between the earnings of immigrants and those of non-migrants decreases with education. However, since I do not test for alternative specifications, the exponential functional form remains only one possible among others. In any case, the fact that the coefficient is negative and significant, as opposed to zero, does imply that the loss is more than proportional and not linear in education.

country in any given period three generations of agents are alive. The oldest generation is retired and enjoys the fruits of the previous period of work, in the form of their savings. Adults, representing the middle generation, work and raise their children. The youngest generation consists of children, whose only role is acquiring the level of education decided by their parents. The earnings of an individual depend on her human capital and on the wage rate paid by firms. Wage rates are different in different countries. The adult individual uses her earnings to buy consumption goods, pay for the education of her children, and saves some of them for the next period of life. Education is acquired from teachers. It is assumed that teachers have at least the same level of education children are acquiring. In this economy only children acquire education, while adults are the only ones that make decisions. They decide their children's amount of education, the level of savings and, if born in the origin country, whether to remain there or to migrate to the destination country. Only migration from the origin to the destination country is considered, because the economy is such that, for any level of education, earnings generated in the destination country by the native population are higher than those in the origin country.

III.*1* *Value of Being Born in the Destination Country*

Because adult agents born in the destination country do not need to decide about migration, their problem is simpler and is analyzed first. Using a recursive representation, the value of being an adult having been born in the destination country is

$$V_d(h_t) = \max_{\{s_t, x_t\}} \{\log(c_t - a) + \beta \log(c_{t+1} - \gamma a) + \theta E V_d(h_{t+1})\} \tag{1}$$

subject to

$$\begin{aligned} c_t + w_{d,t}\tau(e^{\delta s_t} - 1) + x_t &= w_{d,t} h_t \\ c_{t+1} &= R_{t+1} x_t \end{aligned} \tag{2}$$

while the human capital in the destination country is accumulated according to the following function

$$\log(h_{t+1}) = \eta_d s_t + \kappa \log(h_t) + \epsilon_{t+1} \tag{3}$$

with

$$\epsilon_{t+1} \sim N(\mu_\epsilon, \sigma_\epsilon^2)$$

The utility directly derived from consumption by the adult generation in the current period t and in the next period $t+1$ is represented by $\log(c_t - a) + \beta \log(c_{t+1} - \gamma a)$, while $EV_d(h_{t+1})$ is the expected value for the future generations. This value is indexed by d for destination country, and is multiplied by $\theta \in [0, +\infty)$ which represents the degree of altruism of parents toward their children. The amount of education given to children is indicated by s_t. The cost of education is given by $w_{d,t}\tau[\exp(\delta s_t) - 1]$, therefore $\tau[\exp(\delta s_t) - 1]$ represents the amount of human capital that is devoted to education. It reflects the fact that higher levels of education cost more, since the returns to education of teachers are convex in education. Multiplying the efficiency cost by the wage rate $w_{d,t}$ in the destination country, I obtain the monetary cost parents pay for their children's

education. Savings are represented by x_t, and R_{t+1} is the interest paid on those savings. The parameter β discounts future consumption. There is also a minimum requirement of consumption a that indicates the subsistence level. This is assumed to be higher in adulthood than in old age, when it is discounted by $\gamma \in (0,1)$. This is primarily because adults need to provide for their children, while elderly people only for themselves.

The parameter η_d corresponds to the returns to education which are allowed to be country specific. Education is more efficiently translated into human capital if the human capital of parents is higher, reflecting the inter generational transmission of ability. The uncertainty of the returns to the educational investment is reflected by the shock ϵ, which is identically and independently distributed.

III.2 *Value of Moving*

The adult agent born in the origin country can choose to migrate ($\psi_t = 1$) or stay ($\psi_t = 0$), where ψ is a dichotomous variable that indicates the migration choice. Conditional on migrating, we have the following problem

$$V(h_t \mid \xi, \psi_t = 1) = \max_{\{s_t, x_t\}} \{\log(c_t - a) - \xi + \beta[\log(c_{t+1} - \gamma a) + \theta E V_d(h_{t+1})]\} \tag{4}$$

where ξ is a stochastic disutility factor, distributed as

$$\xi \sim \log N(\mu_\xi, \sigma_\xi^2)$$

The budget constraint is

$$c_t + w_{d,t}\tau(e^{\delta s_t} - 1) + x_t = w_{d,t} h_t^{(1-\zeta)} \tag{5}$$

where $\zeta \in (0,1)$ represents the loss of human capital. The next generation's human capital is accumulated by the same function as in equation 3.

The budget constraint reflects the fact that part of the human capital is lost through the transfer and this loss is increasing with the level of human capital. Notice that the value for the next generation is different from the value of migrating. This is because the children of migrants are considered natives and therefore are not subject to any utility cost of being in the destination country, and do not experience any loss of human capital due to migration.

III.3 *Value of Staying*

The problem of the agent who decides to stay is more complicated. In this case the expected value of the future generation takes into account the possibility of children choosing to migrate in adulthood. The recursive form of the problem is synthesized by the following:

$$V(h_t \mid \psi = 0) = \max_{\{s_t, x_t\}} \{\log(c_t - a) + \beta \log(c_{t+1} - \gamma a) +$$
$$\theta\{\int_{\xi}^{\infty} E_\epsilon V(h_{t+1} \mid \xi, \psi_{t+1} = 0) dF_\xi(r) + \int_0^{\xi} E_\epsilon V(h_{t+1} \mid \xi, \psi_{t+1} = 1) dF_\xi(r)\}\}$$

where $F_{\xi}(r)$ is the density function of the shock ξ and $\hat{\xi}$ is such that

$$E_{\epsilon}V(h_{t+1} \mid \psi_{t+1} = 1) - E_{\epsilon}V(h_{t+1} \mid \psi_{t+1} = 0)$$

subject to

$$c_t + w_{o,t}\tau(e^{\delta s_t} - 1) + x_t = w_{o,t}h_t$$

and

$$\log h_{t+1} = \eta_o s_t + \kappa \log h_t + \epsilon_{t+1}$$

The parameter reflecting the returns to education here is indexed by *o*, to indicate that human capital is accumulated using the technology available in the source country. It is finally possible to characterize the migration decision, together with other decisions, as follows:

$$V(h_t, \xi) = \max_{\{s_t, x_t, \psi_t\}} \{V(h_t \mid \xi, \psi_t = 0) + V(h_t \mid \xi, \psi_t = 1)\} \tag{6}$$

III.4 *Population Flows and Distribution Changes in the Origin Country*

The solution to the problem in 6 is characterized by three optimal policy functions for the choice of savings, education and migration: $x(h_t, \xi)$, $s(h_t, \xi)$ and $\psi(h_t, \xi)$. Once the policy functions are calculated, given an initial distribution of human capital in the origin country, it is possible to compute the population flow out of the country and the change in the human capital distribution. The emigration rate depends on the distribution of the psychological cost as well as that of human capital. The distribution of the psychological cost is the same for everyone. Therefore, conditional on human capital, the probability that one person migrates, calculated before knowing the realization of the shock, is equal to the share of individuals who will migrate after the shock is known. The following

$$e(h_t) = Prob\{\psi(h_t, \xi) = 1 \mid h_t\} = Prob = \{0 \leq V(h_t \mid \xi, \psi_t = 1) - V(h_t \mid \xi, \psi_t = 0)\} \tag{7}$$

represents the emigration rate, i.e. the proportion of agents who decide to migrate at any level of human capital. The population of adults staying in the origin country after the decision to emigrate is

$$P_t^r = P_t \int_0^{\infty} [1 - e(h)] dF_t(h) \tag{8}$$

where P_t^r is the population of adults who decide to stay, P_t is the population size before the emigration decision, and $dF(h_t)$ is the distribution of human capital before the migration decision.

Following emigration, the distribution of human capital changes, and the new one is

$$F_t^r(h) = \frac{P_t}{P_t^r} \int_0^h [1 - e(y)] dF_t(y) \tag{9}$$

The human capital of next period adults is a function of their parents' human capital as well as acquired education, the latter also being a function of parents' human capital. Therefore

$$F_{t+1}(h) = \frac{P_t^r}{P_{t+1}} \int_0^{\infty} I(h_{t+1}(y) \leq h) dF_t^r(y) \tag{10}$$

where $I(\cdot)$ is the indicator function and shows the next period human capital distribution of adults, where

$$\log h_{t+1}(h_t) = \eta_o s_t(h_t) + \kappa \log h_t + e_{t+1}$$

The labor force, the total amount of labor devoted to the production of consumption goods, is composed of only adult agents. However, not all adults participate in the labor force. Some adults educate the next generation and are not included in the labor force as defined above. The production of consumption goods follows the production function

$$Y_{j,t} = A_j K_{j,t}^{\alpha} L_{j,t}^{1-\alpha} \tag{11}$$

where K_t is aggregate capital and L_t is the aggregate labor supply in terms of efficiency units, $A > 0$ and $\alpha \in (0,1)$. Firms maximize profits.

The aggregate labor supply for the consumption goods sector at time t in the origin country is given by the following

$$L_t = P_t^r \{ \int_0^{\infty} h(y) dF_t(y) - \int_0^{\infty} s(y) \tau (e^{\delta s(y)} - 1) dF_t(y) \} \tag{12}$$

The first integral gives the aggregate number of efficiency units available in the economy, while the second term specifies the amount of those units employed in the education sector.

Given the savings decisions of agents present in each country at any point in time, the total amount of savings cam also be calculated as

$$S_{j,t+1} = P_{j,t}^r \int_0^{\infty} x(y) dF_j^r(y) \tag{13}$$

However, the total amount of physical capital in each country also depends on the assumptions made about international capital markets. Here, I assume that both countries are small relative to the world market and that capital is free to move across international borders. In this scenario, the interest rate is determined in the world market and it is set as given. Consequently, physical capital is either exported or imported, so as to keep the interest rate at the fixed international level. Therefore

$$R^w = R_j = A_j \alpha K_j^{\alpha-1} L_j^{1-\alpha} = A_j \alpha k_j^{\alpha-1} \tag{14}$$

where R^w is the world interest rate and $k = K/L$ is the physical capital per efficiency unit of labor. Because R^w and, consequently, R_j are constant, k_j is also constant. This implies that there

will be a flow in or out of savings to compensate for any change in L_j. I can characterize the net investments abroad as follows

$$NI_{j,t} = S_{j,t} - K_{j,t+1} \tag{15}$$

Another implication of having a free international capital market is that wages are also constant, since the marginal product of labor is constant. This implies that

$$A_o k_{o,t}^{\alpha-1} = A_d k_{d,t}^{\alpha-1} \tag{16}$$

or

$$\frac{A_o}{A_d} = \left(\frac{k_{d,t}}{k_{o,t}}\right)^{\alpha-1} \tag{17}$$

where wages are given by

$$w_{j,t} = (1-\alpha) A_j k_{j,t}^{\alpha} \tag{18}$$

Therefore we can express the ratio of wages in the origin and destination countries in terms of the TFPs:

$$\frac{w_o}{w_d} = \frac{A_o}{A_d}\left(\frac{k_{o,t}}{k_{d,t}}\right)^{\alpha} = \frac{A_o}{A_d}\left(\frac{A_o}{A_d}\right)^{\frac{\alpha}{1-\alpha}} = \left(\frac{A_o}{A_d}\right)^{\frac{1}{1-\alpha}} \tag{19}$$

In the following section the model as described is calibrated. The values of the parameters of the model are chosen so that the model replicates significant moments from relevant data. Once the model is calibrated it will be used to give quantitative predictions under different policy regimes.

IV. Calibration

In order to calibrate the model the parameter values are chosen to match relevant moments from the data. The period length is chosen to be 30 years, which approximates the length of the working life of a generation. I pick the discount rate to be 0.99 per quarter, as standard in the macroeconomic literature, so that β is equal to $0.99^{120} = 0.3$. The implied interest rate is equal to 4% per year. Therefore, since the period is 30 years, I set $R = 3.2434$.

The subsistence levels of consumption (a) are chosen to reflect the extreme poverty line for expenditure given by the World Bank for Mexico. In August 2000, the amount reported in US dollars at purchasing parity power, averaging rural and urban areas, was 85.05 dollars per month. I calculate this amount to be about 30% of the life time earnings of the lowest educated group of Mexicans living in Mexico. I set $\gamma = .5$ to reflect the fact that during elderly agents do not have to provide for their children, but only for themselves, therefore reducing the household by half. While this value is arbitrary, it does not greatly affect the calibration in that it only substantially affects savings, which are not targeted in the calibration.

IV.*1 Matching Data Moments*

All of the other parameters of the model are deduced by matching a set of simulated moments to the selected moments from the observed data.

The regression in TABLE II reports biased estimates of the return to education for Mexicans and non-Mexicans, the wage gap between immigrants and non-immigrants, and the loss of human capital due to imperfect transferability. The bias is induced in the data, because the amount of human capital possessed by individuals is not observed. To obtain unbiased parameters from the calibration procedure, I use the notion of "indirect inference" (GOURIEROUX and MONFORT [1996]). The method consists of reproducing the same regression calculated with the observed data with simulated data obtained from the model. The same biased estimators can be obtained by omitting the variable that is unobservable in the data from the simulated regression. This way unbiased estimates can be obtained by choosing the parameters of the model that minimize the distance between the estimates obtained from the data and the simulated ones. To implement the procedure, the first step, given a set of parameters, is to solve the model. Then I generate a set of T times S random numbers from each shock distribution of the model. Combining the T draws of each distribution, I construct a set of $T * S$ pairs of shocks. Each pair identifies a simulated individual. I evaluate the migration decision for all pairs, as well as the earnings and the education acquired in the previous period, and build a dummy variable that takes the value of one if the individual identified with the pair migrates, and zero otherwise. Using the simulated data I run auxiliary regressions with log earnings as the dependent variable, education, the immigrant dummy variable and the interaction between the two as independent variables. Because the human capital of individuals in the regression is omitted, the coefficients obtained by the auxiliary regression are affected by the same bias as those in TABLE II. Finally, I choose the parameters of the model so that the biased coefficients of the auxiliary regression are as close as possible to the estimates in TABLE II.

Similarly, from the simulated data I compute several moments that have a counterpart in the observed data. These include the emigration rates and the educational distribution for the five education groups considered, as well as the mean of the educational distribution in the US. The model assumes that migration and education choices are made once by agents either at the beginning of their working lives (migration) or earlier by their parents (education). Accordingly, the moments are intended to measure the choices of one generation. In order to do this, rather than looking at only one cohort, which would result in a small sample, I look at the choices made by all those individuals aged between 18 and 65 in the censuses of 2000 and average these choices. To average the choices I use as weights the product of the census weights in both censuses and the share of Mexican residents in the US for each cohort[15].

TABLE III shows the values assigned to all parameters, while TABLE IV shows the moments chosen to be matched. The last column of TABLE III contains the values of the parameters set using statistics from other sources or normalized. The rest of the table shows the parameters obtained by the calibration procedure. The last three rows contain those parameters that are allowed to vary across both countries.

15. The use of the share of Mexican residents as weights is important to return an accurate average migration rate that reflects the importance of each cohort in the pool of migrants. More details on how the migration rates are computed are given in Section 2.

IV.2 *Results*

FIGURE 2 shows how well the calibrated model fits the emigration rates by education seen in the data. The fit is very good for the first three education levels and for the last but less for the high school level of education. In particular the model is not capable replicating the downturn of the migration rate at that level of education, although it does show a concavity at the end. This inability is primarily caused by the low flexibility that the model has to reproduce a high level of migration for high school educated and a lower level for more than high school educated Mexicans.

TABLE III. — Parameters of the Model

		Mexico	US
Returns to Ed.	η	0.0357	0.0365
	δ	0.1627	0.0788
Cost of Ed.	τ	0.3930	0.7906
Wage	w	0.1436	1.0000
Human Capital Distr.	μ_h	1.4110	1.1273
	σ_h	0.6675	0.3420
Common Parameters			
Altruism Parameter	θ	0.8855	
Intergenerational H.C. Transfer	κ	0.5426	
Loss of Human Capital	ζ	0.4001	
Disutility Cost Distr.	μ_ξ	3.2616	
	σ_ξ	0.0248	
Shock Distr.	μ_ϵ	0.0000	
	σ_ϵ	0.0247	

The parameters that indicate the returns to human capital are smaller than the biased parameters obtained in the OLS regressions. Thus, the bias in both countries is positive. This is because the relationship between the unobserved human capital of parents and the years of schooling of their children is positive, as is the relationship between earnings and the unobservable. The model predicts an important loss of human capital (ζ is around 40%) and a strong bond between generations. The parameter κ, which measures the intergenerational transfer of human capital from parents to children, is 54%. That is, a little more than half of the human capital accumulated by parents is transmitted to their children. The parameter θ, which measures the altruism of parents toward their children, is 0.8855. Since the model assumes exogenous fertility, fixed at 1 child per parent, altruism per child is also reflected by the same parameter[16]. The other parameters that differ between the two economies are those that identify the cost of education. The τ parameter is larger for the US economy than for the Mexican, while for the parameter δ the opposite is true.

16. DE LA CROIX and DOEPKE [2003] for example calibrate a parameter for altruism equal to 0.271. However, their model includes endogenous fertility choices and the possibility to increase the utility values of future generations to their parents by increasing the number of children. Alternative models of fertility and altruism (see for example MICHEL, THIBAULT and VIDAL [2006]) write the altruism factor as the product of the number of children and a "pure" altruism factor: $\bar{\theta}(1+n)$, where $\bar{\theta}$ is the pure altruism factor and $(1+n)$ the number of children. In this case, assuming 0.271 as a pure measure of altruism as in DE LA CROIX and DOEPKE [2003], to obtain a gross value of 0.8855 we would need 3.27 children per household. Indeed this number is very close to the average children per family in the Mexican economy.

This means that the education costs in Mexico are calibrated to be more progressive than in the US. The parameters are identified by the different education distribution together with the migration rates. It is then clear that the higher progressivity in Mexico matches the lower education attainment in that economy.

TABLE IV. — Data and Simulated Moments

		Data	Simulated
Mig. Rates	No School	0.1194	0.1090
	Primary	0.0309	0.0309
	Lower Secondary	0.0263	0.0285
	Hight School	0.0641	0.0453
	More than H.S.	0.0535	0.0543
Immigrants	No Schooling	0.0567	0.0566
	Primary	0.4012	0.3794
	Lower Secondary	0.2626	0.3096
	Hight School	0.1599	0.1412
	More than H.S.	0.1195	0.1132
US Natives	Av. Years of School	13.4700	12.4910
Auxiliary Regression	Immigrant Dummy	1.8966	1.8785
	Returns to Ed. Mx	0.1031	0.1236
	Returns to Ed. US	0.1089	0.0953
	Returns: Immigrant Gap	-0.0412	-0.0483
		1^{st} Gen. Sim.	2^{nd} Gen. Sim.
Human Capital Distr. in US	Average H.C.	1.0797	1.1194
	St. Dev. H.C.	0.2664	0.3268
Objective Function		0.2950	

IV.3 *Evaluating the Model*

Before using the model to give quantitative predictions of alternative policy scenarios, it is useful to look more in detail at how the model works in providing an explanation of the stylized facts presented earlier. To understand the mechanism that drives the differences in the migration rates it is instructive to look at TABLE V. The table shows the intrinsic and marketable (indicated with ζ) average human capital within each education group. The first two columns of the table show the average human capital by education group for residents in Mexico - first column - and, intrinsic, for Mexican immigrants - second column. The third column shows the marketable human capital of immigrants. The last row shows the overall average human capital. Comparing the numbers in the first two rows gives a measure of the selection with respect to human capital. Concentrating on the last row first, an overall slightly positive, or neutral selection of immigrants can be noticed. In fact, the human capital of immigrants is on average a little higher than that of non-immigrants, 3.19 compared to 3.17.

However, the positive selection is not present at every level of education. For Mexicans with no schooling the selection seems to be absent, while elementary school educated Mexicans are strongly negatively selected. The selections turn positive for lower secondary and high school and then negative again for more than high school. The reason for these differences is that the

migration decisions are driven by human capital rather than by education. FIGURE 3 helps to interpret the table. It shows the migration rate as a function of human capital as predicted by the calibrated model. At low levels of human capital the propensity to migrate is high and decreasing. In this range of migration rates the effect brought about by the loss of human capital dominates. Agents with higher human capital have more to lose from migrating, hence they show less propensity. At middle levels of human capital the migration rate is, instead, increasing. Here two other forces dominate the relationship. The transferability of the intrinsic human capital from parents to children and the altruism of parents toward their children both drive the positive selection. The more human capital parents have the more they can transfer and the better off their children are by being born in the US rather than in Mexico. Interestingly, the positive relationship reaches a peak and then turns again into a negative relationship. This is because parents have an upper limit in the amount of education they can acquire for their children. That is, the gain from migrating for parents with higher human capital is given by higher returns and a lower progression in the cost of education and increases with human capital as long as they are able to invest in more years of education in the US than in Mexico. However, because of the upper limit in the years of education, this incentive stops increasing when the human capital is high enough for a parent to choose the maximum amount possible of education for their children.

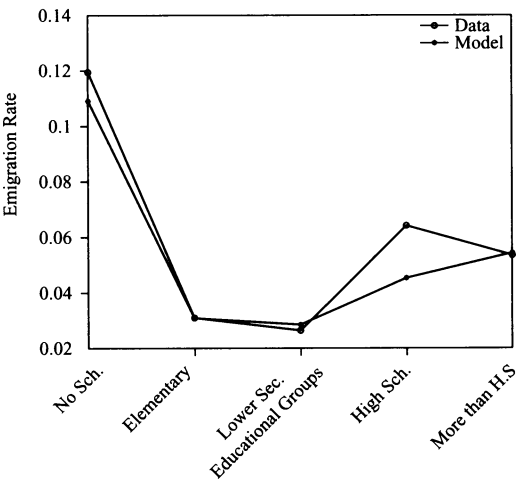

FIGURE 2. — Migration Rates: Model fit

TABLE V. — Average Human Capital Distribution

	MX	Imm.	Imm (ζ)
No School	1.10	1.08	1.05
Elementary	1.93	1.80	1.42
Low Sec.	3.16	3.22	2.01
High School	4.54	4.56	2.48
More than H.S.	6.67	6.56	3.08
Total	3.17	3.19	1.92

FIGURE 3 can explain the results in TABLE V. The first two levels of education are clearly associated with the levels of human capital that are on the first downward part of the migration curve. In this part the selection is negative and for elementary school educated it is clear that those with lower levels of human capital, conditional on education, migrate more. Instead, the lower secondary and high school levels of education are on the upward part, which implies that both groups show a positive selection. Finally, the more than high school educated are in the final downward sloped part of the curve.

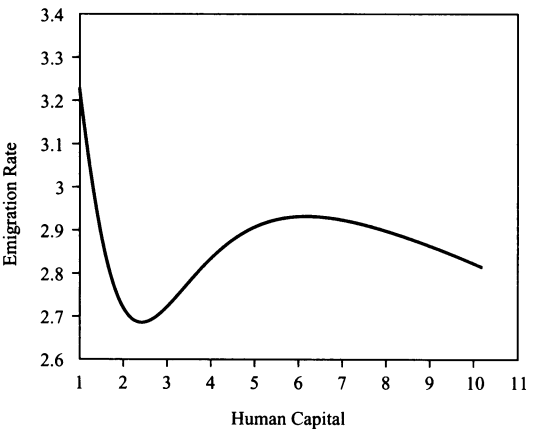

FIGURE 3. — Migration Rate by Human Capital

V. Education and Immigration Policies

The next step is to evaluate migration and education policies using the calibrated model. I propose two simulation experiments. In the first part of this Section I answer the following question: what are the effects on both education and emigration of the *Oportunidades* program, a policy implemented by the Mexican government to improve the education standards of the Mexican population? As there is a strong and special relationship between education and migration, this policy should be expected to have an effect not only on educational attainment but also on migration decisions.

The second part of the section looks at policies implemented in the destination country that have the objective of reducing the immigration flow. These policies act so as to lower the incentive to migrate. Once again the effects of such policies are not only on the migration flows but also on the education distribution of immigrants, as well as on the educational distribution of the population remaining in the source country.

Although I look at two policy options that are implemented by different sovereign governments, and may therefore not be easily interchangeable, knowing what effects they have may assist the US and Mexican governments, as well as international institutions, in negotiating agreements and finding solutions that have the objective of managing the mass migration phenomenon from Mexico to the US[17].

17. Indeed the World Bank on April 9, 2009 approved a loan of 1.5 billion US dollars to finance the *Oportunidades* program.

V.1 *The Oportunidades Program*

The *Oportunidades* program was introduced in Mexico in 1997, with the name of *Progresa* and changed its name in 2002[18]. The program, which aims at increasing the school attendance of children from poor families in rural and urban areas, consists of conditional monetary contributions to poor families with school age children who prove that they attend grades three to twelve at an educational establishment. The contributions increase with the grade, reflecting the higher opportunity cost of education at higher grades. Moreover, the program also has other provisions aimed at reducing poverty and malnutrition.

To evaluate the program in the context of the model, I first need to calculate how the schedule of contributions translates in a reduction of the cost of schooling as parameterized in the model. TABLE VI shows the contribution schedule to poor families that have school children attending school. The first column indicates the monthly payments in current pesos (these values are taken from BEHRMAN, PARKER and TODD [2005], TABLE I), the second column the yearly contributions (12 times the monthly transfer) in PPP adjusted US dollars in 2000, while the third column shows the cumulated benefits up to the corresponding grade. The education part of the policy is implemented within the model by modifying the cost function to reflect the lower - discounted - cost implied by the government contribution. Therefore, I first calculate the discount for each grade between third and twelve in terms of the model by looking at the share of lifetime income represented by the cumulated subsidy. This is shown in column fourth. Then I choose the two parameters of the cost function for Mexico in order to minimize the distance between the discount in column four and the discount reproduced by subtracting from the old cost function the new cost function obtained with the parameters at the corresponding grades.

The new parameters are then applied to individuals with human capital in the low 20% of the human capital distribution. This reflects the fact that the program involves about 20% of the population[19]. Finally, the program provides 150 (2002) pesos per month to children aged between 4 months and 2 years and up to 4 years if malnourished, that is, a total of 20 or 44 months, 3,000 or 6,600 pesos per child. In terms of the model this represents a lifetime benefit corresponding to about 0.50% and 1.10% of income. This smaller savings is added to the disposable income of all the *Oportunidades* families, while the larger savings is added to the poorest 3% of families, according to the proportion of all malnourished children between 0 and 5 years old[20].

TABLES VII and VIII show how the education and the human capital distributions change due to the program. The first three columns of TABLE VII reproduce the education distributions of Mexicans in the US and Mexico and the total number of male immigrants immigrated between 1995 and 2000 as calibrated in the benchmark model. Columns from 4 to 6 reproduce the same information obtained after simulating the model under the new parametrization that implements the program. The last column reports the percentage change in the number of immigrants for each level of education and in total (last row). From the right-most figure of the last row it is possible to notice the effect of the policy on the number of immigrants: a reduction by 15.76%. The program improves the general condition of Mexican non-migrants lowering their propensity to migrate.

18. For more information about the program see SCHULTZ [2004].
19. The World Bank reports that 4 million families receive benefits under the education part of of the *Oportunidades* program.
20. World Bank World Development Indicators 2009, statistic provided for 2006.

TABLE VI. — Transfer Schedule for the *Oportunidades* Program

Level	Grade	Mo. (pesos)[a]	Yr(USD)[b]	Cumulated[c]	Inc. Share[d]	Model[e]
	Third	100.00	171.35	171.35	0.0024	0.0046
	Fourth	115.00	197.06	368.41	0.0052	0.0071
Primary	Fifth	150.00	257.03	625.44	0.0088	0.0104
	Sixth	200.00	342.71	968.15	0.0136	0.0146
	Seventh	290.00	496.93	1,465.07	0.0206	0.0200
Lower Sec.	Eighth	310.00	531.20	1,996.27	0.0281	0.0268
	Ninth	325.00	556.90	2,553.17	0.0360	0.0354
	Tenth	490.00	839.63	3,392.81	0.0478	0.0461
Secondary	Eleventh	525.00	899.61	4,292.41	0.0605	0.0594
	Twelfth	555.00	951.01	5,243.43	0.0739	0.0761

Notes: *a* Monthly figures in pesos 2002; *b* yearly figures converted in ppp adjusted 2000 US dollars; *c* cumulative subsidies assuming that a child attends up to the corresponding grade; *d* percentage of the subsidy out of the life time income of a parent with zero education (the life time income is calculated following regression in TABLE II); *e* same as point *d* but based on the old and the new parametrization of the model.

TABLE VII. — Education Distribution – *Oportunidades* Policy Program – I

	Before the Program			After the Program			
	% Imm.	% MX	Tot. Imm.	% Imm.	% MX	Tot. Imm.	% Change
No School	16.77	5.66	149,600	16.73	5.01	125,754	-15.94
Elementary	29.27	37.94	261,181	28.88	38.63	217,089	-16.88
Low Sec.	21.99	30.96	196,167	21.91	31.00	164,672	-16.06
High School	16.21	14.12	144,651	15.77	14.04	118,555	-18.04
More than H.S.	15.76	11.32	140,602	16.70	11.32	125,529	-10.72
Total	100.00	100.00	892,201	100.00	100.00	751.599	-15.76

However, the decrease in the number of immigrants is not evenly distributed across the education groups. At lower levels of education, from no schooling to lower secondary, the reduction is in line with the overall reduction, from 15.94% of the no schoolers to 16.88% of the elementary educated. More remarkable is the difference between the high school educated, that show the sharpest reduction of 18.04% and the more than high school educated who have the lowest reduction, 10.72%.

TABLE VIII shows the average human capital distribution within each education category and overall. The numbers in the last row, second and third-last column, show that the policy is effective at increasing the overall human capital of Mexicans. However, the percentage change among Mexican non-migrants is negligible, while the change among immigrants is significantly larger. That is, as a result of the policy, the flow of Mexican immigrants from Mexico to the US becomes smaller in numbers and better in quality as measured by human capital per person.

TABLE VIII also shows that the effect of the policy on human capital is not equal across the education groups. At the lower secondary and high school level the effect of the policy is positive, while at lower and higher levels of education it is negative. This is true for both immigrants and non-migrant Mexicans, however, except for the group with no education,

the differences are larger for immigrants than for non-migrants. This fact suggests that the self-selection pattern is strengthened by the policy. It is stronger and positive where it was already positive and stronger and negative where it was already negative with the exception of those with no-schooling, for which the selection remains negative but becomes weaker. The reason why the lowest education group behaves differently is because of the provision of the program that transfers resources to poorer families. This provision targets individuals with the lowest human capital among the group of non-educated Mexicans - the poorest group - and reduces their incentive to migrate making the negative selection into migration of this group weaker.

TABLE VIII. — Human Capital Distribution – *Oportunidades* Policy Program – I

	Before the Program			After the Program			% Change		
	MX	Imm.	Imm. (ζ)	MX	Imm.	Imm. (ζ)	MX	Imm.	Imm. (ζ)
No School	1.10	1.08	1.05	1 09	1.07	1.04	-1.22	-1.00	-0.59
Elementary	1.93	1.80	1.42	1.92	1.78	1.41	-0.44	-0.93	-0.59
Low Sec.	3.16	3.22	2.01	3.16	3.22	2.01	0.04	0.05	0.03
High School	4.54	4.56	2.48	4.54	4.57	2.49	0.03	0.14	0.08
More than H.S.	6.67	6.56	3.08	6.67	6.55	3.08	-0.01	-0.22	-0.13
Total	3.17	3.19	1.92	3.17	3.22	1.93	0.01	0.76	0.37

As for the other groups, by lowering the cost of education the policy pushes Mexicans with low levels of human capital to invest more in their children's education. This implies that these children have lower levels of human capital conditional on years of schooling. This explains why elementary educated individuals have a lower average human capital and explains the strengthening of the negative selection since those with lower human capital are more likely to migrate. However, more education in terms of years of schooling also increases human capital. At the lower secondary and high school levels an increased average years of schooling drives the higher average human capital. In fact, those with higher human capital are more likely to migrate, as the original positive selection pattern suggests, which implies the strengthening of the positive selection. Finally, the more than high school educated have a slightly lower average human capital than before the policy. This is likely due to the fact that some parents with lower human capital may decide to invest more and have their children more than high school educated. This slightly lowers the average human capital of this group particularly among immigrants because of the negative selection.

V.2 *Restrictive Immigration Policy*

Turning to destination country policies, I now examine what happens if restrictive policies to control the flow of immigrants are implemented. I assume that such policies can be evaluated either by introducing a monetary cost of moving or by implementing other types of policies such as building a wall that makes it harder to freely cross the border, or making it longer to obtain

legal documents to enter the US. The second set of policies, I assume, have mainly a time cost, which effectively reduces the utility gain from migration.

The US, unlike other countries like Canada and New Zealand, does not have a policy that strongly discriminates between immigrants on grounds of education[21]. Most of the immigrants that legally enter the US are sponsored by a relative, American citizen or permanent resident. A smaller proportion is sponsored by an employer. However, the total number of all immigrants is kept to a maximum of 675,000 per year (though this number can be higher in some years). Because there are many more applications every year than the number of visas the government plans to issue, applicants may have to wait to become permanent residents.

However, many immigrants in the US, especially from Mexico, choose to immigrate illegally. HANSON and SPILIMBERGO [1999] report estimates suggesting that illegal immigrants crossing the border that divides Mexico from the US are as many as 160,000 per year – a number that matches that of legal immigrants from Mexico. Moreover, according to HANSON and SPILIMBERGO [1999], the effort put into patrolling the US-Mexican border has had little effect on reducing illegal immigration so far.

In this subsection I first consider a policy that reduces the programmed number of immigrants to be admitted to the US while at the same time increasing the patrolling effort along the border to discourage illegal immigration. I assume that the consequence of this policy is to increase the utility cost of migrating. In the model I simulate this effect by increasing the average of the disutility distribution (ξ). Moreover, to make it possible to compare the effects of this policy with the effects of the *Oportunidades* program, I increase this parameter by the amount necessary to generate the same overall effect on the number of immigrants.

TABLES IX and X show the effect of the policy on the education and the human capital distributions. From TABLE IX it is possible to notice that the highest reduction in the number of immigrants is among the high school educated Mexicans, who decrease by 21.77%, while the lowest is among the non-educated, decreasing by 9.47%. It is also interesting to see the effect of the policy on the education distributions. In Mexico the education distribution slightly improves, while among immigrants it worsens significantly.

TABLE X clearly indicates that overall the policy negatively affects of the quality of immigrants. The overall effect is mainly due to the change in the education distribution of immigrants.

TABLE IX. — Education Distribution – Restrictive Policy – I

	Before the Program			After the Program			
	% Imm.	% MX	Tot Imm.	% Imm.	% MX	Tot. Imm.	% Change
No School	16.77	5.66	149,600	18.02	5.38	135,427	-9.47
Elementary	29.27	37.94	261,181	29.90	38.07	224,737	-13.95
Low Sec.	21.99	30.96	196,167	21.67	31.01	162,873	-16.97
High School	16.21	14.12	144,651	15.06	14.17	113,156	-21.77
More than H.S.	15.76	11.32	140,602	15.35	11.37	115,406	-17.92
Total	100.00	100.00	892,201	100.00	100.00	751,599	-15.76

21. Canada, for example, admits every year a large number of immigrants compared to its population (0.65% compared to the 0.35% of the US). Most of these immigrants are admitted through a point-based system. Points are gained by applicants for permanent residence on the basis of several characteristics, education being one of the most important.

TABLE X. — Human Capital Distribution – Restrictive Policy – I

	Before the Program			After the Program			% Change		
	MX	Imm.	Imm. (ζ)	MX	Imm.	Imm. (ζ)	MX	Imm.	Imm. (ζ)
No School	1.10	1.08	1.05	1.09	1.07	1.04	-0.63	-0.50	-0.29
Elementary	1.93	1.80	1.42	1.93	1.79	1.41	-0.32	-0.69	-0.43
Low Sec.	3.16	3.22	2.01	3.15	3.22	2.01	-0.03	-0.21	-0.12
High School	4.54	4.56	2.48	4.54	4.58	2.49	0.01	0.27	0.16
More than H.S.	6.67	6.56	3.08	6.67	6.54	3.07	0.01	-0.42	-0.25
Total	3.17	3.19	1.92	3.17	3.12	1.89	0.12	-2.30	-1.52

Another policy aimed at discouraging illegal immigration is to impose fines on employers who hire them. The rationale of this policy is to reduce the gain from illegal immigration, as employers willing to hire illegal immigrants would pay them less to insure themselves against the risk of being fined.

In the following experiment I look first at the consequences of a decision by the US to introduce stricter laws against the employment of illegal immigrants. I assume that the effect of stricter laws would be similar to a fee immigrants would have to pay to enter the US. Although the fee is a great simplification, it does reflect several features of this type of policy. First of all, as most of the illegal immigrants belong to the lower end of the education distribution, it is reasonable to assume that the cost of such a policy would affect lower educated migrants more than higher educated ones. Given that the gain from migration is proportional to education, collecting the same amount of money from every immigrant leads to a higher cost in terms of gain reduction from migration for the lower educated than for the higher educated.

However, higher educated immigrants are also affected. A tighter policy against illegal immigrants would increase the number of applications for legal immigration making the queue for everybody longer. Thus, the cost is applied to everyone. As in the previous case the monetary cost to pay is chosen to have the same overall effect on the number of immigrants as in the *Oportunidades* program.

TABLES XI and XII summarize the effects of the policy. Looking at TABLE XII it is possible to see that indeed the effect on overall average human capital is positive as predicted for example by URRUTIA [1998][22]. TABLE XI provides the explanation for this effect. The decline in the number of immigrants is lowest among the highest educated group.

TABLE XI. — Education Distribution – Restrictive Policy – II

	Before the Program			After the Program			
	% Imm.	% MX	Tot. Imm.	% Imm.	% MX	Tot. Imm.	% Change
No School	16.77	5.66	149,600	17.69	5.29	132,953	-11.13
Elementary	29.27	37.94	261,181	28.70	38.01	215,739	-17.40
Low Sec.	21.99	30.96	196,167	20.98	31.24	157,699	-19.61
High School	16.21	14.12	144,651	15.38	14.06	115,631	-20.06
More than H.S.	15.76	11.32	140,602	17.24	11.41	129,578	-7.84
Total	100.00	100.00	892,201	100.00	100.00	751,599	-15.76

22. URRUTIA [1998] finds that an entry fee applied to every immigrant would be effective in selecting immigrants with more human capital, and would maximize the welfare gain resulting from migration in the destination country.

Overall, such a policy has a positive effect in terms of immigrants' quality. However, the *Oportunidades* program reduces the share of non-educated among the Mexican immigrants and non-migrants, while both restrictive policies actually raise this share among immigrants and reduce it less among non-migrants. This has an important policy implication for the destination country. Although restrictive policies are effective, they need to be continuously implemented by the destination country to sustain the effect. In particular this is true for preventing those immigrants that immigrate mainly because of poverty, with low levels of education and likely to be entering the US illegally.

TABLE XII. — Human Capital Distribution - Restrictive Policy – II

	Before the Program			After the Program			% Change		
	MX	Imm.	Imm. (z)	MX	Imm.	Imm. (z)	MX	Imm.	Imm. (z)
No School	1.10	1.08	1.05	1.09	1.07	1.04	-0.85	-0.59	-0.34
Elementary	1.93	1.80	1.42	1.92	1.78	1.41	-0.55	-1.28	-0.79
Low Sec.	3.16	3.22	2.01	3.15	3.23	2.02	-0.14	0.14	0.09
High School	4.54	4.56	2.48	4.53	4.57	2.49	-0.05	0.11	0.07
More than H.S.	6.67	6.56	3.08	6.66	6.56	3.08	-0.16	-0.12	-0.08
Total	3.17	3.19	1.92	3.17	3.21	1.92	0.05	0.16	0.15

VI. Conclusion

Mexico offers a unique opportunity for researchers to understand the causes of emigration, because the vast majority of Mexican migrants choose the US as their country of destination. This allows their performance in the labor market to be observed and compared with individuals remaining in Mexico. Analyzing data from both the US and Mexican Censuses, a U-shaped relationship between education and migration emerges: the lowest educated and the higher educated Mexicans are those who have the most to gain from migrating to the US. Conversely, the middle educated - i.e. those Mexicans with six and nine years of schooling - have relatively lower gains and, therefore, tend to migrate less.

The model I propose reproduces both qualitatively and quantitatively this main pattern. I use the model to evaluate the effects of two types of policies on both the migration flow and the education distribution of immigrants and non-migrants. The first type of policy I consider in this paper is implemented in the source country, and affects migration only indirectly: the *Oportunidades* program of the Mexican government. The second is a set of hypothetical restrictive immigration policies implemented by the US - the destination country - to reduce the immigration inflow.

With regard to the first policy, I show that this program is effective not only in improving the education distribution of Mexicans, but also in lowering the emigration pressure that is mainly directed at the United States. Moreover, I find that the quality of immigrants in the US improves substantially as a result of the program. Restrictive immigration policies, instead, may have undesirable effects. My findings demonstrate that a policy that reduces the planned number of immigrants legally admitted into the US, and that makes it harder for all Mexicans indiscriminately to enter the US, has negative effects on the human capital distribution of immigrants. This is because the

disincentive to migrate introduced by this policy is stronger for higher educated potential migrants than for those at the lower end of the education distribution. This impacts negatively on the quality of immigrants and results in a significant loss of human capital imported by the US. Conversely, a policy that discriminates against lower educated Mexicans by imposing restrictions proxied by a monetary cost, has effects on the human capital distribution that are similar to those obtained under the *Oportunidades* program. However, both restrictive policies have a minimal effect on the education distribution in Mexico, which implies that in the long run the pressure at the border is not altered. In fact at lower levels of education immigrants are generally very poor and are not easily discouraged from the prospect of making a better living elsewhere. The everyday experience of thousands of Mexicans crossing the border illegally, often at great risk to their lives, to find a low paid job in the US is testimony to this. My analysis of the *Oportunidades* program suggests that this phenomenon can be mitigated more effectively by increasing education opportunities in source countries, rather than by policies implemented in the destination country that aim to discourage migration.

My explanation in terms of intergenerational altruism and transmission of human capital also has another important implication. Contrary to previous findings (BORJAS [1993]), my model implies that future generations of recent immigrants from Mexico should be expected to assimilate as fast as descendants of previous cohorts. This is because selection at higher levels of human capital is positive and immigrants transmit more human capital to their children than that used by the labor market. Thus, consistently with the findings in CAPONI [2011] the model predicts that second generation immigrants are expected to perform better than first generation immigrants, overcoming the disadvantage their parents faced in relation to the native population.

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Appendix

TABLE A.I — Immigration Regression

Age	No-Educ.	Primary	Lower Sec.	High School	13+	R^2	N. Obs.	Weight
All	0.1194	0.0309	0.0263	0.0641	0.0535			
18	0.0365 (0.0082)	0.0083 (0.0019)	0.0069 (0.0017)	0.0222 (0.0032)	0.1358 (0.0319)	0.0162	7,306	0.0281
19	0.1889 (0.0194)	0.0400 (0.0041)	0.0277 (0.0037)	0.0858 (0.0054)	0.2533 (0.0367)	0.0683	7,381	0.0260
20	0.2125 (0.0174)	0.0468 (0.0042)	0.0328 (0.0038)	0.0965 (0.0053)	0.1859 (0.0212)	0.0795	8,837	0.0304
21	0.3276 (0.0232)	0.0658 (0.0052)	0.0537 (0.0049)	0.1296 (0.0063)	0.2399 (0.0201)	0.1143	8,097	0.0260
22	0.2249 (0.0166)	0.0608 (0.0045)	0.0528 (0.0044)	0.1375 (0.0058)	0.1434 (0.0135)	0.1038	10,301	0.0330
23	0.3391 (0.0201)	0.0715 (0.0049)	0.0591 (0.0046)	0.1578 (0.0059)	0.0977 (0.0108)	0.1217	10,461	0.0330
24	0.2693 (0.0180)	0.0679 (0.0047)	0.0544 (0.0045)	0.1483 (0.0059)	0.0669 (0.0088)	0.1087	10,403	0.0340
25	0.2675 (0.0175)	0.0610 (0.0046)	0.0461 (0.0043)	0.1207 (0.0054)	0.0585 (0.0077)	0.0953	10,289	0.0346
26	0.2829 (0.0184)	0.0525 (0.0046)	0.0425 (0.0044)	0.1078 (0.0055)	0.0609 (0.0074)	0.0896	9,282	0.0326
27	0.2466 (0.0179)	0.0549 (0.0046)	0.0419 (0.0044)	0.1074 (0.0055)	0.0597 (0.0076)	0.0855	9,318	0.0324
28	0.2376 (0.0177)	0.0486 (0.0044)	0.0335 (0.0041)	0.0886 (0.0052)	0.0508 (0.0070)	0.0744	8,833	0.0316
29	0.2255 (0.0178)	0.0393 (0.0045)	0.0353 (0.0043)	0.0900 (0.0053)	0.0469 (0.0067)	0.0726	8,162	0.0296
30	0.0742 (0.0100)	0.0353 (0.0036)	0.0296 (0.0037)	0.0658 (0.0044)	0.0397 (0.0056)	0.0474	9,859	0.0364
31	0.1606 (0.0166)	0.0502 (0.0051)	0.0293 (0.0048)	0.0699 (0.0056)	0.0395 (0.0068)	0.0607	6,430	0.0239
32	0.0828 (0.0108)	0.0305 (0.0036)	0.0242 (0.0039)	0.0476 (0.0044)	0.0340 (0.0057)	0.0394	7,837	0.0302
33	0.0789 (0.0119)	0.0263 (0.0037)	0.0225 (0.0040)	0.0486 (0.0046)	0.0333 (0.0054)	0.0377	7,021	0.0272
34	0.0675 (0.0111)	0.0270 (0.0037)	0.0230 (0.0042)	0.0508 (0.0047)	0.0315 (0.0056)	0.0377	6,883	0.0264
35	0.0623 (0.0093)	0.0267 (0.0034)	0.0228 (0.0041)	0.0470 (0.0047)	0.0290 (0.0051)	0.0354	7,287	0.0282
36	0.0696 (0.0095)	0.0244 (0.0035)	0.0254 (0.0045)	0.0444 (0.0049)	0.0224 (0.0050)	0.0349	6,607	0.0259
37	0.0519 (0.0102)	0.0257 (0.0036)	0.0251 (0.0046)	0.0409 (0.0051)	0.0219 (0.0052)	0.0312	5,820	0.0230
38	0.0475 (0.0083)	0.0192 (0.0030)	0.0150 (0.0039)	0.0411 (0.0046)	0.0216 (0.0043)	0.0281	6,633	0.0266
39	0.0568 (0.0088)	0.0207 (0.0031)	0.0164 (0.0042)	0.0373 (0.0048)	0.0155 (0.0045)	0.0281	6,012	0.0241
40	0.0359 (0.0065)	0.0169 (0.0026)	0.0166 (0.0039)	0.0411 (0.0047)	0.0157 (0.0041)	0.0252	7,113	0.0277

TABLE A.II — Immigration Regression - Continuer A

Age	No-Educ.	Primary	Lower Sec.	High School	13+	R^2	N. Obs.	Weight
38	0.0475	0.0192	0.0150	0.0411	0.0216	0.0281	6,633	0.0266
	(0.0083)	(0.0030)	(0.0039)	(0.0046)	(0.0043)			
39	0.0568	0.0207	0.0164	0.0373	0.0155	0.0281	6,012	0.0241
	(0.0088)	(0.0031)	(0.0042)	(0.0048)	(0.0045)			
40	0.0359	0.0169	0.0166	0.0411	0.0157	0.0252	7,113	0.0277
	(0.0065)	(0.0026)	(0.0039)	(0.0047)	(0.0041)			
41	0.0853	0.0217	0.0135	0.0364	0.0208	0.0335	3,899	0.0160
	(0.0119)	(0.0040)	(0.0057)	(0.0062)	(0.0054)			
42	0.0321	0.0121	0.0178	0.0267	0.0125	0.0186	5,885	0.0246
	(0.0071)	(0.0025)	(0.0038)	(0.0046)	(0.0038)			
43	0.0440	0.0148	0.0155	0.0326	0.0113	0.0224	4,566	0.0189
	(0.0084)	(0.0029)	(0.0047)	(0.0055)	(0.0046)			
44	0.0503	0.0116	0.0162	0.0330	0.0204	0.0251	4,405	0.0177
	(0.0079)	(0.0029)	(0.0051)	(0.0060)	(0.0051)			
45	0.0245	0.0129	0.0111	0.0344	0.0080	0.0191	5,051	0.0207
	(0.0060)	(0.0025)	(0.0042)	(0.0052)	(0.0044)			
46	0.0310	0.0128	0.0193	0.0322	0.0104	0.0204	3,826	0.0156
	(0.0071)	(0.0030)	(0.0053)	(0.0065)	(0.0050)			
47	0.0302	0.0159	0.0143	0.0330	0.0138	0.0203	3,517	0.0144
	(0.0084)	(0.0032)	(0.0057)	(0.0071)	(0.0056)			
48	0.0248	0.0082	0.0160	0.0258	0.0089	0.0163	4,117	0.0167
	(0.0054)	(0.0024)	(0.0047)	(0.0057)	(0.0046)			
49	0.0264	0.0095	0.0177	0.0370	0.0093	0.0201	3,783	0.0156
	(0.0064)	(0.0027)	(0.0051)	(0.0064)	(0.0051)			
50	0.0158	0.0087	0.0093	0.0264	0.0113	0.0137	4,812	0.0192
	(0.0044)	(0.0021)	(0.0042)	(0.0053)	(0.0042)			
51	0.0358	0.0129	0.0091	0.0239	0.0208	0.0204	2,426	0.0097
	(0.0081)	(0.0036)	(0.0066)	(0.0088)	(0.0069)			
52	0.0187	0.0078	0.0044	0.0272	0.0118	0.0143	3,397	0.0143
	(0.0054)	(0.0024)	(0.0048)	(0.0061)	(0.0050)			
53	0.0166	0.0080	0.0126	0.0215	0.0113	0.0128	2,879	0.0118
	(0.0057)	(0.0027)	(0.0057)	(0.0068)	(0.0052)			
54	0.0161	0.0055	0.0107	0.0247	0.0071	0.0129	2,992	0.0121
	(0.0048)	(0.0024)	(0.0049)	(0.0062)	(0.0053)			
55	0.0118	0.0056	0.0105	0.0156	0.0073	0.0092	3,133	0.0122
	(0.0040)	(0.0021)	(0.0047)	(0.0063)	(0.0052)			
56	0.0162	0.0056	0.0101	0.0264	0.0070	0.0132	2,684	0.0108
	(0.0048)	(0.0025)	(0.0055)	(0.0070)	(0.0058)			
57	0.0170	0.0079	0.0075	0.0306	0.0074	0.0140	2,180	0.0087
	(0.0057)	(0.0028)	(0.0079)	(0.0088)	(0.0067)			
58	0.0197	0.0063	0.0083	0.0223	0.0092	0.0134	2,416	0.0095
	(0.0048)	(0.0027)	(0.0066)	(0.0084)	(0.0068)			
59	0.0140	0.0074	0.0146	0.0265	0.0061	0.0129	2,266	0.0088
	(0.0051)	(0.0028)	(0.0069)	(0.0086)	(0.0073)			
60	0.0069	0.0033	0.0092	0.0190	0.0076	0.0079	3,598	0.0134
	(0.0025)	(0.0016)	(0.0049)	(0.0057)	(0.0046)			
61	0.0172	0.0113	0.0100	0.0258	0.0173	0.0144	1,431	0.0053
	(0.0077)	(0.0039)	(0.0098)	(0.0144)	(0.0101)			
62	0.0134	0.0072	0.0069	0.0200	0.0059	0.0103	2,048	0.0081
	(0.0050)	(0.0026)	(0.0071)	(0.0089)	(0.0076)			
63	0.0101	0.0049	0.0064	0.0143	0.0096	0.0080	2,192	0.0085
	(0.0039)	(0.0023)	(0.0060)	(0.0082)	(0.0067)			
64	0.0105	0.0054	0.0188	0.0174	0.0035	0.0103	1,940	0.0077
	(0.0042)	(0.0026)	(0.0078)	(0.0090)	(0.0082)			
65	0.0083	0.0028	0.0074	0.0041	0.0064	0.0058	2,323	0.0088
	(0.0030)	(0.0018)	(0.0053)	(0.0063)	(0.0058)			

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