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Abstract

We study human capital depletion and formation in an economy open to out-migration, as opposed to an economy which is closed. Under the natural assumption of asymmetric information, the enlarged opportunities and the associated different structure of incentives can give rise to a brain gain in conjunction with a brain drain. Migration by high-skill members of its workforce notwithstanding, the home country can end up with a higher average level of human capital per worker.

Keywords

Migration, brain drain, skill formation, asymmetric information

JEL-Classifications

F22, J24, J61

Comments

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1. Introduction

For at least three decades (Grubel and Scott, 1966), the literature on labor migration between developing and developed countries has reflected the view that this migration is associated with a brain drain: the countries of origin lose high-skill workers. The loss is considered to be real since absent migration the home country would have had a more skillful workforce, and per capita output (and national welfare) would have been higher; greater openness seems to have an unfavorable repercussion. The literature on the brain drain has consequently concentrated on the question of how to mitigate this adverse consequence (Bhagwati and Wilson, 1989). The prevalence of the consequence has been firmly taken for granted.

In this paper we question the inevitability of this received wisdom. The key idea is that compared to a closed economy, an economy open to migration differs not only in the opportunities that workers face but also in the structure of the incentives they confront; higher prospective returns to skills in a foreign country impinge on skill acquisition decisions at home. We develop the change in opportunities and incentives to factor in the changing informational environment. Employers in the foreign country are neither perfectly informed nor equally uninformed over time about the skill levels of individual migrant workers. Employers who do not share the same culture, background, and language as home country employers and migrants lack the framework to assess the productive qualities and skills of migrant workers. When we co-model these three considerations (opportunities, incentives, and information) we find that the brain drain may in effect be a blessing in disguise: migration could well result in a brain gain for the home country. The argument is as follows: faced with an opportunity to migrate and receive higher expected returns to investment in human capital, optimizing workers in the home country, H , acquire human capital and migrate. Employers in the destination country, F , initially pay all migrant workers the same wage based on the average product of the group of migrants. Subsequently, after deciphering individual skills, employers tailor their wage payments to *individual* productivities. The relatively low-skill workers enjoy a pre-discovery high wage in F , but a lower wage following discovery. Such a

wage adjustment can prompt return migration by these workers.¹ We calculate the average level of human capital in H when it is a closed economy, and then following migration *and* return migration. We specify conditions under which the post-migration cum post-return average level of human capital in H is higher than the corresponding level if migration had not been permitted, in which case we say that a brain gain obtains. Inter alia, our results suggest that a brain gain is more likely to occur the larger is the share of low-skill workers in the occupation, the steeper is the wage schedule with respect to skill in F , and the flatter is the wage schedule with respect to skill in H .

2. The model

Since our objective is to illustrate a possibility rather than to claim a universal domain, we develop a very simple model.

Consider *a given occupation* in an isolated economy which consists of equally skilled high-skill workers, and equally skilled low-skill workers. Let α denote the fraction of the high-skill workers in the occupation and let $1 - \alpha$ be the fraction of the low-skill workers *in the occupation*. Furthermore, assume that θ_s^0 and θ_u^0 are the levels of human capital optimally acquired by high-skill workers and low-skill workers under autarky. Workers differ in their innate learning abilities and not all workers are equally efficient in acquiring human capital.

Alternatively, assume that a migration opportunity is present. The decision to migrate or to stay put depends on the wage differential between the foreign country and the home country.

The wages for a worker with skill level θ are $w_H(\theta)$ and $w_F(\theta)$ in the home country and in the foreign country, respectively. To reflect the fact that F is rich and H is poor, it is assumed that $w_F(\theta) > w_H(\theta)$ for every θ . If $w_F(\theta)$ and $w_H(\theta)$ are linear in θ , we have

¹ For evidence on the extent and composition of return migration see Stark (1995).

$$w_H(\theta) = h_0 + h_1\theta \quad h_0, h_1 > 0 \quad (1)$$

$$w_F(\theta) = f_0 + f_1\theta \quad f_0, f_1 > 0 \quad (2)$$

and $(f_0 - h_0) + (f_1 - h_1)\theta > 0$ for all θ .

Given that H workers are likely to have a preference for H life-style because of cultural factors, family relationships, and so on, we assume that H workers apply a discount factor $0 < k < 1$ to F wages when comparing them with H wages. Thus whether or not to migrate is decided by comparing $kw_F(\theta)$ with $w_H(\theta)$.

Assume that the skill of each H country worker is known to employers in H , where he or she has been observed for some time, but is unknown in F . While each worker knows his or her θ , employers in F cannot observe this θ instantaneously upon migrants' arrival. The skills of the migrant workers cannot be easily discerned, and screening them is imprecise and expensive. (We exclude the possibility that migrants invest in devices that might accurately identify their skill level to F country employers.)

Faced with a group of workers whose individual productivity is unknown, the employer will offer the same wage to all such workers based on the average product of all members of the group. To simplify, we assume that the wage offered is equal to the average product of the group of migrant workers.

The average F country wage of a group of H country workers with skill levels θ_s and θ_u , with α the fraction of high-skill workers and $1 - \alpha$ the fraction of low-skill workers, is thus:

$$\bar{w}_F(\theta_s, \theta_u) = \alpha w_F(\theta_s) + (1 - \alpha) w_F(\theta_u). \quad (3)$$

After spending some time in F , the true skill levels of migrants may be discovered through observation by F country employers. Early spells of employment thus act as a screening device. When individual skills are identified, workers receive a wage based on their individual productivity. To account for the employers' ability to decipher the true skill levels of migrants, we introduce $0 \leq m \leq 1$, the probability of reinstatement of

symmetric information. When $m = 1$, information is fully symmetric, while when $m = 0$, complete asymmetry prevails. Hence, the average F country wage for each skill group is:

$$\hat{w}_F(\theta_u) = (1 - m)\bar{w}_F(\theta_s, \theta_u) + mw_F(\theta_u), \quad (4)$$

$$\hat{w}_F(\theta_s) = (1 - m)\bar{w}_F(\theta_s, \theta_u) + mw_F(\theta_s). \quad (5)$$

In order to proceed we draw upon several simplifying assumptions: each cohort of workers lives for two periods and life expectancy is certain; wages in H and F are independent of migration, that is, migration is relatively small; human capital is acquired instantly in the home country; across space and time, human capital does not depreciate nor does it appreciate; individuals are utility maximizers and the utility they derive from a wage is equal to the wage; within a skill type, individuals behave identically.

The costs of acquiring human capital for high-skill workers and for low-skill workers are given by, respectively,

$$C_s(\theta) = \gamma\theta^2, \quad (6)$$

$$C_u(\theta) = \gamma\theta^2\eta, \quad (7)$$

with $\gamma > 0$, $C_i(0) = 0$, $(C_i(\theta))' > 0$, $(C_i(\theta))'' > 0$, $i = u, s$. The coefficient $\eta > 1$ reflects the fact that the costs of acquiring human capital are higher for the less able, low-skill workers than for the more able high-skill workers.

Absent a migration opportunity, the present value of earnings at home is $w_H(\theta_u^0) + \rho w_H(\theta_u^0)$ for low-skill workers, and is $w_H(\theta_s^0) + \rho w_H(\theta_s^0)$ for high-skill workers, with $0 < \rho \leq 1$ being the subjective time discount factor. Equating marginal earnings to marginal costs, the optimal levels of human capital under autarky for high-skill workers and low-skill workers are, respectively,

$$\theta_s^0 = \frac{h_1(1 + \rho)}{2\gamma}, \quad (8)$$

and

$$\theta_u^0 = \frac{h_1(1 + \rho)}{2\gamma\eta}. \quad (9)$$

In the presence of an opportunity to migrate, the levels of human capital chosen under autarkic conditions, θ_u^0 and θ_s^0 , may no longer be optimal. The optimal levels of human capital for low-skill workers and for high-skill workers with migration, θ_u^* and θ_s^* , respectively, are determined by equating the duly revised expected marginal earnings to marginal costs.

In the wake of equations (8) and (9), we assume in the presence of migration that the human capital of low-skill workers is lower than the human capital of high-skill workers, that is, $\theta_s^* > \theta_u^*$.

Workers consider the following problem: to invest in acquiring human capital and stay at home or to invest in acquiring human capital and migrate. If workers stay at home, they receive the same wage in the two periods of their life. If they migrate, they receive a wage equal to the average product of the group of migrant workers in the first period, and a probability mixture of this average wage and their individual F country wage in the second period, conditional on their decision not to return home in this second period. If, however, they do return, their second period wage is, as a matter of course, the home-country wage, which is a function solely of their individual skill level. In deciding whether to migrate, workers, who are endowed with the facility of rational expectations (what they anticipate is in fact realized), compare the expected earnings if they migrate - already taking the new optimal levels of human capital (θ_s^*, θ_u^*) into account - with their earnings at home.

Our interest is in finding out whether, when the dust settles - we employ a notion of steady state - the presence of the migration opportunity, which in turn entails a different investment in human capital, leaves the H country with a lower or a higher average level of human capital than it would have had in the absence of migration. We refer to a rise in the average level of human capital in H as a brain gain.

3. Results

To characterize a situation wherein high-skill workers stay in the foreign country (a brain drain occurs) while low-skill workers do not, we state and prove the following:

Claim: Given the general setup of the model, with the probability of reinstatement of symmetric information, m , maintaining $m = 0$ in the first period and $0 < m \leq 1$ in the second period, migration of the high-skill workers will be permanent and migration of the low-skill workers will be temporary if

$$\max\left(\frac{w_H(\theta_s^*)}{\hat{w}_F(\theta_s^*)}, \frac{w_H(\theta_s^0)}{\bar{w}_F(\theta_s^*, \theta_u^*)}\right) < k < \frac{w_H(\theta_u^*)}{\hat{w}_F(\theta_u^*)}, \quad (10)$$

where $\bar{w}_F(\theta_s^*, \theta_u^*) = \alpha w_F(\theta_s^*) + (1 - \alpha)w_F(\theta_u^*)$ is the average wage in the foreign country in the first period, given the skill levels θ_s^*, θ_u^* , and where $\hat{w}_F(\theta_s^*) = (1 - m)\bar{w}_F(\theta_s^*, \theta_u^*) + m w_F(\theta_s^*)$ and $\hat{w}_F(\theta_u^*) = (1 - m)\bar{w}_F(\theta_s^*, \theta_u^*) + m w_F(\theta_u^*)$ are the average F wages of high-skill and low-skill workers in the second period, respectively.

Proof: We decompose the decision to migrate into two sequential decisions. High-skill workers migrate if their expected first period earnings abroad exceed their earnings at home:

$$w_H(\theta_s^0) < k \bar{w}_F(\theta_s^*, \theta_u^*). \quad (11)$$

However, if high-skill workers migrate in the first period, low-skill workers migrate as well (see Stark (1995) for a proof of this argument). High-skill workers remain abroad if their k discounted average wage in the foreign country during the second period is higher than their home country wage:

$$k[(1 - m)\bar{w}_F(\theta_s^*, \theta_u^*) + m w_F(\theta_s^*)] > w_H(\theta_s^*) \quad (12)$$

Together (11) and (12) yield the left hand side of equation (10).

In contrast, low-skill workers return-migrate if their k discounted average wage in the foreign country during the second period is lower than their home country wage:

$$k[(1 - m)\bar{w}_F(\theta_s^*, \theta_u^*) + m w_F(\theta_u^*)] < w_H(\theta_u^*). \quad (13)$$

This yields the right hand side of equation (10). \square

Note that from (10) it follows that the higher the probability of reinstatement of symmetry in the second period, the more likely it is that high-skill workers will prefer permanent migration to temporary migration. For low-skill workers the opposite holds.

Assuming that (10) holds, the present value of the expected earnings of high-skill workers and the present value of the earnings of low-skill workers are given, respectively, by the following two expressions:

$$E(\theta_s^*) = k \{ \bar{w}_F(\theta_s^*, \theta_u^*) + \rho [(1-m)\bar{w}_F(\theta_s^*, \theta_u^*) + m w_F(\theta_s^*)] \}, \quad (14)$$

$$E(\theta_u^*) = k \bar{w}_F(\theta_s^*, \theta_u^*) + \rho w_H(\theta_u^*). \quad (15)$$

As long as the expected marginal earnings or the marginal earnings exceed the marginal costs of acquiring the human capital that produces the earnings, optimizing individuals will acquire more human capital. With the given wage and cost functions, evaluated at the optimum, the expected marginal earnings of high-skill workers and the marginal earnings of low-skill workers are, respectively (recall equations (1) and (2)):

$$\frac{dE(\theta_s^*)}{d\theta_s^*} = k f_1 [\alpha(1+\rho) + \rho m(1-\alpha)], \quad (16)$$

and

$$\frac{dE(\theta_u^*)}{d\theta_u^*} = k f_1 (1-\alpha) + \rho h_1. \quad (17)$$

Since the marginal costs are

$$\frac{dC_s(\theta_s^*)}{d\theta_s^*} = 2\gamma\theta_s^*, \quad (18)$$

and

$$\frac{dC_u(\theta_u^*)}{d\theta_u^*} = 2\gamma\theta_u^*\eta, \quad (19)$$

the optimal levels of human capital of high-skill workers and of low-skill workers are given, respectively, by equating (16) with (18), and (17) with (19). This yields:

$$\theta_s^* = \frac{k f_1 [\alpha(1+\rho) + \rho m(1-\alpha)]}{2\gamma}, \quad (20)$$

and

$$\theta_u^* = \frac{kf_1(1-\alpha) + \rho h_1}{2\gamma\eta}. \quad (21)$$

To preserve the assumption that $\theta_s^* > \theta_u^*$, we restrict the parameter set to

$$kf_1 \left[\alpha(1+\rho) + \rho m(1-\alpha) - \frac{(1-\alpha)}{\eta} \right] - \frac{\rho h_1}{\eta} > 0. \quad (22)$$

Claim: If equations (10) and (22) hold, and if the optimal levels of human capital acquired by high-skill workers and low-skill workers are given, respectively, by equations (20) and (21), then migration will result in a brain gain if

$$kf_1 > h_1 \left\{ 1 + \frac{\alpha}{1-\alpha} [\eta + \rho(\eta-1)] \right\}. \quad (23)$$

Proof: Recall that we defined a brain gain as a positive difference between the post-migration and the pre-migration average levels of human capital in the H country. Since migration of low-skill workers is temporary and migration of high-skill workers is permanent, only the enhanced human capital of low-skill workers can lead to a brain gain, that is,

$$\theta_u^* > \alpha\theta_s^0 + (1-\alpha)\theta_u^0 \quad (24)$$

has to hold. Recalling (21), (8), and (9), the claim follows. \square

As inequality (23) indicates, with high-skill workers migrating permanently and low-skill workers migrating temporarily, a brain gain is more likely: the larger $(1-\alpha)$, the share of low-skill workers in the occupation; the lower the preference for H life style, that is, the larger² the value of k ; the more future earnings are discounted, that is, the lower the value of ρ ; the flatter the wage function in the home country (the lower h_1); the steeper the wage function in the destination country (the larger f_1); and the smaller

² While at first sight this relationship might appear counterintuitive, upon a second reflection it is what it should be. A small k , for example, would render migration a largely unappealing proposition, invite therefore little acquisition of additional human capital, and result in a smaller likelihood of a brain gain.

η , the factor by which costs of acquiring an additional unit of human capital are higher for low-skill workers than for high-skill workers.^{3,4}

4. Conclusion

The human capital formation response to migration impinges on the incidence and extent of the brain gain that arises from return migration by low-skill workers. We have demonstrated that a brain gain may occur without recourse to the argument that the gain arises from new skills that are acquired abroad and are brought home upon return. Since prospective migration favorably alters the incentives of a poor country's workforce to invest in human capital formation, policymakers may wish to reconsider before embarking on measures that hinder migration.

³ Since an increase in the likelihood of a brain gain, inferred by considering only inequality (23), might well reduce the likelihood of migration as specified by equation (10), it is necessary to verify that equations (10) and (23) hold simultaneously. Moreover, since we restrict our analysis to $\theta_s^* > \theta_u^*$, equation (22) has to hold as well. We have numerically verified that there exist values of k for which equations (10), (22), and (23) are fulfilled simultaneously. The simulations can be obtained from us upon request.

⁴ We model the behavior of several identical low-skill workers as if they were the same as the behavior of a single low-skill worker; the identical low-skill workers are modeled as if they were a "representative agent". We follow the same procedure for high-skill workers. As long as α and $1 - \alpha$ are not extremely small, the behavior of two workers, one low skill and one high skill or, for that matter, the behavior of two representative agents, gives rise to \bar{w}_F being a function of θ_u^* and θ_s^* . An alternative line of reasoning could also be pursued.

Consider the behavior of a single low-skill worker in a large group of workers. This worker may reason that his investment in human capital will have a negligible effect on the average level of human capital. Hence, from this worker's perspective, the average level of human capital is given. In such a case the worker's only concern is to form the optimal level of human capital that will determine his second period, work-at-home earnings. If all low-skill workers reason likewise then, compared to autarky, the marginal benefit conferred by a human capital investment will be lower and hence, low-skill workers will form *less* human capital. The result is a brain drain: the high-skill workers migrate permanently while the low-skill workers, who migrate and then return, possess less human capital than under autarky.

To the extent that an individual worker's investment in human capital is more likely to affect the average level of human capital when the group of workers is small, our key result is more likely to hold the smaller the group of migrant workers.

References

- Bhagwati, Jagdish N. and Wilson, John D., 1989. *Income Taxation and International Mobility*, Cambridge, MA and London: MIT Press.
- Grubel, Herbert B. and Scott, Anthony D., 1966. "The International Flow of Human Capital," *American Economic Review* 56, pp. 268-274.
- Stark, Oded, 1995. "Return and Dynamics: The Path of Labor Migration when Workers Differ in their Skills and Information is Asymmetric," *Scandinavian Journal of Economics* 97, pp. 55-71.

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