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Endogenous Skill Formation and the Source Country Effects of Emigration*

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Abstract

In this paper we set up a simple theoretical framework to study the possible source country effects of skilled labor emigration. We show that for given technologies, labor market integration necessarily lowers GDP per capita in a poor source country of emigration, because it distorts the education decision of individuals. As pointed out by our analysis, a negative source country effect also materializes if all agents face identical emigration probabilities, irrespective of their education levels. This is in sharp contrast to the case of exogenous skill supply. Allowing for human capital spillovers, we further show that with social returns to schooling there may be a counteracting positive source country effect if the prospect of emigration stimulates the incentives to acquire education. Since, in general, the source country effects are not clear, we calibrate our model for four major source countries – Mexico, Turkey, Morocco, and the Philippines – and show that an increase in emigration rates beyond those observed in the year 2000 is very likely to lower GDP per capita in poor economies.

JEL-Classification: F22, J24.

Key words: Emigration; endogenous skill formation; source country effects

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1 Introduction

How to design migration rules is one of the most controversially discussed issues in policy circles and the general public alike. Accounting for concerns of domestic unskilled workers, many industrialized countries nowadays apply selective standards that bias immigration quota toward skilled applicants. That such standards are beneficial for the host (i.e. the immigration) country is by now broadly accepted in the economics discipline. To the contrary, the consequences for the source (i.e. the emigration) country are not settled yet. The rather small existing literature has focused on the effects that emigration of *educated* workers has on those who do not emigrate. The traditional view is that such a *brain drain* is harmful for the source country. As pointed out by Freeman (2006), with exogenous schooling, a fall in the supply of skilled labor raises the wages of skilled non-migrants, while at the same time it reduces the wages of unskilled workers, with negative consequences for income of those who stay in the source country.[1]

Despite the loss of labor, a brain drain can as well be beneficial for the source country. In particular, those who emigrate may pay remittances to their relatives at home or they may bring with them knowledge and experience from the host country when returning in later stages of their working career. A more recent literature has emphasized a further channel through which the source country can benefit even if remittances and return migration do not materialize. The prospect of emigration may raise the expected return to schooling and thus render education more attractive. To the extent that only a small fraction of those who are educated actually emigrates and there is a high social return to education, those who are left behind may actually be better off after the brain drain (see Mountford, 1997; Beine, Docquier and Rapoport, 2001). This argument has sparked a lot of interest in recent years, because it indicates that selective immigration policies in the industrialized world may be beneficial for developing countries as well.

In this paper, we set up a neoclassical model with a single production sector that allows us to discuss the possible losses and benefits from emigration of educated workers in a unified framework. Along the lines of the traditional migration literature, we consider two types of workers who differ in their education levels. We enrich this simple framework with several features that have been emphasized to be important in the new brain drain

[1]Based on the insight that brain drain harms those who are left behind, Bhagwati and Hamada (1974) have called for a tax on educated emigrants in order to counter the negative effect.

literature. In particular, we assume that migration is represented by a lottery with exogenous emigration probabilities (which can be skill-specific). Furthermore, we assume that the agents differ in their abilities and we account for adjustments in the schooling decision that can either be triggered by changes in the emigration probabilities or changes in foreign wages. In contrast to recent work on the brain drain, however, we do not associate schooling with a simple increase in the effective labor supply of workers (see e.g. Stark and Wang, 2002) but instead assume that individuals who acquire education become skilled and thereby complements to unskilled agents in the production process (see e.g. Egger, Falkinger and Grossmann, 2007).

In this setting, we show how the prospect of emigration distorts the private schooling decision with negative consequences for GDP per capita in South. In order to highlight this distortion, we consider identical emigration probabilities for skilled and unskilled workers in our baseline scenario. In this case, a higher emigration probability would not affect GDP per capita in the source country if schooling was exogenous. This corresponds to the traditional view on possible migration effects (see Freeman, 2006). However, with endogenous schooling, individuals have an incentive to adjust their decision upon acquiring education if relative wages in the host country differ from relative wages in the source country. In the empirically relevant case of higher wage inequality in developing countries – which are typically the source countries of brain drain – the incentives for participating in schooling decline with a higher emigration probability. This result is in contrast to one of the key findings of the new brain drain literature that a higher probability of emigration boosts the incentives for education in the source country (see Stark, Helmenstein and Prskawetz, 1998; Beine, Docquier and Rapoport, 2001, 2008).

In our baseline model with the same emigration probabilities for both skill groups, a positive effect on educational attainment can only arise, if wage inequality in the source country is lower than wage inequality in the host country. This, however, is at odds with empirical evidence. In order to account for a positive impact of skilled labor migration on schooling in the source country, we extend our model to selective migration with a positive emigration rate of skilled workers and no migration of unskilled ones (see Mountford, 1997). In this case, the prospect of emigration indeed increases the incentives for education, irrespective of the prevailing international differences in relative wages. Despite this difference to our baseline scenario, GDP per capita also deteriorates emigration if it has an education bias. Similar to the traditional brain drain literature with exogenous schooling, the loss of educated workers lowers skill intensity in production. This raises wages of skilled workers and lowers wages of unskilled workers, with negative consequences on GDP per capita. This effect is counteracted by an increase in the incentives to acquire education. However, it turns out that the second effect cannot dominate and hence GDP per capita is lower in the migration scenario than in a scenario without migration. This is intuitive because the skill intensity typically deviates from its optimal level and less able agents acquire education if migration is possible for skilled workers.

In a further extension to our model, we account for social returns to higher education in order to address a channel for positive source country effects of a brain drain that sparked a lot of interest in recent research. Similar to existing studies, we assume that the social return arises due to a positive externality of education on total factor productivity. To be more specific, we assume that total factor productivity depends positively on the skill intensity in production (see Südekum, 2006, 2008). In this case, the negative GDP per capita effects of emigration are reinforced if schooling incentives fall, while the externality counteracts the negative effect from the distortion in schooling, if acquiring education becomes more attractive. Since it is in general not clear which of the two effects dominates, we calibrate our model for four major source countries: Mexico, Turkey, Morocco, and the Philippines. To give the new brain drain literature a fair chance, we choose a rather accommodating parameterization of the human capital externality. The calibration results indicate that even in this case there is little reason for being overly optimistic about emigration of highly educated agents to boost GDP per capita through adjustments in the schooling decision. However, it may still be possible that emigration leads to benefits through *other* channels, which are excluded from our analysis, such as remittances or return migration.

The remainder of the paper is structured as follows. In Section 2, we review stylized facts on emigration patterns, complementarities between skilled and unskilled workers, wage inequality and social returns to schooling in order to motivate the key assumptions in the theoretical model that we set up in Section 3. In Section 4 we present the main analytical results for the baseline scenario with identical emigration probabilities for skilled and unskilled workers. Section 5 provides two extensions. On the one hand, we discuss selective migration in which only skilled workers are allowed to emigrate, while unskilled workers are immobile. On the other hand, we introduce social returns to schooling by accounting for an externality of education on total factor productivity. Section 6 reports the results from several numerical simulation exercises and provides insights on whether positive GDP per capita effects of emigration can be expected when relying on realistic parameter domains. Finally, Section 7 concludes with a brief summary of the most important results.

2 Stylized facts

In this section, we present a number of stylized facts which will guide our modeling approach. First, recent evidence suggests that emigration of uneducated workers from poor countries is too important a phenomenon to rule it out by assumption. Second, we briefly review recent evidence on the elasticity of substitution between different education groups and come to the conclusion that technological complementarity between workers with different skills indeed exists. Third, we rely on several data sets and different methods to show that real wage income is higher in the host country of emigration, while the education premium is typically much higher in source than in host countries. Fourth, we review evidence on social returns to schooling, since these returns have been emphasized to be important in the recent brain drain literature.

2.1 Emigration rates

Docquier and Marfouk (2006) provide an extensive data set on migration patterns, which has the unique advantage that it differentiates migrants according to their education levels. At the same time, however, it has several disadvantages. In particular, the data contains stocks of immigrants in OECD countries, but it does not provide the same information for non-OECD members. Furthermore, the stock data is only available for the year 2000, so that it cannot be used to compute bilateral flows. Finally, to make the data consistent with our theoretical model, we have to adjust the number of education classes. Docquier and Marfouk (2006) distinguish migrants with a low, medium and high schooling level. Following the existing literature, we combine individuals with low and medium education levels to the group of uneducated (or unskilled) workers, while a high level of schooling refers to educated (or skilled) workers in our model. Despite these shortcomings, the data set can still be used as a source of several interesting stylized facts.

These facts are summarized in Fig. 1, which depicts emigration rates for a collection of (poor) countries that together account for about 75 percent of immigration into the

OECD.[2] The right-hand-side axis records the contribution of each country to the overall stock of emigrants: 18 percent of all emigrants are Mexicans, about 5 percent are Turks, about 4 percent are Indian, Chinese or from the Philippines, and so on. The smallest contributer in this ranking is Peru, which accounts for less than 0.5 percent of world emigration. The left-hand-side axis shows the skill-specific emigration rate for educated (p^e) and uneducated (p^u) individuals. While, $p^e > p^u$ holds for almost all listed countries (with Bulgaria being an exception), the difference in emigration rates, $p^e - p^u$, is rather small on average[3] and it is particularly small for the two largest source countries, Mexico and Turkey. For other, smaller source countries the gap may be larger. Particularly remarkable in this respect are the very high emigration rates of small, poor island states. For example, the emigration rate of educated individuals is 83 percent in Haiti and 85 percent in Jamaica. At the same time, however, we find that $p^u > 0$ also holds in these economies.

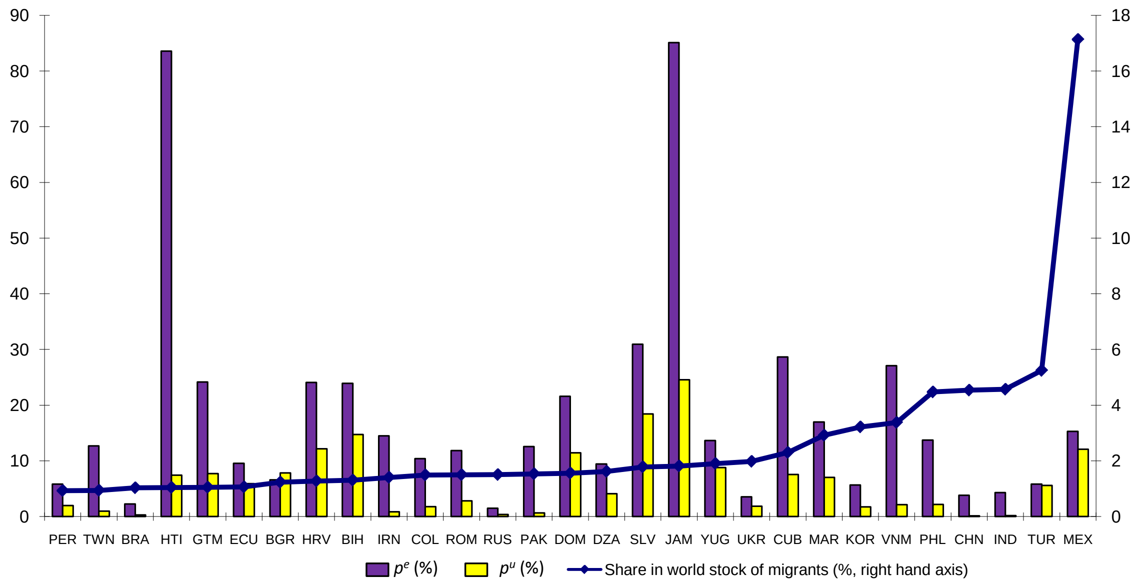

Figure 1: Skill-specific emigration rates and the cumulated stock of emigrants.

One further remark is in order here. The data by Docquier and Marfouk (2006) does not account for illegal and/or undocumented migration and hence the respective emi-

[2]Poor countries are defined to have per capita incomes below the world average in the year of 2000.

[3]The overall migration rate of educated workers is 5.4 percent while that of uneducated workers is 1.4 percent.

gration rates in Fig. 1 may substantially deviate from true ones. The stock of illegal immigrants is estimated to comprise about 30 to 40 million people worldwide, with approximately 10 million of these illegal immigrants living in the U.S. and a similar number living in Europe (Papademetriou, 2005). These numbers are of course only rough estimates, but even if relying on rather conservative figures, the magnitudes involved are substantial and the number of illegal immigrants is growing worldwide. Information about the educational background of illegal migrants is scarce. A survey carried out by the Pew Institute however shows that about two thirds of undocumented Mexican migrants in the U.S. have only very low levels of education (Kochhar, 2005). Hence, it seems fair to conclude that the omission of illegal immigration from the data shown in Fig. 1 biases the emigration rates of uneducated workers downwards, with the respective bias being possibly very large for Mexico.

In summary, we find some evidence for a brain drain from developing countries, but ignoring migration of unskilled workers does not seem justified. In particular, regarding the largest source countries emigration rates for skilled and unskilled workers are of comparable size, implying that identical propensities for both skill groups are probably a fairly good description of real world migration patterns.

2.2 Substitutability of different skills in production

One important assumption which distinguishes our analysis from previous contributions to the new brain drain literature is that workers with different education levels are imperfect substitutes in the production of goods. This feature of technology is widely documented for OECD countries and it is indeed central to many explanations for rising wage inequality (see, e.g., Autor, Katz, and Kearney, 2008). For non-OECD source countries of emigration, evidence is rather scarce. However, a recent comparative study by Aydemir and Borjas (2007) shows that the elasticity of substitution between different education levels is about 3 in Mexico.[4] This is probably the best available estimate and we take it as representative for other poor source countries in our numerical simulation exercises in Section 6.

[4]The hypothesis of workers being perfect substitutes up to efficiency differences is rejected at high degrees of statistical significance.

2.3 Inequality measures

The economic literature usually views the participation in education as an investment decision that is based on the (expected) income for different skill groups (see Becker, 1960). In closed economies the educational choice depends on domestic wages only. If emigration is possible, foreign wages matter as well. In the following, we therefore discuss evidence on both the skill premia within and differences in real labor income between countries. We start with the latter.

Wage differentials between countries. Real wages in typical source countries of emigration are much lower than those in host countries. This is not surprising, since wage differentials are major determinants of emigration (Borjas, 1987). However, the importance of the gap is striking. Focusing on low-skilled workers, Ashenfelter and Jurajda (2004) compare real wages in the fast food sector across a wide range of countries. They find that purchasing power parity (PPP) adjusted U.S.$ wages for *identical* jobs in the U.S., Japan, and Western Europe are four to five times higher than in Eastern Europe, Korea, or Brazil. The respective difference is even more pronounced between rich industrialized economies and China, India, or Colombia. However, the country coverage in this study is fairly limited.

To overcome the problem of small sample size, Table 1 shows PPP adjusted GDP per capita figures for the most important source counties of emigration (data column 4).[5] Moreover, the last column presents GDP per capita of the source country relative to the average GDP per capita of the host country of emigration. The host country averages are thereby computed for each source country separately, using bilateral emigration rates from Docquier and Marfouk (2006) as weights. The per capita income gap ranges between 1.43 for Taiwan to 14.36 for Vietnam in our data set. While this procedure allows us to calculate the respective income gaps for a wide range of developing countries, there is also a shortcoming of this approach: GDP per capita is only a rough measure of real wage income because it also reflects other factors, like factor composition or interest rates. However, we have to rely on this measure, because it is difficult to get detailed information on real wages for a large set of developing countries.

[5]The information is taken from the Penn World Tables mark 6.2 and refers to year 2000 since for this year we have data on skill-specific emigration rates (see above).

Table 1: Characteristics of most important source countries

		Source country				Destination (weighted averages)		
		U/(U+E) (%)	Gini (x100)	Theil (x100)	GDP p.c. (PPP)	Gini (x100)	GDP p.c. (PPP)	q (%)
Peru	PER	77.60	49.3	11.35	4205	38.41	30412	7.23
Taiwan	TWN	80.90	31.6	1.44	19184	32.87	27391	1.43
Brazil	BRA	91.60	59.8	7.79	7194	35.74	28218	3.92
Haiti	HTI	99.00	59.2		2069	40.24	33194	16.04
Guatemala	GTM	94.20	59.8	10.49	3859	41.39	34100	8.84
Ecuador	ECU	81.30	56.0	9.04	4314	32.63	27722	6.43
Bulgaria	BGR	80.90	33.2	7.99	7258	32.86	26359	3.63
Croatia	HRV	89.90	36.5	2.46	8980	31.34	26701	2.97
Bosnia and Herzegovina	BIH	89.90	26.1	3.93	3037	31.29	27644	9.10
Iran	IRN	93.30	44.0	2.89	6046	36.03	29876	4.94
Colombia	COL	90.10	57.8	4.14	6080	39.22	31063	5.11
Romania	ROM	91.10	40.6	1.56	5211	33.64	27083	5.20
Russia	RUS	79.90	48.7	5.93	9263	36.13	29648	3.20
Pakistan	PAK	97.20	29.6	8.13	2477	35.28	27803	11.22
Dominican Republic	DOM	85.50	47.6	9.10	6497	40.78	33182	5.11
Algeria	DZA	93.70	35.4	1.54	5753	28.94	25060	4.36
El Salvador	SLV	89.40	53.5	6.39	4732	30.60	26759	5.65
Jamaica	JAM	95.90	48.7	30.93	4521	38.75	31405	6.95
Serbia and Montenegro	YUG	86.25	37.3	11.81	2095	30.53	26764	12.78
Ukraine	UKR	79.90	46.2	6.64	5003	36.75	30206	6.04
Cuba	CUB	88.70	27.0	0.64	5699	41.19	33706	5.91
Morocco	MAR	94.82	39.4	8.43	3720	30.59	24190	6.50
Korea	KOR	74.20	37.1	2.05	15702	37.53	29976	1.91
Vietnam	VNM	96.23	37.3		2189	38.64	31437	14.36
Philippines	PHL	77.80	49.5	7.95	3826	39.17	31637	8.27
China	CHN	97.30	39.0	0.41	4002	37.46	29865	7.46
India	IND	95.20	36.0	9.17	2644	37.35	29693	11.23
Turkey	TUR	91.50	39.8	6.90	5715	28.76	25707	4.50
Mexico	MEX	88.70	54.6	4.23	8082	41.62	34288	4.24

Host countries: Australia, Austria, Belgium, Canada, Germany, Denmark, Spain, Finland, Spain, Great Britain, Ireland, Italy, Greece, Portugal, Israel, Luxembourg, Sweden, Norway, France, Switzerland, New Zealand, USA, Japan, Netherlands. The sending countries shown in the table together account for more than 75% of immigration into the source countries. Destination Gini and Income per capita have been weighted using total bilateral emigration stocks.

Wage inequality within countries. With regard to cross-country differences in the returns to schooling, we can rely on a large empirical literature. Psacharopoulos and Patrinos (2004) provide a recent survey on Mincerian wage regressions. They report that "*[t]he highest returns are recorded for low-income and middle-income countries*" (p. 112). For example, the average private return to an additional year of schooling ranges between 11.3 and 13.4 percent in the OECD, between 13.6 and 18.8 in emerging non-OECD countries, and between 24.6 and 37.6 in sub-Saharan Africa. Furthermore, returns also differ significantly within these groups of countries. In particular, they are smaller in Europe than in the U.S. (See Wössmann, 2003, for a similar assessment.) Since the schooling differential in years between educated and uneducated workers is roughly 8 to 10 years, the data suggest that the wage premium should be about 100 percent in continental

Europe, slightly higher in the U.S. and above 150 percent in many source countries.

Also notable in this respect is a recent book edited by Lazear ans Shaw (2009) on the structure of wages in several OECD countries. While not directly informative on the wage differential between educated and uneducated individuals, the studies in this book suggest that wage differentials exhibit important variation across countries. For example, the ratio of the 75th to the 25th percentile of the wage distribution in year 2000 is 2.72 in the U.S. and 1.91 in Germany. We may take these percentiles as representative for the upper and the lower tier of the wage distribution and identify their ratio as a measure of inequality between educated and uneducated individuals.

Data from existing country reports indicate that wage inequality importantly contributes to overall income inequality, so that aggregate indicators of inequality can be used to infer cross-country differences in the education premium. Data column 2 in Table 1 shows the most recent available Gini coefficients of overall income inequality for urban populations in developing countries taken from the World Income Inequality Database. Across the main source countries of emigration, the Gini coefficient varies between 27 percent (Cuba) and 59.8 percent (Brazil). We also compute the average Gini coefficients in the host countries by weighing host country Ginis with source-country specific bilateral emigration rates. Data column 6 contains the results of this calculations. It turns out that, aside from only a few exceptions (most notably Cuba), inequality is larger in the source than in the host countries of emigration.

Finally, to check robustness of our results, we can use information on wage inequality across occupations in industrial sectors from Galbraith and Lu (2001). These authors calculate the Theil index on wage inequality which reaches a value of 7 percent on average in the 119 poorest countries while it has a value of 3 percent on average in the richest 25 economies. Data column 3 in Table 1 reports further details on this index for the key source countries of emigration. While the Theil indices are only partly informative about cross-country differences in returns to education they are highly correlated with Gini coefficients (for which data coverage is higher). In summary, we can thus conclude that the evidence in this subsection strongly suggests that wage inequality is considerably higher in poor source countries than in the rich host countries of emigration.

2.4 Social returns to schooling

There exists a large literature that emphasizes the positive spillovers from educated to uneducated workers, implying that private and social returns to education differ. Indeed, as pointed out by Schultz (1988, p. 545), "*education is widely viewed as a public good (with positive externalities), which increases the efficiency of economic and political institutions while hastening the pace of scientific advancement on which modern economic growth depends.*" Theoretical work has also pointed to the relevance of human capital externalities as a source of economic development (see e.g. Lucas, 1990). However, reliable empirical work on the magnitude of these externalities is scarce and only available for industrialized economies (mainly the U.S.).

Rauch (1993) uses micro-level data to quantify human capital externalities. Taking the average schooling gap between educated an uneducated workers to be approximately 8 years, the numbers provided by Rauch imply that a 10 percent increase in average schooling (evaluated at the minimum schooling requirement of 8 years) increases productivity of all workers by about 2.4 to 4.1 percent. Acemoglu and Angrist (2000) criticize that Rauch's estimates are likely to be upward biased due to problems of regressor endogeneity. They propose to use a natural experiment to quantify the size of human capital externalities in the U.S. In their analysis the externalities are rather small (not larger than 1 percent), and they cannot reject the null hypothesis of returns being zero. The final word on the size of spillovers is still out, in particular for our sample of poor source countries. However, recent evidence for the U.S. suggests that human capital externalities are probably not very large.

The conclusion that the social returns to schooling should not be expected to be large also follows from the observation in the literature that a reliable estimate of these returns should capture "*the full social benefits of education which may contain any externalities arising from education, and the full social costs of education, including any public funding*" (Wössmann, 2003, p. 373). Hence, by abstracting from the social costs of education the results in Rauch (1993) may substantially overestimate the true social returns to education. Things become even more complicated when taking into account that the social costs of education critically depend on the prevailing schooling system and thus may differ substantially between countries. For an assessment on how the existence of social costs affects the returns to education, see Psacharopoulos and Patrinos (2004).

3 An emigration model with endogenous skill supply

We consider a small one-sector economy, 'South', which is populated by a unit mass of individuals. The representative firm in this economy employs skilled, E, and unskilled, U, labor to manufacture a homogeneous good Y. Considering a linear-homogeneous technology, we can write the production function in intensive form as $Y = AUf(e)$, where $e \equiv E/U$ denotes the skill intensity in production and A measures total factor productivity (TFP).[6] $f(\cdot)$ has the usual properties, $f'(\cdot) > 0$ and $f''(\cdot) < 0$, and it satisfies the Inada conditions. Hence, in line with the empirical evidence in Section 2, skilled and unskilled labor are complementary production factors. All markets are perfectly competitive, so that workers are paid their marginal products.

The local supply of skilled and unskilled labor is endogenous and depends on both the individual education decision (discussed in detail below) and the emigration rates of the two skill groups. Following the new brain drain literature (cf. Mountford, 1997; Beine, Docquier and Rapoport, 2001), emigration is modeled as a lottery outcome, with all workers of a specific skill group facing the same probability of successful emigration, $p^i \in (0, 1)$, $i = E, U$. We assume that the host country of emigration, 'North', is sufficiently rich to render emigration always beneficial for Southern workers. Intuitively, this is the case if TFP in South is sufficiently small.

Individuals in the Southern economy differ in their innate learning abilities $a \in [0, 1]$. These abilities are distributed according to a c.d.f. $G(a)$, with $G'(a) > 0$. Educated agents supply a efficiency units of skilled labor E, while uneducated agents supply one unit of unskilled labor U.[7] Hence, $1 - a$ describes the private cost of education in terms of lower working time. Risk neutral agents maximize expected income by choosing whether or not to get educated. The expected income crucially depends on learning abilities and the skill-specific propensities to emigrate. Using an asterisk to indicate Northern variables and denoting skilled and unskilled wages per efficiency unit by r and w, respectively, the expected return to a unit of skilled and unskilled labor is given by $\mathbb{E}r = p^e r^* + (1 - p^e)\, r$ and $\mathbb{E}w = p^u w^* + (1 - p^u)\, w$, respectively. The marginal individual, that is indifferent between

[6] For the moment, we treat A parametrically, while in Section 5 we assume that TFP depends positively on the skill intensity in production in order to account for social returns to schooling.

[7] We do not account for the possibility that educated individuals execute unskilled tasks (see Davidson, Matusz and Shevchenko, 2008). This presumes that the returns to skilled labor are higher than the returns to unskilled labor, which we take for granted in the subsequent analysis.

education and non-education, is determined by the cutoff ability condition $\bar{a} = 1/\mathbb{E}\omega$, where $\mathbb{E}\omega \equiv \mathbb{E}r/\mathbb{E}w$ is the expected return to education. One can rewrite that condition in terms of *within-country wage inequality measures (i.e. skill premia)* $\omega \equiv r/w$ and $\omega^* \equiv r^*/w^*$, and the *between-country unskilled wage differential* $q \equiv w^*/w$:

$$\bar{a} = \frac{1}{\mathbb{E}\omega} = \frac{1 + p^u (q-1)}{(1-p^e)\,\omega + p^e \omega^* q}. \tag{1}$$

With a share p^e of educated and a share p^u of uneducated individuals leaving South to work in North, the supply of unskilled and skilled labor that is available for production in the source country is given by $U^s = (1-p^u)G(\bar{a})$ and $E^s = (1-p^e)\int_{\bar{a}}^1 adG(a)$, respectively. Labor market clearing hence implies that the skill intensity in Southern production is given by

$$e(\bar{a}) \equiv \frac{(1-p^e)\int_{\bar{a}}^1 adG(a)}{(1-p^u)\,G(\bar{a})}, \tag{2}$$

where $\lim_{\bar{a}\to 0^+} e(\bar{a}) = \infty, \lim_{\bar{a}\to 1^-} e(\bar{a}) = 0$, and $e'(\bar{a}) < 0$ hold. Intuitively, a higher ability threshold means that less individuals participate in education and hence the skill intensity in Southern production falls.

Using the skill intensity from Eq. (2) in the solution to the profit-maximization problem of the competitive producers, which is characterized by $r = f'(e)$ and $w = f(e) - ef'(e)$, it is straightforward to determine the skill premium (per efficiency unit of labor) in South as well as the between-country unskilled wage differential. The equilibrium values of these two variables are given by

$$\omega = \frac{f'(e(\bar{a}))}{f(e(\bar{a})) - e(\bar{a})f'(e(\bar{a}))} \quad \text{and} \quad q = \frac{w^*}{Af(e(\bar{a})) - e(\bar{a})Af'(e(\bar{a}))}, \tag{3}$$

respectively. The first expression determines a positive relationship between the skill premium ω and marginal ability $\bar{a}$. This is intuitive, as a higher cutoff threshold reduces the number of educated workers and thereby lowers skill intensity, with a positive impact on the skill premium. Furthermore, under a linearly homogeneous production technology the higher skill premium is associated with a decline in the absolute return to unskilled labor in South and, hence, between-country unskilled wage inequality must increase for a given w^*. This explains the positive relationship between $\bar{a}$ and q as determined by the second expression in Eq. (3).

The equilibrium cutoff ability, skill intensity and wage inequality are jointly determined by Eqs. (1)-(3). Fig. 2 illustrates the equilibrium in the $(1/\mathbb{E}\omega, \bar{a})$-space. The upward-sloping 45-degree line depicts the left-hand-side of Eq. (1). Furthermore, substituting

Eq. (2) into Eq. (3) and using the resulting expression in the right-hand-side of Eq. (1) gives a function $\Omega(\bar{a})$, which is positive, monotonic, and strictly decreasing in $\bar{a}$. It is convex to the origin and satisfies $\lim_{\bar{a}\to 0}\Omega(\bar{a}) = \infty$.[8] When $\bar{a}$ goes up, a smaller fraction of agents invests into schooling and the education intensity in production goes down (see Eq. (2)). This puts downward pressure on wages for uneducated agents, while those of educated individuals rise. Hence, both the inverse of the skill premium, $1/\omega$, and $1/\mathbb{E}\omega$ fall. Fig. 2 shows that the model exhibits a unique equilibrium, with the equilibrium cutoff ability level being denoted by $\bar{a}(p^e, p^u)$ to indicate the dependence of the cutoff level on the prevailing emigration rates, p^e and p^u.

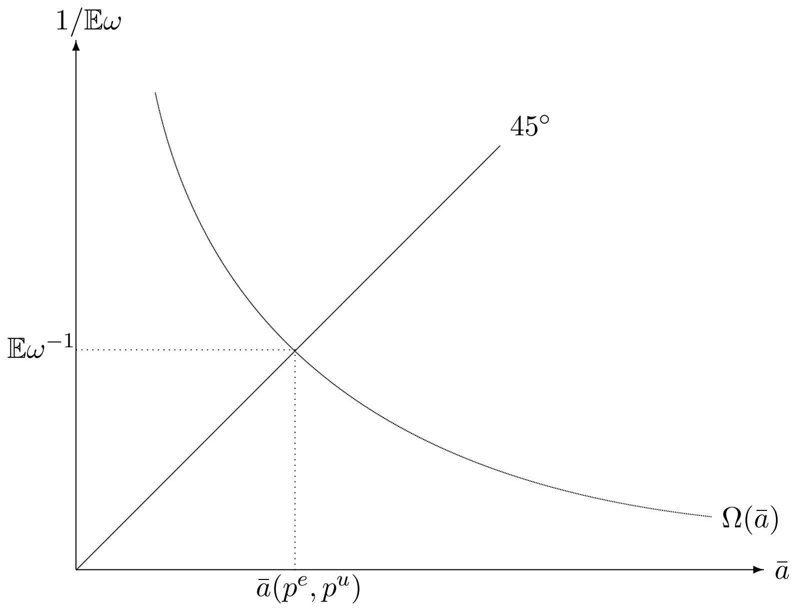

Figure 2: Equilibrium in the source country

In the next two sections, we are particularly interested in the effects that emigration exhibits on the source country. To determine these effects, we look at the change of GDP

[8] An explicit solution for $\Omega(\bar{a})$ is given by

$$\Omega(\bar{a}) = \frac{p^u w^* + (1-p^u) A\left[f(e(\bar{a})) - f'(e(\bar{a}))\, e(\bar{a})\right]}{p^e r^* + (1-p^e) A f'\left[e(\bar{a})\right]},$$

from where it is straightforward to calculate $\Omega'(\bar{a}) < 0$, when accounting for $e'(\bar{a}) < 0$.

per capita.[9] GDP per capita is given by

$$V = \frac{(1-p^u)G(\bar{a})\, Af(e(\bar{a}))}{(1-p^e)+(p^e-p^u)G(\bar{a})}, \tag{4}$$

where $(1-p^e)+(p^e-p^u)G(\bar{a})$ represents the size of resident population in South (i.e. the number of non-migrants). Furthermore, since GDP per capita adjustments do not account for changes in the distribution of income, we also calculate income inequality between educated and uneducated non-migrants. Notably, income inequality differs from the skill premium per efficiency unit of labor, because it also depends on the level of efficiency units provided by skilled workers. Denoting effective labor per educated worker by $\rho \equiv \left[\int_{\bar{a}}^{1} adG(a)\right] / [1-G(\bar{a})]$, income inequality in South is given by $R \equiv \omega\rho$.

This completes the description of the formal setup. In the following section, we provide a comparative-static analysis on the effects that a change in the emigration probabilities exhibits on the source country. Thereby, we rely on the empirical observation that in the two largest source countries, Mexico and Turkey, there is not a sizable difference between the emigration rates of educated and uneducated workers and, hence, assume $p^e = p^u \equiv p$. The case of (quality-)selective migration with $p^e > 0$ and $p^u = 0$ is considered in Section 5.

4 The case of identical emigration probabilities

We now consider emigration probabilities that are the same for both education groups. Then, the impact of a higher propensity to emigrate on cutoff ability $\bar{a}$ and skill premium ω can be summarized in the following way.

Proposition 1. *A pari passu increase in the emigration propensities for both education groups lowers (raises) the incentives for education if the skill premium in the host country is lower (larger) than the skill premium in the source country. The skill premium in South increases (declines) in this case.*

[9] It is notable that in general changes in GDP per capita need not to be identical to changes in total income of those who are left behind. The reason is that the the average income of emigrants can differ from GDP per capita prior to migration. Due to this observation, we have studied the consequences of emigration on total income of non-migrants in a previous version of this manuscript. However, since the effects on total income of non-migrants and GDP per capita turned out to be qualitatively the same in the considered scenarios, we have decided to simplify our analysis and thus only look on GDP per capita changes in the subsequent analysis.

Proof. Analysis in the text. □

The impact of an increase in emigration propensity p ($\equiv p^e = p^u$) on $\bar{a}$ and ω can be read off from Fig. 2. A higher p increases the expected income of both skill groups, because of $r^* > r$ and $w^* > w$. The expected income shift is however more pronounced for uneducated workers if the skill premium in North is lower than the skill premium in South and, hence, schooling becomes less attractive. Graphically, the $\Omega(\bar{a})$-locus shifts outwards in Fig. 2, implying an increase in $\bar{a}$. Since not all agents who change their schooling decision in view of the higher emigration propensity can indeed emigrate, the prospect to emigrate induces an *underinvestment* in education and hence it leads to an increase in the Southern skill premium. Conversely, if the skill premium in North is higher than the skill premium in South, the incentives for acquiring education increase. In this case, the $\Omega(\bar{a})$-locus shifts inwards in Fig. 2, so that $\bar{a}$ increases. Since not all newly educated workers can actually emigrate, there is *overinvestment* in education with a negative effect on the Southern skill premium.

The result in Proposition 1 is remarkable, because it qualifies the insight from the new brain drain literature that higher emigration probabilities render the participation in schooling more attractive and, hence, can be interpreted as a substitute for an education subsidy in developing countries (see Stark and Wang, 2002). As it turns out from our analysis, if the increase in emigration propensity for skilled workers is accompanied by a *pari passu* increase in the propensity to emigrate for unskilled workers, the schooling incentives fall in the empirically relevant case of a higher skill premium in the poor source than the rich host country of emigration.[10]

Even though the case of a higher Southern skill premium seems to have considerable empirical support, we do not need to impose any assumption concerning the relation between ω and ω^*, when deriving our results on GDP per capita effects. The reason is that except of the borderline case with $\omega = \omega^*$ emigration distorts the private schooling decision and, hence, always exhibits a negative effect on per capita income. For a more formal treatment of the respective GDP per capita effect, we can note that in the case of identical emigration rates, Eq. (4) simplifies to $V = G(\bar{a})\, Af(e(\bar{a}))$. Then, the following result is immediate.

[10] Clearly, in our model cross-country differences in the skill premium are only a good proxy for the cross-country differences in income inequality if the effective skilled labor supply per educated worker does not differ too much between the source and the host country of emigration.

Proposition 2. *An increase in the emigration probability p leaves GDP per capita unaffected if the schooling decision and thus cutoff ability $\bar{a}$ as well as the skill intensity $e(\bar{a})$ remain unaffected. In contrast, if the increase in p leads to an adjustment in the schooling decision and thus to a change in cutoff ability $\bar{a}$ and in skill intensity $e(\bar{a})$, GDP per capita falls.*

Proof. We can consider $dV/dp = dV/d\bar{a} \times d\bar{a}/dp$. Noting that $dV/d\bar{a} = G'(\bar{a})Af(e(\bar{a})) + G(\bar{a})Af'(e(\bar{a}))\,e'(\bar{a})$ and substituting $e'(\bar{a})G(\bar{a})/e(\bar{a}) = -G'(\bar{a})\left[1 + \bar{a}/e(\bar{a})\right]$, according to Eq. (2), implies

$$\frac{dV}{d\bar{a}} = AG'(\bar{a})\left[f(e(\bar{a})) - f'(e(\bar{a}))\,e(\bar{a})\left(1 + \frac{\bar{a}}{e(\bar{a})}\right)\right],$$

Using Eqs. (1) and (3), we further obtain

$$\frac{dV}{d\bar{a}} = AG'(\bar{a})f'(e(\bar{a}))\left[\frac{pq}{\omega\left[(1-p)\,\omega + p\omega^* q\right]}\right](\omega^* - \omega).$$

Noting from Proposition 1 that $d\bar{a}/dp >, =, < 0$ if $\omega >, =, < \omega^*$, we can conclude that $dV/dp < 0$ if $\omega \neq \omega^*$ and $dV/dp = 0$ if $\omega = \omega^*$. This completes the proof of Proposition 2. □

The prospect of emigration implies that the incentives for education become increasingly dependent on Northern relative factor prices. However, only local technology conditions are relevant for maximizing GDP per capita in South. An increase in p widens the gap between the incentives for schooling and the optimal relative Southern skill intensity, as long as the factor price differential in North and South do not coincide (i.e., $\omega^* \neq \omega$). If the incentives for education do not change, i.e. if $\bar{a}$ is constant, the relative skill supply remains unaffected and so does GDP per capita. Hence, the negative GDP per capita effect of a *pari passu* increase in the emigration propensity of educated and uneducated workers do not materialize in a model with exogenous skill supply.

Beyond the GDP per capita effects of emigration, we can also determine the distributional consequences in the Southern economy by looking at the impact that a change in the emigration propensity exhibits on income inequality R. The following proposition summarizes these effects.

Proposition 3. *An increase in migration propensity p raises (reduces) the income ratio $R(\bar{a}_p)$, if the skill premium in South is higher (lower) than the skill premium in North, i.e. if $\omega > (<)\omega^*$.*

Proof. We can substitute $e'(\bar{a}) < 0$, according to Eq. (2), and $d\omega/de(\bar{a}) < 0$, according to Eq. (3) into $d\omega/d\bar{a} = e'(\bar{a})d\omega/de(\bar{a})$, to conclude that $d\omega/d\bar{a} > 0$. Furthermore, we can note that $d\rho/d\bar{a} = G'(\bar{a}) \left[\int_{\bar{a}}^{1}[a - \bar{a}]dG(a)\right] \Big/ [1 - G(\bar{a})]^2 > 0$. Putting together, we thus obtain $dR/d\bar{a} > 0$. Noting finally $d\bar{a}/dp >, =, < 0$ if $\omega >, =, < \omega^*$ from Proposition 1, completes the proof of Proposition 3. □

By virtue of Proposition 3, the distributional consequences of emigration depend on whether the skill premium in South is lower or higher than the skill premium in North. Emigration into an egalitarian economy (with $\omega > \omega^*$) raises both the skill premium ω and the income ratio between educated and uneducated workers, R. The opposite holds true for emigration into a non-egalitarian country (with $\omega < \omega^*$). As empirical stylized facts indicate that North is more egalitarian, we can conclude that a *pari passu* increase in the emigration propensities for both education groups not only lowers GDP per capita but it also raises income inequality in South.

5 Extensions

The aim of this section is twofold. In Subsection 5.1 we study the consequences of a (quality-)selective immigration policy in North, which implies that emigration is only an option for educated Southern individuals. This allows us to check robustness of our results with respect to changes in the migration lottery. In Subsection 5.2 we briefly discuss the role of social returns for the GDP per capita effects of a brain drain.

5.1 Selective migration

In line with the setup in Section 3 we assume that emigration is the outcome of a lottery, with skill-specific propensities $p^e > 0$ and $p^u = 0$. Unfortunately, with selective migration the formal analysis turns out to be quite complicated with a general linear-homogeneous production technology. Therefore, we rely on a Cobb-Douglas technology in the subsequent analysis. In particular, we assume $Y = AG(\bar{a})e_E^{\alpha}$, with $e_E \equiv (1 - p^e)e(\bar{a})$ and $\alpha \in (0, 1)$. Furthermore, in the interest of readability we discuss our results in an intuitive way and refer the reader interested in the formal derivation of our results to the working paper version of this manuscript in Egger and Felbermayr (2007).

If North introduces a (quality-)selective migration policy, there is a direct negative effect on Southern GDP per capita due to a loss in the mass of educated workers and, hence, a fall in skill intensity for given private schooling decisions. However, there is also an indirect effect, because the expected income for skilled workers and, therefore, the incentives to acquire education increase (recall $r^* > r$). As a consequence, cutoff ability $\bar{a}$ falls and $e(\bar{a})$ increases. Graphically, a higher p^e shifts the $\Omega(\cdot)$-locus inwards in Fig. 2. The increase in $e(\bar{a})$ counteracts the negative effect on skill intensity e_E and, in fact it may overturn it if the elasticity of labor supply with respect to cutoff ability $\bar{a}$ is sufficiently large.[11] Irrespective of whether e_E is higher or lower in the scenario with selective migration than in a scenario without migration, GDP per capita will definitely fall when skilled workers obtain a prospect of emigration. The reason for a negative impact on GDP per capita is twofold. On the one hand, with selective migration, the private schooling decision cannot be expected to establish an efficient skill intensity outcome and, on the other hand, less able agents acquire education in the source country.

While the GDP per capita effect of selective migration is unambiguous, the distributional consequences turn out to be less clear. This has the following reason. As pointed out above, there are two counteracting effects of selective migration on skill intensity in production, with the sign of the overall impact being unclear. However, since under a Cobb-Douglas technology the skill premium is inversely proportional to skill intensity and given by $\omega = [\alpha/(1-\alpha)][(1-p^e)e(\bar{a})]^{-1}$, the impact of selective migration on the skill premium is unclear as well. With the skill premium per efficiency unit being a crucial determinant of factor return R, it is hence not surprising that in response to selective migration income inequality may decrease or increase. The compositional effect, however, reinforces the indirect negative effect on ω due to changes in the schooling decision, so that a decline in the skill premium is sufficient for a decline in relative factor return R.

[11] There is a notable difference to our baseline model with identical emigration propensities for both education groups. In this baseline model a change in the propensity to emigrate does not exhibit a direct impact on skill intensity. Put differently, for a given cutoff ability $\bar{a}$, an increase in the propensity to emigrate does not affect the skill intensity if $p^e = p^u$ (see our discussion in Section 4). Hence, a higher propensity to emigrate only affects the skill intensity to the extent that it changes the incentives to acquire education and thus cutoff ability $\bar{a}$.

5.2 Social returns to education

In this subsection we account for social returns to education, which have been put forward in the brain drain literature as the driving force behind positive GDP per capita effects of emigration (see Beine, Docquier and Marfouk, 2001). In particular, we assume that total factor productivity, A, depends on the skill intensity in the production process. (See Südekum, 2006, 2008 for a similar approach.) More specifically, we postulate that $A = e_E^{\gamma}$, where γ is a positive parameter. This opens a second channel through which a change in schooling incentives affects per capita output in the source economy. Quite generally, whenever e_E falls due to emigration – which happens, e.g., when $p^e = p^u$ and $\omega > \omega^*$ – the negative GDP per capita effect derived above is magnified. In contrast, when e_E rises – which may happen, e.g., in the case of selective migration with $p^e > p^u = 0$ – the negative GDP per capita effect is counteracted and, possibly, average income in the source country increases. Hence, at least in this case, accounting for a social return to education may generate an ambiguity in the GDP per capita effects of emigration on the source country. In order to assess the likelihood of a positive GDP per capita effect, we use numerical simulation techniques to quantify the positive and negative implications of emigration.

Before we turn to these numerical exercises in Section 6, we briefly discuss the role of social costs as another important determinant of the social returns to education (see Section 2). There is no doubt that in virtually all countries some part of education is provided by the public sector. Our model is flexible enough to account for public provision and finance of education. To see its impact, we can denote by D the *fixed* amount of public education spending, which is financed by a proportional tax $\tau \in (0, 1)$ on local wage income. With respect to the education technology, we abstract from rivalry and assume that an educated worker with ability a supplies aD efficiency units of skilled labor. Supposing for simplicity that $p^e = p^u = p > 0$, the government budget constraint is

$$D = \tau(1-p)AG(\bar{a})f\left(e\left(\bar{a}\right)\right). \tag{5}$$

Proposition 2 states that if $\omega \neq \omega^*$, emigration lowers GDP per capita, $V = AG\left(\bar{a}\right)f\left(e\left(\bar{a}\right)\right)$. Hence, with D being constant, Eq. (5) implies that the tax burden for non-migrants increases. All other things equal, this reinforces the negative effects of a migration lottery on the group of non-migrants.[12]

[12] In the presence of migration, the Southern policy makers may want to cut back on D. This incentive

6 Quantifying the effects of brain drain

In order to assess whether, in the presence of social returns to education, GDP per capita can be stimulated by a brain drain, we conduct a numerical simulation analysis for four important source countries: Turkey, Mexico, Philippines and Morocco. The first two economies feature a very low gap in the propensities to emigrate for educated and uneducated workers and their average income differential vis-á-vis the host countries is not too big and similar in size. The latter two economies both display a strong bias of emigration rates toward educated workers. They are poorer than the former two ones, but between them, they are comparable regarding their relative average income gap to their respective average destination countries.

To calibrate our model, we need to parametrize the production function. For this purpose, we consider a (CES) technology with a constant elasticity of substitution between educated and uneducated workers of σ. In line with evidence for Mexico discussed in Section 2.2 we set $\sigma = 3$.[13] Our discussion of empirical evidence on the quantitative importance of human capital spillovers in Section 2.4 leads us to compute two scenarios, one for $\gamma = 0$ and the other for $\gamma = 0.36$. This parameter choice spans the most extreme values found in the literature and may therefore delimit the interval within which the 'true' extent of social benefits may lie. Note, however, that the more recent empirical literature strongly points toward social benefits that are closer to zero. Furthermore, we do not account for social costs of education and, hence, by setting $\gamma = 0.36$ we are likely to significantly overestimate the possible GDP per capita gains from brain drain.

To determine the supply of skilled and unskilled labor, we proceed in two steps. First, we calibrate the share of educated workers in total labor income such that, at the observed emigration rates[14] shown in Table 1, the respective economies reproduce empirically reasonable education premia of 3.5 in Mexico, 3.2 in the Philippines, 2.6 in Turkey and 2.5 in Morocco.[15] Second, regarding abilities we simply consider a uniform distribution. This

is taken into account in Egger, Falkinger and Grossmann (2007).

[13]Choosing $\sigma = 1$ would lead to a Cobb-Douglas technology as the one considered in Subsection 5.1. Also note that our model would converge to the standard new-brain-drain literature benchmark case without losses from emigration due to changes in skill intensity (see e.g. Stark, Helmenstein and Prskawetz, 1998) when $\sigma \to \infty$.

[14]The emigration rates in 2000 are $p^e = 15.3, p^u = 12.07$ for Mexico; $p^e = 5.82, p^u = 5.59$ for Turkey; $p^e = 16.96, p^u = 7.00$ for Morocco; and $p^e = 13.73, p^u = 2.17$ for Philippines.

[15]We compute the ratio between Gini coefficients of income inequality and the 75th to the 25th percentile

seems the most natural choice given the absence of direct evidence. Since our theoretical results do not hinge on specific functional forms of $G(a)$, we can be optimistic that the choice of a uniform distribution does not restrict the generality of our results in qualitative terms.

In all numerical exercises, we fix the education bias of emigration $b \equiv p^e/p^u$, by the empirically observed value for the year of 2000 and plot the cutoff ability $\bar{a}$, the skill premium ω (whose benchmark value at observed emigration rates turns out to be higher than ω^* in all of our exercises), GDP per capita V (relative to its initial level without migration) and income inequality R as a function of p^e.

6.1 The case of non-selective migration

Figure 3 shows the results from our numerical exercises for Turkey and Mexico when $\gamma = 0$. In the case of Turkey, there is almost no education bias ($b = 1.04$), since p^e and p^u are of approximately similar magnitudes according to Fig. 1. Hence, we expect that the numerical analysis replicates the results in Propositions 1 and 2. In the case of Mexico, educated workers have an emigration probability that is about 3 percentage points larger than the one for uneducated agents and the education bias of emigration b is equal to 1.27. Income in both source countries is four to five times smaller than the emigration-rate weighted average income in the respective host countries. In both economies the degree of domestic inequality is larger than the weighted foreign counterpart.

The numerical exercise clearly shows that, given the absence of an education bias, an increase in the emigration rate lowers education incentives and, hence, drives up $\bar{a}$ in Turkey. This is because the expected return to schooling falls, once foreign employment opportunities are taken into account. Furthermore, we find that along with an increase in the cutoff ability level, emigration reduces GDP per capita. In the status quo, where p^e is about 6 percent, GDP per capita is 0.1 percent lower than in the counterfactual situation with no migration. It would be 0.25 percent lower if the emigration rate were to double. Proposition 3 suggests that the factor income ratio R should increase if b is identical to unity. Our simulation exercise confirms this and shows that emigration has a sizable effect on inequality.

ratio of the earnings distribution (which we take as a proxy for the wage premium). Data on percentiles is available for the OECD, so that we use the OECD multiple to calibrate wage premia for our source countries using their reported Gini coefficients.

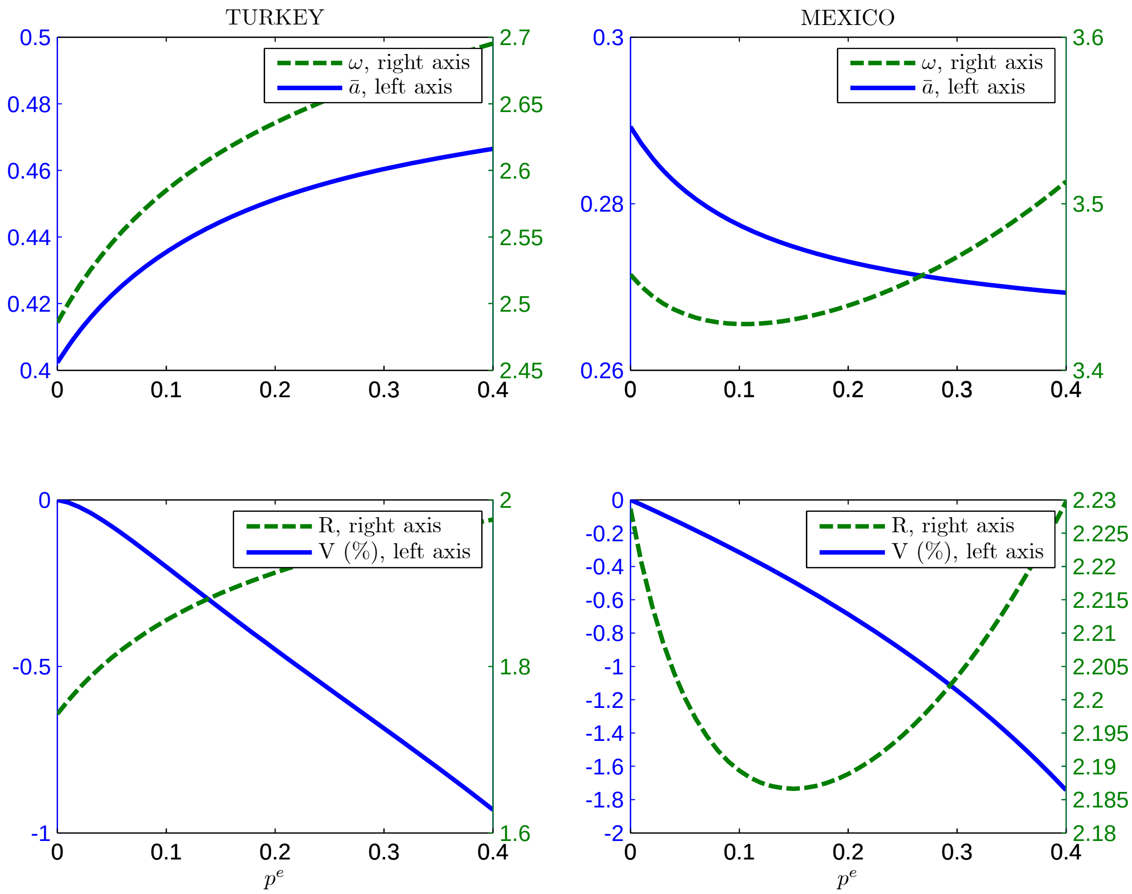

Figure 3: Turkey and Mexico: Welfare and distribution effects of emigration *without* spillovers.

The case of Mexico is different since b is substantially above unity. In this case, an increase in p^e boosts education incentives because it increases the likelihood of emigration overproportionally for educated workers. As a consequence, $\bar{a}$ falls and a higher fraction of individuals receive schooling, when p^e increases. Abstracting from a positive externality of schooling, the distortion in the education decision leads to a fall in GDP per capita of Mexico. In contrast to the case of Turkey, the effect of an increase in p^e on Mexican income inequality is inversely hump-shaped. At the observed level of $p^e = 0.15$, the predicted income inequality is lower than in the counterfactual where $p^e = 0$, but variation in R due to migration is much smaller than in the case of Turkey.

Figure 4 allows for a positive externality of human capital formation on total factor productivity. In both countries, we set the size of the externality to the highest justifiable level and assume $\gamma = 0.36$. Since the education bias in emigration rates is fairly low in Turkey, we would expect from our discussion in sections 4 and 5.2 that the negative GDP per capita effect is even more pronounced if education exhibits an externality on TFP. The reason is that with wage inequality being higher in the source than in the host country of emigration, a *pari passu* increase in the propensities to emigrate for both skill groups lowers the incentives to acquire education and hence reduces the skill intensity in source country production. This intuition nicely bears out in Figure 4. Furthermore, the impact of a change in the propensity to emigrate on income inequality in Turkey remains almost unaffected by the introduction of a *Hicks-neutral* positive externality of schooling on TFP.

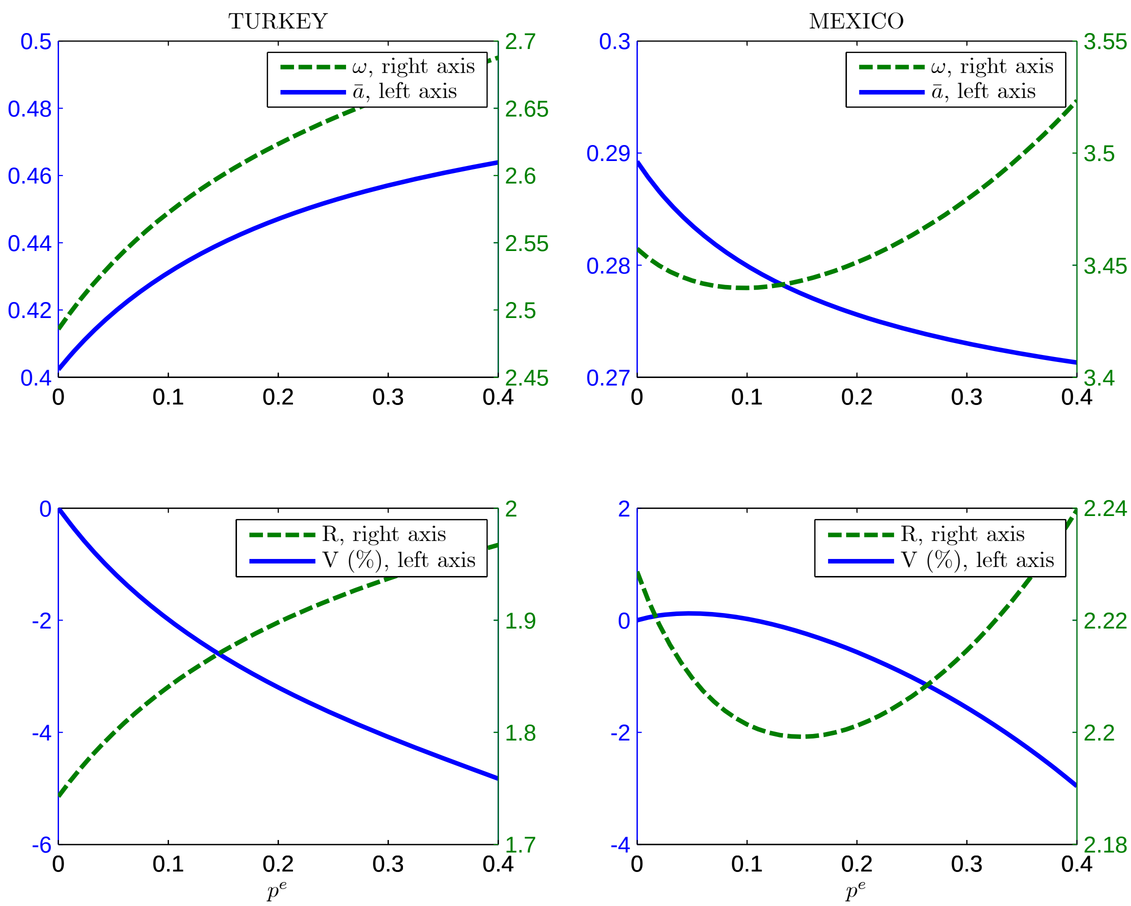

Figure 4: Turkey and Mexico: Welfare and distribution effects of emigration *with* spill-overs.

Things are different in Mexico, where the education bias of emigration is more pronounced than in the case of Turkey. Due to this bias, a higher participation in schooling induces an increase in TFP, which counteracts the negative impact on GDP per capita from the distortion in the private education decision. For relatively low emigration rates, the first effect dominates and hence GDP per capita increases when the propensity to emigrate goes up. Evaluated at status quo emigration rates ($p^e = 0.15$), however, it is the second effect that dominates and GDP per capita turns out to be slightly lower (-0.2%) than in the counterfactual situation with no migration. From Fig. 4 we can conclude that the GDP per capita effect of an increase in the emigration propensity is hump-shaped and reaches a maximum at rather low levels of emigration rates. Interestingly, at status quo emigration rates, $\gamma = 0.36$ turns out to minimize the loss, while lower or higher values of γ turn out to further increase it. The reason is that any change in TFP affects the relative incentive to acquire human capital through its impact on between country inequality. This can further dissociate actual enducation decisions from those that would maximize GDP per capita.

6.2 The case of selective migration

We now turn to a numerical assessment of the impact of emigration on Morocco and the Philippines. In both countries, emigration rates are strongly biased toward educated workers (see footnote 14). Hence, the emigration patterns differ substantially from the stylized setup in Section 4. However, the empirical patterns also differ from those assumed in Section 5.1, as emigration of uneducated workers seems to be important as well. Furthermore, the elasticity of substitution between educational classes is assumed to be 3 in our numerical exercises, while it was set equal to one in the selective migration scenario studied in Section 5.1.

Fig. 5 depicts the situation without any externality in human capital formation (i.e. $\gamma = 1$). As expected, from the analysis in Section 5.1, (quality-)selective migration raises the incentives for acquiring education and hence it lowers the ability cutoff for education, $\bar{a}$. While this is true for either economy, the effect turns out to be stronger in the Philippines, whose average host economy (of emigration) features a larger degree of earnings inequality. In both countries, overall income inequality, R, falls. Turning to GDP per capita, the numerical exercise confirms our insights from the analysis in Section 5.1, at least for the emigration rates depicted in Fig. 5. In both countries, GDP per capita is lower in the

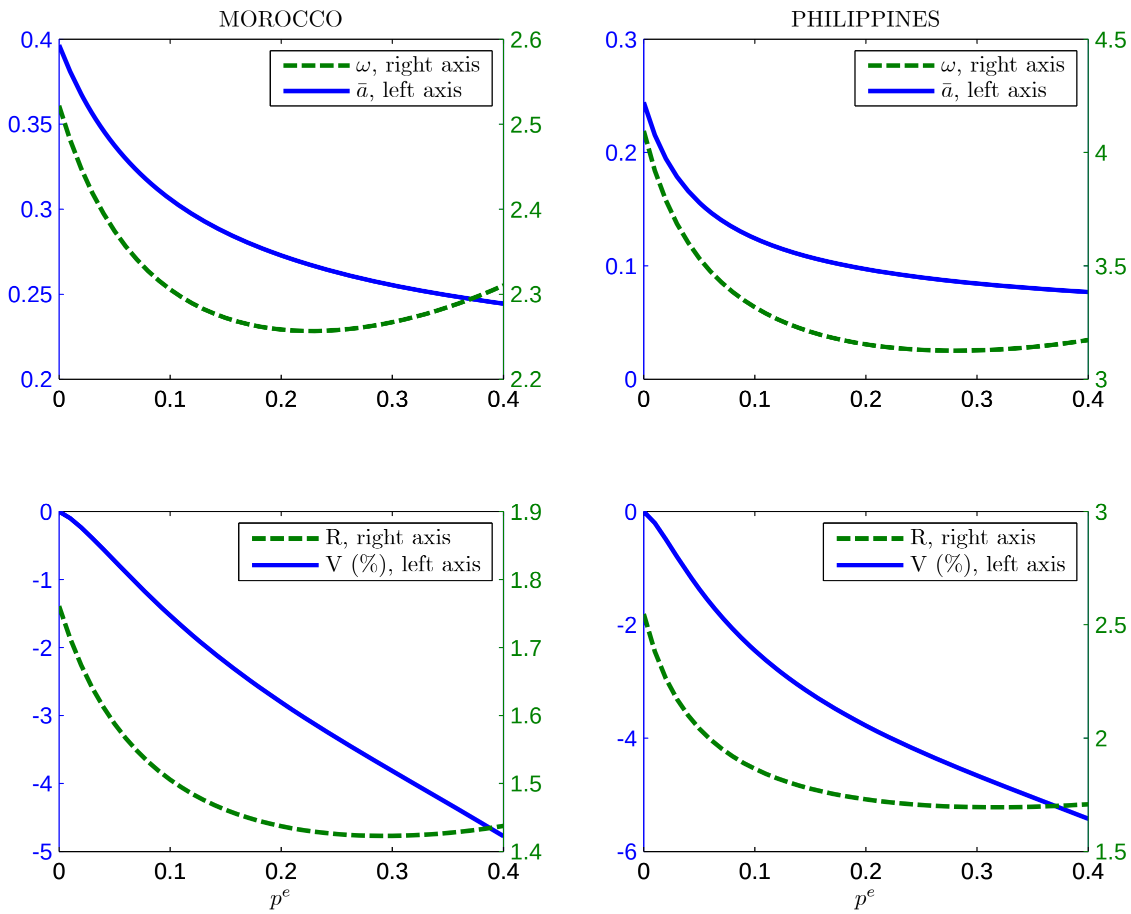

Figure 5: Morocco and Philippines: Welfare and distribution effects of emigration *without* spillovers.

status quo than in the reference case of no emigration. The loss is quite dramatic: 2.5% in the case of Morocco (at $p^e = 0.17$) and 3.9% in Philippines (at $p^e = 0.14$).

Next, we analyze a scenario with a positive externality of schooling. The respective results for Morocco and the Philippines are depicted in Fig. 6. Since social returns to human capital formation are usually believed to be strongest for middle-income countries, and substantially weaker for very poor ones, we set $\gamma = 0.1$ to parametrize the externality.[16] For this parameter value, we find that a higher propensity to emigrate not only raises the

[16]Clearly, with $\gamma = 0.36$ the TFP externality would be stronger and, hence, a positive GDP per capita effect of higher emigration rates more likely. However, note that also the elasticity of substitution σ plays a crucial role, with lower values making losses more likely and larger.

incentives to acquire education but it may indeed stimulate GDP per capita due to an increase in TFP. In the case of Morocco, a positive GDP per capita effect materializes only for rather small emigration rates, while at the status quo rates its GDP per capita is lower than in the counterfactual situation of no migration. In contrast, in the Philippines the GDP per capita is higher for almost all considered emigration rates and it reaches a maximum at a rate that is not too far away from its status quo. Similar to Turkey and Mexico, the inclusion of a schooling externality does not influence the distributional effects of emigration significantly.

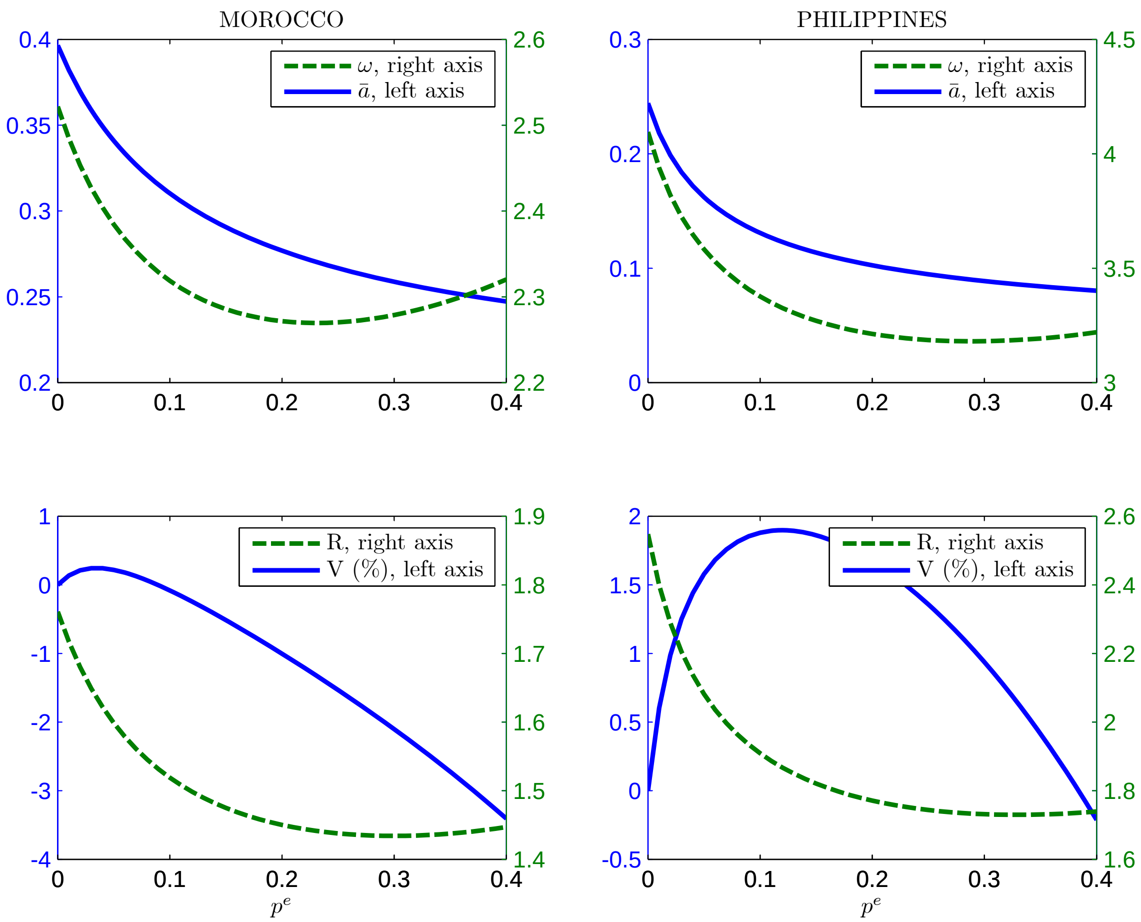

Figure 6: Morocco and Philippines: Welfare and distribution effects of emigration *with* spill-overs.

7 Concluding remarks

Can skilled labor emigration really be beneficial for the source country, as claimed by the new brain drain literature? To address this question, we have set up a simple model to study the potential losses and benefits of skilled labor emigration in a unified framework. In particular, we have shown that, irrespective of whether emigration is biased toward education or not, it always lowers GDP per capita in the source country, if schooling is endogenous. Furthermore, accounting for social returns to schooling, which are assumed to arise due to an externality of education on total factor productivity, we show that the negative effect on the source country is amplified if the prospect of emigration reduces the incentives to acquire education, while a positive effect of a brain drain possibly materializes if education is stimulated and not all newly educated workers can actually emigrate.

Since with social returns to schooling the effects of a brain drain are not clear in general, we rely on numerical simulation techniques to assess the relative strength of the counteracting forces for four important source countries of emigration. Our numerical exercise highlights that GDP per capita effects of skilled labor emigration critically depend on a number of important source country features, such as the education bias of emigration, the degree of income inequality relative to the average host country, and, most importantly, the size of the human capital externality. Relying on rather large values for the size of this externality, we find that in only one out of four cases, the source country may indeed have a higher GDP per capita under status quo emigration rates than in the counterfactual no migration scenario. However, even this result may be too optimistic, because, aside from considering a parameterization of the externality which is at the upper bound of empirically realistic levels, we have totally ignored social costs of education, which arise due to public finance of the schooling system. Indeed, accounting for these costs will substantially reduce the social returns to education and, hence, we can conclude that in contrast to the main insight from the new brain drain literature our analysis does not provide strong support for a positive brain drain effect on the source country of emigration – at least when abstracting from remittances and return migration.

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