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The Importance of Brain Return in the Brain Drain-Brain Gain Debate

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Return Migration and the Brain Drain-Brain Gain Debate*

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Abstract

Recent theoretical and empirical studies have emphasized the fact that the perspective of international migration increases the expected returns to skills in poor countries, linking the possibility of migrating (brain drain) with incentives to higher education (brain gain). If emigration is uncertain and some of the higly educated remain such channel may, at least in in part, counterbalance the negative effects of brain drain. Moreover recent empirical evidence seems to show that temporary migration is widespread among highly skilled migrants (such as Eastern Europeans in Western Europe and Asians in the US). This paper develops a simple tractable overlapping generations model that provides a rationale for return migration and predicts who will migrate and who returns among agents with heterogeneous abilities. We use parameter values from the literature and the data on return migration to calibrate our model and simulate and quantify the effects of increased openness on human capital and wages of the sending countries. We find that, for plausible values of the parameters, the return migration channel is very important and combined with the incentive channel reverses the brain drain into significant brain gain for the sending country.

Key Words: Skilled Migration, Return Migration, Returns to Education.

JEL Codes: F22, J61, O15.

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1 Introduction

While the flee of highly educated workers from less developed countries (brain drain) has a *direct* negative impact on the average human capital and the average productivity of the sending countries, there may be *indirect* effects that importantly reduce this negative impact and may even turn it into a brain gain. Openness to international migration may increase the opportunities of poor countries' people and increase their incentives to get education. Recently the debate on the consequences of the brain drain has intensified[1]. Some researchers have taken very strong stands in denouncing the costs of brain drain (especially in the medical field) for poor countries[2] but other recent articles (Beine et al. 2001; Batista et al. 2007; Docquier and Rapoport 2007) based on extensive empirical data of highly educated migrants points to clear evidence in favor of the "schooling incentive" acting on remaining citizens. Our view is that, especially for middle income economies (such as several East Asian and Eastern European countries) that have large rates of highly skilled migration there is a further important and overlooked mechanism of "brain gain" from international mobility: the return migration of highly educated workers. We will review the literature and present new evidence that shows how return migration is not a marginal phenomenon but it interest as much as one fourth of the migrants and could be particularly relevant for highly educated. Two questions then arise: why do highly educated return? and accounting for these returns does the international mobility of highly skilled look better for the sending countries? Moreover in the presence of selective migration who would be more likely to leave? and who would be more likely to return? This paper provides a frame and some numerical simulations to think about these questions qualitatively and quantitatively.

We develop a simple overlapping generation model of a small open economy in which optimizing agents decide (in sequence) on the level of education to be acquired, whether to migrate and whether to return after one period abroad. By calibrating some key parameters to the wage differentials, education returns and migration and return flows between Eastern -Western Europe and US-Asia we analyze the impact of international mobility on the average human capital (and wages) in the emigration countries. We choose these groups of countries because have in mind specifically skilled migration from countries with medium level of income per person to countries with high income per person. The largest propensity to emigrate, both overall and among highly educated, is in fact among middle-income countries (such as Eastern Europe, Asia and Latin America) rather then from the poorest countries (such as Africa). Moreover, at least in our reading of the evidence, some countries of Eastern Europe and Asia are economies with large number of emigrants as well as returnees. Our model allows us to identify the sources of human capital gain and drain and to quantify them for different

[1] Early contributions arguing for a negative impact of brain drain on developing countries are Gruber and Scott (1966), Bhagwati (1976), Bhagwati and Hamada (1974) Bhagwati and Rodriguez (1975).

[2] Remarkable for its extreme thesis and for the very influential outlet where it appeared was an article on the February 23, 2008 issue of "The Lancet" a leading medical journal entitled: "Should active recruitement of health workers from sub-Saharan Africa be viewed as a crime?"

level of international mobility. As in the recent brain-drain literature international mobility (from the poorer country) is summarized by a probability of emigrating, for people who would like to do so. Such uncertainty captures the fact that due to restrictions, immigration regulations and quotas, people who choose to migrate and select themselves to be in the "line" of potential emigrant, often do not succeed and remain in the country. Besides the choice of education and migration we also analyze the choice of return. This introduces another potential margin for the sending country to benefit from mobility of highly educated because we consider that the experience abroad enhances the productivity of human capital at home. This seems in line with several recent case-studies that emphasize how returnees have been important sources of entrepreneurship (McCormick and Wahba, 2004) and start-ups in high tech (IT) sectors in countries such as India (Commander, Chanda and Kangasiemi, 2004) and in the Hsinchu Science Part in Taipei (Luo and Wang 2004). Gundel and Peters (2008) analyzing immigrants in West Germany over the period 1984-2006 find that the highly skilled have a larger probability of re-migration relative to the less skilled and that the share of return migrants is rather large (between 40 and 50% of the immigrants, re-emigrate within 20 years). Zucker and Darby (2007) find that in the period 1981-2004 there was a strong tendency of "star scientists" in several science and technology fields in the US, to return at least for periods in their country of origin to promote start-up of high tech firms (especially to China, Taiwan and Brazil). Our model takes return migration seriously and shows how the beneficial effects of international mobility of highly educated workers are affected by it.

We find that the possibility of migrating and returning to the country of origin has two positive effect on the average human capital and wages in the sending country. First, those individuals who plan to migrate and return invest more in schooling as their return to schooling, while abroad and as returnees, is higher than if they stay in the home country. This effect is similar in spirit to the "incentive" effect emphasized by Baine et al. (2001): one does not need permanent migration to have the positive incentive effects. In particular if there is a wage and productivity premium for returnees, who can exploit, for instance, entrepreneurial abilities and skills acquired abroad, migration and return stimulate education even more than permanent migration. Second, the return of workers with international experience enhances the average human capital of the sending country. We simulate our model using parameter values and data that mirror the differences between Eastern European and Western European economies. We find that it is plausible to expect positive effect on the average human capital of Eastern European countries for looser migration polices, in the long run. We also show that 25% to 50% of the human capital and wage gains from freer migration accrue to the Eastern European countries through the return channel relative to the pure incentive channel studied by the literature so far. For reasonable share of return migrants (20 to 30% of those who emigrated) our model reveals that their role can be critical in evaluating the benefits of labor mobility to the sending country. Temporary migration with a "productivity premium" for returnees is the scenario that mostly benefit the sending country.

The rest of the paper is organized as follows. Section 2 reviews the empirical literature on brain drain, brain gain and brain return, emphasizing recent evidence of a significant positive indirect effect of emigration of highly educated on human capital through incentives and returns. Section 3 presents some new empirical evidence on the characteristics of immigrants from Asia and Eastern Europe to the US and on their tendency to return. Section 4 develops and solves a simple overlapping generation model in which workers of a poorer country decide about education, migration to a richer country and return. The model provides several insights on what are the key determinants of each decision in a country with no perspectives of emigration and in a country with increasing likelihood of emigration. Section 5 uses parameters from the literature to simulate the impact of looser emigration policies. In section 6 we consider the effect of a more sophisticated policy in which the probability of emigrating depends on the permanent or temporary nature of migration. Finally we look at the effect of emigration if there are positive externalities of human capital. Section 7 provides concluding remarks.

2 Stylized facts and Literature Review

The recent theoretical and empirical literature on skilled migration from less developed countries has revalued the possibility that international mobility may benefit human capital in the sending countries in the long run. The channels that have been emphasized are three: incentives, remittances and returns. Beginning with Beine, Docquier and Rapoport. (2001) and followed by Stark (2003) and recent contributions by Schiff (2005) and Beine, Docquier and Rapoport (2006) the theoretical literature on international migration of highly skilled workers has noticed that, at least in theory, the access to international labor markets, where returns to human capital are higher than domestically, may induce people in less developed countries to pursue higher education. Such incentive mechanism combined with the uncertainty of migration (due to immigration laws and procedures) may result in higher education of people who end up staying in the country. Wether this mechanism is only a theoretical curiosum or has empirical relevance has been recently tested by Beine, Docquier and Rapoport (2006) using the database assembled by Docquier and Marfouk (2006). While there seems to be some evidence of this incentive effect at work, the combined net effect of brain drain and brain gain seems positive only in countries with low emigration rates. The analysis of remittances in relation to emigration of highly skilled workers is not very large and does not reach strong conclusions. While some micro-studies (such as Lucas and Stark 1985) find a positive effect of education on the probability of sending remittances, at the aggregate level Faini (2007) finds that migrants' remittances decrease with the proportion of skilled individuals. In general there seem to be little evidence that higher educated remit significantly more than the rest of emigrants. The third channel, return migration, has attracted renewed attention in the recent years. On one hand several studies (Borjas and Bratesberg 1996, Dustmann and Weiss 2007) show that the percentage of migrants who return within 10 to 20 years to their country of origin is substantial (between 25 and 30% of the initial group). On the other hand recent evidence for less developed countries (Batista el al 2007) and for middle income or fast growing countries (Luo and Wang 2002, Commander et al 2004, Gunder and Peters 2008) emphasize how the returnees may be particularly concentrated among highly educated, and often among the most successful of them (Zucker and Darby, 2007). There is also evidence that very successful skilled workers are likely to return as entrepreneurs in their home country (Dustman and Kirchkamp 2001), earning high returns to their human and entrepreneurial capital. The interaction between the selection mechanism (who emigrates and then who, among those, returns) and the number of emigrants and returnees determines the impact on human capital and wages in the sending countries. If migration uncertainty provides incentives for people to get educated and then highly educated emigrants have high return rates, then the worries about brain drain may be overstated. An important issue is the empirical identification of the size and characteristics of returning migrants. Some theories would predict that only the less successful or gifted among emigrants return (Borjas and Bratsberg 1996). There seems to be mounting evidence, however, that especially in fast growing countries (China, India, Taiwan) the returnees are among the very best, because the country of origin pays a big premium on international experience. Dustmann and Weiss 92007) clearly show from UK data that the tendency of return migration is much stronger among workers in highly skilled occupations (their Table 2) and that it happens mostly within ten years from their arrival (Figure 3). Similarly Gunder and Peters (2008) show a much higher remigration rate for highly than for less educated. The next section confirms that return migrants are a sizeable group and do not seem to be negatively selected even for the population of eastern Europe and and Asians in the U.S. We provide some simple statistics following immigrants in the long run and assessing their likelihood of re-migration.

3 Some Evidence on Return Migration from the U.S. (1975-2005)

In this section we present some simple evidence, based on US census data, mainly to characterize the size of return migration of foreign-born in the U.S.. Dustmann and Weiss (2007) provide evidence from the U.K. based on a similar approach to the one we use here. Differently from them we are more interested in the return migration not immediately after the immigrants' arrival (1-4 years) but, provided that the immigrant stays few years, what fraction of them return after 10, 20 and 25 years. Moreover we are particularly interested in the return migration of workers who moved to the rich country when young or very young as they accumulate experience in prime working years and return to the country of origin when still in working age. Such is the scenario that best fit the theoretical model developed in section 4. Those returnees are likely to be beneficial to their country of origin as they enhance their human capital and they make it available to their country of origin. Even to simply measure the percentage of returnees and their education level is very hard and requires several assumptions, as no dataset follows immigrants in the country of temporary residence and then back into their country of origin. The U.S. census data are certainly the more detailed and reliable source for identifying immigrants present in the U.S. and their period of entry, age and education consistently across decades. Hence our approach is to follow several cohorts of immigrants identified by their period of entry in the US, over time, first observing them in the 1980 census and then in the 1990 and 2000 Censuses and in the 2005 American Community Survey. We measure in each year how many of them are left in the U.S. once we account for the mortality rates of the cohort (not very large except for the later years as we consider only people who immigrated when young). Such exercise is complicated by measurement errors, due to misreporting of the year of entry in successive censuses, and the small size of some cohorts may exacerbate such problem. More importantly we also notice that the Immigration Reform and Control Act of 1986 (the "Amnesty") probably induced several undocumented late entrants to declare an earlier date of entry to benefit from the legalization. This reason makes the recording of the cohort entered in the 1980-85 and 1985-1990 period particularly imprecise (in fact in the Census data such cohort increases significantly in size from 1990 to 2000, which is impossible) and particularly so for Central American immigrants (likely to be the group most affected by the Amnesty). For later cohorts (post 1990) we do not have enough years to characterize their return behavior after 10-20 years, so we choose to focus on cohorts that entered the US in the 1975-1979 period and were first observed in a census in year 1980. This cohort of immigrant is interesting, first because we observe 25 years of its history and hence we can record their long-run return behavior. Second, this cohort was also analyzed in an earlier study of return migration by Borjas and Bratberg (1996) who were, however, interested in the short-run return specifically between their arrival and 1980. They found that 17% of the full sample of immigrants had left the US before 1980 and for some groups (European and Latin American) this share was even higher. Our analysis considers those who stayed at least up to 1980, accumulating therefore between 1 and 5 years of experience in the United States, and analyze their permanence patterns afterwards. The other assumption made here is that living workers not in the US are likely to be back in their country rather than in a third country.

Table 1 shows the data for four cohorts (aged 13-17,18-22, 23-27 and 28-32 when entering the US) who entered in 1975-1979, over the 1980-2005 period, including immigrants from all countries. The values reported in the rows labelled "Males", "Females" and "Total" are the shares of living persons in the respective group still resident in the US, once we account for the specific mortality rates of the cohort using the mortality rates relative to the age groups by sex and year as reported by the National Center of Health Statistics (2008). On average the share of immigrants arrived in 1975-79 remaining in 2000-2005 is around 0.8 with some cohorts leaving in larger and other in lower proportions. In the aggregate group (age 13-32 at entry, reported in the last section of Table 1) there is not much difference between men and women permanence rates as they are between 0.79 and 0.80 as of year 2000. In general measurement error can be large and pollute the estimates. This is confirmed by the fact that for several groups the percentage of remaining migrants in 1990 is smaller than for year 2000 (which is impossible unless a significant group of people migrated back and forth between their country and the US and the respondents identify correctly the year of original entry in the US). The average value for the ”staying rate” as of 2000-2005 is about 0.8, implying that even in a place as the U.S. where often people believe that immigrants come to stay, and even selecting only the immigrants who stayed at least 1-4 years, we still observe a re-migration rate of about 20%. It is particularly interesting to distinguish the pattern of re-migration by country of origin. We report the rate of permanence by cohort and gender for Eastern European Immigrants in Table 2 (our simulation in section 5 considers the case of Eastern Europe as reference). The rate of permanence for Asian immigrants are reported in Table 3 and for Latin Americans in Table 4 (the largest group). Three interesting patterns emerge from the comparison. First, for both Eastern European and Asian the re-migration rate for the cohorts of people who entered when young is between 15 and 25% within the 25 years considered. This is similar to the behavior of the group inclusive of all immigrants. The staying rates for male immigrants, Eastern European and Asian is also represented in Figure 1 and for both sexes is reported in Figure 2. For some cohorts the percentage is higher and for some a bit lower but on average it is safe to interpret the numbers as implying a 20% re-migration rate. Most of those migrants left within the first ten years. Second for Asian and Eastern European male individuals (likely to be working and the main source of income in the family) have in general somewhat larger re-migration rates, so that between 20 and 25% of males returned from the U.S.. Third, and most interestingly, Latin American have a very different re-migration pattern. They essentially did not re-migrate and in many cases (because of measurement errors or re-classification of possibly undocumented, immigrants who arrived later) the share of remaining immigrants entered in 1975-1979 is above1 or very close to it. For this reason, the group of Latin Americans serves somewhat as a control. Assuming that most Latin Americans from that cohort remained in the US, this imply that in most cases the mismeasurement and reclassification errors lead to upward bias of the shares of those who stay (as they are systematically above one for this group). Particularly serious seems the upward bias in 2000. This would imply that the estimates of staying rates for other groups (and for the total) might be upward biased as well so that remigration rates of 20%-25% may be a *lower* bound implying that rates between 25 and 35% are not unreasonable.

Harder to read is the evidence about the selection of re-migrants along the skill (schooling) dimension. We report for each cohort the share of people with some college education or more. Table 1 shows that in most cases (except for the youngest group who entered at 13 and was in large part still in school as of 1980) the share of highly educated individuals does not change much. In general it increases by between 1 and 3 percentage points. Such increase is the combination of two effects: school upgrading by individuals of the cohort once in the US and selective out-migration. Interestingly, similar increases in the share of highly educated are observed among immigrants from any country (Europe, Asia and Latin America). As we know that for Latin American there was essentially no out-migration we can infer that an educational upgrading of 2-3% points is very reasonable for most immigrant cohorts. That would imply that the out-migrants are not negatively selected in each cohort (as originally argued in Borjas and Bratsberg 1996) as the remaining people in each cohort have a share of highly educated rather stable or increasing by 2-3 percentage points only (compatibly with the school upgrading). While there is not strong evidence of a positive selection of return migrants (which would imply significant reduction of the share of highly educated in the cohort) there seems to be at least a neutral selection and may be a moderately positive one if, for some groups, the education upgrading of the cohort was larger than for Latin American immigrants.

All in all the long-run analysis of return migration of foreign-born in the US, suggests that return-rates of 20-30% after 20 years are, in general, quite reasonable and particularly likely for immigrants returning to middle-low income countries such as Eastern Europe and Asia . Immigrants from Latin America, however, seem to return at much lower rates, if at all. Finally there is not evidence of negative selection of return-migrants along the educational range.

4 The Model

4.1 Production and Wages

Consider an economy (the Home country, indicated with an H) with heterogeneous workers (indexed by i) who produce one non-durable good Y according to the following aggregate production function:

$$Y = A_H L_H \overline{\chi} \tag{1}$$

where A_H indicates total factor productivity (TFP), L_H equals total employment and $\overline{\chi}$ defines the average human capital in the economy. Each individual j supplies one unit of labor and χ_i units of human capital so that the average human capital $\overline{\chi}$ is equal to $\frac{1}{L_H}\sum_1^{L_H}\chi_i$. As customary in the "Mincerian" approach to human capital we assume that the human capital of each individual is an exponential function of her schooling, h_i so that $\chi_i = e^{\eta_H h_i}$ where $\eta_{_H}$ represents the returns to schooling in the home country. The production function exhibits constant return to scale in total labor (and omits physical capital) so that it can be though as a long-run production function in which capital adjusts to keep the capital output ratio constant and the productivity of a worker is determined by TFP and by her level of human capital. In fact the marginal productivity (and wage) in the Home country of worker i in logarithmic terms is given by:

$$\ln(w_{Hi}) = \ln(A_H) + \eta_H h_i \tag{2}$$

Assuming a production function in the foreign country (F) similar to (1) with country-specific total factor productivity and country-specific returns to schooling the wage that individual i would earn abroad is

$$\ln(w_{Fi}) = \ln(A_F) + \eta_F h_i \tag{3}$$

As we are considering the issue of emigration from a relatively poor country we assume that $\ln(A_H) < \ln(A_F)$ so that part of the wage differential between countries is due to different productivity levels (in favor of F, the rich country). Moreover following the literature on "appropriate technological choice" and skill-biased technological progress (e.g. Acemoglu 2002; Caselli and Coleman 2006) we assume that the return to schooling are higher in Foreign than at Home because a larger share of highly educated workers in that country induces adoption of technologies that use human capital more efficiently so that: $\eta_H < \eta_F$.

The agents in the Home economy are described by an overlapping generation structure. They live 2 periods (denoted as 1, when they are young and 2 when they are old) and they can decide at the beginning of the first period whether to migrate and at the beginning of the second period whether to stay in Foreign or come back to Home. At the beginning of their first period they also decide how much education (schooling) to get and they pay its cost. To simplify the consumption side of the model we assume that there are no financial markets so that in each period people consume all their wage income purchasing good Y. Moreover we assume that the agent's utility function is separable over time and logarithmic in each period so that expressions (2) and (3) represent also the period utility from working (and living) at Home (2) or Abroad (3).

As there is no uncertainty in wages in order to generate a non-trivial decision about migrating back or staying in F at the beginning of the second period we assume that Home workers who have been abroad for one period "enhanced" their human capital as they learned new skills and techniques. If they decide to return this would enhance their earning per unit of initial human capital (as an augmentation of their human capital). This extra-benefit, however, would not be reaped if they stay in Foreign where they would simply have the same returns in the second period as they did in the first. This assumption is justifies by the evidence of return migration towards middle-income countries were returnees with high skills can access entrepreneurial activities and add extra-gains by acting as skilled entrepreneurs[3]. Moreover some middle-income countries, especially those that are catching up in the development ladder, seem to put an extra-bonus on brains who have had experience abroad. A simple way to capture this "return premium", that seems associated with particularly high skills is to represent the (logarithmic) wage of a person who returns to the Home country in the second

[3] For instance, Luo and Wang (2004) show that in the Hsinchu science Park in Taipei a large share of companies was started and run by returnees. McCormick and Wahba (2001) show a high probability of literate returnees to invest their own savings and be entrepreneurs. Commander, Chanda and Winters (2004) find that Indian IT firms in 2000 reported a large shares of their most skilled workers as having international experience. Finally Zucker and Darby (2007) show that many international star scientists in the field of biotechnologies in the 1980-2000 period (key for high tech start up) went from the U.S. to their country of origin with very positive effect on it. China, Taiwan and Brazil seem to be net receivers of these star scientists over that period.

period of her life after having been abroad as:

$$\ln(w_{FH}^2) = \ln(A_H) + \eta_H(\kappa h_i) \tag{4}$$

where w_{FH}^2 indicates the wage in the second period of one's life (superscript) for individual j who has been abroad and returned home. The parameter $\kappa > 1$ is a scaling factor for human capital associated with the experience abroad. If the individual chooses to remain abroad in the second period she will still earn wage (3). The relevant case in our analysis that would lead to return migration is when $\eta_H\kappa > \eta_F$, and we restrict ourself to such a case, providing empirical justification for it in section 5. We finally assume that there are costs of living abroad (material as well as psychological) and those cost can be specific to the period of life. We express them in utility units and denote them with M_1 and M_2 where the subscripts refer to the period in which they are incurred. In general we consider as relevant the case in which $M_1 > \ln(A_F) - \ln(A_H)$ which imply that cost of living abroad are large enough that not all workers from H move to the foreign country. At the same time it make sense to think that the cost of living abroad decreases from the first to the second period after migration (adjustment to the new country, integration and adoption of local customs would make it more pleasant to live abroad) so that $M_2 < M_1$ and possibly $M_2 < 0$ if there is a cost of returning once settled abroad. Finally if $\eta_H\kappa > \eta_F$ and the net gains from returning increase with the human capital of workers h_i then in order for some people to stay abroad in the second period it must be $\ln(A_F) - M_2 > \ln(A_H)$[4]. As the majority of migrants does not return we assume that this condition holds as well.

4.2 Migration and Return

At the beginning of the period 1 (youth) individual i chooses how much schooling to get, h_i, and simultaneously pays the cost k_i for such education. Immediately afterwards (still at the beginning of period 1) she also chooses whether to be considered for the possibility of migrating. We treat migration as a lottery. It is voluntary to decide wether to participate to the lottery or not. Once an individual has entered she faces the same probability of migrating as any other participant[5]. We index the decision to enter the lottery with the variable l_i which takes a value of 0 if the individual does not participate and 1 if she does. Once the education and lottery decision are resolved the individual participates in production and earns the wages in the home country (if she stayed out of the lottery or entered but was not selected to migrate) or abroad if she entered the lottery and was selected as migrant. The probability of being selected as migrant is $p \in [0, 1]$. At the beginning of the second period people who remained at home continue to earn wage w_{Hi} (we assume that the cost of moving in the

[4]If the inequality does not hold then the worker with lowest human capital ($h = 0$) would return and thereore all the others will too.

[5]The uncertainity from the migration decision stems from quotas, restrictions and rules imposed by the immigration policy of rich countries. In section 6 below we analyze the case in which the lottery does not assign equal probability to all applicants but discriminates according to either their observed educatio or the period of stay (permanent versus temporary)

second period are too high to make it profitable or that the receiving country has policy largely penalizing the immigration of older workers) while emigrants living abroad can decide whether to stay in F or to return. We index their decision to return with the indicator variable q_i that takes a value of 0 if the person stays abroad and of 1 if she returns.

The only uncertainty in the model is given by the uncertain migration perspectives for workers who enter the migration lottery. Other than that workers know their salary at Home and in Foreign and for simplicity we assume that productivity and returns to schooling do not change. The optimal decision of the individuals can easily be obtained starting with her last period and proceeding backwards. If the individual remains at Home during her first period her utility in the second period is $\ln(w_H)$ and no choice is needed; if she migrated in the first period she has to decide wether to return ($q_i = 1$) or not ($q_i = 0$) and such choice depends on whether the utility of living abroad net of the costs, $\ln(w_H) - M_2$, is larger or smaller than the utility from returning $\ln(w_{HF})$. Substituting expressions 3 and 4 into the inequality one easily obtains the optimal choice q_i^*as a function of individual's schooling:

$$q^*(h_i) = \begin{cases} 1 & \text{if} \quad h_i > \frac{\ln(A_F) - \ln(A_H) - M_2}{\eta_H \kappa - \eta_F} \\ 0 & \text{if} \quad h_i < \frac{\ln(A_F) - \ln(A_H) - M_2}{\eta_H \kappa - \eta_F} \end{cases} \tag{5}$$

As the benefits from returning increase with the human capital level, only individuals with high education would benefit enough to offset the difference between productivity net of costs $\ln(A_F) - M_2$ abroad and productivity at home $\ln(A_H)$. Plugging the optimal decision about returning we can the solve the first period inter-temporal optimization with respect to the decision to enter the lottery (l_i) and the amount of human capital acquired. The lifetime expected utility of agent i is:

$$\begin{aligned} U(h_i, l_i, q^*(h_i)) &= (1 - l_i)\ln(w_H^1) + l_i[p\left(\ln(w_F^1) - M_1\right) + (1-p)w_H^1] - k_i \\ &+ \frac{1}{1+\delta} l_i p[(1 - q_i^*)(\ln(w_F^2) - M_2) + q_i^* \ln(w_{FH}^2)] + \frac{1}{1+\delta}(1 - l_i p)w_H^2, \end{aligned} \tag{6}$$

where $\frac{1}{1+\delta}$ is the intertemporal discount factor, and k_i is the individual utility cost of acquiring human capital that we assume depends on the innate abilities of individual i, ν_i distributed over an interval $[\underline{\nu}, \overline{\nu}]$. q_i^* denotes the optimal decision about return. As in models in which school signals individual abilities, the costs of schooling are decreasing in individual ability and concave in the amount of human capital acquired, according to the following function:

$$k_i = \frac{\theta h_i^2}{\nu_i}. \tag{7}$$

Where θ is an exogenous shifter of schooling costs. As the decision to enter the immigration lottery is binary, it boils down to the comparison of the following two expected utility levels:

$$\ln(w_H^1) + \frac{1}{1+\delta}\ln(w_H^1) \quad \text{vs.} \tag{8}$$
$$p(\ln(w_F^1) - M_1) + (1-p)\ln(w_H) +$$
$$\frac{1}{1+\delta}p[(1-q^*(h_i))(\ln(w_F^2) - M_2) + q^*(h_i)\ln(w_{FH}^2)] + \frac{1}{1+\delta}(1-p)\ln(w_H)$$

that imply the following optimal choice of l_i^*

$$l_i^* = \begin{cases} 1 & \text{if} \quad h_i > \frac{M_1(1+\delta)+(1-q_i^*)M_2-(\ln(A_F)-\ln(A_H))(2+\delta-q_i^*)}{(2+\delta)(\eta_F-\eta_H)+q_i^*(\kappa\eta_H-\eta_F)} \\ 0 & \text{if} \quad h_i < \frac{M_1(1+\delta)+(1-q_i^*)M_2-(\ln(A_F)-\ln(A_H))(2+\delta-q_i^*)}{(2+\delta)(\eta_F-\eta_H)+q_i^*(\kappa\eta_H-\eta_F)} \end{cases} \tag{9}$$

The parameter restrictions imposed above imply that the denominator of the right hand side expression $(2+\delta)(\eta_F - \eta_H) + q_i^*(\kappa\eta_H - \eta_F)$ is certainly positive. Hence only workers with human capital above a certain threshold would enter the lottery as they would profit from migration. Notice that the probability of "winning the migration lottery" p does not affect the threshold level of human capital for the decision to enter the lottery. The reason is simple. Workers with human capital above the threshold are those whose utility net of costs increases by migrating. Hence they would take any probability of migrating over the certainty of staying. To the contrary those who do not participate (with human capital below the threshold) are better off not migrating.

The two functions (5) and (9) define two thresholds. One that we call h_S, defines the lowest educational level for which it is beneficial to emigrate and the other h_{RM} defines the lowest human capital level for which it is beneficial to migrate and return in the second period. Permanent migration exists only if $h_S < h_{RM}$ in which case some workers migrate and stay abroad and other return. To the contrary if $h_S > h_{RM}$ all migrants (still selected among the highly educated) are temporary (i.e. return during the second period).

Putting together conditions (5) and (9) and assuming that $h_S < h_{RM}$ (which is the relevant case for the parameter choice in 5.1) we can partition the range of schooling levels of workers into three intervals. For a level of human capital below the following threshold:

$$h_i < \frac{M_1(1+\delta) + (1-q_i)M_2 - (\ln(A_F) - \ln(A_H))(2+\delta)}{(2+\delta)(\eta_F - \eta_H)} \equiv h_S \tag{10}$$

workers choose to stay at Home (hence $l_i^* = 0$, $q_i^* = 0$) both periods. For human capital between the values reported below:

$$\frac{M_1(1+\delta) + (1-q_i)M_2 - (\ln(A_F) - \ln(A_H))(2+\delta)}{(2+\delta)(\eta_F - \eta_H)} < h_i < \frac{\ln(A_F) - \ln(A_H) - M_2}{\eta_H\kappa - \eta_F} \tag{11}$$

workers choose to enter the migration lottery and, conditional on emigrating, they stay in the destination country ($l_i^* = 1$, $q_i^* = 0$), while if the "loose the lottery" they will stay both periods in the Home country. Finally for values of human capital larger than the threshold h_{RM} (RM for return migration) defined in (12) workers choose to enter the lottery and, conditional on emigrating, they would return to the Home country in their second period of life ($l_i^* = 1$, $q_i^* = 1$).

$$h_i > \frac{\ln(A_F) - \ln(A_H) - M_2}{\eta_H \kappa - \eta_F} \equiv h_{RM} \tag{12}$$

4.3 The Schooling Decision

Differentiating (6) with respect to human capital h_i, and keeping in mind that q_i^* and l_i^* are equal to either 0 or 1 so that we only need to keep track of the thresholds h_S and h_{RM} , optimal schooling is the following linear function of the individual's quality ν_i

$$h_i^* = \frac{\frac{2+\delta}{1+\delta}(\eta_H + l_i^* p(\eta_F - \eta_H)) + \frac{1}{1+\delta} l_i p q_i^* (\eta_H \kappa - \eta_F)}{2\theta} \nu_i \tag{13}$$

Such relationship depends on the subsequent optimal choice of participating to the migration lottery and of returning. Those choices in turn depend on the values of h_i relative to the thresholds.The easiest way to analyze the optimal choice of schooling and migration as a function of ν_i is to consider the three different migration choices and plot, for each one of them, the optimal schooling choice as a function of ν_i. This gives the following three functions:

$$\begin{aligned}
h_i^{S*} &= \frac{\eta_H}{2\theta} \frac{2+\delta}{1+\delta} \nu_i \quad \text{for} \quad l_i^* = 0 \\
h_i^{MM*} &= \frac{1}{2\theta} \frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) \nu_i \quad \text{for} \quad l_i^* = 1, q_i^* = 0 \\
h_i^{MR*} &= \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \nu_i \quad \text{for} \quad l_i^* = 1, q_i^* = 1
\end{aligned} \tag{14}$$

Where the notation h_i^{S*} , h_i^{MM*}, h_i^{MR*} indicate, respectively, the optimal amount of schooling for people who stay at Home (S) for people who Migrate and remain abroad (MM) and for people who migrate and return (MR). It is clear from the coefficients that the linear relation between ν_i and schooling becomes steeper as workers decide to migrate and to migrate and return. The optimal functions in (14) together with the threshold values 10 and 12 determine the correspondence between individual quality ν_i, schooling and migration decision. Figure 1 illustrates the relation between ν_i and h_i^* and reports the threshold values 10 and 12 determining the migration behavior. The figures show that workers of ability lower than ν_S , formally given by expression (15) below would choose to acquire relatively low education and not even enter the immigration lottery ($l_i^* = 0$, $q_i^* = 0$).

$$\nu_S \equiv \frac{2\theta}{\frac{2+\delta}{1+\delta}(\eta_H + p(\eta_F - \eta_H))} \frac{M_1(1+\delta) + M_2 - (\ln(A_F) - \ln(A_H))(2+\delta)}{(2+\delta)(\eta_F - \eta_H)} \tag{15}$$

For ability levels between ν_S and ν_{RM} (defined in equation 16 below) workers choose to acquire an intermediate level of education enter the lottery for emigrating and, conditionally on migrating they stay in the destination country ($l_i^* = 1$, $q_i^* = 0$)

$$\nu_{RM} = \frac{2\theta}{\frac{2+\delta}{1+\delta}(\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta}p(\eta_H\kappa - \eta_F)} \frac{\ln(A_F) - \ln(A_H) - M_2}{\eta_H\kappa - \eta_F} \tag{16}$$

Finally, for ability levels larger than ν_{RM} workers enter the migration lottery and return to the home country in the second period of their lives ($l_i^* = 1$, $q_i^* = 1$). The three bold red segments in Figure 1 represent the schooling levels of the three groups of workers (stayers, temporary migrants and returning migrants) and show how high ability workers are selected among the possible migrants (remember that in the end they only migrate with probability p) and among the emigrants those with highest skills and education returns after one period. This features are consequences of the key assumptions that $\eta_F > \eta_H$ and $\eta_H\kappa > \eta_F$. Namely the foreign-country pays higher schooling premium to workers, but the human capital premium at home for returnees makes the perspective of migrating and returning for some highly educated individuals even more attractive than permanent migration. While the chosen range of parameters in section 5 implies that the ability threshold for migrating ν_S is well below the ability threshold ν_{RM} it is in principle possible that the opposite is true and $\nu_{RM} < \nu_S$. Such case arises for small values of η_F (that has to be still larger than η_H) and large values of κ[6].In that case the "intermediate" group of permanent migrants no longer exists. As illustrated in Figure 2 as soon as workers find it profitable to migrate they actually prefer to migrate and return so workers with personal abilities below ν_{RM} stay at home while those with abilities higher than ν_{RM} migrate in the first period and return in the second period. As in almost all documented cases, even when return migration is large, the majority of migrants do not return to their country of origin we regard this second case as unlikely and focus on the relevant case in which there are permanent migrants as well as returnees.

Before proceeding further we want to emphasize the role of p, the probability of migration, in affecting schooling of each group. An increase in p in our model has two effects. First, it will increase the slope of h_i^{MM*} and therefore decrease the value of the threshold ν_S. This implies that a larger range of workers (those with abilities between ν_S and $\overline{\nu}$) would get more schooling than before; this is the incentive effect already pointed out in the literature by Beine et al (2001) and Stark (2003). However people in this group will also have an higher probability of leaving; this is the classic brain drain effect. The other effect of an increase in p, which is specific

[6]Appendix 1 shows the derivation of the average schooling in this case.

to this model, is that it will also increase the slope of h_i^{MR*} and hence decrease the threshold ν_{RM}. This is a double "bonus" for the home country because it will increase the share of returnees (those with ability between ν_{RM} and $\overline{\nu}$) as well as their education. Hence in a model where there are perspectives of return migration and they are linked to the human capital of the migrant an increase in probability of migrating may have a significant positive impact on top of the incentive effect: more international mobility will increase the quality and the share of returnees[7].

The simple model presented above allows us to solve for the average level of human capital of workers in the Home country. Given the simple (logarithmic) wage equations in (2), (3) and (4) once we know the human capital level for an individual or a group we can easily compute their logarithmic wage. To make the model operational and derive expressions for average schooling and wages we assume that the distribution of abilities $\nu \in [0, \overline{\nu}]$ is uniform with density $1/\overline{\nu}$. Moreover the Home country population consists of two generations: the young (denoted with the subscript 1) and the old (denoted with the subscript 2). The pre-migration size of each generation at time t is denoted by the ϕ_{1t} and ϕ_{2t} (respectively for the young and the old) and the post-migration size, which is relevant to compute average human capital (and average wages) is given, respectively, by $\phi_{1t}(1 - m_{1t})$ and $\phi_{2t}(1 - m_{2t})$ where m_{1t} and m_{2t} are the share of young and old living abroad. Therefore the average human capital in the Home country in period t, $\overline{h}_t$ is given by the following expression:

$$\overline{h}_t = \frac{\phi_{1t}(1 - m_{1t})\overline{h}_{1t} + \phi_{2t}(1 - m_{2t})\overline{h}_{2t}.}{\phi_{1t}(1 - m_{1t}) + \phi_{2t}(1 - m_{2t})} \tag{17}$$

where $\overline{h}_{1t}$ and $\overline{h}_{2t}$ are the average level of schooling of young and old people who live at Home. The young are those who did not emigrate (either by choice or because did not win the lottery) while the old are a mixture of those who return and those who remained. In the next section we express the dependence of $\overline{h}_{1t}$ and $\overline{h}_{2t}$ on the parameters of the model, and analyze in particular their dependence on the probability of migrating.

4.4 Average Human Capital and Wages

If there is no possibility of emigration ($p = 0$), everybody in the source country chooses the lowest level of education as function of her ability $h_i^{S*}(\nu_i)$. Average human capital in autarky would be the same in the Home country for young and old individuals and would equal:

$$\overline{h}^A = \frac{1}{2} h_i^{S*}(\overline{\nu}) = \frac{\eta_H}{4\theta} \frac{2 + \delta}{1 + \delta} \overline{\nu}. \tag{18}$$

Now consider the case with positive probability of migration $0 < p < 1$. As noted above some workers have an incentive to invest in more schooling and opt for emigration (Possibly with return), depending on their

[7] The analytical derivation of the dependence of thresholds ν_S and ν_{RM} on p is shown in Appendix 2.

ability. The average human capital of those in the young generation remaining in the Home country depends on the averaging of human capital for three groups. Considering the relevant case (see section 5) in which $\nu_S < \nu_{RM}$[8], there will be a group of least educated who does not enter the lottery for migrating and pursues the lowest possible level of education per ability. A second group gets an intermediate level of education and enters the lottery but is not selected to migrate and a third group get the highest education (in the perspective of migrating and returning) but also is not selected. Expression **??** below shows the average human capital of the young generation as a weighted average of the mean human capital in each of these three groups, where the weight is the share of that group in the total of the young population in the Home country (after migration).

$$\overline{h}_1 = \frac{\frac{1}{2}h^{S*}(\nu_S)\nu_S.}{\nu_S + (1-p)(\overline{\nu} - \nu_S)} + \frac{\frac{1}{2}\left[h^{MM*}(\nu_{RM}) + h^{MM*}(\nu_S)\right](1-p)(\nu_{RM} - \nu_S)}{\nu_S + (1-p)(\overline{\nu} - \nu_S)} \\ \frac{\frac{1}{2}\left[h^{MR*}(\bar{\nu}) + h^{MR*}(\nu_{RM})\right](1-p)(\bar{\nu} - \nu_{RM})}{\nu_S + (1-p)(\overline{\nu} - \nu_S)} \tag{19}$$

The first term in the right hand side of 19 is the product of average human capital of individuals who prefer staying at Home (and hence do not participate to the lottery) that is given by $\frac{1}{2}h^{S*}(\nu_S)$ and their share in the total non-migrating young population, given by $\frac{\nu_S.}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}$[9]. The second term contains the average human capital of workers who get an education to migrate and remain abroad $\frac{1}{2}\left(h^{MM*}(\nu_{RM}) + h^{MM*}(\nu_S)\right)$ times their share in the non-migrating young population $\frac{(1-p)(\nu_{RM}-\nu_S)}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}$.The third term equals the product of average human capital for individuals who plan to migrate and return, $\frac{1}{2}\left(h^{MR*}(\bar{\nu}) + h^{MR*}(\nu_{RM})\right)$, but end up not migrating times their share in the non-migrating population $\frac{(1-p)(\bar{\nu}-\nu_{RM})}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}$. The average human capital of the old generation in the Home country can be calculated in a similar way. The only difference is that even the individuals who migrated, whose ability was between ν_{RM} and $\bar{\nu}$ are now back in the Home country. Hence the expression of average human capital for the old generation is given by:

$$\overline{h}_2 = \frac{\frac{1}{2}h^{S*}(\nu_S)\nu_S}{\nu_S + (1-p)(\nu_{RM} - \nu_S) + (\bar{\nu} - \nu_{RM})} + \frac{\frac{1}{2}\left[h^{MM*}(\nu_{RM}) + h^{MM*}(\nu_S)\right](1-p)(\nu_{RM} - \nu_S)}{\nu_S + (1-p)(\nu_{RM} - \nu_S) + (\bar{\nu} - \nu_{RM})} \\ \frac{\frac{1}{2}\left[h^{MR*}(\bar{\nu}) + h^{MR*}(\nu_{RM})\right](\bar{\nu} - \nu_{RM}).}{\nu_S + (1-p)(\nu_{RM} - \nu_S) + (\bar{\nu} - \nu_{RM})} \tag{20}$$

The interpretation of the three terms on the right hand side of 20 is the same as in 19. In fact the only difference in the calculation of the shares is that in the second period all workers in the $[\nu_{RM}, \bar{\nu}]$ in-

[8]See the appendix for average human capital when $\nu_S > \nu_{RM}$.

[9]Because of the uniform distribution fo abilities the share is expressed by the simple ratio of the support of ν for the group and the total support, accounting for the fact that in the interval $[\nu_s, \nu]$ only a fraction $(1-p)$ ends up staying.

terval are at Home (as those who migrated return) and the total size of the population at home is equal to $\frac{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})}{\bar{\nu}}$.

If we substitute the expressions for h^{S*}, h^{MM*} and $h^{MR*}(\bar{\nu})$ from (14) into (19) and (20) we obtain the following expressions, linking the average human capital of the young to the parameters and to the threshold values ν_S and ν_{RM} :

$$\begin{aligned}\overline{h}_1 = \frac{1}{4\theta} \quad & \frac{2+\delta}{1+\delta}\eta_H \frac{\nu_S^2}{\nu_S+(1-p)(\overline{\nu}-\nu_S)} \\ & +\frac{1}{4\theta}\frac{2+\delta}{1+\delta}[\eta_H+p(\eta_F-\eta_H)]\frac{(1-p)(\nu_{RM}^2-\nu_S^2)}{\nu_S+(1-p)(\overline{\nu}-\nu_S)} \\ & +\frac{1}{4\theta}\left[\frac{2+\delta}{1+\delta}(\eta_H+p(\eta_F-\eta_H))+\frac{1}{1+\delta}p(\eta_H\kappa-\eta_F)\right]\frac{(1-p)(\bar{\nu}^2-\nu_{RM}^2)}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}\end{aligned} \tag{21}$$

And the average human capital of the old generation would be::

$$\begin{aligned}\overline{h}_2 = \frac{1}{4\theta} \quad & \frac{2+\delta}{1+\delta}\eta_H \frac{\nu_S^2}{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})} \\ & +\frac{1}{4\theta}\frac{2+\delta}{1+\delta}[\eta_H+p(\eta_F-\eta_H)]\frac{(1-p)(\nu_{RM}^2-\nu_S^2)}{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})} \\ & +\frac{1}{4\theta}\left[\frac{2+\delta}{1+\delta}(\eta_H+p(\eta_F-\eta_H))+\frac{1}{1+\delta}p(\eta_H\kappa-\eta_F)\right]\frac{(\bar{\nu}^2-\nu_{RM}^2)}{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})}\end{aligned} \tag{22}$$

In steady state, when parameter values and immigration policies are stable, one can calculate the average human capital for the whole population by combining in expression 17 the average human capital of young and old from (21) and (22) accounting for the fact that the share of individuals who are in the Home country from the first generation, $(1-m_1)$, is equal to $\frac{\nu_S+(1-p)(\bar{\nu}-\nu_s)}{\bar{\nu}}$ and the share of individual at Home for the second generation, $(1-m_1)$, is $\frac{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})}{\bar{\nu}}$.

Finally to evaluate the average wages in the Home economy, which provide a simple measure of income per capita as labor is the only factor of production in the model, we can easily combine the average wage for workers in each of the three groups (between 0 and ν_S , between ν_S and ν_{RM} and between ν_{RM} and $\bar{\nu}$) weighted by the share of that group among young/old workers (if we are calculating the average wage for a cohort) or in the total population if we are calculating the average wage (income per person) overall. Let us define as $\overline{w}_{L1}$, $\overline{w}_{M1}$ and $\overline{w}_{H1}$ the average wage of workers, respectively, with low ability (below ν_S), medium abilities (between ν_S and ν_{RM}) and high abilities (above ν_{RM}) when they are young and with $\overline{w}_{L2}$, $\overline{w}_{M2}$ and $\overline{w}_{H2}$ their average wage when they are old. While the average wage and the size of the first two groups are the same when young or old, the average wage and the size of the third group (migrants who return) is different and we have to keep track of the fact that only a fraction $(1-p)$ of them is in the home country when young while the whole group is in the country when old. To avoid redundant notation we call $\overline{w}_{L1} = \overline{w}_{L2} = \overline{w}_L$ and $\overline{w}_{M1} = \overline{w}_{M2} = \overline{w}_M$ and the average wage for the young generation $\overline{w}_1$ for the old generation $\overline{w}_2$ and overall $\overline{w}$ are given by the following expressions:

$$\begin{aligned} \overline{w}_1 &= \overline{w}_L\left(\frac{\nu_S}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}\right)+\overline{w}_M\left(\frac{(1-p)(\nu_{RM}-\nu_S)}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}\right)+ \\ & \overline{w}_{H1}\left(\frac{(1-p)(\bar{\nu}-\nu_{RM})}{\nu_S+(1-p)(\overline{\nu}-\nu_S)}\right) \end{aligned} \tag{23}$$

$$\begin{aligned} \overline{w}_2 &= \overline{w}_L\left(\frac{\nu_S}{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})}\right)+\overline{w}_M\left(\frac{(1-p)(\nu_{RM}-\nu_S)}{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})}\right)+ \\ & \overline{w}_{H2}\left(\frac{(\bar{\nu}-\nu_{RM})}{\nu_S+(1-p)(\nu_{RM}-\nu_S)+(\bar{\nu}-\nu_{RM})}\right) \end{aligned} \tag{24}$$

$$\overline{w} = \frac{\phi_1(1-m_1)\overline{w}_1+\phi_2(1-m_2)\overline{w}_2.}{\phi_1(1-m_1)+\phi_2(1-m_2)} \tag{25}$$

where $\phi_1$and ϕ_2 are the pre-migration population of the currently young and old cohorts and $(1-m_1)$ and $(1-m_2)$ are the shares of those cohorts in the home country, that differ my the fraction of workers who return. Using the production function and expressions (2) and (4) to calculate individual wages (for stayers and returnees) the average wage for each of the three groups is given by the following expressions:

$$\overline{w}_L = \frac{1}{\nu_S}\int_0^{\nu_S} A_H e^{\eta_H \frac{\eta_H}{2\theta}\frac{2+\delta}{1+\delta}\nu} d\nu \tag{26}$$

$$\overline{w}_M = \frac{1}{\nu_{RM}-\nu_S}\int_{\nu_S}^{\nu_{RM}} A_H e^{\eta_H \frac{1}{2\theta}\frac{2+\delta}{1+\delta}(\eta_H+p(\eta_F-\eta_H))\nu} d\nu \tag{27}$$

$$\overline{w}_{H1} = \frac{1}{(\bar{\nu}-\nu_{RM})}\int_{\nu_{RM}}^{\overline{\nu}} A_H e^{\eta_H \frac{1}{2\theta}\left(\frac{2+\delta}{1+\delta}(\eta_H+p(\eta_F-\eta_H))+\frac{1}{1+\delta}p(\eta_H\kappa-\eta_F)\right)\nu} d\nu \tag{28}$$

$$\begin{aligned} \overline{w}_{H2} &= \frac{(1-p)}{(\bar{\nu}-\nu_{RM})}\int_{\nu_{RM}}^{\overline{\nu}} A_H e^{\eta_H \frac{1}{2\theta}\left(\frac{2+\delta}{1+\delta}(\eta_H+p(\eta_F-\eta_H))+\frac{1}{1+\delta}p(\eta_H\kappa-\eta_F)\right)\nu} d\nu + \\ & +\frac{p}{(\bar{\nu}-\nu_{RM})}\int_{\nu_{RM}}^{\overline{\nu}} A_H e^{\eta_H\kappa \frac{1}{2\theta}\left(\frac{2+\delta}{1+\delta}(\eta_H+p(\eta_F-\eta_H))+\frac{1}{1+\delta}p(\eta_H\kappa-\eta_F)\right)\nu} d\nu \end{aligned} \tag{29}$$

Notice that the difference between $\overline{w}_{H1}$ and $\overline{w}_{H2}$ is the return of the share p of workers who were abroad and who are now endowed with the extra-productivity term $\eta_H\kappa$ to their human capital. Due to the exponential dependence of wages on schooling and, in turn, abilities, it is easy to solve the integrals above. Expressions (38), (39), (40) and (**??**) in Appendix 3 provide the analytical solutions to (26)-(29). In the next section and we discuss and simulate in detail the response of human capital and wages to different migration policies emphasizing the differential impact depending on ability, the role of migration costs and the relevance of migrants' return.

5 Simulation of Migration Policies

The model presented above is quite stylized. Most of the variable analyzed in it, however, have a measurable empirical counterpart. We can then impose some structure by informing our choice of the parameters through existing parameter estimates or features of the data. we can then ask the model to provide at least some plausible magnitudes in the analysis of the effects of migration policies on human capital and wages of the Home country. To make things more plausible we think of Eastern Europe as the Home Country and Western Europe as the Foreign country in our simulation. Immigration policies can be seen as increasing progressively the probability of migration p from 0 (in the late eighties) to the current rates of 10-15% of the population. Our model allows us to identify the effects of such policy changes on schooling and wages as well as the potential further effects of increased mobility (for p above 0.15). More importantly, however, the model allows us to evaluate the relative strength of the effect produced by the "pure drain from migration", by the "incentive effect from migration" and the new effect stemming from "incentives from migration and return" that is the relative innovation of this paper. Rather than taking too seriously the overall effects we intend to show how, for plausible parameter values, the return channel induces important effects on incentives, human capital and wages, relative to migration without return. This allows us to discuss the option of using the "return premium" (κ in the model) as a possible migration policy instrument as long as a country may affect the return to human capital accumulated abroad, or enhance the return to skills in order to induce a reversal of the brain drain. Let us first describe the parameter choice in the base case and in plausible variations and then, in turn, we will discuss the effects of increased international migration and the role of return migration.

5.1 Parameter Choice

Table 5 shows the choice of parameters that we use in our baseline simulation. They are obtained from the literature or chosen as to calibrate observed migration and return flows. The ratio of labor productivity abroad and at home, $A_H \ /A_F$, is set equal to 2, to capture the approximate relative productivity differences of two to one, due to TFP and capital differences between the average Eastern European country and Germany-UK (as representative of the West) measured in the late eighties and reported in Hall and Jones (1999). This assumption implies that the difference in logarithmic productivity $\ln(A_F)$ - $\ln(A_H)$ that is the term entering all the relevant expressions in section 4 is equal to $\ln(2)$. We further assume that the returns to one year of schooling are $\eta_H = 0.04$ and $\eta_F = 0.08$ for the home and foreign country, respectively. These values are based on average returns to schooling in Poland and East Germany (for the East) and in Western Germany and the UK (for the West) both taken around the early nineties, when the iron curtain collapsed. Those returns are available at Hendricks (2004). The parameter κ is chosen so that the condition $\eta_H\kappa - \eta_F > 0$ is satisfied and some highly educated workers would return. Given the choice of η_H and η_F the inequality imply that κ should be larger than 2. As we documented in section 3 above return rates of 20-30% for migrants of Eastern Europe to the US and the UK seems quite plausible. Hence κ is chosen as to deliver return migration rates between 0.2 and 0.4 at the current migration rates; this turns out to be around 2.4. The pre-migration size of the cohort of young and old workers (ϕ_1 and ϕ_2) are both set equal to 0.5 (so that total population is standardized to 1). The utility costs of residing abroad in the first and second period of life, M_1 and M_2 are chosen so as to generate two important feature of the data. First $M_1 + \frac{M_2}{1+\delta} > [\ln(A_F) - \ln(A_H)]\frac{2+\delta}{1+\delta}$ so that the present discounted utility cost for the least skilled workers is higher than the present discounted benefit from migrating. This implies that at least for the least skilled worker it is too costly to migrate and not everybody would migrate, even in the presence of no legal restrictions to migration. This reflect the fact that a section of the population (likely to correspond to the group with lowest skills) will not migrate even with no migration barriers. Second $M_2 < \ln(A_F) - \ln(A_H)$ so that not all emigrants will return in the second period, again while the percentage of returnees is possibly quite large the majority of emigrants remain abroad for their whole life. This is a feature that we like our model to mirror. The chosen parameter values and the restrictions above imply that in all considered cases the threshold h_S is strictly larger than 0 and the threshold h_{RM} is strictly larger than h_S. We show simulations with different values of M_1 and M_2 near the inequality thresholds. The variable h is literally interpreted as years of schooling, while individual ability ν (that does not have a natural scale) is standardized to vary between a lower bound $\underline{\nu}$=0 and an upper bound $\bar{\nu}$ such that highest human capital attained in autarky $h_i^{S*}(\overline{\nu}) = \frac{\eta_H}{2\theta}\frac{2+\delta}{1+\delta}\overline{\nu}$ is equal to college education (16 years). Moreover such choice plus the uniform distribution assumption implies that the average years of schooling in autarchy is equal to 8. This is a remarkably good approximation for the eastern European economies around the 1985-1990 period. The Barro and Lee (2000) dataset, in fact puts the average schooling in transitional economies in Eastern Europe at 8.5, with Poland at the low end of the spectrum with an average of 6.8 year in 1990 and East Germany, Hungary and Czechoslovakia at the high end with average schooling between 8.7 and 10.1 years. The parameter δ is chosen to be equal 0.5 that implies a yearly discount rate of 2% and a length of one period (half working life) of 20 years.

5.2 Baseline Case

Table 6 shows the effect on average schooling and wages of progressively looser migration policies, corresponding to higher probability of emigration, from 0 to 0.3. This cover most of the empirically relevant range as except for very small Caribbean islands and few African countries no economy has emigration rates larger than 30%. This simulation is what we consider the baseline case. In the simulation we use a utility cost of living abroad equal to 1.5 times the logarithmic wage differential ($1.5*\ln(2)$) between the rich and poor country and a cost of remaining abroad the second period equal to 0.67 (two thirds) of the logarithmic wage differential. We choose the parameter κ to be 2.4. From a schooling level equal to primary education only (8 years) for the young generation (first row) the old generation (second row) and the overall average (third row) under no migration we can follow in each row the level of $\overline{h}_1$, $\overline{h}_2$ and $\overline{h}$ as the probability p increases. Recall that eight years of schooling corresponds roughly to the average for eastern Europe in the nineties. In the following three rows we report the average wages for the young cohort ($\overline{w}_1$) the old cohort ($\overline{w}_2$) and the population overall ($\overline{w}$). In order to identify the winners and losers of freer migration we also report, in the following three rows, the average wage of each of the four relevant skill groups characterized by different education levels and migration behavior. Those with ability below ν_S (Low) who do not pursue migration earn wage $\overline{w}_L$ (both as young and old) defined by equation (26); those with ability between ν_S and ν_{RM} (Medium) who pursue migration and remain abroad if they manage to leave, earn wage $\overline{w}_M$ (both as young and old) defined by condition (27); finally those with ability above ν_{RM} (High) who pursue migration and return earn average wage equal to $\overline{w}_{H1}$(given by expression 28) when young if they do not succeed in migrating. The whole cohort earns an average of $\overline{w}_{H2}$ when old which is inclusive of the returnees and those who stayed at home and is defined by expression (29). All average wages are standardized so that the average wage in the autarchy case equals 1. Hence it is easy to calculate from the reported numbers the percentage variation of wages with migration policies as well as the relative wages across groups. Finally the last two rows report the percentage of total population living abroad (emigration rates comparable to those measured by Docquier and Marfouk 2006) and the return rate, i.e. the percentage of total migrants who return.

The baseline case implies that workers with less than 3 years of schooling ($h_s = 2.88$) will not pursue migration, those with schooling between 2.88 years and 14.4 years pursue permanent migration while those with more than 14.4 years will pursue migration and, if they are able to leave the country when young, they will return to the home country when old (these values are reported in the footnotes to Table 5) . The overall long-run effect of higher migration probability on average education is strictly positive in the chosen range. Average education increases by 2.5 years going from no international mobility to significant mobility, $p = 0.3$. Such increase is an average between an increase by 2 years of schooling for the young generation, due to the incentive effect generated by the possibility of migration and an increase by 3 years for the old generation, whose highly educated members have enhanced their human capital abroad. Even at $p = 0.15$, a moderate level of international mobility, the average education gain relative to autarchy is equal to 1.2 years. Such improvements in average schooling produce an increase in average wage (income per worker) of almost 10% in the case $p = 0.15$ relative to autarchy and of 29% in the case of $p = 0.30$. These are large gains. At the probability of migrating equal to 0.15 the young generation has an average wage larger by 5% than in autarchy simply due to the incentives to higher education, and the older generation, that includes high earning returnees receives an average wage 14% high than in autarchy. Keep in mind that these gains do not include the wage gains of permanent migrants and are reached for actual emigration rates (last row) of 12.6% and rate of return migration of 27%. Both of them are well within the range observed for Eastern European countries around year 2000. While our model assumes that the wage premium to human capital accumulated abroad is particularly large for highly educated workers the important message is that the combination of incentives and return migration, for plausible values of returns to schooling and return rates is able to produce very positive effects on the home-country education (and wages) in the long-run. In the considered range of the migration probability (0 to 0.3) the incentive-plus-return effects more than offset the drain effect from selective migration. Figure 5a, shows the behavior of average human capital for the young, the old generation and their aggregate as p varies between 0 and 1. Interestingly we see that while the effect of p on human capital of the first generation is hump shaped, becoming negative for high values of p (because higher levels of schooling are coupled with migration of some of the most highly educated) the effect on human capital of the second generation is always positive and increasing with p. While only between 17 and 38% of emigrants return (see last row of Table 6), the fact that they are selected among the highly educated significantly increases human capital of the old generation. In our simulation the positive effect of mobility on the human capital of the old generation dominates the effect on the young generation. Even in the range of p where the last effect becomes negative, at high values of p, the average level of human capital $\overline{h}$ increases in p over the whole range between 0 and 1. In the plausible range, between 0 and 0.3, which is the one detailed in Table 6, both the generation of young and old experience increasing levels of average schooling as p increases.

Row seven to ten of Table 6 report the wages of the different groups of workers with low, medium and high education. This last group is split between young highly educated, inclusive only of individuals who did not migrate, and old highly educated, inclusive of those who remained plus the returnees. Recall that the returnees have the extra-wage premium due to their experience abroad. This implies that the average wage of the older group is higher than that of the younger group. Looking at each group we see that the average wage (and schooling) of the group with lowest abilities does not change much as p increases, in fact it declines a bit. Migration incentives do not generate any change in education per unit of ability for this group and selection produces lower average schooling (because the threshold ν_S decreases as p rises). The average wage of the intermediate group also does not change much with p. This however is the result of two opposite effect. Higher p increases the schooling of each ability type, but it also produces a selection of individuals with progressively lower abilities in the range of potential migrants (ν_S and ν_{RM} decrease). Finally the two groups with highest education experience the largest increase in wages (and schooling) as p increases because on one hand workers choose more schooling per unit of ability (effect on $\overline{w}_{H1}$) and on top of that returnees receive the enhanced returns $\kappa\eta_H$ to schooling (effect on $\overline{w}_{H2}$). Both the increase in average schooling (and wages) of the group with ability above ν_{RM} and the increase in size of this group relative to the others, increases produce the positive effect on average schooling and wages as p increases.

5.3 The Role of Incentives and Return Migration

The positive effect on average human capital and wages illustrated in Table 6 result from the fact that the education incentives plus the productivity premium for returnees reverse the negative impact of skilled migration. It is interesting to know i) How large would the decrease in average human capital be if the two positive channels were not operating ii) How much of the human capital gains are due to incentives induced by permanent migration and how much to the extra-incentives and net gains added by the possibility of return migration. In order to answer these two questions we examine two alternative scenarios. Table 7a shows the simulated wage and schooling effects when we completely silence the return channel (by setting $\kappa = 1$ so that there is no return premium and therefore no return) but maintain the possibility of permanent migration and its incentive effect. Table 7b shows the differences between variables in this scenario and the baseline. Then Table 8a shows wages and schooling levels for the case of no incentive effects of permanent migration (by imposing a fixed correspondence between ability and schooling level, unaffected by expected returns) and no return migration. In this case selective migration (as returns to schooling are still higher abroad) only produces a drain of highly educated. Table 8a shows the differences in the value of the relevant variables in this scenario vis-a-vis the baseline. Keep in mind that as there is no return in either of the cases illustrated in Table 7 or 8, the average wages (schooling) of the young and old are the same, and there are only two relevant groups, those with ability below the migration threshold (ν_S) whose wage is denoted as w_L and those with ability above it whose wage is w_H.

Three interesting facts emerge from the analysis of the tables. First, the incentive effects of international migration (Table 7) are enough to produce positive human capital and wage effect on the Home country for the parameter combination used in the baseline case and for reasonable values of p. Figure 5b shows the effect of incentives alone on average wages, namely the case reported in Table 7a. We see that only for very high values of p (above 0.8) the drain effect is large enough to cause a decrease in human capital. This is interesting news as sometimes the positive incentive effect is considered as a theoretical curiosum, while it seems very plausible in our model. Second, with no incentive effects nor return migration (Table 8a and figure 5c) there is instead a significant reduction of average schooling as international mobility increases. This is the standard brain drain effect in presence of selective migration. Under this scenario, for $p = 0.3$ average schooling is half year smaller than it would be in autarchy and average wages are 2% smaller. Figure 5c shows the globally negative effect of free mobility on average Home wages under this scenario. Third, of the human capital and wage differentials between the case with no incentive and no return and the baseline case (reported in Table 8b) around 50 to 75% is due purely to the incentive mechanism created by emigration possibility while 25 to 50% of the gains are due to to the return mechanism. For instance considering average wages for a probability $p = 0.15$, they are 10% lower than the baseline case in the case with no incentive and return (Table 8b), while they would be only 5% lower in the case with incentives and no return (Table 7b). The group most severely penalized by the lack of migration and return opportunity is, obviously, the group with highest ability. Its wage would be 33% lower than the baseline at $p = 0.15$ while those with very low ability (below ν_S) would not loose anything from lack of return (or migration) opportunities because they would not take advantage of them anyway.

5.4 Sensitivity to Parameters

A very important parameter to determine the gains from and the incentives for return immigration is $\boldsymbol{\kappa}$, the proportional premium to schooling returns. Its size (2.4) has been chosen to generate, for the given values of other parameters, a return migration in the range around 20 to 35%. Table 9 shows the values of schooling and wages when that parameter increases to 2.5. While we think of $\boldsymbol{\kappa}$ as a premium that the economy pays to returning migrants because of their higher human capital one could also consider it as a policy instrument. If a country rewards the human capital accumulated abroad and introduces incentives to compensate returnees (high κ) this may generate an impact on their schooling, return and wages. Simulations in Table 9 show that the small increase in $\boldsymbol{\kappa}$ (from 2.4 to 2.5) produces, already for $p = 0.15$ average schooling of 9.3 years (plus 0.2 years relative to the baseline) and average wages of 1.13 (+3% relative to the wages in the baseline case). The increased impact takes place mainly due to an increased effect on the old generation as now a larger share of emigrants return. The variable most dramatically affected by the increase in $\boldsymbol{\kappa}$ is the rate of return migration (last row) now ranging between 38 and 54% (somewhat high but still compatible with the Dustmann and Weiss (2007) estimates of return migration from the UK). Notice, importantly, that the increase in average wages is mainly driven by the very large expansion of the group of highly educated who return. The average wage of this group (reported in the rows of Table 9 headed by w_{H1} and w_{H2}) is lower than in the baseline case. This is due to the very large expansion of this group that now contains workers with much lower ability level as well (lower ν_{RM}). For given ν the wage of workers is higher in this scenario than in the baseline case.

Table 10 shows the effects of reducing migration costs in the first period (M_1 reduced by 20%) and Table

11 shows the effect of increasing the costs of staying abroad in the second period (M_2) by around 20%. The impacts are relatively small and as expected. In the first case, shown in Table 10, cheaper migration induces more emigrants and stronger incentives. The effect, relative to the baseline case, is a larger emigration rate of the young generation, and a very small increase in schooling and wages for each generation (again the extra-incentive effect is larger than the extra drain effect). In the second case, shown in Table 11, the higher cost of staying abroad in the second period induce higher return rates but smaller emigration rates (relative to the baseline) with a net effect on schooling and wages of either generation almost null. In this case the return rate, however, seems too large (between 60 and 70%) to be realistic.

6 Extensions

6.0.1 Migration probability depends on schooling

An interesting extension to the model is to treat potential permanent and temporary migrant as facing different probabilities of migration. First, our self-selection model implies that those preferring migration with return have higher schooling and most rich country have immigration laws that make it easier for those people to migrate. Second temporary migration of highly educated is definitely easier to pursue. Programs such as H1B in the US (or higher education study and work visas) are non-immigration visas targeted to exactly this purpose. For this reasons it makes sense to include in the model a variation that implies that those workers who choose (to enter the lottery for) permanent migration have a probability p_1 of actually migrating, while those who prefer to migrate and return enter a lottery with probability p_2 of succeeding, with $p_2 > p_1$.This modifies the optimal schooling functions when people migrate, h_i^{MM*} and when they migrate to return h_i^{RM*}. In particular the first will become a less steep function of ν so that the threshold ν_S increases, and selection of migrants becomes stronger, while the second becomes a less steep function of ν so that the threshold ν_{RM} decreases and people with lower ability choose higher education, migration and return. Intuitively now the option of migrating and returning becomes more appealing because it carries higher probability of happening and it becomes worth for a larger range of abilities to go for that route. Notice that the assumption of the model is that individuals self-sort in one of the two lotteries (for temporary or permanent migration) and the sorting is done optimally, in the sense that each person chooses the lottery that maximizes expected utility[10]. For large differences between p_2 and p_1 the case of no permanent migration can arise.

In Table 12 we analyze plausible cases that generate both temporary and permanent migrants. In particular we maintain a difference between p_2 and $p_1$equal to 0.10 and we increase p_1 from 0 to 0.2. In this scenario the proportion of returning migrants increase substantially while permanent migrants as a share of the population

[10]If we were to allow an individual to participate to both lotteries at the same time and choose the preferred outcome, then we should modify slightly the analysis.The qualitative implications, however, would be the same.

decrease. The human capital of the first generation is slightly decreased relative to the baseline (as the incentives for the young permanent migrant decrease relative to the baseline) but the human capital of the second generation is increased (as a larger fraction migrates and return)[11]. The average value that is most affected by this change is the average wage of old highly educated, now higher as it includes more highly paid returnees. In general, however, this example illustrates that many of the benefits to average domestic schooling and wages are still present even when migration policies discriminate between levels of education, giving higher probability of success to highly educated perspective migrants who seek a temporary stay abroad. Still fundamental to obtain such results is the presence of the incentives to return (high value of κ).

6.0.2 Human Capital Externalities

One reason why the migration of educated individuals is often considered very costly for the sending country is that, either because of learning, technological adoption, fiscal contribution to productive public goods or other reasons, there may be a positive externality of average human capital which would produce a larger income per capita loss in case of decrease in the average human capital due to migration. An easy way of incorporating this in our model is to thinks of a production function modified as follows:

$$Y = A_H(\overline{\chi})L_H\overline{\chi} \tag{30}$$

where labor productivity A_H depends on average human capital $\overline{\chi}$. This is a popular specification used, for instance, in Acemoglu and Angrist (2001). It is useful to specify the term A_H as a simple exponential function of the average schooling ($\overline{h}$) defined in expression 17 with the parameter γ capturing the intensity of the human capital externalities, as follows: .

$$A_H(\overline{\chi}) = \overline{A}_H\left(e^{\eta_H\overline{h}}\right)^{\gamma} \tag{31}$$

The factor $\overline{A}_H$ is a constant capturing the exogenous determinants of productivity of the Home country while the term $\left(e^{\eta_H\overline{h}}\right)^{\gamma}$ says that productivity of country H depends on its average human capital (exponential function of its average schooling) with an elasticity of $\gamma\eta_H$ that we call ζ for brevity.The parameter γ expresses the intensity of the external returns as share of the private returns η_H while ζ expresses the strength of the externality as external return to one year of schooling. The empirical literature (Rauch 1993, Acemoglu and Angrist 2001, Ciccone and Peri 2006) provides us with plausible estimates of it. The logarithm of the wage of individual with schooling h_i in the home country is:

[11] We compare the variables in the baseline case in which p corresponds to the average of p_1 and p_2 for the current case.

$$\ln(w_{Hi}) = \ln(\overline{A}_H) + \zeta\overline{h} + \eta_H h_i \quad (32)$$

The externality affects individual logarithmic wages by adding to it a linear term in average schooling. This is the way in which such externality is modelled in Acemoglu and Angrist 2001. Similarly the wage of a returnee with human capital h_i is:

$$\ln(w_{Hi}) = \ln(\overline{A}_H) + \zeta\overline{h} + \kappa\eta_H h_i \quad (33)$$

On the other hand we assume that the foreign country is large enough that migration does not affect its average human capital so that the wage in the foreign country remains as in expression (3). There are two ways in which the externality affects immigration decision and their impact on wages. First, if as we saw above, immigration increases (through incentives and return) the average schooling in H, this pushes up wages for all and fewer people will have incentives to migrate. Second, for the same amount of migration with a positive externality we would observe a larger positive average wage effect.

In order to solve for the equilibrium value of $\overline{h}$ in the home country we first substitute expressions (32) and (33) into the utility function (6) and solve the maximization problem to find the threshold values ν_S and ν_{RM} as a function of $\overline{h}$ and parameters. Then using (21) and (22) into the expression (17) we obtain average schooling $\overline{h}$ as a function of the thresholds ν_S and ν_{RM} that in turn depend on $\overline{h}$. Such implicit equation, numerically solved for the baseline parameter values produces the equilibrium value of average schooling.

Table 13 shows the schooling and wage level in this case. In particular we choose a value for the parameter $\zeta = 0.02$ which implies external return to schooling equal to half of their private return. This is a plausible value, hard to reject even by the estimates obtained in the more conservative studies (Acemoglu and Angrist 2001 and Ciccone and Peri 2006). Moreover we now calibrate $\ln(\overline{A}_H) + \zeta\overline{h}$, which represents the new productivity term in the Home country to be equal to $\ln(\varphi)$. There are two main effects of the schooling externalities. First as the incentive and return channels increase average schooling the externality pushes up everybody's wages and reduces the incentive to further migration. Hence overall migration rates are reduced and the net effect on average schooling at each level of p is smaller than in the case of no migration. Second, due to the externality, even this smaller increase in average schooling generates a higher increase in wages of each group (due to the external effect).

Both effect are visible, although small in table 13. The average schooling for $p = 0.30$ is 10.50 (rather than 10.53 in Table 6) years of schooling but the average wage is 1.37 (rather than 1.29 in Table 6) due to a gain, through the externality, of all workers. As in our model migration and return generate a positive net schooling effect the presence of a human capital externality reduces the migration needed to eliminate wage incentives for home residents to migrate. It attenuates migration and increases wages. If the net schooling effect of migration were negative, however, schooling externalities would reinforce the tendency to migrate (as migration would reduce the wage of those remaining pushing them to migrate even further) and possibly induce a vicious out-migration cycle.

7 Conclusions

This paper considers return migration as an important phenomenon if we want to quantify precisely the effects of increased international mobility of highly educated on the wages and human capital of middle income countries with significant migration of skilled workres. We document that for regions such as Eastern Europe and Asia return migration may imply that 20 to 30% of highly educated emigrant return home when they are still productive and contribute importantly to the average income and wages of the sending country. We develop an overlapping generation model that allows us to think of the incentive effect of migration on schooling, as well as the choice of migrating permanently or migrating and returning. We parametrize the model to match productivity and returns to schooling typical of Eastern Europe (Home) and Western Europe (Foreign) as well as the observed temporarily. Three are our main results. First we show that the incentive and return effect together reverse the drain effect of selective migration so that average schooling and wages in Eastern Europe would increase with freer mobility. This is because the perspective of migrating increases schooling of most individuals and, among the highly educated a relevant share returns. Second the return motive adds to the incentive motive if there is a wage premium for returnees. Considering the return option (on top of the schooling incentives) generates in our simulations an extra positive effect on the human capital and wage gains from international mobility that amounts to about 25% of the gains from the incentive effect only. Finally a crucial parameter to quantify the incentive of returning migrants is the wage premium obtained by returnees. There is anecdotal evidence that workers with international experience receive a significant wage premium when they return to their middle income countries of origin. More research is needed to measure this effect precisely and to evaluate in which countries return migrants receive the largest premium and are, therefore, more likely to be a large fraction of the emigrants.

8 Appendix 1: Average human capital and wages when $\nu_{RM} < \nu_S$.

In the case of $\nu_{RM} < \nu_S$, there is no permanent migration: those with ability below ν_{RM} do not opt for the lottery and stay at home, while those with ability above migrate, if they win the lottery, and return (Figure 4). Therefore, average human capital for the young generation is given by

$$\overline{h}_1 = \frac{\frac{1}{2}h^{S*}(\nu_{RM})\nu_{RM}}{\nu_{RM} + (1-p)(\overline{\nu} - \nu_{RM})} + \frac{\frac{1}{2}\left[h^{MR*}(\overline{\nu}) + h^{MR*}(\nu_{RM})\right](1-p)(\overline{\nu} - \nu_{RM})}{\nu_{RM} + (1-p)(\overline{\nu} - \nu_{RM})} \tag{34}$$

and average human capital for the old generation is given by

$$\overline{h}_2 = \frac{\frac{1}{2}h^{S*}(\nu_{RM})\nu_{RM}}{\overline{\nu}} + \frac{\frac{1}{2}\left[h^{MR*}(\overline{\nu}) + h^{MR*}(\nu_{RM})\right](\overline{\nu} - \nu_{RM})}{\overline{\nu}} \tag{35}$$

Substituting the expressions for h^{S*}, h^{MM*} and h^{MR*} from (14) into (34) and (35) we obtain

$$\begin{aligned}\overline{h}_1 = \frac{1}{4\theta} \quad & \left[\frac{2+\delta}{1+\delta}\eta_H \frac{\nu_{RM}^2}{\nu_{RM} + (1-p)(\overline{\nu} - \nu_{RM})}\right. \\ & \left. + \left[\frac{2+\delta}{1+\delta}(\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta}p(\eta_H\kappa - \eta_F)\right]\frac{(1-p)(\overline{\nu}^2 - \nu_{RM}^2)}{\nu_{RM} + (1-p)(\overline{\nu} - \nu_{RM})}\right]\end{aligned} \tag{36}$$

and

$$\begin{aligned}\overline{h}_2 = \frac{1}{4\theta} \quad & \left[\frac{2+\delta}{1+\delta}\eta_H \frac{\nu_{RM}^2}{\overline{\nu}}\right. \\ & \left. + \left[\frac{2+\delta}{1+\delta}(\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta}p(\eta_H\kappa - \eta_F)\right]\frac{(\overline{\nu}^2 - \nu_{RM}^2)}{\overline{\nu}}\right].\end{aligned} \tag{37}$$

Appendix 2: The derivatives of ν_{RM} and ν_S with respect to p.

An increase in emigration probability p decreases the ability thresholds for permanent and temporary migration ν_S and ν_{RM} and, therefore, the shares of migrants and return migrants:

$$\frac{\partial \nu_S}{\partial p} = -\frac{2\theta}{\frac{2+\delta}{1+\delta}} \frac{M_1(1+\delta) + M_2 - (\ln(A_F) - \ln(A_H))(2+\delta)}{(2+\delta)(\eta_F - \eta_H)} \frac{(\eta_F - \eta_H)}{(\eta_H + p(\eta_F - \eta_H))^2},$$

which is negative for $M_1 + \frac{M_2}{1+\delta} > (\ln(A_F) - \ln(A_H))\frac{2+\delta}{1+\delta}$ and $\eta_F > \eta_H$,

and

$$\frac{\partial \nu_{RM}}{\partial p} = -2\theta \frac{\ln(A_F) - \ln(A_H) - M_2}{\eta_H\kappa - \eta_F} \frac{\frac{2+\delta}{1+\delta}(\eta_F - \eta_H) + \frac{1}{1+\delta}(\eta_H\kappa - \eta_F)}{\left(\frac{2+\delta}{1+\delta}(\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta}p(\eta_H\kappa - \eta_F)\right)^2},$$

which is negative for $\ln(A_F) - \ln(A_H) > M_2$, $\eta_F > \eta_H$ and $\eta_H\kappa > \eta_F$.

Appendix 3: Average Wages by Group, Explicit Solution.

Calculating the integral, and solving for the average wages of the low-, middle- and high-skilled in (26)-(**??**) gives the following expressions:

$$\overline{w}_L = \frac{1}{\nu_S} A_H \frac{1}{\eta_H \frac{\eta_H}{2\theta} \frac{2+\delta}{1+\delta}} \left[e^{\eta_H \frac{\eta_H}{2\theta} \frac{2+\delta}{1+\delta} \nu_S} - 1 \right] \tag{38}$$

$$\begin{aligned} \overline{w}_M \quad = \quad & \frac{1}{\nu_{RM} - \nu_S} A_H \frac{1}{\eta_H \frac{1}{2\theta} \frac{1+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H))} \\ & \left[e^{\eta_H \frac{1}{2\theta} \frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) \nu_{RM}} - e^{\eta_H \frac{1}{2\theta} \frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) \nu_S} \right] \end{aligned} \tag{39}$$

$$\begin{aligned} \overline{w}_{H1} \quad = \quad & \frac{1}{(\bar{\nu} - \nu_{RM})} A_H \frac{1}{\eta_H \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right)} \\ & \left[e^{\eta_H \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \bar{\nu}} - e^{\eta_H \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \nu_{RM}} \right] \end{aligned} \tag{40}$$

$$\begin{aligned} \overline{w}_{H2} \quad = \quad & \frac{(1-p)}{(\bar{\nu} - \nu_{RM})} A_H \frac{1}{\eta_H \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right)} \\ & \left[e^{\eta_H \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \bar{\nu}} - e^{\eta_H \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \nu_{RM}} \right] \\ + \quad & \frac{p}{(\bar{\nu} - \nu_{RM})} A_H \frac{1}{\eta_H \kappa \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right)} \\ & \left[e^{\eta_H \kappa \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \bar{\nu}} - e^{\eta_H \kappa \frac{1}{2\theta} \left(\frac{2+\delta}{1+\delta} (\eta_H + p(\eta_F - \eta_H)) + \frac{1}{1+\delta} p(\eta_H \kappa - \eta_F) \right) \nu_{RM}} \right] \end{aligned} \tag{41}$$

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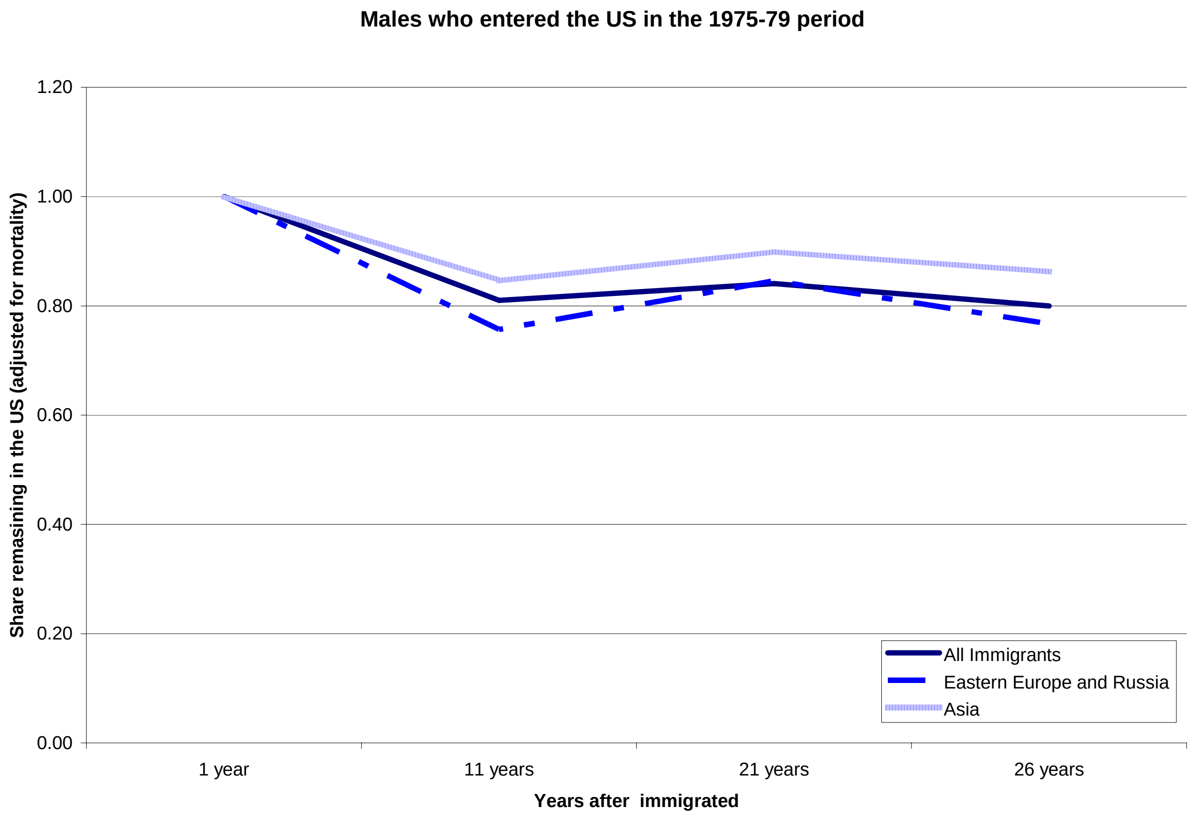
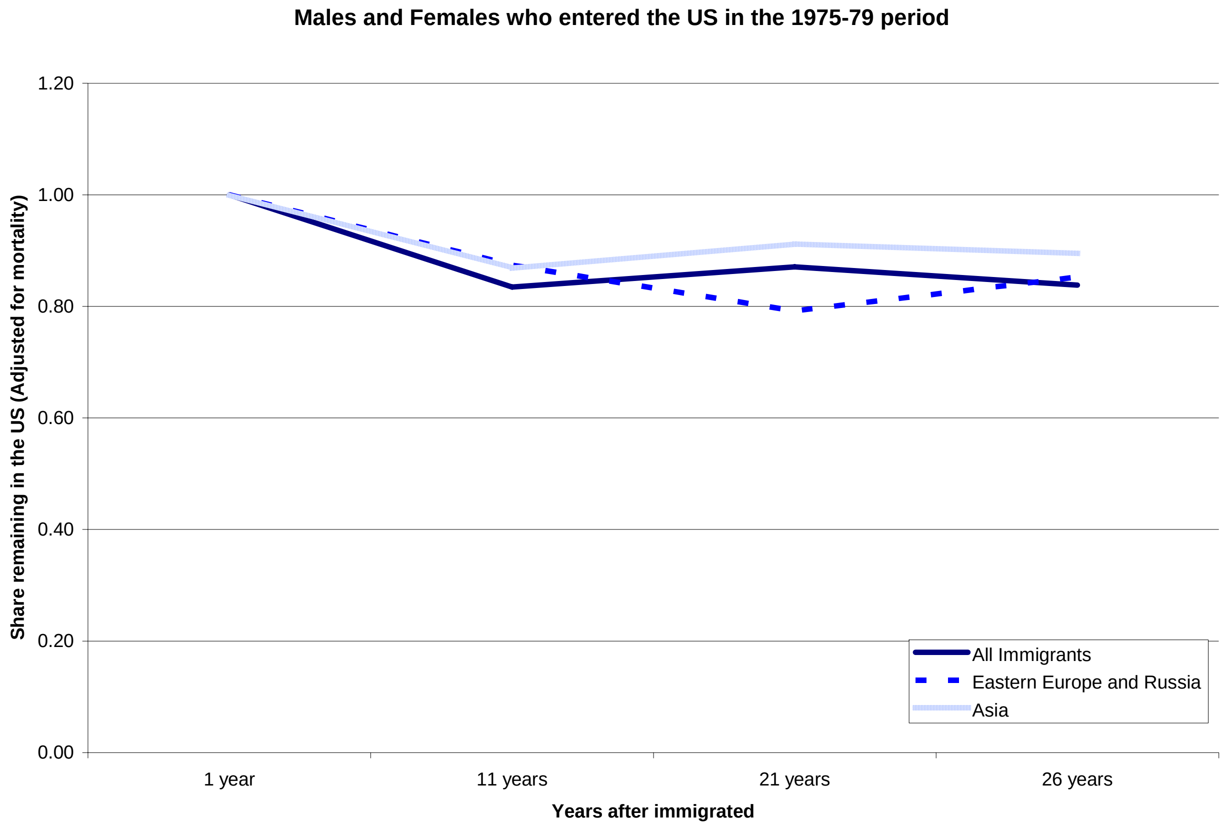
Figures and Tables

Figure 1
Share of surviving immigrants entered in 1975-79 remaining in the US, Males



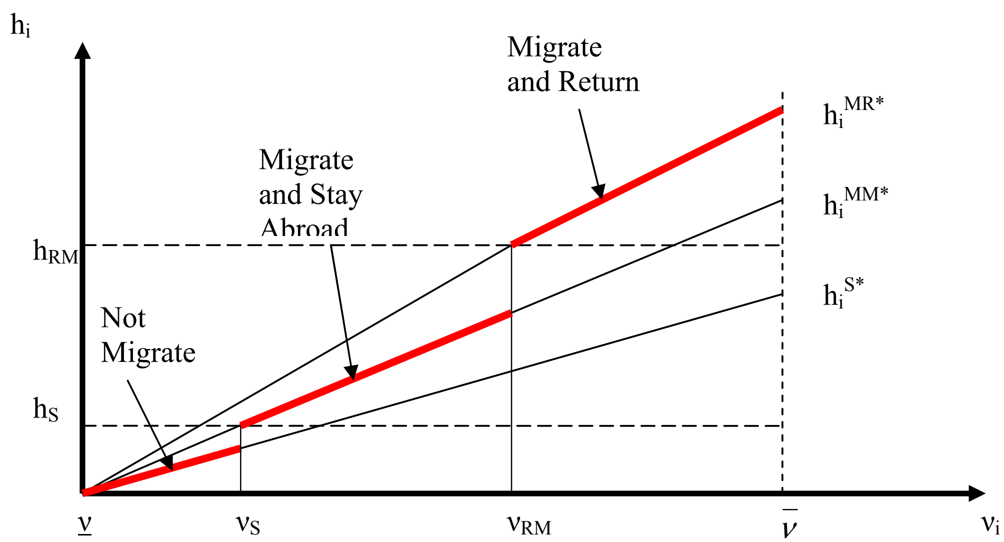
Note: Authors' calculation on IPUMS 1980-90-00 and ACS 2005. The year of entry in the US is identified by the variable YRIMMIG, consistently reported from 1980. The size of the initial cohort is scaled every year accounting for the mortality rates specific to the group age and sex for the relevant decade. The mortality rates by age group and sex are from the national center for Health statistics, Data Warehouse, Table HIST_290.

Figure 2
Share of surviving immigrants entered in 1975-79 remaining in the US, Males and Females



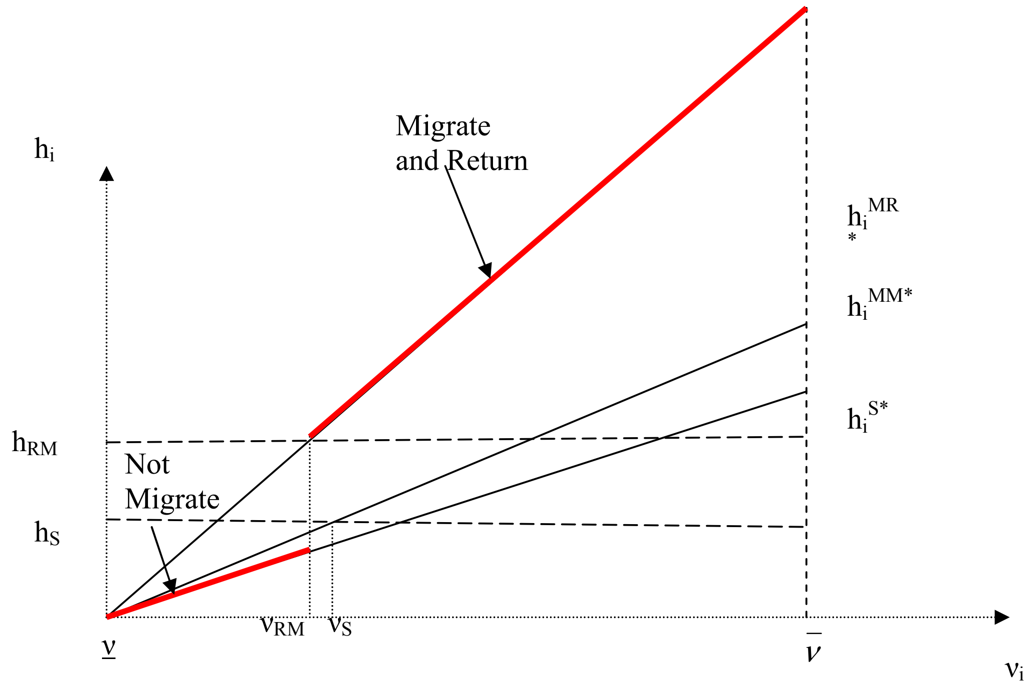
Note: Authors' calculation on IPUMS 1980-90-00 and ACS 2005. The year of entry in the US is identified by the variable YRIMMIG, consistently reported from 1980. The size of the initial cohort is scaled every year accounting for the mortality rates specific to the group age and sex for the relevant decade. The mortality rates by age group and sex are from the national center for Health statistics, Data Warehouse, Table HIST_290.

Figure 3
Optimal schooling and Migration Decisions as a function of personal abilities



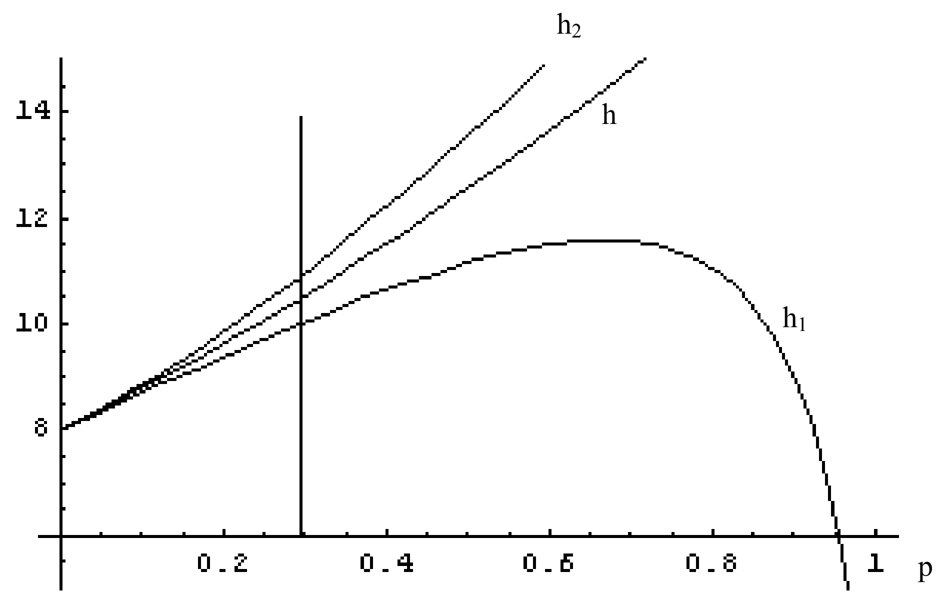
Note: The Relation between abilities ν and schooling h depends on the expected returns to schooling. The flattest line represents the relation for workers who do not emigrate, the intermediate one for those who migrate and remain abroad and the steepest one for those who migrate and return. The thresholds ν_S identifies the ability level below which workers prefer staying, while above it they prefer participating to the migration lottery and ν_{RM} identifies the ability level above which migrant prefer to return in the second period.

Figure 4
Optimal schooling and Migration Decisions Case of no Permanent migration



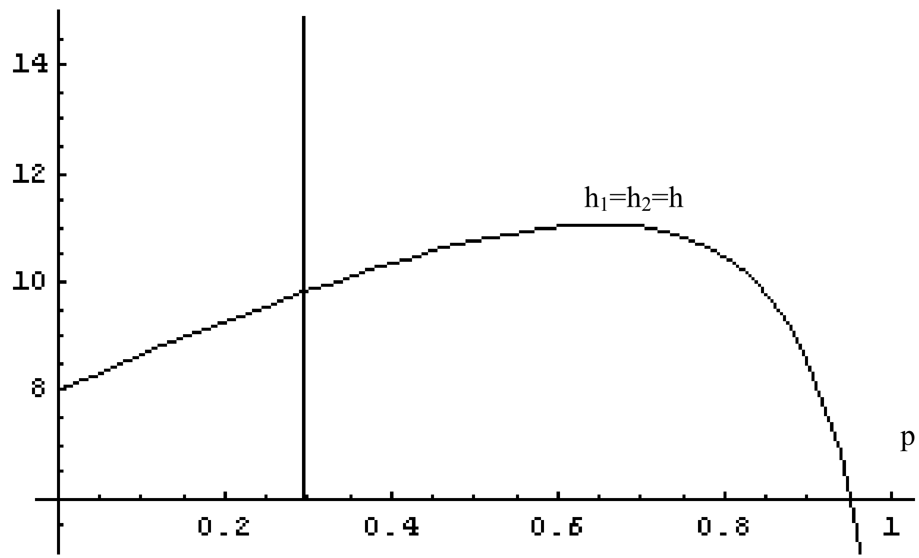
Note: The above figure represents the configuration of parameters for which the ability level ν_{RM} represnts the threshold for migrating and for returning, so that workers with higher ability are all temporary migrants in the sense that they spend one period abroad and come back to the Home country in the second period. This configuration arises for values of η_F close to η_H and large values of κ.

Figure 5a
Average schooling of the young, old and overall as a function of emigration probability – Baseline



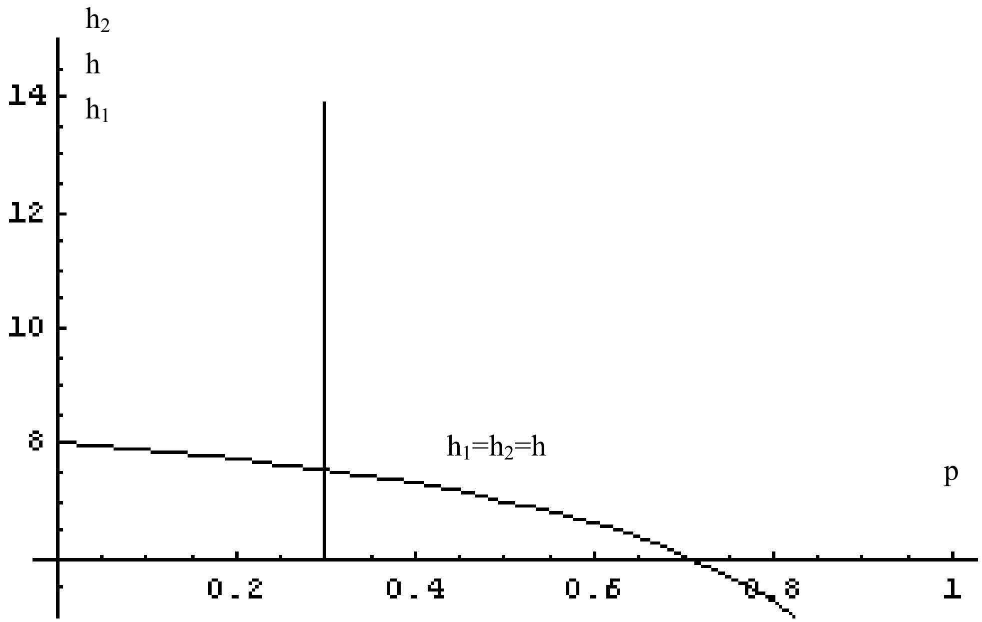
Note: Simulated average schooling for the young generation (h_1), the old generation (h_2) and overall for probability of succeeding to migrate (p) ranging from 0 to 1. The parameter Values used to obtain the figures are the same as those used in Table 7.

Figure 5b
Average schooling of the young, old and overall as a function of emigration probability – Case with no return migration.



Note: Simulated average schooling for the young generation (h_1), the old generation (h_2) and overall for probability of succeeding to migrate (p) ranging from 0 to 1. The possibility of return migration is ruled out in this simulation. The parameter values used to obtain the figures are the same as those used in Table

Figure 5c
Average schooling of the young, old and overall as a function of emigration probability – Case with no return migration and no incentive effects.



Note: Simulated average schooling for the young generation (h_1), the old generation (h_2) and overall for probability of succeeding to migrate (p) ranging from 0 to 1. The schooling decision is independent of future returns, hence migration has no incentive effects on schooling. The possibility of return migration is ruled out. The parameter values used to obtain the figures are the same as those used in Table 8.

Table 1: Long-term permanence rates of immigrants in US, Arrival Cohort 1975-79, Immigrants from all foreign countries

	In 1980	In 1990	In 2000	In 2005
Cohort aged 13-18 when immigrated				
Males	1	0.94	0.96	0.88
Females	1	0.91	0.99	0.92
Total	1	0.93	0.98	0.90
Share of remaining immigrants with some college education	0.24	0.37	0.38	0.40
Cohort aged 18-22 when immigrated				
Males	1	0.84	0.89	0.83
Females	1	0.84	0.93	0.88
Total	1	0.84	0.91	0.86
Share of people with some college education	0.42	0.44	0.43	0.44
Cohort aged 23-28 when immigrated				
Males	1	0.78	0.78	0.76
Females	1	0.88	0.87	0.87
Total	1	0.82	0.82	0.81
Share of remining immigrants with some college education	0.46	0.49	0.47	0.49
Cohort aged 28-32 when immigrated				
Males	1	0.81	0.72	0.75
Females	1	0.87	0.84	0.86
Total	1	0.84	0.77	0.81
Share of remining immigrants with some college education	0.42	0.45	0.43	0.46
All cohorts aged 13-32 when immigrated				
Males	1	0.82	0.81	--
Females	1	0.87	0.89	--
Total	1	0.84	0.85	--
Share of remining immigrants with some college education	0.43	0.44	0.43	--

Note: Authors' calculation on IPUMS 1980-90-00 and ACS 2005. The year of entry in the US is identified by the variable YRIMMIG, consistently reported from 1980. The size of the initial cohort is scaled every year accounting for the mortality rates specific to the group age and sex for the relevant decade. The mortality rates by age group and sex are from the national center for Health statistics, Data Warehouse, Table HIST_290. The education variable used is educrec, and if it is larger than 7 people are classified as having some college education.

Table 2: Long-term permanence rates of immigrants in US, Arrival Cohort 1975-79, Immigrants from Eastern Europe

	In 1980	In 1990	In 2000	In 2005
Cohort aged 13-17 when immigrated				
Males	1	0.95	0.99	1.32
Females	1	0.85	0.71	0.71
Total	1	0.88	0.79	0.89
Share of remaining immigrants with some college education	0.26	0.50	0.47	0.67
Cohort aged 18-22 when immigrated				
Males	1	0.78	0.98	0.88
Females	1	0.72	0.68	0.93
Total	1	0.74	0.81	0.91
Share of people with some college education	0.51	0.50	0.55	0.66
Cohort aged 23-27 when immigrated				
Males	1	0.72	0.70	0.65
Females	1	0.81	0.87	0.72
Total	1	0.77	0.79	0.69
Share of remaining immigrants with some college education	0.50	0.61	0.57	0.64
Cohort aged 28-32 when immigrated				
Males	1	0.75	0.42	0.76
Females	1	0.47	0.69	0.62
Total	1	0.60	0.56	0.69
Share of remaining immigrants with some college education	0.52	0.58	0.54	0.54
All cohorts aged 13-32 when immigrated				
Males	1	0.72	0.80	--
Females	1	0.72	0.79	--
Total	1	0.72	0.79	--
Share of remaining immigrants with some college education	0.49	0.55	0.53	--

Note: Authors' calculation on IPUMS 1980-90-00 and ACS 2005. The year of entry in the US is identified by the variable YRIMMIG, consistently reported from 1980. The size of the initial cohort is scaled every year accounting for the mortality rates specific to the group age and sex for the relevant decade. The mortality rates by age group and sex are from the national center for Health statistics, Data Warehouse, Table HIST_290. The education variable used is educrec, and if it is larger than 7 people are classified as having some college education. Immigrants from Eastern europe-Russia are identified as those whose country of birth variable (BPL) has values between 450 and 463.

Table 3: Long-term permanence rates of immigrants in US, Arrival Cohort 1975-79, Immigrants from Asia

	In 1980	In 1990	In 2000	In 2005
Cohort aged 13-18 when immigrated				
Males	1	0.87	0.93	0.78
Females	1	0.76	0.94	0.87
Total	1	0.82	0.94	0.82
Share of remaining immigrants with some college education	0.36	0.70	0.72	0.72
Cohort aged 18-22 when immigrated				
Males	1	0.87	0.94	0.90
Females	1	0.82	0.91	0.88
Total	1	0.84	0.92	0.89
Share of remaining immigrants with some college education	0.60	0.70	0.67	0.70
Cohort aged 23-28 when immigrated				
Males	1	0.82	0.85	0.82
Females	1	0.95	0.93	0.97
Total	1	0.89	0.89	0.89
Share of remaining immigrants with some college education	0.62	0.67	0.66	0.69
Cohort aged 28-32 when immigrated				
Males	1	0.84	0.78	0.87
Females	1	0.88	0.89	0.94
Total	1	0.86	0.84	0.90
Share of remining immigrants with some college education	0.56	0.62	0.58	0.60
All cohorts aged 13-32 when immigrated				
Males	1	0.85	0.87	--
Females	1	0.89	0.92	--
Total	1	0.87	0.90	--
Share of remaining immigrants with some college education	0.58	0.64	0.62	--

Note: Authors' calculation on IPUMS 1980-90-00 and ACS 2005. The year of entry in the US is identified by the variable YRIMMIG, consistently reported from 1980. The size of the initial cohort is scaled every year accounting for the mortality rates specific to the group age and sex for the relevant decade. The mortality rates by age group and sex are from the national center for Health statistics, Data Warehouse, Table HIST_290. The education variable used is educrec, and if it is larger than 7 people are classified as having some college education. Immigrants from Asia are identified as those whose country of birth variable (BPL) has values between 500 and 525.

Table 4: Long-term permanence rates of immigrants in US, Arrival Cohort 1975-79, Immigrants from Latin America

	In 1980	In 1990	In 2000	In 2005
Cohort aged 13-18 when immigrated				
Males	1	1.11	1.21	1.13
Females	1	1.11	1.28	1.19
Total	1	1.11	1.24	1.16
Share of remaining immigrants with some college education	0.12	0.20	0.20	0.23
Cohort aged 18-22 when immigrated				
Males	1	1.01	1.10	1.06
Females	1	1.03	1.20	1.11
Total	1	1.02	1.14	1.08
Share of remaining immigrants with some college education	0.20	0.21	0.20	0.23
Cohort aged 23-28 when immigrated				
Males	1	0.84	1.23	0.85
Females	1	0.93	1.26	1.01
Total	1	0.88	1.24	0.98
Share of remaining immigrants with some college education	0.21	0.22	0.23	0.23
Cohort aged 28-32 when immigrated				
Males	1	0.89	0.87	0.89
Females	1	1.07	1.05	1.03
Total	1	0.98	0.95	0.96
Share of remaining immigrants with some college education	0.17	0.20	0.21	0.22
All cohorts aged 13-32 when immigrated				
Males	1	0.95	0.99	--
Females	1	1.03	1.10	--
Total	1	0.98	1.01	--
Share of remaining immigrants with some college education	0.19	0.20	0.21	--

Note: Authors' calculation on IPUMS 1980-90-00 and ACS 2005. The year of entry in the US is identified by the variable YRIMMIG, consistently reported from 1980. The size of the initial cohort is scaled every year accounting for the mortality rates specific to the group age and sex for the relevant decade. The mortality rates by age group and sex are from the national center for Health statistics, Data Warehouse, Table HIST_290. The education variable used is educrec, and if it is larger than 7 people are classified as having some college education. Immigrants from Latin America are identified as those whose country of birth variable (BPL) has values between 200 and 300.

Table 5: Choice of Parameters.

Baseline	A_F	A_H	φ	η_F	η_H	κ	Φ_1
	2 φ	φ	1	0.08	0.04	2.4	0.5
	Φ_2	θ	δ	$\underline{\nu}$	ν	M_1	M_2
	0.5	1	0.5	0	480	1.5 ln(2)	0.67 ln(2)

Table 6:
Migration probability and source-country variables. Baseline scenario.

p	**0**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**
			Schooling				
h_1; average schooling of young	8	8.34	8.68	9.03	9.37	9.78	10.03
h_2; average schooling of old	8	8.39	8.84	9.32	9.84	10.39	10.97
h: Average schooling	8	8.37	8.76	9.18	9.61	10.06	10.53
			Wages				
w_1[a]	1	1.01	1.03	1.05	1.06	1.08	1.10
w_2[a]	1	1.03	1.08	1.14	1.22	1.33	1.45
w[a]	1	1.02	1.05	1.09	1.15	1.21	1.29
w_L	0.75	0.75	0.75	0.75	0.74	0.74	0.74
w_M	1.01	1.01	1.01	1.01	1.01	1.01	1.01
w_{H1}	1.31	1.33	1.36	1.38	1.41	1.44	1.47
w_{H2}[a]	1.31	1.43	1.56	1.71	1.87	2.05	2.26
			Migration rates				
Share of emigrants	0	0.041	0.083	0.126	0.169	0.213	0.258
Share of Returnees among emigrants		0.177	0.228	0.274	0.314	0.351	0.383

Note: We standardized all the wages to be relative to the average wage in the case of no emigration. The threshold values are h_S=2.88, h_{RM}=14.44.

Table 7a
Case with no Return Migration.

p	**0**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**
h_1; average schooling of young	8	8.32	8.64	8.95	9.26	9.55	9.83
h_2; average schooling of old	8	8.32	8.64	8.95	9.26	9.55	9.83
h: Average schooling	8	8.32	8.64	8.95	9.26	9.55	9.83
$w_1 = w_2 = w$	1	1.01	1.03	1.04	1.06	1.07	1.09
w_L	0.75	0.75	0.75	0.75	0.74	0.74	0.74
$w_M = w_{H1} = w_{H2}$	1.05	1.07	1.09	1.11	1.13	1.15	1.17
Share of emigrants	0	0.041	0.083	0.126	0.169	0.213	0.258
Share of Returnees among emigrants		0	0	0	0	0	0

Note: Same parameter values as in baseline, except for κ=1.
We standardized all the wages to be relative to the average wage in the case of no emigration
The threshold value is only one: h_S=2.88, Individuals with schooling above that level attempts to migrate and, if they succeed they remain abroad.

Table 7b:
Case with no Return migration; Differences with the Baseline.

p	0	0.05	0.10	0.15	0.20	0.25	0.30
h_1; average schooling of young	0	-0.01	-0.04	-0.07	-0.11	-0.15	-0.20
h_2; average schooling of old	0	-0.07	-0.19	-0.36	-0.58	-0.83	-1.13
h: Average schooling	0	-0.04	-0.12	-0.22	-0.35	-0.51	-0.69
w_1	0	-0.01	-0.00	-0.01	-0.01	-0.00	-0.01
w_2	0	-0.01	-0.05	-0.09	-0.16	-0.25	-0.36
w	0	-0.01	-0.02	-0.05	-0.08	-0.13	-0.19
w_L	0	0	0	0	0	0	0
w_M	0.03	0.05	0.07	0.09	0.12	0.14	0.16
w_{H1}	-0.26	-0.26	-0.27	-0.27	-0.28	-0.29	-0.30
w_{H2}	-0.26	-0.36	-0.47	-0.60	-0.74	-0.90	-1.08
Share of emigrants	0	0	0	0	0	0	0
Share of Returnees among emigrants	0	-0.177	-0.228	-0.274	-0.314	-0.351	-0.383

Table 8a: Case with no return migration and no incentive effects

p	0	0.05	0.10	0.15	0.20	0.25	0.30
h_1; average schooling of young	8	7.93	7.87	7.79	7.71	7.62	7.52
h_2; average schooling of old	8	7.93	7.87	7.79	7.71	7.62	7.52
h: Average schooling	8	7.93	7.87	7.79	7.71	7.62	7. 52
$w_1 = w_2 = w$	1	0.99	0.99	0.99	0.98	0.98	0.98
w_L	0.75	0.75	0.75	0.75	0.75	0.75	0.75
$w_M = w_{H1} = w_{H2}$	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Share of emigrants	0	0.040	0.081	0.122	0.163	0.204	0.245
Share of Returnees among emigrants		0	0	0	0	0	0

The relationship between ability ν and schooling is fixed and equal to the one with no migration in the baseline case. Parameter κ=1. The remaining parameters are as in the baseline case
We standardized all the wages to be relative to the average wage in the case of no emigration
The threshold value is only one: h_S=2.88, Individuals with schooling above that level attempts to migrate and, if they succeed they remain abroad.

Table 8b:
Case with no return migration and no incentive effects
Differences with the Baseline

p	0	0.05	0.10	0.15	0.20	0.25	0.30
h_1; average schooling of young	0	-0.40	-0.81	-1.23	-1.65	-2.08	-2.50
h_2; average schooling of old	0	-0.46	-0.96	-1.52	-2.12	-2.76	-3.44
h: Average schooling	0	-0.43	-0.89	-1.38	-1.89	-2.43	-3.01
w_1	0	-0.01	-0.03	-0.05	-0.07	-0.09	-0.12
w_2	0	-0.03	-0.08	-0.15	-0.23	-0.34	-0.47
w	0	-0.02	-0.06	-0.10	-0.16	-0.22	-0.30
w_L	0	0.01	0.01	0.01	0.01	0.01	0.01
w_M	0.03	0.03	0.04	0.04	0.04	0.04	0.04
w_{H1}	-0.26	-0.28	-0.31	-0.33	-0.36	-0.39	-0.41
w_{H2}	-0.26	-0.37	-0.51	-0.65	-0.82	-1.01	-1.20
Share of emigrants	0	-0.001	-0.002	-0.004	-0.006	-0.009	-0.013
Share of Returnees among emigrants	0	-0.177	-0.228	-0.274	-0.314	-0.351	-0.383

Table 9: Case with higher skill premium for returnees

p	0	0.05	0.10	0.15	0.20	0.25	0.30
h_1; average schooling of young	8	8.36	8.73	9.10	9.46	9.81	10.15
h_2; average schooling of old	8	8.46	8.96	9.48	10.03	10.60	11.19
h: Average schooling	8	8.41	8.85	9.30	9.76	10.23	10.72
w_1 [a]	1	1.01	1.03	1.05	1.07	1.09	1.11
w_2 [a]	1	1.04	1.11	1.19	1.29	1.41	1.56
w [a]	1	1.03	1.07	1.12	1.18	1.26	1.35
w_L	0.75	0.75	0.75	0.75	0.74	0.74	0.74
w_M	0.95	0.95	0.95	0.95	0.95	0.94	0.94
w_{H1}	1.24	1.26	1.29	1.31	1.34	1.37	1.39
w_{H2}	1.24	1.35	1.47	1.62	1.78	1.96	2.16
Share of emigrants	0	0.041	0.083	0.126	0.169	0.213	0.258
Share of Returnees among emigrants		0.385	0.425	0.460	0.491	0.519	0.544

Note: We standardized all the wages to be relative to the average wage in the case of no emigration
κ =2.5 ln(2). The remaining parameter values are as in the baseline case. The threshold values are h_S=2.88, h_{RM}=11.55.

Table 10: Case with lower cost of migration in the first period

p	0	0.05	0.10	0.15	0.20	0.25	0.30
h_1; average schooling of young	8	8.39	8.79	9.20	9.61	10.02	10.43
h_2; average schooling of old	8	8.45	8.95	9.49	10.08	10.70	11.36
h: Average schooling	8	8.42	8.87	9.35	9.85	10.38	10.93
w_1	1	1.01	1.03	1.05	1.07	1.09	1.11
w_2	1	1.03	1.08	1.15	1.24	1.35	1.48
w	1	1.02	1.06	1.10	1.16	1.22	1.31
w_L	0.72	0.72	0.72	0.72	0.72	0.72	0.72
w_M	0.98	0.97	0.97	0.97	0.97	0.97	0.96
w_{H1}	1.31	1.33	1.36	1.38	1.41	1.44	1.47
w_{H2}	1.31	1.43	1.56	1.71	1.87	2.05	2.26
Share of emigrants	0	0.047	0.095	0.143	0.191	0.239	0.288
Share of Returnees among emigrants		0.154	0.200	0.241	0.279	0.313	0.343

Note: We standardized all the wages to be relative to the average wage in the case of no emigration
Same parameter values as in baseline, except for M_1=1.3 ln(2).
The threshold values are: h_S=0.80, h_{RM}=14.44.

Table 11: Case with higher cost of staying abroad in the second period

p	**0**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**
h_1; average schooling of young	8	8.34	8.69	9.03	9.35	9.67	9.97
h_2; average schooling of old	8	8.45	8.93	9.42	9.92	10.43	10.96
h: Average schooling	8	8.40	8.81	9.23	9.66	10.08	10.51
w_1	1	1.01	1.03	1.05	1.06	1.08	1.10
w_2	1	1.05	1.11	1.19	1.28	1.39	1.51
w	1	1.03	1.07	1.12	1.18	1.25	1.32
w_L	0.77	0.76	0.76	0.76	0.76	0.75	0.75
w_M	0.91	0.91	0.91	0.91	0.91	0.91	0.91
w_{H1}	1.17	1.19	1.22	1.24	1.26	1.29	1.32
w_{H2}	1.17	1.26	1.36	1.47	1.59	1.74	1.89
Share of emigrants	0	0.038	0.078	0.118	0.160	0.202	0.245
Share of Returnees among emigrants		0.631	0.657	0.679	0.699	0.716	0.732

Note: We standardized all the wages to be relative to the average wage in the case of no emigration
Same parameter values as in baseline, except for M_2=0.8 ln(2).
The threshold values are: h_S=3.81, h_{RM}=8.66.

Table 12: Case with different probability for Temporary and Permanent Migration

p_1 (Permanent Migration)	**0**	**0**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**
p_2 (Temporary Migration)	**0**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**
h_1; average schooling of young	8	8.16	8.53	8.88	9.22	9.55	9.86
h_2; average schooling of old	8	8.32	8.82	9.35	9.90	10.48	11.09
h: Average schooling	8	8.24	8.67	9.12	9.58	10.04	10.52
w_1^a	1	1.01	1.02	1.04	1.06	1.08	1.09
w_2^a	1	1.05	1.11	1.19	1.29	1.41	1.55
w^a	1	1.03	1.07	1.12	1.18	1.25	1.34
w_L^a	0.75	0.75	0.75	0.75	0.75	0.74	0.74
w_M^a	1.01	0.98	0.98	0.98	0.98	0.98	0.98
w_{H1}^a	1.31	1.36	1.38	1.41	1.44	1.47	1.50
w_{H2}^a	1.31	1.56	1.71	1.87	2.05	2.26	2.48
Share of emigrants	0	0.019	0.064	0.110	0.156	0.202	0.249
Share of Returnees among emigrants		1	0.537	0.484	0.479	0.488	0.501

Note: We standardized all the wages to be relative to the average wage in the case of no emigration
Same parameter values as in baseline, except for different probability of migrating in the "temporary migration" or in the "permanent migration" lottery.
The threshold values are: h_S=2.88, h_{RM}=14.44.

Table 13: Case with schooling externalities

p	**0**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**
h_1; average schooling of young	8	8.33	8.67	9.01	9.34	9.66	9.96
h_2; average schooling of old	8	8.41	8.86	9.34	9.86	10.40	10.91
h: Average schooling	8	8.37	8.77	9.18	9.61	10.05	10.50
w_1^a	1	1.02	1.04	1.07	1.10	1.12	1.15
w_2^a	1	1.04	1.10	1.19	1.29	1.42	1.56
w^a	1	1.03	1.07	1.13	1.20	1.28	1.37
w_L^a	0.75	0.76	0.76	0.77	0.78	0.79	0.79
w_M^a	1.01	1.01	1.01	1.01	1.01	1.01	1.01
w_{H1}^a	1.31	1.33	1.35	1.38	1.40	1.43	1.45
w_{H2}^a	1.31	1.42	1.55	1.68	1.82	1.98	2.15
Share of emigrants	0	0.040	0.081	0.121	0.161	0.201	0.240
Share of Returnees among emigrants		0.213	0.301	0.382	0.457	0.525	0.588

Note: We standardized all the wages to be relative to the average wage in the case of no emigration
Same parameter values as in baseline, except for the presence of schooling externality, as described in the main text. The parameter capturing the intensity of human capital externalities is set to ζ=0.02.
The threshold values, h_S and h_{RM} are now functions of p.