UNITED NATIONS UNIVERSITY
UNU-WIDER
World Institute for Development Economics Research

Research Paper No. 2007/44

Migration Taxes and Human Capital Formation

Some Implications for Development

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July 2007

Abstract

Use of migration tax as an instrument for financing development expenditure in poorer countries has received renewed attention recently and is evolving as an important subject of research in development economics. This paper discusses a related issue where the revenue collected by taxing skilled and unskilled migrants moving from poor to rich countries can help raising the level of human capital in the source country. The paper provides an unifying analysis for two distinct strands of literature—one claims that lack of restriction on skill migration promotes human capital formation and the other, the more conventional one, argues for greater restriction against negative impact of brain drain. Considering that both human capital formation and migration involve risk, we then explore a connection between imposition of migration tax, human capital formation and risk aversion. For a country with low level of human capital to start with, we establish that a proportionally higher migration tax imposed on the *unskilled migrants* considerably raises the average level of human capital for all non-migrants. The disincentive effect of the migration tax and its use as educational subsidy shifts the critical relative risk aversion among the non-migrants in favour of acquiring more human capital. The proposed migration tax pattern also raises the average income level of all individuals and only conditionally for the non-migrants.

Keywords: migration tax, human capital, skill, risk aversion
JEL classification: H24, J24, J31, J61

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This study has been prepared within the UNU-WIDER project on New Directions in Development Economics directed by Augustin Fosu.

UNU-WIDER gratefully acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1810-2611 ISBN 92-9190-987-4 ISBN 13 978-92-9190-987-2

Acknowledgements

I would like to thank Anthony Shorrocks, Basudeb Guha-Khasnobis, and others present at the seminar on 24 May 2007 at UNU-WIDER. I am indebted to Subbu Subramanian and Augustin Fosu for insightful suggestions for improving the paper. The remaining errors are mine.

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Typescript prepared by Lorraine Telfer-Taivainen at UNU-WIDER

1 Introduction

The research on international mobility of the skilled and the unskilled labour has proliferated along a wide range of issues and has used an equally large number of methodologies. One such issue, which received enthusiastic attention lately, is that of international migration of labour and human capital formation in the source country.[1] Notably, Stark et al. (1997, 1998), Stark and Wong (2001) have shown in a number of papers that a positive probability of migration to a rich country raises the average skill level in the poor origin country. It essentially deals with a situation where the residents of the origin country receive higher inducement to acquire human capital when the country opens up to international migration of the skilled workers. Migration opportunities work as a substitute for domestic tax subsidy schemes aimed at raising the prevailing level of human capital to a socially desirable state. Opening up to migration, albeit controlled, is a desirable policy according to these studies and stands in sharp contrast to the literature that advocates stricter skill migration controls in support of the age-old brain drain hypothesis. The present study is an attempt at unifying these two contrasting ideas.

Here, we discuss an explicit link between *measures* towards migration controls and changes in the level of average human capital in poor countries. In particular, we argue that the imposition of 'migration taxes'[2] as an instrument of migration control can also improve the average level of human capital and hence the welfare level in the source country. The inducement to acquire human capital operates through transfer of the tax revenue within the source country, and simultaneously via creation of disincentives towards migration for certain skill types.

The reason for invoking the economically and politically rather controversial issue of migration tax, are many. These include on the one hand, Bhagwati's (1976, 1979, 1987) earlier economic and political (representation without taxation) arguments in favour of taxing the brain drain, and some more recent concerns on the other. Under the present practices in many developing countries, education even up to the graduate level is state-sponsored and thus extremely subsidized. The majority of workers who choose to emigrate acquire their basic as well as technical and professional trainings under such free regimes. Once they emigrate permanently, the state not only loses its future taxpayers, but also faces possibilities of lower economic growth due to lack of skill.[3] Consequently, there has been recent resurgence of policy dialogues towards taxing the migrants and sharing the proceeds between the host and the destination countries.

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1 See Docquier and Rapoport (2004) for a survey.

2 Initially designed by Jagdish Bhagwati and popularly called 'Bhagwati tax'. A flat migration tax rate of 1-3 per cent was first implemented for migrants from the Philippines. It raised about 23 million in Philippines dollars between 1973-76. The USA continually practices taxing its resident workers abroad and the present estimate is as high as $20 billion.

3 According to Straubhaar and Wolburg (1998), however, taxing immigrants is only legitimate if the human capital acquired in the home country leads to significantly higher income in the immigration country relative to people with less human capital. For more on the ethics of imposing migrant taxes and its effects on the economy, see a collection of articles in Bhagwati and Wilson (1989).

Desai et al. (2004) take up the examples of India and USA as large source and host countries respectively, and offer a set of (for developing countries in general) direct, co-operative or exit tax schemes with significant merits attached to each proposal. The migration tax (whether collected by authorities in the rich country following bilateral negotiations, or 'directly' transferred by the migrants to their home country government)[4] as an instrument clearly differs from the more popularly discussed political economy issues of setting domestic income tax and/or public goods provision in the presence of immigration in a rich country labour market (for example, Mayr 2007; Thum 2004).

It is also well known that the emigration of very low-skilled workers (to adjacent countries, mostly) has often been influenced by abject poverty, racial or religious discrimination, fear of political persecution and similar other reasons. It is beyond the scope of the present paper to accommodate all such types of migrations (including, illegal) and therefore, we consider only those types of emigrants who migrated for employment based on their optimizing decisions. Such optimization, it is widely acknowledged, strongly reflects on the risk involved in migration and holds equally true for optimization leading to human capital formation.[5] As a natural reaction to these rather pervasive phenomena, we develop a crucial interaction between risk aversion, human capital formation and migration as an illustration of the optimization problems facing the agents at different levels of decision making. In fact, the coefficient of risk aversion in our model accommodates and represents several factors that can potentially affect human capital formation and migration for workers in a poor country. The factors which are often known to affect decisions towards human capital formation and migration include innate abilities that can only be discovered with a crucial time lag, access to credit, access to information, family size and intra-household dependence pattern, prevalence of asymmetric information in the foreign country labour market, and etc. It is well known that all of these factors contain diverse elements of risk and that using a utility function with income risk can appropriately represent all individuals facing decision making problems on human capital formation and migration.

Incidentally, a number of recent studies also discuss the relationship between migration (internal and international) and risk preference (for example, Conroy 2007; Jaeger et al. 2007; Driouchi et al. 2006; Chen et al. 2003; etc.). Among these, the report by Driouchi et al. (2006) deserves special attention given that its purpose is almost similar to that of the present paper. They show that the level at which education is valued, labour productivity across countries and the emigration rate, all positively affect the formation of human capital in the presence of risk aversion in the source country.

The rest of the paper is organized as follows. In Section 2 we present a model on the relationship between migration and human capital formation in the source country.

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4 The precise method of tax administration is outside the purview of the present paper. Detailed information on how such tax proposals may be implemented is found in Desai et al. (2004).

5 Among the papers that deal with investment in human capital formation and attitude towards risk, Levhari and Weiss (1974: 950) offer perhaps the most revealing relationship between the two—'The hypothesis that human capital is more risky need not imply that investment in human capital is discouraged or that the expected marginal return in human capital is higher'—in need of an optimization that might generate a deterministic pattern.

Section 3 discusses the human capital impact of migration taxes. Section 4 takes up the implications for income disparity among the non-migrants, and Section 5 concludes.

2 The model

Let us consider an economy with a mass of unskilled workers equal to one. At some point of time *t*, the mass of workers make a decision on whether they acquire human capital or remain unskilled. Human capital formation involves direct costs, is not instantaneous and no income is earned during this phase. The wages of skilled and unskilled workers are set exogenously at w_S and *w*, respectively, with ($w_S > w$) and that within each skill category the workers are homogeneous in characteristics. We skip the *t* subscript for all such specifications. Assume further that each individual faces a constant relative risk aversion (CRRA) type of von Neumann-Morgenstern indirect expected utility function: $U = W^{1-r}$, where *W* is wealth and *r* is the coefficient of risk aversion. The utility function also implies decreasing absolute risk aversion (DARA), i.e. the level of absolute risk aversion falls as more and more of wealth is acquired. However, the only form of wealth that these individuals have is their wage income. The mass of workers are distributed uniformly over the scale of risk aversion, $r \in [0,1)$, and we do not make any a priori presumption about an individual's risk preference.

We follow a standard textbook exposition in motivating the optimization exercise on whether human capital should or should not be acquired.[6] The optimization yields a deterministic distribution of educational choice among the unit mass. Thus, our analysis begins with describing the indirect expected utility facing an unskilled individual at time *t* and discounted over his/her working lifetime (EU_U):

$$EU_U = \int_0^n \left(\frac{1}{2a}\int_{-a}^{a} (w+\varepsilon)^{1-r} d\varepsilon\right) e^{-\rho t} dt \qquad (1)$$

where, 'ε' is a uniformly distributed random fluctuation ($\varepsilon \in [-a, a]$, $E(\varepsilon) = 0$ *and* $E(\varepsilon^2) = \sigma_\varepsilon{}^2$), added to the unskilled wage *w*, *n* is the number of years an unskilled individual works and ρ is the discount rate, with $EU_U'(r) < 0$, $EU_U''(r) > 0$ (derivations are provided in Appendix II).

On the other hand, the discounted indirect expected utility facing the individual who acquires human capital (EU_S), is given by:

$$EU_S = \int_s^{n+s} \left(\frac{1}{2b}\int_{-b}^{b} (w_S+\beta)^{1-r} d\beta\right) e^{-\rho t} dt - \int_0^s (D^{1-r}) e^{-\rho t} dt \qquad (2)$$

6 See Appendix I for details.

where 'β' is the random fluctuation associated with skilled wage, $\beta \in [-b,b]$, $E(\beta)=0$, *and* $E(\beta^2)=\sigma_\beta^{\,2}$.[7] D is the direct cost of education, s is the number of years put in education, and $(n+s)$ implies that skilled persons work 's' years more than the unskilled. Again, $EU_S'(r)<0$, $EU_S''(r)>0$, and $\left|EU_U'(r)\right|<\left|EU_S'(r)\right| \forall r \in [0,1)$. Equalizing (1) and (2) given the parameters w, w_S, a, b, ρ, n, s *and* D, solves for r^* as the critical relative risk aversion for the mass. Consequently, the individuals who are distributed in the range [0, r^*] acquire human capital, since the discounted indirect expected utility from human capital formation exceeds that from remaining unskilled over this zone. The converse applies for those who are distributed in the range [r*, 1), where the discounted expected utility from remaining unskilled exceeds that from acquiring human capital. One or more individuals who are distributed at r^* remain indifferent between the two options. In other words, the critical risk aversion determines the optimum level of human capital produced in that society at time t, such that, the total (and the average, given mass equal to one and that the mass is uniformly distributed over r) number of skilled workers present in the economy is $\int_0^{r^*} f(r)dr = r^*$. Conversely, the number of people who remain unskilled is given by (1-r^*). This is shown in Panel A of Figure 1.

Given the initial distribution, both skilled and unskilled workers face the option of working at home or migrate to a rich country where the skilled and unskilled wages are $w_S^* > w_S$ and $w^* > w$, respectively. Also, consider $w_S > w^*$, so that unskilled migrants do not find it rewarding to migrate as unskilled. Wages in the foreign country are also set exogenously at $(w_S^* > w^*)$ and are not sensitive to the extent of migration (migration is relatively small and uncorrelated across skill types). Besides, the skill level of a particular migrant is readily interpreted and discovered in the foreign country, i.e. information is symmetric. This poses a subsequent optimization problem facing the two categories of workers distributed uniformly over the scales of relative risk aversion, now related to the choice of migration, instead of human capital formation: $r_S \in [0,1)$, $r_U \in [0,1)$. For the skilled workers this implies a comparison between the discounted indirect expected utilities based on their pay-offs at home and abroad (i.e., $EU_S(w_S) = EU_S^*(w_S^*)$):

$$\int_s^{n+s} \left(\frac{1}{2b}\int_{-b}^{b} (w_S+\beta)^{1-r_S} d\beta\right) e^{-\rho t} dt = \int_s^{n+s} \lambda_S \left(\frac{1}{2m}\int_{-m}^{m} (w_S^*+\mu)^{1-r_S} d\mu\right) e^{-\rho t} dt \qquad (3)$$

where μ is the random fluctuation associated with skilled wage in the foreign country and distributed uniformly, $\mu \in [-m,m]$, $E(\mu)=0$ *and* $E(\mu^2)=\sigma_\mu^{\,2}$. λ_S is the 'discount factor' (see Katz and Stark 1987) with which a skilled migrant discounts his

7 Dutta et al. (1999) use the British Household Panel Survey to show that income variance for the more educated is less than that for the rest. This is reflected in our choice of parameters later.

income abroad and may broadly be defined as the cost associated with migration.[8] Once again, $EU_S^{*'}(r) < 0$, $EU_S^{*''}(r) > 0$ and $|EU_S'(r)| < \left|EU_S^{*'}(r)\right| \forall r \in [0,1)$. As a control in favour of an unbiased comparison we hold that the magnitude of the fluctuations relative to wages at home and abroad are same, i.e., $\frac{b}{w_S} = \frac{m}{w_S^*}$, as also the number of years a skilled worker remains in employment. Using equation (3) we therefore solve for r_S^* as the critical relative risk aversion among the skilled workers, and following similar logic as above, the group of skilled workers who are distributed in the zone $[0, r_S^*]$ migrate to the rich country and the rest distributed between $[r_S^*, 1)$ stay home. Therefore, the actual number of skilled migrants is $(r^* r_S^*)$. The distribution is depicted in Panel B of Figure 1.

It is straightforward to conjecture now that for the unskilled workers also an exactly same comparison with all the specifications as detailed in the previous paragraph holds in favour of determining the critical relative risk aversion, such that the equilibrium distribution of workers who migrate and those who stay is distinctly identified. Thus, $EU_U(w_U) = EU_U^*(w_U^*)$ solves for r_U^* and is shown in Panel C of Figure 1.[9]

$$\int_0^n \left(\frac{1}{2a}\int_{-a}^{a}(w+\varepsilon)^{1-r_U}\,d\varepsilon\right)e^{-\rho t}\,dt = \int_0^n \lambda_U\left(\frac{1}{2z}\int_{-Z}^{Z}(w^*+\xi)^{1-r_U}\,d\xi\right)e^{-\rho t}\,dt \qquad (4)$$

Clearly, the economy settles for a new skilled-unskilled ratio at home $\frac{r^*(1-r_S^*)}{(1-r^*)(1-r_U^*)}$ and this ratio can be same as or different from the initial distribution of skill. According to Driouchi et al. (2006) if the post-migration skilled-unskilled ratio exceeds the initial ratio at home then there is a brain gain. It is a brain drain otherwise. While such implications follow directly from this model as well (comparing the old and new skilled-unskilled ratio, brain gain results if $r_S^* < r_U^*$), we want to invoke the role of migration tax in order to obtain a more policy-sensitive and intuitively challenging relationship between migration, human capital formation and average income. The sequence of events attains the following nature. The government imposes skill specific taxes on those who have already migrated and redistributes the proceeds to those non-migrant workers who remain unskilled. If it is a one time policy, it raises the skill level for once and do not have any further impact. If however, it continues over subsequent time periods two implications follow: one, the unskilled non-migrants always take into account the subsidy in reconsidering the utility from human capital formation, which can potentially alter r^*; and two, all future migrants would consider the tax factor before

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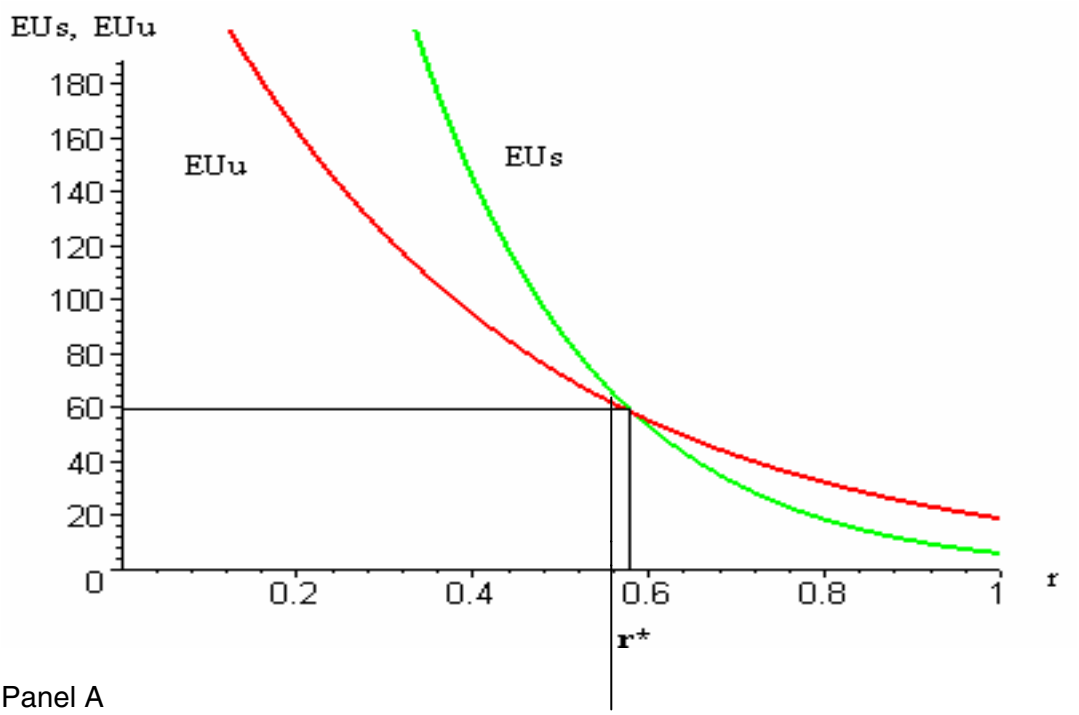
8 Mayr (2007) models cost of migration directly. Here the discount factor subsumes such costs (along with distance from family and culture, food habits etc.) and explicit consideration of the cost does not affect the direction of our results.

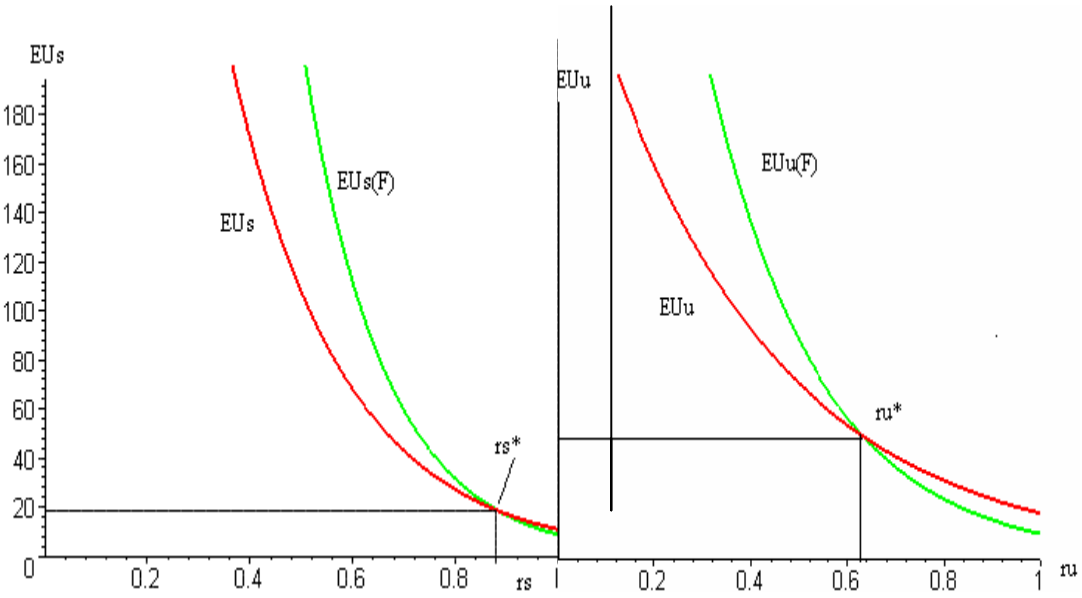
9 Panels A, B and C in Figure 1 are generated by Maple 5.0 and the detailed program is available on request. It should be noted that the graphs and numerical results are offered as examples as against the near impossibility of obtaining analytical solutions algebraically and have been tested over a wide range of values to check for variations.

they migrate, which can change r_S^*, r_U^* and consequently the level of subsidy. This conjoins migration tax, educational subsidy and human capital formation in two dynamic relationships that we explore next.

Figure 1: Distribution of human capital and migration patterns on a scale of risk aversion



Panel A



Panel B Panel C

Note: Figure 1 generated from the following values assigned to the parameters and variables: $\frac{a}{w} = 0.2 = \frac{z}{w*}, \frac{b}{w_S} = 0.05 = \frac{m}{w_S^*}, \; s = 11, \; n = 54, \; \rho = 0.05, \; D = 3, \lambda_S = 0.9, \lambda_U = 0.6.$

3 Migration tax

Let us re-define the objective of the government at this point. It intends to raise the level of human capital in the economy for those who stay behind, by imposing migration taxes and using the revenue. The rise in the average level of human capital would imply an increase in the level of critical risk aversion among the mass, such that more unskilled workers are distributed in the range where human capital formation yields higher expected utility than remaining unskilled. Let τ_S and τ_U be the tax rates imposed in the destination country on the skilled and unskilled migrants respectively. For simplicity, assume that both identification of the migrants across skill types and the collection of tax are costless[10] for the foreign tax authority and the tax revenue is fully transferred back to the country where the migrants originate. The government of the origin country decides to redistribute this tax revenue completely to the unskilled mass in the country as per unit subsidy (θ) towards educational expenses. This is an exclusively tax-financed subsidy[11] and therefore contingent on the budget constraint $B(\theta, r^*)$ facing the government:

$$(1-r^*)\theta(1-r_U^*) = r^* r_S^* \tau_S + (1-r^*) r_U^* \tau_U \qquad (5)$$

LHS of equation (5) is the amount of the subsidy to be distributed among the unskilled non-migrants, against the tax revenue collected (RHS) from the distribution of migrants as obtained above. Also, as r^* is known the value of θ is easily calculated from (5). The amount of subsidy in any $t+1$ period depends on the flow of migrants in period t, and this flow of migrants in period t is a function of the tax rates prevailing at that time. The subsidy distributed would then affect the level of r^* in period $t+1$. Suppose all migrants who migrated prior to period t are exempted from paying taxes. This provides the first dynamic relationship between θ and r^*. Thus, equation (5) depicts combinations of (θ, r^*) that maintains the balanced budget with, $\frac{\delta r^*}{\delta \theta} > 0$, $\frac{\delta^2 r^*}{\delta \theta^2} < 0$. Figure 2 explores three distinct cases that can be generated from the relationship in $B(r^*, \theta)$. First, we consider the case of uniform migration taxes across skill types displayed as $B(\theta, r^*)\big|_{\tau_S = \tau_U}$ and subsequently, two other cases: $B(\theta, r^*)\big|_{\tau_S > \tau_U}$ and $B(\theta, r^*)\big|_{\tau_S < \tau_U}$. There is no spillover effect of migration tax on one skill type, on the level of migration for the other.

When educational subsidy is available the unskilled workers at home reconsider the utility from human capital formation. Comparing that to the utility from remaining unskilled potentially results in a new r^* at time $t+1$. This characterizes the second dynamic relationship between θ and r^*. More specifically, the educational subsidy offered by the government now adds a component to the indirect expected utility function for human capital formation ($EU_{S\theta}$). The mass of unskilled non-migrants

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10 In fact, in most developed countries the legal migrants are clearly known to the tax authorities often via references to bilateral tax treaties, and therefore imposition of a migrant-specific tax should incur no extra cost.

11 See Stark and Wang (2001) for a similar treatment in favour of raising the level of human capital.

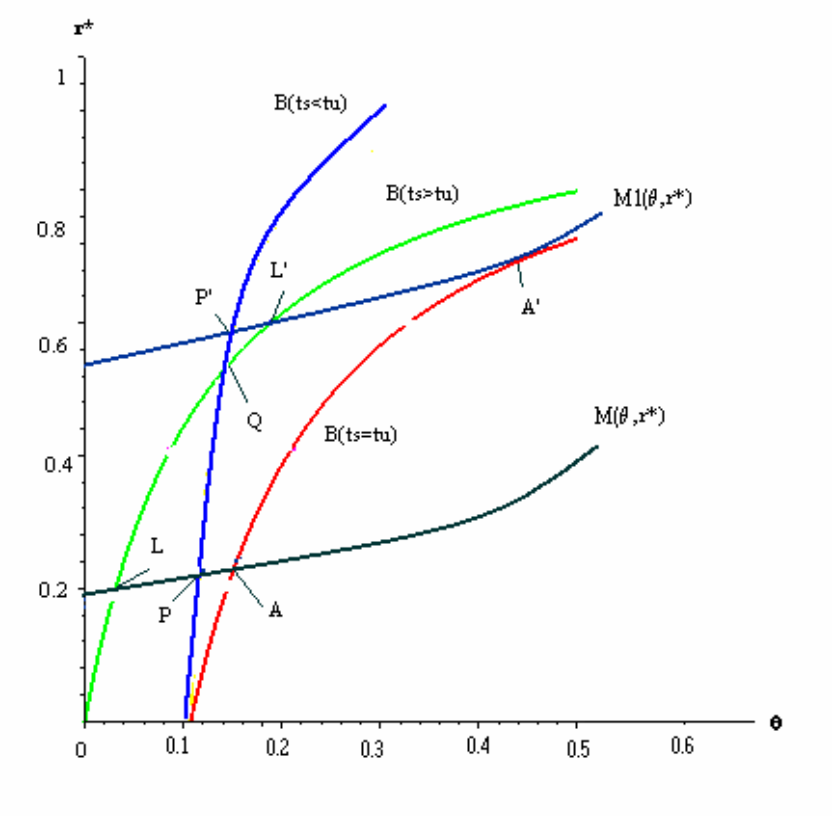
compares the ρ-discounted lifetime utility from human capital formation to that from remaining unskilled under the re-distributive regime.

$$EU_U = \int_0^n \left(\frac{1}{2a}\int_{-a}^{a}(w+\varepsilon)^{1-r}\,d\varepsilon\right)e^{-\rho t}\,dt = \int_s^{n+s}\left(\frac{1}{2b}\int_{-b}^{b}(w_S+\beta)^{1-r}\,d\beta\right)e^{-\rho t}\,dt - \int_0^s (D-\theta)^{1-r}\,e^{-\rho t}\,dt = EU_{S\theta} \tag{6}$$

Given the parameter values, equation (6) offers a combination of (θ, r^*) that maintains the equality. Let us define such possible combinations as $M(\theta, r^*)$ with $\frac{\delta r^*}{\delta\theta} > 0$ and $\frac{\delta^2 r^*}{\delta\theta^2} > 0$. Figure 2 delineates $M(\theta, r^*)$ at two different 'initial' levels of r^*, obtained by holding the value of $M(\theta, r^*)$ at $\theta = 0$. The position of $M(\theta, r^*)$ plays a crucial role in determining which type of migration tax would be most effective in raising the level of human capital. For example, if in the pre-tax pre-subsidy regime, the level of critical risk aversion among the mass is rather low (due to, say, high cost of education), then the location of the curve may be one like $M(\theta, r^*)$ as in Figure 2. Then a regime of flat migration taxes ($\tau_S = \tau_U$) turns out to be most effective in raising the level of human capital in the economy. In fact, as the graphical exposition shows, 5 cents per dollar flat tax on the migrants can generate a subsidy of about 15 cents for the unskilled non-migrants. Evidently, it also raises the critical relative risk aversion to a higher level than is obtained under the no-subsidy regime. A policy of higher migration tax on the unskilled workers ($\tau_S < \tau_U$) is also more effective than taxing skilled workers at a higher rate. These are shown by points *A*, *P* and *L* in Figure 2 where the 'new' r^* under the flat tax regime exceeds that attained under the other two alternatives. In fact, a rank ordering of the impact of migration tax would be: $(\theta, r^*)\big|_{\tau_S=\tau_U} > (\theta, r^*)\big|_{\tau_S<\tau_U} > (\theta, r^*)\big|_{\tau_S>\tau_U}$. Undoubtedly, in the first two cases, the tax burden on the unskilled worker is higher than in the third case. It follows that a regressive tax pattern generates higher levels of human capital among the unskilled non-migrants.

Alternatively, if the pre-tax pre-subsidy critical relative risk aversion is already at a high level as shown by the $M_1(\theta, r^*)$ curve in Figure 2, then the rank ordering of the impact of migration tax changes in favour of taxing the skilled workers at a higher rate, albeit the flat migrant tax remains the most effective instrument: $(\theta, r^*)\big|_{\tau_S=\tau_U} > (\theta, r^*)\big|_{\tau_S>\tau_U} > (\theta, r^*)\big|_{\tau_S<\tau_U}$ (*A'*, *L'* and *P'*, respectively). There is a possible third option when any $M(\theta, r^*)$ intersects both $B(\theta, r^*)\big|_{\tau_S>\tau_U}$ and $B(\theta, r^*)\big|_{\tau_S<\tau_U}$ at the same point (*Q* in Figure 2). If the economy starts at such a level of r^*, then taxing skilled migrants at a higher or a lower rate would provide equivalent increases in the level of r^*. However, in all such cases the policy of imposing a flat tax across the skill types dominates the impact on human capital formation, implying that a higher tax burden on the unskilled unambiguously promotes human capital formation.

Figure 2: The dynamic relationships between migration tax, redistribution and human capital



Note: $M(\theta, r^*)$ is generated from the following values of the parameters:

$$\frac{a}{w}=0.2,\ \frac{b}{w_S}=0.05,\ s=11,\ n=54,\ \rho=0.05,\ D=8.$$

For $M_1(\theta, r^*)$: $\frac{a}{w}=0.2,\ \frac{b}{w_S}=0.05,\ s=11,\ n=54,\ \rho=0.05,\ D=3$

And for $B(\theta, r^*)$ with the three cases,

$$r_S^* = 0.92, r_U^* = 0.683$$

$$\tau_S = \tau_U = 0.05;\ \tau_S > \tau_U\ (=0.05>0.01)\ ;\ and\ \tau_S < \tau_U\ (=0.01<0.05)$$

Let us provide some intuitive explanations for these seemingly unconventional results. First, consider a low level of r^* to begin with. The objective of the government is to tax the migrants and use the revenue to subsidize education at home for those who are distributed in the region where discounted expected utility from acquiring human capital is lower than remaining unskilled. Under the circumstances, if the government taxes the unskilled workers at a proportionally higher rate than the skilled workers it favours higher human capital formation in two different ways. On the one hand, the non-migrant unskilled workers get the benefit of educational subsidy to acquire human capital and on the other, take notice of the fact that if they migrate as 'skilled' workers they face a lower tax rate. It must be noted that even the flat tax as percentage of unskilled foreign wage is considerably higher compared to the tax burden per unit of skilled wage abroad. Thus, the proportionately higher migration tax discourages unskilled workers to remain

unskilled and migrate as unskilled workers. In other words, a (proportionately or directly) higher tax on unskilled workers turns out to be both the stick and the carrot that the government may use to induce greater human capital formation in the country.

Second, consider an economy where the level of human capital is already high (as shown by $M_1(\theta, r^*)$ in Figure 2), and it positively biases the number of skilled migrants. A *ceteris paribus* flat tax can then generate larger tax revenue to be distributed as a higher per unit subsidy (point A' in Figure 2, where the same 5 cent per dollar tax can now generate a per unit subsidy of about 50 cents). The incremental human capital formation is also more sensitive to taxing the skilled workers at a higher rate than the unskilled workers. Clearly, the contrasting tax patterns as one observes under the initial levels of low and high human capital formation may be representative of how countries with dissimilar emigration experiences may choose to deal with the imposition of migrant taxes.

Proposition 1: A flat migration tax across skill types (and therefore regressive) is most effective in raising the level of human capital for the unskilled non-migrants under all cases. A higher unskilled tax relative to skilled tax is also more effective in raising the level of human capital if the economy starts from a low level of human capital.

4 Implications for income levels

Finally, let us discuss the impact of such taxes on the level of income for the non-migrants. Define the total (and average) income level for the skilled and unskilled non-migrants as follows:

$$\Omega = w_s(1-r_S^*)r^* + w(1-r_U^*)(1-r^*) \tag{7}$$

where, $r_S^* = f(\tau_S)$, $f' < 0$, $f'' < 0$; $r_U^* = g(\tau_U)$, $g' < 0, g'' < 0$. These imply that as tax rates on the skilled and the unskilled go up independently, the level of critical risk aversion falls for each type. This follows directly from a post-tax comparison of the level of expected utilities for the skilled and the unskilled (reformulating equations 3 and 4) solving for lower levels of r_S^* *and* r_U^*:

$$\int_s^{n+s} \left(\frac{1}{2b}\int_{-b}^{b} (w_S + \beta)^{1-r_S} d\beta\right) e^{-\rho t} dt = \int_s^{n+s} (1-\tau_S)\lambda_S \left(\frac{1}{2m}\int_{-m}^{m} (w_S^* + \mu)^{1-r_S} d\mu\right) e^{-\rho t} dt \tag{3}'$$

and

$$\int_0^{n} \left(\frac{1}{2a}\int_{-a}^{a} (w+\varepsilon)^{1-r_U} d\varepsilon\right) e^{-\rho t} dt = \int_0^{n} (1-\tau_U)\lambda_U \left(\frac{1}{2z}\int_{-Z}^{Z} (w^*+\xi)^{1-r_U} d\xi\right) e^{-\rho t} dt \tag{4}'$$

However, following (6), $r^* = k(\theta)$, $k' > 0, k'' > 0$, and $\theta = l(\tau_S, \tau_U)$, $l' > 0, l'' < 0$ in the post-subsidy regime. A rise in the amount of subsidy increases the level of critical risk aversion among the non-migrants increasingly, such that more unskilled workers are now distributed in the range where human capital accumulation yields greater utility. On the other hand, a rise in either type of migrant taxes (holding the other as constant)

would raise the level of subsidy.[12] This allows us to observe the impact on Ω when one type of migration tax changes, at a given level of the other type. Therefore,

$$\left.\frac{\delta\Omega}{\delta\tau_S}\right|_{\tau_U} = w_s \frac{\delta(1-r_S^*)}{\delta\tau_S} r^* + w_s(1-r_S^*)\frac{\delta r^*}{\delta\theta}\frac{\delta\theta}{\delta\tau_S} + w(1-r_U^*)\frac{\delta(1-r^*)}{\delta\tau_S}$$

or, $$\left.\frac{\delta\Omega}{\delta\tau_S}\right|_{\tau_U} = -w_s \frac{\delta r_S^*}{\delta\tau_S} r^* + w_s(1-r_S^*)\frac{\delta r^*}{\delta\theta}\frac{\delta\theta}{\delta\tau_S} - w(1-r_U^*)\frac{\delta r^*}{\delta\theta}\frac{\delta\theta}{\delta\tau_S} \qquad (8)$$

where, $\frac{\delta r^*}{\delta\theta}>0$, $\frac{\delta\theta}{\delta\tau_S}>0$, and $\frac{\delta r_S^*}{\delta\tau_S}<0$, such that,

$$\left.\frac{\delta\Omega}{\delta\tau_S}\right|_{\tau_U} > 0,\ iff,\ \left(\frac{\delta r_S^*/\delta\tau_S}{\delta r^*/\delta\tau_S}\right) < \frac{w_s(1-r_S^*)-w(1-r_U^*)}{w_S r^*}.$$

Since, $\left(\frac{\delta r_S^*/\delta\tau_S}{\delta r^*/\delta\tau_S}\right)<0$, the sufficient condition is , $[w_s(1-r_S^*)-w(1-r_U^*)]\geq 0$

i.e., $\left.\frac{\delta\Omega}{\delta\tau_S}\right|_{\tau_U} > 0,\ if,\ \frac{w_S}{w}\geq\frac{1-r_U^*}{1-r_S^*}$.

Similarly, with regard to the tax on unskilled workers, the change in income is given by:

$$\left.\frac{\delta\Omega}{\delta\tau_U}\right|_{\tau_S} = w_s(1-r_S^*)\frac{\delta r^*}{\delta\theta}\frac{\delta\theta}{\delta\tau_U} - w(1-r_U^*)\frac{\delta r^*}{\delta\theta}\frac{\delta\theta}{\delta\tau_U} - w(1-r^*)\frac{\delta r_U^*}{\delta\tau_U} \qquad (9)$$

It should be noted that the sufficient condition for increase in the average income of the non-migrants is the same for any *ceteris paribus* change in the rate of migration tax facing the unskilled workers, i.e., $\left.\frac{\delta\Omega}{\delta\tau_U}\right|_{\tau_S} > 0,\ if,\ \frac{w_S}{w}\geq\frac{1-r_U^*}{1-r_S^*}$. A comparison of (8) and (9) further implies that an increase in the tax imposed on the unskilled migrants, as compared to skilled migrants, would be more productive in raising the relative income, i.e., $\left(\frac{\delta\Omega}{\delta\tau_S}-\frac{\delta\Omega}{\delta\tau_U}\right)<0$, if and only if, $\frac{\delta r_U^*/\delta\tau_U}{\delta r_S^*/\delta\tau_S} < \frac{w_S r^*}{w(1-r^*)}$, where, $\frac{\delta r_U^*/\delta\tau_U}{\delta r_S^*/\delta\tau_S}$ is the ratio of the sensitivity of unskilled migration to unskilled tax, and the sensitivity of skilled migration to skilled tax. On the other hand, $\frac{w_S r^*}{w(1-r^*)}$ is the ratio of skilled-to-unskilled income in the pre-migration regime.

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12 This assumes that both types of migrants exist in a relatively inelastic zone, where a change in the tax rate does not affect the relative risk aversion considerably, for example, $\left(-\frac{\delta r_S^*}{\delta\tau_S}\frac{\tau_S}{r_S^*}\right)<1$. More generally, therefore, the effect of tax on subsidy can go either way.

Proposition 2: Any increase in the unskilled migration tax dominates the relative change in average income vis-à-vis skilled migration tax, if and only if the skilled-to-unskilled income ratio in the pre-migration regime is strictly greater than the ratio of the change in unskilled migration to unskilled tax relative to the same for skilled migration.

5 Concluding remarks

Taxing migrants to raise the level of income for the non-migrants is a complex and moot proposition. Yet, in recent times the phenomenal increase in the global trends in labour migration predominantly originating from the developing world opens up questions on whether it can be a viable policy to benefit a large number of non-migrants. One certain way in which migration helps the improvement of living conditions (and alleviation of poverty) in the source countries is via remittances. However, it is also widely acknowledged that the larger share of remittances comes from the relatively unskilled migrants in favour of maintaining their families at home. The contributions from the skilled migrants are both low and highly volatile on account of various reasons. Moreover, there is insufficient evidence on the extent of spillovers such remittances, a considerable portion of which is transferred in kinds, generate for the larger society. Thus, migration taxes as a stable alternative may be justified on many such grounds (in addition to the ones already discussed in earlier studies) giving the government options to use a potentially large resource more efficiently.

While the creation or existence of legal and political environment in favour of implementing such taxes is another issue in need of further research, the present study tries to establish that migrant taxes can be beneficial in raising the level of human capital in the origin country—a subject not discussed in the existing literature. The procedure follows a traditional tax subsidy scheme that operates on a set of individuals maximizing their own discounted lifetime utility from choices towards human capital formation and migration. It turns out that the effect of migration taxes would be positive and most significant in raising the average level of human capital for the non-migrants if the unskilled migrants face a relatively higher tax burden on their income. This is particularly appealing for an economy where the pre-migration pre-tax level of human capital formation is low. A scheme of flat migration tax would nevertheless be effective in raising the skill level further for countries with high or medium levels of human capital. The proportionately (or actually) higher migration tax creates a disincentive for unskilled migrants to migrate as unskilled workers. At the same time, since the policy of the state is to redistribute the migration tax as educational subsidy, a larger number of unskilled workers find it rewarding to acquire human capital with or without future intentions of undertaking migration. If they do not migrate they earn the skilled wage at home, and if they do they end up paying a lower (or proportionally lower) tax than the unskilled. Thus, despite a seemingly inequitable proposition this offers a potential win-win situation for a large number of unskilled non-migrants.

A few extensions can enrich the results of this model. Wages, instead of being treated as exogenous, may respond to the mobility of workers. It is possible when migration is large and either or both the origin and the destination countries are small. The impact of migrant taxes needs to be re-evaluated in that case. Moreover, we did not consider any tax sharing arrangement between any two countries that may be bilaterally involved in implementing this policy and therefore the implications are restricted to local welfare. Once that is brought into account it is quite plausible that the implications for global

welfare would be considerable in addition to the fact that a lower restriction on the movements of skilled workers by itself is believed to be welfare enhancing in a global sense. The impact on local and global income distribution is another aspect that requires further attention in the related context.

Appendix I

Freeman's (1986: 375-76) summary of the various dimensions of the 'demand for education' and its reference to Mincer's (1974) model for determination of the education-earnings relation is well known and is based on the following comparison:

$$\int_0^n W_t e^{-\rho t} dt = \int_s^{n+s} W_{St} e^{-\rho t} dt + \int_0^s (W'_{St} - D) e^{-\rho t} dt$$

Where, W_t is the unskilled wage, W_{St} is the skilled wage, W'_{St} is the wage the agent earns during the period over which human capital is acquired, D is the direct cost of education and ρ is the discount rate. n and $(n+s)$ are the number of years unskilled and skilled workers respectively work. If $W'_{St} = 0 = D$, the above comparison between the choices in favour or against human capital formation boils down to the following condition: $\int_0^n W_t e^{-\rho t} dt = \int_s^{n+s} W_{St} e^{-\rho t} dt$, which yields, $\frac{W_S}{W} = e^{\rho s}$, the so-called log earnings function and determines what factors would influence the supply of skilled labour most.

Appendix II

Derivation of equation (1): $EU_U = \int_0^n (\frac{1}{2a} \int_{-a}^{a} (w+\varepsilon)^{1-r} d\varepsilon) e^{-\rho t} dt$

$$EU_U = \frac{(e^{-\rho n} - 1)}{2a(-2+r)\rho} \left[(w+a)^{2-r} - (w-a)^{2-r} \right], \text{ such that, } EU'_U(r) < 0,\ EU''_U(r) > 0 \qquad \text{(A1)}$$

Derivation of equation (2): $EU_S = \int_s^{n+s} (\frac{1}{2b} \int_{-b}^{b} (w_S + \beta)^{1-r} d\beta) e^{-\rho t} dt - \int_0^s (D^{1-r}) e^{-\rho t} dt$

$$EU_S = \frac{(e^{-\rho n} - 1) e^{-\rho s}}{2b(-2+r)\rho} \left[(w_S + b)^{2-r} - (w_S - b)^{2-r} \right] + \frac{D^{1-r}}{\rho} (e^{-\rho s} - 1) \qquad \text{(A2)}$$

Again, $EU'_S(r) < 0,\ EU''_S(r) > 0$, and $\left| EU'_U(r) \right| < \left| EU'_S(r) \right| \forall r \in [0,1)$.

Equating (A1) and (A2) one determines the critical relative risk aversion among the mass of workers in the home country, in favour or against human capital formation. This is displayed in Panel A of Figure 1, where given the values of the parameters, we solve for $r^* = 0.584$.

Similarly, we derive the expressions for EU_S^* and EU_U^* from the RHS of equations (3) and (4) respectively, as,

$$EU_S^* = \frac{\lambda_S (e^{-\rho n} - 1) e^{-\rho s}}{2m(-2+r_S)\rho} \left[(w_S^* + m)^{2-r_S} - (w_S^* - m)^{2-r_S} \right] \qquad \text{(A3)}$$

Where, $EU_S^{*\prime}(r) < 0,\ EU_S^{*\prime\prime}(r) > 0$. This equated with (A2) yields the critical risk relative risk aversion among the skilled workers—on the choice between migrating or staying

home, $r_S^* = 0.92$, as displayed in Panel B of Figure 1. Also, it can be seen from this relationship that $\left|EU_S'(r)\right| < \left|EU_S^{*'}(r)\right| \forall r \in [0,1)$.

And, for the unskilled workers:

$$EU_U^* = \frac{\lambda_U (e^{-\rho n} - 1)}{2z(-2 + r_U)\rho}\left[(w_U^* + z)^{2-r_U} - (w_U^* - z)^{2-r_U}\right] \quad \text{(A4)}$$

Equating that to equation (A1) yields, $r_U^* = 0.683$ and shown in Panel C of Figure 1.

Now, once migration tax is introduced, equations (A3) and (A4) changes to

$EU_S^* = \frac{(1-\tau_S)\lambda_S (e^{-\rho n} - 1)e^{-\rho s}}{2m(-2 + r_S)\rho}\left[(w_S^* + m)^{2-r_S} - (w_S^* - m)^{2-r_S}\right]$, and

$EU_U^* = \frac{(1-\tau_U)\lambda_U (e^{-\rho n} - 1)}{2z(-2 + r_U)\rho}\left[(w_U^* + z)^{2-r_U} - (w_U^* - z)^{2-r_U}\right]$ with τ_S and τ_U as taxes imposed on the skilled and the unskilled migrants, respectively. Based on the tax revenue the government collects, a per unit subsidy of θ is offered to the unskilled migrants in the origin country. This affects the level of r^* as obtained from the previous equality of (A1) and (A2). In other words, the new solution requires a comparison of the expected utilities in the re-distributive regime as given by equation (6):

$$\int_0^n \left(\frac{1}{2a}\int_{-a}^{a}(w+\varepsilon)^{1-r}d\varepsilon\right)e^{-\rho t}dt = \int_s^{n+s}\left(\frac{1}{2b}\int_{-b}^{b}(w_S+\beta)^{1-r}d\beta\right)e^{-\rho t}dt - \int_0^s (D-\theta)^{1-r}e^{-\rho t}dt$$

However, as discussed earlier equation (6) generates a dynamic relationship between the provision of subsidy and the critical risk aversion, where, the RHS of equation (6) now yields: $EU_{S\theta} = \frac{(e^{-\rho n} - 1)e^{-\rho s}}{2b(-2+r)\rho}\left[(w_S + b)^{2-r} - (w_S - b)^{2-r}\right] + \frac{(D-\theta)^{1-r}}{\rho}(e^{-\rho s} - 1)$ (A5)

Equating (A1) and (A5) we obtain the relation described as $M(\theta, r^*)$:

$$\frac{(e^{-\rho n} - 1)}{2a(-2+r)\rho}\left[(w+a)^{2-r} - (w-a)^{2-r}\right] = \frac{(e^{-\rho n} - 1)e^{-\rho s}}{2b(-2+r)\rho}\left[(w_S + b)^{2-r} - (w_S - b)^{2-r}\right] + \frac{(D-\theta)^{1-r}}{\rho}(e^{-\rho s} - 1)$$

Or,

$$\ln(\theta) = D + \ln(-\exp)\left[\frac{-\ln\left[\begin{array}{l} be^{-\rho n}e^{\ln(w-a)^2}e^{-r^*\ln(-w^2+a^2)}e^{r^*\ln(w_S^2-b^2)}\left\{(w+a)^2-(w-a)^2\right\} \\ \quad -be^{r^*\ln(w_S^2-b^2)} - ae^{-(\rho s+\rho n-\ln(w_S-b)r^*)}\left\{(w_S+b)^2-(w_S-b)^2\right\} \\ \quad -ae^{-(\rho s-\ln(w_S+b)r^*)}(w_S-b)^2(1-e^{-\rho n}) \end{array}}{2ab(-2+r^*)(1-e^{-\rho s})}\right] - r^*\ln(w_S^2-b^2)}{(-1+r^*)}\right] \tag{A6}$$

With $\frac{\delta r^*}{\delta\theta} > 0$ and $\frac{\delta^2 r^*}{\delta\theta^2} > 0$. Substituting the parameter values as $\frac{a}{w} = 0.2,\ \frac{b}{w_S} = 0.05,\ s = 11,\ n = 54,\ \rho = 0.05,\ D = 3,$ we obtain the relationship for $M(\theta, r^*)$ as shown in Figure 2.

Finally, the budget constraint facing the government is given by: $(1-r^*)\theta(1-r_U^*) = r^* r_S^* \tau_S + (1-r^*) r_U^* \tau_U$, which generates the relationship described as $B(\theta, r^*)$,

$$r^* = \frac{\theta(1-r_U^*) + r_U^*\tau_U}{\theta(1-r_U^*) + r_S^*\tau_S - r_U^*\tau_U} \tag{A7}$$

Such that, $\frac{\delta r^*}{\delta\theta} > 0$ and $\frac{\delta^2 r^*}{\delta\theta^2} < 0$, and the three possible cases discussed above (i.e. $\tau_S = \tau_U;\ \tau_S > \tau_U;$ *and* $\tau_S < \tau_U$) are shown in Figure 2. The interaction between (A6) and (A7) generates a new r^* for different combinations of τ_S *and* τ_U, demonstrating how skill specific migration taxes affect the critical relative risk aversion in a country and hence the level of human capital formation.

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