SNF Working Paper No. 32/08

Migration Policy, Illegal Migrants, Self-Selection and Brain Drain

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SNF Project No. 1104
Globalisering, regional utvikling

INSTITUTE FOR RESEARCH IN ECONOMICS AND BUSINESS ADMINISTRATION
BERGEN, December 2008
ISSN 1503-2140

Migration Policy, Illegal Migrants, Self-Selection and Brain Drain

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Abstract

We compare two migration policies: an open migration policy, where all migrants can migrate legally; and a selective migration policy, where migrants are selected according to skills. We show that since the selective migration policy can create illegal migration, it has the following effects relatively to the open migration policy: (1) it weakens the chances of a positive self-selection of skilled migrants; (2) it reduces the possibility of a beneficial brain gain; and (3) it dampens the effectiveness of education policies. Accordingly, since illegal migration can conduce to brain waste (i.e.: skilled workers working as unskilled), the selective migration policy reduces the incentives of individuals to acquire education and of skilled workers to migrate.

Keywords: Illegal migration, self-selection, brain drain.
JEL Classification: F22, J61.

1 Introduction

In the last decade we have assisted in the developed world, in particular in the United States (US) and in the European Union (EU), to a change of focus in the migration policies. From one side, migration policies stopped to be only directed to legal migrants and started to include

*The idea for this paper came from discussions with Nicola Coniglio and Kjetil Bjorvatn. I am also grateful to Agnar Sandmo, Davide Sala, Fernando Aragón, Gerald Willmann, Gregory Corcos, Jiegen Wei, Karolina Ekholm, Philipp Schröder, Simon Evenett, Jørgen Nielsen and Victor Norman for helpful comments during the preparation of this work. The usual disclaimer, however, applies.

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also illegal migrants (Hanson, 2006)[1]. From other side most developed countries launched some type of selective migration policies to attract skilled workers (Bauer et al., 2000)[2].

Illegal migration is a concern for developed countries mostly because of the numbers involved. For example, Passel (2005) estimates that in the US total illegal immigrant population has increased from 9.3 million in 2002 to 10.3 million in 2004 and that illegal migration flows are around 500,000 per year. Comparable figures have also been found for the EU (Jandl, 2004). Given that illegal migration is seen as something undesirable because of a set of negative externalities for the receiving migration country (for example, the creation of a "grey" economy or increase in crime rates), most developed countries have putted in place a set of policies to fight illegal migration. An extreme example of these policies is the debate in the US on the militarization of the Mexico-US border, in order to reduce illegal migration from Mexico to US. In the EU similar measures have been proposed in relation to illegal migrants from the North of Africa.

In turn, the interest on selective migration policies relates with a public debate in most developed countries on the "quality" of migrants. By "quality" of migrants, politicians and the media usually mean if migrants are skilled or unskilled workers, with the former being the "quality" migrants. Accordingly, by using selective migration policies developed countries expect to attract more skilled workers. The idea behind selective migration policies is that in a globalized world, international competitiveness can only be achieved by attracting the more qualified brains. In the same way illegal migrants can create negative externalities, it is believed that skilled migrants promote positive externalities for the hosting economy (for example, increase in economic growth through an increase in the stock of human capital stock and in the level of knowledge spillovers).

The issue of the selectivity of migrants is not new in economics. In fact, there is a whole literature on self-selection, which main research question is if skilled individuals positively self-select to migration. The dominant view, which finds a high degree of support from empirical work, is that there is a tendency towards a positive self-selection (Schultz, 1975 and Chiquiar and Hanson, 2005). The positive self-selection is due to

[1]Illegal migration can be defined as the immigration that violates the immigration laws of the destination country. For example an immigrant that enters illegally in a country or an immigrant with an expired visa

[2]Selective migration policies make it easier for skilled workers to get a legal migration visa relatively to unskilled ones. One well known example of a selective migration policy is the Canada's point system.

the fact that, when compared to the unskilled, skilled individuals have lower migration costs and higher returns from migration[3].

In the other side of the coin, however, is the developing world. Developing countries have also expressed apprehension about illegal migration, but their main concern is the "quality" of the migrants that leave to work abroad. Accordingly, while developed countries want to attract skilled workers, developing countries do not want to lose them. In fact, the traditional view in economics is that international migration leads developing countries to lose high-skilled workers to developed countries, due to higher wages in the latter (Grubel and Scott, 1966 and Bhagwati and Hamada, 1974). The economic literature has labeled this as the brain drain phenomenon[4]. In view of that, brain drain is detrimental to poor countries through a set of negative externalities (for example, reduced productivity of those left behind, higher costs of public goods and loss of the investment made in human capital formation).

Recent contributions, in turn, argue that the negative brain drain story does not necessarily need to hold (Docquier and Rapoport, 2007). Accordingly, in a developing economy closed to international labor flows, the returns to education are very low and this discourages individuals to invest in education. However, if an individual is able to migrate to a high wage developed country, he might have extra incentives to acquire education relatively to autarchy. Migration, in this sense, increases the returns to education. This new view then defends that while migration opens the door for a negative brain drain, in some cases this negative effect might be offset by a beneficial brain gain due to an increase in the incentives of natives to acquire human capital. Therefore, migration conduces to a negative brain drain when the number of people that acquire education does not compensate for the number of skilled people that migrate. Conversely, a positive brain gain arises when the number of people that acquire education more than offsets the number of skilled people that migrate.

In particular the literature on beneficial brain gain presents three main mechanisms that can allow a developing country to achieve a positive brain gain: return migration (Dos Santos and Postel-Vinay, 2003 and Stark et al., 1997); remittances (Cox Edwards and Ureta, 2003); and uncertain migration status (Mountford, 1997 and Beine et al., 2001)[5].

[3] A recent view, however, defends that the possibility of a positive self-selection is less likely for non-economic migrants (as refugees) and short-term migrants (as seasonal workers). See Borjas (1987) and Chiswick (1999).

[4] A controversial example of brain drain is that of African doctors that migrate to work in developed countries, i.e.: the developed world has the benefits of African skilled migrants without paying for their education (World Bank, 2006).

[5] Uncertainty migration status refers to the uncertainty that an individual faces

Accordingly, the possibility of a beneficial brain gain is increased if: the flow of skilled workers returnees is sufficiently high (return migration channel); if remittances reduce substantially liquidity constraints in the education of the younger (remittances channel); and if many individuals that have invested in human capital do not migrate because they do not get legal status (uncertain migration status channel)[6].

With the discussion above in mind, in this paper we look at four interlinked phenomena: migration policy, illegal migration, brain drain and self-selection. Our starting point is that migration policies affect illegal migration flows. In fact, it is argued that very restrictive policies have as a consequence to increase illegal migration (Hanson, 2006). In addition, we know that illegal migrants are subject to a different set of constrains from legal ones. In particular, a skilled worker that migrates illegally has probably no other choice than to work as unskilled. In other words, a skilled illegal migrant is subject to brain waste (i.e.: a reduction of migrants' rewards to skills in the destination country)[7]. However, to our knowledge, the economic literature on brain drain and self-selection has focused the attention only on legal migration. Given this, our aim is to analyze the effects of migration policies and illegal migration: (1) on education decisions, (2) on self-selection, (3) and on brain drain.

The motivation for this research comes from a set of empirical facts on illegal migration. First, Rivera-Batiz (1999) and Kossoudji and Cobb-Clark (2002) show that illegal immigrants from Mexico in the US have a significant wage penalty relatively to legal migrants and that, as a result, the returns to human capital are much higher for Mexican legal immigrants than for illegal ones. Second, Chiquiar and Hanson (2005), Hanson (2006), Mckenzie and Rapoport (2007) and Orrenius and Zavodny (2005) present evidence of a positive self-selection for immigrants with up to nine years of education but of a negative self-selection for immigrants with more than nine years of education. They attribute this pattern, at least in part, to illegal migration. Third, Mckenzie and Rapoport (2006) and de Brauw and Giles (2006) find evidence of a significant negative effect of illegal migration on schooling attendance and attainments in rural Mexico and in rural China. Accordingly, in a context where the chances to be able to migrate legally are very low, the prospect of migration do not necessarily increase education incentives.

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when asking for a legal migration visa. In particular it is assumed that individuals that do not obtain legal visa do not migrate. In our paper, on the contrary, we allow individuals with no legal visa to migrate illegally.

[6] See Commander et al. (2004) for a comprehensive review of the various channels through which a beneficial brain gain can arise.

[7] Coniglio et al. (2006) and Mattoo et al. (2007) report that brain waste is indeed a significant phenomenon for skilled illegal migrants.

In this paper we then check the robustness of the positive self-selection and the beneficial brain gain arguments to illegal migration and migration policy. In particular, we compare a selective migration policy (where migrants are selected according to skills), with an open migration policy (where all migrants can enter legally in one country). We show that since the former can create illegal migration, a selective migration policy has the following effects relatively to an open migration policy: (1) it weakens the chances for a positive self-selection; (2) it reduces the possibility of a beneficial brain gain; and (3) it dampens the effectiveness of education policies. Accordingly, since illegal migration can conduce to brain waste (i.e.: skilled workers working as unskilled), a selective migration policy potentiates a brain waste risk for skilled migrants[8]. Therefore, not only selective migration policies might not be effective for developed countries to attract skilled-workers, but these policies can also hurt human capital formation in the developing world.

2 The Model

The model in this section is based on Docquier and Rapoport's (2007) stylized model on self-selection and brain-drain. To Docquier and Rapoport (2007) we add migration policy (in particular, an open and a selective migration policy) and illegal migration. The world economy is made up of two countries: the origin and the destination migration country. We focus in the origin migration country, which is a small developing open economy, and we treat as exogenous the destination migration country, which is a developed economy (see table 1 for a summary of the parameters used in the model)[9].

By construction, results in terms of brain drain and the education incentives of migration are mostly relevant to developing countries. However, results relative to the self-selection of skilled migrants are also of interest to developed countries. In fact, as discussed in the introduction, this is one of the main objectives behind selective migration policies.

[8]The brain waste risk refers to the uncertainty that skilled workers face when migrating without knowing their future legal status. Accordingly, skilled migrants run the risk of not getting legal status and to end up working as unskilled with the associated wage penalty (i.e.: brain waste). In this sense, the uncertainty associated with the brain waste risk differs from the uncertain migration status case above. In the uncertain migration status case, an individual with no legal visa does not migrate, and therefore does not face a brain waste risk.

[9]In a subsequent section we discuss the case with more than one destination migration country.

1<h<2	Skill premium
0<c<1	Education costs
0<τ<1	Wage penalty for illegal migrants
0<k<1	Migration costs
0<ρ<1	Migration costs penalty for illegal migrants
0<γ<1	% of migrant's second period working life spent in the destination country
0<Z<1	Education subsidy rate
0<T<1	Education tax rate

Figure 1: Parameters in the model

2.1 Production, Human Capital and Wages

Individuals in the origin country live and work for 2 periods, $t = 1, 2$. In the first period, all individuals work as unskilled, but they can also choose to take education simultaneously. Therefore in the first period, besides working, an individual chooses either to get education in order to become a skilled worker (S) or to not get education and stay unskilled (U). In the second period, all individuals work according to the skill level acquired in the first stage, but they can decide where to work (in the origin or in the destination country). As explain below, if individuals decide to migrate, they can end up migrating legally or illegally.

Labor supply in period t in the origin country equals the amount of unskilled and skilled labor available in the economy:

$$L_t = U_t + S_t \tag{1}$$

We consider a very simple linear production function:

$$Y_t = w_t E_t \tag{2}$$

Where w_t is the wage rate. In turn, E_t is labor in inefficient units and equals:

$$E_t = U_t + hS_t \tag{3}$$

Where $h > 1$ is the skilled productivity premium, which is individual specific. Skilled workers are then heterogeneous in productivity[10].

The stock of human capital can then be written as:

$$H_t = \frac{E_t}{L_t} = \frac{U_t + hS_t}{U_t + S_t} = 1 + P_t\,(h - 1) \tag{4}$$

[10] We ignore all the issues related with principal-agent wage models, where workers' productivity is imperfectly observed (see Stark et al., 1997).

Where P_t is the proportion of skilled workers in the origin country:

$$P_t = \frac{S_t}{U_t + S_t} \tag{5}$$

With this formalization we want to capture the idea of positive spillovers on human capital formation.

2.2 Individual Education Choices: Autarchy

In order to illustrate the education incentives of individuals, we consider first an autarchy scenario with no migration in the second period. If in the first period an individual only works, his wage rate is then w_1. In turn, if in the first period an individual besides working also takes education, he has to pay the education costs cw_1, with $0 < c < 1$. The parameter c is, then, the opportunity costs of education, which is individual specific. Therefore, individuals are heterogeneous on the ability to learn.

In the second period all individuals just work. Unskilled workers will earn w_2 and skilled workers hw_2. As such, the condition to acquire education in autarchy is just:

$$(1 - c)\, w_1 + hw_2 > w_1 + w_2 \tag{6}$$

In the steady state when $w_1 = w_2 \equiv w$ this condition simplifies to:

$$c < c_{Aut} \equiv h - 1 \tag{7}$$

Where the sub-script Aut stands for autarchy. In other words, all individuals with $c < c_{Aut}$ will acquire education. It can be easily noted that in order to obtain interior solutions we need that $h \in]1, 2[$. If otherwise, all individuals would have incentives to acquire education.

2.3 Individual Migration Choices: Open Economy

In an open economy, in terms of international migration, at the end of period 1 an individual can decide to migrate abroad. In the destination country the wage per-efficiency units for natives is $w^* > w$. We consider w^* to be exogenous to the model. In addition, the wage premium for skilled workers in the destination country is the same as in the origin country (i.e.: $h = h^*$)[11].

When an individual migrates legally, his wage is going to be the same as for natives from the destination country, i.e.: w^* if he is unskilled and hw^* if he is skilled. When an individual migrates illegally, however, he suffers a wage penalty τw^*, with $0 < \tau < 1$. The parameter τ intends to

[11] Results are not changed substantially if $h \neq h^*$.

capture the wage losses of illegal migrants with respect to legal ones[12]. Furthermore, under illegal migration a skilled illegal migrant cannot use his skills in the destination country, i.e.: a skilled illegal migrant is the same as an unskilled illegal migrant. In this sense, and by assumption, illegal skilled migrants are subjected to brain waste, i.e.: $\tau w^* < hw^*$.

In addition, migration is costly. Migration costs include not only the monetary cost to move from one country to another, but also other costs such as those related with adapting to a new culture and being away from dear ones. Accordingly, we assume that legal migrants incur in kw^*, with $0 < k < 1$; and illegal migrants incur in ρkw^*, with $\rho > 1$. In other words, we allow for higher migration costs for illegal migrants in relation to legal ones[13].

2.4 Open versus Selective Migration Policies

In the second stage an individual migrates if, and only if, the gains from migration are larger than the benefits of not migrating. As usual in the brain drain literature, we consider only one channel for beneficial brain gain: temporary migration[14]. We then assume that migrants spend a share γ of their second period working life in the destination country and $1 - \gamma$ as returnees[15].

Additionally, we compare two alternative migration policies by the destination migration country: an open migration policy, and a selective migration policy. In the open migration policy, all individuals can migrate legally. Then, for skilled and unskilled workers the probability of getting a legal visa can be defined as $p_S = p_U = 1$, respectively.

In turn, in the selective migration policy, skilled workers are favored in relation to unskilled ones. In particular, we consider that the destination migration country only awards legal status to some skilled workers. We then assume that skilled workers have a probability $p_S \in (0, 1)$ of getting a legal visa (and a probability $(1 - p_S) \in (0, 1)$ of being unsuccessful in getting a legal visa). Unskilled workers on the contrary have

[12] Empirical evidence in fact shows that, relatively to legal migrants, illegal migrants are paid lower wages, have poor working conditions and are more subject to violations of the protections afforded by the destination country labor laws (see Rivera-Batiz, 1999; Kossoudji and Cobb-Clark, 2002; and Vayrynen 2003).

[13] The available empirical evidence seems to support this assumption (see Salt and Stein, 1997). In addition, results do not change if $\rho = 1$.

[14] Temporary migration fits well with illegal migration, given that as defended by Chiswick (2001) illegal migration is by nature temporary. This is so, not only because illegal migrants aim at becoming legal, but also because they usually remain in the destination country for shorter periods than legal migrants.

[15] Below we are going to discuss the robustness of our results to the other two beneficial brain gain channels mentioned in the introduction: uncertain migration status and remittances.

a probability $p_U = 0$ of getting a legal visa[16]. Therefore, with a selective migration policy, unskilled individuals can only migrate illegally; in turn, skilled individuals can either migrate legally or illegally[17].

In this sense, the migration decision here has a different type of uncertainty from the uncertain migration status case discuss in the introduction (see also Docquier and Rapoport, 2007). In the uncertain migration status case, if an individual does not get legal status, he does not migrate, i.e.: an individual is uncertain about his migration decision, which depends on legal status. In our paper, if an individual does not get legal status, he migrates illegally, i.e.: an individual is uncertainty about his legal status, and therefore his earnings, but not about his migration decision. However, the uncertainty in relation to earnings introduces a brain waste risk for skilled workers. Accordingly, a skilled individual that decides to migrate might end up migrating illegally and as a result with lower returns to skills (i.e.: brain waste)[18].

For a given individual, then, the life time income for alternative migration choices, under both the open and the selective migration policies, is as follow:

$$\begin{gathered} I\left(U,NM\right)=w_1+w_2 \\ I\left(U,MI\right)= \\ w_1+p_U w^*\left(\gamma-k\right)+\left(1-p_U\right)w^*\left(\gamma\tau-\rho k\right)+\left(1-\gamma\right)w_2 \\ I\left(S,NM\right)=\left(1-c\right)w_1+hw_2 \\ I\left(S,MI\right)= \\ \left(1-c\right)w_1+p_S w^*\left(\gamma h-k\right)+\left(1-p_S\right)w^*\left(\gamma\tau-\rho k\right)+\left(1-\gamma\right)hw_2 \end{gathered} \quad (8)$$

Where NM stands for non-migration and MI for migration.

3 Open Migration Policy

Under the open migration policy all individuals can migrate legally, i.e.: $p_S = p_U = p = 1$. We are going to show that this policy has the following

[16] Accordingly, for our results to hold we just need that $p_S > p_U$.

[17] It is not correct to think that only the unskilled migrate illegally. Coniglio et al. (2006), on a survey on illegal migrants in Italy, report that 30% had secondary school (9 years of schooling), 22% high-school (12 years of schooling) and 5% University (16 or more years of schooling). Hanson (2006) estimates similar education characteristics for illegal migrants from Mexico in the US.

[18] As we discuss below, allowing for the same type of uncertainty as in the uncertain migration status case (for example letting some potential migrants to give up migration if they do not get legal status) does not change our results.

effects: it increases the incentives to acquire education; it promotes a positive self-selection; and it contributes to a beneficial brain gain[19].

3.1 Self-Selection

At the steady state a skilled and an unskilled worker will migrate if and only if, respectively[20]:

$$\begin{aligned} S_{p=1} &: h\gamma\left(\omega-1\right) > k\omega \\ U_{p=1} &: \gamma\left(\omega-1\right) > k\omega \end{aligned} \tag{9}$$

From here results that relation between skilled and unskilled workers' incentives to migrate is:

$$S_{p=1} - U_{p=1} = \gamma\left(\omega-1\right)\left(h-1\right) > 0 \tag{10}$$

Under the open migration policy, therefore, a skilled worker has always more incentives to migrate than an unskilled worker. However, in order to have a positive self-selection (i.e.: only the skilled migrate) we need that the $S_{p=1}$ condition is satisfied but the $U_{p=1}$ condition is not (equation 9). This is the case if $I\left(U, MI\right) < I\left(U, NM\right)$ and $I\left(S, MI\right) > I\left(S, NM\right)$, or:

$$\omega\left(\gamma-k\right)+\left(1-\gamma\right) < 1 < \omega\left(\gamma-\tfrac{k}{h}\right)+\left(1-\gamma\right) \tag{11}$$

We can then see that a positive self-selection is promoted when the returns to skills (h) are high[21].

In order to follow the brain drain literature, in the rest of this section we assume that equation 11 is always satisfied. The positive self-selection condition is necessary for two reasons. First, and as can be seen from equations 9 and 11, we eliminate corner solutions where all individuals migrate. This is so, because unskilled workers do not migrate, and only some skilled workers migrate, given that they are asymmetric on h. Second, and as we are going to prove below, migration increases the incentives of individuals to acquire education. As a consequence, this opens the door for a beneficial brain gain.

[19] In this section we basically reproduce Docquier and Rapoport's (2007) results. The only difference is that we interpret them in terms of an open migration policy.

[20] The subscript $p = 1$ indicates open migration policy.

[21] Only h can promote a positive self-selection, since it is the only parameter that affects skilled and unskilled workers' migration decisions asymmetrically; all the other parameters (ω, γ and k) work symmetrically for the two groups.

3.2 Migration and Education Incentives

With the open migration policy only the following individuals will acquire education (compare $I(S, MI)$ with $I(U, NM)$):

$$c < c_{p=1} \equiv \omega(\gamma h - k) + (1 - \gamma) h - 1 \tag{12}$$

To check if migration increases the education incentives of natives relatively to autarchy, we compare equations 12 and 7:

$$c_{p=1} - c_{Aut} = \gamma h(\omega - 1) - \omega k > 0 \tag{13}$$

As long as the positive self-selection condition holds (equations 9 and 11), then as expected, the incentives to acquire education under the open migration policy are higher than under autarchy.

3.3 Brain Drain or Brain Gain?

With the open migration policy, assuming a uniform distribution of abilities, the proportion of educated workers in the origin country is:

$$P_{p=1} = \frac{(1 - \gamma) c_{p=1}}{1 - \gamma c_{p=1}} \tag{14}$$

The possibility of a beneficial brain gain emerges if the derivative of P with respect to γ is positive at the skilled workers' threshold level of migration (equation 9):

$$\left[\frac{dP_{p=1}}{d\gamma}\right]_{h\gamma(\omega-1)=k\omega} = \frac{(h-1)(h-2)+h(\omega-1)-k\omega}{(1-\gamma(h-1))^2} \tag{15}$$

It is straightforward to note that: first, the sign of the previous expression depends only on the numerator since the denominator is always positive; and second, the sign of the numerator is determined by the parameters ω, k and h. In particular, and making $\Delta_{p=1} = (h-1)(h-2) + h(\omega - 1) - k\omega$, we can show that:

$$\begin{aligned} \frac{d(\Delta_{p=1})}{d\omega} &= h - k > 0 \\ \frac{d\Delta_{p=1}}{dk} &= -\omega < 0 \\ \frac{d\Delta_{p=1}}{dh} &= \omega - 2(2 - h) \lesseqgtr 0 \end{aligned} \tag{16}$$

As such, the skill premium (h) has an ambiguous effect on brain drain[22]. In turn, high relative wage destination-origin (ω) and low migration costs (k) contribute for a beneficial brain gain.

[22] Accordingly, h only contributes positively for a beneficial brain drain for high ω.

4 Selective Migration Policy

Under the selective migration policy, unskilled individuals can only migrate illegally, since $p_U = 0$; skilled workers, in turn, might either migrate legally or illegally, given that $p_S \in (0,1)$. We are going to show that results from the open migration policy are weakened with the selective migration policy, due to the existence of illegal migration. We proceed in the same fashion as above, first looking at self-selection, then education incentives and lastly brain drain.

4.1 Self-Selection

At the steady state the conditions for a skilled and an unskilled worker to migrate are, respectively[23]:

$$\begin{aligned} S_{p_S\in(0,1)} &: \gamma\left(h\left(p_S\omega - 1\right) + \omega\tau\left(1 - p_S\right)\right) > k\omega\left(p_S + \left(1 - p_S\right)\rho\right) \\ U_{p_U=0} &: \gamma\left(\omega\tau - 1\right) > k\omega\rho \end{aligned} \tag{17}$$

The relation between skilled and unskilled workers' incentives to migrate is therefore:

$$S_{p_S\in(0,1)} - U_{p_U=0} = p_S\omega\left(\gamma\left(h - \tau\right) + k\left(\rho - 1\right)\right) - \gamma\left(h - 1\right) \tag{18}$$

It can be easily checked that skilled workers might not have more incentives to migrate than the unskilled ones, i.e.: $S_{p_S\in(0,1)} \lesseqgtr U_{p_U=0}$. This contrasts with the open migration policy where skilled individuals always have higher incentives to migrate than the unskilled (equation 10). In particular, under the selective migration policy a positive self-selection is not guaranteed when the probability of getting legal status is low (low p_S), the relative wage destination-origin is low (low ω), the migration costs are low (low k), the migration costs penalty for illegal migrants is low (low ρ) and the wage penalty for illegal migrants is low (high τ). In turn, the effects of the skill premium (h) and of temporary migration (γ) are ambiguous[24]. Given that migration incentives are primarily influenced by parameters linked to illegal migration (p_S, τ and ρ), we can then assert that illegal migration plays an important role in reducing skilled workers incentives to migrate relatively to the unskilled.

What the above tells us is that selective migration policies might not be the more appropriate policy tool to attract skilled workers. Some

[23] The subscripts $p_S \in (0,1)$ and $p_U = 0$ indicate selective migration policy.

[24] Accordingly, h and γ only increase the incentives of skilled workers to migrate relatively to the unskilled if p_S and ω are high.

studies have in fact showed that for example Canada's selective migration policy has not been very effective in promoting a positive self-selection (Borjas, 1993; Wright and Maxim, 1993; Green and Green, 1995 and Bloom et al., 1995)[25]. Similarly, Barret (1998) presents evidence that if a country does not use selective migration policies, it does not necessarily attracts a lower inflow of skilled workers than countries that use such policies. Our results point out that this might result from the brain waste risk of illegal status that the skilled face when migrating to a country with a selective migration policy.

In any case, for having a positive self-selection we need that $S_{p=1}$ is satisfied but $U_{p=1}$ is not. This is so if $I(U, MI) < I(U, NM)$ and $I(S, MI) > I(S, NM)$, or:

$$\omega(\gamma\tau - \rho k) + (1-\gamma) < 1 < p_S\omega\left(\gamma - \tfrac{k}{h}\right) + (1-p_S)\tfrac{\omega}{h}(\gamma\tau - \rho k) + (1-\gamma) \tag{19}$$

Since under the selective migration policy, and due to illegal migration, skilled workers might not have more incentives to migrate than the unskilled (equation 18), then also the possibility of a positive self-selection is reduced. This is in particular the case when the probability of skilled workers to get legal status (p_S) is low. Further note that relatively to the open migration policy, now the skill premium (h) has an ambiguous effect on self-selection. For one side, h promotes a positive self-selection due to the possibility of legal status (first term on the right hand side of equation 19: $p_S\omega\left(\gamma - \frac{k}{h}\right)$), but from other side it reduces a positive self-selection due to the possibility of illegal status (second term on the right hand side of equation 19: $(1-p_S)\frac{\omega}{h}(\gamma\tau - \rho k)$)[26].

For the same reasons as for the open migration policy, in the rest of this section we assume that equation 19 is always satisfied. We want to study education incentives and brain drain when the selective migration policy supports a positive self-selection since the opposite case is not interesting, i.e.: with a negative self-selection migration does not promote education and brain drain.

4.2 Migration and Education Incentives

With the selective migration policy, only the following individuals will acquire education:

[25] Canada's point system was introduced in 1967. Therefore Canada was one of the first countries to introduce a migration policy based on labor market criteria.

[26] From equation 19 we can also note that the remaining parameters (k, τ, ω, ρ and γ) cannot affect self-selection, since they promote migration symmetrically for unskilled and skilled workers.

$$c < c_{p_S \in (0,1)} \equiv \omega \left(p_S \left(\gamma h - k \right) + \left(1 - p_S \right) \left(\gamma \tau - \rho k \right) \right) + \left(1 - \gamma \right) h - 1 \quad (20)$$

The first question we must ask is if migration increases education incentives relatively to autarchy. To do this we compare equation 20 with equation 7:

$$c_{p_S \in (0,1)} - c_{Aut} = \gamma \left(h \left(p_S \omega - 1 \right) + \left(1 - p_S \right) \omega \tau \right) - \omega k \left(\left(1 - p_S \right) \rho + p_S \right) \quad (21)$$

Then, as for the open migration policy and as it should be expected, as long as the positive self-selection condition holds (equations 17 and 19), the incentives to acquire education under the selective migration policy are higher than under autarchy.

More interesting however is to evaluate the education incentives under the open migration policy and under the selective migration. To check this we compare equation 12 with equation 20:

$$c_{p=1} - c_{p_S \in (0,1)} = \left(1 - p_S \right) \omega \left(\gamma \left(h - \tau \right) + k \left(\rho - 1 \right) \right) > 0 \quad (22)$$

Relatively to the open migration policy, then, the selective migration policy reduces the incentives of individuals to acquire education[27]. The rationale behind this result is that since the selective migration policy might relegate skilled migrants to the illegal status, they run the risk of brain waste. Accordingly, given that brain waste reduces the returns to education, it also reduces education incentives. This effect seems to be confirmed empirically, as we have discussed in the introduction, by Mckenzie and Rapoport (2006) and de Brauw and Giles (2006) for rural migration from Mexico and China.

The disincentive to acquire education, which arises under the possibility of illegal migration, is central in this paper because: first, it is the main force operating behind our results; and second, it is also what makes our results robust to alternative beneficial brain gain channels and to the possibility of amnesties for illegal migrants.

4.3 Brain Drain or Brain Gain?

With the selective migration policy, assuming a uniform distribution of abilities, the proportion of educated workers in the origin country is:

[27] Note that this depends only on illegal migration. Accordingly, temporary migration does not play a role, i.e.: even for $\gamma = 1$ (permanent migration) the previous conclusion holds.

$$P_{p_S\in(0,1)} = \frac{(1-\gamma)\, c_{p_S\in(0,1)}}{1-\gamma c_{p_S\in(0,1)}} \tag{23}$$

The possibility of a beneficial brain gain emerges if the derivative of P with respect to γ is positive at the skilled workers' threshold level of migration (equation 17):

$$\begin{gathered}\left[\frac{dP_{p_S\in(0,1)}}{d\gamma}\right]_{\gamma(\omega(p_S h+(1-p_S)\tau)-h)=k\omega(p_S+(1-p_S)\rho)} = \\ \frac{(h-1)(h-2)+h(p_S\omega-1)+\omega\tau(1-p_S)-k\omega(p_S+\rho(1-p_S))}{\left(1-\frac{\gamma(h-1)(\rho-(\rho-1)p_S)}{p_S+(1-p_S)\rho}\right)^2}\end{gathered} \tag{24}$$

To analyze the effects of the different parameters on brain drain under the selective migration policy, note first that the sign of equation 24 depends only in the numerator since the denominator is always positive. By computing the derivative of the numerator of equation 24 we obtain the following relations (for the sake of notation, we make the numerator of equation 24 equal to $\Delta_{p_S\in(0,1)}$):

$$\begin{aligned}\frac{d\left(\Delta_{p_S\in(0,1)}\right)}{dp_S} &= \omega\left(h-\tau+k\left(\rho-1\right)\right) > 0 \\ \frac{d\left(\Delta_{p_S\in(0,1)}\right)}{d\omega} &= \tau+p_S\left(h-\tau\right)-k\left(\rho-p_S\left(\rho-1\right)\right) \lesseqgtr 0 \\ \frac{d\left(\Delta_{p_S\in(0,1)}\right)}{dk} &= -\omega\left(\rho-p_S\left(\rho-1\right)\right) < 0 \\ \frac{d\left(\Delta_{p_S\in(0,1)}\right)}{d\tau} &= \omega\left(1-p_S\right) > 0 \\ \frac{d\left(\Delta_{p_S\in(0,1)}\right)}{d\rho} &= -k\omega\left(1-p_S\right) < 0 \\ \frac{d\left(\Delta_{p_S\in(0,1)}\right)}{dh} &= p_S\omega-2\left(2-h\right) \lesseqgtr 0\end{aligned} \tag{25}$$

Note first that relatively to the open migration policy, under the selective migration policy not only the skill premium (h) has an ambiguous influence on brain drain, but now that is also the case for the relative wage destination-origin (ω)[28]. In turn, high probability of getting legal status (high p_S), low wage penalty for illegal status (high τ), low migration costs (low k) and low migration costs penalty for illegal migrants (low ρ) can promote a beneficial brain gain. The reverse happens for

[28] The influence of h on brain drain depends on ω and p_S, i.e.: h only contributes for a beneficial brain gain for high ω and high p_S. The influence of ω on brain drain depends on p_S, τ and k, i.e.: ω only contributes for a beneficial brain gain for high τ, high p_S and low k.

low p_S, low τ, high k and high ρ, i.e.: when illegal migration becomes more relevant a negative brain drain might arise.

In this sense, this result may help to explain Beine's et al. (2008) empirical evidence on brain drain. In particular, Beine et al. (2008) show that the countries with a negative brain drain are mostly located in Africa and Latin America. In addition, available empirical evidence also indicates that these two regions have high rates of illegal migration (Hanson, 2006 and Coniglio et al., 2006). Then, if the brain waste mechanism presented in this paper is at work in Africa and Latin America, illegal migration might be partially responsible for the negative brain drain observed in these regions.

Other central issue is to evaluate brain drain outcomes under the open migration policy and under the selective migration policy. To check this we compare equation 15 with equation 24:

$$\left[\frac{dP_{p=1}}{d\gamma}\right]_{h\gamma(\omega-1)=k\omega} - \left[\frac{dP_{p_S\in(0,1)}}{d\gamma}\right]_{\gamma(\omega(p_S h+(1-p_S)\tau)-h)=k\omega(p_S+(1-p_S)\rho)} = \omega\left(1-p_S\right)\frac{(h-\tau)+k(\rho-1)}{\left(1-\gamma(h-1)\right)^2} > 0 \quad (26)$$

We can then see that, relatively to the open migration policy, the selective migration policy reduces the chances of a beneficial brain gain. Accordingly, under the selective migration policy, and due to illegal migration, education incentives triggered by migration are weakened relatively to the open migration policy. In this sense, selective migration policies in developed countries can affect negatively any positive effects that could potentially come through international migration.

5 Education Policy

In this section we analyze if an education policy can increase the chances of a beneficial brain gain relatively to a scenario with no education policy. For simplicity, as in Docquier and Rapoport (2007), we assume that migration costs are zero. The consequence of having $k = 0$ is that, independently of education policy, migration will always promote a beneficial brain gain. However, the important point for education policies is not if migration promotes a beneficial brain gain (since this depends crucially on migration costs), but if an education policy can promote more beneficial brain gain than in the absence of an education policy. Since results for this last issue are not affected by migration costs, we exclude them.

In the education policy scenario, following Docquier and Rapoport (2007), we assume that the government in the origin country collects an income tax on the educated and the uneducated adults that remain in the country. We express this tax in terms of skilled workers' wages, Thw,

with T denoting the tax rate. The tax is used to finance an education subsidy, which is allocated to each young opting to take education. We express the education subsidy in terms of the local wage Zw, where Z denotes the subsidy rate[29].

With an education policy, the life income for alternative migration choices is then[30]:

$$\begin{aligned} I\left(U,NM\right)^{T} &= w_1 + w_2\left(1-Th\right) \\ I\left(U,MI\right)^{T} &= w_1 + \gamma w^{*}\left(p_U + \left(1-p_U\right)\tau\right) + \left(1-\gamma\right)w_2\left(1-Th\right) \\ I\left(S,NM\right)^{T} &= \left(1-c+Z\right)w_1 + hw_2\left(1-T\right) \\ I\left(S,MI\right)^{T} &= \left(1-c+Z\right)w_1 + \gamma w^{*}\left(hp_S + \left(1-p_S\right)\tau\right) + \left(1-\gamma\right)hw_2\left(1-T\right) \end{aligned} \tag{27}$$

Under the education policy, the closed economy critical level of education becomes:

$$c < c_{Aut}^{T} \equiv h - 1 + Z \tag{28}$$

In order to obtain interior solutions for the education policy case, we need to assume that $\left(h+Z\right) \in \left]1,2\right[$. Otherwise all individuals would have incentives to acquire education.

For the no education policy scenario, in turn, the life time income for alternative migration choices is as in equation 7 with $k=0$ and the closed economy critical level of education is as in equation 8.

Next we compare the education policy and the no education policy scenarios. This exercise is done for both the open and the selective migration policies. We are going to show that, under the open migration policy, the education policy of the origin country always promotes a higher beneficial brain gain than in the absence of it. However, this result might not necessarily hold under the selective migration policy, due once again to illegal migration. Furthermore, under the selective migration policy the possibility for the education policy to promote a beneficial brain drain is reduced in relation to the open migration policy.

5.1 Education Policy: Open Migration Policy

For the open migration policy, we start by defining the migration conditions for skilled and unskilled workers. In the education and the no

[29]Implicitly we are assuming that the government budget is balanced and that there is no need for fiscal adjustments due to migration. Introducing these issues would not qualitatively change the results.

[30]The upper-script T refers to the "education policy" case. The upper-script $T=0$ refers to the "no education policy" case.

education policy scenarios we have respectively:

$$S_{p=1}^{T}:\omega>1-T$$
$$U_{p=1}^{T}:\omega>1-hT$$

$$S_{p=1}^{T=0}:\omega>1$$
$$U_{p=1}^{T=0}:\omega>1 \tag{29}$$

As a result, only the following individuals will acquire education:

$$c<c_{p=1}^{T}\equiv\omega\gamma h+(1-\gamma)\,h\,(1-T)+Z+Th-1$$

$$c<c_{p=1}^{T=0}\equiv h\,(\omega\gamma+(1-\gamma))-1 \tag{30}$$

From here it is straightforward to find $P_{p=1}^{T}$ and $P_{p=1}^{T=0}$. To study brain drain, we compute the derivatives of $P_{p=1}^{T}$ and $P_{p=1}^{T=0}$ with respect to ω. In both cases the derivatives are evaluated at the skilled workers' migration threshold level (equation 29):

$$\left[\frac{dP_{p=1}^{T}}{d\omega}\right]_{\omega=1-T}=\frac{(1-\gamma)\,\gamma h}{(1-\gamma\,(h+Z-1))^{2}}>0$$
$$\left[\frac{dP_{p=1}^{T=0}}{d\omega}\right]_{\omega=1}=\frac{(1-\gamma)\,\gamma h}{(1-\gamma\,(h-1))^{2}}>0 \tag{31}$$

Given that these two derivatives are positive, then irrespective of education policy, migration always promotes a beneficial brain gain. As discussed above, the reason for this result is that migration costs are zero. As such, the only interesting thing to know when $k=0$ is if the education policy promotes a higher level of beneficial brain gain than the no education policy case. Comparing the brain drain conditions under the education policy and under the no education policy, we obtain:

$$\left[\frac{dP_{p=1}^{T}}{d\omega}\right]_{\omega=1-T}-\left[\frac{dP_{p=1}^{T=0}}{d\omega}\right]_{\omega=1}=(1-\gamma)\,\gamma^{2}hZ\frac{(1-\gamma(h+Z-1))+(1-\gamma(h-1))}{(1-\gamma(h+Z-1))^{2}(1-\gamma(h-1))^{2}}>0 \tag{32}$$

Therefore, in the open migration policy the education policy always reinforces the possibility of a beneficial brain gain relatively to the no education policy case.

5.2 Education Policy: Selective Migration Policy

For the selective migration policy, we also begin by deriving the migration conditions for skilled and unskilled workers. For the education and the no education policy cases these are, respectively:

$$\begin{aligned} S^{T}_{p_S\in(0,1)} &: \omega\left(p_S\left(h-\tau\right)+\tau\right) > h\left(1-T\right) \\ U^{T}_{p_U=0} &: \tau\omega > 1-hT \end{aligned}$$

$$\begin{aligned} S^{T=0}_{p_S\in(0,1)} &: \omega\left(p_S\left(h-\tau\right)+\tau\right) > h \\ U^{T=0}_{p_U=0} &: \tau\omega > 1 \end{aligned} \tag{33}$$

Then, only the following individuals will acquire education:

$$c < c^{T}_{p_S\in(0,1)} \equiv \omega\left(p_S\gamma h+\left(1-p_S\right)\gamma\tau\right)+\left(1-\gamma\right)h\left(1-T\right)+Z+Th-1$$

$$c < c^{T=0}_{p_S\in(0,1)} \equiv \gamma\omega\left(p_S h+\left(1-p_S\right)\tau\right)+\left(1-\gamma\right)h-1 \tag{34}$$

From these two equations we can derive $P^{T}_{p_S\in(0,1)}$ and $P^{T=0}_{p_S\in(0,1)}$ to study brain drain. Accordingly, as above we compute the derivatives of $P^{T}_{p_S\in(0,1)}$ and of $P^{T=0}_{p_S\in(0,1)}$ with respect to ω and we evaluate them at the skilled workers' migration threshold level (equation 33):

$$\left[\frac{dP^{T}_{p_S\in(0,1)}}{d\omega}\right]_{\omega=\frac{h(1-T)}{p_S(h-\tau)+\tau}} = \left(1-\gamma\right)\gamma\frac{p_S\left(h-\tau\right)+\tau}{\left(1-\gamma\left(h+Z-1\right)\right)^2} > 0$$

$$\left[\frac{dP^{T=0}_{p_S\in(0,1)}}{d\omega}\right]_{\omega=\frac{h}{p_S(h-\tau)+\tau}} = \left(1-\gamma\right)\frac{p_S\left(h-\tau\right)+\tau}{\left(1-\gamma\left(h-1\right)\right)^2} > 0 \tag{35}$$

As such also under the selective migration policy, and due to the absence of migration costs, a beneficial brain gain is promoted independently of education policy. Therefore, again what is important to analyze is if the education policy increases the level of beneficial brain gain relatively to the no education policy case. To know this we compare the brain drain conditions under the education policy and under the no education policy cases:

$$\left[\frac{dP^{T}_{p_S\in(0,1)}}{d\omega}\right]_{\omega\frac{h(1-T)}{p_S(h-\tau)+\tau}} - \left[\frac{dP^{T=0}_{p_S\in(0,1)}}{d\omega}\right]_{\omega=\frac{h}{p_S(h-\tau)+\tau}} =$$

$$(1-\gamma)\left(p_S\left(h-\tau\right)+\tau\right)\frac{\gamma\left(Z(\gamma(2-Z)+2)+\gamma^2(h-1)^2+2h(1-\gamma Z)-\gamma\left(h^2-1\right)-1\right)-1}{(1-\gamma(h+Z-1))^2(1-\gamma(h-1))^2} \lessgtr 0 \tag{36}$$

Then the education policy under the selective migration policy, and contrary to what happens with the open migration policy, do not necessarily increases the possibility of a beneficial brain gain relatively to the no education policy case. In particular, equation 36 tends to be negative when the parameters γ, h and Z are simultaneously very high[31]. Accordingly, an education policy runs the risk of becoming ineffective: the longer migrants stay in the destination country, since the externalities generated by the education subsidy are lower; the higher the skill premium, given that this works by itself to promote education; and the higher the education subsidy, because the opportunity costs of subsidization become very large.

We have then seen that the selective migration policy might reduce the success of education policies. So far, however, we do not know how the selective migration policy does relatively to the open migration policy. Comparing the effectiveness of the education policy under the open and the selective migration policies, we obtain:

$$\left[\frac{dP^{T}_{p_S\in(0,1)}}{d\omega}\right]_{\omega=\frac{h(1-T)}{p_S(h-\tau)+\tau}} - \left[\frac{dP^{T}_{p=1}}{d\omega}\right]_{\omega=1-T} = -\left(1-\gamma\right)\gamma\frac{\left(1-p_S\right)\left(h-\tau\right)}{\left(1-\gamma\left(h+Z-1\right)\right)^2} < 0 \tag{37}$$

The role of the education policy is therefore unambiguously weakened under the selective migration policy relatively to the open migration policy. The rational for this result is once more illegal migration. Accordingly, since illegal migration reduces the incentives of individuals to acquire education, it also renders education policies less efficient.

6 Robustness of Results

In this section we discuss the robustness of our results to two other beneficial brain gain channels (uncertain migration and remittances), to the possibility of amnesties for the illegal and to a multi-country world.

[31] To see this note that the sign of equation 36 depends only on the term in the numerator (all the remaining terms are positive). The cross derivative of the numerator in relation to γ, h and Z equals -4γ.

Start with uncertain migration. In the case analyzed in this paper, when a potential migrant decides to migrate, he does so independently of his legal status, i.e.: when is profitable to migrate, an individual has no uncertainty about his decision. Suppose, instead, that if a skilled individual does not get a legal visa, he decides with probability q_S to not migrate and with probability $(1 - q_S)$ to migrate regardless of the illegality condition. As expected, the skilled individuals with no legal visa that give up of migrating will contribute for a beneficial brain gain. However, this new formulation does not prevent the brain waste risk to arise. Therefore, since the main mechanism in this paper is not affected, results are also not going to be qualitatively altered.

Consider now the case of remittances. Assume that each individual that decides to take education in the origin country receives a remittance R to finance his education[32]. This case is somewhat similar to the education policy above. The only difference is that now who pays for the education of the young are not taxes from those that remain in the country, but emigrants' transfers. As such remittances will also contribute to increase the education incentives of individuals in the origin country. However, remittances do not eliminate the brain waste risk that skilled individuals face under illegal migration. Therefore, again results from our central case are going to be basically the same.

Next, we look at amnesties for illegal migrants. Imagine that an individual that does not get legal status spends a share $\delta \in (0, 1)$ of his working life in the destination country as an illegal and a share $(1 - \delta)$ as a legal, due to amnesties to illegal migrants[33]. In this case the brain waste risk will be reduced, but not totally eliminated. Therefore once more our results are not going to be changed substantially. Furthermore, politicians in recent years have been more reticent to apply amnesties for illegal migrants. If this tendency continues, the amnesty channel for reducing the brain waste risk will also become weaker[34].

Finally, we discuss a multi-country world. Suppose that individuals from the origin country can migrate to $i = 1, 2, ..., n$ destination countries. For simplicity we further assume that all destination countries are symmetric in every respect[35]. Think first of a scenario where all desti-

[32] We do not consider remittances used for other purposes besides education. This would only make a difference if we also introduce credit constrained individuals.

[33] We can also interpret δ as the probability of receiving an amnesty.

[34] Note that the brain waste risk can also affect legal migrants, especially those belonging to some ethnic groups or citizens from certain countries (Mattoo et al., 2008). As such, results in this paper could be extended to more general cases of brain waste, which do not include only illegal migrants.

[35] Accordingly, migrants tend to prefer countries with higher wages, with more job opportunities, and closer in terms of geographical and cultural distance.

nation countries have the same migration policy (either the open or the selective migration policy). In this case migrants will not have any preference for a particular destination country. However, this can change if destination countries differ in the migration policy used. Accordingly, skilled workers will prefer to migrate to countries with open migration policies in order to reduce the brain waste risk. As a result, relatively to a country with a selective migration policy, a country with an open migration policy will be able to attract more skilled workers and therefore to achieve more easily a positive self-selection[36]. In addition, the existence of destination countries with open migration policies can also help origin countries to achieve a beneficial brain gain, given that as we have seen above, open migration policies increase education incentives.

7 Discussion

In this paper we have argued that since migration policies affect migrants' legal status, then, they also affect education incentives, brain drain and self-selection. In particular, more open migration policies tend to create less illegal migration than selective migration policies, given that the latter has more restrictive criteria for admission. In this sense we have compared an open migration policy where all migrants are granted a legal visa, with a selective migration policy where migrants are selected according to skills. Accordingly, under the selective migration policy an individual that does not get a legal visa but decides to migrate becomes an illegal migrant. This is specially penalizing for skilled illegal migrants, because they most likely end up working as unskilled (i.e.: brain waste). In other words, selective migration policies increase the brain waste risk that skilled workers face when migrating.

We then showed that, relatively to the open migration policy, the selective migration policy has several negative effects. For the origin country it reduces the incentives of individuals to acquire education; it weakens the possibility of beneficial brain gain to arise; and it dampens the success of education policies. For the destination country, in turn, it undermines the chances of a positive self-selection. We have also discussed that these results are robust to other beneficial brain gain channels than temporary migration (uncertain migration and remittances), to amnesties for illegal migrants and to a multi-country world.

Our model then carries out some interesting policy implications for developed and developing countries. For developed countries the popularity of selective migration policies might be misleading. In fact, instead

[36]In other words, countries with more open migration policies can cancel-out the effects of selective migration policies put in place in other countries.

of attracting more skilled workers, this policy might on the contrary prevent a positive self-selection. The rational for this result is that selective migration policies, due to the brain waste risk, can reduce the incentives of skilled workers to migrate. In turn, and now from the perspective of developing countries, education policies cannot be seen independently from the migration policies in developed countries, given that the latter affect the former. Accordingly, since selective migration policies from destination countries can reduce the incentives of individuals to acquire education in the origin countries, they can also cancel out any positive effects from education policies in the latter.

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