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ABSTRACT

Beneficial Brain Drain and Non-Migrants' Welfare

Though a net brain gain has tended to be seen as a benefit and referred to as a 'beneficial brain drain' in the literature, its welfare impact for source country residents – or non-migrants – is at best ambiguous. Increased educational investment in response to a brain drain is equivalent to a bet where migrants *(M)* win and where the impact on residents (*R*) – whose well-being is a concern for the government – is ambiguous or negative. I compare residents' welfare a) for an open vs. a closed economy, b) under the presence or absence of education externality, c) with vs. without government intervention, and d) with government's concern equal for *R* and *M* ($R = M$) or greater for *R* ($R > M$). Main findings are: i) residents lose under an open economy in four of the five scenarios considered, with an ambiguous result under an externality and no intervention; ii) optimal education policy has a positive or ambiguous impact on residents' welfare (and a positive impact under a closed economy); and iii) welfare is higher under intervention when $R > M$ than when $R = M$. It is worth noting that, though the standard developing country policy of subsidizing higher education is optimal under an education externality in the case of a closed economy, this result need not hold under an open economy.

JEL Classification: F22, I20, J61

Keywords: brain drain, net brain gain, education policy, source country residents, welfare

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1. Introduction

The number of skilled immigrants – i.e., those with tertiary education – living in OECD member countries has increased at a significantly higher rate than unskilled at least since the 1990s – e.g., the former increased by 63.7 percent from 1990 to 2000 and the latter by 14.4 percent or less than a quarter of the former (Docquier and Marfouk 2006), and the skilled emigration rate or brain drain in 2010/11 exceeded the overall emigration rate in 95 percent of 145 developing countries with available data (UN-OECD Report 2013). Furthermore, the skilled share for OECD immigrants is greater than for OECD's population. For instance, 48 percent of US immigrants in 2011-2015 were college graduates, which is 55 percent higher than the 31 percent for US-born adults (Batalova and Fix 2017). Two major reasons are the increase in the number of countries implementing skill-selective immigration policies – such as the points system – and the globalization of the market for talent (ILO 2006).

The literature's view on the impact of skilled labor emigration (or brain drain) on migrants' source countries has evolved over time. Early studies (e.g., Grubel and Scott 1966; Bhagwati and Hamada 1974, 1982) saw the brain drain as mostly negative. Though they recognized that a brain drain led to various benefits (e.g., remittances, migrants returning with new skills, and greater cooperation), they concluded that its net impact was to reduce non-migrants' welfare.

Starting in the 1990s, a series of papers appeared that were much more sanguine about skilled labor migration. These studies (e.g., Mountford 1997; Vidal, 1998; Beine et al. 2001, 2008) did not appeal to the benefits identified by the early contributors. Rather, they showed – both theoretically and empirically – that since the return on investment in education in the richer host countries is greater than in the source country, migration prospects raise the expected return on education and consequently raise its level. In other words, a brain drain induces a brain gain.

Beine et al. (2008) studied the net impact of the brain drain on source countries' average stock of human capital. They found that most countries with low levels of human capital and low brain drain rates experienced a net brain gain (i.e., an increase in residents' average human capital stock) while countries where the brain drain was over 18 percent and/or the share of the skilled in the population was over 5 percent tended to experience a net brain drain. And though a majority of countries experienced a net brain drain, the overall impact on developing countries' average human capital stock was positive. Based on the latter result, the authors concluded that the traditional pessimistic view of the brain drain is not justified, especially not at the aggregate level.

Another study by Shreshta (2017) finds that a change in the British Army's selection criterion for Nepalese Gurkha soldiers towards a minimum level of education – when none had been required before – had a positive impact on non-migrants' education and income. The author concludes that "Despite not being selected in the British Army or emigrating elsewhere, these non-migrants benefited directly from additional schooling." However, two additional elements – a negative and a positive one – must be taken into account in order to assess whether the policy resulted in a net cost or benefit, namely the cost of producing the additional education and the (potential) positive externality associated with it. These issues are addressed in Sections 2 and 3.

I have argued elsewhere that optimism about the size and impact of the brain drain-induced brain gain may be excessive (Schiff 2006).[1] And though a net brain gain has tended to be seen as a benefit and has been referred to as a "beneficial brain drain" in the literature, its impact on the welfare of the resident (or non-migrant) population is generally ambiguous or negative.

Individuals select the education level that maximizes their expected utility. The latter rises with an opening up of the economy and leads them to increase their investment in education. They are in fact making a bet where they unambiguously win if they are able to migrate and where the impact if they are unable to migrate is either negative or ambiguous. Thus, educated residents – who constitute the majority of educated people in most source countries (Docquier and Marfouk 2006, Beine et al. 2008) – may very well end up worse off. It is nevertheless the case that their education choice is optimal ex ante, though a source country government must deal with the actual situation of its residents and may well be more concerned with their welfare than with that of emigrants (as discussed below). Hence, individual and government objectives need not coincide. This issue is examined in Section 4.

[1] Reasons include: i) High-ability individuals acquire more education and migrate therefore at a higher rate than lower-ability ones, so that the share of residents with high ability and education declines; ii) Unskilled labor migrates as well (even if at a lower rate than skilled labor), so unskilled labor's expected income is also higher than their current income, which reduces the expected return on investment in education; iii) Individuals tend to be risk averse and uncertainty (about completing their education, rate of return if/when completed, host country policies at that time, etc.) should dampen the brain drain's education impact; and more.

Four sets of comparisons of residents' human capital and welfare are conducted under five scenarios. The comparisons are made:

A. For an open vs. a closed economy – i.e., with vs. without a brain drain;

B. With vs. without education externality;

C. In the presence vs. absence of government intervention; and

D. For a government where residents matter more than migrants vs. where they matter equally.

The five scenarios are:

1. No intervention and no education externality;
2. No intervention and an education externality;
3. Intervention – with the government exhibiting the same preferences as the native population – and an education externality;
4. Intervention – with the government considering residents to be more important than emigrants – and no education externality; and
5. Intervention – with the government considering residents to be more important than emigrants – and an education externality.

Scenarios 4 and 5 are motivated by the fact that the resident population's well-being is likely to matter more to the government than that of emigrants. First, the government may have an altruistic motive and work to improve the well-being of its population. Second, the government's effectiveness is likely to be greater regarding its impact on residents' welfare than on emigrants' welfare. Third, if residents are dissatisfied with the government's performance – in areas such as employment, quality and reliability of public goods and services, civil rights, crime, enforcement of property rights, and more – they can voice their dissatisfaction and pressure the government through various means, many of which are not available to emigrants, including voting,[2] demonstrations, strikes, civil disobedience, and even violent action.[3]

[2] Voting is not possible for emigrants from about 70 source countries, including for instance India and the Philippines.

[3] Migrants can also affect their home country [through remittances, trade (e.g., Parsons 2012; Genç 2014), investment (e.g., Kugler and Rapoport 2007; Javorcik et al. 2011), funding political parties, and influencing host countries' policies regarding their home country]. However, the government is likely to be more effective and have a greater impact on residents' behavior than on migrants' behavior. The point made here is a relative one, namely that the source country government tends to consider residents to be more important than emigrants and is more effective in its efforts to influence the former than the latter.

The source country's government intervenes whenever its objective function differs from that of the country's individuals, which occurs when education externalities are present and/or when the government considers residents to matter more than migrants. In such situations, the government can maximize its objective function by using its education policy – i.e., by providing an education subsidy or levying an education tax – in order to influence individuals' educational choices.

Main findings are shown below according to the three types of comparisons mentioned above:

A. *Under a brain drain vs. under a closed economy*

- The brain drain reduces the welfare of the source country's residents in four of the five scenarios, the exception being Scenario 2 (with an externality and no intervention) where the brain drain's impact on residents' welfare is ambiguous.
- The average level of education is higher under a brain drain than in a closed economy, except in Scenarios 4 and 5 where the answer is ambiguous and depends on the importance the government attaches to migrants relative to residents.

B. *With and without government intervention*

- Scenario 3 (residents and migrants matter equally; with an externality). The optimal education policy is a subsidy, which has an ambiguous impact on residents' welfare (and a positive one under a closed economy).
- Scenario 4 (residents matter more than migrants to the government; no externality). The optimal education policy is a tax, which has a positive impact on residents' welfare.
- Scenario 5 (residents matter more; with an externality). Whether a tax or subsidy is optimal is ambiguous, and so is the policy's impact.

C. *When residents matter equally to or more than migrants*

- Intervention results in a higher welfare level for residents when they matter more than migrants to the government than when both matter equally.

Developing countries typically subsidize higher education. However, such subsidies do not necessarily benefits residents under a brain drain. Thus, the fact education policy's impact on residents' welfare differs in important ways under an open than under a closed economy should be incorporated in source countries' policy design.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 solves the model in the absence of government intervention, comparing residents' welfare under brain drain and closed economy, without (with) education externality in Section 3.1 (3.2). Section 4 incorporates government intervention. Section 4.1 assumes same preferences for the government and individuals, and an externality is present. Section 4.2 (4.3) assumes residents matter more to the government than emigrants, and education does not (does) generate externalities. Section 5 provides some policy implications and Section 6 concludes.

2. Model

The "points system" immigration policy, which has prevailed in Australia, Canada and the UK for a number of years, places a great importance on education, with immigration probability increasing with applicants' education level. Additional countries where a share of the immigrants is selected on the basis of educational attainment include Germany, France and the US (Marshall 2011).

For simplicity's sake, I assume individuals are homogenous. Then, a brain drain under a points system raises the average level of education (i.e., it induces a net brain gain or beneficial brain drain) in the absence of intervention. The reason is that i) the brain drain raises the incentive to acquire education and generates a brain gain, while ii) the brain drain itself has no impact on the average education level since migrants and residents are identical. In the case of intervention, a brain drain need not raise average education of homogenous individuals when the government places a greater weight on residents than on migrants' welfare, as shown in Scenarios 4 and 5. [4]

[4] A net brain gain (BG) is not crucial for our results. For instance, a brain drain (BD) can generate a *net* BD under two homogeneous groups, a low-ability one, LG, with optimal education, h, below the minimum required by the host country, and a high-ability one, HG, and with LG's share in the population such that the average h falls under BD. Then, all the paper's results hold but only for HG. In fact, individuals do differ in their intrinsic ability, in which case a BD's impact on average h (ability) is ambiguous (negative). Schiff (2017) shows that, though a BD raises the incentive to acquire h (a BG), the BD itself reduces average h since high-ability individuals acquire more h and thus migrate at a higher rate than low-ability ones. Hence, the share of those with high- (low-) ability [and thus with more (less) h] declines (rises), resulting in an ambiguous (negative) impact on average h (ability).

Assume individuals live and work for one period, and invest in education at the start of the period. Following the recent brain-drain, brain-gain literature, the analysis does not account for potential effects like increased cooperation, return migration with new skills, increased remittances, etc.

Denote the country of origin (destination) by “0” (“d”), income of residents (migrants) by y_0 (y_{d}), expected income by y, migration probability by $p \epsilon [0, 1)$, human capital by $h > 0$, its average value by H, with $h = H$, and consumption by c, with $c > 0$. Individuals are risk-neutral and select h to maximize utility $u = u(c)$, where u rises monotonically with c. As solutions for h that maximize c also maximize u, I assume for simplicity $u = c$.

Residents’ consumption under an open (closed) economy is denoted by $c_0(c_c)$. Their income is $y_0 = \alpha_0 h$, and migrants’ income is $y_{\mathrm{d}} = \alpha_{\mathrm{d}} h, \alpha_0 \epsilon (0, \alpha_{\mathrm{d}})$. Expected income is $\mathrm{y} = (1 - p)y_0 + py_{\mathrm{d}} = (1 - p)\alpha_0 h + p\alpha_d h$. If average education H generates an education externality γH, we have $y = (1 - p)(\alpha_0 h + \gamma H) + p\alpha_d h$ (with $\gamma < \alpha_0$ and $\alpha_d > \alpha_0 + \gamma$).[5] The cost of attaining education level h is $\frac{h^2}{2}$.[6] The individual cost in the case of a budget-neutral education subsidy or tax equal to a share, s, of $\frac{h^2}{2}$ is $\frac{(1-s)h^2}{2} - T$, where T is the budget-neutral lump-sum tax or subsidy, with $s > (<) 0 \Rightarrow T > (<) 0$. Thus, $c = (1 - p)(\alpha_0 h + \gamma H) + p\alpha_d h - \frac{(1-s)h^2}{2} - T$.

As mentioned earlier, under the points system, the immigration probability p increases with education h, i.e., $p = \pi h, \pi > 0$. Thus, $c = (1 - \pi h)(\alpha_0 h + \gamma H) + \pi\alpha_d h^2 - \frac{(1-s)h^2}{2} - T$, or:

$$c = \gamma H + (\alpha_0 - \pi\gamma H)h + \left[\pi(\alpha_d - \alpha_0) - \frac{1-s}{2}\right] h^2 - T, \qquad (1)$$

The government maximizes an objective function, G, that differs from (1) in the following ways. First, it internalizes the education externality γH. Second, residents’ weight in G is 1, while migrants’ weight is $\beta \leq 1$. Third, given its budget-neutrality, the education subsidy/tax and the lump-sum tax/subsidy do not enter G. Thus, $G = (1 - \pi h)(\alpha_0 h + \gamma h) + \pi(\beta\alpha_d)h^2 - \frac{h^2}{2}$, or:

[5] For simplicity, I assume migration is not sufficiently large to generate externalities in the host country.
[6] Income is linear in h_i, while the education cost is quadratic in h_i. Thus, investment in education exhibits diminishing returns, which is consistent with empirical findings.

$$G = (\alpha_0 + \gamma)h + \left[\pi(\beta\alpha_d - \alpha_0 - \gamma) - \frac{1}{2}\right]h^2 > 0. \quad (2)$$

Equations (1) and (2) constitute the basis for the analysis that follows. Section 3 examines no-intervention cases and cases of government intervention are examined in Section 4.

3. No Government Intervention

Sub-section 3.1 assumes education does not generate an externality and Sub-section 3.2 assumes it does.

3.1. No Externality

In the absence of intervention and externality (i.e., $s = T = \gamma = 0$), we have from (1):

$$c = \alpha_0 h + \left[\pi(\alpha_d - \alpha_0) - \frac{1}{2}\right]h^2 > 0, \quad (3)$$

Define $\phi \equiv 1 - 2\pi(\alpha_d - \alpha_0) < 1$ and $\lambda \equiv \frac{\pi(\alpha_d - \alpha_0)}{\phi}$. Note that $\frac{1}{\phi} = \frac{\phi + 2\pi(\alpha_d - \alpha_0)}{\phi} = 1 + 2\lambda$. Maximizing (1), the solution for h (both for residents and migrants) is:

$$h^* = \frac{\alpha_0}{\phi}. \quad (4)$$

Denote residents' variables under an open economy by subscript "0", with $h_0 = h^*$. Their income is $y_0 = \alpha_0 h_0 = \frac{\alpha_0^2}{\phi}$. And thus, consumption is $c_0 = y_0 - \frac{(h^*)^2}{2} = \frac{\alpha_0{}^2}{\phi} - \frac{\alpha_0{}^2}{2\phi^2} = \frac{\alpha_0^2}{2}[2(1 + 2\lambda) - (1 + 2\lambda)^2] > 0$, i.e.:

$$c_0 = \frac{\alpha_0^2}{2}(1 - 4\lambda^2) > 0, \quad (5)$$

where the condition $c_0 > 0$ implies $\lambda < \frac{1}{2}$ (which in turn implies $\pi(\alpha_d - \alpha_0) < \frac{1}{4}$).

Denote variables in the closed economy (where $p = \pi = 0$) by subscript "c." Consumption $c_c = \alpha_0 h_c - \frac{h_c^2}{2}$. Thus:

$$h_c = \alpha_0, \; c_c = \frac{\alpha_0^2}{2}. \quad (6)$$

Comparison of closed and open economy

From (5) and (6), $c_0 = c_c(1-4\lambda^2) < c_c$ and $h_0 = \frac{\alpha_0}{\phi} > h_c = \alpha_0$. Thus, residents are both *overqualified* and *worse off* under an open economy compared to a closed one. The consumption gap, $c_c - c_0 = 2\alpha_0^2\lambda^2$, increases with the skill-selectivity parameter $\frac{\partial p}{\partial h} = \pi$, as $\frac{\partial \lambda}{\partial \pi} = \frac{\alpha_d - \alpha_0}{\phi^2} > 0$, and with host country income α_d (per unit of h), since $\frac{\partial \lambda}{\partial \alpha_d} = \frac{\pi}{\phi^2} > 0$.

The impact of α_0 on $c_c - c_0$ is $\frac{\partial(c_c - c_0)}{\partial \alpha_0} = \frac{4\pi\alpha_0\lambda}{\phi}[\alpha_d - 2\alpha_0(1+2\lambda)] \gtrless 0$, i.e., the impact is ambiguous. On the other hand, accounting for observable (education) and unobservable (ability) selection effects, it was found that $\alpha_d = 2\alpha_0$ on average for migration from 42 developing source countries to the US (Schiff 2017). Then, $\alpha_d - \alpha_0 = \alpha_0$, and $\frac{\partial(c_c - c_0)}{\partial \alpha_0} = \frac{-16\pi\alpha_0^2\lambda^2}{\phi} < 0$. Thus, an increase in source-country income reduces the loss for residents of an opening up of the economy.[7]

3.2. Positive Externality

Assume now a positive externality γH, with $y_0 = \alpha_0 h + \gamma H$. In this case, (1) becomes:

$$c = \gamma H + (\alpha_0 - \pi\gamma H)h + \left[\pi(\alpha_d - \alpha_0) - \frac{1}{2}\right]h^2. \tag{7}$$

Recalling that $H = h$, the solution for h is:

$$h_\gamma^* = \frac{\alpha_0}{\phi_\gamma} > 0,\ \phi_\gamma \equiv 1 - 2\pi\left(\alpha_d - \alpha_0 - \frac{\gamma}{2}\right). \tag{8}$$

For residents, $h_0^\gamma = h_\gamma^* = \frac{\alpha_0}{\phi_\gamma}$ and $c_0^\gamma = \frac{\alpha_0}{\phi_\gamma}(\alpha_0 + \gamma) - \frac{\alpha_0^2}{2\phi_\gamma^2}$, or

$$c_0^\gamma = \frac{\alpha_0^2}{2}\left(1 - 4\lambda_\gamma^2\right) + \alpha_0\gamma\left(1 + 2\lambda_\gamma\right). \tag{9}$$

In the closed economy case, $c = \gamma H + \alpha_0 h - \frac{h^2}{2}$. Thus, we have:

[7] As noted above, $\pi(\alpha_d - \alpha_0) = \pi\alpha_0 < 1/4$. Assuming for illustrative purposes that $\pi = .16$. and $\alpha_0 = 1$, we have $\lambda = .235$ and $4\lambda^2 = .221$. Thus, under these parameter values, residents' welfare is 22.1 percent lower under an open than under a closed economy.

$$h_c^\gamma = \alpha_0,\ c_c^\gamma = \alpha_0\left(\frac{\alpha_0}{2} + \gamma\right). \quad (10)$$

Comparison of closed and open economy

From (8) and (10), we have $h_0^\gamma = \frac{\alpha_0}{\phi_\gamma} > h_c^\gamma = \alpha_0$. And from (9) and (10), it follows that $c_c^\gamma - c_0^\gamma = 2\alpha_0^2\lambda_\gamma\left(\lambda_\gamma - \frac{\gamma}{\alpha_0}\right) \gtrless 0 \Leftrightarrow \lambda_\gamma \gtrless \frac{\gamma}{\alpha_0}$. In other words, the impact of the host country's opening up to educated migrants (brain drain) on source country residents' welfare is *ambiguous*.

The likelihood residents are worse off under an open than under a closed economy increases with:
i) the host country's income, due to α_d's positive impact on λ_γ;
ii) an increase from $\underline{v} = (\alpha_0, \alpha_d)$ to $\underline{v}' = x\underline{v}, x > 1$ – as it raises λ_γ and reduces γ/α_0;
iii) an increase from $\underline{z} = (\alpha_0, \alpha_d, \gamma)$ to $\underline{z}' = x\underline{z}, x > 1$ – as it raises λ_γ and does not affect γ/α_0;
iv) the degree of skill-selectivity of the host country's immigration policy, π, because it raises λ_γ; and
v) a decline in the externality γ, as it reduces $\frac{\gamma}{\alpha_0}$ and raises λ_γ. [8]

Note that $h_\gamma^* < h^*$. The reason is that in the case of an externality, migration generates a gain in income (per unit of h) equal to $\alpha_d - (\alpha_0 + \gamma)$, which is smaller than the gain $\alpha_d - \alpha_0$ in the absence of externality.

4. Government Intervention

This section examines three cases of government intervention. Sub-section 4.1 looks at the case of an education externality, with identical weights for residents and migrants in the government's objective function.[9] [10] The weight of residents is assumed to be greater than that of migrants in Sub-sections 4.2 and 4.3, without an externality in the former and with one in the latter.

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[8] Assuming again that $\alpha_d = 2$, $\alpha_0 = 1$, $\pi = .16$, and setting $\frac{\gamma}{\alpha_0} = \lambda_\gamma$, it follows that $\frac{\gamma}{\alpha_0} = .2$, i.e., $c_{i0} \gtrless c_{ic} \Leftrightarrow \frac{\gamma}{\alpha_0} \gtrless .2$. Thus, under these parameter values, residents are worse (better) off under an open than under a closed economy when education's externality impact is greater (smaller) than 20 percent of education's private impact.

[9] This corresponds to individual preferences, as individuals do not know at the time when they make their educational investment decision whether they will be residents or migrants.

[10] The case of intervention in the absence of externalities is not examined as the optimal education policy in the absence of an externality is $s = 0$, i.e., the optimum is no intervention.

4.1. Positive Externality

As in the previous section, human capital generates a positive externality and the government intervenes by maximizing its objective function G. This section assumes residents and migrants matter equally to the government. The function G is:

$$G = (1-\pi h)(\alpha_0+\gamma)h \; + \; \pi h(\alpha_{\mathrm{d}}h) - \frac{h^2}{2} = (\alpha_0+\gamma)h + \left[\pi(\alpha_d - \alpha_0 - \gamma) - \frac{1}{2}\right]h^2. \qquad (11)$$

The solution for h that maximizes G is:

$$h_{\gamma 1}^{*} = \frac{\alpha_0+\gamma}{\phi_{\gamma 1}},\ \phi_{\gamma 1} \equiv 1-2\pi(\alpha_d - \alpha_0 - \gamma) = \phi_\gamma + \pi\gamma > \phi_\gamma,\ \lambda_{\gamma 1} < \lambda_\gamma. \qquad (12)$$

Residents' education is $h_0^{\gamma 1} = h_{\gamma 1}^{*}$ and their consumption is:

$$c_0^{\gamma 1} = \frac{(\alpha_0+\gamma)^2}{\phi_{\gamma 1}} - \frac{1}{2}\left(\frac{\alpha_0+\gamma}{\phi_{\gamma 1}}\right)^2 = \frac{(\alpha_0+\gamma)^2}{2}\left(1-4\lambda_{\gamma 1}^2\right). \qquad (13)$$

In the closed economy, $c_c^{\gamma 1} = (\alpha_0+\gamma)h \; - \frac{h^2}{2}$. Thus:

$$h_c^{\gamma 1} = \alpha_0+\gamma,\ \ c_c^{\gamma 1} = \frac{(\alpha_0+\gamma)^2}{2}. \qquad (14)$$

Comparison of closed and open economy

From (13) and (14), we have $c_0^{\gamma 1} = c_c^{\gamma 1}\left(1-4\lambda_{\gamma 1}^2\right) < c_c^{\gamma 1}$, and from (12) and (14), we have $h_0^{\gamma 1} > h_c^{\gamma 1}$. Thus, residents are *overqualified* and *worse off* under an open relative to a closed economy.

Comparison with and without intervention under an open economy

Whether residents' consumption is greater in the presence or absence of government intervention is ambiguous, i.e., $c_0^{\gamma 1} \gtreqless c_0^{\gamma}$.[11] This is due to two opposite effects. On the one hand, by considering emigrants' well-being as important as that of residents, the government's optimal education choice (and the education subsidy designed to attain it) is greater than residents' optimal level. On the other hand, the government subsidy internalizes the education externality while individuals do not. The optimal (see below) results in $h_{\gamma 1}^{*} \; = \frac{\alpha_0+\gamma}{\phi_{\gamma 1}} > h_\gamma^{*} = \frac{\alpha_0}{\phi_\gamma}$.

[11] For illustration, take two cases: $\pi = .2$ and $\alpha_d = 2\alpha_0 = 4\gamma$ in both cases, with $\alpha_d = 2$ in Case 1 and $\alpha_d = 1$ in Case 2. The result for $c_0^{\gamma 1} - c_0^{\gamma}$ is negative ($-.078$) in Case 1 and positive ($.257$) in Case 2. [Case 1 (2) figures are: $c_0^{\gamma 1} = 1.045\ (.430)$ and $c_0^{\gamma} = 1.123\ (.173)$].

4.1.1. Education Policy

The optimal education policy is a subsidy s is:

$$s = \frac{\gamma[\phi_{\gamma 1} - \pi(\alpha_0 + \gamma)]}{\alpha_0 + \gamma} = \frac{\gamma \phi_{\gamma 1}(1 - \pi h^*_{\gamma 1})}{\alpha_0 + \gamma} = \frac{\gamma \phi_{\gamma 1}(1 - p)}{\alpha_0 + \gamma} > 0. \quad (15)$$

Proof: See Appendix 1.

From (15), the subsidy increases with externality γ and decreases with the skill-selectivity of the host country's immigration policy, π. In the closed economy, $\pi = 0$ and $s = \gamma/(\alpha_0 + \gamma)$, i.e., the subsidy is equal to the education externality's impact, relative to education's social impact, on residents' income.[12]

Comparison with and without intervention under a closed economy

In this case, $c = \alpha_0 h + \gamma H - \frac{h^2}{2}$, with – see equation (10) – $h_c^{\gamma} = \alpha_0$ and $c_c^{\gamma} = \alpha_0 \left(\frac{\alpha_0}{2} + \gamma\right)$. From (14), we have $c_c^{\gamma 1} - c_c^{\gamma} = \frac{\gamma^2}{2} > 0$. Thus, intervention under a closed economy unambiguously raises residents' welfare. The reason is that the entire source country population is comprised of residents in this case and, by internalizing the education externality, the government takes care of the only source of non-optimality for residents.

4.2. Smaller Migrant Weight, and No Externality

As discussed in the Introduction, a source-country government is likely to be more concerned with the well-being of its resident population than of its emigrants. Thus, assume migrants' weight in the government's objective function G is $\beta \epsilon (0,1)$, while residents' weight is equal to 1.

In this case, $G = (1 - \pi h)\alpha_0 h + \pi h(\beta \alpha_{\mathrm{d}} h) - \frac{h^2}{2}$, or

$$G = \alpha_0 h + \left[\pi(\beta \alpha_d - \alpha_0) - \frac{1}{2}\right] h^2. \quad (16)$$

Define $\phi_\beta \equiv 1 - 2\pi(\beta \alpha_d - \alpha_0) > \phi$, with $\lambda_\beta \equiv \frac{\pi(\beta \alpha_d - \alpha_0)}{\phi_\beta} < \lambda$, and $\frac{1}{\phi_\beta} = 1 + 2\lambda_\beta$.

[12] Assuming again $\alpha_d = 2$, $\alpha_0 = 1$, $\gamma = .5$ and $\pi = .2$, we have $s = .0833$, i.e., the optimal subsidy amounts to 8.33 percent of the education cost. In the closed economy ($\pi = 0$), $s = 1/3$.

Solutions for h_β^*, h_0^β and c_0^β are:

$$h_\beta^* = h_0^\beta = \frac{\alpha_0}{\phi_\beta} < h^* = \frac{\alpha_0}{\phi}, c_0^\beta = \frac{{\alpha_0}^2}{2}\left(1 - 4\lambda_\beta^2\right). \quad (17)$$

Under a closed economy, $\pi = 0$, so that:

$$h_c^\beta = \alpha_0, c_c^\beta = c_c = \frac{{\alpha_0}^2}{2}. \quad (18)$$

Comparison of open and closed economy

Thus, $c_0^\beta = c_c\left(1 - 4\lambda_\beta^2\right) < c_c$. In other words, the resident population is *worse off* under an open than under a closed economy. Moreover, ϕ_β need not be smaller than 1, with $\beta \gtreqless \frac{\alpha_0}{\alpha_d} \Leftrightarrow \phi_\beta \lesseqgtr 1 \Leftrightarrow h_c = \alpha_0 \lesseqgtr h_\beta^* = \frac{\alpha_0}{\phi_\beta}$. Thus, residents are *overqualified* (*underqualified*) for $\beta > (<) \frac{\alpha_0}{\alpha_d}$ under an open economy relative to a closed one.

Comparison with and without intervention

Since $\lambda_\beta < \lambda$, we have $c_0^\beta = \frac{{\alpha_0}^2}{2}\left(1 - 4\lambda_\beta^2\right) > c_0 = \frac{{\alpha_0}^2}{2}(1 - 4\lambda^2)$. Thus, residents are *better off* under intervention in the case where there is no externality and the government has a preference for residents compared to migrants. And since $h_\beta^* < h^*$, intervention reduces residents' over-qualification (with an education tax; see below).

4.2.1. Education Policy

The optimal value for the education policy s, which is denoted by s_β, is

$$s_\beta = -2\pi\alpha_d(1 - \beta) < 0. \quad (19)$$

Proof: See Appendix 2.

Equation (19) shows that the optimal education policy is a tax. The reason is that, though natives consider the benefit from migration (per unit of h) to be equal to $\alpha_d - \alpha_0$, the government considers the benefit to be $\beta\alpha_d - \alpha_0 < \alpha_d - \alpha_0$. The tax declines with migrants' relative importance, β, and rises with the host country's income, α_d, and with the skill-selectivity of its immigration policy,

π. When $\beta = 1$, i.e., when the government has no preference between residents and migrants, $s_\beta = 0$, i.e., the optimum is not to intervene.

4.3. Smaller Migrant Weight and Externality

With a positive externality and $\beta < 1$, $G = (1 - \pi h)(\alpha_0 + \gamma)h + \pi h(\beta\alpha_{\mathrm{d}}h) - \frac{h^2}{2}$, or

$$G = (\alpha_0 + \gamma)h + \left[\pi(\beta\alpha_d - \alpha_0 - \gamma) - \frac{1}{2}\right] h^2. \tag{20}$$

Define $\phi_{\beta'} \equiv 1 - 2\pi(\beta\alpha_d - \alpha_0 - \gamma)$, and $\lambda_{\beta'} \equiv \frac{\pi(\beta\alpha_d - \alpha_0 - \gamma)}{\phi_{\beta'}} < \lambda_{\gamma 1} = \frac{\pi(\alpha_d - \alpha_0 - \gamma)}{\phi_{\gamma 1}}$.

Maximizing G, the solution for $h^*_{\beta'}$ is:

$$h^*_{\beta'} = \frac{\alpha_0 + \gamma}{\phi_{\beta'}} < h^*_{\gamma 1} = \frac{\alpha_0 + \gamma}{\phi_{\gamma 1}}. \tag{21}$$

Residents' consumption is:

$$c_0^{\beta'} = \frac{(\alpha_0 + \gamma)^2}{2}\left(1 - 4\lambda^2_{\beta'}\right). \tag{22}$$

Under a closed economy, $\pi = 0$ and $\phi_{\beta'} = \phi_{\gamma 1} = 1$. Thus:

$$h_c^{\beta'} = h_c^{\gamma 1} = \alpha_0 + \gamma, \text{ and } c_c^{\beta'} = c_c^{\gamma 1} = \frac{(\alpha_0 + \gamma)^2}{2}. \tag{23}$$

Comparison of open and closed economy

From (22) and (23), we have $c_0^{\beta'} = c_c^{\beta'}\left(1 - 4\lambda^2_{\beta'}\right) < c_c^{\beta'}$. Thus, residents are *worse off* under an open than under a closed economy. Also, $h_0^{\beta'} = \frac{\alpha_0 + \gamma}{\phi_{\beta'}} \gtrless h_c^{\beta'} = \alpha_0 + \gamma \Leftrightarrow \phi_{\beta'} \lesseqgtr 1 \Leftrightarrow \beta \gtrless (\alpha_0 + \gamma)/\alpha_d$. Thus, whether education is higher under a closed or open economy is ambiguous in this case.

Comparison with and without intervention

As $\phi_{\beta'} = \phi_{\gamma 1} + 2\pi(1 - \beta)\alpha_d > \phi_{\gamma 1} > \phi_\gamma$, we have $h^*_{\beta'} = \frac{\alpha_0 + \gamma}{\phi_{\beta'}} \gtrless h^*_\gamma = \frac{\alpha_0}{\phi_\gamma}$. Also, comparing (22) and (9), and noting that $\lambda_{\beta'} < \lambda_{\gamma 1}$, we have $c_0^{\beta'} \gtrless c_0^\gamma$. Thus, under an externality and a government with a preference for residents over migrants, whether residents are better off with or without intervention is ambiguous.

<u>*Comparison of intervention when $\beta < 1$ and when $\beta = 1$*</u>

Since $\lambda_{\beta'} < \lambda_{\gamma 1}$, it follows that $c_0^{\beta'} > c_0^{\gamma 1}$. In other words, residents are *better off* when the government considers their well-being to be more important than that of migrants. And from (21), the education level is lower in this case.

4.3.1. <u>Education Policy</u>

The education subsidy or tax of a share $s_{\beta'} \gtrless 0$ of the education cost is given by:

$$s_{\beta'} = \frac{\gamma(\phi_\gamma - \alpha_0 \pi)}{\alpha_0 + \gamma} - \frac{2\pi\alpha_0\alpha_d(1-\beta)}{\alpha_0+\gamma} = s - \frac{2\pi\alpha_0\alpha_d(1-\beta)}{\alpha_0+\gamma} \gtrless 0. \quad (24)$$

<u>Proof</u>: See Appendix 3.

Recall that $s > 0$. Under $\beta < 1$, we have $s_{\beta'} < s$, i.e., the education policy consists of a smaller subsidy ($0 < s_{\beta'} < s$) or a tax ($s_{\beta'} < 0 < s$). In the case where $\beta = 1$, we have $s_{\beta'} = s > 0$, a subsidy.

Note that, just as in Section 4.1, intervention in the case of a closed economy raises residents' welfare.

5. Policy Implications

Developing countries typically subsidize higher education. One of the issues examined in this paper and which is of relevance for policy is the impact of education subsidies on the welfare of source countries' residents. The analysis indicates that the answer varies according to a) whether education externalities are present or not, b) whether the government considers residents' well-being more or equally important to that of emigrants, and c) the specific parameter values.

Specifically:

i) Opening up the economy to migration has a negative impact on residents' welfare in four of the five scenarios examined and an ambiguous impact in one of them, namely under an education externality and absence of intervention.

ii) In the presence of an externality and with residents and migrants equally important to the government, the optimal policy consists of a subsidy. Its impact on residents' well-being is ambiguous.

iii) In the absence of an externality and with residents considered more important than migrants by the government, the optimal intervention is an education tax, which improves residents' well-being;

iv) In the presence of an externality and with residents considered more important than migrants by the government, whether the optimal intervention is a subsidy or tax and whether it improves or worsens residents' well-being is ambiguous.[13]

v) In the presence of an externality, residents are better off when the government considers their well-being more important than that of emigrants.

vi) Under a closed economy and in the presence of an externality, the optimal intervention – which consists of a subsidy – raises residents' welfare.

Thus, in the one intervention case where the education policy unambiguously improves residents' well-being, intervention consists of a tax rather than the standard education subsidy. In another case, the intervention consists of a subsidy but its welfare impact is ambiguous, unless the economy is closed. In the third intervention case, whether the intervention consists of a subsidy or a tax is ambiguous and so is its welfare impact (except when the economy is closed, in which case the impact is positive). Finally, resident welfare is higher when the government considers residents more important than emigrants, rather than equally important.

As far as source countries' policy design is concerned, it is important to note that though the standard developing country policy of subsidizing higher education is optimal under an education externality when the economy is closed, this result need not hold in the presence of a brain drain.

6. Conclusions

Though a brain-drain-induced net brain gain has tended to be seen as a benefit and has been referred to in the literature as a "beneficial brain drain," source country's residents are worse off under a brain drain than under a closed economy in most of the scenarios considered. I also find

[13] With the parameter values used throughout the paper, intervention improves residents' welfare.

that government intervention in terms of an education subsidy or tax raises welfare of the source country's residents in one of the intervention cases examined and has an ambiguous impact in the other two (where residents are considered more important than migrants). Finally, the view that an education subsidy is optimal for a country's resident population under an education externality – and which holds in a closed economy – does not necessarily hold under a brain drain.

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Appendix 1

Given education’s positive externality, the government provides a subsidy equal to a share, s, of the education cost, where s maximizes the government objective function G. The subsidy is financed through a lump-sum tax T. Thus, individual consumption is $c = (1-\pi h)(\alpha_0 h + \gamma H) + \pi h(\alpha_{\mathrm{d}} h) - \frac{(1-s)h^2}{2} - T$, or:

$$c = \gamma H + (\alpha_0 - \pi\,\gamma H)h + \left[\pi(\alpha_{\mathrm{d}} - \alpha_0) - \frac{1-s}{2}\right]h^2 - T. \quad \text{(A1)}$$

Denote h in this case by h_s, with $h_s = \frac{\alpha_0}{\phi_S}$, $\phi_S \equiv 1 - s - 2\pi\left(\alpha_d - \alpha_0 - \frac{\gamma}{2}\right)$. Setting $h_s = h^*_{\gamma 1} = \frac{\alpha_0 + \gamma}{\phi_{\gamma 1}}$, we have $\frac{\alpha_0}{\phi_S} = \frac{\alpha_0+\gamma}{\phi_{\gamma 1}}$, or $s = \frac{\gamma[\phi_{\gamma 1} - \pi(\alpha_0+\gamma)]}{\alpha_0+\gamma}$. Note that $p = \pi h = \frac{\pi(\alpha_0+\gamma)}{\phi_{\gamma 1}}$, implying $\pi(\alpha_0 + \gamma) = p\phi_{\gamma 1}$, so that $s = \frac{\gamma\phi_{\gamma 1}(1-p)}{\alpha_0+\gamma}$. Thus, we have:

$$s = \frac{\gamma[\phi_{\gamma 1} - \pi(\alpha_0+\gamma)]}{\alpha_0+\gamma} = \frac{\gamma\phi_{\gamma 1}(1-p)}{\alpha_0+\gamma} > 0. \quad \text{(A2)}$$

Appendix 2

The government subsidizes or taxes a share $s_\beta \gtreqless 0$ of the education cost. Individuals maximize

$$c_\beta = \alpha_0 h + \left[\pi(\alpha_{\mathrm{d}} - \alpha_0) - \frac{1-s_\beta}{2}\right]h^2 - T_\beta. \quad \text{(A3)}$$

Thus, $h_{s_\beta} = \frac{\alpha_0}{\phi_{S_\beta}}$, $\phi_{S_\beta} \equiv 1 - s_\beta - 2\pi(\alpha_d - \alpha_0)$. Setting $h_{s_\beta} = h^*_\beta$, or $\frac{\alpha_0}{\phi_{S_\beta}} = \frac{\alpha_0}{\phi_\beta}$, implies $\phi_{S_\beta} = \phi_\beta$. Consequently, the solution for s_β is:

$$s_\beta = -2\pi\alpha_d(1-\beta) < 0. \quad \text{(A4)}$$

Thus, the optimal education policy is an education tax.

Appendix 3

Individuals maximize

$$c_{\beta'} = \gamma H + (\alpha_0 - \pi\,\gamma H)h + \left[\pi(\alpha_\mathrm{d} - \alpha_0) - \frac{1-s_{\beta'}}{2}\right] h^2 - T_{\beta'}. \tag{A5}$$

Thus, $h_{s_{\beta'}} = \frac{\alpha_0}{\phi s_{\beta'}}$, where $\phi_{S_{\beta'}} \equiv 1 - s_{\beta'} - 2\pi\left(\alpha_d - \alpha_0 - \frac{\gamma}{2}\right)$. Set $h^*_{\beta'} = h_{s_{\beta'}}$, or $\frac{\alpha_0 + \gamma}{\phi_{\beta'}} = \frac{\alpha_0}{\phi s_{\beta'}}$, where $\phi_{\beta'} \equiv 1 - 2\pi(\beta\alpha_d - \alpha_0 - \gamma)$. Hence, the solution for $s_{\beta'}$ is:

$$s_{\beta'} = \frac{\gamma(\phi_\gamma - \alpha_0\pi)}{\alpha_0 + \gamma} - \frac{2\pi\alpha_0\alpha_d(1-\beta)}{\alpha_0 + \gamma} = s - \frac{2\pi\alpha_0\alpha_d(1-\beta)}{\alpha_0 + \gamma} \gtrless 0. \tag{A6}$$