Migration and back door brain-drain: Do the unequals lose?

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Abstract

This paper attempts to find the impact of skilled-unskilled migration on the skill accumulation of source country in a model of occupational choice. It emphasizes that role of inequality is crucial, and shows that given the allowable limits on skilled and unskilled migration (quota), possibility of migration makes highly unequal countries worse-off. To reduce possibilities of back door brain drain from the unequal world the paper suggests a discriminatory quota policy by the destination countries, which is to set a relatively higher unskilled quota and/or a (relatively) lower skilled quota for the unequals.

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Keywords: skilled-unskilled migration; skill formation; inequality; migration quota.

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1 Introduction

Migration of skilled labor and brain-drain has long been a debated issue in the development economics literature. The brain gain argument asserts that skilled migration does not necessarily imply a net loss or a permanent decay of skills from the sending country. The key idea as Stark et.al. (1997) states is: "an economy open to migration differs not only in the opportunities that workers face but also in the structure of the incentives they confront", which expedites skill accumulation in the source country through various indirect channels (Stark et.al.(1997,1998), Mountford (1997), Vidal (1998), Stark and Wang (2002), Beine et.al.(2001))[2]. One such channel is the strengthening of incentives to accumulate skill via higher skilled wages or returns to skill, following a (temporary) shortage of skills caused by skilled migration. But had there been a simultaneous outflow of unskilled workers it could have increased the unskilled wages or the opportunity cost as well, offsetting some of the incentives created by skilled migration. This argument caught limited attention in the brain-drain literature until recently when Stark and Byra (2012) proposed a negative link between unskilled migration and incentive to skill formation, which they name a 'back-door brain-drain'. Essentially, they look only into the 'cross-effect' of the movement of type Y (unskilled) on the equilibrium distribution of type X (skilled) in the source country and find that such possibility affects the source country's skill accumulation process detrimentally even if there is no skilled outflow or brain-drain from the country *per se*.

Data shows that besides unskilled emigration developing countries do actu-

[2] The direct channel refers to the return of skilled migrants often with entrepreneurial expertise on advanced technological know-hows.

ally have quite a significant proportion of their skilled migrating to selected developed regions. To cite a few: India-4.2, China-3.3; and from Latin American countries: Brazil-1.5, Chile-5, Cuba-27.6, Peru-4.9, Equador-8.1, Mexico-15.2.[3] The present paper, unlike Stark and Byra (2012), attempts to find the combined impact of the negative cross effect caused by unskilled labor movement and the positive direct effect of skilled labor movement on source country's equilibrium skilled stock to find: is it still possible to have a *potential* brain-gain; if not in general, who gains and who loses?

The present paper brings in role of inequality as an important determinant of possible gains or losses in skilled stock as a result of migration. Agents in the model decide over indivisible educational investments out of their wealth (inheritance) and make occupational choices accordingly. Borrowing is costly under capital market imperfection, which makes role of wealth inequality crucial in determining the occupational (skilled-unskilled) distribution. Possibility of migration with allowable limits on migrant stocks or quotas for skilled (q) and unskilled (t) changes the occupational composition. In order to find whether any country with a given level of inequality gets worse-off under the existing quota ($\bar{t}$, $\bar{q}$) regime the model obtains the 'no worse-off' condition for the country in terms of its (potential) skilled stock as a combination of (t,q). It shows that countries with relatively higher inequality implying a higher proportion of unskilled, do actually get worse-off on opening migration. This is also in contrast to the finding of Stark et.al.(1997) who conclude that a brain gain is more likely to occur the larger the share of low-skill workers in the occupation, which is however based only on skilled migration.

[3]Source: Cecily Defoort (2006): http://perso.uclouvain.be/frederic.docquier/oxlight.htm

This study is suggestive of implementing a discriminatory quota practice as compared to the existing level ($\bar{t}$, $\bar{q}$) towards a higher m and/or a lower q for the highly unequal countries. In Section-2 the model is presented, Section 3 explains determination of skilled stock given any inequality level, which is then compared with that under migration to find whether it is worse-off. In Section 4 we provide the concluding remarks.

2 The Model

Consider a small open economy with international capital mobility. There is only one good, the *numeraire*, manufactured by a combination of skilled labor H and unskilled labor L.

Full employment prevails in both the labor markets. Domestic credit market is imperfect.[4] There are N altruistic people. Each agent's choice with respect to occupational investment and employment is as follows:

In the first period of his life, each individual receives inheritance and decides over occupational choice. If he decides not to take education he invests the wealth in capital market. Otherwise, he may choose to invest in education and become a skilled labor. To make any of the above investment decisions, he may borrow from capital market if he does not have adequate wealth. In the second period each individual earns according to the investment made in the first period, consume, and leave a bequest.

[4] That drives a wedge between borrowing and lending interest rates as in Galor and Zeira (1993).

2.1 Production Technology

We assume that a large number of identical firms produce by means of a constant-returns-to-scale Cobb-Douglas technology:

$$Y = H^{\alpha} L^{1-\alpha} \qquad\qquad 0 < \alpha < 1$$

Suppose, v is the skilled wage and w unskilled wage. Each firm chooses employment of skilled and unskilled workers to maximize profit subject to $H + L = N$. This gives:

$$v = \alpha \left(\frac{L}{H}\right)^{1-\alpha} \qquad (1)$$

$$w = (1-\alpha) \left(\frac{H}{L}\right)^{\alpha} \qquad (2)$$

2.2 Preferences and Occupational Choice

The problem facing each agent is to maximize

$$U = c^{\delta} b^{1-\delta} \quad ; 0 < \delta < 1$$

$$\text{subject to } b + c \leq Z$$

where c is consumption, b bequest, Z is the net-wealth:

$$Z = \begin{cases} x(1+r) + w; & \text{if doesn't invest in education} \quad (i) \\ (x-h)(1+i) + v; & \text{if borrows and invests} \quad (ii) \\ (x-h)(1+r) + v; & \text{if invests and lends} \quad (iii) \end{cases}$$

Here x is the inheritance and h is the indivisible education cost. By capital market imperfection $i > r$, where i is the borrowing rate and the lender enjoys r.[5]

As the indirect utility function is increasing in Z, in period 1 the objective is to maximize Z or net-wealth. A person decides to invest in education if his net-wealth by investing in education does not fall short of that he would receive if he remains unskilled. Let s denote the threshold inheritance above which a person decides to invest in education. By comparing (i) and (ii) we get s for $x < h$ as

$$s = \frac{w + h(1+i) - v}{i - r} \tag{3}$$

The skilled-unskilled wage differential must be high enough, so that those who can self-finance education do prefer this choice to remaining unskilled. This amounts to comparing (i) and (iii), which yields

$$v \geq [w + h(1+r)] \quad \text{for} \quad x \geq h \tag{4}$$

3 Equilibrium skilled stock

We assume Pareto distribution of wealth, a standard form of distribution [See Chakravarty and Ghosh (2010)]:

$$f(x) = \frac{\lambda m^{\lambda}}{x^{\lambda+1}}; x \geq m > 1$$

where λ is the Pareto inequality parameter.

[5] This may be due to the tracking cost of the lender.

The higher the value of λ the higher is the level of inequality. The cumulative density function has the expression:

$$F(x) = \int_m^x \frac{\lambda m^\lambda}{X^{\lambda+1}} dX = 1 - \left(\frac{m}{x}\right)^\lambda \tag{5}$$

The number of skilled has the expression $1 - F(s)$ and the number of unskilled laborers working in the economy is $F(s)$. Equilibrium skilled-unskilled ratio H_r gets determined by the self-fulfilling-expectation of agents:

$$H_r = \frac{1}{\left(\frac{s(H_r)}{m}\right)^\lambda - 1} \tag{6}$$

where the right-hand-side is a simplified expression for the ratio of $1 - F(s)$ to $F(s)$, which is decreasing in H_r (by (1) and (3)). The left-hand-side is (obviously) increasing in H_r, hence we get a unique equilibrium for H_r. From this we get eqm.v and w by (1) and (2) respectively.

Note that eqm.H_r is lower for higher λ, since for every level of H_r the right-hand-side of (6) decreases in λ by the fact $s \geq m$. Equilibrium skilled stock is given by:

$$H = \left(\frac{m}{s}\right)^\lambda \tag{7}$$

Claim 1: Eqm. H is lower for higher λ.

Proof done in Appendix 1.

Suppose now unskilled migration is opened up and the foreign country imposes a quota of T migrants. Eqm.H_r now becomes:

$$H_r^u = \frac{1}{\left(\frac{s(H_r^u)}{m}\right)^{\lambda}(1-t)-1} \tag{8}$$

where $t = \frac{T}{N}$. Clearly eqm.H_r under (8) is higher than that obtained by eqn.(6), implying higher skilled stock under unskilled migration for any given level of inequality λ.[6]

Now suppose we open up skilled migration as well with a quota of Q. This changes the right-hand-side of eqn.(6) as:

$$H_r = \frac{1 - q\left(\frac{s(H_r)}{m}\right)^{\lambda}}{\left(\frac{s(H_r)}{m}\right)^{\lambda}(1-t)-1} \tag{9}$$

where $q = \frac{Q}{N}$.

By similar argument as in no-migration it is possible to show that for any given (t, q) combination eqm.H_r is lower for higher λ. It is however, non-trivial now to find whether eqm.H_r, and hence eqm.H, is lower or higher as compared to that under no migration.

To find whether a country is better-off or worse-off under migration we derive the 'no-worse-off curve' (henceforth NWO) for the country, which is a combination of t and q that just makes the country indifferent in terms of its skilled stock H between migration and no migration. This is obtained by comparing eqm.H_r under the two scenarios, as H has a one-to-one direct

[6]This is in contrast to Stark and Byra (2012) who show that the skilled stock decreases on account of an increase in the opportunity cost of educational investment. Here too we find an increase in w but due to an increase in eqm.H_r^u (hence H^u) as determined by the self-fulfiling expectations of agents who now take into account both the rise in opportunity cost (w) as well as the relative fall in the number of unskilled after migration.

relation with H_r. The 'no worse-off condition' (NWC) thus obtained is:

$$\frac{1 - q\left(\frac{s}{m}\right)^{\lambda}}{\left(\frac{s}{m}\right)^{\lambda}(1-t) - 1} = \frac{1}{\left(\frac{s}{m}\right)^{\lambda} - 1}$$

Rearranging terms we get

$$t = \left(\left(\frac{s}{m}\right)^{\lambda} - 1\right) q \tag{10}$$

Eqn.(10) implies that the NWO curve is an upward sloping straight line passing through the origin and rotates rightward for higher inequality level λ [Figure 1].

This is because by eqn.(10), for each level of q, higher t is required for a higher λ to meet the NWC followed by the fact that $H = \left(\frac{m}{s}\right)^{\lambda}$ is lower for higher λ. The intuition is for higher inequality the proportion of credit constrained people for educational investment is higher implying lesser skilled in equilibrium, any marginal rise in skilled migration quota q that tilts the occupational distribution in favor of unskilled has a relatively greater impact on H_r, and hence on the skilled stock H. This is to be neutralized by a larger t in order to make it at least as good as it is under no-migration.

Proposition 1 *Given any quota* $(\bar{t}, \bar{q})$ *there exists* $\bar{\lambda} = \frac{ln\left(\frac{\bar{t}}{\bar{q}}+1\right)}{ln\left[\frac{\left(\frac{\bar{q}}{t}\right)^{\alpha}[(1-\alpha)-\alpha(\frac{\bar{t}}{\bar{q}})]+h(1+i)}{(i-r)m}\right]}$ *such that countries with higher (lower) inequality* $\lambda > (<)\bar{\lambda}$ *are worse-off (better-off) under migration.*

Before proceeding for the proof let us first find the direction of improvement in terms of higher H or higher H_r, shown in Figure 1. Suppose z depicts $(\bar{t}, \bar{q})$

and define $\bar{\lambda}$ such that the country is just indifferent (no worse-off) at z or z lies on its NWO curve.

Putting $t = \bar{t}$ and $q = \bar{q}$ in eqn.(10) we get H_r using (6) and then we get v, w and hence s; we now obtain $\bar{\lambda}$ as:

$$\bar{\lambda} = \frac{ln\left(\frac{\bar{t}}{\bar{q}} + 1\right)}{ln\left[\frac{\left(\frac{\bar{q}}{\bar{t}}\right)^{\alpha}[(1-\alpha)-\alpha(\frac{\bar{t}}{\bar{q}})]+h(1+i)}{(i-r)m}\right]} \tag{11}$$

From eqn.(6) we find that higher (lower) q and lower (higher) t imply lower (higher) H_r, hence lower (higher) H. Now suppose there are three countries with inequality λ_1, λ_2 and $\bar{\lambda}$ with $\lambda_2 < \bar{\lambda} < \lambda_1$. Compare any point $z_1(t_1 > \bar{t}, \bar{q})$ on the NWO curve of λ_1 with the existing quota level $z(\bar{t}, \bar{q})$. This shows that given $\bar{q}$, the existing level of t, $\bar{t}$, falls short of the t required to be on the NWO curve of this highly unequal country making it worse-off. We could prove the same by fixing t at $\bar{t}$ as well, and then comparing point $a_1(\bar{t}, q < \bar{q})$ with z. Here also higher existing q at $\bar{q}$ as compared to q_1, given $\bar{t}$, implies that the unequal country is worse-off.

Similarly, it can be proved for the less unequal country with inequality λ_2 that it is better-off at z under quota $(\bar{t}, \bar{q})$ by fixing $q = \bar{q}$ and comparing point z_2 with z or comparing a_2 by fixing t and then finding the direction of improvement. This shows that relatively equal countries are better-off.

Proposition 1 is suggestive of a 'discriminatory quota practice' by the destination country that can make the sender country at least no-worse-off in terms of potential skill loss or a back-door brain-drain.

Proposition 2 *Highly unequal countries with inequality* $\lambda > \bar{\lambda}(\bar{t}, \bar{q})$ *should opt* *for relatively higher t and/or a lower q.*

4 Conclusion

This paper attempts to check possibilities of back-door brain drain from the source country when migration of both types: skilled and unskilled are open. This follows from Stark and Byra's (2012) proposition that opening up of unskilled migration leads to reduced incentive to skill formation in the source country via increasing opportunity cost even if there is no skilled outflow *per se*. But by similar argument opening up of skilled migration strengthens incentives to accumulate skill. The resultant effect of a two-type migration, which is an empirically proven phenomenon, is not very trivial. In a model of occupational choice where wealth plays crucial role in determining micro level educational investment decisions under capital market imperfection, and hence determining occupational distribution of the economy, it shows that more unequal countries are worse-off in terms of loss in skill. In other words, it shows posibilities of backdoor brain-drain from the unequal world with the opening up of skilled-unskilled migration.

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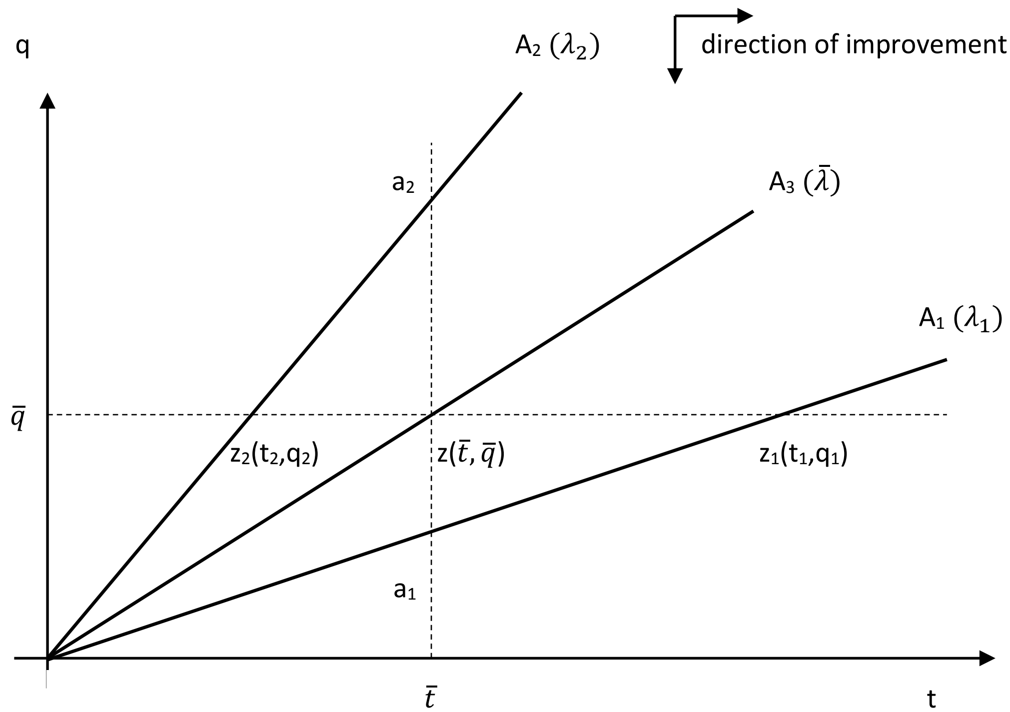
Appendix

Appendix 1:

Let us take two inequality levels λ_1 and λ_2 with $\lambda_2 > \lambda_1$ and check for eqm.H.

As we know H_r is lower for λ_2 we get:

$$\begin{aligned}
\frac{\left(\frac{m}{s}\right)^{\lambda_1}}{1-\left(\frac{m}{s}\right)^{\lambda_1}} &< \frac{\left(\frac{m}{s}\right)^{\lambda_2}}{1-\left(\frac{m}{s}\right)^{\lambda_2}} \\
or, 1+\frac{\left(\frac{m}{s}\right)^{\lambda_1}}{1-\left(\frac{m}{s}\right)^{\lambda_1}} &< 1+\frac{\left(\frac{m}{s}\right)^{\lambda_2}}{1-\left(\frac{m}{s}\right)^{\lambda_2}} \\
or, \frac{1}{1-\left(\frac{m}{s}\right)^{\lambda_1}} &< \frac{1}{1-\left(\frac{m}{s}\right)^{\lambda_2}} \\
or, 1-\left(\frac{m}{s}\right)^{\lambda_1} &> 1-\left(\frac{m}{s}\right)^{\lambda_2} \\
or, \left(\frac{m}{s}\right)^{\lambda_1} &< \left(\frac{m}{s}\right)^{\lambda_2} \\
or, H_{\lambda_1} &< H_{\lambda_2}
\end{aligned}$$


q
direction of improvement
A_2 (λ_2)
A_3 ($\bar{\lambda}$)
A_1 (λ_1)
a_2
a_1
$\bar{q}$
$z_2(t_2,q_2)$
$z(\bar{t},\bar{q})$
$z_1(t_1,q_1)$
$\bar{t}$
t