Macroeconomic instability, migration, and the option value of education*

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Abstract

We explore the relation between variability in the rate of return to human capital and investment in education in the context of migration. Specifically, we show that if migration is a possibility, such variability in the rate of return to human capital can induce residents of developing countries to make greater investments in education. Moreover, providing that education is relatively costly, variability in the return to human capital may increase the average level of education in a developing economy even after expected migration is netted out. Finally, our findings are shown to have explanatory power in relation to education and migratory patterns of minorities.

Keywords: Macroeconomic instability, Income volatility, Migration, Human capital, Ethnic discrimination, Ethnic conflicts, Minorities.

JEL Classification: F22, J15, J24, J71, O15.

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1. Introduction

In this paper we explore how incentives to acquire education are influenced by the variability in the rate of return to human capital in the context of migration.[1] Specifically, we show that if migration is a possibility, such variability in the rate of return to human capital can induce residents of developing countries to make greater investments in education. Moreover, providing that education is relatively costly, variability in the rate of return to human capital may increase the average level of education in a developing economy even once expected migration is netted out. In addition, our findings are shown to have explanatory power in relation to education and migratory patterns of minorities.

The starting point of our analysis is that developing countries tend to be more unstable than developed countries. As Lucas (1988: 4) points out, "the rich countries show little diversity [variability], ... [while] within the poorest countries ... there is enormous variability ... Within the advanced countries, growth rates tend to be very stable over long periods of time ... For poorer countries, however, there are many examples of sudden, large changes in growth rates, both up and down". Such observations have recently received substantial empirical support. For example, Acemoglu and Zilibotti (1997) found a clear decreasing relation between output volatility and initial output per capita, and argued that this could account at least partly for the lack of convergence observed at the international level. The causes of instability in LDCs may be economic in nature - the result, perhaps, of an economy that is non-diversified (Acemoglu and Zilibotti, 1997), or political, due, for example, to political unrest, civil war, social conflicts, or inadequate economic policies (Alesina *et al.*, 1996, Elbadawi and Schmidt, 1998). Income variability is also associated with lower growth rates, as documented by Barro and Lee (1993), Ramey and Ramey (1995), or Elbadawi and Schmidt (1998). For example, Ramey and Ramey (1995) found such negative relationships for both developed and developing countries. Among a series of candidate explanatory variables, they selected volatility in innovation and public spending as clearly associated with lower growth rates, but rejected the investment-based hypothesis, according to which instability would tend to be detrimental to growth because it discourages investments in physical capital. This surprising result, however, may be due to their use of gross investment rates. Indeed, using disaggregated data for a large set of developing countries, Aizenman and Marion (1999) reported a statistically significant negative correlation between various volatility measures and private investment, while public investment was shown to be positively correlated with some measures of volatility.[2]

The impact of instability on private investments in human capital would seem to be

[1] Throughout the text, education and human capital are used synonymously. Besides, since the only source of income in our model is human capital, income variability and rate of return variability are equivalent.

[2] Aizenman and Marion (1999) used as explanatory variables the volatilities in government spendings, money growth, and real exchange rate. All three variables were found to be negatively correlated to private investment, while the first two variables were positively correlated to public investment.

less clear-cut. The only empirical evidence we are aware of is brought up by Flug *et al.* (1998), who tested the impact of income and employment volatilities, financial market imperfections, and income inequality, on enrollment rates in secondary education. Using both cross section and panel data analysis for about one hundred countries over the period 1970-92, they found the following results. While the impact of the last two variables (financial underdevelopment and income inequality) is clearly negative for any specification, when spliting the sample between low-income and high-income countries, employment volatility appeared to have a significant negative effect in low-income countries but a positive and non-significant effect in high-income countries, and income volatility appeared to have a non-significant effect in both low and high-income countries.

From a theoretical viewpoint, these somewhat ambiguous effects of economic volatility on human capital accumulation are not so surprising. On the one hand, indeed, human capital is probably more risky than physical capital since it cannot be bought or sold and cannot be separated from its owner. The possibilities for diversification are therefore very limited in the case of human capital, making human capital decisions very sensitive to risk levels (Levhari and Weiss, 1974).[3] This is particularly compelling in developing countries, where pervasive capital markets imperfections, combined with lack of international financial integration, make it very difficult to hedge against human capital risks (Baxter and Jermann, 1997).[4] But on the other hand, it has long been recognized that instability can induce higher levels of investment in education in two ways. First, education may increase people ability to hedge against uncertainty and reduce such uncertainty by better analyzing information. Second, owners of human capital have access to extended occupational opportunities; as a result, education is imparted with an option value which increases, as is well known, with the variability of the underlying asset (Weisbrod, 1962, Comay *et al.*, 1973). Both effects would seem to be particularly significant within the context of migration. Schultz (1980, p. 646), suggests that when alternative migration opportunities arise, "additional human capital ..... is valuable to better job opportunities and to better locations in which to live". Moreover, as a result of the increasingly selective immigration policies that tend to favor educated individuals, education has become a passport to emigration. Combined with traditional self-selection effects, this explains the overall tendency of migration rates to be much higher for relatively highly educated individuals (Carrington and Detragiache, 1999).

Income variability has also been viewed as an important issue in the migration literature. It is well known that both mean income and income variance impinge on migration decisions. For example, when the market does not allow for a trade-off between a lower mean and reduced variance, risk averse individuals would choose to

[3] Levhari and Weiss (1974) also recognize that "From the social point of view, this needs not be the case since compared with physical capital, human capital is quite flexible in its uses under varying economic circumstances."

[4] In related work, Kalemli-Ozcan *et al.* (2001) found that increased financial integration induces increased specialization, thereby rendering macroeconomic fluctuations *less* symmetric across countries.

migrate even if the mean incomes at origin and destination are the same, provided that income variability at destination and migration costs are sufficiently low. This literature has focused mainly on models with risk-averse individuals (Katz and Stark, 1986), or migration as part of a familial strategy of risk diversification (Stark, 1991, Taylor and Wyatt, 1996, Chen and Chiang, 1998). In both cases, however, this literature has generally ignored any direct connections between education and migration decisions.

At the same time, several recent studies focused on the effects of migration *prospects* on human capital accumulation (Mountford, 1997, Stark *et al.,* 1998, Vidal, 1998, and Beine *et al.,* 2001), suggesting that migration prospects may foster human capital formation and growth in the source country of migrants.[5] To generate this result, these studies assume that there are inter-country wage *differentials.* The essence of the argument is that if the foreign return to education is high, some individuals would buy education in the hope of migrating and benefiting from this high return. However, uncertainty prevails since some individuals may finally choose not to migrate for personal (e.g., familial) reasons, or may not be accepted by immigration authorities in destination countries. In such a context, the overall effect of migration on human capital formation in the source country may well be positive. This occurs, for a given wage differential, when migration probabilities are not too high (so as to preserve the nation's stock of human capital) but high enough to allow for a substantial incentive effect.

In contrast to these two bodies of literature, we assume the mean return to human capital to be equal at the origin and destination, and focus on the effects of instability (or income variability) on education and migration decisions made by risk-neutral individuals. Within our model education is a means of enabling individuals to access migration opportunities. Conversely, such migration opportunities impart education with an option value.[6] For example, if education opens doors to other countries, education may provide individuals with a *put* option, whereby they can avoid low income realizations in their home country. Using this perspective, we suggest that new economic insight may be obtained by considering education and migration decisions against a background of income variability.

The remainder of this paper is organized as follows. Section 2 outlines our basic model, in which we consider one developing and one developed economy. As explained above, developing countries tend to exhibit higher levels of macroeconomic instability. Therefore, the developing country in our model is assumed to show a variable rate of return to human capital, while in the developed country it is assumed to be fixed. We focus on education and migration decisions made by risk-neutral individuals in their first and second periods of life, respectively. The individual invests in education without knowing its domestic rate of return. After the domestic rate of return is

[5] Most papers use an OLG framework in the spirit of Galor and Tsiddon (1997). Using a slightly different perspective, Stark *et al.* (1997) also elaborate on the possibility of a brain gain with a brain drain.

[6] It has also been argued that migration itself has an option value (Burda, 1995).

known, he or she decides, based on this realization, whether to migrate. We show that the *expected* level of education may rise or fall in response to a greater rate of return variability. We find that the net effect depends on the cost of education. If this is high, the main reason for acquiring education would be its option value. In this case, the expected post-migration level of education is increased. However, if education costs are low, the opposite holds. In Section 3, the model is extended to allow for intergroup differences in income variability, with special reference to ethnic and religious minorities. Indeed, such groups often represent a substantial proportion of the immigrants from developing countries, and, in spite of the fact that they may face discrimination in the access to public education, their members are frequently better educated than the members of the dominant group. This has previously been explained in the human capital literature by considering education (and, obviously, migration) as means of avoiding labor-market discrimination. We propose a complementary explanation, based on the higher (macro-generated) income volatility faced by minority groups as a result of discrimination policies and ethnic tensions, which tend to be exacerbated in bad economic times. We briefly review the evidence on this issue, justify why minority groups face higher income variability, and show how our framework generates the results that minority members may be better educated and apparently less patriotic than members of the majority group (i.e., migrate in higher proportion at given ability levels). Section 4 offers some concluding remarks.

2. The Model

Consider a small open developing economy A consisting of a continuum of individuals, each of whom lives two periods. Without loss of generality, the number of individuals in A is normalized to unity. At birth, each individual is assigned an ability endowment a, where a is an independent drawing of a random variable distributed on $[0, 1]$ with a density function $g(a)$. Individuals receive no financial endowments but can borrow during the first period and return the loan during the second period of their life. The rate of interest is zero and capital markets are perfect.[7] All individuals are risk-neutral, their time discount rate is zero, and their utility is proportional to their consumption. Information is complete.[8]

In his first period of life, each individual is offered one indivisible unit of education at a constant positive cost α, the maximal value of which is normalized to unity: $0 \leq \alpha \leq 1$. This investment in human capital is the only investment outlet available, so that the individual's first-period consumption is either 0 or $-\alpha$. The individual's human capital is then given by ae, where $e = 0$ if the individual does not acquire

[7] Of course, this assumption is not realistic. It is well known that capital markets in LDCs are imperfect, and that such imperfections impinge on education decisions. We neglect these aspects, that are central in the literature on inequality and growth (Galor and Zeira, 1993), and focus on other determinants of the education decision.

[8] On migration under asymmetric information, see Katz and Stark (1987 and 1989).

any education, and $e = 1$ if the individual acquires the unit of education offered. In keeping with the literature in this area we assume that human capital is measured in efficiency units and is perfectly transferable between locations. The individual's second-period income is given by wae, where w ($w > 0$) is the return to human capital in the location in which the individual resides in period two. An individual may either stay in the home country A or migrate to a large developed economy, B.[9] Since the second-period income of an uneducated individual is zero in either location, only educated individuals can migrate.

The return to human capital in B equals 1. However, as well recognized in the migration literature, individuals generally prefer living in their home country. Thus, each individual's valuation of a dollar of consumption in B is discounted to k, where k is an independent drawing of a random variable distributed on $[0, 1]$ with a density function $h(k)$, and a and k are independently distributed. Thus, each individual is characterized by and knows the values of two parameters - his ability level, a, and his valuation of consumption abroad, k.

As extensively discussed above, developing economies tend to be more unstable than developed economies. To reflect this, we assume w, the return to human capital in A, to be variable. Note that the no-education income is implicitly fixed at zero whatever the state of the economy. This should *not* be interpreted, however, as meaning that acquiring education makes one's life riskier.[10] Rather, it follows from the above discussions that if the set of possible occupations for the non-educated is characterized by relatively high risks, as seems to be the case, e.g., in agriculture, this would provide further incentives to acquire education. The same option-value argument that we put forward in the context of inter-country migration could well be applied to intersectoral mobility within one country. Making the no-education income invariable, therefore, simply allows us to focus on inter-country differences in the volatility of the return to human capital.

With these understandings, we assume the value of w, which is revealed after the individual makes the education decision but *before* the migration decision, to be $1 + \gamma\epsilon$, where γ is a positive constant, and ϵ is a random economy-wide variable with a density function $f(\epsilon)$ defined on $[-1, 1]$. Note that w is assumed to be unaffected by migration.[11] In order to enable us to focus on the effects of variability in the return to education in A, we assume that the *mean* return to education in A equals the return in B : $E(\epsilon) = 0 \Rightarrow E(w) = 1$. Also, the variance of ϵ, $E(\epsilon^2)$ is assumed to be a constant and equal to σ^2 so that the variance of the return to education in A is $\gamma^2\sigma^2$.

[9] We do not consider restrictions on labor mobility. Djajic (1989) analyzes the effects of quantitative and qualitative restrictions on the volume and skill composition of migration flows.

[10] On the contrary, poorer households in developing countries not only tend to have lower incomes, but also more variable income and/or consumption streams (Morduch, 1994).

[11] This may be justified, for example, by assuming A to be a small open economy (i.e., which takes the world interest rate as given), perfect competition, and constant returns to scale. As well known, under such assumptions, the capital/labor ratio is fixed, making the domestic return to labor (to human capital) unaffected by migration.

Hence, the variability of w is increasing in γ. Finally, to ensure that $1+\gamma\epsilon \geq 0$ for all ϵ, we assume $\gamma < 1$.

Under this set of assumptions, the following results emerge.

First, it is immediate that domestic income variability (a positive γ) is a necessary condition for migration to be observed. This may be stated formally as follows:

Proposition 1: Assume some individuals are educated. Then some individuals will migrate from A to B for certain outcomes of ϵ if and only if $\gamma > 0$.

Proof: An educated individual who remains in A has a second-period income equal to $(1+\gamma\epsilon)ae$, whereas if he migrates to B his second-period income is kae. Thus, migration will take place if and only if:

$$1+\gamma\epsilon < k \tag{2.1}$$

for some ϵ and k. Since $k \leq 1$, condition (2.1) implies that $\gamma\epsilon$ must be negative; since $\gamma \geq 0$, this can only occur if $\gamma > 0$ (and $\epsilon < 0$).■

It is straightforward to see from (2.1) that an educated individual would migrate if and only if:

$$\epsilon \leq \epsilon^*(k) \equiv \frac{k-1}{\gamma}.$$

Therefore, $\epsilon^*(k)$ is the minimal value of ϵ for which an educated individual with a given k will not migrate. Since, by assumption, $\epsilon \geq -1$, migration would occur only if $\epsilon^*(k) > -1$, i.e., if $\gamma + k > 1$. Also, since $k \leq 1$, $\epsilon^*(k) \leq 0$ for all k, implying that no one from A migrates if the realized value of ϵ is non-negative. It also follows from the above discussion that the probability, $\pi(k)$, that an educated individual would migrate is strictly positive if $k > 1-\gamma$. Also, since individuals never migrate if $\epsilon \geq 0$, it follows that $\pi(k)$ is less than one-half. Thus, if $\gamma > 0$, $\frac{1}{2} > \pi(k) > 0$ for all educated individuals for whom $\gamma + k > 1$.

Second, it is clear that the migration probability for an educated individual can never decrease (and generally increases) in response to higher domestic variability. This is due to the fact that in order to make migration worthwhile, the domestic return must be sufficiently below its mean (unity), so as to outweigh the fact that a dollar in B is only worth k to the migrant. For a small γ this is relatively unlikely. As γ increases, however, the weight attached to negative realization of ϵ is greater, thereby increasing the probability of migration. Moreover, if $k = 1$, *all* negative realizations of ϵ imply migration, the probability of migration is $\frac{1}{2}$, and is unaffected by γ. This is summarized in the following proposition:

Proposition 2: Assume some individuals are educated**.** Then, an increase in the variability of the domestic return to education raises the probability, $\pi(k)$, that an educated individual with $k < 1$ would migrate, and leaves $\pi(k)$ unchanged and equal to $\frac{1}{2}$ for individuals with $k = 1$.

Proof:

$$\pi(k) = \int_{-1}^{\epsilon^*(k)} f(\epsilon)d\epsilon$$

so that $\frac{\partial \pi(k)}{\partial \gamma} = f(\epsilon^*)\frac{\partial \epsilon^*(k)}{\partial \gamma}$. But,

$$\frac{\partial \epsilon^*(k)}{\partial \gamma} = \frac{1-k}{\gamma^2},$$

and this is positive for $k < 1$. If $k = 1$, $\epsilon^* = 0$, and, thus, $\frac{\partial \epsilon^*(k)}{\partial \gamma} = 0$. ■

As stated in Proposition 2, increased variability in the domestic return to education generally raises the probability that an educated individual would migrate.

Consider now the relation between the variability of the domestic return to human capital and the decision to invest in education. If the realization of ϵ is such that $\epsilon < \epsilon^*(k)$, educated individuals would migrate to B and their lifetime income would be $-\alpha + ka$. If, however, $\epsilon \geq \epsilon^*(k)$, they would remains in A and their lifetime income would be $-\alpha + (1+\gamma\epsilon)a$. Thus, the expected lifetime income of an educated individual is given by:

$$V(a,k) \equiv -\alpha + \int_{-1}^{\epsilon^*(k)} kaf(\epsilon)d\epsilon + \int_{\epsilon^*(k)}^{1} (1+\gamma\epsilon)af(\epsilon)d\epsilon \tag{2.2}$$

Using (2.2), a series of results may be derived regarding the pre-migration and (expected) post-migration proportions of the educated among the population. Hereafter, we investigate the impact of the education cost, α, and the volatility parameter, γ, on the number of individuals acquiring education (Propositions 3 to 6) and on the expected proportion of educated in the remaining population (Propositions 7 to 9).

Proposition 3: If $\alpha = 0$, all individuals (other than those with $a = 0$) would invest in education.

Proof: This follows immediately from (2.2), since

$$\int_{-1}^{\epsilon^*(k)} kaf(\epsilon)d\epsilon + \int_{\epsilon^*(k)}^{1} (1+\gamma\epsilon)af(\epsilon)d\epsilon \geq \int_{-1}^{1} (1+\gamma\epsilon)af(\epsilon)d\epsilon = a.$$

■

Clearly, if the cost of education is zero, anyone with a strictly positive ability, a, would benefit from investing in education.

Proposition 4: If $\alpha = 1$, investment in education will occur if and only if $\gamma > 0$.

Proof: From (2.2) a necessary and sufficient condition for some individuals to invest in education for a given α is that $V(a,k) > 0$, for some a and k, where:

$$V(a,k) = \left\{ \begin{array}{c} -\alpha + a\int_{-1}^{\epsilon^*(k)} kf(\epsilon)d\epsilon + a\int_{\epsilon^*(k)}^{1}(1+\gamma\epsilon)f(\epsilon)d\epsilon \\ -\alpha + a\int_{-1}^{1}(1+\gamma\epsilon)f(\epsilon)d\epsilon = -\alpha + a \end{array} \right\} \text{if } \left\{ \begin{array}{c} \gamma + k > 1 \\ \gamma + k \leq 1 \end{array} \right\}$$

Thus, $\gamma + k \leq 1$ implies that $V(a,k) = -\alpha + a$, and $\gamma + k > 1$ implies that $V(a,k) > -\alpha + a$. Hence, if $\alpha = 1$ and $\gamma + k \leq 1$, $V(a,k) = a - 1 \leq 0$. Thus, if $\alpha = 1$ and $\gamma = 0$, implying that $\gamma + k \leq 1$, even individuals with the highest ability level (i.e., for which $a = 1$), and, therefore, all individuals with lesser ability, do not invest in education. Conversely, if $\gamma > 0$, then, since $k = 1$ for some individuals, $\gamma + k > 1$ for some individuals, so that $V(a,k) > a - 1$. This implies that $V(1,k) > 0$. Hence, if $\gamma > 0$ and $\alpha = 1$, some individuals invest in education.■

Proposition 5: If $\gamma > 0$, then, regardless of the value of α, there will always be some individuals who invest in education.

Proof: This follows immediately from Proposition 4, because the benefit derived from investing in education rises as α declines.■

Proposition 4 informs us that even if the cost of education is greater or equal to the return to education in either A or B some individuals will nonetheless invest in education if $\gamma > 0$. To understand why this is the case, note that by allowing individuals to migrate, education enables them to determine whether they earn k or $1 + \gamma\epsilon$ once the value of ϵ is known. This means that the individual's second-period income is $a \max(k, 1+\gamma\epsilon)$, i.e., he has the option of selling his human capital for k if the domestic wage is below k, and for $1 + \gamma\epsilon$ if it exceeds k. Clearly, $a \max(k, 1 + \gamma\epsilon) > a$ providing that migration is a possibility, i.e. $\gamma + k > 1$, a condition that is always satisfied for a sufficiently large k if $\gamma > 0$, and is never satisfied if $\gamma = 0$.Thus, even if $\alpha = 1$, individuals with a sufficiently high ability level, and certainly those with $a = 1$, invest in education. Proposition 5 then simply generalizes Proposition 4.

Income variability, therefore, is a sufficient condition for investments in education to be observed. More importantly, the number of educated individuals can be shown to be increasing with the variability of the domestic rate of return to education:

Proposition 6: The number of individuals in A investing in education is an increasing function of γ.

Proof: Assume a given k. Let a^* be the value of a which solves for $V(a,k) = 0$. Thus, $a^*(k)$ is the minimum level of ability at which an individual would invest in education. Hence, the proportion $\rho(k)$ of individuals investing in education, is given by:

$$\rho(k) = \int_{a^*(k)}^{1} g(a)da.$$

Thus,

$$\frac{\partial \rho}{\partial \gamma} = -\frac{\partial a^*(k)}{\partial \gamma} g(a^*(k)).$$

But from (2.2):

$$a^*(k) = \frac{\alpha}{\int_{-1}^{\epsilon^*(k)} kf(\epsilon)d\epsilon + \int_{\epsilon^*(k)}^{1} (1+\gamma\epsilon)f(\epsilon)d\epsilon}. \tag{2.3}$$

Hence,

$$\frac{\partial a^*(k)}{\partial \gamma} = -\frac{\int_{\epsilon^*(k)}^{1} \epsilon f(\epsilon) d\epsilon}{[\int_{-1}^{\epsilon^*} k f(\epsilon) d\epsilon + \int_{\epsilon^*}^{1} (1+\gamma\epsilon) f(\epsilon) d\epsilon]^2},$$

which is negative, since, given $\epsilon^* > -1$, $\int_{\epsilon^*}^{1} \epsilon f(\epsilon) d\epsilon > \int_{-1}^{1} \epsilon f(\epsilon) d\epsilon = 0$. Thus, for a given k, the proportion of individuals investing in education increases with γ. It follows immediately that this holds true for the population as a whole.■

The higher the volatility parameter γ, the greater the number of A's residents investing in education. However, unfortunately, higher volatility also brings about more expected migration from A to B. What then is the net impact of γ on the educational profile of the residents of A after migration has been netted out? If $\gamma = 0$, only individuals with ability exceeding α would invest in education. In this case, the number of educated individuals in A would be, therefore, $\int_{\alpha}^{1} g(a) da$. By contrast, if $\gamma > 0$, the actual migration is a random variable, since it depends on the realization of ϵ. We therefore have to work with expected values. Our interest is in the difference between the expected number of educated individuals in A after migration has been netted out, $\delta \equiv \rho(1-\pi)$, and $\int_{\alpha}^{1} g(a) da$, the proportion of the educated in the population when there is no volatility (and, consequently, no migration). Denoting

$$\Delta = \rho(1-\pi) - \int_{\alpha}^{1} g(a) da,$$

the following results obtain:

Proposition 7: For $\alpha = 1$, $\Delta > 0$, i.e., the number of educated individuals in A after migration has been netted out is greater for $\gamma > 0$ than for $\gamma = 0$.

Proof: If $\alpha = 1$ then $\int_{\alpha}^{1} g(a) da = 0 \Rightarrow \Delta = \rho(1-\pi)$. But, from Proposition 5, $\gamma > 0$, implies that $\rho > 0$. In addition, as shown above, π generally lies between 0 and 1/2. Hence $\Delta > 0$.■

Proposition 8: For $\alpha = 0$, $\Delta < 0$, i.e., the number of educated individuals in A after migration has been netted out is smaller for $\gamma > 0$ than for $\gamma = 0$.

Proof: If $\alpha = 0$, then $\int_{\alpha}^{1} g(a) da = 1$, implying that all individuals invest in education (see Proposition 3). However, since $\pi(k)$ generally lies between 0 and 1/2, $\rho(1-\pi) < 1$, so that $\Delta < 0$.■

Proposition 9: If abilities are uniformly distributed, then, for individuals for whom $\gamma + k > 1$, a value of α exists, denoted by $\alpha^*(k)$, such that $\Delta < 0$ for $\alpha < \alpha^*(k)$ and $\Delta > 0$ for $\alpha > \alpha^*(k)$.

Proof: Noting that π is independent of α :

$$\frac{\partial \Delta}{\partial \alpha} = (1-\pi)\frac{\partial \rho}{\partial \alpha} + g(\alpha) = -(1-\pi)\frac{\partial a^*(k)}{\partial \alpha} g(a^*(k)) + g(\alpha).$$

But, from (2.3) :

$$\frac{\partial a^*(k)}{\partial \alpha} = \beta \equiv \frac{1}{\int_{-1}^{\epsilon^*(k)} kf(\epsilon)d\epsilon + \int_{\epsilon^*(k)}^{1}(1+\gamma\epsilon)f(\epsilon)d\epsilon},$$

where $1 > \beta > 0$. Thus,

$$\frac{\partial \Delta}{\partial \alpha} = -(1-\pi)\beta g(a^*(k)) + g(\alpha).$$

A sufficient condition for $\frac{\partial \Delta}{\partial \alpha} > 0$ is that $g(a^*(k)) \leq g(\alpha)$. This, of course, is always valid for the uniform distribution, and may be valid for other distributions.

Combining the facts that $\frac{\partial \Delta}{\partial \alpha} > 0$ if $g(a)$ is a uniform distribution with $\Delta(\alpha = 1) > 0$ (Proposition 7) and $\Delta(\alpha = 0) < 0$ (Proposition 8) concludes the proof.■

The last three results can be interpreted as follows. As mentioned above, income variability increases the number of educated individuals and, simultaneously, the number of potential migrants. The first effect, which manifests ex-ante (in the first period), may be referred to as the "option value effect", while the second effect, which is potential and materializes only in bad economic (second) periods, may be referred to as a "brain drain effect". The total effect of income variability on the proportion of educated in the population is, therefore, ambiguous, and depends on which effect dominates. As the cost of education, α, increases, the option value effect becomes increasingly important so that, for a sufficiently high α (and certainly for $\alpha = 1$), the option effect dominates. Thus, a large α (and certainly $\alpha = 1$) implies that the impact of domestic return variability is to increase the expected equilibrium average number of educated individuals in A.

Until now, we have considered the effects of economy-wide shocks on the education and migration decisions of its residents. This was done assuming that such instability affects the country's population uniformly. However, this need not be the case. It may well be that within a particular country, some regions or groups experience greater income variability. In particular, this is likely for discriminated-against minorities, who more often than not experience amplified (macro-generated) income variability. The next section explores this issue.

3. Minorities and Migration

Minority groups often represent a substantial proportion of the immigrants from developing countries, and tend to be better educated than majority members. This is quite remarkable, since such groups often face discrimination in the form of restricted access to public education (e.g., through reduced quantity or quality of infrastructures, restricted access to financing, etc.). The phenomenon is hard to assess empirically, since most receiving countries generally ignore the educational attainments and, with almost no exceptions, the religion or ethnic origin of their immigrants. An exception, however, is given by the recent Australian data on immigrants from Malaysia, Sri Lanka, and Fiji, three countries that are ethnically divided and have minorities

subject to discrimination. The data show that minority members indeed tend to be significantly better educated than majority members, and represent a proportion of the immigrants that is significantly higher than their relative size in the origin country.[12] The same conclusions arise from many country monographs focusing on intergroup differences in education and (international and internal) migration patterns. For example, in his study on labor migration in Asia, Martin (1991, p. 187) notes that "Malaysians of Chinese origin appear the most likely to emigrate", while the high educational record of this group is well documented (e.g., Sudha, 1997, Johnson and DaVanzo, 1998). In the same vein, Gani and Ward's (1995) study on the migration of skilled workers from Fiji to New-Zealand illustrates how education provides its owners with an option to emigrate, an opportunity that has materialized for the Indian minority in the face of Fiji's recent political turmoil. In their research on the sources of ethnic inequality in Vietnam, van de Walle and Gunewardena (2001) also found substantial returns to migration for the educated members of the rural minorities. Last, in their study of the determinants of female rural-urban migration in eight African countries, Brockeroff and Eu (1993, p. 573) confirm that migration probabilities increase with education and note quite incidentally that "in no country are women from the largest ethnic group more likely than others to migrate from rural areas".

Starting with Kuznets (1960), economic historians have been interested in the effects of ethnic discrimination on the human capital decisions of discriminated-against groups. The theory of human capital suggests that minority members are likely to be more educated than members of the majority when human capital provides a means of avoiding discrimination (Brenner and Kiefer, 1981). For example, discrimination against minorities has often taken the form of physical expulsion, implying that minorities tend to invest in mobile assets (human capital) rather than physical ones (real estate, factories). As noted by Brenner and Kiefer (1981: 518), "a discriminated-against group which has had physical capital confiscated in the past might tend to take the probability of confiscation of an asset into consideration when making an investment. Further, a group which had been compelled to emigrate from a country might take the portability of an asset into consideration when making an investment in a new country, especially if it continues to face discriminations". Similarly, labor market discrimination may cause minority members to gravitate toward self-employment, which is often associated with a higher level of education (physicians, lawyers etc.).

Our main concern, however, is not with the direct effects of discrimination on education decisions, but with the additional indirect effects of discrimination on education *via* income variability. Political studies on ethnic conflicts in developing countries emphasize that hard economic times tend to exacerbate ethnic tensions (Gurr, 1993, Horowitz, 1998), placing a substantial number of minority groups in a vulnerable position (or "at risk", as Gurr (1993) put it).[13] In other words, the degree of hostility faced

[12] For more details on the Australian data, see Tremblay (2000).

[13] Among the 230 "minorities at risk" listed by Gurr (1993), 72 groups were located in Africa (representing 41% of the continent's population) and 49 in Asia (12% of the population).

by minority groups is likely to depend on the country's general economic situation. For example, sporadic anti-minority riots are known to be directed against middleman minorities, which often serve as a scapegoat for domestic difficulties (Cooter and Landa, 1984; Samarasinghe and Coughlan, 1991).[14] To the extent that labor and product markets are facets of such tensions, this implies that minorities will generally face higher income variability than members of the majority. Moreover, ethnic (or religious, linguistic, regional, etc.) discrimination is often initiated at governmental level and used for countercyclical redistributive purposes. Examples of such "policies" include privileged access to public jobs and loans, ethnically biased tax systems, and sometimes public harassment and organized violence against minorities.[15] In addition, discrimination against members of minorities, whatever its source, is likely to cause them to engage in less asset diversification (i.e. to concentrate on human capital) as well as face the greater uncertainties associated with self-employment. All this will further increase the variability of minority incomes.

In view of these considerations, minority members are likely to face greater income variability than the rest of the population. To capture these effects and to determine their implications, let the variability of the domestic return to human capital for the majority group be smaller than the variability of the return to human capital for members of the minority. Denote the returns to human capital for majority members by $w_1 = 1 + \gamma_1\epsilon$ and for minority members by $w_2 = 1 + \gamma_2\epsilon$ where $\gamma_2 \geq \gamma_1$.[16] This implies that educated minority members would migrate if $1 + \gamma_2\epsilon < k$ whereas educated majority members would migrate if $1 + \gamma_1\epsilon < k$. Thus, for a given k, a member of the majority would migrate if $\epsilon < \epsilon_1^* = -\frac{1-k}{\gamma_1}$ and a member of the minority would migrate if $\epsilon < \epsilon_2^* = -\frac{1-k}{\gamma_2}$. The probability, $\pi_2 = \int_{-1}^{\epsilon_2^*} f(\epsilon)d\epsilon$, that an educated minority member would migrate is therefore greater than the probability, $\pi_1 = \int_{-1}^{\epsilon_1^*} f(\epsilon)d\epsilon$, that an educated majority member would do so.

One implication of the above is that members of a minority will often be viewed as less loyal to the home country than members of the majority. Remember that the value of k measures the relative utility of consumption at home and abroad. Clearly, an individual with a high k does not put a high premium on domestic consumption. In this sense, he or she might be viewed as 'less loyal' than someone with a lower k. However, even if k is identically distributed among minority and majority members, the number of educated minority members leaving the home country in bad times would be disproportionately large. This fact may be (incorrectly) used to surmise that members of the minority are less patriotic or loyal to the home country.

Moreover, since, as per Proposition 6, $\frac{\partial \rho}{\partial \gamma} > 0$, the proportion of minority members

[14] The term "middleman minorities" characterizes groups that are both intermediate in terms of socio-economic status and caught in social conflicts between other groups (e.g., producers and consumers, employers and employees, struggle for power between two major competing groups, etc.).

[15] See Bardhan (1997) for a political economy approach to such conflicts.

[16] To enable us to focus on return *variability*, it is assumed that the average returns to human capital for minority and majority members are equal.

who are educated will exceed that of the majority. Since only the educated migrate, the high proportion of educated minority members implies an even greater migration by minority members in bad times, thus reinforcing the view that minority groups are less loyal than members of the majority. Conversely, since they are on average better educated than members of the majority, members of the minority will have a higher income per ability level if they remain in the home country. A higher variability in the domestic return to education may therefore go part of the way towards explaining the ubiquitous nationalist claim that minority members are both less loyal and undeservedly richer than members of the majority.[17] In our model, ethnic discrimination and conflict may thus cause minority groups to end up with increased emigration, while non-migrating members of the minority may be richer than members of the majority with similar labor market characteristics.[18] In both cases, hostility is likely to develop, thus reinforcing any initial intergroup differences in income variability. This in addition to similar (but differently motivated) effects discussed in earlier work.

The following Table summarizes these results, where Λ relates to the sign of the difference between majority and minority members. Recall that ρ_i gives the proportion of the educated in group i, and π_i is the probability that an educated individual from group i would migrate. and Therefore, $\rho_i \pi_i$ is the expected proportion of migrants from group i. As is apparent from the Table below, y_i is the average income of the non-migrating fraction of group i.

	Majority	Minority	Λ
ρ_i	$\int_{a_1^*}^{1} g(a)da$	$\int_{a_2^*}^{1} g(a)da$	$< \mathbf{0}$
π_i	$\int_{-1}^{\epsilon_1^*} f(\epsilon)d\epsilon$	$\int_{-1}^{\epsilon_2^*} f(\epsilon)d\epsilon$	$< \mathbf{0}$
$\rho_i \pi_i$	$\int_{-1}^{\epsilon_1^*} f(\epsilon)d\epsilon \int_{a_1^*}^{1} g(a)da$	$\int_{-1}^{\epsilon_2^*} f(\epsilon)d\epsilon \int_{a_2^*}^{1} g(a)da$	$< \mathbf{0}$
y_i	$\int_{\epsilon_1^*}^{1}(1+\gamma_1\epsilon)af(\epsilon)d\epsilon g(a)da$	$\int_{\epsilon_2^*}^{1}(1+\gamma_2\epsilon)af(\epsilon)d\epsilon g(a)da$	$< \mathbf{0}$

4. Conclusion

In this paper, we presented a model of investment in education where the domestic return to human capital is uncertain and migration is a possibility.

Our rationale may be summarized as follows. Education buys a person the ability to migrate in response to higher incomes offered elsewhere. In the face of a variable domestic return to education and a fixed foreign return to education, this implies that education constitutes a put option: if the realization of the domestic return is

[17] It should be noted, however, that this last result may be attributed to the fact that the only investment channel in our model is human capital, and we assumed no liquidity constraints. The result that minority groups do better than majority groups in good times would be modified and may even be reversed once non-human capital and/or differential acces to credit markets are introduced.

[18] Since such features may well induce further hostile attitudes towards the minority, an interesting extension for future research would be to analyze the dynamics at work behind ethnic hostility and conflicts.

low, the educated individual can sell his education at a pre-determined private return abroad. As is well known, the value of an option is increasing in the variability of the underlying asset. Thus, the value of education is an increasing function of the variability of the domestic return to education. This result does not, in any way, depend on risk aversion. This implies that the domestic demand for education is an increasing function of the variability of the domestic return to education. In addition, such variability has an effect on the amount of migration done. The greater the variability, the higher the proportion of domestic return realizations for which educated individuals migrate. Thus, an increase in the variability of the domestic return to education has two effects: it increases the amount of education bought domestically, as well as the amount of migration done. The main result of the analysis is that in a developing economy open to emigration, the expected (post-migratory) level of education may well increase with the variability of the domestic return to human capital if education is sufficiently costly. This suggests that the possibility of migration may enhance human capital formation even if the mean return to human capital is equalized internationally.

We then applied the model to the issue of discriminated-against minorities, who face higher levels of income volatility as a result of ethnic discrimination and conflicts. According to the predictions of our model, this implies that minority members may be better educated and apparently less patriotic (migrate in higher proportion) than members of the majority. These implications, illustrated by extensive evidence from LDCs, have been shown to complement the direct effects of discrimination previously highlighted in the human capital literature.

References

Acemoglu, D. and F. Zilibotti (1997): Whas Prometheus Unbound by Chance? Risk, Diversification and Growth, *Journal of Political Economy*, 105, 4: 709-51.

Aizenman, J. and N. Marion (1999): Volatility and investment: evidence from developing countries, *Economica*, 66: 157-79.

Alesina, A., S. Ozler, N. Roubini and P. Swagel (1996): Political instability and economic growth, *Journal of Economic Growth*, 1: 189-211.

Barhan, P. (1997): Method in the madness? A political-economy analysis of the ethnic conflicts in Less Developed Countries, *World Development*, 25, 9: 1381-1398.

Barro, R.J. and J.W. Lee (1993): Losers and winners in economic growth, NBER Working Paper No 4341.

Baxter, M. and U.J. Jermann (1997): The international diversification puzzle is worse than you think, *American Economic Review*, 87, 1: 170-80.

Beine, M., F. Docquier and H. Rapoport (2001): Brain drain and economic growth: theory and evidence, *Journal of Development Economics*, 64, 1: 275-89.

Brenner, R. and N.M. Kiefer (1981): The Economics of the Diaspora: Discrimination and Occupational Structure, *Economic Development and Cultural Change*, 29, 3: 517-34.

Brockerhoff, M. and H. Eu (1993): Demographic and socioeconomic determinants of female rural to urban migration in Sub-Saharan Africa, *International Migration Review*, 27, 3: 557-77.

Burda, M.C. (1995): Migration and the Option Value of Waiting, *Economic and Social Review*, 27, 1: 1-19.

Carrington, W.J., and E. Detragiache (1999): How extensive is the brain drain?, *Finance and Development*, June: 46-49.

Chen, K.P. and S.H. Chiang (1998): Migration as portfolio selection, mimeo., York University.

Comay, Y., A. Melnik and M.A. Pollatschek (1973): The option value of education and the optimal path for investment in human capital, *International Economic Review*, 14, 2: 421-435.

Cooter, R. and J. Landa (1984): Personal versus impersonal trade: the size of trading groups and Contract Law, *International Review of Law and Economics*, 4, 1: 15-22.

Djajic, S. (1989): Skills and the pattern of migration: the role of qualitative and quantitative restrictions on international labor mobility, *International Economic Review*, 30, 4: 795-809.

Elbadawi, I. and K.H. Schmidt (1998): Macroeconomic policies, instability and growth in the world, *Journal of African Economies*, 7, 0 (Supplement 2): 116-68.

Flug, K, A. Spilimbergo and E. Wachtenheim (1998): Investment in education: do economic volatility and credit constraints matter?, *Journal of Development Economics*, 55: 465-81.

Galor, O. and D. Tsiddon (1997): The distribution of human capital and economic growth, *Journal of Economic Growth*, 2, 1: 93-124.

Galor, O. and Zeira, J. (1993): Income distribution and macroeconomics, *Review of Economic Studies*, 60, 1: 35-52.

Gani, A. and B.D. Ward (1995): Migration of professionals from Fiji to New Zealand: A reduced form supply-demand model, *World Development*, 23, 9: 1633-37.

Guillaumont, P., S. Jeanneney-Guillaumont, and J.F. Brun (1999): How instability lowers African growth, *Journal of African Economies*, 8, 1: 87-107.

Gurr, T.R. (1993): *Minorities at risk*, Washington DC: United States Institute of Peace Press.

Horowitz, D.L. (1998): Structure and strategy in ethnic conflict: A few steps toward synthesis, In Pleskovic, B. and J.E. Stiglitz (eds.): *Annual World Bank Conference on Development Economics*, Washington D.C.: The Worl Bank, pp. 345-70.

Johnson, R.W. and J. DaVanzo (1998): Economic and cultural influences on the decision to leave home in peninsular Malaysia, *Demography*, 35, 1: 97-114.

Kalemli-Ozcan, S., B.E. Sorensen and O. Yosha (2001): Economic integration, industrial specialization, and the asymmetry of macroeconomic fluctuations, *Journal of International Economics*, 55, 1: 107-37.

Katz, E. and O. Stark (1986): Rural to urban migration in LDCs in the presence of risk aversion, *Journal of Labor Economics*, 4: 134-49.

Katz, E. and O. Stark (1987): International Migration in the Presence of Asymmetric Information, *Economic Journal*, 97, 387: 718-26.

Katz, E. and O. Stark (1989): International Labour Migration under Alternative Informational Regimes: A Diagrammatic Analysis, *European Economic Review*, 33, 1: 127-42.

Kuznets, S. (1960): Economic Structure and Life of the Jews, in Finkelstein, L. (ed.): *The Jews, their History, Culture and Religion*, New York: Harper, Vol. II, pp. 1597-1666.

Levhari, D. and Y. Weiss (1974): The effect of risk on the investment in human capital, *American Economic Review*, 64, 6: 950-963.

Lucas, R.E.(1988): On the mechanics of economic development, *Journal of Monetary Economics*, 22, 3: 3-42.

Martin, P.L. (1991): Labor Migration in Asia, *International Migration Review*, 25, 1: 176-93.

Morduch, J. (1994): Poverty and vulnerability, *American Economic Review - Papers and Proceedings*, 84, 2: 221-5.

Mountford, A. (1997): Can a brain drain be good for growth in the source economy?, *Journal of Development Economics*, 53, 2: 287-303.

Ramey, G. and V.A.Ramey (1995): Cross-Country Evidence on the Link Between Volatility and Growth, *American Economic Review*, 85, 5: 1138-51.

Samarasinghe, S.W.R. and R. Coughlan, eds. (1991): *Economic dimensions of ethnic conflicts*, London: Pinter Publishers.

Schultz, T.W. (1980): Nobel Lecture: The Economics of Being Poor, *Journal of Political Economy*, 88, 4: 639-651.

Stark, O. (1991): *The migration of labor*, Oxford and Cambridge, MA: Basil Blackwell.

Stark, O., C. Helmenstein and A. Prskawetz (1997): A brain gain with a brain drain, *Economics Letters*, 55: 227-34.

Stark, O., C. Helmenstein and A. Prskawetz (1998): Human Capital Depletion, Human Capital Formation, and Migration: A Blessing or a 'Curse', *Economics Letters*, 60, 3: 363-67.

Sudha, S (1997): Family size, sex composition and children's education: ethnic differentials over development in Peninsular Malaysia, *Population Studies*, 51, 2: 139-51.

Tremblay, K. (2000): Ethnic conflicts, migration and development, Unpublished PhD Dissertation, University of Paris-Sorbonne, January.

van de Walle, D. and D. Gunewardena (2001): Sources of ethnic inequality in Vietnam, *Journal of Development Economics*, 65, 1: 177-207.

Vidal, J.-P. (1998): The effect of emigration on human capital formation, *Journal of Population Economics*, 11, 4: 589-600.

Weisbrod, B.A. (1962): Education and investment in human capital, *Journal of Political Economy*, Supplement, October: 106-123.

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