Does International Migration Benefit the Sender Country? The Mexico-U.S. case

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Abstract

The impact of Mexican immigration on the U.S. is a controversial subject of debate. However, far less work examines its effects on Mexico, most of which focuses solely on remittances. Using National Transfer Accounts (NTA) methodology, this study takes a broader approach to assessing the impact of emigration on Mexico by considering losses in forgone labor income and assets, as well as savings in not having to fund the consumption of emigrants and remittances. We introduce a method to quantify the effects of emigration on Mexico's demographic dividend as well as investment in educational human capital. Preliminary results suggest that remittances have the largest impact on Mexico's economy, equaling the combined effects of lost income, assets, and consumption. Moreover, emigration has had a relatively small effect on Mexico's demographic dividend and a portion of its GDP goes toward investing in the educational human capital of Mexican immigrants in the U.S.

1 General Framework

Recent decades have seen a surge of literature on the effects of Mexican immigration on the U.S. (National Research Council, 1997; Borjas, 1999; Chiswick, 1978; Massey et al., 2002). Far less work exists on the effects of Mexican emigration to the U.S. on the sending country. The work that does address this topic focuses almost exclusively on remittances and does not address the broader macroeconomic effects of Mexican emigration to the U.S. on Mexico. These effects include changes in Mexico's age composition due to emigration, resulting losses in productivity, forgone asset accumulation, and other opportunity costs of losing a sizeable portion of working-age population. Given Mexico's rapidly aging population (Wong and Palloni, 2009), fluctuating Gross Domestic Product (GDP) (Central Intelligence Agency, 2011), and decreasing immigration to the U.S. (Passel and Cohn, 2009), the strong emphasis on the effects of remittances is regrettable.

This study differs from previous efforts in examining the broader macroeconomic effects of emigration on Mexico. It presents calculations on Mexico's loss of prime age labor through emigration to the U.S. and cost in lost production and foregone asset accumulation. It also examines gains from not having to fund the consumption of emigrants as well as increased revenue from remittances. Among its more novel contributions is its employment of National Transfer Account (NTA) methodology to estimate lost human capital (by investing in the education of emigrants) as well as the impact of emigration on the demographic dividend and border-crossing costs.

2 Methods

Migration Age-Specific Cost (MASC) function

This study examines Mexico's loss of prime age labor through emigration to the U.S. We calculate the number of Mexicans *missing* from Mexico due to emigration to the U.S. and define an age-specific cost function that captures the cost in lost production and foregone asset accumulation. We also examine gains from not having to fund the consumption of migrants as well as increased revenue from the remittances. The economic loss due to the absence of migrants at age x for the country of origin at time t is calculated as follows:

$$MASC_t(x) = P_{t,usmx}(x) * [y^l_t(x) + y^a_t(x) - c_t(x) - r_t(x)], \quad (1)$$

where $P_{t,usmx}(x)$ stands for the number of Mexicans age x who are living in the U.S. at time t, $y^l_t(x)$ is the average labor income for a Mexican age x at time t, $y^a_t(x)$ represents the net private asset income for an individual age x at time t, $c_t(x)$ denotes average consumption for an individual age x at time t, and $r_t(x)$ stands for *per capita* remittances from an x year-old-Mexican-origin individual outside Mexico at time t. The age profiles for y^l, y^a, c and r are cross-sectional estimates for a particular year t, which are obtained using the National Transfer Account (NTA) methodology (Mason et al., 2011).

Labor income: In the NTA framework, labor income represents a comprehensive measure of output attributed to labor, which is defined as all compensation to workers, including earnings, the portion of entrepreneurial income which is a return to labor (assumed to be two-thirds), fringe benefits, and taxes paid to the government by employers on behalf of employees.

Consumption: Under the same framework, household consumption is allocated by each member of the household and distributed by age over the lifecycle. The consumption by an individual is defined as the sum of private and public consumption, each of which is further disaggregated into education, health care and other consumption. See (Mason et al., 2011) for details.

Asset income The reallocation of assets is another key element in the NTA flow accounts, which extends the scope of the classic lifecycle saving model in a more realistic way. "Asset-based reallocations" and net transfers are used in this realistic framework to finance the portion of consumption which is not covered by labor income. Asset-based reallocations are defined as asset income less saving. Asset income consists of returns to capital and property income. Private capital income includes one-third the operating surplus of corporations, a share of mixed income that is attributed to capital, and the rental value of owner-occupied housing. All capital income is net of depreciation. Property income includes interests, dividends, rent, and other components (NTA project: www.ntaccounts.org).

Remittances: The remittance profile is estimated in an indirect way using NTA data from the U.S. Details are shown below.

Human capital

Migration represents a transfer of human capital from the place of origin to the recipient one. In the context of international migration, human capital can be approximated as the investment made, by the sender and recipient countries, on health and education. Since this paper is focused on measuring the effects of migration on the sender country, we limit the analysis to the human capital investment made by Mexico on Mexican-origin individuals currently living in the U.S. We focus on the investment on education, since there are difficulties in monetarily quantifying the effects of the health of migrants on the sender country. Therefore, we use educational attainment and its investment costs to quantify those skills.

There are two channels for investment in education: public and private. In Mexico, most primary and secondary education is provided by the public sector. The public sector is also important in providing tertiary education, even though the private sector plays a larger role in providing this form education than primary and secondary education. For graduate studies, the public sector is again the main option. The difference in tuition between private and public institutions is very important in some cases and enormous for professional education in many respects. Familial investment in education also plays a role. Familial investment consists primarily in the provision of educational expenses (books[1], clothing, tuition, etc.).

We rely on the following elements to quantify the present value of the stock in educational human capital: a) estimates of age-specific consumption of public and private education, b) information on the highest level of educational attainment for the migrant population, c) year of emigration to the United States, and d) other assumptions delineated below.

Estimates of the human capital created by education requires quantifying the cost of education acquired in Mexico in the past for individuals living in the U.S. during the reference year. This information is usually not available, particularly for years far in the past. The approach we take consists of taking a cross-section of the age profile of education for an available year (it might be the year of reference for the analysis) and estimating equivalent values by age for the past.

The equation we use for this calculation is as follows. We express the expenditure on consumption in education for the reference year, t, for an individual age x as $E_t(x)$, where x can take any value in the discrete interval $[6, 40]$. The lower bound in the interval reflects the fact that in Mexico primary education starts at age six, whereas the value of 40 is taken from empirical evidence (Mejía-Guevara, 2008) showing that expenditures in education after that age are not significant. Given this age profile, the cost of education in time s ($t-s$ years ago), for $s < t$ is given as follows:

$$E_s(x) = E_t(x)e^{-\lambda(t-s)}, \tag{2}$$

where λ is the rate of productivity growth. The cost of education in year t is the present value of the education $t-s$ years ago. The equation is as follows:

$$E_{t,s}(x) = E_t(x)e^{-\lambda(t-s)}e^{r(t-s)} = E_t(x)e^{(r-\lambda)(t-s)}, \tag{3}$$

where r is the real discount rate, and $E_{t,s}(x)$ is the cost of education in the past adjusted to present values.

As mentioned before, two other elements must be considered in this procedure: the year of arrival to the U.S. and the maximum level of education attained by each individual. Since information on the country in which individuals received a particular degree is not available, we assume uninterrupted years of education. For example, if an individual began her education in 1980 (beginning in the fall as is established in Mexico) and she reported ten years of education, then we assume she finished in 1990 (during the summer of that year), so the cost of her education when

[1]Text books are provided for free in public institutions during primary and secondary education.

she was 6 year old in 1980, valued at 2010, is $E_{2010,1980}(6)$, whereas the cost in 1990 (she was 16 years old!) is $E_{2010,1990}(16)$.

Given this convention, the investment in educational human capital in Mexico for a migrant i living in the U.S. at time t is given by:

$$HC_t^i(x') = \sum_{s=t_{ye}^i}^{t_{ye}^i+hd^i} E_{t,s}(x) \tag{4}$$

where t_{ye}^i is the year of first enrollment and hd^i the number of years of education for that migrant.

There is another important detail to consider involving the timing of arrival and the location in which the individual was educated. Some individuals might have received a portion of their education in the U.S. These years of education should not be included in calculations of the cost of education in Mexico. That is, if the individual j reports hd^j years of education, but $t_a^j - t_{ye}^j < hd^j$, where t_a^j is the time of immigration to the U.S. for the individual j, this individual was attending school when she migrated to the U.S. If that is the case the only change necessary in equation (4) is the substitution of the term hd^i by $t_a^j - t_{ye}^j$.

The last step in the calculation consists of adding the investment in human capital (as in the expression (4)) for all individuals by age to obtain an age profile for the stock of human capital in education at time t.

Border-crossing costs

Border-crossing costs are considered in determining the financial capital spent by migrant population in Mexico. We use information reported in the Mexican Migration Project (MMP) to estimate the cost of hiring *coyotes* for the period 1935-2004. The approach for this calculation is similar to the one used in estimating human capital. We compute the present value of the capital invested when crossing the border.

The approach is as follows. We state that cf_s is the average *coyote* fee at year s, the year of the first successful cross, r is the same discount rate used for the human capital case and c_0 represents the proportion of expenses, different from *coyote* fees, which migrant population incur during the crossing experience. Then, the present value of the capital spent for crossing the border at year t -the base year- for an individual i aged x is as follows:

$$PhC_t^i(x) = cf_s * (1 + c_0) * e^{r(t-s)}, \tag{5}$$

where $t - s$ is the period since the first successful cross. Therefore, the stock of financial capital at the base year t for all individuals aged x is given by:

$$PhC_t(x) = \sum_i PhC_t^i(x). \tag{6}$$

The MMP provides information for several crossing attempts. However, in this approach we only take the cost of the first successful attempt since the costs for subsequent ones might be covered -partially or completely- with resources the migrant might have accumulated from previous experiences within the U.S. Preliminary results are presented in the following section.

Impact of migration on the demographic dividend

An important question to consider is how international migration affects the demographic dividend for the sender country. Because the migrant population is usually younger, persistent migrant flows potentially shift the age composition of the sending country toward an older population and increase the dependency ratio.

We estimate the first demographic dividend using the age profiles of consumption and labor income following the approach of Andrew Mason and Ronald Lee (2006). Under this approach, the dividend occurs during that period of the demographic transition in which the proportion of the working age population increases substantially relative to the young and elderly. We take the age profiles of consumption and labor income for an average Mexican in a base year, but change the population weights according to the levels of migration over the demographic transition period. Hence, the effect of migration is obtained by taking the difference of the first dividend using the actual population and the counterfactual scenario in which it is assumed there was no migration over the period of analysis.

Following Andrew Mason and Ronald Lee (2006), output per effective consumers is defined as:

$$\frac{Y_t}{N_t} \equiv \frac{L_t}{N_t}\frac{Y_t}{L_t}, \tag{7}$$

where $\frac{L_t}{N_t}$ is the economic support ratio, L_t is the effective number of producers, and N_t is the effective number of consumers. These quantities, in turn, are defined as:

$$L_t = \sum_{x=0}^{\omega} \gamma(x)P_t(x) \text{ and } N_t = \sum_{x=0}^{\omega} \alpha(x)P_t(x) \tag{8}$$

where $\gamma(x)$, $\alpha(x)$ are coefficients that measure differences by age of productivity and consumption, and $P_t(x)$ represents the population aged x. The coefficients are time-invariant by assumption.

Expressing the first term of the right-hand side of 7 as a growth rate (by taking the natural log of both sides and taking the derivate with respect to t), we get :

$$\frac{\dot{L}_t}{L_t} - \frac{\dot{N}_t}{N_t}. \tag{9}$$

Equation 9 defines the first demographic dividend, or the rate of growth of the effective labor force, $\frac{\dot{L}_t}{L_t}$, less the rate of growth of the number of effective consumers, $\frac{\dot{N}_t}{N_t}$. To compute the effect of migration on the demographic dividend, we assumed no emigration. We then define the population who never emigrated as $P_{t,S}$ and population who emigrated as $P_{t,M}$. Moreover, since we have two population subgroups, the number of effective producers and consumers is defined as follows:

$$L_t = L_{t,S} + L_{t,M} \text{ and } N_t = N_{t,S} + N_{t,M} \tag{10}$$

where $L_{t,M}$ and $N_{t,M}$ are defined as : $L_{t,S} = \sum_{x=0}^{\omega} \gamma_S(x)P_{t,M}(x)$, and $N_{t,S} = \sum_{x=0}^{\omega} \alpha_S(x)P_{t,M}(x)$. In these equations, $\gamma_S(x)$ and $\alpha_M(x)$ are time-invariant coefficients that define variations by age in productivity and consumption for the population who stayed at Mexico, respectively; and $\gamma_S(x)$

and $\alpha_M(x)$ for the population that we know emigrated in reality.

Thus, combining equations 9 and 10, and rearranging terms, we obtain:

$$\left[\frac{\dot{L_{t,S}}}{L_t} - \frac{\dot{N_{t,S}}}{N_t}\right] + \left[\frac{\dot{L_{t,M}}}{L_t} - \frac{\dot{N_{t,M}}}{N_t}\right]. \tag{11}$$

Then, the first term defines the first dividend for the population who stayed in Mexico and the second term for the population who would emigrate. By simplicity, we assume that if emigrants have never left Mexico they would consume and generate income as any average Mexican; that is: $\gamma_S(x) = \gamma_M(x) = \gamma(x)$, and $\alpha_S(x) = \alpha_M(x) = \alpha(x)$.

3 Results

Components of the MASC function and base scenario

The age profiles of the components of the MASC function are based on NTA estimates for Mexico for 2004 and the U.S. for 2003. The consumption, labor income and asset income profiles are taken from Mejía-Guevara (2011) who reports complete NTA estimates for Mexico in 2004. The y^a profile corresponds to private asset-based reallocations. The age profile for remittances is approximated using the distribution by age of labor income for the U.S. in 2003 (Lee et al., 2008), adjusted to the total of all remittances reported in the National Accounts of Mexico.

For the other profiles, y^l, c, y^a, we assume that the average value of a typical Mexican is a good approximation for the levels of consumption, labor income and assets of a migrant had she never left Mexico.

Figure 1(a) displays the age profiles of y^l,c, E, and r, as well as for asset income which includes net operating surplus for corporations, y^a, and that which does not include this sum, y^a_{nosc}. The dramatic difference between these two latter curves indicates the extent to which corporate operating surplus accounts for nearly 60% of the total asset income in Mexico. This figure also demonstrates that whereas labor income peaks at age 40, asset income which does not include net operating surplus for corporations peaks 15 years later at age 55. Asset income becomes increasingly important after age 50, as it is one of the means by which individuals fund their consumption when their labor income declines. Moreover, consumption is greater than both labor and asset income up to age 31, at which point individuals start generating a surplus (when y^l is bigger than c) which lasts until around age 48. Remittance income, the focus of much migration literature to date, peaks at around age 50 and represents a similar amount as asset income when not incorporating net operating surplus costs. Not surprisingly, education spending peaks at very young ages.

Figure 1(b) depicts the age distribution of people born in Mexico, but living in the U.S. in 2004, as well as the age profile of labor income earnings for an average U.S. citizen in 2003. This figure shows that Mexican-born individuals in the U.S. are concentrated in prime working ages, an age range in which the labor income of the average U.S. citizen is rising but not at its peak. Average earnings peak in the 50s for U.S. citizens, an age group with relatively few Mexican-born individuals.

[figures 1(a) and 1(b) around here]

The age distribution of the MASC function (i.e. labor and asset income minus consumption and remittances) is shown in figure 2(a). We present losses in asset income which include net operating surplus costs for corporations (represented by the dashed line) and which do not include this quantity (represented by squares). Important differences can be seen in the age distribution of the MASC function. The solid black line represents loss which includes asset income (includes corporate net operating surplus cost). As this figure demonstrates, child migrants represent a gain (a negative loss) for Mexico because they do not produce labor income or assets, but have significant levels of consumption and do not send remittances. However, subsequent results show that child migrants represent potential gains if they are properly invested in.

Net loss which includes corporate operating surplus is negative up until age 20 (representing *savings* generated by child migration for Mexico) at which point it increases and becomes positive around age 30. This indicates that beginning at age 30, Mexican immigrants in the U.S. represent a loss in labor and asset income in Mexico that is not offset by consumption and remittances. The MASC function peaks at age 40 and declines monotonically to zero at the end of the lifecycle. Net loss declines after age 40 as a result of labor income declines but it never becomes a gain again because of the negative effect of lost assets belonging to the migrant elderly population. For example, ejidos represent an important part of asset income for many Mexicans. Massey (1990) finds that in some Mexican communities, ejido ownership was as high as 81%.

However, as noted, corporate-owned assets represent a substantial amount of total asset income in Mexico. The typical migrant likely does not own these corporate assets. Therefore, figure 2(b) displays net loss that does not include corporate operating surplus (represented by the dashed line). This is compared to the solid line which represents net loss that does include corporate operating surplus. The figure suggests that migration represents a net gain for Mexico at almost all ages when taking into account the fact that migrants are not likely to own corporate assets. It should be noted that the latter scenario represents an extreme case in which migrants do not own *any* corporate assets is therefore, a conservative estimate.

[figures 2(a) and 2(b) around here]

It is important to note that the baseline scenario assumes that the migrant population would have the same level of assets as the Mexican average had they never left Mexico. The same is assumed for labor income and consumption. These premises are justified if we consider the following statement from Massey (2005)

...it is not the poorest and least developed communities that send the most migrants. On the contrary, other factors being equal, the communities with the highest rates of out-migration are those that are most developed...

Chiquiar and Hansen (2005) come to a similar conclusion in their assessment of the wages Mexican immigrants would have received in Mexico had they never migrated. The authors find that given their education and skill set, Mexican immigrants in the U.S. would fall in the middle of the income distribution if they stayed in Mexico.

Results from Albo et al. (2009) corroborate with this finding. Using data from the United Nations Development Programme (2007), the authors find a positive correlation between average income and the probability of migrating, with the relationship appearing strongest in the middle-income strata. For this reason, assuming that migrants would have the same labor income, assets, and consumption patterns as an average Mexican had they never left Mexico seems reasonable.

Loss over time

While the previous sections describe absolute loss to Mexico caused by emigration, the magnitude of this loss cannot be fully understood without assessing its relative value. Figure 3 demonstrates Mexico's economic loss due to emigration as a proportion of its Gross Domestic Product (GDP) in the years 2000, 2002, and 2004. It also describes the contribution of each of the different components of the MASC function. Complete NTA estimates are available for y^l, c and y^a for these years. However, for remittances, we use the age profile of labor income earnings of the U.S. for 2003 as representative of the three years because no other profiles are available. We took information from IPUMS (Miriam King et al., 2010) to estimate the age structure of the Mexican origin population living in the U.S. at that time (defined as those people who have reported being born in Mexico). Figure 3 demonstrates that the gains created by not having to fund the consumption of emigrants once they leave Mexico and their remittances is more than offset by losses in labor and asset income. Net loss for 2004 is approximately 1% of GDP, but it is greater for the years 2000 and 2002, which are 1.7% and 1.9%, respectively. It appears that two factors are influencing the lower loss observed in 2004: greater losses in asset income are offset by a greater amount of remittances entering the country. The previous section demonstrates the importance of assets in determining the loss to Mexico due to emigration. However, when we take all the elements together, it appears that remittances play an important role as well. Were it not for remittances, Mexico would lose an amount close to 5% of its GDP each year due to emigration.

[figure 3 around here]

Human capital

While figure 2(b) suggests that Mexico gains from emigration, this graph is but one method of measuring loss that must be compared with other measures. Another means of measuring loss is by considering Mexico's cumulative loss of labor income due to emigration relative to its investment in human capital via spending on education. We consider two forms of expenditures on education, public and private. Under the NTA framework, per capita values for public and private education are calculated as a component of total consumption. This requires that estimates on expenditures consider the age distribution of the entire population.

However, a concern with the results presented in figure 2(a) are the different metrics of the numerator and the denominator. The cost of education represents the present value of the accumulation of multiple years of education, whereas the GDP represents an income flow for a single year (2004).

To address this issue, we consider an alternative method of expressing the cost of education. Specifically, we estimate the present value of educational spending on migrants by age as a proportion of the labor income, YL, these migrants generated in Mexico *if they had never migrated to the U.S.* To do this, we follow the same approach used to estimate the human capital investment in education, namely equation 4. These amounts include all expenditures made in the past in Mexico

Table 1: Investment in human capital as a proportion of labor income produced in Mexico before migration, YL1, labor income produced in Mexico had emigrants never left Mexico, YL2, and 2004 GDP (%), assuming no return migration (P100) and a 25 percent return migration rate (P75)

	private		**public**		**total**	
Metric	P100	P75	P100	P75	P100	P75
YL100 (YL2)	4.7	3.6	10.9	8.3	15.6	11.9
YL100 (YL1)	12.9	9.9	30.0	22.9	42.9	32.8
YL75 (YL2)	6.3	4.8	14.5	11.1	20.8	15.9
YL75 (YL1)	16.4	12.6	38.1	29.1	54.6	41.7
GDP	9.3	7.1	21.7	16.5	31.0	23.7

for education obtained before their departure. We include people with only a few years of education as well as those with higher levels education.

The results are illustrated in figure 4 for immigrants 20 years and older in 2004. This figure demonstrates that younger immigrants represent a substantial cost for Mexico in terms of lost human capital investment. These migrants were educated in Mexico but did not produce much labor income before they migrated to the United States. For example, the total investment in education for 20-year-old immigrants was almost 120 percent (82 percent public and 36 percent private) of the labor they produced in Mexico. The relative cost is even much bigger for younger migrants (not displayed). In this way, younger immigrants are more expensive than older migrants who spent part of their working years in Mexico.

[figure 4 around here.]

However, in considering the costs of emigration to Mexico, it is imperative to consider the role of return migration. Massey (2007) estimates that after 2000, the probability of return for a Mexican immigrant was 25 percent. These migrants were educated in Mexico and emigrated to the U.S. but eventually returned to Mexico to produce labor income. Table 1 considers this 25 percent return migration rate. It displays estimates on the cost of human capital investment as a proportion of labor income and 2004 GDP assuming no return migration, P(100), and a 25 percent return migration rate, P(75). It also considers costs in terms of two forms of labor income: labor income produced by migrants before they emigrated to the U.S., YL1, and the labor income they would have produced in Mexico had they never left Mexico, YL2. This table demonstrates that assuming a 25 percent return migration rate, the cost of human capital investment on emigrants amounts to 42.9 percent of the labor income these migrants produced in Mexico before they emigrated to the U.S. This cost represents 16 percent of the labor income they produced in Mexico had they never left Mexico. These estimates indicate the high cost of educating individuals in Mexico without absorbing their labor income once they are adults due to emigration.

Border-crossing costs

As mentioned, we obtain information on the costs of *coyotes* over time from the MMP. These costs do not represent those of the national population since the sample only includes certain localities which are not chosen randomly (Jorge Durant and Massey, 2004). However, given evidence as to the representativeness of the MMP (Massey and Zenteno, 2000), we still use this data to obtain an approximation.

The variable c_0 in equation (5) represents extra costs apart from *coyote* fees that migrants incur during the border crossing such as food, travel costs, and housing. We assume $c_0 = 0.2$, i.e., a 20 percent of the *coyote* fee, which is an arbitrary value that could be refined with proper information. Average values for all individuals crossing during that year were introduced in equation (5) to determine the present value for an individual in 2004. In order to conduct this procedure we use mean values from MMP as an approximation.

An additional caveat is that *coyote* fees are reported in U.S. dollars and the conversion to Mexican pesos may be problematic given the enormous variation in exchange rates during the last 30 years, particularly during the 80's, a period of hyperinflation and recurrent crisis in Mexico. This problem was addressed by estimating the present value in dollars instead of pesos using a real discount rate of $r' = 3\%$, instead of the 5% used in the human capital section. Estimating the present value in U.S. dollars guards against the risk of incorrect calculation due to the monetary instability of the Mexican peso economy during the 80's and 90's. The final values are expressed in Mexican pesos using the average exchange rate for 2004 reported by the Central Bank of Mexico. In the final step, equation (6) is used to obtain a stock value of the total costs corresponding to the migration trip.

Figure (5) shows aggregate values of border-crossing costs by age. The solid line represents aggregate border-crossing costs as a proportion of 2004 GDP (scale on left). The punctuated line represents costs as a proportion of the labor income migrants produced with in Mexico (scale on right). This figure demonstrates the high total cost of border-crossing for Mexican immigrants in the U.S., particularly for working-age adults. Though it is one of the smaller components of loss to Mexico due to emigration, border-crossing costs of the 20-35 year age group alone amounted to almost half of a percent of the 2004 GDP. The total present value of border-crossing costs across all ages is equivalent to 1.6% of the 2004 GDP.

When observed as a proportion of labor income produced in Mexico, total border-crossing costs are highest among 20-year-old migrants since they were educated in Mexico but emigrated as soon as they reached the age of labor income production.

[figure 5 around here]

Demographic dividend

As previously mentioned, the key driver in the demographic dividend is the change in the population age composition. Figure 6(a) illustrates the difference between the age distribution of the actual population (with emigration) and the counterfactual population without emigration in 2004. We use population projections for Mexico for the years 1950-2050 (Partida-Bush, 2008), and the age composition of the Mexican-origin first and second generation living in the U.S. in the years 1994-2009 (Miriam King et al., 2010). We construct one scenario without emigration in which the stock of first and second generations of the Mexican-origin population living in the U.S. is added to the Mexican population (dotted blue line on figure 6(a)) and compare it to the actual age distribution (solid red line on figure 6(a)). The difference between both curves illustrates that the population Mexico loses to emigration is concentrated among the working ages.

[figures 6(a) and 6(b) around here]

Figure 6(b) displays the difference in the growth rate of effective producers and effective consumers as well as the effect of emigration on these rates. The solid lines pertaining to the years 1995 and 2010 indicate the amount that emigrants and their children affected these totals. The dashed line indicates the growth rates only of the population who stayed. This figure demonstrates that both the growth rate of effective producers and effective consumers would increase without emigration. This is not surprising as emigrants decrease the number of effective producers in Mexico by emigrating mostly at working-ages but also have children which would increase the number of effective consumers had they not left Mexico.

The net effect of these changes on the demographic dividend are also displayed in figure 6(b). This figure displays actual and projected values of the demographic dividend. The 1990s saw declines and fluctuations in the economic support ratio in Mexico, a period also characterized by rising rates of emigration to the U.S. (Massey et al., 2002). This pattern for the first dividend had been observed in previous work (Mejía-Guevara et al., 2010), but it isn't until now that the effect of emigration becomes clear.

The dashed line demonstrates the stages of Mexico's first demographic dividend which is expressed as the difference between the growth rate of effective producers and the growth rate of effective consumers. The fist dividend peaks in 1995 and decreases monotonically thereafter. The solid line represents the counterfactual dividend had emigrants never left Mexico whereas the long-dashed line represents the dividend created only by the population who never migrated.

The difference is small because of the big variability in the estimation when using the counterfactual scenario. This variability can be explained by the irregular patterns of international migration during this period. One hypothesis is that the more prominent variations are due to changes in the age structure of migrants rather than the second generation. Many of the former often risk the threat of deportation due to their undocumented status.

4 Discussion

While remittances are an important element in measuring the macroeconomic impact of migration on a sender country, they constitute but one of its multitude of effects. This analysis examines the benefits of migration on the sender country in terms of consumption, savings and remittances, and losses in terms of lost production and asset accumulation among the migrant population. The net balance is obtained by summing up all of these elements and the net gain or loss depends on the magnitude of the effect of each of the elements as well as on the age composition of the migrant population. It also determines the effect of emigration on the demographic dividend, educational human capital, and aggregate transportation costs.

In Mexico, a cross-sectional analysis indicates that labor income, consumption and assets play an important role in the estimation of loss to Mexico due to migration. However, high levels of consumption in Mexico in 2004 relative to the labor income offset the negative effects of the loss in production and asset accumulation at the aggregate level. When all elements are taken into account, remittances make the greatest difference. In other words, the net effect in income, assets, and consumption is roughly equal to the effect of remittances.

Moreover, this analysis reveals that migrants' children represent a gain for Mexico because they consume, but do not produce nor accumulate assets. However, they also represent losses in human capital were they properly invested in. Prime-age adult emigrants clearly represent a loss for Mexico because the lack of production and asset accumulation.

Migration also has an effect on the demographic dividend by modifying the age composition of the population and its economic dependency. The age composition of the first and second generations of Mexican-origin is concentrated on young age groups, particularly prime-age adults. Had these people never migrated (and assuming their fertility rates would be comparable with those observed in Mexico during the period of analysis), their presence in Mexico would shift the age composition of Mexico toward a younger population. Evidence for Mexico suggests overall small changes, on average, over the first demographic dividend for the period of available information, with variations over time, reflecting the irregular patterns of migration during that period.

The present value of human capital investment for the Mexican-origin population currently in the U.S. is equivalent to 8% of the GDP of 2004, of which approximately 5% corresponds to investments made by the public sector. The low level of average educational attendance reported by the migrant population and the relative importance of primary public education in Mexico support these findings. The age structure of the stock of educational human capital is concentrated mainly in prime-age adults, reflecting their age composition. This estimation takes into account changes in productivity by assuming a constant rate of technological progress during the period of analysis and also changes in price levels. The age distribution of this human capital reflects the synthetic cohort analysis employed here and might be ignoring the effects of changes in the age structure of educational expenditures.

Finally, we constructed an age profile for the stock of capital representing transportation costs, i.e. *coyotes* and miscellaneous transportation costs, as a present value in the base year using information from the MMP for a period of around 70 years . We calculate aggregate costs of *coyotes*, which has have increased dramatically since the last twenty years, a period characterized by the changes in migration policy implemented by the United States authorities as an strategy to reduce the unauthorized migration coming from Mexico (Massey et al., 2002). The aggregate values estimated by age reflect the actual age composition of the migrant population. By summing them up, we obtain the total stock of the investment which amounts around 1.6% of the 2004 GDP, an amount similar to the total remittances sent to Mexico in 2002.

This work aims to contribute to the debate on the effects of migration from the standpoint of the sender country as well as introduce new methods to measure these effects. The methods employed in this paper can be extrapolated for longer periods of time to capture the long-term effects of future migration flows and changes in the age composition of both the migrant population living abroad and the Mexican population.

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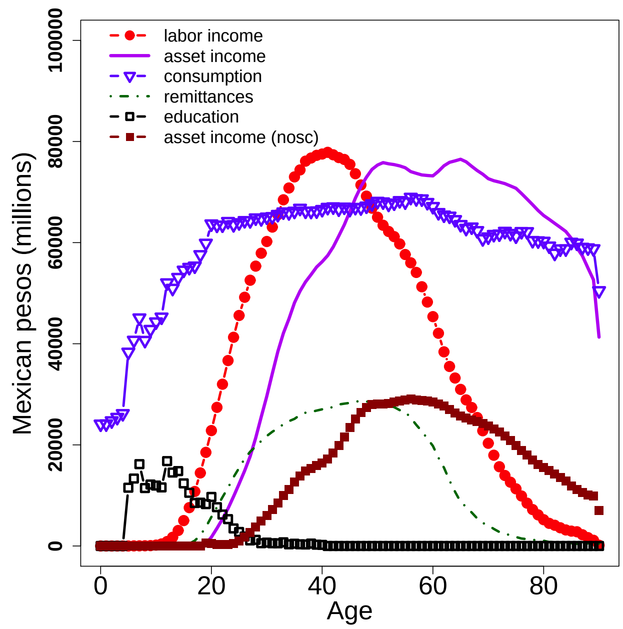
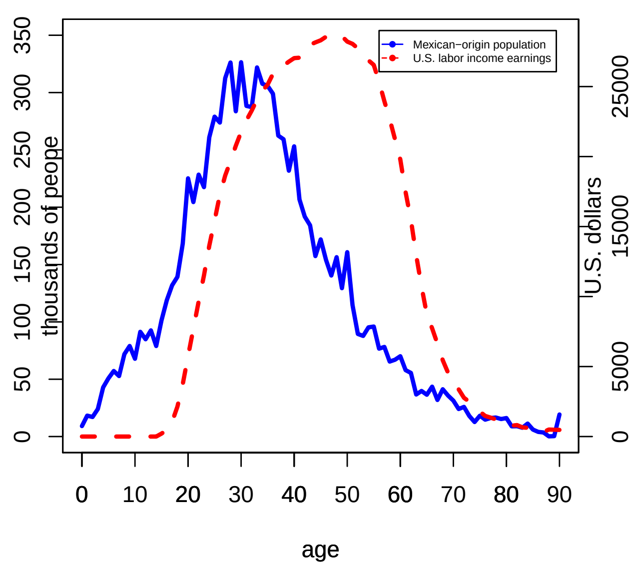
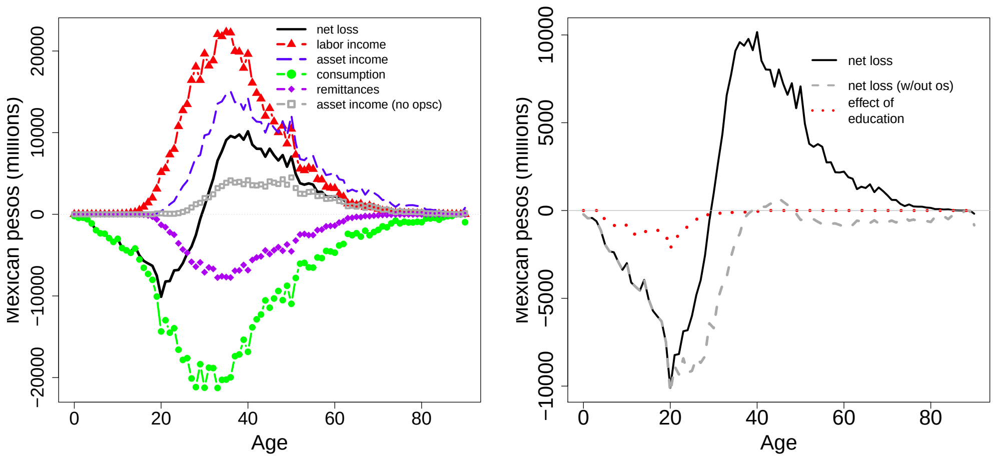


(a) $y^l(x)$ = labor income, $y^a(x)$ = asset income, $c(x)$ = consumption, $r(x)$ = remittances, $E(x)$ = education, and $y^a_{nosc}(x)$ = assets, no operating surplus costs



(b) Age distribution of people born in Mexico living in the U.S. in 2004 and labor income earnigs age profile of the U.S. in 2003.

Figure 1: Age distribution of the components of the loss function.



(a) Net loss from international migration in Mexico.

(b) Effect of operating surplus of corporations and education over the net loss by age

Figure 2: Components of net loss

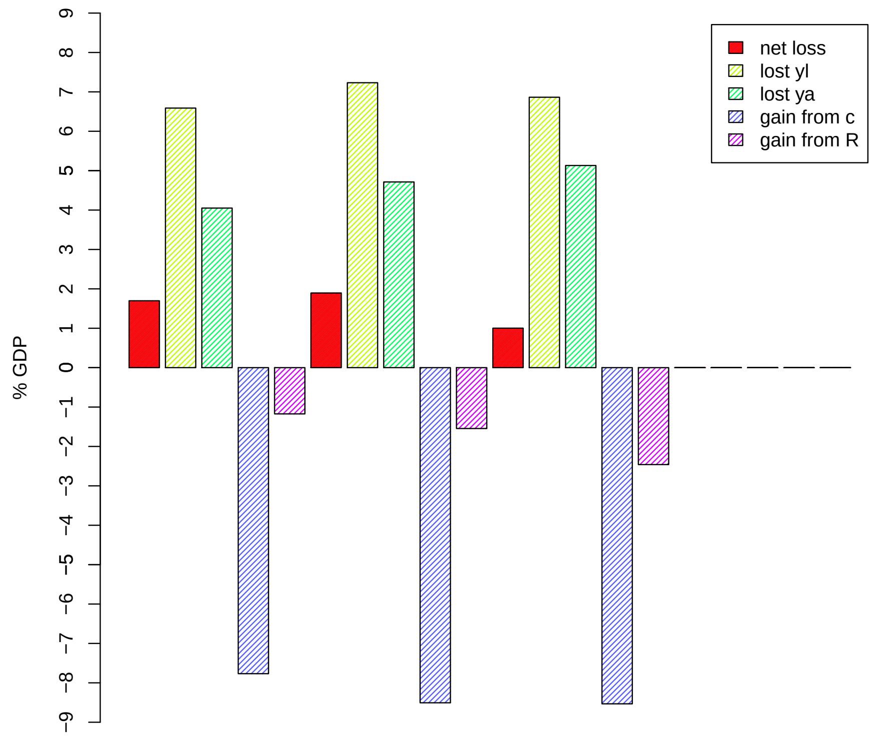


Figure 3: Net loss to emigration over time in the years 2000, 2002,and 2004, and its components.

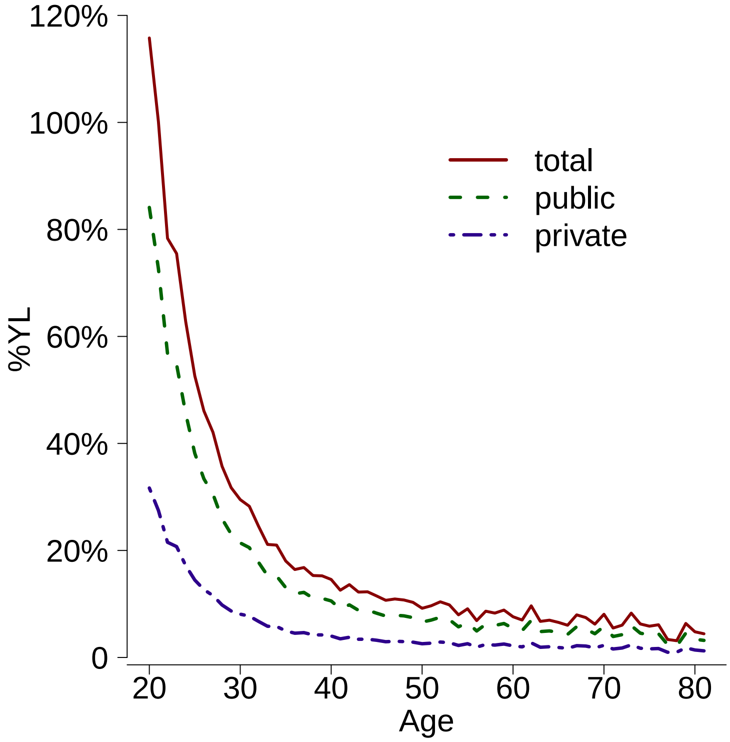


Figure 4: Present value of investment of human capital by age in 2004 as a share of the present value of labor income, YL, by age

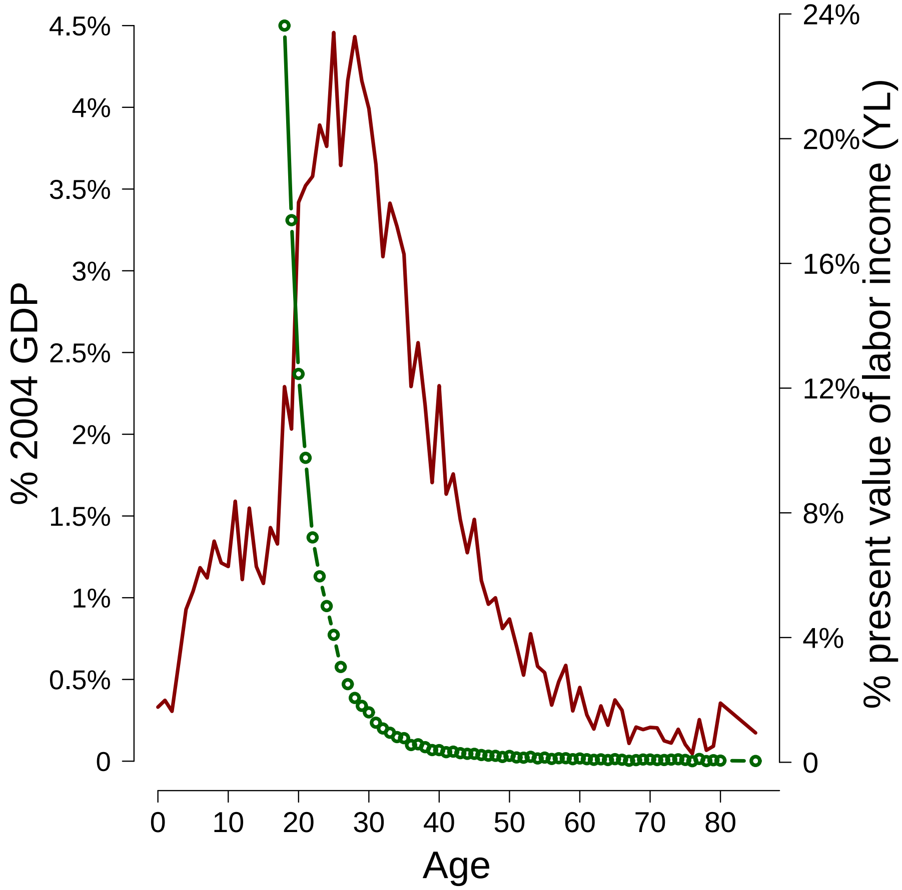
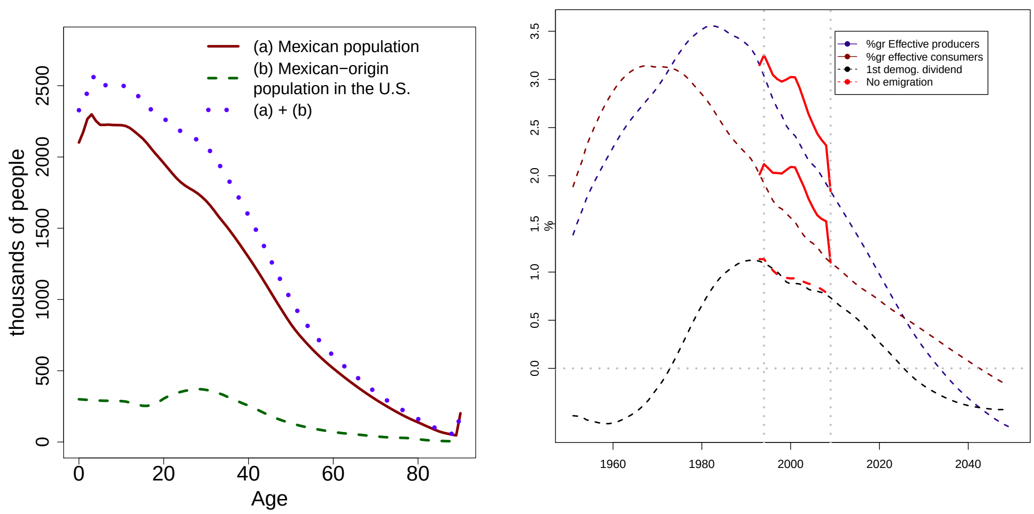


Figure 5: Costs of *coyotes* and other (travel, food, housing).



(a) Age distribution of the Mexican population without emigration (a), and of the first and second generation Mexican-origin population in the U.S. (2004) (b).

(b) Growth rate of effective consumers and producers in Mexico and the effect of emigration.

Figure 6: Effects of migration over the demographic dividend of Mexico.